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Productivity in the Insurance Company: A Meta-Regression Analysis

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ABSTRACT

Purpose – This study attempts to examine the studies using Malmquist Productivity Index (MPI) in calculating the productivity of insurance sector and to identify the factors influencing their total factor productivity change through meta-regression analysis.

Design/Methodology/Approach – This study employed 29 empirical articles which were published between 1977-2023 and which met the inclusion criteria.

Findings – The results on the meta-regression analysis revealed that the publication year of the studies and the income groups of the countries did not have an impact on the total factor productivity. The number of observations, number of variables, and branch of the insurance company were statistically significant on the estimation of total factor productivity change.

Discussion – In this study, a meta-regression analysis systematically highlights the effects of methodological assumptions on the productivity of insurance companies and synthesize empirical findings. The study serves to make the literature more accessible to researchers who will use the MPI method for measuring the productivity of insurance companies. This study is expected to guide managers in enhancing the productivity of insurance companies, considering national requirements, making and implementing legal regulations, and identifying policies.

1. INTRODUCTION

Insurance companies enhance economic growth through intermediation activities. It continues to act as a financial market stabilizer in the global economy (Ward & Zurbruegg, 2000; Ilyas & Rajasekaran, 2022). It promotes long-term investments (Beck & Webb, 2003; İlyas & Rajasekaran, 2022). Insurance companies have played a crucial role in the economic development of countries. It is of upmost significance to increase productivity of insurance companies.

Productivity is a criterion of performance. It is one of the indicators of competitiveness of companies (Pitaloka et al., 2018; Sukmaningrum et. al., 2023). When output increases while input remains constant, productivity increases (Tarwaka, 2005; Sukmaningrum et. al., 2023). When assessing their productivity, firms should identify the variables that affect their productivity. Productivity increase can accelerate the performance and service quality of firms. Productivity enables the determination of competitive pricing and correct resource allocation in a company (Filippaki et. al., 2009; Sukmaningrum et. al., 2023). Firms are eager to identify variables that affect their productivity. The Malmquist Productivity Index (MPI) is acknowledged as one of the most common techniques used in the literature to measure the productivity of firms.

MPI is used in economics (Ashiagbor et al., 2023; Abdulahi et al., 2023; Kordić & Višić, 2023), business (Athar, et al., 2023; Chen et al., 2022; Cowie, 2023), environment (Gökgöz & Yalçın, 2023; Koiry & Huang, 2023; Wang & Ren, 2023), green sustainable technology sciences (Demiral & Sağlam, 2023; Llanquileo-Melgarejo & Molinos-Senante, 2023; Qu et al., 2023), management (Habib & Mourad, 2023; Rubio-Picón et al., 2023; Mitropoulos & Mitropoulos, 2022) to measure productivity change.

This study is an attempt to explore the studies utilizing the MPI in the productivity measurement of insurance companies and to determine the factors influencing the total factor productivity changes used in the productivity measurement of insurance companies through meta-regression analysis. The study also strives to enhance accessibility to the literature to researchers who will use the MPI in measuring the productivity of insurance companies and to pinpoint the variables that affect productivity. The risk of bias and limitations inherent in a single study calculating the efficiency of insurance companies with the MPI were eliminated

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through a meta-regression analysis. The study is expected to contribute to the literature by providing an efficient overview with effective, valid and reliable parameter estimates for future studies utilizing the Malmquist Productivity Index for productivity assessment in insurance companies.

2. METHOD

2.1. SEARCH STRATEGY

On August 1, 2023, relevant works were systematically reviewed using Web of Science, Scopus, and Google Scholar. The literature review employed a comprehensive search encompassing all files with the keywords such as "productivity (ALL FIELD) and insurance (ALL FIELD)" The research process adhered to the PRISMA guidelines (Moher et al., 2009).

2.2. SELECTION OF STUDIES

This study reviewed all studies published between 1977 and 2023 identifying 46024 studies in the initial scan by the authors. The author independently scrutinized the titles, abstracts, keywords, text, and references of all manuscripts to mitigate selection bias and reveal whether eligibility criteria were met.

