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MULTIPLE DISCRIMINANT ANALYSIS: A MODEL DEVELOPMENT FOR SELECTION OF STATE-OWNED ENTERPRISES FOR PRIVATIZATION IN THE DEVELOPING COUNTRIES

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ABSTRACT

The purpose of this study is to develop a model for systematic selection of state-owned enterprises for privatization in the developing countries based on empirical data rather than on an ad-hoc approach like it has been done up to now. Decision makers who want to privatize a specific SOE can determine its likelihood of success as well as how to rehabilitate the target SOE in order to improve its chance of successful privatization. Stepwise Multiple Discriminant Analysis would be used to develop a prediction model. Factor Analysis would be used to reduce the number of variables to be applied in the SMDA model. The pooled-variance t test would be used for the before-after privatization performance comparison.

INTRODUCTION

Privatization which is broadly defined as the transfer of state-owned enterprises (SOEs) into the private hands in order: a/ to promote efficiency; b/ to develop the private business sector and c/to reduce government subsidies[1] has been discussed and applied in many countries such as Canada[2], the United Kingdom[3], France[4], Italy[5] and in many developing countries[6]. The literature on the subject ranges from general discussions about privatization such as the works done by Austin, Wortzel and Coburn[7] or Aylen[8] and Berg[9] to the techniques of privatization such as the studies by Brooke[10] or Bradley and Gelb[11] and Warrett[12] or about competition and regulation issues by Forsyth[13] or on financing issues by Bucheit[14] . None of the existing studies have empirically explored the success or failure of the SOEs which have been privatized in the developing countries and none has tried to develop a model of prediction of success or failure in order to determine which SOEs should be selected and how to increase the chance of success via rehabilitation of the target firms to be privatized.

Although there are plenty of privatization cases to be used for the development of a data base for empirical investigation, nothing has been done in this area yet. Most studies are descriptive or prescriptive in nature without any empirical evidence to guide policy makers in their selection process. It would be significant to develop a model of selection for empirical testing to see whether the likelihood of successful privatization as measured by the SOEs performance post- privatization could be improved with the right selection and rehabilitation measures. After all, a successful privatization program in a country is measured not only by the number of privatized SOEs but also by how many actually become more efficient post-privatization.

THE MODEL

I. COMPONENTS AND VARIABLES

The major components of the model which contain the relevant variables cited in the literature of privatization as well as by the practitioners could be grouped into five categories and they are: 1/ host country government's (HCG) commitment to privatization; 2/ institutional adaptation to the privatization requirements; 3/ SOEs 'readiness; 4/ investors' interest and trust in participating in the privatization process and 5/ donors' interest and commitment to support the privatization effort discussed as follows.

A. Government Commitment

The government commitment could be measured by the absence (0) vs. the existence (1) of the following variables needed to enhance the likelihood of success in privatization:

1. *Privatization Policy*: The HCG's commitment to privatization is clear when there is an explicit privatization policy which spells out in writing what and why the HCG wants to privatize the SOEs. The existence of such policy would enhance the likelihood of success because not only commitment is important but also such policy provides a clearer direction for privatization planning and implementation.

2. *Privatization Strategy*: The HCG's commitment becomes even stronger when a strategy of privatization exists because it shows clearly that it has seriously considered how to carry out its policy. Once again, the existence of a strategy would enhance the chance of success.

3. *Privatization Committee*: The existence of a privatization committee is indicative of the HCG's commitment to privatization. A permanent committee shows a stronger commitment than an ad-hoc one. Also, a permanent committee tends to produce better privatization decision than an ad-hoc one for the simple reason of time commitment and hence higher learning curve. Finally, a privatization committee normally consists of representatives from the responsible ministries which have SOEs under their umbrellas as well as representatives from the private business sectors. Such committee would tend to understand better what might be successful and what might not as it has the balanced view of all constituencies of privatization, namely the sellers, the potential buyers and the management of the SOE which constitute the product in the transaction.

4. *Target List of SOEs for Privatization*: The longer the list, the higher the desire of the HGC to privatize its SOEs. Normally, the list would exclude the national-security sensitive SOEs and hence, the risk of renationalization of the privatized SOEs would be diminished; therefore, enhancing the chance of successful privatization.

5. *Public Statements Made by Political Leaders*: The HCG's commitment would be most obvious if the Prime Minister or better than that the President himself makes a public statement supporting privatization.

6. *Privatization Law/Decree*: The HCG's commitment translated into actual action by issuing a Presidential decree/law would enhance the privatization success as such law/decree describes the rule of the game for the involved parties to follow.

