Dynamics of Private Sector General Insurance in India: A Case Study

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The service industry in India has achieved a phenomenal growth in the recent past and among them, insurance is one sector, which has witnessed a high decibel growth thanks to the investor friendly regulator in the name of Insurance Regulatory Development Authority (IRDA). Of particular interest is the period since the year 1999 with the insurance sector undergoing major structural changes with a series of reforms initiated by successive governments. The growth the market has achieved in terms of 18-20% in life insurance and 15-17% in non-life insurance stands testimony to that. The present study probes deeply into India's general (non-life) insurance sector – the key players, the interrelationships and the causal linkages among these key players, and develops a system dynamic model based on such relationships with a case study of a private sector insurance company of India, the ICICI Lombard General Insurance Company Limited. The model has been run using VENSIM software. Both the causal loop as well as the stock-flow diagrams is presented and model simulation runs have been analyzed. The implications of the study results have been discussed.

Keywords: Economic Liberalization, Private Sector, General Insurance Sector, System Dynamics, Simulation Modeling

1. Introduction

India's service sector industry appears to be finally coming of age in the post liberalization period but the potential for further expansion still looks immense. New economy organizations are spreading their wings into service industry like banking, financial services, insurance, communication, entertainment, telecommunications, and so on. The service industry in India has achieved a phenomenal growth in the recent past and among them, insurance is one sector, which has witnessed a high decibel growth. This is largely due to the efforts of Insurance Regulatory Development Authority (IRDA). The growth the market has achieved in terms of 18-20% in life insurance and 15-17% in non-life insurance stands testimony to that (Senthil and Narayanan, 2004).

Insurance is an economic device whereby the individual substitutes a small certain cost (the premium) for a large uncertain financial loss (the contingency insured against) which would exist if it were not for the insurance contract: an economic device for

reducing and eliminating risk through the process of combining a sufficient number of homogeneous exposures into a group in order to make the losses predictable for the group as a whole. An insurance company is an organization chartered to operate as an insurer. This organization is primarily engaged in the business of furnishing insurance protection to the public. The insurance sector in India has around a full circle from being an open competitive market to nationalization and back to a liberalized market again.

The present study probes into the dynamics of the general insurance sector in India, especially after the initiation of a series of economic reforms in this sector, in a system dynamics framework. This has been attempted by means of a case study of a private sector insurance company that has come into existence precisely as a result of this reform process, namely, the ICICI Lombard General Insurance Company Limited.

2. General Insurance Sector in India

The Indian insurance industry is segmented into two distinct markets: the life insurance market and the non-life, or general, insurance market. Life Insurers transact life insurance business; the rest is transacted by General Insurers. No composites are permitted as per law. The business of insurance essentially means defraying risks attached to any activity over time (including life) and sharing the risks between among entities, both persons and organizations. Insurance companies are important players in financial markets as they collect and invest large amounts of premium. Insurance products are multi purpose and offer the following benefits: protection to the investors; accumulate savings; and direct these savings into sectors needing huge long-term investments.

Insurance is estimated to be about USD nine billion business in India and the gross premium collection is about 2% of GDP growing between 15% and 20% per annum. Regarding general insurance, with the expected growth in the Indian economy and new players moving in, the market is expected to grow at 18% per annum. Over the last ten years, the compounded average growth rate for the industry works out to more than 15% (Senthil and Narayanan, 2004).

2.1 Indian Position in General Insurance within Global Scenario

The insurance market has been expanding rapidly and the combined growth rate of both the life and non-life sectors over the last two years is 25%. The growth rate of life insurance has been slightly over 26% and general insurance 23%. Although impressive, the insurance industry is relatively small by international standards. In 2002, the global insurance market was estimated to be about USD 2627 billion and India accounted for only 0.59% (Rao, 2004). This has also been corroborated by another study. This other work reports that the Indian Insurance market accounts only for 0.59 per cent of USD 2, 627 billion global insurance markets. According to this report, the volume of life insurance premium is expected to increase from USD 188 billion in 2003 to USD 450 billion by 2014 and non-life premium would increase from USD 123 billion to USD 250 billion over the same period. In fact the same study has ranked India and China as the fastest growing markets for insurance business (source: http://sify.com/finance/fullstory.php?id=13915606, 11 August 2005).

There is still a vast untapped potential for providing insurance cover in India. The insurance penetration in India, measured by the ratio of premium paid to the gross domestic product (GDP), has gone up from 2.71% in 2001 to 2.88% in 2003 whereas the global average was 7.83% and 8.06% respectively. In developed countries like the United States the penetration rate was as high as 9.61% and in Japan 10.81%. Further, the non-life insurance penetration in India was only 0.62% in 2003 while it averaged 3.48 % globally. It was 2.20% in Japan and 5.23 % in the United States (source: http://www.directories-today.com/insurance.html).