2.3. DATA EXTRACTIONS

Exclusions from the scope encompassed duplicate downloads, papers, books and book chapters, together with studies having low quality scores, focusing on insurance sector activity, and those with samples signifying country groups. Figure 1 displays the selection process of studies.

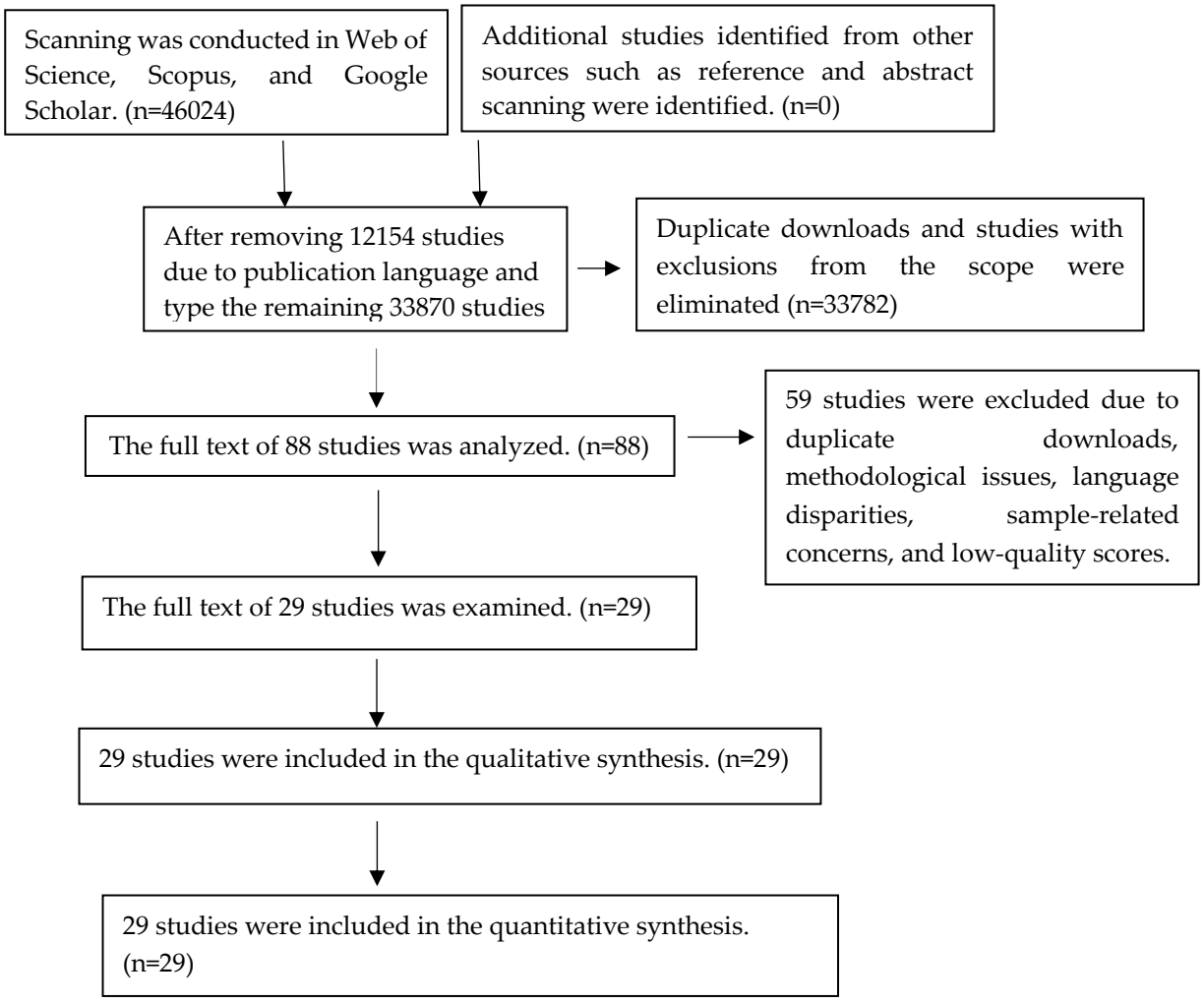

Figure 1. Flow Diagram of the Study (Moher et al., 2009; Kaya & Algın, 2022)

The author carried out a thorough review of all studies. After eliminating duplicate and irrelevant studies, 88 studies were chosen for full-text review. Duplicate studies and out of scope studies possessing low quality scores were excluded during the full text review.

