A censored Switching Regression Approach to Evaluating the Effect of Sunk Costs and Firm-Level Diseqilibrium on Export Performance

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Abstract

For a given foreign demand, a firm's exports are analyzed as the result of interaction between its technology and marketing capabilities. The existence of considerable sunk costs provides a source of disequilibrium internal to the firm, where the weakest side of these two capabilities determines the firm's actual exports. To analyze this hysteresis, a censored switching regression model consisting of the technology and marketing regimes is introduced in the strategic management framework. In this model, the effect of sunk costs is captured as the difference between the technology capability and the marketing capability, each depending on the characteristics of the individual firm. However, the relative effects of sunk costs across firms, sectors and size groups are compared with the use of the conditional probability of excess marketing probability. Subsequently, these results are used to measure the firm-specific effectiveness of export support systems for lowing sunk costs and thereby penetrating export markets with the use of data obtained from a specific sample of Korean small and Medium sized enterprises for which sunk costs are deemed to be especially important.

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I Introduction

Despite ever-increasing recognition of the importance of manufactures exports to economic growth, economists have been relatively silent on the effectiveness of various specific export promotion policies and of how their effectiveness might vary across enterprises according to the relative importance of different constraints which these firms face. Indeed, trade models use equilibrium models and typically ignore firm-level variables in order to concentrate on macro- or industry- level factors such as exchange rates, tariff rates and other general types of policies.

Recently, however, several papers analyzing firm behavior among both exporters and non-exporters have begun to emerge. For example, Bernard and Jensen (1995a & b, 1996a & b) found significant differences between exporters and non-exporters among US manufacturing plants.[1] Similar differences have been observed among the firms in other countries, especially in developing countries where the interest is greatest (Roberts and Tybout, 1997 for Colombia; Aw and Batra, 1994 for Taiwan; Aitken, Hanson, and Harrison, 1997 for Mexico; and Bernard and Wagner, 1997 for Germany). In particular, Aitken, Hanson, and Harrison (1997) provided evidence that plant size, wages, and especially foreign ownership are positively related to the decision to export. They also examined whether spillovers associated with one firm's export activity reduced the cost of exporting for other firms and then found evidence of spillovers from multinational enterprises but not from general export activity. Roberts and Tybout (1997) showed that in the presence of sunk costs, a firm's prior export experience as well as some plant characteristics, such as size of capital, plant age and ownership structure, are positively related to the propensity to export. Aw and Hwang (1995) found that the bulk of the difference in output between the groups of producers was explained by the larger size of exporters relative to non-exporters and there were significant differences in productivity levels between exporters and non-exporters. On the other hand, Kim, Nugent and Yhee (1997) analyzed the role of transaction costs as sunk costs in Korean small and medium-sized enterprises' choice among alternative export channels, under the assumption that firm-specific transaction costs for a given channel are a function of the firm's characteristics.[2]

Among others, Bernard and Jensen (1996b) and Roberts and Tybout (1997) more explicitly considered sunk costs in determining export performance, showing that such costs serve as barriers to entry into and out of export markets. Both such studies tested for the effects of entry costs at the firm-level by estimating the coefficient(s) of a dummy variable indicating whether or not a firm had participated in export markets in the previous period. None of these papers has examined the effects of specific trade promotion variables and their variation across firm types.

This paper follows Bernard and Jensen (1996b), and Roberts and Tybout (1997) in considering sunk costs as barriers to entry into and out from export markets and plant-level characteristics in explaining variations in export behavior across firms. However, in this paper, a distinctive disequilibrium analysis is employed in which sunk costs play the crucial role of distinguishing between a firm's potential production and its potential marketing. Thereby, the sunk costs provide a source of disequilibrium internal to the firm rather than between supply and demand. A firm's actual exports are realized only when the firm's production potential (or technological capability) and (international) marketing capability are equalized and realized.[3] From this perspective, either its technological capability or its international marketing capability

[1] In particular, exporters were found to have more workers, proportionally more white collar workers, higher wages, higher productivity, greater capital intensity and a higher probability of being part of a multinational firm than non-exporters.

[2] Four channels were considered: direct exporting, foreign buyers, non-profit agencies, and subcontracting.

[3] The definitions of the technology capability and marketing capability will be given in Section II-1.

will constrain a firm's export performance. If a firm possess neither or only one of these capabilities, it remains a non-exporter. If one capability is weak relative to the other capability, a firm's export behavior is constrained by the weaker of the two capabilities. Sunk costs, especially when combined with uncertainty, can impede adjustments of the respective capabilities. Such problems are especially acute in small and medium-sized enterprises (SMEs) since they are likely to be especially weak in one or the other or both of these capabilities. At the same time, SMEs become an especially important class of firms for evaluating the effectiveness of specific export promotion variables that are often focused on SMEs.

Therefore, in this paper, we use a switching regression model with censoring to identify which constraint - technological capability (T-regime) or marketing capability (M-regime) - is the binding one as far as export performance is concerned in a sample of Korean SMEs. Unlike Bernard and Jensen (1996b), and Roberts and Tybout (1997) which use but one logit equation, our switching regression model consists of two equations, one corresponding to each regime type. This switching regression model has the flexibility of (i) analyzing a firm's export behavior in terms of both the T and M regimes which relate directly to each firm's two main activities, production management and marketing management, (ii) identifying those plant characteristics which exert the greatest influence over each regime type, and (iii) capturing the role of sunk costs in terms of the estimated probabilities of excess marketing capability.[4] This is done for a sample of Korean SMEs spread over four specific sectors in which SMEs have been prominent in exports and where the Korean government has had SME and export support systems in place for some time. For each type of support, we identify its effects not only on actual exports but also on each regime type (or constraint). In this way we analyze the role of sunk costs in export performance from a disequilibrium perspective.

The organization of this paper is as follows: Section II discusses the concept, role and sources of sunk costs, and provides a framework for analyzing SME export performance. In Section III, a switching model is set up, and the data and measures used described. Section IV reports the results. A summary of the findings and policy implications is given in section V.

II Sunk Costs and the Analysis of SME Export Performance

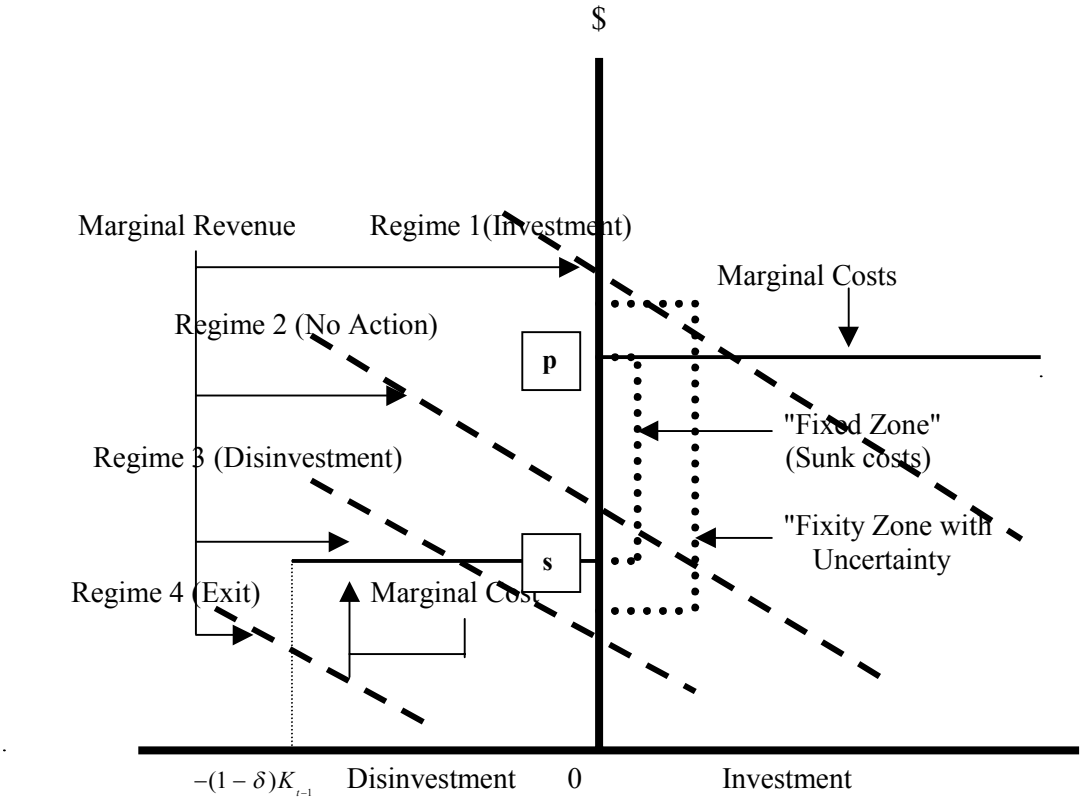
II-1 Sunk Costs

Sunk costs are investment expenditures that cannot be fully recovered through transfer or sale once undertaken. The extent of sunk costs depends on the difference in value between the original outlay less depreciation and its alternative use (salvage value, resale or transfer price). The larger that difference, the more sunk costs can distort a firm's optimal decision in a competitive environment.

Asplund (1995) collected information on salvage values of individual machine tools in Swedish manufacturing industries in both 1960 and 1990 to show that 47% and 78%, respectively, of the discarded assets were scrapped rather than sold on second-hand markets. This means that in both samples these investments are largely sunk costs. He also showed that for an average "new" machine, a firm can expect to get back from instant resale only 10-55% of the initial price. Sutton (1991) considered R & D and advertising costs as additional sources of exogenous and endogenous sunk costs that can serve as barriers to entry and exit and thereby affect industry structure. Bernard and Jensen (1996b) showed that, if a firm exported yesterday but not today, it would lose all the sunk costs spent for penetrating export markets. On the other hand, Robert and Tybout (1997) showed that by staying out of export markets more than 2 years

[4] The probability of excess technology capability is just 1 minus the probability of excess marketing capability.

Figure 1 Investment Behavior under Sunk Cost



makes a firm lose all the sunk costs spent to enter export markets. This is why sunk costs are believed to matter and are an increasingly common feature of economic analysis.

To explain the role of sunk costs, Barham and Chavas (1997) used Figure 1 after deriving an optimal investment rule in a dynamic framework. In this figure, there are two marginal costs on investment: One is the unit purchase price of capital, p, when there is a positive investment. The other is the unit salvage value, s, when there is a disinvestment. To avoid an arbitrage opportunity, p must be greater than s. The sunk cost is the difference between the two marginal costs. In regime 1, a positive investment occurs because the present value of marginal product of investment is greater than the marginal cost. In regime 2, however, if the present value of marginal product lies between the two marginal costs like, a firm has no incentive either to invest or to disinvest. This is a "zone of asset fixity" wherein a firm's behavior would not be affected by small changes in the economic environment. Finally, in regime 3, the firm disinvests or exits from the market because the present value of marginal product is below the unit salvage value.