For the Indian insurance industry to be able to mobilize long-term savings to support economic growth and also facilitate economic development by providing insurance cover to a large segment of her people as well as to business enterprises throughout India, what is paramount is to have strong insurers who are able to provide consumers with a wide range of world-class products and services at competitive price; adopt international best practices; operate through various distribution channels for the convenience of consumers; maintain high professional standards; are productive; cost-efficient and financially resilient to both market volatility and competitive pressures (Rao, 2004).

2.2 General insurance in India: The milestones

General Insurance Corporation of India (GIC) was incorporated on 22 November 1972 under the Companies Act, 1956 as a private company limited by shares. GIC was formed for the purpose of superintending, controlling and carrying on the business of general insurance.

As soon as GIC was formed, the Government of India (GOI) transferred all the shares it held of the general insurance companies to GIC. Simultaneously, the nationalized undertakings were transferred to Indian insurance companies. After a process of mergers among Indian insurance companies, the following four companies were left as fully owned subsidiary companies of General Corporation of India.

(i). National Insurance Company Limited
(ii). The New India Assurance Company Limited
(iii).The Oriental Insurance Company Limited
(iv). United India Insurance Company Limited

The next landmark happened on 19th April 2000, when the Insurance Regulatory and Development Authority Act, 1999 (IRDAA) came into force. This act also introduced amendments to earlier acts including the Insurance Act, 1938 that removed the exclusive privilege of GIC and its subsidiaries carrying on general insurance in India.

In November 2000, GIC was re-notified as the 'Indian Re-insurer' and through administrative instruction its supervisory role over subsidiaries was ended. With the General Insurance Business (Nationalization) Amendment Act 2002 (40 of 2002) coming into force from March 21, 2002, GIC ceased to be a holding company of its subsidiaries. Their ownership was vested with Government of India. The Insurance Regulatory and Development Authority (IRDA) issued the first batches of licenses in 2001.

2.3 Overall market scenario: The private sector general insurance

Since the four years that the sector has opened, the private sector general insurance sector has witnessed a series of development. Consumer awareness has improved. Competition has brought more products and better customer servicing. It has had a positive impact on the economy as well in terms of income generation and employment growth. Four years of insurance sector privatization has brought about significant changes in the insurance business in India, be it product development, customer servicing, marketing and awareness.

These changes were led by private players ICICI Lombard, Bajaj Allianz and Iffco-Tokio, and consequently, general insurance industry grew by an impressive 15 per cent in the first quarter of 2005-06. The non-life insurance industry, consisting of 5 public and 8 private players, grew by 14.75 per cent in premium collection till June 2005, as per figures released by regulator IRDA (source: http://sify.com/finance/fullstory.php?id=13915606, 11 August 2005).

Table 1 presents the relative market share figures for private and public sector general (non-life) insurance in India. It can be observed that in the general insurance private player category, the premium amount had shown significant improvement and went up by 57.35% in 2004-05 compared to the previous year, 2003-04. The public category has a premium amount went down by 5.53% in 2004-05 as compared to 2003-04. All the new players have excelled and continued to maintain a high growth of 61%. The market share of the private players has gone up from 14% to 19.65% and of the public players has fallen from 85.91% in 2003-04 to 80.35% in 2004-05. Total general insurance has grown with a percentage of 12.83% (source: http//www. Directories-today.com/insurance.html, 19 August 2005).

Table 1:

***Market Share**: private and public sector general insurance companies*

General Insurers	Share for the year ended March, 2004	Share for the year ended March, 2005	% change, 2004-05 over 2003-04
Royal Sundaram	1.61	1.83	28.48
Tata-AIG	2.2	2.59	32.7
Reliance General	1	0.89	0.39
IFFCO-Tokyo	1.84	2.8	71.62
ICICI-Lombard	3.16	4.89	74.69
Bajaj Allianz	2.97	4.71	79.03
HDFC CHUBB	0.7	0.98	59.2
Cholamandalam	0.6	0.94	75.94
New India	25.23	23.25	-3.99
National	21.31	21.14	-11.94
United India	18.94	16.31	-2.84
Oriental	17.66	16.79	-7.28
ECGC	2.78	2.86	16.36
PRIVATE TOTAL	14.09	19.65	57.35
PUBLIC TOTAL	85.91	80.35	-5.53
GRAND TOTAL	100	100	12.83

3. ICICI Lombard: A Background

ICICI Lombard General Insurance Company Limited is a 74:26 joint venture company of ICICI Bank Limited and the US-based Fairfax Financial Holdings Limited. ICICI Bank is India's second largest bank; while Fairfax Financial Holdings is a diversified financial corporate engaged in general insurance, reinsurance, insurance claims management and investment management.

Lombard Canada Ltd, a group company of Fairfax Financial Holdings Limited, is one of Canada's oldest property and casualty insurers. ICICI Lombard General Insurance Company received regulatory approvals to commence general insurance business in August 2001. Among its personal products are health insurance, home insurance, motor insurance, and travel insurance. Among its business products are fire insurance, marine insurance, industrial insurance, corporate insurance, liability insurance, and shop insurance. The fire insurance business, which has low loss ratios, comprises 61% of the Company's portfolio.

