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Product diversification versus technical efficiency of conglomerate life microinsurance companies: evidence from India

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Abstract
We look at technical efficiency and productivity changes in the life microinsurance (LMI) portfolio of insurance companies in India. The central objective is to empirically examine the 'tug of war' between efficiency and product diversity in the Indian insurance market. The data used in this research is available in the Handbook on Indian Insurance Statistics (Insurance Regulatory and Development Authority of India). First, we emphasise that four-fifths of LMI insurers in our sample were technically inefficient. Second, through the use of the data envelopment approach (DEA), Malmquist total factor productivity index (MTFP), and Tobit regression analyses, we demonstrate that insurers could improve managerial ability by organising inputs in the production process more effectively. Finally, we provide empirical support for the *strategic focus hypothesis* by demonstrating that product diversification has adverse effects on the technical efficiency of insurers.

Keywords Life microinsurance · Technical efficiency · Product diversification · Data envelopment analysis · Diversification · Productivity

Introduction

The Indian life insurance industry has witnessed a remarkable transformation in the last two decades, following the economic liberalisation that opened up the domestic markets by allowing the entry of foreign (private) companies. There has also been an increased interest in rural financial services. This is why life microinsurance (LMI)

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was given priority in such a pro-poor policy environment. Rapid developments in the microfinance sector together with self-help group activities have supported the outreach of microinsurance. Before the advent of the twenty-first century there were only a few informal insurance schemes in India run by non-governmental organisations or cooperatives beyond the ambit of any regulatory framework.

In 2002 the Insurance Regulatory and Development Authority of India (IRDAI) framed the 'Obligations of Insurers to Rural or Social Sectors' to catapult insurance penetration into the informal sector. In order to further enhance the outreach, it also framed microinsurance regulations (2005) that required private/public health insurance companies to develop and distribute microinsurance products in rural areas. In 2015 it revised the microinsurance regulation that provided guidance on product development, risk coverage levels and the widening of distribution channels for LMI products, and recommended a mandatory 25-hour training for LMI agents. It also introduced a micro variable life policy that combined systematic premium payment with term insurance benefits. In addition, IRDAI has constituted self-regulating bodies such as life insurance councils, the Actuarial Society of India, and the Indian Institute of Insurance Surveyors and Loss Assessors (IIISLA) to implement guidelines and ensure conformity. The Indian government provides a premium subsidy for buying Aam Aadmi Bima Yojana (AABY) (literally translated as 'insurance plans for the common man') policies to families living below the poverty line. In 2015 a government-sponsored one-year term life insurance scheme (Pradhan Mantri Jeevan Jyoti Bima Yojana) was started to provide affordable life coverage to the economically weaker population.

On the initiative of the government and under regulatory requirements, several private and public insurance companies developed new LMI products and formed ties with microfinance institutions or non-governmental organisations to penetrate the microinsurance market. However, the amount of products on offer may have compromised managerial efficiency. We empirically examine this tug of war between efficiency and product diversity in the Indian insurance market. Currently 14 out of 24 life insurance companies offer LMI. However, despite the expertise and the robust processes, insurers continue to encounter several challenges in the microinsurance market. A higher claim ratio, the excessive cost of underwriting policies in rural markets, and difficult administration of multiple products adversely affect efficiency and therefore profitability. For these reasons an insurer may not be able to benefit from the economies of scope arising from offering a range of insurance products (including LMI).

While research that looks at both diversification *and* technical efficiency of insurers is scarce, there has been some enquiry into the technical efficiency and dynamic slack analysis of life insurance companies. When insurers offer multiple products together with LMI, the effect of product diversification is expected to lead to cost savings. In the absence of a reduction in cost and technical efficiency, as demonstrated in this paper, insurers may shy away from diversifying into the LMI market despite the regulatory requirements. Thus the intriguing question of whether a combination of life, health, and life microinsurance (LHM) products in an insurer's portfolio—as opposed to just life and health (LH) related products—enhances or reduces technical efficiency, prompted us to carry out the present study.

It is recognised that the efficiency of an organisation depends on inputs (expenses, assets, investment) and outputs (equity, effectiveness) and requires an optimal allocation of resources to provide the desired output without wastage. Scale economies enhance cost efficiency when an insurer operating on a considerable scale can spread the cost of managerial expenses over large production units. The *conglomeration hypothesis* promulgates the idea that diversification enhances efficiency. Scope economies arise when firms allocate inputs (such as information systems, investment departments, service centres, managerial expertise, and other physical inputs) in collaborative production and offer several products to the same target market, thereby reducing search, marketing, and transaction costs (Teece 1980; Berger et al. 2000). The *strategic focus hypothesis*, on the other hand, highlights the scope diseconomies of diversification. The cost of administrating and coordinating several lines of business (including the marketing and servicing of multiple products) would mitigate the cost economies of scope (and thereby reduce overall cost efficiency). Furthermore, agency conflict often allows incumbent managers to focus on their own private benefits rather than (and often at the expense of) company objectives (Jensen 1986; Meyer et al. 1992).

The popularity of the data envelopment approach (DEA) (Eling and Luhnen 2010) as a measure of efficiency (usually involving complex mathematical programming) follows directly from its merits. Several studies have used DEA to evaluate the relative efficiency of decision-making units (DMUs) in the insurance industries of Japan (Fukuyama 1997), Greece (Barros et al. 2010), France (Fecher et al. 1993), Taiwan (Chang et al. 2011), Italy (Cummins et al. 1997), India (Sinha and Chatterjee 2011; Shetty and Savitha 2018; Tone and Sahoo 2005) and China (Yao et al. 2007). A seminal study on microinsurance programmes by Biener and Eling (2011) noted a negative relationship between size and technical efficiency. Tone and Sahoo (2005) report allocative inefficiencies of life insurance companies in India, and Sinha (2007) also shows a deterioration in the efficiency of Indian life insurance companies. Yet another study on India (Parida and Acharya 2017) found marginal improvements in the technical efficiency and productivity of life insurance companies after the deregulation of the Indian life insurance industry.