According to Barham and Chavas (1997), the distortions due to sunk costs are: (i) the "zone of asset fixity" in regime 2 where the firm fails to react to economic signals, (ii) the irreversible character of the effects after their original cause is removed, and (iii) when combined with uncertainty, sunk costs have adverse effects on investment. If a firm has a positive probability of exiting during its planning horizon, sunk costs act as the disincentive to invest. That is, sunk costs in connection with uncertainty act as entry barriers under very general conditions. On the contrary, if a firm has a positive probability of re-entry during its planning horizon, sunk costs reduce the incentive to disinvest and to exit. Therefore, the range of "fixity zone" becomes wider as shown in the figure. In summary, sunk costs reduce resource mobility, particularly when it is combined with irreversibility and uncertainty, by acting as a barrier to both

entry and exit. By limiting the mobility of a firm's resources, both a firm's technological and marketing capabilities can be limited for a given period.

Kim (1997) defines a firm's technological capability as "the ability to make effective use of technological knowledge in efforts to assimilate, use, adapt, and change existing technologies". A firm's technological capability in any period consists of three elements: production, investment (including duplication and expansion), and innovation. For each firm, these three elements form the firm's technology capability for any given period and can be represented by various characteristics of each firm's internal and external environment as explained in the following sub-section on the sources of sunk costs.

The kinds of investment outlays needed for satisfying foreign demand are more site-specific, time-specific, and/or firm or industry-specific than for those needed for satisfying domestic demand. The physical features of such investments make them costly to install, remove, or relocate. For this reason the value of such investments can fall sharply over time. Such features make it costly to retrofit or transfer them to other firms, industries or countries. According to Sutton (1991), a major source of such sunk costs are the costs of adaptive R & D expenditures, restructuring, and retraining to improve productivity promptly in the face of changes, either foreseen or unforeseen.

Similarly, a firm's marketing capability can be defined in terms of three parallel elements, namely, the maintenance of existing export markets, entry into new markets, and innovation in marketing techniques. Each entails sunk costs, a difference between the original value of such outlays and their value in an alternative use. Among these are (i) the costs of advertising, identifying appropriate trading partners, and obtaining information about market conditions in export markets, [5] (ii) the costs of constructing and maintaining marketing networks, (iii) the costs of developing new marketing techniques, (iv) the costs of negotiating, writing and enforcing contracts between the parties, and (v) the costs of information on government regulations and other policies in both foreign and domestic markets. These sunk costs are likely to be especially large for SMEs because of their concentration on rather specific niche markets.

Despite the obvious relevance of these kinds of costs in export markets, surprisingly few attempts have been made to use the sunk cost perspective for testing hypotheses concerning alternative means of penetrating international markets and for deriving policy implications.

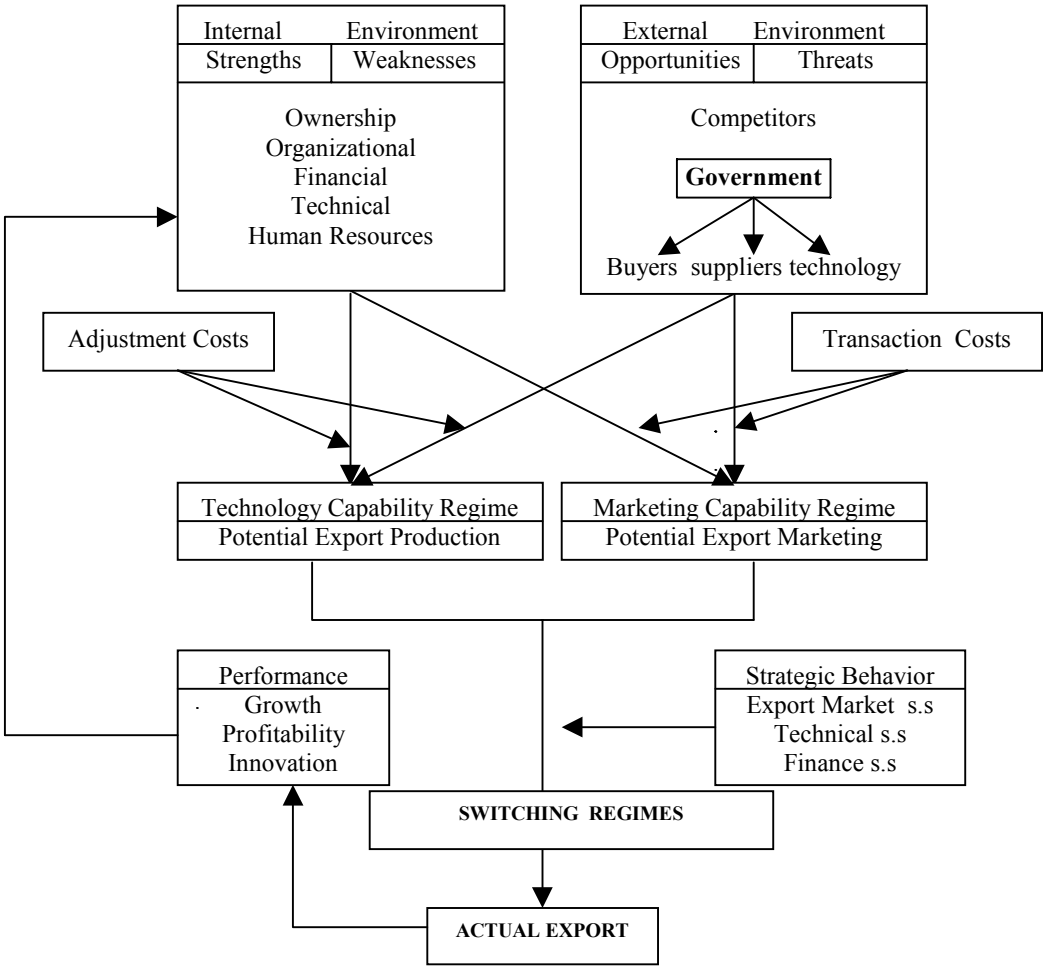
II-2 A Disequilibrium Framework for the Analysis of SME Exports

Our framework for the analysis of SME exports is a disequilibrium one based on the concept of strategic management. Strategic management can be viewed as in Dess and Miller (1993) as a series of steps in which a CEO should accomplish the following tasks: (i) analyze the opportunities and threats or constraints that exist in the external environment; (ii) analyze the organization's internal strengths and weaknesses; (iii) identify the organization's objectives; (iv) formulate strategies (at the corporate, business unit and functional levels) to match the organization's strengths and weaknesses with the opportunities and threats offered by its external environment; (v) implement those strategies; and (vi) engage in strategic control activities to ensure goal attainment.

Any SME possesses a specific internal environment consisting of a certain financial, technical, human and organizational endowment of resources, as well as a certain size. The internal environment has been accumulated through the history of the firm and determines the SME's strengths and weaknesses as far as foreign markets are concerned. There also exists an external environment, which includes the existing as well as changing conditions in technology,

[5] For some pioneering efforts along these lines see Keesing, 1979, Wortzel and Wortzel, 1979, and Morawetz, 1981. More recent studies that are more closely related to the present study include Berry and Escandon, 1994, Berry and Levy, 1994, Itoh and Urata, 1994, Kim and Nugent, 1993, 1994, Levy, 1991, and Levy et al. 1994.

Figure 2 Framework for SME Analysis



finance, labor, capital and export markets, and governmental and other support systems that maybe available to the firm. The various characteristics of this external environment can act as either opportunities or threats to a firm. At any given point in time, the firm may be incompletely adjusted to these opportunities and threats. The internal and external environmental conditions specify the predetermined and/or exogenous structure that provides the basis for each firm to choose its optimal managerial strategies. In strategic management theory, the determination of a firm's internal environment and external environment is called Strengths, Weaknesses, Opportunities and Threats Analysis (*SWOT* Analysis). The analysis identifies the particular factors in the exogenous structure that affect the technological or marketing capabilities or both.

The flow chart in Figure 2 summarizes an SME's strategic decision making process for exporting. By following the arrows in the diagram, the flow of an SME's decision making process can be easily understood. The external environment includes those elements external to the SME that directly affect the formulation and accomplishment of its business objectives and, in turn, its success and failure. Major elements include: (i) foreign buyers, (ii) suppliers including creditors, (iii) competitors, (iv) government as a regulator/facilitator and (v) technology.

One of the most important elements in the external environment of an SME is the government. The government can enable a firm to draw upon opportunities and to mitigate the threats to it stemming from other elements in the external environment by providing various types

of support. Since SMEs may be too weak to handle the large sunk costs in catering to export markets, public assistance in managing these sunk costs can be extremely important. The arrows in Figure 2 going from the government element to the suppliers element (financial support system), to the buyers element (marketing support system), and finally to the technology element (technical support system) represent the various ways in which government may act as a catalyst.

Since different SMEs may be at different stages in their respective life cycles, they may pursue different competitive strategies, each requiring a different combination of resources and capabilities. In this respect, the censored switching regression model developed in the next section can be useful in identifying the relative extent to which the technology constraint is more (or less) binding than the marketing constraint. This is measured in terms of the probability of an excess marketing constraint. The time pattern of this probability of excess marketing/ technology constraint is traced out, thereby identifying different stages through which SMEs may evolve. By averaging the probabilities by sector or industry, it is possible to find which sector or industry is booming or decaying in its business cycle and/or life cycle. From such a disequilibrium analysis, the appropriate role for government support to SMEs at different points in their life cycle can be better identified.

III A Censored Switching Regression Model and Data

To get some idea about how the concept of switching regimes can be applied to SMEs and their exports, turn to Table 1 that is based on a survey on Korean SMEs in 1989. The table shows several reasons why Korean SMEs suffer from bottlenecks in finance. Out of 941 firms in the sample, 34.6% identified the shortage of sales, the main source of a firm's internal finance, as the primary bottleneck. In other words, this large percentage of Korean SMEs sold less in 1989 than they could produce technologically, indicating the marketing constraint to be binding.

