Title	Official export credits in Thailand : the reallocation analysis
Sub Title	
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Publisher	Society of Business and Commerce, Keio University
Publication year	1998
Jtitle	Keio business review Vol.36(1998), ,p.1- 24
JaLC DOI	
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Notes	
Genre	Journal Article
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=AA00260481-19990000-0 0737461

KEIO BUSINESS REVIEW
No.36, 1998
pp.1-24.

Final version received on 29th September 1998

Official Export Credits in Thailand: The Reallocation Analysis

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Abstract

The Official Export Credit facility in Thailand has been provided from The Bank of Thailand through the Export-Import Bank of Thailand (EXIM Bank) as one type of financial supports to exporters. However, the credit allocation is done by commercial banks which tend to be more risk averse and, therefore, are likely to finance less to small and medium-size enterprises, that are the main target of this facility. This paper propose an idea of allocating limited credits in order to obtain maximum exports with respect to the potential to export of each industries group by applying a multiple regression model with credit proportions as explanatory variables. Finally, the method of comparative advantage is introduced in order to eliminate the bias caused by scale problems in the original method. Through the allocation scheme presented here, total estimated exports may increase approximately by one-forth.

Key Words

Packing Credit Facility, EXIM Bank, Maximization of Export, Optimal Allocation of Credit, Official Export Credit

1. Introduction

The Official Export Credit was brought to attention originally according to the zero growth rate of the country's exports in 1996 that could be regarded as a sign of the economic crisis Thailand is still facing with. With limited resources due to such an economic condition, it might be more helpful if any potential ways to promote more of the country's exports by using already available tools could be found out. One of these tools is the Official Export Credit given to exporters from the Bank of Thailand through the EXIM Bank, known as the Packing Credit Facility, which is only one that can be regarded as the Official Export Credit facility. EXIM Bank also provides other facilities for exporters by raising its own funds.

However, concerning the Packing Credit facility, only half of the total amount obtained by exporters comes from the central bank. Another half is obliged to be financed by distributors, the commercial banks. Thus, according to a sound banking practice, those commercial banks appear to allocate credits to large-size exporters with lower risks rather. Nevertheless, such distributions are against the basic concept of support from EXIM Bank that more emphasis should be placed on small and medium-size producers. Therefore, here we have tried to find out any possible way to reach a higher level of exports by reallocating the credit which is available at the constant limit of 30 billion Baht.

One assumption must be made here that, if the allocation could be done by the national organization concerned, rather than by commercial banks, it might be more efficient and, therefore, lead to higher level of exports. To consider this possibility of credit allocation by the government sector, the relationships between the value of exports and the value of Official Export Credits are necessary for an analysis. Thus, the study will concentrate on the Packing Credits from the Bank of Thailand, covering the period since the introduction of the new regulation, which obliges commercial banks to be responsible for the other half of the credit amounts, from 1988 to 1996, for which the latest data is available.

A question may arise why you study only Packing Credits that just make of 6% of export values instead of total credits financing the export sector. Admittedly very few businesses operate by their own funds. Looking at a whole export credits, amounts to almost the export values, you will get only 1-1 correspondent relationships.

This paper is divided into 5 parts with an introduction. The second part is devoted to the former literature concerning the topic of our interest. The third and fourth parts provide the model used in our analysis as well as the simulation results respectively. Finally, the fifth part presents the final conclusion of this paper in brief. Sources of information and idea appeared in this paper are available in References. The derivation of equations in reduced form is provided in Appendix.

2. Literature Reviews

Although there are a few studies that are directly related to the topic of our interest, two are worth mentioning here. Chantarangsu (1991)[1] analyzes the role of the Bank of Thailand in directing the Official Export Credits and the effects to total exports. In general when an exporter is financed by the Packing Credit program, he will face a lower borrowing interest rate. Accordingly the exporter will be able to make strength of an international price competitiveness. This should somehow positively affect the total amount of exports. Using annual data from the year 1968 to 1987, Chantarangsu proves the significance of Official Export Credit by her linear export equation below:

$$\begin{aligned}\log(\text{total export}) = {} & 0.3007509 \log(\text{credit from Bank of Thailand}) \\ & + 1.4366079 \log(\text{exchange rate}) \\ & + 0.9160670 \log(\text{export price index}) \\ & - 0.2154693 \log(\text{dummy variable: economic condition})\end{aligned}$$

The log-linear export equation in her study shows a high R squared value of 0.992323, and an adjusted R squared of 0.990276. All the independent variables are

[1] Varisa Chantarangsu, "Official Export Financing from Bank of Thailand," (National Institution of Development Administration: NIDA, 1991).

significant with 95% confidence. According to this regression model, Official Export Credits from Bank of Thailand have a very small positive relationship with total exports because credits are given to large-size exporters that are less likely to export new kinds of goods to foreign markets than do the smaller ones. Credits are also concentrated in only few kinds of traditional export items which are less demanded in the world market.

Nitiaphaidharm (1991),[2] at the same time, analyzes Official Export Credits from Bank of Thailand by using statistics tools with quite similar objectives. The Bank of Thailand has aimed to finance exporters as well as distribute credits to small and new producers to encourage the income distributions to those in less developed sectors. Though markets for the country's agricultural and manufacturing products should then be expanded to match with the production capacities, Packing Credits allocation still depends on the nature of exports. As Thai exporters appear to be a price taker in the world market, credits are given to lessen the burden of an exporter's costs.

Nitiaphaidharm demonstrates an export equation by using the annual data from 1976 to 1990. His study also shows the high value of R squared and adjusted R squared of 0.977591 and 0.968627, respectively. His export model can be defined as:

$$\begin{aligned}\log(\text{total export}) = & -7.5164 \text{ (intercept term)} \\ & +1.5779 \log(\text{gross domestic products}) \\ & -0.1993 \log(\text{ratio of Official Export Credit from Bank}) \\ & +0.0048 \log(\text{net foreign direct investment}) \\ & +0.0105 \log(\text{terms of trade})\end{aligned}$$

Nevertheless, according to the T-test values, other variables, apart from GDP appear to be significantly low until the null hypothesis, that those coefficients are not significant at 95% confidence, must be accepted. Moreover, the Official Export Credits and total exports show a negative relationship.