7. *Privatization Fund*: The establishment of a privatization fund would provide the necessary source of financing which constitutes one of the major bottleneck to privatization. This is indicative that the HCG has carefully planned its privatization effort and hence the likelihood of success would be greater.

8. *Number of Privatized SOEs*: Finally, the number of SOEs which have been actually privatized is the strongest indicator of the HCG's commitment to successful privatization.

B. Institutional Adaptation

The prerequisites to successful privatization are the institutional adaptations which would provide a favorable economic environment discussed as follows:

1. *Fiscal Policy*: Tax incentives on dividend and capital gain are necessary to stimulate ownership of stocks issued from privatized SOEs which in turn facilitates the development of a capital market and promotes financial broadening and financial deepening. Tax incentives are also necessary to attract foreign investors to participate in the privatization transactions. Also, a decrease of subsidies to the SOEs is a clear indication of HCG's firm intention to force privatization of inefficient SOEs.

2. *Monetary Policy*: Policy which promotes the development of existing financial institutions such as insurance companies or pension funds in order to allow them to actively participate in the financing aspects of privatization would enhance the likelihood of success of privatization. Monetary policy could also promote the creation of new financial institutions such as mutual funds or investment companies in order to help the process of financial intermediation between savings and securities investments rather than the traditional bank deposits.

Favorable monetary policy would stimulate the capital market with new instruments created for trading, giving the investors more choices. With more participants and a place for trading, the trading volume would increase and the necessity of an uniform accounting procedure would have to be used in order to maintain investors confidence especially when a strong Security Exchange Commission is put in place.

3. *Development Plan*: The existence of a substantial section reserved specifically for privatization planning would normally enhance the likelihood of success because objectives are normally spelled out, costs, financial resources and impacts are identified.

4. Private Sector Development: Investment laws and price decontrol policy need to be stimulative to the development of the private sector in order to support the privatization effort as more competition will take place and efficiency becomes a must for survival in the absence of government subsidies.

C. SOEs Readiness

1. Management Support: Management of the privatized SOEs need to be involved from the outset of the privatization effort in order to ensure their support. Contrary to general belief that SOE management would automatically object to privatization because of the fear of losing jobs, well informed management which knows about the short term and long term impacts of privatization and the measures to be taken to smooth out the ownership transfer process would give the support.

2. Employee Communication: Communication with the employees, training for relocation, compensation for early retirement and the possibility of employee ownership of the SOEs to be privatized would normally reduce resistance from the employees.

3. SOEs Performance: Highly liquid, efficient and profitable SOEs are always more likely to be successful post-privatization. Yet, less profitable SOEs or even losing ones could also be successful post-privatization if they have the necessary ingredients for profit such as without price control for example. The financial performance variables to be used would be as follows:

. *Liquidity*:	. Current ratio
. *Efficiency*:	. Account receivable turnover ratio . Inventory turnover ratio . Current asset turnover ratio . Fixed asset turnover ratio . Total asset turnover ratio
. *Leverage*:	. Debt to total asset ratio . Interest coverage ratio
. *Profitability*:	. Return on investment . Return on equity . Gross profit margin . Operating profit margin . Net profit margin . Earning per share

D. Participation

Privatization cannot be successful unless there are potential investors who are interested in the SOE because they foresee the potential profit earned from the enterprise.

The interest can be from the local business community as well as from foreign investors. The broader the impacts on the country post privatization, the better. For this reason, the method of ownership transfer could affect the scope of the privatization impacts. An outright liquidation can simply transfer the ownership to a few owners and this approach might not be beneficial in the long run to the development of a capital market because such method does not provide the ingredients for financial broadening nor deepening. In contrast, a public offering of stocks coupled by an employee stock ownership plan (ESOP) would create a broader impact. The Stepwise Multiple Discriminant Analsis model hopefully would help to determine the various level of contribution to the likelihood of success of a target SOE by each different method of ownership transfer.

E. Donors' Commitment

The donors'commitment could be indicated first by the interest of the head of mission in the HC, whether the person represents AID or any other aid development institutions. The next indicator of donors' commitment which are facilitators to successful privatization consists of the existence of a written strategy for privatization and the financial resources allocated.

II. METHODOLOGY

In order to test the pre-post privatization performance, the average and standard deviation of the liquidity, efficiency, debt and profitability ratios before and after privatization are computed and the *pooled variance t-test* is used. The *pooled-variance t value* is used because it reduces the risk of having an observed significance level to be somewhat larger than it should be had the standard t statistic been used instead.