The selection of input and output in any efficiency analysis of the insurance industry becomes complex when the risk and investment management functions (risk pooling, financial services and intermediation) assume utmost importance. The existing literature specifies labour, business services and material, and financial capital as input variables for the calculation of DEA (Eling and Luhnen 2010). Most researchers have adopted the value-added approach to select output variables. This approach advocates the inclusion of the real value of any incurred loss, plus the addition to reserves (as a proxy for the function of risk bearing and financial services) (Berger et al. 2000; Eling and Luhnen 2010; Leverty and Grace 2010; Cummins 1999; Yuengert 1993; Grace and Timme 1992). Any income generated by the investment technically belongs to the policyholders and is a reflection on the intermediary function of the insurers (Brockett et al. 2005). Kao and Hwang (2008) suggest that returns from investment and reinsurance premiums should be counted as outputs, and business expenses and compensation should be counted as inputs. Meimand et al. (2002), on the other hand, consider the commission and the number of complaints as inputs, and the number of claims as

outputs. Jeng et al. (2007) consider labour, business services, cost of equity, assets, and underwriting and investment expenses as input, and benefit payments and return on assets as outputs. Biener and Eling (2011) choose labour, business services, equity and debt capital as inputs, and benefits plus additions to reserves, investments and coverage ratio as outputs.

Extensive research focusing on scale economies in the U.S. observed that large insurance firms are operating at decreasing returns to scale (Yuengert 1993; Gardner and Grace 1993). Other studies (Kellner and Mathewson 1983; Meador et al. 1998; Toivanen 1997) also confirm cost economies of diversification, but some report decreases in efficiency when the companies diversify their product line (Fields and Murphy 1989; Worthington and Hurley 2002). In reality, several researchers (Hoyt and Trieschmann 1991; Jeng and Lai 2005; Liebenberg and Sommer 2008) have found that product diversification has an adverse effect on efficiency and profitability. Yet another example of the latter concerns the U.S. specific study that also reported the absence of cost economies of scope in the insurance industry (Grace and Timme 1992). On the contrary, Berger et al. (2000) examine the validity of each of the *conglomeration hypothesis* and the *strategic focus hypothesis* for specific insurers, although Cummins et al. (2010) conclude that the latter have a significantly greater empirical validity. Insurance companies that offer life policies financially outperform those that do not (Elango et al. 2008). The research of Chakraborthy et al. (2012), which identified a positive influence of claims ratio, distribution ratio and firm size on technical efficiency, also found that companies offering life and non-life products were more efficient than those offering only life products.

Apart from product diversification, firm-specific factors such as the size of assets, financial leverage and market share also determine the efficiency of insurers. In this context, the *quiet life hypothesis* states that firms with substantial market power face lower competitive pressure, and so the managers can focus entirely on productivity without worrying too much about a loss of market share (Hicks 1935; Rhoades and Rutz 1982). The slack in management and expense preference behaviour to retain a large market share in concentrated markets results in a high cost per unit of output. Few authors (Berger and Hannan 1998; Coccorese and Pellecchia 2010; Hao and Chou 2005) have supported the relationship between efficiency and market power in the banking industry (consistent with the *quiet life hypothesis*). Thus the insurer's size also affects efficiency. Yao et al. (2007) find large firms to be more efficient than small firms. Our paper re-examines this claim in the Indian market to understand the relationship between diversification and efficiency for both large and small companies. Financial leverage (measured by liabilities to equity ratio) reflects financial risk and future financial distress for insurers. Therefore, efficient risk management (specifically, cost efficiency) is required to reduce the risk of insolvency. Hence we test the effect of financial leverage on technical efficiency.

Research objectives and hypothesis

It is questionable whether insurers offering LMI along with life and health policies are more efficient compared to their counterparts who keep out of the LMI market. Therefore, the purpose of this study is first to compare the technical efficiency of the LMI portfolio of insurance companies and the efficiency changes from 2012 to 2017 and second, to examine whether *the conglomeration* or *strategic focus hypothesis* is empirically validated in the Indian life insurance industry. We also empirically examine the *quiet life hypothesis*—the idea that larger firms are likely to be more efficient than smaller ones with fewer assets (Yao et al. 2007). We do this in the Indian context.

Materials and methods

In this study the first objective was explored using DEA measures of efficiency for the insurers who offer life microinsurance policies. The Malmquist total factor productivity index (MTFP), which gauges efficiency changes over a period, was also used. The next objective was analysed in two stages: (i) efficiency scores of LHM and LH insurers were measured; and (ii) the determinants of efficiencies were understood using generalised regression analyses. What makes DEA an established technique for measuring efficiency is its flexibility in incorporating multiple input and output variables (Eling and Luhnen 2010). Each insurer's efficiency score is calculated relative to a 'most-efficient' frontier (valued at unity). Thus the firms that have an efficiency score of less than unity could garner capacity to improve future performance. Numerous studies have been conducted to assess the performance of insurance companies using the DEA technique (Eling and Luhnen 2010; Chang et al. 2011; Kao and Hwang 2008).

Selection of input and output variables

Any LMI portfolio represents a product line of life insurance companies. We have considered a different set of variables to measure the efficiency of life microinsurers. As the data on the widely used input and output variables are not available, we have considered as input variables the number of branches (as a proxy for the number of agents) and commission charged (Chang et al. 2011). The output variables are incurred benefits—the claim amount paid to policyholders when a risk event occurs—and the number of policies sold (Chang et al. 2011; Biener and Eling 2011; Leverty and Grace 2010).