According to the interesting results of Chantarangsu's study, here we have tested her export equation by extending the data until the year 1996 in order to prove the model's validity for more updated data and circumstances. We use the export model with explanatory variables as in her study by using data from the year 1968 to 1996. Regarding the economic condition, we follow Chantarangsu's concept by regarding none of the year extended as a critical condition since she considers only a decrease of total export amounts as a critical condition as in the year 1974 and 1983. The output of our extended regression analysis shows less fitted results of this model. Moreover, the credit variable is proved to be no longer significant with 95% confidence, and even turned out to be minus as shown in the estimation output in Table 2.1. However, the results of the non-logarithmic model in Table 2.2 shows that Packing Credits has a more significant negative relationship with export values.

[2]Chaiyant Nitiaphaidharm, "The Inefficiency of Export Credits Policy from Bank of Thailand," (National Institution of Development Administration: NIDA, 1991).

Table 2.1 Log-Lin Regression Output of Chantarangsu's Export Model

LS//Dependent Variable is log (Total Export)
Sample: 1968-1996
Included observations: 29
Excluded observations: 0 after adjusting endpoints

Variable	Coefficient	Std. Error	T-Statistic	Prob.
constant	−9.661570	2.473979	−3.905276	0.0006
log(Exchange Rate)	3.447438	0.947282	3.639294	0.0012
log(Export Price Index)	2.846562	0.464956	6.122215	0.0000
log(Credits from BOT)	−0.174472	0.130102	−1.341039	0.1920

R-squared	0.943020	Mean dependent var	11.88714
Adjusted R-squared	0.936183	S.D. dependent var	1.455015
S.E. of regression	0.367567	Akaike info criterion	−1.874258
Sum squared resid	3.377636	Schwartz criterion	−1.685665
Log likelihood	−9.972481	F-statistic	137.9177
Durbin-Watson stat	0.598184	Prob(F-statistic)	0.000000

Remarks: number after the apprentice shows an exponential power of explanatory variable terms

Table 2.2 OLS Regression Output of Chantarangsu's Export Model

LS//Dependent Variable is Total Export
Sample: 1968-1996
Included observations: 29
Excluded observations: 0 after adjusting endpoints

Variable	Coefficient	Std. Error	T-Statistic	Prob.
constant	−2104190	587692.0	−3.580430	0.0014
Exchange Rate	69750.01	28623.81	2.436783	0.0223
Export Price Index	14834.56	2243.028	6.613623	0.0000
Credits from BOT	−9.924497	2.730625	−3.634515	0.0013

R-squared	0.803349	Mean dependent var	340993.2
Adjusted R-squared	0.779751	S.D. dependent var	418682.6
S.E. of regression	196490.7	Akaike info criterion	24.50418
Sum squared resid	9.65E+11	Schwartz criterion	24.69278
Log likelihood	−392.4599	F-statistic	34.04291
Durbin-Watson stat	0.865496	Prob (F-statistic)	0.000000

Remarks: number after the apprentice shows an exponential power of explanatory variable terms

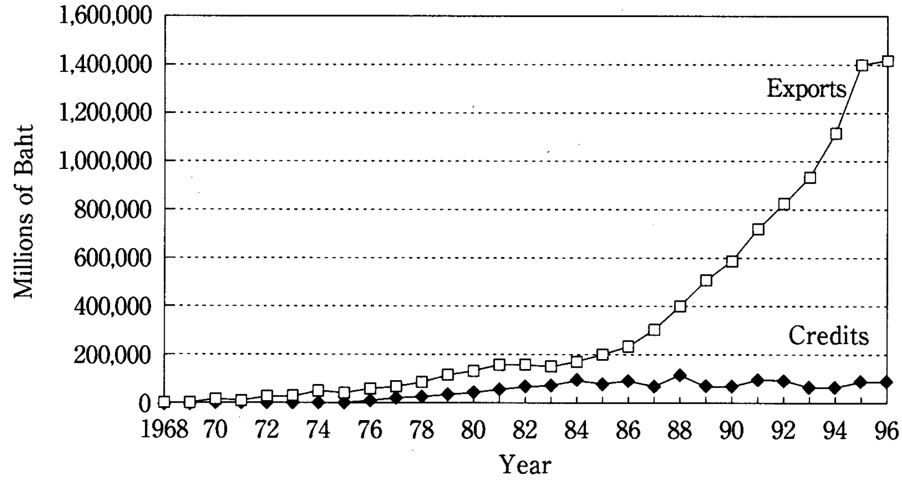
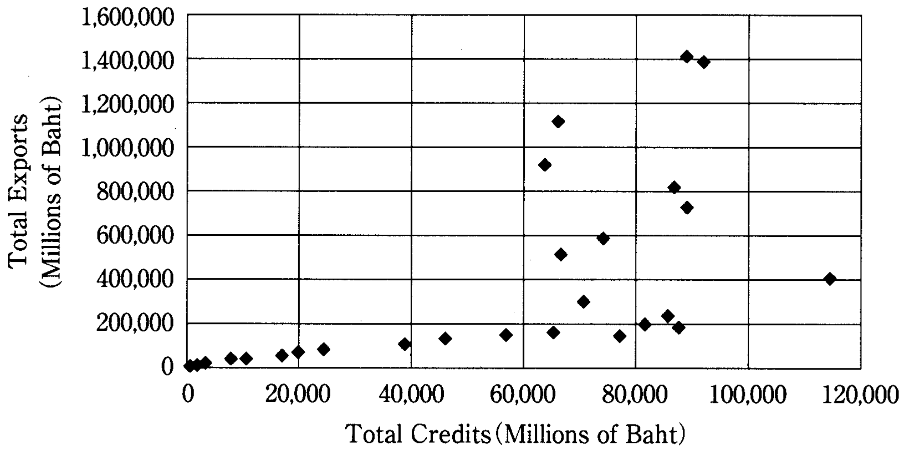