2.4. QUALITY ASSESMENT

A 12- question quality checklist covering the purpose, method, data collection tools and sample was deployed for calculating the quality score of the studies (Appendix 1/Table 1) (Haghdoost & Moosazadeh, 2013; Moosazadeh et al., 2014; Rezaei et al., 2017; Rezaei et al., 2019; Kaya & Algın, 2022). Each question in the checklist received a quality score, with 1 point for meeting the criteria and 0 point for not meeting it. The total quality score must be at least 8 (Moosazadeh et al., 2014). Those with scores between 10-12 were included in the study. The average quality percentage of the studies was determined to be 89.6%. 29 studies with a total quality score of 83.33% and above were selected for analysis (Appendix 2/ Table 2).

2.5. STATISTICAL ANALYSIS

Publication year, number of observation, continent, the country's income group, data collection year, number of variables, branch of insurance company, Malmquist productivity index, software used, and quality score data were collected for each study. Most of the studies employing the Malmquist Productivity Index in measuring the productivity of insurance companies were carried out in India. In most studies whose sample is Asia, the total factor productivity change is above 1. In countries other than Germany and Austria, which are in the high-income group, the insurance company total factor productivity change is above 1. In most of the studies examined, the branch of insurance companies whose productivity was calculated was life insurance. The studies in the pool of meta-regression analysis deployed Eviews, R, DEAP, MaxDEA programs to calculate the productivity change of insurance companies. Table 3 (Appendix 3) depicts the key features of the studies examined. The mean effect size is 0.948 (95% CI: 0.902 to 0.973). Heterogeneity is indicated by I^2 (I-squared=93.0% p-value <0.001). A meta-regression analysis was conducted to evaluate the total factor productivity change estimates derived from the data. Malmquist Productivity Index was used as the dependent variable in the Tobit model (Table 4). Based on the current literature and model features, the number of observations, the number of variables and the year of data collection were used as explanatory variables, while the income group of the country where the study was conducted, the continent, the year of publication and the branch were used as dummy variables.

The study serves under the key assumption that the reported functional form of total factor productivity change scores in the literature can be explained by the characteristics of the studies, including the number of samples, the number of variables in the model and estimation techniques. To explore this, the following four models are estimated.

Model 1: $\mathrm{MPI} = f(D, G)$

Model 2: $\mathrm{MPI} = f(D, G, B, K)$

Model 3: $\mathrm{MPI} = f(D, G, B, K, Y)$

Model 4: MPI = f(D, G, B, K, Y, VY, ÜG)

The following variables were used in the proposed model:

MPI: Malmquist productivity index

V: Number of variables

O: Number of observation

B: Branch

C: Continent

YP: Year of publication

DY: Data collection year

CI: Country's income group

Table 4. Tobit Analysis Results for MPI

Variables	Model 1		Model 2		Model 3		Model 4	
	Tobit (S.E)	p	Tobit (S.E)	p	Tobit (S.E)	p	Tobit (S.E)	p
Constant	0.0000391 (0.00000422)	0.0000***	0.0000244 (0.00000802)	0.0023**	0.0000229 (0.00000810)	0.0047**	0.0000271 (0.00000888)	0.0023**
DV	0.064086 (0.015039)	0.0000***	0.077312 (0.017306)	0.0000***	0.082536 (0.017944)	0.0000***	0.078054 (0.017679)	0.0000***
DOBS	-0.0000222 (0.0000109)	0.0419*	-0.000022 (0.0000106)	0.0370*	-0.0000221 (0.0000102)	0.0307*	-0.0000225 (0.0000109)	0.0396*
B			0.00000941 (0.00000448)	0.0356*	0.0000104 (0.00000458)	0.0230*	0.0000104 (0.00000447)	0.0196*
K			0.0000035 (0.000003)	0.2438	0.00000363 (0.000003)	0.2260	0.00000572 (0.00000332)	0.0855
DY					-0.00000183 (0.00000243)	0.4514	-0.00000363 (0.00000275)	0.1870
DVY							-0.000893 (0.006858)	0.8964
YG							-0.00000461 (0.00000395)	0.2427
Log-likelihood	303.1551		304.8411		305.1108		305.8967	
Regression S.E	0.00000702		0.00000753		0.0000079		0.00000842	

