OPERATING EFFICIENCY IN THE U.S. PROPERTY-CASUALTY INSURANCE INDUSTRY

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ABSTRACT

Data Envelopment Analysis (DEA) is proposed here as a method to compare organizational efficiency values over time. DEA is commonly used to compare competing organizations using a common set of standards in order to find that one or some of them can be declared to be more efficient than others. The technique is modified here to compare the United States property-casualty industry operating results to itself over discrete time periods. The financial measures being compared are discounted to a common base to provide equitable comparisons. The results show that the industry has had declining operating efficiency over recent years.

INTRODUCTION

The property – casualty insurance industry is vitally important to the economy and the population of the country. It touches the lives of the entire population. Coverage includes such diverse instrumentalities as homeowners, auto, medical malpractice, credit, business continuation, shipping, boilers and liability. Coverage availability has become a virtual necessity for individuals and businesses alike. The viability of the industry is essential to individual and business financial security. It is with this concern in mind that the question of the efficiency of the industry is opened.

Entities, whether governmental, private or commercial, can be thought of as having a set of inputs, some processing activities and a set of outputs. There is a sense that the entity is efficient if it obtains a great amount of output while expending few inputs. Data Envelopment Analysis (DEA) is typically used to compare the relative efficiency of each of a set of operating units. These operating units are usually called decision–making units (DMUs). The technique was pioneered by Charnes, Cooper and Rhodes (1978) and extended by Banker, Charnes and Cooper (1984). Cooper, Seiford and Tone have recently published a text on the use of DEA (1999). The cross-sectional application of DEA technique has been applied in many environments including; the public sector (McCarty and Yaisawarng (1993) and Vanden Eeckaut, Tulkens and Jamar (1993)), the financial sector (Lovell and Pastor (1997), Barr, Seiford and Siems (1993), (1994) and Siems and Barr (1998)), and the insurance industry (Cummins, Weiss and Zi (1999), and Cummins and Zi (1998)).

While DEA has traditionally been used to establish a relative measure of efficiency of any of several competing entities, uniquely, it will be used here to track efficiency of a single entity over time. The operating statistics at consecutive time points are used herein as the distinct entities or DMUs.

The work done here proposes to track the efficiency of the entire aggregate United States property – casualty insurance industry over the 24 years 1978 – 2001. The purpose is to observe if operating efficiency has remained relatively constant or if there appears to be any trend toward either higher or lower efficiency over time.

Data Envelopment Analysis

The formal DEA model is:

Minimize: $Z = E_i$ (Ia)

Subject to:

$\sum_{i=1}^{n} w_i = 1$ (Ib)

$\sum_{i=1}^{n} v_{ij} w_i \geq v_{ij}$ all outputs j (Ic)

$\sum_{i=1}^{n} u_{ij} w_i \leq u_{ij} E_i$ all inputs j (Id)

all w_i, $E_i \geq 0$

Here, E_i is the efficiency ratio of outputs relative to a set of inputs for the i = 1, …n DMUs. We index the outputs so that v_{ij} is the observed amount of each of j outputs obtained from the u_{ij} inputs for the i^{th} DMU.

The objective function in (Ia) serves to determine the relative efficiency level E_i for DMU_i. Constraint (Ib) forces the relative weights in the composite DMU to sum to one. This causes the individual weights to be percentages of the total composite entity. The constraints of (Ic) force the several outputs of the composite to be at least as large as the corresponding outputs from any individual DMU, which clearly is needed for an efficient entity. Finally, constraints (Id) require that the several inputs of the weighted average composite DMU be no greater than E_i% of those of any DMU_i. As always in a linear programming formulation, the variables are also required to be nonnegative.

The United States Property – Casualty Insurance Industry

The work developed here will monitor industry operating efficiency over time through the use of two output variables and four input variables. Real values of these variables are used in order to make them comparable over the entire time horizon of the study. They are obtained by dividing the nominal value by the urban household consumer price index (CPI), 1981-82 = 100. The output variables are real net investment income and real augmented underwriting gain or loss. The input variables are lagged real bond holdings, lagged real stock holdings, real aggregate policyholder surplus and real operating expenses. An additional DMU IDEAL is created to provide a standard of comparison for all years.

Optimal results were obtained by running the model for each year of the study. It is seen there that efficiency relative to the variables defined was high in the early years. Efficiency was greater than 90% for all years through 1986. After that there was a steady decrease in annual efficiency through the year 2001, where it had fallen to 61.52%. This finding is of substantial concern because operating efficiency affects the viability of the industry, which is of obvious concern to the insurers. It is also alarming to commercial enterprise, the government and to consumers who desire reliable insurance protection. Therefore, the question of the important related factors arises. These related factors can be addressed for both the inputs and the outputs.

The nature of the declining operating efficiency can also be explored by examining the slack variables of the several input constraints. There are four inputs being considered here: lagged real bond holdings, lagged real stock holdings, lagged real policyholder surplus and real operating expense. The first three of these are lagged because the amounts available at the beginning of the year are the funds available for investment or underwriting activity over the year. In each of these input constraints the slack variable is the amount by which the given input level exceeds $0 \leq E\% \leq 1.0$ of the DMU_{IDEAL} corresponding input.

As discussed above, real lagged stock and bond holdings are included because they directly affect the level of the real net investment income output. For real bond holdings, after relatively small slack in the early years the slack gradually grew to between 13,000 and 22,000 ($million) since 1990. Bond holdings have thus been generally larger than would have been used by DMU_{IDEAL} in obtaining portfolio returns.

In comparison, slack amounts for real stock investments have been relatively small or even zero for several years of the study, only increasing to approximately 35% of the bond holding during the late 1990's bull market. DMU_{IDEAL} would have required the use of stock portfolio levels which are not substantially less than were actually used in the industry until the late 1990's.

CONCLUSION

It is not the purpose of this work to pursue the root causes of the secular decline in operating efficiency. Instead, the warning is made that consequences of continued efficiency decline might be important for the industry and the economy. As measured by the availability of policyholder surplus, there is growing underwriting capacity availability. This may indicate that insurers are more interested in seeking profits from management of the stock and bond investment portfolios than from underwriting activity, where annual profits have been erratic and often negative. The insurers have consistently used their human and physical resources well, since the slack levels from real operating expenses have been zero for most of the years. That is, insurers have not spent unnecessary amounts of money annually in operating the underwriting enterprise. This suggests that the worsening operating results from underwriting gain or loss are attributable to market pricing and loss experience. That problem has large implications that are of concern to the economy and consumers, as well as the property – casualty industry.