We have calculated technical efficiency scores of LHM and LH insurers. Input variables also include operating expenses and the number of agents/branches as a proxy for labour and business services, and equity capital (subsuming reserves and surplus) (Tone and Sahoo 2005; Cummins et al. 2004). We have considered real incurred losses as a proxy for the functions of risk pooling and financial

services (Berger et al. 2000; Chang et al. 2011; Biener and Eling 2011; Leverty and Grace 2010; Yuengert 1993). Another output variable—the income from an investment—reflects the intermediary function of insurers (Grace and Timme 1992; Brockett et al. 2005). As a social output measure we have taken the number of policies sold, since we could not access the data on coverage ratio (Biener and Eling 2011). Technical efficiency was estimated assuming input orientation and variable returns to scale (VRS). Our choice for assuming VRS allows the flexibility to incorporate firms that may be experiencing decreasing returns to scale, increasing returns to scale, or constant returns to scale. In the interest of robustness we do not want to impose any specific form of returns to scale on the aggregate of our data. The DEA efficiency scores were calculated separately for each year for both LHM and LH insurers, and the Mann–Whitney rank test was used to see whether the two groups of DMUs (LHM versus LH) are equally efficient.

Specification of the regression model

The efficiency scores estimated by DEA for LHM and LH insurance companies were regressed on firm-specific characteristics to empirically test the validity of the *conglomeration* or *strategic focus hypothesis* in the Indian life insurance industry. Since efficiency scores vary from 0 to 1, we also employed generalised Tobit regressions to account for the possibility of mass points. The dependent variable was the DEA score; our explanatory variables are the size (natural logarithm of total assets) (Huang and Eling 2013), product categories (LHM or LH) (Biener and Eling 2011), market share (percentage of firm's premium to total premium), and financial leverage (liabilities divided by equity). The key variable of interest is the dummy variable for product diversification (LHM = 1, LH = 0).

Data

Twenty-four life insurance companies operate in India, either specialising in life products or offering LH or LHM products. Of these, eleven companies offer LHM, nine sell LH policies, and the remaining four provide life and life microinsurance products. We have selected a sample of 12 LMI firms to address our primary objective, and a sample of 17 firms (9 LHM and 8 LH) for our regression analyses. The data on 85 firm-years for the study period is available in the Handbook on Indian Insurance Statistics published every year by the Insurance Regulation and Development Authority of India (IRDAI). We combined this data with the annual reports of insurance companies to compile our complete data set. Life Insurance Corporation of India (LIC), the firm with the highest market share, was included in the sample to test whether the effect of product diversification on efficiency is contingent on firm size.

Results

Summary statistics

The list of insurance companies is shown in Table 1, and the type of products together with the input and output data to assess the technical efficiency of companies providing life microinsurance are shown in Table 2. The maximum number of branches increased marginally from 4800 in 2012–2013 to 4897 in 2016–2017, and the average number of branches increased from 655 in 2012–2013 to 690 in 2016–2017.

Efficiency results of life microinsurance portfolio

On average, microinsurers were about 80% technically efficient in 2012–2013 (Table 3). This technical efficiency average increased to 85.1% in 2013–2014, then declined from 77.2% in 2014–2015 to 62.1% in 2015–2016, and increased to 73.4% in 2016–2017. Throughout these 5 years the technical efficiency of all the firms taken together averaged 75.9%.

Table 1 List of insurance companies considered for the study

1	Aviva Life Insurance Company Ltd (A)	Composite
2	Birla Sun Life Insurance Company Ltd (B)	Composite
3	ICICI Prudential Life Insurance Company Ltd (C)	Composite
4	IDBI Federal Life Insurance Company Ltd (D)	Composite
5	Life Insurance Corporation of India (E)	Composite
6	HDFC Standard Life Insurance Company Ltd (F)	Composite
7	SBI Life Insurance Company Ltd (G)	Composite
8	PNB MetLife India Insurance Company Ltd (H)	Composite
9	Edelweiss Tokio Life Insurance Company Ltd (I)	Composite
10	Tata AIA Life Insurance Company Ltd (J)	Composite
11	Aegon Religare Life Insurance Company Ltd (K)	Life and health
12	Bharti AXA Life Insurance Company Ltd (L)	Life and health
13	IndiaFirst Life Insurance Company Ltd (M)	Life and health
14	Max Life Insurance Company Ltd (N)	Life and health
15	Reliance Life Insurance Company Ltd (O)	Life and health
16	Star Union Dai-ichi Life Insurance Company Ltd (P)	Life and health
17	Future Generali Life Insurance Company Ltd (Q)	Life and health
18	Bajaj Allianz Life Insurance Company Ltd (R)	Life and health
19	Exide Life Insurance Company Ltd (S)	Life and health
20	Canara HSBC OBC Life Insurance Company Ltd (T)	Life and micro life
21	Sahara India Life Insurance Company Ltd (U)	Life and micro life
22	DHFL (DLF) Pramerica Life Insurance Company Ltd (V)	Life and micro life
23	Shriram Life Insurance Company Ltd (W)	Life and micro life

Table 2 Summary statistics for the input and output variables: life microinsurance DEA model

	Input		Output	
	Number of branches	Commission (INR in millions)	Benefits paid (INR in millions)	Number of policies
2012–2013				
Maximum	4800	196.5	4490.24	17,464,107
Average	655	17.31	384.01	1,575,964
SD	1325	56.44	1293.17	5,004,511
2013–2014				
Maximum	4839	134.52	4584.53	14,093,123
Average	1335	38.54	1319.38	4,027,625
SD	668	12.21	395.3	1,307,173
2014–2015				
Maximum	4877	189.1	4326.2	20,997,066
Average	675	17.82	375.92	1,997,172
SD	1343	54.06	1244.2	5,997,951
2015–2016				
Maximum	4892	173.59	3967.48	23,056,210
Average	688	17.56	360.12	2,504,342
SD	1345	49.45	1138.14	6,633,251
2016–2017				
Maximum	4897	225.66	4858.41	23,446,285
Average	690	25.47	473.37	2,757,940
SD	1347	64.48	1391.6	6,724,251