Not: ***p<0,001 **p<0,010 *p<0,05

The models in this study were estimated using the Tobit method. Considering the data used in the analysis, Tobit is considered as the most methodologically appropriate. The insurance company's branch, continent, country's income group, publication year, data collection year were included in Model 1, and publication year, data collection year, country's income group were incorporated in Model 2. Besides, data collection year and country's income group were involved in Model 3. Moreover, Model 4 included the effect of all variables. Most of the variables in Model 1, Model 2, Model 3 and Model 4 were significant at least at 5% level. The number of variables, number of observations and variables belonging to the branches of the insurance company had an impact on the estimation of total factor productivity change across the models.

The continent in Model 2, continent, the year of publication in Model 3, continent, the year of publication, data collection year and the income group of the country where the publication took place in Model 4 were not statistically significant. The parameter estimate of the continent variable in Model 2, Model 3 and Model 4 was not statistically significant. The continent, publication year, data collection year and income group of the country where the study was conducted across studies did not significantly affect the total factor productivity change estimates. The number of variables and observations used in the study proved to be statistically

significant across all four models. Notably, the parameter estimate of the insurance companies' branch dummy variable held statistical significance in three out of the four models. The sample of studies that calculate the productivity of insurance companies in the Takaful branch using MPI is Indonesia and Malaysia. Within these nations, the studies reveal a low level of productivity in the Takaful branch of insurance companies.

3. CONCLUSION

The trend towards studies on calculating the productivity of insurance companies using the Malmquist Productivity Index (MPI) has increased over the last 5 years. The study examined 29 empirical articles published between 1977 and 2023 that deployed MPI in calculating the productivity of insurance companies that met the inclusion criteria. A meta-regression analysis was utilized to identify the variables affecting total factor productivity in the reviewed articles.

This study endeavors to establish the connection between studies on the productivity of insurance companies through using the meta-analysis. All studies related to the subject in the literature were reviewed. Most of the studies using MPI in assessing the productivity of insurance companies were carried out in Asian countries. The total productivity change of insurance companies in Germany and Austria, which are in the high-income group, is low. In most countries outside Asia, the productivity change of insurance companies is high. In most of the studies examined, the branch of insurance companies is life insurance. Total factor productivity change scores demonstrated a negative and significant relation with the number of observations, while the year of data collection was positively and significantly related. There is no such a meta-analysis study specifically published on analyzing the productivity of insurance companies in Turkey. Furthermore, the relevant literature holds no meta-analysis studies that calculate the productivity of insurance companies using MPI. In this study, a meta-regression analysis systematically highlights the effects of methodological assumptions on the productivity of insurance companies and synthesize empirical findings. The study serves to make the literature more accessible to researchers who will use the MPI method for measuring the productivity of insurance companies. This study is expected to guide managers in enhancing the productivity of insurance companies, considering national requirements, making and implementing legal regulations, and identifying policies.

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Appendix1.

Table 1. The checklist of items used for the quality assessment (Moosazadeh et al., 2014)

No	Questions	Score	
		Yes=1	No=1
1	Are the research questions clearly stated?	29/29	
2	Is the approach appropriate for the research question?	29/29	
3	Is the study context clearly described?	29/29	
4	Is the role of the researcher clearly described?	21/29	
5	Is the sampling method clearly described?	0/29	
6	Is the sampling strategy appropriate for the research question?	29/29	
7	Is the method of data collection clearly described?	29/29	
8	Is the of data collection method appropriate clearly described?	29/29	
9	Is the method of analysis clearly described?	29/29	
10	Are the main characteristics of the population well described?	29/29	
11	Is the analysis approporiate for the research question?	29/29	
12	Are the claims made supported by sufficient evidence?	29/29	

Appendix2.