With around 1000 employees and 75 offices across India, ICICI Lombard has the largest equity base amongst private players in the non-life sector. The company's identification of retail as a thrust area, reentry into motor insurance and introduction of new products in energy, weather, crop, etc along with aggressive overall growth targets needed further empowering of the frontline agent, enabling the mobile workforce and establishing online enters.

The two primary reasons for the choice of ICICI Lombard General Insurance Company Limited for this case study are the following:

1. ICICI Lombard is India's number one private sector general insurance company. This can be observed from Table 1 that clearly shows that both in the year 2004 and in the year 2005; ICICI Lombard had the highest general insurance market share in India among all the private players in the business.
2. This is the first general insurance company in India to be *ISO 9001:2000* certified. This shows that the quality management processes in the organization have been standardized making it a fit case for carrying out a study related to private sector general insurance in India.

4. The Study Methodology: System Dynamics

System dynamics (Forrester, 1961; Wolstenholme, 1990; Coyle 1979, 1996; Mohapatra et *al*., 1994; Maani and Cavana, 2000) has been adopted as the primary methodology for our analysis. It allows one to use a systems approach in visualizing and solving a problem holistically. It possesses many desirable characteristics such as generality, ease of communication, ability to explicitly represent physical flows and inherent capability to model non-linearity and produce model behavior in time. For instance, adopting such a methodology, Roy, Jain and Mohapatra (2001) have carried out a study on simulation and forecasting of scientific manpower under various policy regimes taking the case study of an R&D laboratory in India.

Regarding service sector industries, one finds that system dynamics has been adopted to study process structure in a wide variety of application areas. Dutta (2001) has carried out a system dynamics study of online service provision. Dutta and Sridhar

(2002) have modeled the growth of cellular services in India using this methodology. As regards the insurance sector, Franco (2005) has developed a system dynamics model of insurance dynamics, specifically, the pricing of insurance coverage. Swartz and Judson (2003) have probed into the functioning of small business insurance carriers who work for small business clients. In another paper, Swartz and Judson (2003) have looked specifically into the insurance claims process by presenting a system dynamics model that includes the metrics of loss adjustment expense (costs), severity (the claim amount), and customer satisfaction.

5. The Model Description

The following are the detailed description of the variables used in the system dynamics model.

1. ***Total new policies****:* It is the total number of new policies written by the company during a financial year .It is a level variable. Its initial value **(***249531***)** is taken directly from the company annual report 2003-04. This is given by (total new policies (t-1) + rate of issuing new policies * total new policies (t-1)).
2. ***Rate of issuing new policies****:* It is the rate at which the new policies are added. It is a rate variable whose value (*0.4*) is taken to be a conservative estimate of the data obtained from company's annual report 2003-04.
3. ***Reinsured policies****:* These are the policies that are continued for the next financial year, that is, these policies are reinsured. It is an auxiliary variable. This is given by (reinsurance percentage * total new policies).
4. ***Reinsurance percentage****:* It is the fraction of the new policies that are reinsured. It is a constant variable whose value (*0.4*) is calculated from the annual report data 2003-04.
5. ***Rate of inflation***: It is the rate of inflation of Indian economy. It is a constant whose value *(0.5)* is assumed to remain constant throughout the period of simulation.
6. ***Net claims incurred***: It is the total number of claims filed on the company. It is an auxiliary variable. It is given by (total active policies * percentage of claims incurred).
7. ***Percentage of claims incurred****:* It is the fraction of the total policies for which the claims are filed. It is a constant whose value (*0.11*) is calculated from the annual report 2003-04 of the company.
8. ***Net claims settled****:* It is the total number of the claims settled by the company. It is an auxiliary variable. The units are in INR. This is given by (claims settlement rate * net claims incurred * average policy price).
9. ***Claim settlement rate****:* It is the rate at which claims that are incurred by the company are settled by it. It is a constant whose value (*0.89*) is taken from the company annual report 2003-04.
10. ***Agents' commission****:* It is the fraction of the money that is provided to the agents who brings the policies for the company. It is an auxiliary variable. This is given by (net premium * rate of commission).
11. ***Rate of commission***: It is the percentage of the money that is paid to the agents. It is a constant whose value is taken from IRDA directives which states that *17.5%* should be the rate of commission. Its value is assumed to be constant throughout the simulation period.