Financial statements needed to test the pre-post privatization ratios as well as all the macro-economic variables which have been cited in the literature on privatization as determinants of success or failure such as gross national product, consumption, business investment, government expenditures, exports or the micro-economic variables such as type of industry, number of employees, level of employee participation, age of the SOEs, method of transfer, method of financing, pre-privatization financial performance or management support are available at the World Bank and the US Agency for International Development.

For the *t-test* of hypothesis that post-performance is equal or less than pre-performance, the profitability ratios are cash ratios which mean that all non-cash expenses such as depreciation and amortization are added back to the gross profit, operating profit and net profit in order to compute the cash gross profit margin, cash operating profit margin, cash net profit margin, cash return on investment and cash return on equity from the balance sheets and income statements of the SOEs. The cash ratios used would minimize the difference in accounting methods used for depreciation and their impacts on taxation.

In order to reduce the vast number of variables which have been pointed out in the literature on privatization, a list of variables are formed based on the current literature and factor analysis is used to form groups of variables with common construct. This methodology is based on the assumption that the multitude of observed variables may have one underlying common factor which explains their covariations. This study will begin with an initial factor extraction whereby no assumption is made about the relationship between variables then the orthogonal rotation based on the equamax method is used to rotate the axis for obtaining a simpler and hence more interpretable solution.

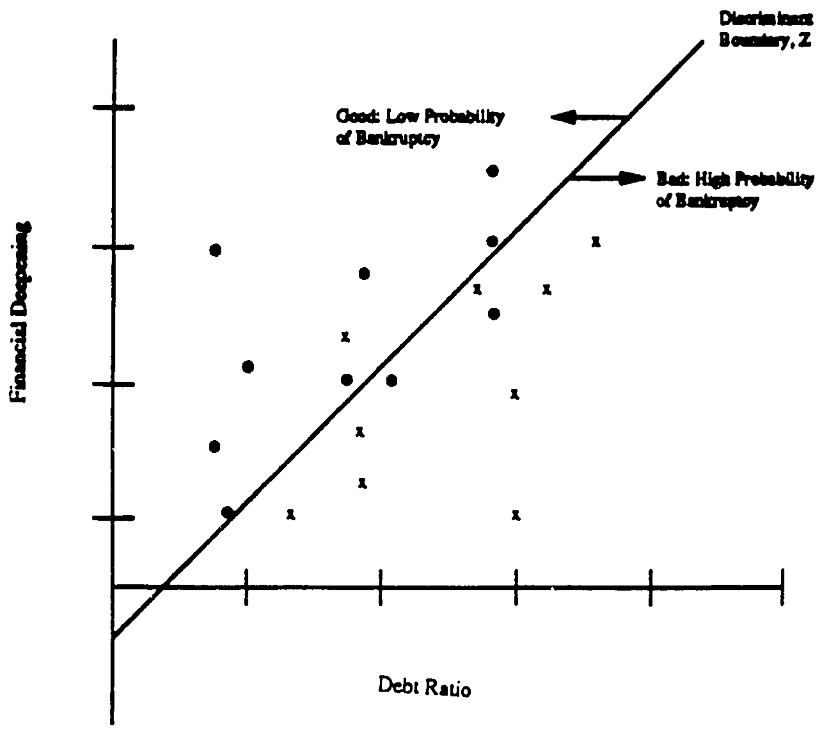
Finally, the above key variables are used in a stepwise multiple discriminant analysis (SMDA) in order to discriminate the failed privatized SOEs from the successful ones. A paired sample of failures and successful cases are selected based on asset sizes and are matched in number. Stepwise MDA would select the most relevant variables which contribute best to the prediction power of the model. For validation purpose, the MDA model results are then compared to the actual observed cases of failure from the ex-post sample to determine the percentage of misclassification. An ex-ante sample containing cases which took place after the period of the model building is also used to better simulate the real world decision process. The Wilks' Lamda is used to test the significance of the difference between success-failure groups.

III. EXPECTED RESULTS

The expected result from the above excercize would be a multiple discriminant model shown as follows:

$$Z = a + bX_1 + cX_2 + dX_3 + eX_4 \ldots\ldots + nX_n$$

with the X_i as the selected relevant variables which would affect the likelihood of the privatized SOEs to be successful post-privatization. They could be for instance the return on investment ratio of the SOEs and the financial broadening of the country as shown on a simplified two-dimension graph below:



The discriminant boundary discriminates the target SOEs which would have a low vs. a high probability of success by situating them at different areas of the graph. This discrimination would be helpful to policy makers at deciding which SOEs to target for privatization and which ones need to be rehabilitated prior to privatization via which rehabilitation option. Finally, it is expected that the model might not be applicable to all SOEs in the sample when their Z scores is situated in the zone of ignorance.