Table 3 Technical efficiency scores and ranking of life microinsurers

DMU	2013	2014	2015	2016	2017	Average	Ranking
A	1.000	1.000	0.995 (irs)	1.000	n.a.	0.998	3
B	1.000 (drs)	1.000	0.701 (irs)	0.932 (drs)	1.000	0.926	6
C	1.000 (drs)	0.538 (drs)	0.291 (drs)	0.414 (drs)	0.384 (drs)	0.525	10
D	1.000	1.000	1.000	0.711 (irs)	1.000	0.942	4
J	0.354 (irs)	0.834 (irs)	1.000 (irs)	0.177 (irs)	0.242 (drs)	0.521	11
E	1.000	1.000	1.000	1.000	1.000	1.000	1
F	0.281 (drs)	1.000	1.000	0.171 (drs)	0.279 (drs)	0.544	9
T	1.000 (irs)	1.000	1.000	1.000	1.000	1.000	1
U	0.236 (irs)	1.000	0.213 (irs)	0.213 (irs)	0.207 (irs)	0.373	12
V	1.000	1.000	1.000	0.688 (drs)	1.000	0.937	5
W	0.695 (drs)	0.396 (irs)	0.922 (drs)	1.000	0.972 (drs)	0.797	7
G	1.000	0.438 (irs)	0.142 (irs)	0.153 (drs)	1.000 (drs)	0.546	8
Mean	0.797	0.851	0.772	0.621	0.734	0.759	

Source Authors' calculation

Irs Increasing returns to scale, *drs* Diminishing returns to scale

In 2016–2017 Aviva did not issue new life microinsurance policies

Productivity performance of life microinsurance portfolio

The MTFP along with its components appear in Table 4. The positive change we observe in MTFP from 2013–2014 to 2016–2017 is potentially attributable to both technological progress and positive increments in technical efficiency.

An initial look also indicates that many companies improved technical efficiency during the study period.

Descriptive analysis of inputs, outputs, and explanatory variables

During the study period from 2012–2013 to 2016-2017 LHM insurers paid INR 188,247.9 million (Indian rupees) as claim benefits, earned INR 186,043.1 million from investment and issued 30,344 policies (Table 5). These insurers also incurred operating expenses of INR 29,954 million, invested equity worth INR 22,447.55 million and employed 162,857 agents. Similarly, LH insurers incurred, on average, operating expenses of INR 6298.85 million, an equity investment of INR 21,780.74 million, and deployed 42,860 agents to sell 1494 policies. They paid claim benefits of INR 20,659.3 million and earned INR 11,030.3 million from their investments.

For all insurers excluding LIC the financial leverage ratio was 5.569, and total assets were INR 6531.3 million. LIC had an average debt-equity ratio of 3.163, higher total assets worth INR 229,086.7 million and the most significant market share (average of 74.3%). LHM insurers (excluding LIC) had marginally greater assets than LH insurers.

Technical efficiency results: LHM and LH companies

The technical efficiency for LHM players averaged 89.2%, and for LH players 86.4%. Thus at first sight it seems that the difference in efficiency is only marginally significant (Table 6).

Malmquist total factor productivity index (MTFP) change

The MTFP for LHM insurers (Table 7) decreased by 4% over the study period, whereas it decreased by 63.75% for LH insurers. However, the latter had, on average, a higher MTFP (45.8%) than LHM insurers (13.2%). On average, the deterioration in MTFP was due to technical efficiency change rather than technological change for both LHM and LH insurers during 2013–2014 and 2014–2015. Efficiency change contributed to positive MTFP for both types of insurers in 2015–2016 but only for LH insurers in 2016–2017.

Table 4 MTFP from 2012 to 2017

Period	Technical change	Technical efficiency change	Pure technical efficiency change	Scale efficiency change	Total factor productivity change
2013–2014					
A	0.732	1.000	1.000	1.000	0.732
B	0.459	2.421	1.000	2.421	1.100
C	0.738	1.087	0.538	2.019	0.803
D	1.067	1.000	1.000	1.000	1.067
J	0.935	1.495	2.357	0.634	1.398
E	1.117	1.000	1.000	1.000	1.117
F	1.096	5.275	3.563	1.480	5.782
T	0.132	5.593	1.000	5.593	4.655
U	0.600	1.402	4.241	0.331	0.841
V	0.167	1.000	1.000	1.000	0.167
W	1.124	0.717	0.570	1.260	0.806
G	0.870	0.400	0.438	0.913	0.348
Mean	0.630	1.655	1.139	1.453	1.042
2014–2015					
A	1.012	0.978	0.995	0.983	0.990
B	1.717	0.581	0.701	0.829	0.997
C	1.265	0.676	0.540	1.254	0.856
D	1.141	1.000	1.000	1.000	1.141
J	2.585	0.993	1.199	0.828	2.567
E	0.964	1.000	1.000	1.000	0.964
F	2.237	1.000	1.000	1.000	2.237
T	1.040	1.000	1.000	1.000	1.040
U	1.351	0.247	0.213	1.161	0.334
V	1.318	1.000	1.000	1.000	1.318
W	1.110	1.798	2.329	0.772	1.995
G	1.576	0.298	0.325	0.916	0.470
Mean	1.374	0.780	0.804	0.970	1.071
2015–2016					
B	0.845	0.919	1.330	0.691	0.777
C	0.635	1.163	1.426	0.816	0.739
D	1.294	0.733	0.900	0.814	0.948
J	0.873	0.249	0.184	1.356	0.217
E	0.991	1.000	1.000	1.000	0.991
F	0.698	0.168	0.173	0.973	0.117
T	1.206	1.000	1.000	1.000	1.206
U	0.928	3.882	1.006	3.858	3.601
V	1.798	1.000	1.000	1.000	1.798
W	1.495	1.515	1.084	1.397	2.264
G	0.728	1.017	1.075	0.946	0.740
Mean	1.222	0.875	0.795	1.100	1.068