12. ***General capital reserve***: It is the profit that is transferred to the reserve of the company. It is a level variable. The units are in INR. Its initial value ($2.29849*10^9$) is taken directly from the company annual report 2003-04. This is given by (general capital reserve (t-1) + profit after tax).
13. ***Underwriting:*** It is the number of the policies which are written but do not become active. It is an auxiliary variable. This is given by (total new policies * (1 – company productivity index)).
14. ***Total active policies:*** It is the actual number of the policies those are active for the period of one year .It is an auxiliary variable. This is given by (total new policies + reinsured policies – underwriting).
15. ***Market share:*** It is the share of the total capital involved in the general insurance industry of the company .It is in percentage .It is an auxiliary variable. This is given by (net premium / (total capital involved)).
16. ***Total capital involved in general insurance sector:*** It is the total capital involved in the general insurance sector. It is a level variable. Its initial value ($1.445* 10^{11}$) is taken from the annual report 2003-04 of the company. It is increasing at the rate of (*20%*) which is taken to be the constant growth rate whose value (*0.20*) obtained from the annual report 2003-04. The units are in INR. This is given by total capital involved ((t-1) * growth of general insurance sector + total capital involved (t-1)).
17. ***Profit after tax:*** It is the profit of the company after the expenses and tax has been taken into account. It is an auxiliary variable. The units are in INR. This is given by (investment income + net premium - expenses - net claims settled).
18. ***Investments:*** These are the investments made by the company in the government bonds and securities, equity share, mutual funds etc. It represents the total investment made. The units are in INR. This is given by (fraction of capital invested * general reserve capital).
19. ***Fraction of capital invested***: It represents the fraction of the general reserve capital that is invested. It is a constant value *(0.2)* is a conservative estimate inferred from the data obtained from the annual report 2003-04 of the company.
20. ***Expenses:*** These are the expenses that include the operating expenses, taxes, etc. It is an auxiliary variable. The units are in INR. This is given by (operating expenses + investments + agents' commission).
21. ***Operating expenses:*** These include the expenses required to operate the company. It is a level variable whose initial value is taken directly from the annual report 2003-04. The increase in it is assumed to be *10%*. The units are in INR. His is given by (operating expenses (t -1)*0.1 + operating expenses (t -1)).
22. ***Company productivity index:*** It is an index used to measure the productivity of the company. This is given by ((general reserve capital - expenses) / general reserve capital * market share).
23. ***Average policy price***: It is the average price of a policy. Its value *(20300)* is taken directly from the company report 2003-04. It is increasing at a rate of *5%* that is the inflation rate of Indian economy.
24. ***Net premium***: It is the rate premium earned by the company. It is an auxiliary variable whose initial value ($7.908*10^9$) is taken directly from the company annual report 2003-04. This is given by (total active policies * average policy price).

25. ***Rate of increase in operating expenses:*** It is the rate of increase in the operating expenses. It is a constant whose value is (*0.1*).
26. ***Rate of interest on investments***: It is the rate at which companies earn interest on the investments made in government securities, bonds, mutual funds, etc. It is a constant whose value is *7%*.
27. ***Investment income***: It is the income that the company earns on the investments in the form of interest rates. It is an auxiliary variable whose value (rate of interest on investment * investment).
28. ***Growth of the general insurance sector*** - It is the rate at which the general insurance sector in India will be growing. It is a constant whose value is *20%*.

6. The Causal Loop Diagram

A Causal Loop diagram is a graphical tool to qualitatively capture the mental models of the system as understood by the model makers. The Causal Loop diagram of the system dynamics model in the present case displays the relationships among the basic factors that are responsible for the growth and existence of general insurance sector in the Indian context. The structure and dynamics of operation in this sector are sought to be explained here. The model has been developed considering the case of ICICI Lombard General Insurance Company Limited. The causal loop diagram of our model is presented in Figure 1.