Figure 2.1 Time Series Data of Total Exports and Official Export Credits



R-squared = 0.4034

Figure 2.2 The Relationship between Total Exports and Packing Credits

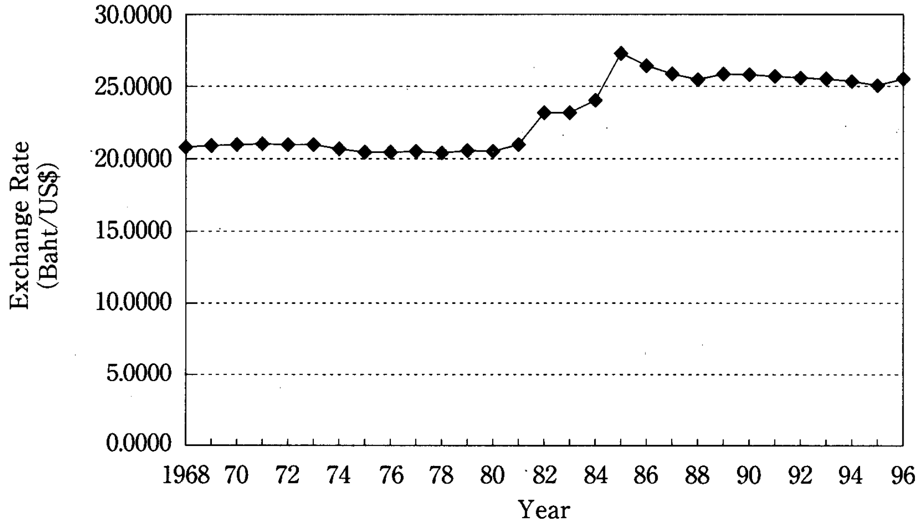


Figure 2.3 Time Series Data of Exchange Rate (Baht/US $)

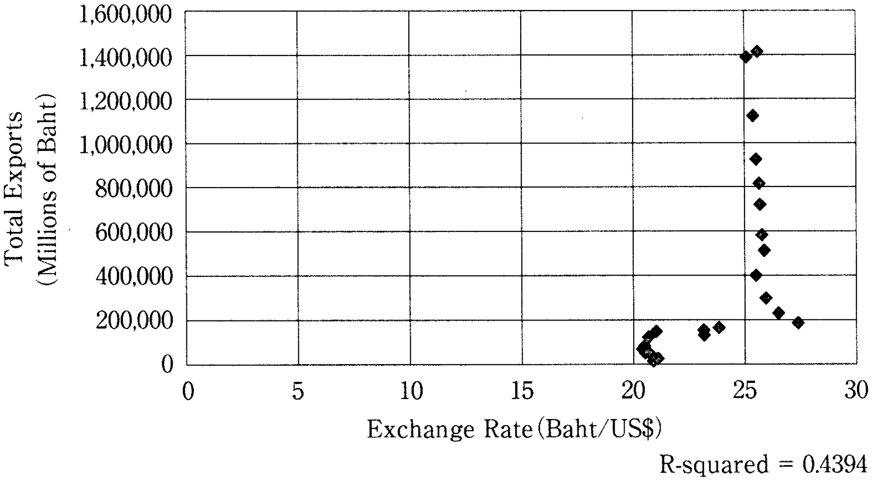


Figure 2.4 The Relationship between Total Exports and Exchange Rate (Baht/US $)