Table 4 (continued)

Period	Technical change	Technical efficiency change	Pure technical efficiency change	Scale efficiency change	Total factor productivity change
2016–2017					
B	1.116	1.834	1.073	1.709	2.047
C	1.194	0.411	0.476	0.864	0.491
D	0.906	1.364	1.111	1.228	1.236
J	0.807	2.116	1.321	1.602	1.708
E	1.114	1.000	1.000	1.000	1.114
F	0.664	1.633	1.604	1.018	1.085
T	0.796	1.000	1.000	1.000	0.796
U	1.247	2.754	0.966	2.850	3.435
V	1.549	1.000	1.000	1.000	1.549
W	0.951	0.964	0.972	0.991	0.916
G	0.961	3.930	5.546	0.709	3.778
Mean	1.001	1.389	1.181	1.176	1.391

Source Authors' calculation

Econometric analysis of the determinants of technical efficiency

The determinants of technical efficiency for LHM and LH insurers are shown in Tables 8, 9 and 10. From the Ordinary Least Squares (OLS) estimation reported in column (1) of Table 8 we see that the dummy variable of interest has a negative coefficient, suggesting that LHM insurers are, on average, less efficient compared to LH insurers. However, in such an analysis there are reasons to believe that standard errors are questionable, since certain firm characteristics remain correlated over time. In column (2) we show bootstrapped standard errors which also support the OLS findings that companies offering a combination of LHM products have lower efficiency compared to those offering LH products. The third column presents regression with bootstrapped standard errors (clustered at the firm level), showing that the original results still stand. It could be argued that the effect of product diversification (offering LHM instead of LH) is contingent on the intrinsic characteristics of each firm (for example, firm size may matter). To control for individual firm effects on technical efficiency, fixed-effect regressions (Table 9) were carried out to tease out the pure effect of diversification (after nullifying the individual insurer effects). In addition, random effects correct for autocorrelation and heteroscedasticity. The results of Table 9 are an attempt at understanding the pure effect of diversification. We infer that the insurers providing LMI along with life and health combined products are less efficient and can move at an outward production frontier (say, by adopting contemporary technology). Finally, generalised Tobit regression model with robust standard errors (corrected for motor insurance and heteroscedasticity) are reported in Table 10. Column (a) shows the results for an unrestricted Tobit specification. In column (b) we impose a lower limit of zero, and in the last

Table 5 Descriptive statistics for the input and output variables: LHM and LH insurers

		Output			Input		
		Benefits paid (INR in million)	Income from investment (INR in million)	Number of policies sold (in '000)[a]	Operating expenses (INR in Million)	Equity[b] (INR in Million)	Number of agents[a]
2013 Mean (SD)	LHM	169178.7 (416420.9)	135583.4 (365591.9)	27800 (85190)	24383.27 (50473.69)	19900.15 (13893.6)	168194 (356353)
	LH	17110.9 (23598.23)	965.3 (1417.92)	967 (1070)	6536.24 (5531.6)	19451.38 (14030.42)	4284478 (5461583)
2014 Mean (SD)	LHM	213163 (488603.4)	189537.73 (445656.1)	3503 (9297)	33156.52 (72978.24)	20013.34 (13541.5)	187393 (3640493)
	LH	22210.96 (29465.43)	12898.83 (15744.94)	1835 (2100)	6488.9 (5066.53)	21132 (16670.71)	46531 (56321)
2015 Mean (SD)	LHM	183942.75 (443532.78)	221145.76 (515481.9)	3094 (9108)	28563.62 (68802.52)	21826.49 (13801.21)	1635929 (3537027)
	LH	25375.39 (28682.54)	20728.3 (24293.85)	1616 (1759)	6535.5 (4951.06)	22527.4 (19124.38)	39845 (43482)
2016 Mean (SD)	LHM	182138.4 (439599.2)	165431.8 (493604)	3103 (9108)	29690.62 (69505.61)	23961.33 (15111.04)	1547495 (321662)
	LH	18883.16 (17711.49)	4349.79 (4057.70)	1570 (1666)	6113.61 (4996.87)	21897.9 (21327.72)	41213 (43402)
2017 Mean (SD)	LHM	212212.42 (513477.4)	237379.91 (592892.7)	3033 (8925)	36884.43 (89008.53)	26532.85 (18864.61)	1570973 (345033)
	LH	19716.27 (19819.21)	16209.28 (18960.49)	1481 (1551)	5820.02 (4872.36)	2389.5 (23841.92)	43868 (51949)

[a]Decimals are rounded

[b]Includes reserves and surplus

LHM Companies offering life, health and life microinsurance products; LH Companies providing life and health products