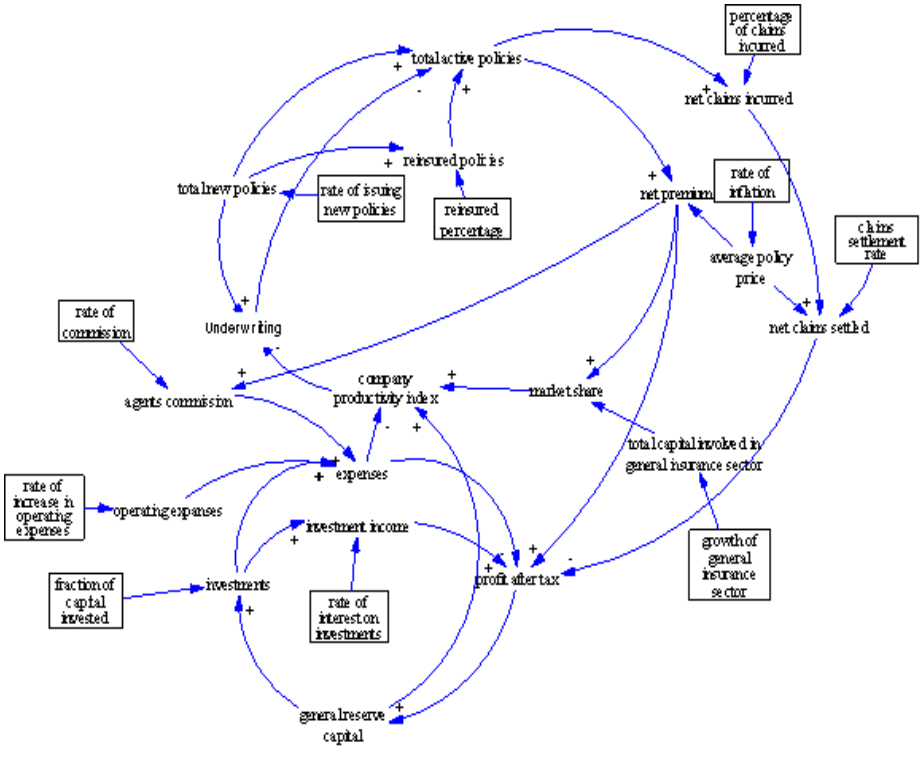


Figure 1: *Model Causal Loop Diagram*

7. Model Explanation

A general insurance company functions on the basis of its general reserve capital. The volume of this capital affects the company productivity index (a positive causation). An increase in company productivity index decreases underwriting (a negative causation) of policies, which, in turn, would signify that a larger number of total active policies are currently in operation (another negative causation). A larger number of total active policies would lead to an increased net premium value and consequently a higher market share for the company and a higher profit after tax. A higher profit after tax would increase the general reserve capital of the company and subsequently the company productivity index. This completes a feedback loop in this causal diagram. Further, a higher value of net premium earned by the company would also mean that the company has to shell out a larger amount as agents' commission leading to higher expenses and lower company productivity index. Furthermore, an increased net premium leads to an increased share of the company in the general insurance marketplace (market share), and consequently a higher company productivity index.

The rate of issuing new policies determines the number of total new policies that enters the system at any point of time. However, not all policies that enter the system end up being active policies (becoming part of total new policies). The policies that do not become active are underwritten (indicated by the variable underwriting). A higher percentage of underwritten policies would adversely affect the number of policies that are active. However, a fraction of the new policies entering the system at a particular point of time continues to remain in vogue for a longer time and they appear in the system as reinsured policies and do not enter as new policies for the subsequent time period.

Another feedback loop comprises increased expenses leading to a reduction in profit after tax consequently decreasing general reserve capital followed by a lowering of investments and hence expenses. A decreased expenses level also leads to an increased company productivity index and thus it is also linked to the first feedback loop mentioned above.

The first feedback loop may also be linked to another loop comprising total active policies with a positive causal link to net claims incurred followed by net claims settled in that order. However, a higher number of net claims settled would lead to a lowering of profit after tax thus reducing general reserve capital and consequently company productivity index.

The model is a representation of the dynamics of the general insurance sector as a whole. This is evident from the consideration of the variable total capital involved in general insurance sector in the model. For the particular case of ICICI Lombard under discussion, the variable market share represents competitive positioning of the company in the sector. The variable average policy price indicates the average price of the different policies under circulation in the sector. Therefore, price of the policies offered by various companies has not been taken as a discriminating factor in determining market share of a particular company in this model. The market share of a particular company (ICICI Lombard in our case) is affected by variables that reflect how the company is performing in the market such as net premium, net claims settled, company productivity index, total capital involved in general insurance sector, etc.