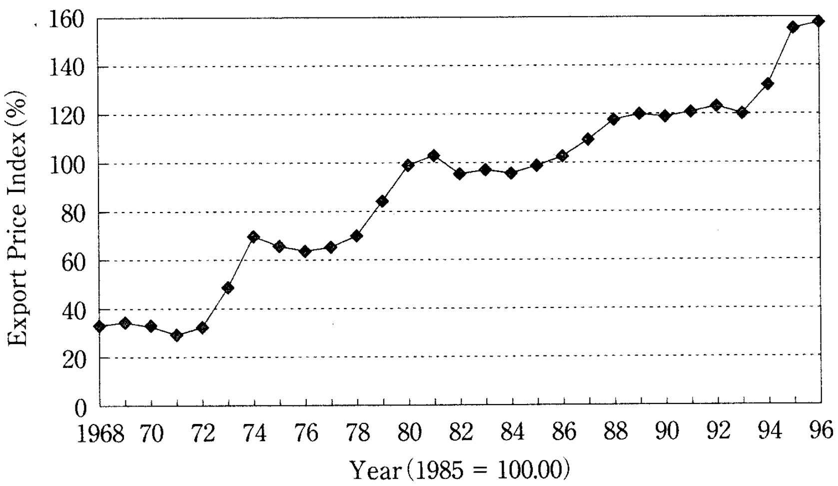


Figure 2.5 Time Series Data of Export Price Index

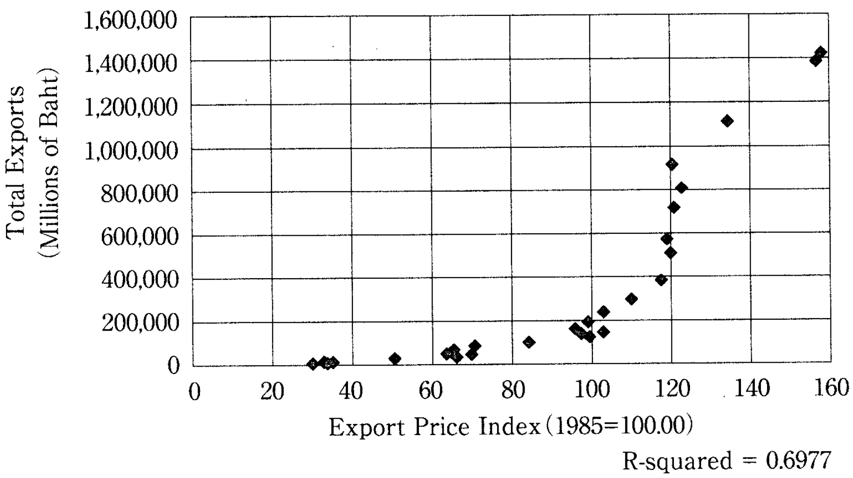


Figure 2.6 The Relationship between Total Exports and Export Price Index

3. Model Specification

In this section, we derive the model used for analyzing their relationship. It should be emphasized that we are trying to reach the maximization of the country's exports under the appropriate allocation of Official Export Credits. It is, however, noteworthy that only the effects from export credits toward export revenues are tended to be analyzed in this study. The important assumption of "*ceteris paribus*" is always held.

We assume here that the Official Export Credit should somehow have an effect on the value of export. Since the ratio of Official Export Credit to total export is only 6%, the direct effect in the total terms can be less significant. In this study, therefore, we will assume the relationship to vary by each item of export industry instead of being directly related in total terms. In other words, the relationship of each industries group will be analyzed separately.

Let Y_i represent export value of industry i, thus, the term $\sum_{i=1}^{n} Y_i$ will represent total exports of the country. X_i, on the other hand, is the credit allocated to industry i, and similarly, the term $\sum_{i=1}^{n} X_i$ represents the total credits. We can mathematically rewrite this relationship as:

$$\sum_{i=1}^{n} Y_i = Y_1 + Y_2 + \ldots + Y_n \qquad (1)$$

$$\sum_{i=1}^{n} X_i = X_1 + X_2 + \ldots + X_n = \bar{X} \qquad (2)$$

If we consider volumes of export as the differences between domestic supplies and domestic demands, assuming that the country is small and has no effect on the world market either regarding price or quantity, then the export value is those volumes timed by the price level. Concerning domestic demands and supplies, we need to make a clear assumption that will be used in this study to avoid confusion that may be caused by the different definition used in each study.

Assume that domestic supplies, S, are determined by price level, P, and production cost, C. As the export credit, X, helps to lessen the producer's cost burden, so it will affect the supplies in the opposite way of production cost. While the domestic demands, D, totally depend on price. The nominal export value, Y, is a product of export volume, E, multiply P. These can be rewritten as the relationships for the industry i as:

$$E_i = S_i(\overset{+}{P_i}, \overset{-}{C_i}, \overset{+}{X_i}) - D_i(\overset{-}{P_i}) \qquad (3)$$

$$E_i = f(P_i, C_i, X_i,) ; \qquad E_i P_i = Y_i \qquad (4)$$

Equation (4) represents some factors that appear to be significant in determining the export revenue of industry i. In order to maximize equation (1) subject to condition in equation (2), the Lagrange-Multiplier method is applied. The Lagrange function can be written as:

$$Z = Y_1(P_1, C_1, X_1,) + Y_2(P_2, C_2, X_2,) + \ldots + Y_n(P_n, C_n, X_n,) + \lambda(\bar{X} - X_1 - X_2 - \ldots - X_n)$$

The first-order condition for free extremum of the above function will consist of the set of simultaneous equations:

$$Z_\lambda=\bar{X}-X_1-X_2-\dots-X_n=0 \quad \text{or} \quad 0+X_1+X_2+\dots+X_n=\bar{X}$$
$$Z_1=\frac{\partial Y_1}{\partial X_1}-\lambda=0 \quad \text{or} \quad -\lambda+\frac{\partial Y_1}{\partial X_1}=0$$
$$Z_2=\frac{\partial Y_2}{\partial X_2}-\lambda=0 \quad \text{or} \quad -\lambda+\frac{\partial Y_2}{\partial X_2}=0$$
$$\vdots$$
$$Z_n=\frac{\partial Y_n}{\partial X_n}-\lambda=0 \quad \text{or} \quad -\lambda+\frac{\partial Y_n}{\partial X_n}=0$$

From the above simultaneous equations, we can apply Cramer's rule theoretically or other methods in order to obtain a final solution. Due to the previously mentioned assumption of *ceteris paribus,* other factors will simply become constant. In order to pursue the calculation, the relationship between each X_i and Y_i is necessary. The maximization of equation (1) provides us with the optimum level of each X_i, which will lead to the maximum export value with respect to the constraint $\bar{X}$.

One more assumption must be made—that there is a time lag between the relationship of these two terms, export credit and export value. The Official Export Credit given to one industry should not immediately affect the value of export. On the other hand, it should be effective for the export value of the next period. Thus, we can obtain the relationship as shown in the equation (5), when t is the period of time.

$$Y_i^t=y_i(X_i^{t-1}) \tag{5}$$

Since we assume 90 days maturity date of the exporter's promissory notes, a lag of one quarter should be reasonably realistic. Moreover, there is an argument that it is not necessary that credit is the explanatory variable for export. On the other hand, it might be the opposite. This time lag assumption is another way to avoid such problems. The polynomial regression model used in our study should be valid if we consider the export credit as one variable of factors of production.

However, as we proceeded to analyze the relationship by econometrics methods, the absolute term of packing credits appear to be less significant than expected. As a result, we will try to use proportional form of credit instead, as used by Nitiaphaidharm. In this study, we go another step further as, here, *the value of export is determined by both the proportional credits received by one industry when compared to the total export value of that industry, as well as by the proportional credits received by the industry when compared to the total credits.*

Lying behind this idea is the scale effect. To consider a proportional rate of credits given to a certain category of export should be more sensible than considering the actual value. However, a definition of proportion can be interpreted in two ways; proportional rate to exports of that industry and proportional rate to total credits. The former expresses how significant the credits are realized in its own industry. While the latter expresses the importance of the industry is in the creditor's eyes, in compare to other industries. As a result, we have applied both definitions as an explainable variable of industry exports.