Table2. Quality Assessment Results

No	Yazar(lar)	Soru												Puan (%)
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
1	Sukmaningrum et al. (2023)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 =%92
2	Ashiagbor et al. (2023)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 =%92
3	Nguyen & Nguyen (2022)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 =%92
4	Ilyas & Rajasekaran (2022)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 =%92
5	Yu et al. (2021)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
6	Lim et al. (2021)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 =%92
7	Oppong et al. (2019)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
8	Ohene-Asare et al. (2019)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
9	Masud et al. (2019)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 =%92
10	Ilyas & Rajasekaran (2019)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 =%92
11	Biener et al. (2016)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 =%92
12	Alhassan & Biekpe (2015)	1	1	1	0	0	1	1	1	1	1	1	1	10/12 = %83.3
13	Chen et al. (2014)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
14	Dutta (2013)	1	1	1	0	0	1	1	1	1	1	1	1	10/12= %83.3
15	Cummins & Xie (2013)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
16	Carrington et al. (2011)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
17	Nektarios & Barros (2010)	1	1	1	0	0	1	1	1	1	1	1	1	10/12= %83.3
18	Chen & Chang (2010)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
19	Luhnen (2009)	1	1	1	0	0	1	1	1	1	1	1	1	10/12= %83.3

20	Kasman & Turgutlu (2009)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
21	Barros et al. (2009)	1	1	1	0	0	1	1	1	1	1	1	1	10/12= %83.3
22	Jeng & Lai (2008)	1	1	1	0	0	1	1	1	1	1	1	1	10/12= %83.3
23	Yao et al. (2007)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
24	Barros et al. (2005)	1	1	1	0	0	1	1	1	1	1	1	1	10/12= %83.3
25	Fukuyama et al. (2001)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
26	Cummins et al. (1999)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
27	Fukuyama (1997)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92
28	Sinha & Khan (2000)	1	1	1	0	0	1	1	1	1	1	1	1	10/12= %83.3
29	Chakraborty (2018)	1	1	1	1	0	1	1	1	1	1	1	1	11/12 = %92

Appendix3.

Table3. Studies Examined in Meta-Regression Analysis

Author(s)	Country	Branch	Method	Sample Period	TFPCH	Software
Sukmaningrum, P. S., Hendratmi, A., Shukor, S. B. A., Putri, M. R., & Gusti, R. P. (2023)	Indonesia	Sharia Life Insurance, Takaful	MPI, Regression Analysis	2014-2005 / 2018-2019 (t=6)	0.9642	Eviews 9 DEAP 2.1
Ashiagbor, A. A., Dziwornu, R., Gbade, A. V., Offei-Kwafo, K., & Liticia, G. (2023)	Ghana	Life Insurance	MPI	2015–2020 (t=6)	0.8738	R (FEAR)
Nguyen, B. N., & Nguyen, P. A. (2022)	Vietnam	Life & Non-Life Insurance	DEA, MPI	2016-2020 (t=5)	1.01	DEAP 2.1
Ilyas, A. M., & Rajasekaran, S. (2022)	India	Non-Life Insurance	Bootstrapped MPI, Truncated Regression Analysis	2005–2016 (t=12)	1.007	x
Yu, F. P., Chen, H., Luo, J. Q., & Kuang, H. B. (2021)	China	Non-Life Insurance	DEA, MPI	2004–2017 (t=14)	1.003	x
Lim, Q. M., Lee, H. S., & Har, W. M. (2021)	Malaysia	Conventional & Takaful Insurance	DEA, MPI, Panzar–Rosse Method	2000-2001 / 2016-2017 (t=8)	0.989	DEAP
Oppong, G. K., Pattanayak, J. K., & Irfan, M. (2019)	Ghana	Life, Non-life, Reinsurance, Broking, Reinsurance Broker, Oil and Gas, Insurance Agents	MPI, System GMM	2008 - 2016 (t=9)	0.779	x
Ohene-Asare, K., Asare, J. K. A., & Turkson, C. (2019)	Ghana	Life & Non-Life Insurance	DEA, Cost MPI, Truncated	2005-2014 (t=12)	1.032	MaxDEA Pro v6.93.