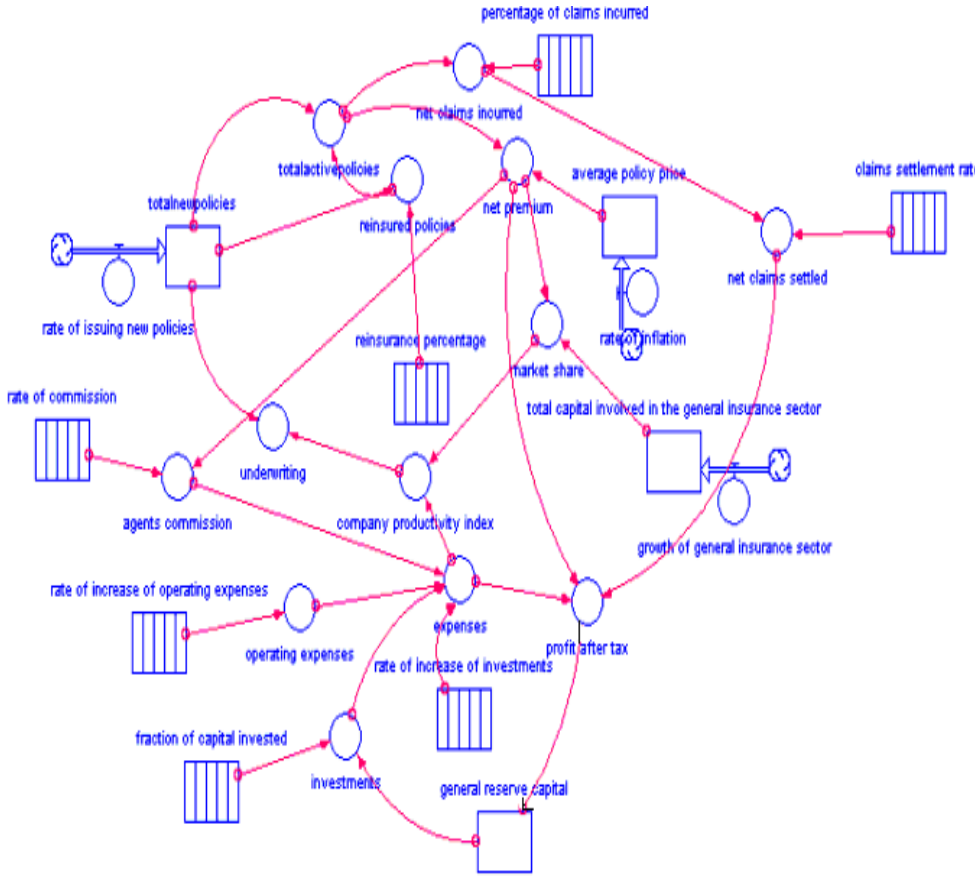


Figure 2: *Model Stock and Flow Diagram*

For simulating the model, the causal loop diagram has been made operational by converting it into a stock and flow diagram developed on system dynamics platform where the symbols and notations have their usual meaning. The stock and flow diagram is presented in Figure 2.

8. The Model Simulation Runs

The system dynamics model has been simulated with 2003-04 being the base year. The simulation runs of the model for different variables of interest are presented in Figure 3 through Figure 7. The model has been simulated for a period of 10 years for all the variables of interest till the year 2013-14.

Figure 3 through Figure 7 show the simulation runs of total active policies, expenses, net claims settled, general reserve capital, and net premium respectively. Interestingly, all the simulation runs are similar in their behavior and predictably so. The figures are seen to increase slowly at first till the year 2007-08, and then an exponential rise in the figures are predicted by the model. This is the period when the

company is expected to start realizing the full potential of the economic reforms initiated in this sector and start exploiting the vast untapped general insurance sector market. The model presupposes that the policies that govern these dynamics would continue to remain in force for the period of the model simulation run.