Let Y represent total exports while X represent total credits. Then y_i and x_i will represent the export of and the credit to industry i, respectively. To rewrite the above paragraph as a mathematical equation, or as a polynomial function of the industry i, we will obtain the following relationships:

$$y_i = f\left(\frac{x_i}{y_i}, \frac{x_i}{X}\right) \tag{6}$$

Equation (6) is the general equation used in our study in order to achieve the first stage of our analysis. We will have a total of 4 equations representing the relationship between exports and the credits of 4 groups of industries, in the same form as equation (6). The optimal allocation of X can be done by using the differential method to maximize these equations subject to constraint $X = 30$ billion Baht. The maximization of Y leads to the optimal credit proportion allocated to each industry.

Following this assumption we will examine the time series data of exports and packing credits categorized into 4 major industry groups significantly financed through this program with another item as the group of "other" industries. Under the conceptual framework that this packing credit can be considered as one factor of production cost, the relationship between both terms need not be linear. By processing the data through the econometrics tools, we have reached the most fitted form of relationship between export credit and export value which can generally be written as:

$$y_i = c_o + c_{11}\left(\frac{x_i}{X}\right) + c_{12}\left(\frac{x_i}{X}\right)^2 + \ldots\ldots + c_{1m}\left(\frac{x_i}{X}\right)^m + c_{21}\left(\frac{x_i}{y_i}\right) + c_{22}\left(\frac{x_i}{y_i}\right)^2 + \ldots\ldots + c_{2n}\left(\frac{x_i}{y_i}\right)^n \tag{7}$$

Using the polynomial equation (7), we randomly put both terms inside the model of each industry with an exponential power from 1 to 4 at first. Then according to their probability values, we delete those with highest ones to eliminate the insignificant variables. Which term should disappear is determined by its significance. Thus, we can see from the industry equations that each has a different form of equation. Repeating this routine, we finally get a satisfying equation with an acceptable R squared value as well as having all significant variables at 95% confidence.

In order to keep the model as simple as possible, the exponential power of the variables in both terms is limited to under 5 degree. However, from our examination, we can say that the higher the degree of variables is, the less they appear to be significant. Although it is significant, the coefficient of such a high degree variable tends to be very low until the least difference of outputs could be observed.

The effectiveness of this model is expected to be valid in explaining variations of export as it can be measured by the coefficient of determination (R^2) in each relationship equation. However, by no means should the results be taken as a completed export equation. Similarly, we have no intention to mislead the reader that the export credits in our study is the one and only important factor in determining the country's exports.

4. Simulation Results

4.1 Optimal Allocation of Credits

As mentioned earlier, the total exports will be divided into 5 groups of industries, each contains similar items as will be described here. The food group consists of 4 industries—fresh and frozen shrimp, canned food, frozen fowl, and fresh and frozen seafood. The agricultural and natural resources group consists of 4 industries; tapioca, rubber, precious stones and jewelry, and furniture and parts regarded as products from wood. Lastly, the manufacturing group consists of 4 industries; IC, textile, footwear and plastic. Note here that we still have rice as one special single item because the credits going to this item make up around one-fourth of the total credits. Special care should be put on this item. Resultantly, we have 5 equations including "others."

After we have reached the best fitted relationship function in the polynomial regression model of proportional credits as in equation (7) for each industry, we will come to the second stage, *the maximization of exports*. The concept is simple—to pursue the mathematics of calculus through some differential method against these 5 equations with respect to the constraint of 30 billion Baht. However, there are some difficulties in practice that are hard to be coped with.

According to the model specification, we have not only x, but also y on the right-hand side of every equation. This makes our functions be in an implicit form which need even more complicated differentiation methods. With the high power of polynomial equations, there are more than one solution to this equation.

For example, in the case of the third-degree polynomial for the term that includes y, there will be four correct solutions. Some of these solutions may even turn out to be a complex number, and some are negative. In some cases, one solution may be responsible for the explanation of variation in exports in one interval, while another may be responsible for the remaining intervals. Therefore, we are going to consider only the maximum value of these solutions each proportion of credits.

The above problems are complicated and difficult to be solved. We can simplify the process by using the random test where actual credit data are substituted into the equations to find the real valid solution. Fortunately the outcome appears to confirm the validity of only the maximum value of all the solutions. In order to calculate the optimal allocation of credits to each industry in percentage terms, we will substitute the credit proportions given to each industry into each equation because our model with y on the right-hand side is difficult to be solved mathematically. The general reduced form of those equations used in the substituting process will be shown in Appendix.

The substituted proportions start from 1-50 per cent based on the political assumption that each group of industries should gain at least a smallest amount, says 1%, of credits, and should not gain more than half of the total credits. One can say that this misleads the concept of maximization of exports. We must agree with such claims, but, at least, each of these groups has been financed through the Packing Credit Facility in a large amount compared to other industries. To completely ignore them would certainly discourage the economy. Thus, we have introduced a new idea as shown in the next section. The regression outputs and simulation results of each group are provided and illustrated in Tables 4.1-4.5 and Figures 4.1-4.15.

4.2 Comparative Advantages Method

The optimal allocation we obtained from above calculation of the potential absolute value of exports as shown in Table 4.6 might discourage such industries that used to receive a large proportion of credits. Thus, concerning this problem, we go another step further by considering comparative terms as well. This can be done by dividing all the results of export value in each industry by its highest amount before maximizing them. Therefore, the highest value of exports that can be reached in each industries group through this calculation is only 1, while the highest total export level cannot exceed 5. This will eliminate a bias caused by differences in scale of each industry's exports. In other words, due to this calculation we put more emphasis on the maximum export value of each industry rather than the maximum total export value.

The results are almost opposite to that of the first method. Note here that in the calculation, we have set a lower limit of proportions of credit as 5% for each group. These results are also shown in the Table 4.7. Therefore, we have provided the optimal way for the concerned authorities according to their policy whether to support absolute or comparative advantages.