On the contrary, 39.8 % out of 941 firms could not produce more, though they could sell more than what they produced (the second and third reasons). This means that those SMEs were

Table 1 Reasons of Bottleneck in Korean SME Finance

Unit: %

Size (# of workers)	1 - 20	21-50	51-100	101-300	301-	Average
Shortage of sales	34.9	35.7	29.7	38.0	35.3	34.6
Expansion of production facilities	17.2	20.7	27.2	22.1	22.1	21.6
Increase in operation cost	16.7	21.4	16.8	17.8	13.2	18.2
Other	31.2	22.2	26.3	22.1	29.4	25.6
Sum	100	100	100	100	100	100

*. Unit: % *. Sample size of SMEs: 941 *. year: 1989 *. Source: Park, Yang and Lee (1992)

subject to a technological constraint, rather than a marketing constraint. To separate one constraint from the other, we use a switching regression model.

In this section, under the assumption that there exist considerable sunk costs in export markets, we develop a censored switching model consisting of a technology capability regime and a marketing capability regime. Subsequently, the likelihood function for estimating the switching regression, and data and variables used are discussed.

III-1 A Censored Switching Regression Model

We assume that SMEs treat export markets and domestic markets differently even if the products sold in the two markets should be the same. Therefore, we shall ignore firms' behavior in domestic markets and focus on their behavior in export markets. Korean SMEs are assumed to act as price takers in export markets. For a given period, the quantity of goods sold in export markets was bounded by either its technological capability or its marketing capability. Moreover, neither its current technological nor its marketing capability can be adjusted flexibly and instantaneously from its existing level because of existing sunk costs. As explained above, sunk costs hinder resource mobility by creating a "fixity zone", a hindrance which is reinforced when uncertainty and irreversibility prevail. Thus, a profit-maximizing firm will choose the level of exports q_{it} as:

$$\begin{aligned} \underset{q_{it}}{Max}\ \Pi_{it} &= ([TR(q_{it}) - PC(q_{it}) - MC(q_{it})] / \Omega_{it-1}) \\ \textit{subject to} \quad & q_{it} \le b_{it} \\ & q_{it} \le m_{it} \\ & i = 1, 2, \cdots, N \quad t = 1, 2, \cdots, T, \end{aligned} \tag{1}$$

where Π_{it}, TR, PC, MC and q_{it} is the profit, total revenue, production cost and marketing cost and the desired quantity of exports for the i^{th} firm in the t^{th} time period, and Ω_{it-1} denotes the internal and external environment of the i^{th} firm at the beginning of time t. The technology constraint of the i^{th} firm at t^{th} time period is specified as

$$b_{it} = \sum_{j=1}^{J} \alpha_j X_{jit}^{T} + \sum_{h=1}^{H} \gamma_h^{T} X_{hit}^{C} + \varepsilon_{it}\ , \tag{2}$$

and the marketing constraint is specified as

$$m_{it} = \sum_{k=1}^{K} \beta_k X_{kit}^{M} + \sum_{h=1}^{H} \gamma_h^{M} X_{hit}^{C} + \eta_{it}\,, \tag{3}$$

where X_{jit}^{T}, X_{kit}^{M} and X_{hit}^{C}, $j = 1,2,3 \ldots J$ $h = 1,2, \ldots, H$ $k = 1,2, \ldots, K$ are technology variables, marketing variables and common variables in the internal and external environment of the i^{th} firm at the beginning of time t.

All possible adjustments are conditional on Ω_{it-1}. Because of sunk costs, each of the current technological and marketing capabilities vary over a very limited range around the technology and marketing capabilities determined by Ω_{it-1}. In other words, sunk costs prevent firms from balancing production and marketing capabilities without hindrance. Hence, we may view the excess of technology over marketing capabilities as due to the effect of sunk costs on the production side and the converse as due to the sunk costs on the marketing side. Therefore, we have either one of the following two cases for the solution of (1) for q_{it}^{*}:

Case 1: $q_{it}^{*} = b_{it}$ *and* $q_{it}^{*} < m_{it}$.

Case 2: $q_{it}^{*} = m_{it}$ *and* $q_{it}^{*} < b_{it}$.

The above two cases can be expressed as the following minimum function.

$$q_{it}^{*} = Min(b_{it}, m_{it}) \tag{4}$$

Then, the actual export ex_{it} equals

$$\begin{aligned} ex_{it} &= q_{it}^{*} \qquad if\ q_{it}^{*} > 0 \\ &= 0 \qquad if\ q_{it}^{*} \le 0. \end{aligned} \tag{5}$$

The model consisting of only (1)-(4) is in the same form as a canonical disequilibrium model (Fair and Jaffee, 1971; Amemiya, 1984; Quandt, 1988; and Laroque and Salanie, 1994), which is a switching regression model. However, the model becomes a censored switching model when (5) is added, which is the model estimated in this paper. The negative values of q_{it}^{*} measure the degree to which a non-exporter is incapable of becoming an exporter. That is, the closer a firm's negative value of q_{it}^{*} is to 0, the more likely a non-exporter may become an exporter.

According to (1)-(5), a representative SME's CEO decides on the planned amount of exports in two steps at the beginning of each period. In the first step, for a given demand conditions in export markets, he sees the possible production amount and the possible marketing amount respectively based on the firm's internal and external environments at the beginning of the period. He then tries to balance the two amounts by changing the adjustable variables. Finally, after balancing, he chooses the planned amount on the basis of the binding capability.

For variances and covariances among errors in (2) and (3), we assume that

$$\begin{aligned} \mathrm{cov}(\varepsilon_{it}, \varepsilon_{js}) &= \sigma_{\varepsilon}^{2} \quad when\ i = j\ and\ t = s \\ &= 0 \quad otherwise, \\ \mathrm{cov}(\eta_{it}, \eta_{js}) &= \sigma_{\eta}^{2} \quad when\ i = j\ and\ t = s \\ &= 0 \quad otherwise, \\ \mathrm{cov}(\varepsilon_{it}, \eta_{js}) &= (0, \Sigma),\ \Sigma = \begin{bmatrix} \sigma_{\varepsilon}^{2} & \sigma_{\varepsilon\eta} \\ \sigma_{\varepsilon\eta} & \sigma_{\eta}^{2} \end{bmatrix} \quad when\ i = j\ and\ t = s \\ &= 0 \qquad\qquad\qquad\qquad otherwise. \end{aligned} \tag{6}$$

When the switching regression model (2)-(5) are estimated, each estimated coefficient measures the marginal effect of each predetermined or exogenous variable on the potential production and the potential marketing amounts, b_{it} and m_{it}, in export markets. In order to know the marginal effect of each exogenous variable on actual export, ex_{it}, the equation for actual export, ex_{it}, must be derived from the switching regression model.

First, the closed form equation for q_{it}^{*} given as (2)-(4) is given by[6]

[6] For a detailed derivation, see Quandt (1988) or Madalla (1990).

$$
\begin{aligned}
& q_{it}^{*} = E(q_{it}^{*}) + \vartheta_{it} \\
& E(q_{it}^{*}) = \Phi(\upsilon_{it})\alpha' X_{it}^{T} + (1-\Phi(\upsilon_{it}))\beta' X_{it}^{M} - \sigma\phi(\upsilon_{it}), \\
& \Phi \text{ is the standard normal } cdf, \\
& \sigma^{2} = \sigma_{\varepsilon}^{2} + \sigma_{\eta}^{2} - 2\sigma_{\varepsilon\eta}, \\
& \upsilon_{it} = (\beta' X_{it}^{M} - \alpha' X_{it}^{T}) / \sigma, \\
& Var(\vartheta_{it}) = \sigma_{\varepsilon}^{2}\theta_{1it} + \sigma_{\eta}^{2}\theta_{2it} + \sigma_{\varepsilon\eta}\theta_{3it} + \theta_{4it}, \\
& \theta_{1it} = \Phi(\upsilon_{it}) + \upsilon_{it}\phi(\upsilon_{it}), \\
& \theta_{2it} = 1 - \Phi(\upsilon_{it}) + \upsilon_{it}\phi(\upsilon_{it}), \\
& \theta_{3it} = -\upsilon_{it}\phi(\upsilon_{it}), \quad \textit{and} \\
& \theta_{4it} = \sigma^{2}\upsilon_{it}^{2}\Phi(\upsilon_{it})[1-\Phi(\upsilon_{it})] - \sigma^{2}\phi(\upsilon_{it})^{2} - 2\sigma^{2}\phi(\upsilon_{it})\Phi(\upsilon_{it}) \\
& \textit{where } X_{it}^{T} = (X_{jit}^{T}, X_{hit}^{C}) \textit{ and } X_{it}^{M} = (X_{kit}^{M}, X_{hit}^{C}).
\end{aligned}
\tag{7}
$$

Since actual export, ex_{it}, is the q_{it}^{*} that is left-censored at 0, the ex_{it} equation can be obtained by applying the standard tobit-type expectation to q_{it}^{*} as follows.

$$
\begin{aligned}
& ex_{it} = E(ex_{it}) + \varphi_{it} \\
& E(ex_{it}) = (1-F(-\tau_{it}))E(q_{it}^{*} / q_{it}^{*} > 0) \\
& \tau_{it} = E(q_{it}^{*}) / \sqrt{Var(\varphi_{it})}, \\
& E(q_{it}^{*} / q_{it}^{*} > 0) = \frac{1}{1-F(0)} \int_{0}^{\infty} q_{it}^{*} f(q_{it}^{*}) d(q_{it}^{*}), \\
& f(q_{it}^{*}) = \int_{q_{it}}^{\infty} g(q_{it}^{*}, m_{it}) d(m_{it}) + \int_{q_{it}}^{\infty} g(b_{it}, q_{it}^{*}) d(b_{it}), \\
& F \text{ is the } cdf \text{ of } q_{it}^{*}, \; f \textit{ is the density of } q_{it}^{*} \textit{ and} \\
& g \textit{ is the joint density of } b_{it} \textit{ and } m_{it} \\
& \text{and } \varphi_{it} \textit{ is the error term.}
\end{aligned}
\tag{8}
$$

Equation (8) is used to predict the marginal effect of each exogenous variable on actual export after the parameters in both regimes of (2) and (3) are estimated by the MLE method. We do so by plugging the estimates of α's, β's and γ's obtained from MLE into (8) and differentiating it with respect to each exogenous variable.