SD Standard Deviation

Table 6 Technical efficiency scores and ranking of LMH and LH insurers

DMU	2013	2014	2015	2016	2017	Average	Ranking
LMH							
A	1.000 irs	1.000 irs	1.000 irs	1.000 irs	1.000 irs	1.000	1
B	0.493 irs	0.620 irs	0.592 irs	0.680 irs	0.803 irs	0.638	10
C	0.865 irs	0.992 drs	0.926 drs	0.879 irs	0.726 drs	0.878	7
D	0.823 irs	1.000 irs	1.000 irs	1.000 irs	1.000 irs	0.965	2
E	1.000	1.000	1.000	1.000	1.000	1.000	1
F	0.471 irs	1.000	1.000	1.000	1.000	0.894	6
G	0.939 irs	1.000 drs	0.786 irs	0.753 irs	0.583 irs	0.812	8
H	0.600 irs	1.000 irs	1.000 irs	1.000	1.000	0.920	5
I	1.000 irs	1.000 irs	1.000 irs	0.956 irs	0.867 irs	0.965	2
J	0.674 irs	0.842 irs	0.794 irs	1.000 irs	0.683 irs	0.799	9
Mean	0.786	0.945	0.909	0.926	0.866	0.892	
LH							
K	0.698 irs	0.864 irs	0.602 irs	0.672 irs	1.000 irs	0.767	8
L	0.463 irs	0.431 irs	0.353 irs	0.313 irs	0.373 irs	0.387	9
M	0.811 irs	1.000	1.000	1.000	1.000	0.962	5
N	1.000	1.000	1.000	1.000	1.000	1.000	1
O	1.000	1.000	1.000 drs	1.000	1.000	1.000	1
P	1.000	1.000	1.000 irs	1.000	1.000	1.000	1
Q	1.000	1.000	0.829 irs	0.639 irs	0.604 irs	0.814	7
R	0.955 irs	1.000	1.000	1.000	1.000	0.991	4
S	1.000	0.778 irs	0.729 irs	1.000	1.000	0.901	6
Mean	0.880	0.897	0.834	0.847	0.886	0.864	

Source Authors' calculation

LHM Companies offering life, health and life microinsurance products; LH Companies providing life and health products

Irs Increasing returns to scale, *drs* Diminishing returns to scale

column both the upper and the lower limits are endogenously estimated along with the regression coefficients. In all these specifications the insurer-type dummy (LHM or LH) consistently remains significantly negative, demonstrating the validity of the *strategic focus hypothesis*.

Discussion

This study highlights several noteworthy findings on the technical efficiency of LMI insurers and the relevance of conglomeration or *strategic focus hypothesis* in India which will be alluded to in this section. The key results can be summarised as follows: (i) insurers having LMI portfolios in addition to LH could benefit from increasing efficiency; (ii) MTFP shows an increase in productivity of 14.3%, the

Table 7 MTFP: a comparison of LMH and LH insurers

Period	Technical change	Technical efficiency change	Pure technical efficiency change	Scale efficiency change	Total factor productivity change
2013–2014					
LMH	1.206	1.012	1.235	0.976	1.220
LH	3.652	0.962	1.016	0.947	3.515
2014–2015					
LMH	1.273	0.910	0.959	0.949	1.159
LH	1.303	0.931	0.914	1.019	1.213
2015–2016					
LMH	0.825	1.101	1.023	1.076	0.909
LH	0.797	1.044	1.005	1.039	0.832
2016–2017					
LMH	1.267	1.008	0.927	1.087	1.277
LH	1.122	1.136	1.060	1.072	1.274
Mean					
LMH	1.077	1.051	1.030	1.020	1.132
LH	1.436	1.015	0.997	1.018	1.458

Source Authors' calculation

LHM Companies offering life, health and life microinsurance products; LH Companies providing life and health products

primary sources of change being technical progress and scale efficiency; (iii) the majority of LHM and LH insurers are not technically efficient; (iv) the productivity of both LHM and LH insurers has declined over the last 5 years; and (v) lower efficiency scores for LHM insurers compared to LH insurers document the *strategic focus hypothesis*.

First, we can infer from the DEA scores that life microinsurers in India could continue to produce the same level of outputs with some reduction in inputs (and become *efficient*). Three firms reported deterioration in technical efficiency, and seven companies experienced improvement in productivity.

Second, the LMI portfolio showed notable total factor productivity changes during the study period, suggesting that the industry is moving closer to the *ideal* frontier in each successive period. The positive productivity growth was decomposed to both positive technical efficiency change in 2013–2014 and 2016–2017 and positive technical change in 2014–2016. An improvement in scale efficiency countered technical regress in 2013–2014 and 2016–2017, while upward movement of the production frontier (technical progress) counterbalanced deterioration in technical efficiency in 2014–2016. During the same period pure efficiency had an adverse effect on technical efficiency change, possibly suggesting a lack of intra-firm diffusion. These findings suggest that LMI was capable of providing sufficient coverage to the target population in 2013–2014 and 2016–2017. However, resource usage could have been improved in 2014–2015 and 2015–2016. The production could have increased by 3% in 2014–2015 if insurers had adjusted the production scale.

Table 8 Results of OLS regression analysis: economies of scope and technical efficiency

	OLS[a] Coefficient (SE)	Unclustered Bootstrapping[b] Coefficient (SE)	Clustered Bootstrapping[c] Coefficient (SE)
Years (dummy)	0.019* (0.009)	0.019 (0.124)	0.019 (0.018)
Types of insurance (Ref: LH insurers)	− 0.168* (0.082)	− 0.168* (0.099)	− 0.168* (0.073)
Market share	− 5.323 (4.036)	− 5.323 (7.09)	− 5.323 (7.65)
Size	− 0.029 (0.067)	− 0.029 (0.107)	− 0.029 (0.165)
Financial leverage	− 0.0003 (0.0002)	− 0.0003 (0.005)	− 0.0003 (0.000)
A	0.049 (0.034)	0.432*(0.134)	0.432* (0.080)
B	− 0.248* (0.076)	0.134 (0.182)	0.134 (0.187)
C	0.165 (0.180)	0.548 (0.366)	0.548 (0.245)
D	Reference	0.383* (0.15)	0.383* (0.076)
E	5.125 (3.6433)	5.509 (17.72)	5.509 (6.98)
F	0.170 (0.233)	0.553 (0.382)	0.553 (0.482)
G	0.078 (0.1723)	0.462 (0.339)	0.462 (0.371)
H	− 0.136 (0.1134)	0.246**(0.139)	0.246 (0.22)
I	− 0.053 (0.053)	0.329*(0.118)	0.329 (0.102)
J	− 0.129** (0.072)	0.254 (0.159)	0.254* (0.127)
K	− 0.383* (0.111)	Reference	Reference
L	− 0.748* (0.094)	− 0.365* (0.086)	− 0.365* (0.062)
M	− 0.153 (0.092)	0.229* (0.094)	0.229 (0.097)
N	− 0.026 (0.122)	0.380* (0.194)	0.380 (0.253)
O	− 0.065(0.099)	0.316* (0.136)	0.317 (0.186)
P	− 0.124 (0.088)	0.259* (0.095)	0.259 (0.093)
R	0.373* (0.116)	0.373* (0.179)	0.373 (0.263)
Constant	1.24* (0.309)	0.857** (0.451)	0.857 (0.666)