APPLICATION IMPLICATIONS

The above model could be used for the formation of a list of potentially successful SOEs because of their known chance of success. All SOEs which are not classified as national security type could be fed into the model for evaluation. The model will position the various target SOEs on the MDA graph and the decision makers could determine how far each SOE is away from being successful if it would be privatized. The logical order of privatization would be to privatized the ones which have a highest chance of success to be followed by the next highest and so on.

Another application possibility is to determine how a given rehabilitation measure could move the position of a given SOE from a low likelihood of success into a higher chance of success. Up to now, the popular belief has been capital restructuring via the reduction of leverage financing or fixed asset improvement. By using sensitivity analysis to test the different rehabilitation measures individually as well as by a combination of several at the same time, the model would show how such measure(s) might move the target SOE toward the successful zone and by how far. This kind of application not only helps to enhance the chance of successful privatization but it also helps to keep cost under control when useless rehabilitation can be avoided. For example, if the decision makers plan on rehabilitating plant and equipment (which is variable X_{n-3} for instance), or to restructure the capitalization (X_{n-6}) or to rely on joint venture (X_{n-8}) with a foreign investor instead of an outright liquidition (X_{n-9}), they could do a sensitivity analysis with each variable then with a combination of all or set of variables as they wish. The option(s) which move the SOE to a higher likelihood of success with the least cost would be the recommended strategy.

In applying the model, the researcher must make sure that the data is suitable to all the statistical method assumptions of normality. Alternative statistical methods might need to be substituted in case of assumption violations. Also, in the area of SOE financial performance measurement, similar tax structures and accounting standards must exist unless some adjustments are made to ensure comparability. It would also be advisable that SOEs from the same economic sector are used in the sample for comparability. Finally, the sample size must be large enough in order to make the SMDA result reliable.

ENDNOTES

1. Vuylsteke Charles. *Techniques of Privatization of State-Owned Enterprises- Method and Implementation*. World Bank Technical Paper No. 88. Washington D.C.: World Bank, October 1989.

2. Mawe, C. J., and Patterson, N. "Privatization: The Case of Urban Transportation Development Corporation Ltd." *Business Quarterly Review*, November 1987.

3. Kay, J.; Mayer, C, and Thompson, D., editors. *Privatization and Regulation: The UK Experience*. Oxford: Clarendon Press, 1986.

4. Bance, P., and Monier, L. "The Privatization of Public Enterprises in France". *Annals of Public and Cooperative Economy*, No. April-June 1986, pp. 181-203.

5. Stefani, Giorgio. "Privatizing Public Enterprises in Italy: The Case of State Holdings". *Annals of Public, Social and Cooperative Economy*, No.2, April-June 1986, pp. 231-251.

6. Belassa, Bela. *Public Enterprises in the Developing Countries: Issue of Privatization*. Development Research Department. Washington D.C.: World Bank, Discussion Paper No. 292, May 1987.

7. Austin, James E.; Wortzel, Lawrence; and Coburn, Jonh F. "Privatizing State-Owned Enterprises: Hope s and Realities". *Columbia Journal of World Business*. Fall 1986, pp. 51-60.

8. Aylen, Jonathan. "Privatization in Developing Countries". *Lloyds Bank Review*, No. 163, January 1987, pp. 15-30.

9. Berg, Elliot, and Shirley, Mary. *Divestiture in Developing Countries*. Washington D.C.: World Bank, May 1987.

10. Brook, Michael Z. *Selling Management Services Contracts in International Business*. London: Holt, Rhinehare and Winston Ltd., 1985.

11. Bradley, Keith, and Gelb, Alan. "Employee Buyouts of Troubled Companies". *Harvard Business Review*, September-October 1985, pp. 121-130.

12. Warrett, Rosemary. "Brazilian Debt-Equity Swaps". *Corporate Finance*, September 1987, No. 34, pp. 89-92.

13. Forsyth, Peter. "Airlines and Airports: Privatization, Competiticn and Regulation". *Fiscal Studies*, 5:1, February 1984, pp. 61-75.

14. Bucheit, Lee C. "Converting Sovereign Debt into Equity Investments". *International Law Review*, September 1986, pp. 10-14.