If there exist a flexible mechanism to equate tq_{it}^{*} with mq_{it}^{*}, the q_{it}^{*} becomes the standard tobit model:

$$
\begin{aligned}
& q_{it}^{*} = \sum_{r=1}^{R} \delta_{r} X_{rit} + \xi_{it} \\
& ex_{it} = q_{it}^{*} \quad \textit{if} \quad q_{it}^{*} > 0 \\
& \qquad i = 1, 2, \cdots, n \quad r = 1, 2, \cdots, R \quad t = 1, 2, \cdots, T
\end{aligned}
\tag{9}
$$

Here, X_{rit} $r = 1,2, \ldots, R$ include all the variables of X^T_{jit}, X^M_{kit} and X^C_{hit}, $j = 1,2,3 \ldots, J$ $h = 1,2, \ldots, H$ $k = 1,2, \ldots, K$ in (2) and (3). Then, the equation of actual export, ex_{it}, becomes:

$$
\begin{aligned}
ex_{it} &= E(ex_{it}) + \varsigma_{it} \\
E(ex_{it}) &= \Phi(\kappa_{it})(E(q^*_{it}) + \lambda^e_{it}\sqrt{Var(q^*_{it})}), \\
E(q^*_{it}) &= \sum_{r=1}^{R} \delta_r X_{rit} \\
\lambda^e_{it} &= \phi(\kappa_{it}) / \Phi(\kappa_{it}), \\
\kappa_{it} &= E(q^*_{it}) / \sqrt{Var(q^*_{it})}.
\end{aligned}
\tag{10}
$$

Although it can be easily derived, the variance and covariance structure of the error terms in equation (10) is not given here because only the marginal effect of each exogenous variable on ex_{it} is of interest. By plugging the estimates of the parameters in (9), obtained by applying the standard tobit method, into (10) and then differentiating (10) with respect to each exogenous variable, the marginal effect of each exogenous variable on actual export, ex_{it}, is computed for each observation.

III-2 Estimation: Maximum Likelihood Method

The switching regression model consisting of (2)-(5) is the same-type as the canonical disequilibrium model except that the ex_{it} in (5) is left-censored at 0.

In applying the MLE method for the canonical disequilibrium model, it is well-known that: (i) there exists the possibility of unbounded ML function and the perfect correlation between errors in two regimes, and (ii) the ML estimators could provide only local solutions. To overcome these difficulties, several estimation methods (such as nonlinear least squares method, the moment- generating function method, EM algorithm method and a modified MLE method) have been developed. However, the MLE method is adopted here because it is efficient. We try to avoid the aforementioned difficulties in estimation by assuming (as is commonly done) that there is no correlation between the two regimes and by starting the iterations from the estimate obtained by applying the standard tobit to equations (2) and (3) with ex_{it} as the dependent variable instead of b_{it} and m_{it}.

Powers (1993) dealt with various kinds of likelihood functions for endogenous switching regression models with limited dependent variables. One of his likelihood functions can be used for our purposes but must be modified because our switching regression model consisting of (2)-(5) is censored and without known sample separation. There are more regimes for the likelihood function here.

Let $g(b_{it,}, m_{it})$ be the joint normal density of b_{it} and m_{it}.

Case 1: $ex_{it} = 0 \quad and \quad b_{it} < m_{it}$

$$
L_{1it} \equiv pr(ex_{it} = 0 / b_{it} < m_{it}) = \int_{-\infty}^{0}\int_{b_{it}}^{\infty} g(b_{it}, m_{it}) dm_{it} db_{it} / \pi_{it} \tag{11}
$$

Case 2: $ex_{it} = 0 \quad and \quad b_{it} > m_{it}$

$$
L_{2it} \equiv \Pr(ex_{it} = 0 / b_{it} > m_{it}) = \int_{-\infty}^{0}\int_{m_{it}}^{\infty} g(b_{it}, m_{it}) db_{it} dm_{it} / (1 - \pi_{it}) \tag{12}
$$

Case 3: $ex_{it} > 0 \quad and \quad b_{it} < m_{it}$

$$L_{3it} \equiv h(ex_{it} / b_{it} < m_{it}) = \int_{ex_{it}}^{\infty} g(ex_{it}, m_{it}) dm_{it} / \pi_{it} \tag{13}$$

Case 4: $ex_{it} > 0 \quad and \quad b_{it} > m_{it}$

$$L_{4it} \equiv h(ex_{it} / b_{it} > m_{it}) = \int_{ex_{it}}^{\infty} g(b_{it}, ex_{it}) db_{it} / (1 - \pi_{it}) \tag{14}$$

where π_{it} is the unconditional probability that the technology capability regime in the i^{th} firm is binding at time *t*. That is:

$$\begin{aligned} \pi_{it} &\equiv pr(b_{it} < m_{it}) \\ &= \int_{b_{it}}^{\infty} g(b_{it}, m_{it}) dm_{it} \end{aligned} \tag{15}$$

Let d_{it} be the dummy variable, which takes 1 if the i^{th} firm is an exporter at time t, 0 otherwise. Combining cases 1 through case 4, we get the following unconditional likelihood function for the i^{th} firm:

$$L_{it} = (1 - d_{it})(\pi_{it} L_{1it} + (1 - \pi_{it}) L_{2it}) + d_{it}(\pi_{it} L_{3it} + (1 - \pi_{it}) L_{4it}) \tag{16}$$

Taking a natural logarithm for equation (16) and summing over observations yields the log-likelihood function:

$$\ln L = \sum_{i=1}^{N} \sum_{t=1}^{T} \ln L_{it} \tag{17}$$

This likelihood function is maximized to obtain the ML estimators of $\alpha's$, $\beta's$ and $\gamma's$ under the assumption that there is no contemporary correlation between the errors in the two regimes. The independence assumption allows (11) through (14) to be written in much simpler form.

The probability that each firm is bounded by the T-regime, i.e., the probability of excess marketing capability, needs to be computed in order to figure out the effects of sunk costs on each firm's export behavior. The probability of a firm bounded by the M-regime, i.e., the probability of excess production capability, is simply 1 minus the probability of excess marketing capability. For convenience, the probability of excess marketing capability will be used instead of the probability of excess production capability. The closer is this probability to 0.5, the less dominant will be either constraint. The closer it is to 1, the more dominant is the technology capability constraint, and the closer it is to 0, the more dominant is the marketing capability constraint. Instead of using the unconditional probability of excess marketing capability of equation (15), the following conditional probability of excess marketing capability, which is based on more information and provides a sharper discrimination between two regimes,[7] will be used.

$$\begin{aligned} \pi_{it}^{c} &\equiv pr(b_{it} < m_{it} / ex_{it}) \\ &= (1 - d_{it}) \pi_{it} \bar{L}_{3it} / (\pi_{it} \bar{L}_{3it} + (1 - \pi_{it}) \bar{L}_{4it}) + d_{it} \pi_{it} L_{3it} / (\pi_{it} L_{3it} + (1 - \pi_{it}) L_{4it}) \end{aligned} \tag{18}$$

[7] See Burkett (1981) and Quandt and Rosen (1985).

where $\overline{L}_{3it}$ is the same as L_{3it} except that b_{it} is substituted for ex_{it} in the lower bound of the integral and $\overline{L}_{4it}$ is the same as L_{4it} except that m_{it} is substituted for ex_{it} in the lower bound of the integral. Then, the life cycle or business cycle of each sector or size-group in export markets can be predicted by averaging the probabilities of excess marketing capability for all firms in that respective sector or size group.

Finally, the properties of ML estimators need to be mentioned. Hartley and Mallela (1977) proved the strong consistency and asymptotic normality of the ML estimators for the canonical disequilibrium model under the assumption that the variances of error terms in the model are bounded away from 0. This is still true for a local ML estimator. As we know, the switching regression model (3) is very similar to the canonical disequilibrium model except that q_{it}^{*} is left-censored. All the conditions for consistency and asymptotic normality of the ML estimators are unaffected by the left-censoring of q_{it}^{*}. Thus, the same procedure can be used to prove the strong consistency and asymptotic normality of the ML estimators for the censored switching regression model (3).

III-3 Data[8] and Variables

For Korean SMEs, reliable data on their exports, endowments, other characteristics, and the means used for penetrating export markets are unavailable from official statistical sources. Furthermore, information on the use and evaluation of SME support mechanisms by SMEs themselves is virtually nonexistent. For this reason, Kim and Nugent (1994) conducted an in-depth survey of a sample of SMEs. In order to assure sufficient variety in the use of different export mechanisms and sources of support at minimum cost in terms of sample size, they selected four sectors on the basis of the following criteria: (i) the complexity of technology, (ii) the rate of technological change in products, (iii) the degree of subcontracting, and (iv) the number of years in which Korean firms have been exporting. They considered only sectors in which SMEs were relatively prominent in employment and exports. The selected sectors are: woven textiles (WT), auto parts (AP), electronic parts and components (EP) and factory automation (FA). FA uses small batch technology and has a high rate of technological change but relatively low export intensity and little experience in exporting. AP and EP use large batch production technology but vary in their rates of technological change, export propensity and experience. On the other hand, WT uses virtually continuous production technology and has a low rate of technological change.

Having selected the sectors, Kim and Nugent (1994) sampled SMEs from each sector using the following rules: (i) the sample sizes in each sector were approximately proportional to the number of SMEs in the sector, and (ii) within each sector, a stratified random sampling procedure was used. This had the effect of making the probability of a firm's inclusion in the sample roughly proportional to its contribution to sectoral employment among SMEs. Through this procedure, 122 SMEs were selected: 42 in WT, 20 each in AP and EP, and 40 in FA.
Although we have four years of panel data (1988 to 1991), the number of observations used in the censored switching regression model is 342 instead of 488, since some observations have missing values and some one period lags are used for some variables in order to avoid simultaneity bias.

The value of each export support variable is evenly divided over the previous 3 years. For SMEs which had been in existence for less than three years, the value was distributed evenly over the years in existence. Table 2 summarizes the distribution of the observations by sector and size group and all firms and for exporters and non-exporters, separately.

Table 3 contains all the variables used in this paper and their expected effects on both regimes. In this table, quantitative measures of various internal capabilities and external factors

[8] For more detail on the data and means of data collection, see Kim and Nugent (1994).