*, ** indicates a significance level of 5%, 10%, respectively

[a]$F(21, 63) = 17.86$, $p = 0.00$; Adjusted $R^2 = 0.7651$

[b]Wald $\chi^2(21) = 346.56$, $p = 0.00$; Adjusted $R^2 = 0.6868$

[c]Wald $\chi^2(21) = 2834.93$, $p = 0.00$; Adjusted $R^2 = 0.6868$

Technological progress during the study period has positively contributed to MTFP. Since two-fifths of the insurers have shown worsening of MTFP over the study period, the policymakers could guide the inefficient insurers in adjusting the production scale to reduce the deviation from the ideal production frontier and encourage the adoption of advanced technology to minimise the input required to achieve desired output. The IRDAI, the regulator of the insurance industry in India, could stress the adoption of 'insurtech' that includes data analytics, wearables, IoT devices and predictive models for risk assessment in underwriting, claims management, product design and fraud detection.

Third, our finding that four-fifths of LHM insurers and two-thirds of LH insurers are operating at less than optimum level is indeed a cause for concern. Few LH

Table 9 Results of fixed effect and random effect regression analysis: economies of scope and technical efficiency

	Fixed effects panel Coefficient (SE)	Random effects panel Coefficient (SE)
Years (dummy)	0.019** (0.010)	0.019** (0.010)
Types of insurance (Ref: LH insurers)	− 0.168* (0.069)	− 0.168 * (0.069)
Market share	− 5.323 (3.550)	− 5.323 (3.55)
Size	− 0.029 (0.099)	− 0.029 (0.099)
Financial leverage	− 0.0003 (0.0002)	− 0.0003 (0.0002)
A	–	Reference
B	–	− 0.297* (0.082)
C	–	0.116 (0.163)
D	–	− 0.049 (0.069)
E	–	5.076 (3.256)
F	–	0.121 (0.159)
G	–	0.029 (0.154)
H	–	− 0.185** (0.106)
I	–	− 0.102 (0.076)
J	–	− 0.178* (0.072)
K	–	− 0.432* (0.104)
L	–	− 0.797* (0.097)
M	–	− 0.202* (0.095)
N	–	− 0.051 (0.118)
O	–	− 0.114 (0.105)
P	–	− 0.173** (0.097)
R	–	− 0.058 (0.116)
Constant	1.448* (0 .493)	1.289* (0.442)
	F statistics = 2.00, p = 0.09	Wald $\chi^2 = 205.22$, p = 0.00

*, ** indicates a significance level of 5%, 10%, respectively

companies and LHM insurers operated under increasing returns to scale. These companies should focus on growth strategies to expand the scale of production and the size of their operations. The managers of inefficient firms could expedite measures to improve efficiency by better resource management and technological improvements such as robots for claims management and artificial intelligence powered insurance chatbots (automated insurance agents). They could improve net margins by maximising investment income, and use digital marketing (including social media) to boost the sale of policies. The IRDAI could amend the relevant regulations and directly support the insurers and supervise their implementation. At the same time, the policyholders' interests such as data security should be ensured, and practices of discrimination and exclusion of certain categories of risks should be discouraged.

Table 10 Results of Tobit regression analysis: economies of scope and technical efficiency

	Without restriction (a)	Restriction on lower limit = 0 (b)	Restriction on lower limit = 0 and upper limit = 1 (c)
	Coefficient (SE)	Coefficient (SE)	Coefficient (SE)
Years (dummy)	0.019** (0.008)	0.019** (0.008)	0.025 (0.025)
Types of insurance (Ref: LH insurers)	− 0.168* (0.059)	− 0.168* (0.059)	− 0.369* (0.138)
Market share	− 5.323**(3.056)	− 5.323 ** (3.056)	− 6.131**(3.967)
Size	− 0.029 (0.085)	− 0.029 (0.085)	− 0.108 (0.191)
Financial leverage	− 0.0003** (0.0002)	− 0.0003 (0.0002)	0.0309 (0.013)
A	Reference	Reference	Reference
B	− 0.297* (0.071)	− 0.297* (0.071)	− 0.297* (0.081)
C	0.116 (0.140)	0.116 (0.140)	0.116 (0.142)
D	− 0.049 (0.059)	− 0.049 (0.059)	− 0.049 (0.057)
E	5.076** (2.803)	5.076** (2.80)	5.076**(2.801)
F	0.121 (0.137)	0.121 (0.137)	0.121 (0.139)
G	0.029 (0.132)	0.029 (0.132)	0.029 (0.131)
H	− 0.185* (0.091)	− 0.185* (0.091)	− 0.185* (0.095)
I	− 0.102 (0.066)	− 0.102 (0.066)	− 0.102 (0.062)
J	− 0.178* (0.062)	− 0.178* (0.062)	− 0.178* (0.06)
K	− 0.432* (0.089)	− 0.432* (0.089)	− 0.432* (0.09)
L	− 0.797* (0.083)	− 0.797*(0.083)	− 0.797* (0.079)
M	− 0.202* (0.082)	− 0.202* (0.082)	− 0.202* (0.081)
N	− 0.051 (0.102)	− 0.051 (0.102)	− 0.051 (0.102)
O	− 0.114 (0.090)	− 0.114 (0.090)	− 0.114 (0.090)
P	− 0.173* (0.083)	− 0.173** (0.083)	− 0.173* (0.08)
R	− 0.058 (0.100)	− 0.058 (0.100)	− 0.058 (0.103)
Constant	1.289* (0.380)	1.289* (0.380)	1.289* (0.382)
	LR $\chi^2 = 123.14$, p = 0.00	Wald $\chi^2 = 123.14$, p = 0.00	LR $\chi^2 = 107.99$, p = 0.00
	Log likelihood = 83.4	Log likelihood = 83.4	Log likelihood = 5.53