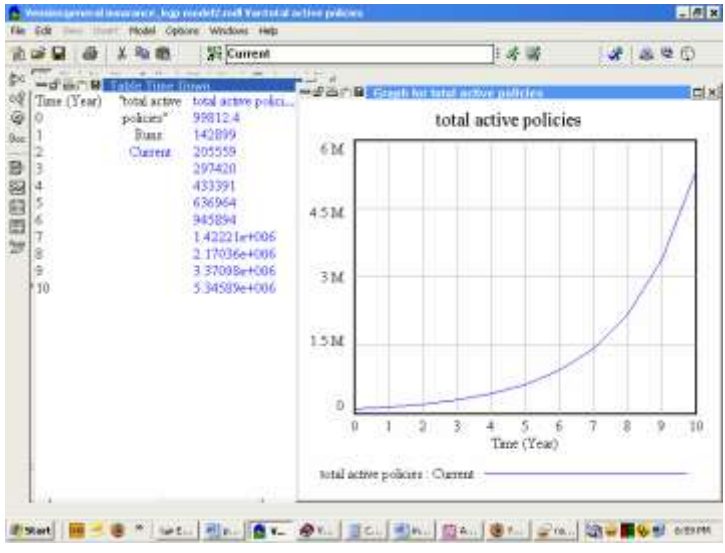


Figure 3: *Simulation Run: Total active policies*

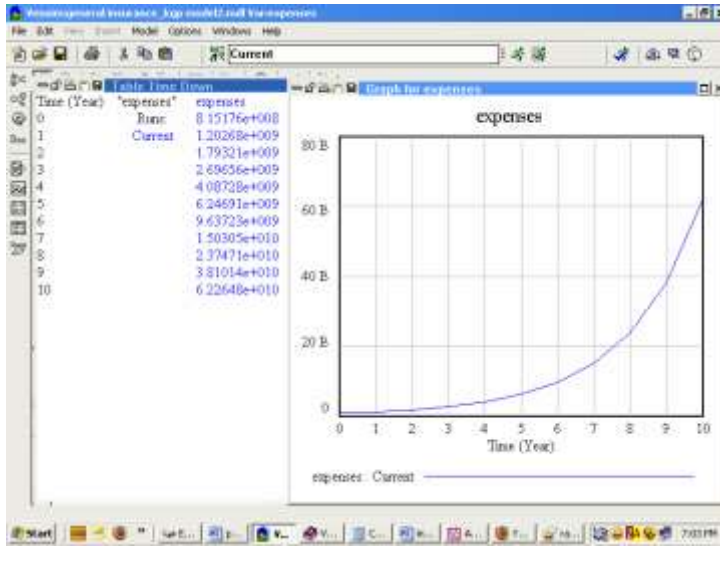


Figure 4: *Simulation Run: Expenses*

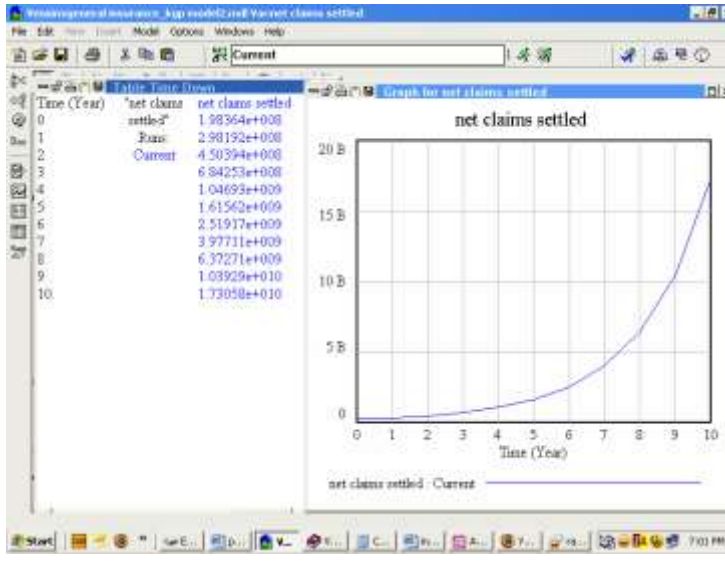


Figure 5: *Simulation Run: Net claims settled*

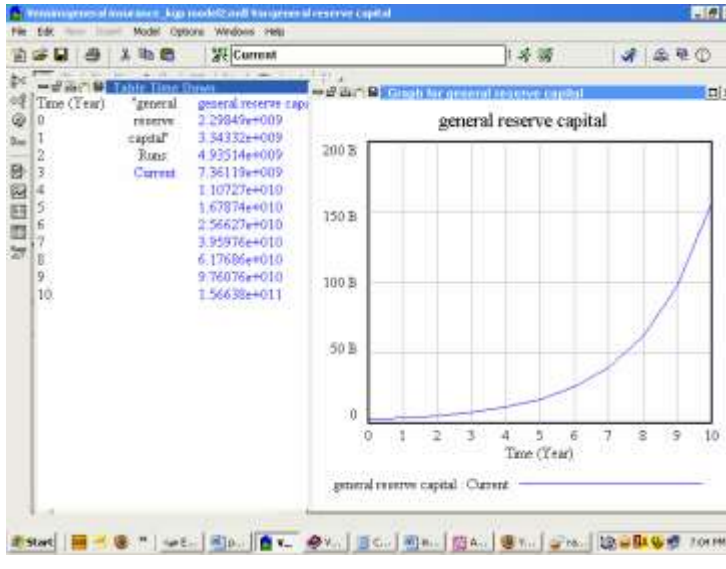


Figure 6: *Simulation Run: General reserve capital*

9. Conclusions

The insurance sector in India, life and non-life, has witnessed recent changes in laws and regulations and opening up of the sector to private participation. The present study attempts to probe deep into the structure of one such private sector player working in the non-life insurance sector, namely, the ICICI Lombard General Insurance Company Limited, develops a system dynamics model based on the causalities and interrelationships among the variables that reflect the present

performance and future prospects of this company in respect of this industry sector, and simulates and predicts the likely behavior of some critical factors in this scenario over time - total active policies, expenses, net claims settled, general reserve capital, net premium, and market share.