Table 2 Observation and Percentage by Sector and Size

Group	Size	WT		AP		EP		FA		Total	
		Obs.	%	Obs.	%	Obs.	%	Obs.	%	Obs.	%
ALL	Size 1	26	7.5	11	3.2	10	2.9	50	14.4	97	27.9
	Size 2	27	7.8	19	5.5	17	4.9	35	10.1	98	28.2
	Size 3	41	11.8	12	3.4	24	6.9	18	5.2	95	27.3
	Size 4	25	7.2	13	3.7	8	2.3	12	3.4	58	16.7
	Total	119	34.2	55	15.8	59	17.0	115	33.0	348	100.0
Exporter	Size 1	18	5.2	2	0.6	2	0.6	2	0.6	24	6.9
	Size 2	18	5.2	11	3.2	11	3.2	11	3.2	51	14.7
	Size 3	29	8.3	6	1.7	20	5.7	14	4.0	69	19.8
	Size 4	19	5.5	13	3.7	8	2.3	11	3.2	51	14.7
	Total	84	24.1	32	9.2	41	11.8	38	10.9	195	56.0
Non-Exporter	Size 1	8	2.3	9	2.6	8	2.3	48	13.8	73	21.0
	Size 2	9	2.6	8	2.3	6	1.7	24	6.9	47	13.5
	Size 3	12	3.4	6	1.7	4	1.1	4	1.1	26	7.5
	Size 4	6	1.7	0	0.0	0	0.0	1	0.3	7	2.0
	Total	35	10.1	23	6.6	18	5.2	77	22.1	153	44.0

Note: Using L to represent the number of employees: Size 1: L<50 *; Size 2:50<=L<100; Size 3: 100<=L<200; Size 4: L>=200. The percentages reported in all cells except those in the last column are of the number of observations in the cell relative to the total number of observations. The percentages reported in the last column are those in that row compared to the group total.

have been obtained through factor analysis and each of several different types of SME support systems has been related to both the external and internal environment. The variable names are given in italics in the middle column of the table and the expected direction of effects on the different regime types in the last two columns. In what follows we identify certain hypotheses concerning these results as indicated by H1- H14.

1. Plant Characteristics

(i) Retrospective variables

(H1) The number of years from the establishment year to first export year (bfexyr) is expected to have a negative effect on a firm's export. (H2) The expected sign of the number of years from first export to the current year (afexyr) must be strongly positive.

"bfexyr" and "afexyr", which belong to this category, measure the degree of readiness for first export at the start-up year and of the learning through accumulated experience in exporting respectively. A firm with high "bfexyr" means that it needed more time until its first export, suggesting that the firm was less prepared for exporting at its start-up. More experience in exports makes a firm's access to export markets easier by reducing its sunk costs.

(ii) Type of Ownership

(H3) A firm with corporate-type ownership, equ=1, exports more than a firm with private ownership, equ=0.

The former is generally larger in size than the latter, and so the former could more fully take advantage of economies of scale in export markets.

(iii) Labor, Capital and Productivity[9]

(H4) More production workers (lpdw) increase production capability of a firm for exporting. (H5) The expected effects of management workers (lmgw) are positive on both sides. (H6) However, the size effect of marketing (lmkw) workers on exporting is ambiguous. (H7) the capital size (lcap) is expected to have positive effects on both regimes.

To avoid simultaneity bias, one time-lag is taken for our measures for labor, capital, which are: labor and capital discussed here, and productivity variables discussed next. An increase in "lmkw" may not cause an increase of a firm's marketing capability in export markets. Instead, it could contribute to expand domestic market alone.

(H8) A firm with high productivity exports more.

Productivity is one of the most important proxies measuring a firm's past success.[10] The firms that have succeeded in the past are the "good" firms with higher productivity. Inversely, a firm must have had its productivity to succeed in export markets. To avoid this causality problem, one-time lag is taken for productivity variables.

A firm with high productivity can compete effectively in export markets. Labor productivity (lprman) and capital productivity (lprcap) are considered here.

(iv) Product Change and Buyer Concentration

(H9) The number of new products introduced each period (inn) has a negative effect for the T-regime, but a positive effect for the M-regime. (H10) High buyer concentration (buycon) would have a positive effect on the M-regime.

An increase in the number of new products introduced each period should help a firm attract more buyers by satisfying quickly changes in buyers' needs. On the other hand, it needs more sunk costs to adopt new technology and new facilities in replacement with the existing technology and facilities that become obsolete relatively quickly. High buyer concentration guarantees more stable marketing through sub-contracting and long-term contracts with LEs or foreign buyers.

(v) CEO's Backgorund

(H11) The dummy for graduate education (gradedu) has positive effects on both regimes. The dummy for technology experience (jobtt) has a positive effect on the T-regime. And, the dummies for sales experience (jobss) and the dummies for export experience (jobexx) have positive effects on the M-regime.

To control for "unobserved" managerial abilities that may introduce permanent heterogeneity among firms,[11] several dummy variables describing a CEO's background are introduced. They are dummy variables for graduate education (gradedu), technology experience (jobtt), sales experience (jobss) and export experience (jobexx). Each CEO's previous experience is expected to lower adjustment costs and/or the transaction costs of penetrating export markets.

[9] The debate on the direction of causality between exports and productivity is rather heated (Aw and Hwang, 1995).
[10] Firm size is another proxy (Bernard and Jensen, 1996b).
[11] Bernard and Jensen (1996b) and Robert and Tybout (1997) show how and why managerial background is important in explaining persistent heterogeneity among firms.

Table 3 Variables, Regimes and Expected Signs

Category	Sub-Category		Variable	Description	Expected Sign	
					T-Reg.	M-Reg.
Plant	Retrospective		*bfexyr*	Years before first export	-	-
			afexyr	Years after first export	+	+
	Ownership		equ	Dummy on corporate form	+	+
	Labor and Capital	Labor	*lpdw*	No. of production workers	+	***
			lmgw	No. of Marketing workers	***	-
			lmkw	No. of Marketing workers	***	-
		Capital	*lcap*	Paid in capital (Billion Won)	+	+
	Productivity		*lprman*	Labor productivity (Billion Won)	+	+
			lprcap	Capital productivity (Billion Won)	+	+
	Product Change		*inn*	No. of new products	?	+
	Buyer Concentration		*buycon*	% concentration of first three buyers		+
	Mana-ger's dummy	Education	*gradedu*	Education above college	+	+
		Previous Experience	*jobtt*	Manager's technology experience	+	***
			jobss	Manager's sales experience	***	+
			jobexx	Manager's export experience	***	+
Factor Analysis	Internal Factors		*cfac1*	marketing and management capability	+	***
			cfac2	Financial capability	+	+
			cfac3	Technology capability	+	***
			cfac4	External relations	+	+
	External Factors		*efac1*	Resource Tightness	-	-
			efac2	Finance Tightness	-	-
			efac3	Technical Dynamics	-	-
			efac4	Market competition	-	-
			efac5	Market-size	-	-
SME Support Systems	Market-ing	Designation Dummy	*fdeg1*	Promising SMEs	***	?
			fdeg23	Business or item in "Kairestsu"	***	?
		Dummy	*mdeg1*	Reserved business area to SMEs	***	?
			mdeg2	Item produced by collective contract	***	?
		Penetrating	*pen*	Penetrating export market	***	?
	Techno-logy	Non- Financial	*tecsup*	Technological supports	?	***
		Financial	*ftesup*	Tech. Development	?	***
			fwcsup	Working capital	?	?
	Both		*exfsup*	Export Finance	?	?
			forsup	Credit Guarantee Systems used	?	?
		Non-Financial	*mdeg3*	Membership of KOTRA	?	?
		Tax	*tesup*	Tax exemptions received	?	?
			iesup	Income exemptions received	?	?
			trsup	Tax reductions received	?	?
			resup	Reserves received	?	?
			sdsup	Special depreciation	?	?
Sector Dummy			*ap*	Automotive parts sector	-	-
			ep	Electronic parts sector	-	-
			fa	Factory automation sector	-	-
Time Dummy			*td90*	1990	?	?
			td89	1989	?	?

Notes: i) All support variables except the marketing dummy variables denote the number of different sources belonging to the corresponding categories used by the SME. ii) "***" indicates that the corresponding variable is not included in the corresponding regime. iii) "?" indicates that the expected sign of the variable is ambiguous a priori, the sign to be determined empirically. iv) All variables in monetary units are based on constant prices of 1990.

(vi) Sector and Time Dummy Variables

(H12) The dummy variables for other sectors compared to Woven Textile sector will be expected to show negative effects on exports since the WT has highest export propensity. (H13) For the time dummies, the direction of their effects on export cannot be determined a priori.

Using sector dummies is the simplest way to capture the heterogeneity over sectors. The Woven Textile sector (WT), which has high export propensity, is used as the reference sector, and the year 1989 as the reference year. On the other hand, the time dummies are supposed to catch not only the technology and marketing progress but also the effect of change in exchange rate over time.

2 Subjective Variables

(H14) *In relation to the eleven factors derived through factor analysis, positive effects on exports are expected for the internal* ***capability*** *factors and negative effects for the external* ***tightness*** *factors.*

Eleven standardized factors from CEO's subjective evaluations of each firm on internal and external environment were derived[12], which summarize the CEO's subjective *SWOT* analysis. The names of the internal capability factors were marketing and management capability (cfac1), financial capability (cfac2), technology capability (cfac3) and external relation capability (cfac4). The names of the external capability factors were resource tightness (efac1), finance tightness (efac2), technical dynamics (efac3), market competitiveness (efac4) and small market (efac5).

3 SME Support Variables

One of the most important features of SMEs in Korea is their weakness in technology, marketing and financing capabilities. They depend largely on LEs and government-led institutions explicitly or implicitly. As a result, the support from external agents such as LEs and the government have a big impact on their behavior. The support from LEs through vertical or horizontal integration helps SMEs strengthen their marketing capability but not their technology capability. Instead, the support from government has been the most reliable and important source for improving both technology and export marketing.

Although they are divided into two groups of technology supports and marketing supports, SME support variables are classified into 4 groups for convenience: supports for stable marketing, non-financial supports, financial supports and tax supports. Dummies for designation as a Promising SMEs (fdeg1), business or item in "Kairestsu" (fdeg23), reserved business area to SMEs (mdeg1) and item produced by collective contract (mdeg2) belong to the supports for stable marketing. Penetrating export market (pen), membership of KOTRA (mdeg3) and technological training and supports (tecsup) belong to the non-financial supports. Technology development (ftesup), working capital (fwcsup), export finance (exfsup), credit guarantee systems used (forsup) are the financial support variables. Tax exemptions received (tesup), income exemptions received (iesup), tax reductions received (trsup), tax reserves received (resup) and special depreciation (sdsup) are the tax support variables.

Table 3 shows the variables belonging to each of four groups. The detail can be found in Kim and Nugent (1994) must be referred. We shall not make any conjecture about the effectiveness of each support variable. However, it should be noted that some support variables are only for exporters while the others are for both exporters and non- exporters.

[12] To see the derivation of the factors and the corresponding factor loadings, see Kim and Nugent (1994).