*, ** indicates a significance level of 5%, 10%, respectively

Fourth, the MTFP gradually declined for both LHM and LH insurers over the study period. The deterioration was higher for LH insurers in comparison to LHM insurers (except in 2016–2017). Technical progress and management techniques have increased productivity rather than the size of operations. Therefore, managers do apply their expertise in efficiently organising the inputs, but they fail to choose the optimum size of resources to achieve the desired level of production. In contrast, the productivity change in LH insurance firms was, on average, due to an appropriate scale of operations and technological advancement. As such, a negative contribution of pure technical efficiency indicates that the LH managers disregarded standard management practices and misallocated input resources. In 2015–2016

regressive growth in MTFP for both types of insurers was triggered by technical regress. An improvement in technical efficiency during the same period could not impede MTFP deterioration, which highlights the importance of the adoption of new technology. During 2015–2017 LH insurers experienced higher scale efficiency change more than pure technical efficiency change, while technical progress contributed to productivity changes for LHM insurers. Accordingly, LHM insurers should work towards improving technical efficiency, and LH insurers should focus on the adoption of the latest technology and benchmark human resource practices to improve pure technical efficiency.

Lastly, the regression results show a negative relationship between the addition of microinsurance to the LH portfolio and efficiency. It also provides evidence that the efficiency of insurers in India increased from 2012 to 2017. LHM insurers are less efficient (in comparison to LH insurers) in using advanced technology to reach the desired output, and excessive use of inputs for servicing multiple products has wiped out cost economies. Several researchers support our findings that specialised insurers are more technical and cost-efficient than those offering several products (Worthington and Hurley 2002; Jeng and Lai 2005; Liebenberg and Sommer 2008; Cummins et al. 2010; Luhnen 2009; Kader et al. 2010). On an equivalent note, our findings confirm the relevance of the *strategic focus hypothesis,* whereby insurers specialised in life and health are found to be more efficient than those offering multiple products (LHM insurers). When an insurer offers multiple products catering to the needs of different market segments, it requires management skills and technology to allocate optimum inputs and control operating expenses, including commission. In the absence of such expertise and technical progress, efficiency declines. The cost of diversification may offset its benefits by increasing the agency costs when the mechanisms to monitor the managers are insufficient and poor performing product divisions are subsidised by larger internal capital. In the case of LH insurers, experienced managers with product focus achieve cost savings in many lines of operations such as underwriting, hiring, training of agents, and claims management. Thus LHM insurers may detract from the LMI market, and the potential new entrants may refrain from offering LMI products. The question then arises whether LMI should be offered even if it makes insurers inefficient, or whether insurers should focus on core products to be on the production frontier. The tremendous effort and moral persuasion of the IRDAI would be futile if insurers chose the latter. Hence it is imperative for the regulator to promote measures and amend existing regulations to support inefficient firms in reaching the most efficient frontier directly. These measures should include a ceiling on commission, promotion of insurance chatbots and e-insurance, development of an extensive microinsurance agents' network that can cross-sell other financial products, and robot-centred claims management. Furthermore, future studies should compare the technical efficiency of LH with those offering life microinsurance products to gauge the relative efficiency of LMI portfolios vis-à-vis LH products.

Finally, there is no relationship between market share and technical efficiency. Thus our findings show that the *quiet life hypothesis* does not necessarily apply to the Indian insurance companies. In contrast to the literature (Yao et al. 2007; Cummins et al. 2004), we find that both large and small firms lose out on efficiency

because of diversification. Irrespective of intrinsic characteristics of firms such as firm size and market share, insurers have a trade-off between product diversification and technical efficiency. In the same way, financial leverage turned out to be an insignificant predictor of efficiency. There are few data limitations related to an LMI portfolio, and future studies should include other inputs and outputs and incorporate unexplained antecedents to efficiency.

Conclusion

The significant relationship between product diversification and technical efficiency as explicated in this study does indeed promulgate the evidence for the *strategic focus hypothesis* in the Indian life insurance industry. The mandatory IRDAI requirement to service rural and social sectors prompted life insurers to provide LMI products; however, the inclusion of LMI requires more resources than serving the LH market. Thus LHM insurers are compelled to make the difficult trade-off between LMI portfolio and technical efficiency. Nevertheless, the inefficient insurance companies can emulate benchmark management practices and adopt state-of-the-art technology (Internet of Things) to move upwards to the frontier of best practices. The total factor productivity of the LMI portfolio has grown over the last 5 years mainly due to the contribution of technical efficiency rather than technical progress, while pure efficiency change was negative, indicating managerial ineffectiveness and inability to organise and utilise inputs in the production process. Hence LHM insurers with LMI products should realise productivity growth and efficiency through technical advancement, improved managerial efficiency, and adoption of best practices and optimum size of operations.

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