5. Concluding Remarks

In this paper, the optimal allocation of Official Export Credits that leads to maximum total export is derived, assuming the credit distributor, commercial banks, to allocate their credits, half of which is supported by the Bank of Thailand, as wished by a governmental authority. Our analysis shows that Thai total export values could then increase by almost 25% by the appropriate proportions of credits which are suggested in the study.

The relationship between credit facilities and export values is assumed to vary by each industry. These relationships are derived through econometric analyzing tools to be in a non-linear form based on their time series data. The mathematics of calculus is applied to obtain the maximum total exports due to optimal credit allocation, as named the method of absolute advantage. However, emphasizing more of the potential maximum exports within each industry, the method of comparative advantage is therefore introduced.

We can see the results obtained by both methods of calculation are in the opposite way. The consideration of absolute advantages implies a more emphasis on credits given to manufacturing industries sector. While concerning the comparative advantages, the agricultural and natural resources group seems to deserve the most emphasis. However, one similar conclusion that can be noticed from both methods is the significance of the jewelry industry that might be worth financed in a considerable amount. The authorities concerned should clearly determine their objectives of export promotion so that appropriate financing policies can be implemented.

Both the quantitative and the descriptive parts provided in this study are believed to be somehow useful to introduce the reallocation of Official Export Credits as one potential option for the country's export promotion policies. Also this concept should be true for other facilities of financial support from the government. Apart from this Official Export Credits, any possible application deserves a careful consideration.

Table 4.1 Regression Output of Rice Industry

LS//Dependent Variable is Exports of Rice
Sample: 1968: 2-1996: 4
Included observations: 35
Excluded observations: 0 after adjusting endpoints

Variable	Coefficient	Std. Error	T-Statistic	Prob.
(% x/y Rice)	972.2146	348.4135	2.790405	0.0092
(% x/y Rice)2	−67.86819	18.59065	−3.650663	0.0010
(% x/y Rice)3	1.389866	0.407572	3.410114	0.0019
(% x/y Rice)4	−0.009168	0.003001	−3.054656	0.0048
(% x/X Rice)	879.6197	224.7339	3.914049	0.0005
(% x/X Rice)4	−0.021634	0.007500	−2.884504	0.0073

R-squared	0.652977	Mean dependent var	9721.314
Adjusted R-squared	0.593145	S.D. dependent var	2430.192
S.E. of regression	1550.102	Akaike info criterion	14.84696
Sum squared resid	69681692	Schwartz criterion	45.11359
Log likelihood	−303.4846	F-statistic	10.91358
Durbin-Watson stat	1.119940	Prob (F-statistic)	0.000006

Remarks: number after the apprentice shows an exponential power of explanatory variable terms