IV Estimation Results

IV-1 Model selection and Merits of Censored Switching Model

Our criteria for model specification are consistent with economic theory, statistical significance of included variables and good explanatory power. An iterative general to specific specification search strategy is adopted. We start with a model with the largest number of RHS variables containing all the variables described in table 3, then compared it with the same model without support variables to see whether any of the support variables was significant in SMEs' exports. According to the result of the LR-test between the two specifications, the SME support variables appeared to be very significant even at $\alpha = 0.01$. Thus, the largest model was chosen as the maintained hypothesis to select the final specification. After estimation at each stage, the variables with t-values less than 0.5 were dropped, and the corresponding LR-test between the previous specification and the new specification was carried out to detect any significant change. After four steps, the estimates shown in the 2nd and 3rd columns of table 4 was obtained as the final specification.

We can compare and contrast the results of the two-regime censored regression model (2)-(5) with the standard tobit model (9) having the same RHS variables as the final specification. The estimation result of tobit model is given in the 4th column of Table 4. By plugging the estimates from both the censored switching regression model and tobit model into (8) and (10), respectively, and then differentiating (8) and (10) with respect to each of RHS variables, the marginal effect of each RHS variable on actual exports is obtained for each of the models. These marginal effects on actual export are averaged over all the observations, exporters, or non-exporter, which are given from the 5th column to the 10th in Table 4.

As shown in the bottom of the 2nd and the 3rd columns in the Table 4, unlike the usual application using cross-sectional or panel data, the values of R^2 and $\overline{R}^2$ are very high in both models. Notably, they are about 4% higher in the switching model than in the standard tobit model. This is one of the advantages of the switching model relative to the standard tobit model. Another advantage of the switching model is the ability to more sharply discriminate in export performance between exporters and non-exporters. The averaged marginal effects of RHS variables on actual exports among non-exporters compared with those among exporters are much smaller in the switching model than in the standard tobit model. Third, the effects of almost all the SME support variables except for "mdeg1", "mdeg2" and "mdeg3" are larger in absolute terms and more significant in the switching regression model. Finally, the switching model allows one to gain a deeper understanding of a firm's export behavior from both the technology and marketing perspectives, while the standard tobit model focuses on only the realized data. The switching model allows decision-makers inside firms (CEOs) and policy makers outside firms to balance and allocate efficiently the resources available between the technology and marketing sides.

IV-2 Marginal Effects on Two Regimes and Testing Hypotheses

In this sub-section, the hypotheses on parameters set up in section III-3 are tested and the effectiveness of each SME support variable is evaluated. The marginal effects of the RHS variables on two regimes are given the 1st and 2nd columns in Table 4. In the table, the estimates in the dark-shaded cells with the dark-highlighted numbers are significant at $\alpha = 0.01$, the estimates in the dark-shaded cells without the dark-highlighted numbers are significant at $\alpha = 0.05$, and the estimates in the a-little-dark cells but are not highlighted are significant at

$\alpha = 0.1$. The averaged marginal effects of RHS variables on actual exports are given the 5th to the 7th columns in Table 4.

(i) Retrospective variables

As expected, the signs of "bfexyr" on both capability regimes are negative and those of "afexyr" are positive. Hypotheses (H1) and (H2) are verified in that "bfexyr" has a much stronger negative effect on the T-regime than on the M-regime, while "afexyr" has a stronger effect on the M-regime. The longer the waiting period to first exports is, the inferior the technology and marketing capabilities on exports. In other words, the firm with longer waiting period to the first exports suffers from severe technological and marketing constraints in exporting, particularly from technological constraints. It is because the firms having longer waiting period have depended largely on the domestic market in doing their business. As such, their business size tends to remain small and to be poorly equipped.

On the contrary, the period from first export to the current period has a very strong positive effect on exports, particularly export marketing capability. The length of the period can be used as a proxy for measuring the benefits of learning through the accumulated experience from the previous exports. The longer a firm has stayed in export markets, the more benefits the firm enjoys in terms of sunk costs. The positive effect of plant age on the propensity to export observed by Roberts and Tybout (1997) is not observed here. For exporters, the positive effect of plant age on the propensity to export is clearly verified since "afexyr" has a strong positive effect on exports. However, for non-exporters, plant age has a strong negative effect on the propensity to export since "bfexyr" has a strong negative effect.[13] When all the firms, including both exporters and non-exporters, are considered, there is no clear effect of age on export propensity.

(ii) Type of Ownership:

Although the hypothesis (H3) states that a firm with corporate-type ownership (equ=1), should export more than an individually owned firm (equ=0), this dummy variable was dropped in the final specification because its effect was found to be statistically insignificant.

(iii) Labor, Capital and Productivity

Again as shown in Table 4, both the number of production workers (lpdw) and the number of management workers (lmgw) have significant positive effects on the T-regime but not on the M-regime, and the number of marketing workers (lmkw) has a significant negative effect on the M-regime. Thus, this result is consistent with hypotheses (H4), (H5) and (H6), though the effect of "lmkw" on the M-regime appeared to be negative.

On the other hand, the capital amount turned out to have a positive and significant effect only on the M-regime. Greater capital increases export marketing, which is consistent with (H7) although it is not significant in The T-regime. According to the corresponding estimate, when capital increases by 1 unit, the export marketing capability appears to increase by about 1.5 times. This shows how important capital can be in determining a firm's export marketing capability.

By contrast, labor productivity has little effect on an SME's marketing capability but a very strong positive effect on technology capability. Indeed, when labor productivity increases by 1 unit, technology capability for exporting increases by about more than ten times. Capital productivity has a greater impact on the M-regime than on the T-regime, although its effects are significant in both regimes. This result supports (H8).

[13] An increase in firm age increases "afexyr" for exporters , however, decreases "bfexyr" for non-exporters.

Table 4 Censored Switching Regression Model and Tobit Model

	Switching Regimes		Tobit	Switching Regimes			Tobit		
	T-Reg	M-Reg		Exp	N-Exp	All	Exp	N-Exp	All
	Estimate	Estimate	Estimate	Mean	Mean	Mean	Mean	Mean	Mean
CONT	3.432***	-1.830***	-1.937***	0.923	0.077	0.551	-1.492	-0.237	-0.940
Bfexyr	-0.216***	-0.046*	-0.103***	-0.115	-0.011	-0.069	-0.080	-0.013	-0.050
Afexyr	0.052*	0.158***	0.118***	0.080	0.008	0.048	0.091	0.014	0.057
Lpdw	0.010***		0.008***	0.005	0.000	0.003	0.006	0.001	0.004
Lmgw	0.032**	0.015	0.014	0.020	0.002	0.012	0.011	0.002	0.007
Lmkw		-0.095***	-0.047***	-0.034	-0.003	-0.020	-0.036	-0.006	-0.023
Lcap	NS	1.524***	0.958***	0.541	0.055	0.327	0.738	0.117	0.465
Lprman	10.753***	NS	5.193***	4.928	0.450	2.959	4.000	0.635	2.520
Lprcap	0.023**	0.101***	0.073***	0.046	0.005	0.028	0.056	0.009	0.035
Inn	-0.103***	0.141***	-0.022	0.003	0.001	0.002	-0.017	-0.003	-0.011
Buycon		0.020***	0.009***	0.007	0.001	0.004	0.007	0.001	0.005
Jobss		2.858***	0.912***	1.015	0.103	0.614	0.703	0.112	0.443
Jobexx		-1.160***	0.655**	-0.412	-0.042	-0.249	0.504	0.080	0.318
cfac1	0.390**	-0.300**	0.063	0.072	0.005	0.043	0.048	0.008	0.031
cfac2	0.391**	NS	0.170	0.179	0.016	0.108	0.131	0.021	0.083
efac2	0.530***	0.555***	0.256**	0.440	0.042	0.265	0.197	0.031	0.124
efac3	1.123***	0.922***	0.861***	0.842	0.080	0.507	0.664	0.105	0.418
efac4		-0.384***	0.068	-0.136	-0.014	-0.082	0.053	0.008	0.033
efac5		-0.340**	-0.096	-0.121	-0.012	-0.073	-0.074	-0.012	-0.047
fdeg1		-1.022***	-0.263	-0.363	-0.037	-0.220	-0.202	-0.032	-0.128
fdeg23		5.520***	0.743*	1.960	0.200	1.186	0.572	0.091	0.361
mdeg1		1.848***	1.339***	0.656	0.067	0.397	1.031	0.164	0.650
mdeg2		-6.584***	-6.286***	-2.338	-0.238	-1.415	-4.842	-0.769	-3.051
mdeg3	0.368	NS	0.497	0.169	0.015	0.101	0.383	0.061	0.241
tecsup	-0.160*		0.026	-0.073	-0.007	-0.044	0.020	0.003	0.013
forsup	0.268	1.140***	0.636***	0.528	0.052	0.319	0.490	0.078	0.309
ftesup	1.209***	NS	0.338**	0.554	0.051	0.333	0.261	0.041	0.164
fwcsup	-0.760***	-0.183	-0.446***	-0.413	-0.038	-0.248	-0.343	-0.054	-0.216
pen		0.421***	0.095	0.149	0.015	0.090	0.073	0.012	0.046
exfsup	0.311	0.619***	0.393***	0.362	0.035	0.219	0.303	0.048	0.191
tesup	-0.919***	0.435***	-0.356***	-0.267	-0.023	-0.159	-0.274	-0.043	-0.173
iesup	-0.838**	NS	0.012	-0.384	-0.035	-0.230	0.009	0.002	0.006
trsup	0.269	-0.909***	-0.120	-0.199	-0.022	-0.121	-0.092	-0.015	-0.058
resup	0.279*	NS	0.165	0.128	0.012	0.077	0.127	0.020	0.080
sdsup	1.688***	-0.336**	0.486***	0.654	0.058	0.392	0.375	0.059	0.236
AP	NS	-6.645***	-0.985*	-2.360	-0.240	-1.428	-0.759	-0.120	-0.478
EP	NS	-2.991***	-1.298***	-1.062	-0.108	-0.643	-1.000	-0.159	-0.630
FA	NS	-4.154***	-1.869***	-1.475	-0.150	-0.893	-1.440	-0.229	-0.907
td90	-0.368	NS	-0.197	-0.169	-0.015	-0.101	-0.152	-0.024	-0.096
td91	NS	-0.400***	-0.177	-0.142	-0.014	-0.086	-0.137	-0.022	-0.086
SIGMA	1.251***	0.534***	1.314***	***	**significant at alpha=0.01**				
R^2	0.90804		0.86282	**	**significant at alpha=0.05**				
$\overline{R}^2$	0.89109		0.84545	*	**significant at alpha=0.1**				

Note1: NS denotes that the corresponding variable was dropped in the final specification because of insignificance.

Note2: The 5th to the 10th columns are the averaged marginal effects on actual exports.