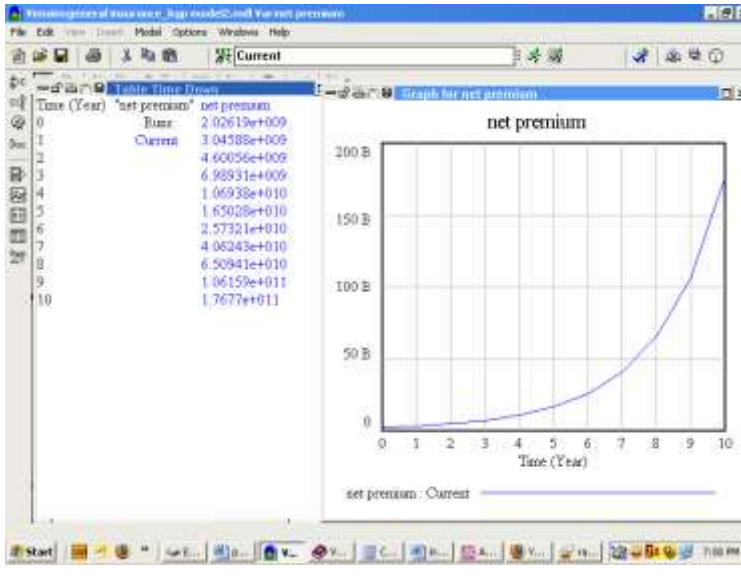


Figure 7: *Simulation Run: Net premium*

For forecasting future scenarios on the basis of past data of a variable, there are approaches such as time series forecasting (exponential smoothing methods, averaging methods, ARIMA modeling, etc.). Roy and Sharma (2007) have carried out an analysis of technical manpower potential in India using time series forecasting methods. However, all these methods require extensive data and also are unable to capture non-linear interactions in social and economic systems. In the present case, data availability for analysis were limited as private sector general insurance has come into Indian economic scenario only in the past few years (IRDA issued the first batches of licenses in 2001 only). Moreover, the entire dynamics of this growing sector are complex and non-linear and as such a suitable methodology is required to capture the interactions among the different variables. System dynamics has been adopted as the methodology for structural and policy analysis of the general insurance sector in India taking a case study of a private player (ICICI Lombard) as it provides us with a paradigm with which complex, dynamic and non-linear interactions in social systems can be understood and analyzed and new structures and policies can be developed to obtain desired improved behavior of systems.

The causal lop diagram of the model has helped us understand the various factors and drivers at play in this emerging and critical sector of the Indian economy. These variables have been explained in detail (including their measurement characteristics) and the model assumptions have been clearly delineated. The model is limited by the choice and selection of the variables that are included, and those that have been left out. The study is limited by the fact that the scenario in this industrial

sector is constantly varying, and it is almost impossible to keep pace with the changing environment.

10. References

1. Coyle, R.G. (1979). Management System Dynamics, Chichester: John Wiley & Sons.
2. Coyle, R.G. (1996). System Dynamics Modeling: A Practical Approach, London: Chapman and Hall.
3. Dutta, A. (2001). "Business Planning for Network Services: A Systems Thinking Approach", Information Systems Research, 12(3), 260-283.
4. Dutta, A. and Sridhar, V. (2002). "Modeling Growth of Cellular Services in India: A System Dynamics Approach", Proceedings of the 36th Hawaii International Conference on System Sciences, IEEE.
5. Forrester, J.W. (1961). Industrial Dynamics, MIT Press.
6. Franco, D. (2005). "Insurance Dynamics: Managing Information Flows", in Sterman, J.D., Repining, N.P., Langer, R.S., Rowe, J.I. and Yanni, J.M. (eds.), Proceedings of 23rd International Conference of the System Dynamics Society, Boston, USA, July 17-21, The System Dynamics Society, SUNY, Albany, New York, USA.
7. http://sify.com/finance/fullstory.php?id=13915606, 11 August 2005.
8. http://www.directories-today.com/insurance.html, 19 August 2005.
9. http://www.icicilombard.com/Content/PDFs/Annual03-04.pdf.
10. http://www.indiainfoline.com/pefi/insr/rep8.html.
11. http://www.irna.ir/en/news/view/menu-237/0506241288163953.htm.
12. Maani, K.E. and Cavana, R.Y. (2000). Systems Thinking and Modeling: Understanding Change and Complexity, Auckland: Pearson Education.
13. Mohapatra, P.K.J., Mandal, P. and Bora, M.C. (1994). Introduction to System Dynamics Modeling, Hyderabad: Universities Press.
14. Rao, C.S. (2004). "The Role of Actuaries in the Indian Insurance Industry in Post Liberalization Era", 6th Global Conference of Actuaries, February 18, New Delhi.
15. Roy, S. and Upadhyaya, S.S. (2007). "Technical Manpower Employment Potential in India: Analysis and Policy Implications", Journal of Technical Education and Practical Training, Vol. 2 (to be published).
16. Roy, S., Jain, A. and Mohapatra, P.K.J. (2001). "Forecasting and Simulation of Scientific Manpower under Various Policy Regimes: Case study of an R&D laboratory in India", Manpower Journal, Vol. XXXVII (1), 23-45.
17. Senthil, M. and Narayanan, A.G.V. (2004). Insurance Marketing: A Paradigm Shift, www.indianmba.com.
18. Szwartz, G. and Judson, R. (2003). "Insurance Claim Capacity Dynamics", in Eberlein, R.L., Diker, V.G., Langer, R.S. and Rowe, J.I. (eds.), Proceedings of 21st International Conference of the System Dynamics Society, July 20-24, New York City, USA, The System Dynamics Society, SUNY, Albany, NY, USA.
19. Szwartz, G. and Judson, R. (2003). "Small Business Insurance Dynamics". In Eberlein, R.L., Diker, V.G., Langer, R.S. and Rowe, J.I. (eds.), Proceedings of 21st International Conference of the System Dynamics Society, July 20-24, NY, USA, The System Dynamics Society, SUNY, Albany, New York, USA.
20. Wolstenholme, E.F. (1990). Systems Enquiry, Chichester: John Wiley & Sons.