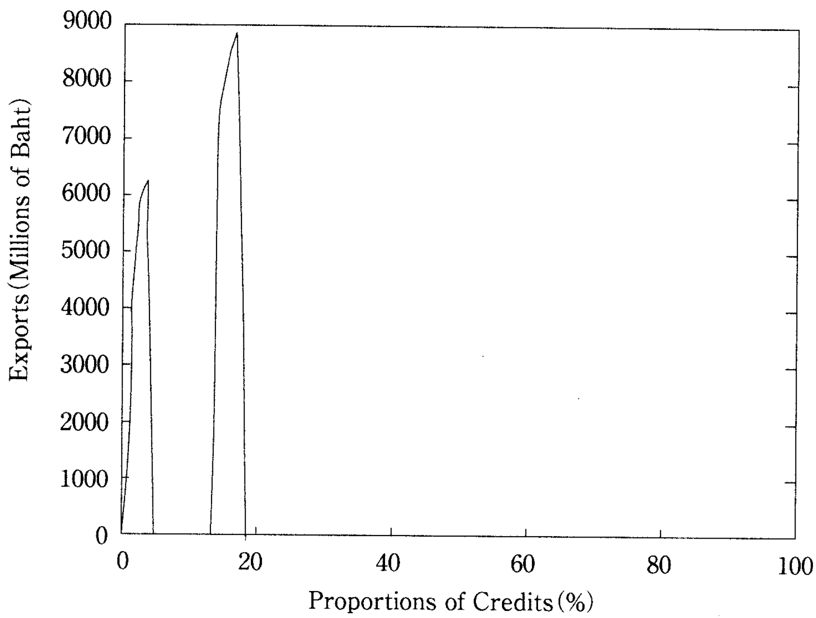


Figure 4.1(A) Maximum Value of Estimated Exports in Rice Industry

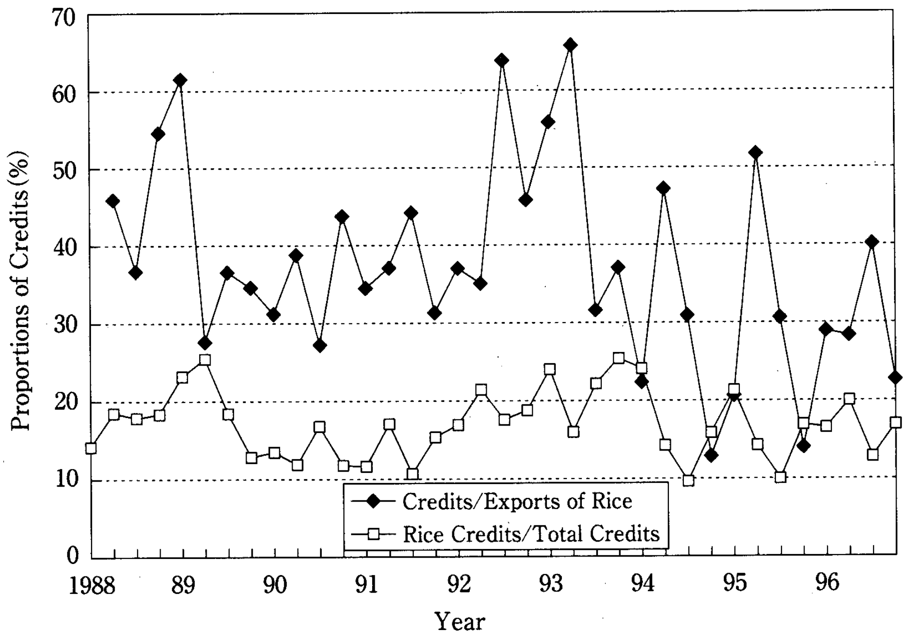


Figure 4.1(B) Proportional Changes in Credits of Rice Industry

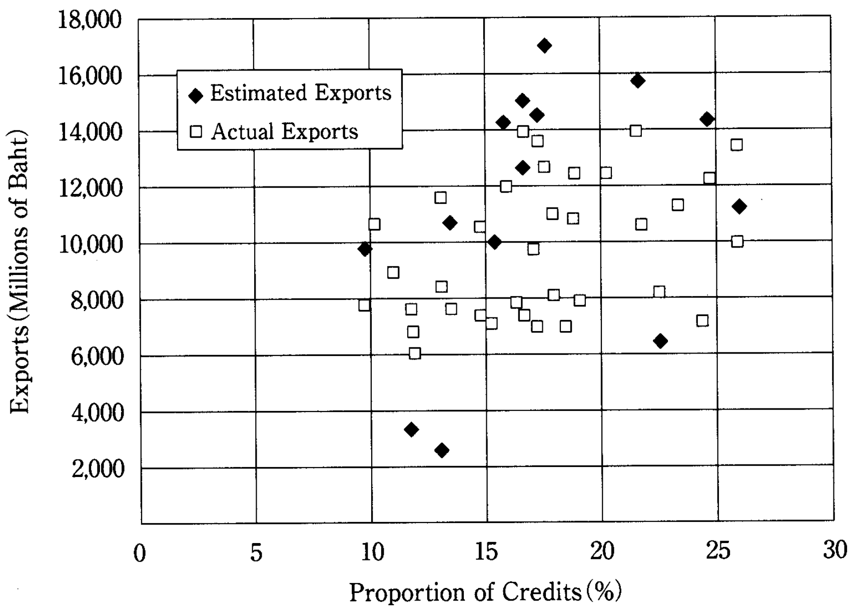


Figure 4.1(C) The Estimated and Actual Exports of Rice Industry

Table 4.2 Regression Output of Food Industries

LS//Dependent Variable is Exports of Food
Sample: 1968: 2-1996: 4
Included observations: 35
Excluded observations: 0 after adjusting endpoints

Variable	Coefficient	Std. Error	T-Statistic	Prob.
(% x/y Food)	2540.468	332.5249	7.639933	0.0000
(% x/y Food)2	−120.3202	15.99917	−7.520403	0.0000
(% x/y Food)3	1.434634	0.200543	7.153132	0.0000
(% x/X Food)2	16.88203	2.694975	6.264263	0.0000

R-squared	0.828408	Mean dependent var	22426.03
Adjusted R-squared	0.811802	S.D. dependent var	6791.583
S.E. of regression	2946.307	Akaike info criterion	16.08383
Sum squared resid	2.69E+08	Schwartz criterion	16.26158
Log likelihood	−327.1298	F-statistic	49.88706
Durbin-Watson stat	1.158510	Prob(F-statistic)	0.000000

Remarks: number after the apprentice shows an exponential power of explanatory variable terms