According to the estimates, the productivity variables exert the greatest influences over both the technological and marketing capabilities of firms. High productivity of labor and capital

makes a firm successful in export markets. Inversely, a firm that has succeeded in export markets has higher productivity. That is why CEOs and policy makers must focus on improving productivity, especially labor productivity if they are to succeed in export markets.

(iv) New Products, Buyer Concentration and Manager's Background

As expected in (H9), the estimated numbers of new products developed (inn) have the same directions of effects on the T-regime and the M-regime. More new products every year add to the burden on a firm's technology capability for export markets; however, they also stimulate and expand the firm's export marketing capability. This is because the development of new products requires a lot of sunk costs, but also serves to help attract more buyers.

On the other hand, the more a firm's sales are concentrated on the first three buyers (buycon), its marketing capability appears to become higher. This phenomenon is related to SMEs' subcontracting relationship with small numbers of LEs or foreign buyers. A firm with a higher subcontracting ratio has higher buyer concentration and so enjoys stronger marketing capability. Thus, (H10) is confirmed.

A CEO's sales experience (jobss) turns out to have a substantial positive effect on the marketing capability of his firm while his previous export experience (jobexx) has a smaller but negative impact. The latter implies that previous experience in exports makes him shrink from, rather than stimulating, exporting, perhaps because of difficult experience in exports. Clearly, the estimate for "jobss" is consistent with (H11) while that of "jobexx" is not.

(v) Sector Dummies and Time Dummies

As indicated by the entries for the three sectoral dummy variables, firms in the AP, EP and FA lag substantially behind the (excluded) WT sector in marketing capability for exporting, while there are no differences in technology capability among them. Hence, although improvements in technological capabilities can increase exports in all sectors, the expansion of marketing capability is crucial only for the AP, EP and FA sectors.

On the other hand, the time dummies, which can pick up the influence of time-varying influences like exchange rates,[14] show that compared to the omitted year 1989 and 1990 marketing capability in 1991 was significantly lower. Except for this, however, there were no other effects of the time dummies on either of the regimes.

(vi) Manager's Subjective Evaluations

The signs of the estimates for the manager's own subjective evaluation of the firm's marketing and management capability factor (cfac1) in Table 4 are positive in the T-regime and negative in the M-regime respectively. Although the positive effect in the T-regime was expected (H13), the negative effect on the M-regime was not. The effect of "cfac1" on actual exports, however, which is determined by the interaction between the T-regime and the M-regime, is positive as shown Table 4.

The positive sign of the financial capability factor (cfac2), and the negative signs of the market competitiveness (efac4) and small market size factors (efac5), respectively, are all as expected. A CEO's confidence on his firm's financial capability increases his firm's technological and marketing capability in export markets. When the CEO thinks that the markets are very competitive and small, the firm appears to be weak in export marketing capability.

However, the strong positive effects of "efac2" on both regimes, implying that the financial tightness yields positive effects on technological and marketing capabilities were not

[14] The exchange rate of won per dollar was increasing during the period of 1989-1991.

expected. This seems to be the result of the firm's effort to solve its financial difficulties by exporting more, which helps the firm qualify to receive special export support funds such as "forsup" and "exfsup". On the other hand, when a CEO thinks that production technology changes quickly, i.e., receives positive scores for "efac3", it makes the firm stronger in export markets.

(vii) SME Support Variables

The measures of SME support variables for stabilizing SMEs' marketing include: designating a SME to promising SME (fdeg1), fostering the horizontal and the vertical integration with LEs (fdeg23), reserving some business areas for exclusive use by SMEs (mdeg1), and improving bargaining power through collective contracts (mdeg2). The main purpose of these policies is to stabilize SMEs' marketing capability over time since SMEs, particularly small-sized SMEs, are apt to be bankrupt even under a weak business cycle. According to Table 4, firms which are integrated horizontally or vertically with LEs (FDEG23=1) or have their product areas reserved for SMEs have much greater marketing capability in export markets than others. On the other hand, the firms participating in collective contracts (MDEG2=1) reveal their poor marketing capabilities in export markets. This may reflect the fact that collective contracts are primarily used in domestic marketing. The negative impact on export marketing of the designation as promising SMEs (FDEG1) was unexpected since this designation was given to those firms (mostly small) which were deemed promising in technology or exporting.

Not surprisingly, support specifically designed to help SMEs penetrate export markets and given only to exporters (PEN) has a comparatively large effect on SMEs' export marketing capabilities. On the other hand, the effect of support received by the firm for modernizing or upgrading technology capability including the improvements in design and quality of the products (tecsup) has a negative effect on the T-regime. Yet, since both exporters and non-exporters are eligible for this kind of support, this negative effect on exports via the T-regime is not surprising. Of the four kinds of financial support considered here ("forsup", "ftesup", "fwcsup" and "exfsup") only "exfsup", financial support for export and overseas investment, is directly connected with exports. Since such support is often given to firms that are supposed to export in the near future, the direction of causality could be a problem in this case. Nevertheless, it is shown to have a very significant positive influence on export marketing capability but an insignificant one on technology capability. The variable measuring the use of credit guarantee systems for SMEs (forsup) has effects similar to those of "exfsup", i.e., positive and significant for the M-regime, but not for the T-regime. The financial support for technology development measure (ftesup) has a large positive effect on technology capability. On the other hand, the effect of support received from the fund for working capital or management stability (fwcsup) appears to be negative.

Among tax incentive variables, the special depreciation (sdsup) on working assets, facilities for productivity improvement, and other facilities and investment for research and training (resup) appear to have strong positive effects on the T-regime. As explained in section II, the tax support through special depreciation lowers the sunk costs existing in both regimes by allowing a firm to recover quickly the investment for exporting. Both the use of tax exemptions (tesup) and income exemptions (iesup) are shown in Table 4 to have negative effects on technology capability. However, the effect of "tesup" on actual exports is greatly weakened by the positive effect it has on the M-regime.

IV-4 Predicted Means of T-regime, M-regime and Actual Export

By plugging the parameter estimates from the switching regression model into the

Table 5 Sign Test for Mean of Predicted Values of Each Regime and Predicted Actual Export by Firm Size and Sector

Unit: ₩ billion

Group	Exporter						Non-Exporter				
	T-Regime		M-Regime		Predicted	Actual	T-Regime		M-Regime		Predicted
	Mean	p-value	Mean	p-value	Export	Export	Mean	p-value	Mean	p-value	Export
Size1	2.796	0.000	3.152	0.000	2.484	2.497	0.960	0.002	-3.977	0.000	0.017
Size2	2.602	0.000	3.354	0.000	1.806	1.663	-0.165	0.329	-3.058	0.000	0.144
Size3	3.385	0.000	4.382	0.000	2.312	2.222	-0.675	0.103	-1.573	0.010	0.111
Size4	4.908	0.000	4.747	0.000	3.521	3.754	-0.704	0.266	-2.180	0.002	0.002
WT	4.539	0.000	5.802	0.000	3.831	3.947	-0.730	0.063	-1.103	0.046	0.237
AP	1.146	0.000	2.456	0.000	1.110	1.058	-0.477	0.201	-2.196	0.003	0.044
EP	3.255	0.000	4.194	0.000	2.310	2.181	-0.399	0.259	-2.722	0.000	0.043
FA	3.480	0.000	1.401	0.000	1.020	0.913	1.085	0.000	-4.572	0.000	0.011
Total	3.506	0.000	4.057	0.000	2.517	2.510	0.261	0.118	-3.204	0.000	0.071

Note 1: "Mean" is the mean of the predicted values in each of the regimes by size and sector.
Note 2: "Predicted Export" is actual export predicted from the estimated T-regime and M- regime.

respective α's, β's and γ's in equations (2) and (3), the predicted values for both of the technology capability regime and the marketing capability regime are obtained. Then, the predicted values are averaged for each group to get the mean of that group. It is of interest to test the sign of the average of the predicted values for the firms in each group. Table 5 shows the result of the sign tests by firm size and sector. In the table, a striking distinction between exporters and non-exporters is observed. The means of the predicted values for exporters are very significantly positive in both regimes regardless size and sector. However, those for non-exporters are significantly negative in the M-regime. They are also insignificantly negative in the T-regime for all groups except for those of size 1 and the FA sector, where the signs are significantly positive even though the magnitudes are small. According to this result, although non-exporters are weak in technological capability, they are still weaker in marketing capability in export markets. This is why non-exporters cannot export. Particularly, non-exporters belonging to size group 1 have technological readiness for exporting but cannot find a way to sell their products in export markets because of the insurmountable barrier of sunk costs. Even if there were considerable foreign demand for their products, non-exporters would be without a channel for connecting themselves with buyers. This phenomenon is similar for non-exporters in the FA sector because most of them belong to size group 1. Therefore, some effective policies for facilitating export marketing should be directed to non-exporters in the FA sector or in size group 1. More generally, policies for enhancing non-exporters' technology capabilities should be accompanied by policies designed to help firms to satisfy foreign buyers' needs.

On the contrary, exporters seem to have no problem in marketing capability relative to technological capability, except for the FA sector where the mean of the predicted values in the M-regime is less than that in the T-regime. However, it does not necessarily mean that a firm or a sector, whose technological capability is greater (less) than marketing capability, does not need to expand marketing capability (technology capability). For example, the firm or sector could be small, export little and be subject to severe adjustment costs and substantial sunk costs in export markets. Thus, both firms themselves and government support policies should be aimed at achieving balance between the two regimes.

The predicted values of actual exports in Table 5 can be obtained by plugging the coefficient estimates from Table 4 into equation (8). Although the means of the T-regime and of the M-regime are very different from the mean of actual exports, respectively, the predicted values for actual exports in Table 5 are very close to actual exports, which explains the high $\bar{R}^2$ of

.891 for the switching model in Table 4. In particular, the predicted values of actual exports for non-exporters are pretty close to zero, even though non-exporters have large negative scores for marketing capability. The reason is that these negative scores cause the excess marketing probability to approach zero, which is the weight for the mean of the M-regime in computing the predicted values of actual exports.

In the above discussion, it is implicitly assumed that the variances of the two regimes are similar. Under this assumption, the stronger of the two capabilities, i.e., the regime which is more binding in determining actual exports, can be identified by comparing the means of the two regimes. If this assumption does not hold, the variances of the regimes must be considered also. Indeed, according to Table 4, the variance estimates in the two regimes are 1.251^2 and 0.531^2 respectively, implying that the estimate in the T-regime is 6 times as big as that in the M-regime. Thus, even if the means of the two regimes are considerably different from each other, the more binding of the constraints cannot be concluded definitely for each group of firms. To solve this problem, a measure reflecting the information on the variations of two regimes is needed. For this purpose, we use the conditional excess marketing probability as discussed in the next section.