			Regression Analysis			
Masud, M. M., Rana, M. S., Mia, M. A., & Saifullah, M. K. (2019)	Malaysia	Life Insurance	DEA, MPI	2012-2016 (t=5)	1.025	x
Ilyas, A. M., & Rajasekaran, S. (2019)	India	Non-Life Insurance	DEA, Bootstrapped MPI	2005–2016 (t=12)	1.321	x
Biener, C., Eling, M., & Wirfs, J. H. (2016)	Switzerland	Life, P/C Reinsurance	DEA, MPI, Truncated Regression Analysis	1997–2013 (t=7)	1.097	x
Alhassan, A. L., & Biekpe, N. (2015)	South Africa	Non-Life Insurance	DEA, MPI, Truncated Regression Analysis, Logistic Regression Analysis, System GMM	2007-2012 (t=6)	1.113	R (FEAR) 1.0 of Wilson.
Chen, F. C., Liu, Z. J., & Kweh, Q. L. (2014)	Malaysia	General Insurance	DEA, MPI, OLS, Tobit Analysis	2008-2011 (t=4)	1.212	x
Dutta, A. (2013)	Indian	Life & Non-Life Insurance	DEA, MPI	2005–2006 / 2009–2010 (t=5)	1.016	x
Cummins, J. D., & Xie, X. Y. (2013)	US	Property-Liability Insurance	DEA, MPI	1993–2009 (t=17)	1.065	x
Carrington, R., Coelli, T., & Rao, D. S. P. (2011)	Australia	Health Insurance	DEA, MPI	2001–2002 / 2004–2005 (t=4)	0.997	x
Nektarios, M., & Barros, C. P. (2010)	Greece	Life, Non-Life & Mixed Insurance	DEA, MPI	1994–2003 (t=10)	1.083	x
Chen, M. S., & Chang, P. L. (2010)	Taiwan	Life Insurance	DEA, MPI, One Way ANOVA	1997-2006 (t=10)	1.033	x

Luhnen, M. (2009)	German	Property-Liability Insurance	DEA, MPI, Truncated Regression Analysis	1995–2006 (t=12)	0.918	FEAR 1.11 , R
Kasman, A., & Turgutlu, E. (2009)	Turkey	Life, Non-life Insurance	TFP	2000–2005 (t=6)	0.954	x
Barros, C. P., Nektarios, M., & Peypoch, N. (2009)	Greece	Life Insurance	Luenberger Index, MPI	1994-1995 / 2002-2003 (t=10)	1.161	x
Jeng, V., & Lai, G. C. (2008)	Taiwan	Life Insurance	DEA, MPI	1981-2004 (t=24)	1.192	x
Yao, S., Han, Z., & Feng, G. (2007)	China	Life Insurance, Non-Life Insurance	DEA, MPI, Regression Analysis	1999–2004 (t=6)	0.975	Banxia Frontier Analyst, DEA Excel Solver
Barros, C. P., Barroso, N., & Borges, M. R. (2005)	Portugal	x	DEA, MPI, Tobit Analysis	1995–2001 (t=7)	1.161	x
Fukuyama, H., & Weber, W. L. (2001)	Japan	Non-life Insurance	DEA, MPI	1983-1994 (t=12)	1.085	x
Cummins, J. D., Tennyson, S., & Weiss, M. A. (1999)	US	Life Insurance	DEA, MPI, Probit Analysis	1988-1995 (t=8)	1.521	x
Fukuyama, H. (1997)	Japan	Life Insurance	DEA, MPI, Probit Analysis	1988-1993 (t=6)	1.189	x
Sinha, A., & Khan, T. L. (2000)	Indian	Non-Life Insurance	DEA, Bootstrapped MPI	2001-2012 (t=12)	1.011	x
Chakraborty, J. (2018)	Indian	General Insurance	DEA, MPI	2006-2007 / 2015-2016 (t=10)	1.039	x