IV-5 Excess Marketing Capability Probability

One of the purposes of this paper is to examine the pattern over time of the excess marketing probabilities by sector or size for exporters and non-exporters, separately. With knowledge of the time path of such probabilities by sector and size, the life-cycle/business-cycle of each sector or size group with respect to technological and marketing capabilities can be explained. To do this, a panel data set with a relatively long time series would be needed. The data used here, however, is an incomplete panel data with only a three observations over time, implying that the inferences we draw are confined to this three-year period.

According to Table 7, the averages of the conditional excess marketing probabilities for exporters and non-exporters are 51.2% and 0.2%, respectively. The percent of observations with the average probability more than 0.5 are 47.2% and 0% among exporters and non-exporters, respectively. This means that exporters have little in the way of marketing problems compared to their technological problems, while non-exporters have no marketing ability in export markets. Table 6 also shows that the marketing capabilities of WT and especially AP sector firms declined from 1989 to 1991. On the other hand, the excess marketing probability of EP firms increased steadily from 49.9% to 58.7%. Firms in the WT, AP and EP sectors are much less constrained by marketing capabilities than their technological capabilities. Clearly, they need means with which to overcome their technological constraints on exports. The time-pattern of excess marketing probabilities can also be very important for coping with the existing and emerging difficulties and uncertainties. As explained above, the WT and AP firms are shown to have gradually lost their marketing capabilities in export markets. Some measures for stimulating marketing capabilities, therefore, would have to be undertaken.

On the other hand, the most problematic sector in export marketing is the FA sector. This is due to the lack of experience in export markets, and to the attributes of the products that have been designed primarily to meet the standards and needs of the domestic market. Only a few large firms in the FA sector export, while most small-sized firms do not. However, according to Table 6, the FA sector is the only sector in which non-exporting firms have a significant technological capability for exporting. If the marketing capability of such firms could be increased, the prospects of exports in this sector could be greatly increased.

For other non-exporters, the prospects of exporting are less bright since such firms face the more difficult barrier to exports of large sunk costs. While their technology capabilities are also very weak, their marketing capabilities are even weaker.

Table 6 Means of π_{it}^{c} and Percentage of Observations with $\pi_{it}^{c} > 0.5$ by Sector and Year

Group	Sector	1991		1990		1989		total	
		cp	%	cp	%	cp	%	cp	%
Exporter	WT	0.541	48.4	0.584	53.6	0.609	56.0	0.576	52.4
	AP	0.497	41.7	0.659	63.6	0.705	66.7	0.611	56.3
	EP	0.587	53.8	0.556	50.0	0.499	42.9	0.546	48.8
	FA	0.227	25.0	0.325	28.6	0.287	25.0	0.282	26.3
	All	0.487	44.1	0.536	49.3	0.533	48.3	0.518	47.2
All	WT	0.401	35.7	0.402	36.6	0.424	38.9	0.408	37.0
	AP	0.300	25.0	0.403	38.9	0.375	35.3	0.357	32.7
	EP	0.383	35.0	0.390	35.0	0.368	31.6	0.380	33.9
	FA	0.069	7.5	0.114	10.0	0.099	08.6	0.094	8.7
	total	0.273	24.6	0.303	27.7	0.300	27.1	0.291	26.4

Note: "cp" stands for conditional probability of excess marketing capability.

Table 7 Means of π_{it}^{c} and Percentage of Observations with π_{it}^{c} >0.5 by Size

Group	Size 1		Size 2		Size 3		Size 4		All	
	CP	%	CP	%	CP	%	CP	%	CP	%
Exporter	0.440	33.3	0.499	43.1	0.587	56.5	0.481	45.1	0.518	47.2
Non-Exporter	0.001	0.0	0.004	0.0	0.005	0.0	0.000	0.0	0.002	0.0
All	0.110	8.2	0.262	22.4	0.427	41.1	0.423	39.7	0.291	26.4

Note: *. L: Number of employment *. Size 1: L<50 *. Size 2:50<=L<100 *. Size 3: 100<=L<200 *. Size 4: L>=200

Table 7 shows the means of excess marketing probabilities and the percentages of the observations with the probability of more than 0.5 by size of firm. Size is one of the most important variables for representing a firm's technological and marketing capabilities and export potential. As noted above, exporters are typically much larger than non-exporters. While larger firms may have several advantages over smaller ones, of particular interest is the pattern of excess marketing probability by size. According to Table 7, although the probability of excess marketing capability is slightly lower in size 4 than in size 3, the tendency among exporters is for the average of the probabilities to increase as size increases. That means that size (measured by the number of workers) affects the relative marketing capability of a firm. However, after size group 3, the effect begins to fade away because the export ratio out of total sales also begins to decrease.

V Summary and Policy Recommendation

By using a censored switching regression model, we have analyzed Korean SMEs' export behaviors in micro-economic level and in the strategic management (disequilibrium) framework. Although the model is slightly more complicated than traditional ones, it provides results that can be firm-specific. Although both switching and censoring problems are allowed for, the estimators from the model are still consistent and asymptotically normal. The R^2 and $\overline{R}^2$ of the censored switching regression model on actual exports were 90.8 % and 89.1 % respectively, demonstrating an excellent fit despite the relatively few RHS variables used. On the basis of such estimates, the model sharply distinguished exporters from non-exporters. For exporters, the average predicted values of technology capability and marketing capability were naturally very

significantly positive. In all size groups except size group 4 and all the sectors except for AP, marketing capability was higher than technology capability. However, at the firm level, 47.2 % of exporters have a probability of excess marketing capability less than 0.5, implying that a substantial percentage of firms was suffering more from insufficient marketing capability than from technology capability (Table 6). Furthermore, the values and signs of excess marketing capability vary over sectors and sizes (Table 5). Thus, policies for balancing the technology capability and marketing capability are desirable to promote the actual exports of SME's efficiently.

On the other hand for non-exporters, with the exception of firms in size group 1 and the FA sector, the technology capability is extremely low and in fact negative, implying that non-exporters are not ready to export from the point of the technology capability. The reason why firms in size group 1 had a positive technology capability is that almost all non-exporters in the technologically sophisticated FA sector are in size group 1 and capable of exporting from the technological capability perspective. Much worse than that, however, is that non-exporters' marketing capability was very significantly negative, implying that non-exporters are faced with very difficult-to-surmount sunk costs in penetrating export markets. This phenomenon is more serious for firms in size group 1 and the FA sector. Lowering their sunk costs in export markets is the most important and urgent task if those non-exporters, particularly in size 1 and the FA sector, that were ready to export in the technology-side, are to succeed in export markets.

According to the descriptive statistics,[15] SME exporters have had greater experience in exports, more workers, higher productivity, particularly capital productivity, more new products, greater buyer concentration and higher CEO's previous sales experience than non-exporters. These findings are consistent with those of Bernard and Jensen (1995a, 1995b, 1996a and 1996b), and of Roberts and Tybout (1997).

Considering that Korea's SMEs compete with comparable exports of lower wage countries, it is noteworthy that in this study the marginal effect of labor productivity appears to be the most important factor in promoting exports. Every unit increase of labor productivity increases actual exports by about five times. Thus, improving labor productivity is the most important factor to succeed in export markets. More capital through factory automation, development and adoption of advanced technology, more productive training for workers, and restructuring are among the best ways with which to improve labor productivity. According to the descriptive statistics, capital productivity in exporters is twice that of non-exporters.

On the other hand, vertical or horizontal integration with large enterprises (LEs) seems to have helped SME exports very considerably. That is, almost all SMEs are related with LEs through subcontracting relationships. In our sample, the ratio of subcontract-receiving out of total sale in size 1 was about 68 % and the ratio of SMEs participating in the subcontracting (including both receiving and placing of orders) was more than 85 % in Korea in 1990. Although such integration of SMEs with LEs can secure markets for SMEs, deep dependence on LEs can impeded the development of SMEs' own internal marketing and technological capabilities. As a result, cyclical fluctuations in LE business activity can easily be transferred to SMEs. The recent financial crisis in Korea, which started at the end of 1997, has tended to make SMEs the scapegoats by forcing financial institutions to cut off SMEs from credit, leaving many SMEs vulnerable to financial failure stemming from their shortcomings in terms of technological and marketing capabilities.

With respect to the non-financial support variables, the support to penetrate export markets by government or non-profit agencies had a strong effect on SMEs' marketing capability in export markets. To help SMEs identify and connect with appropriate buyers is very important for lowering sunk costs in accessing export markets. Yet, more specific, reliable, cost-efficient and accessible form of support for SMEs in penetrating export markets must be designed.

[15] See Kim, Nugent and Yhee (1997) for details.

Among financial supports, while the credit guarantee systems was the most effective in export marketing, the financial support for developing new technology was very effective in increasing technology capability, and the support for export and overseas investment also was effective for marketing capability. Financial support systems need to be sophisticated to meet international rules under the control of IMF and WTO but the special conditions faced by individual SMEs must be given greater consideration.

For tax supports, special depreciation allowances appear to have had a strong effect on exports. The special depreciation allowances for facilities, asset investment and restructuring for improving technology and productivity would appear to be especially useful for export promotion by reducing the sunk costs associated with particular foreign markets and niches.

Conditional on the sample, the averages of the conditional excess marketing probabilities are 51.2% for exporters and 0.2% for non-exporters and the percentages of observations with excess marketing probability over 0.5 are 48.8% for exporters and 0% for non-exporters. That is, the exporters have few serious problems in marketing relative to technology while non-exporters have virtually no marketing ability in export markets. Since non-exporters had a considerably negative marketing capability and a zero technology capability, the excess marketing probability for the non-exporters cannot but be zero.

It is of interest to examine the time path of excess marketing probability. The marketing capabilities of WT and especially AP firms declined sharply from 1989 to 1991. On the other hand, the EP's excess marketing probability increased steadily from 49.9% to 58.7%. This pattern would be very important in deciding the timing, the magnitude and kind of SME support policies. With respect to size, excess marketing probability increased for firms in size groups 1-3 but declined slightly for firms in size group 4. As a whole, we conclude that larger SMEs have greater marketing capability.

When all SMEs are divided into two sub-groups- one bound by the T-regime and the other bound by the M-regime – the use of excess marketing probabilities can facilitate the design of more efficient support systems. The forms of support aimed at promoting technological capability for the groups binding to the T-regime and the supports oriented to marketing capability for the groups binding to the M-regime could improve the efficiency of resources used for SME supports by balancing technology capability and marketing capability.

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