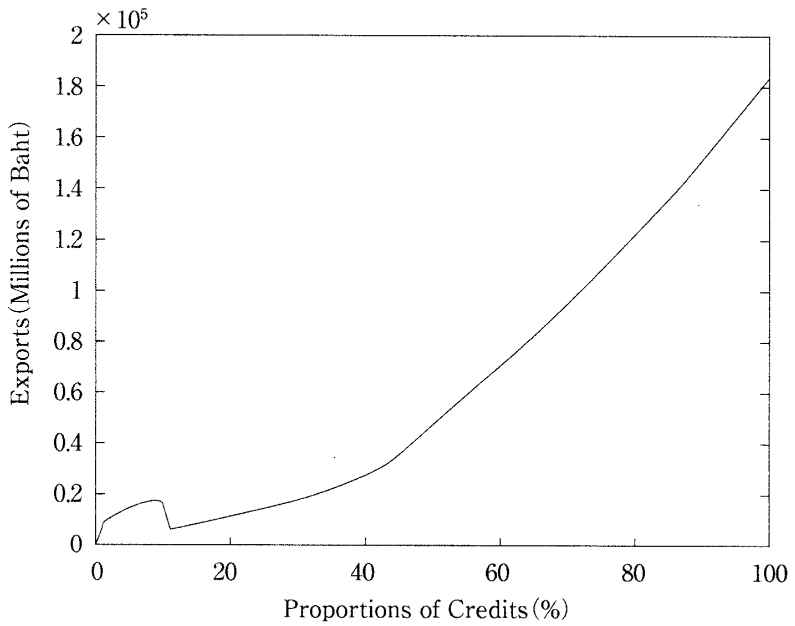


Figure 4.2(A) Maximum Value of Estimated Exports in Food Group

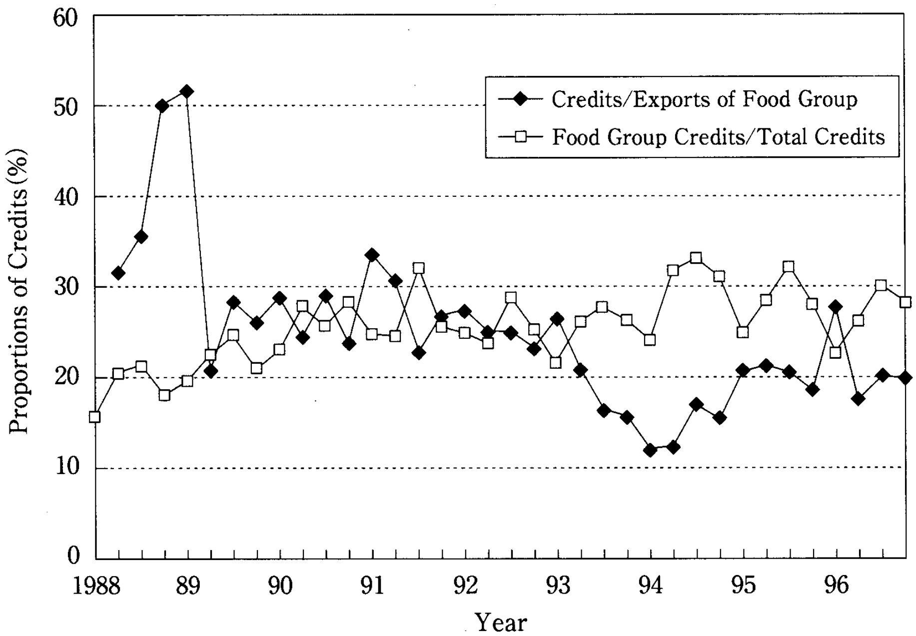


Figure 4.2(B) Proportional Changes in Credits of Food Industries

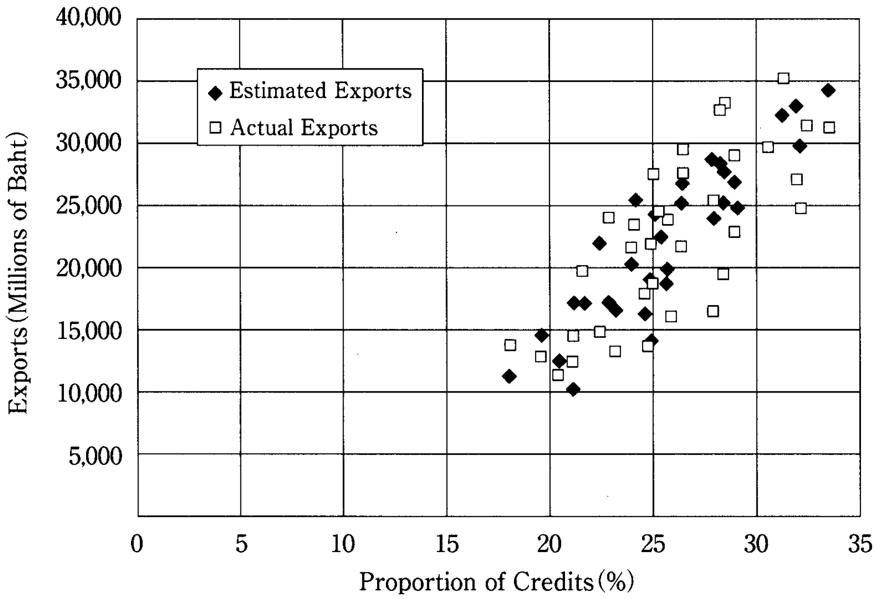


Figure 4.2(C) The Estimated and Actual Exports of Food Industries

Table 4.3 Regression Output of Agricultural and National Resources Industries

LS//Dependent Variable is Exports of Agricultural and National Resources Products
Sample: 1968: 2-1996: 4
Included observations: 35
Excluded observations: 0 after adjusting endpoints

Variable	Coefficient	Std. Error	T-Statistic	Prob.
(% x/y Agriculture) 2	−114.0601	14.65934	−7.780711	0.0000
(% x/y Agriculture) 3	2.479104	0.372239	6.659987	0.0000
(% x/X Agriculture)	3459.121	237.6302	14.55674	0.0000
(% x/X Agriculture) 2	−54.58004	12.42612	−4.392365	0.0001

R-squared	0.769155	Mean dependent var	26195.77
Adjusted R-squared	0.746815	S.D. dependent var	8556.687
S.E. of regression	4305.508	Akaike info criterion	16.84251
Sum squared resid	5.75E+08	Schwartz criterion	17.02027
Log likelihood	−340.4068	F-statistic	34.42977
Durbin-Watson stat	1.252031	Prob (F-statistic)	0.000000

Remarks: number after the apprentice shows an exponential power of explanatory variable terms

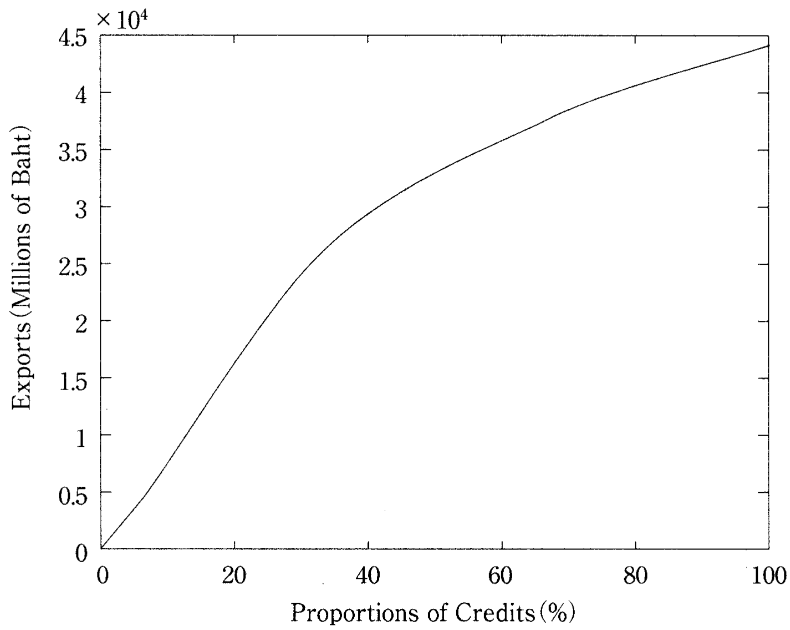


Figure 4.3(A) Maximum Value of Estimated Exports in Agricultural and Natural Resources Group

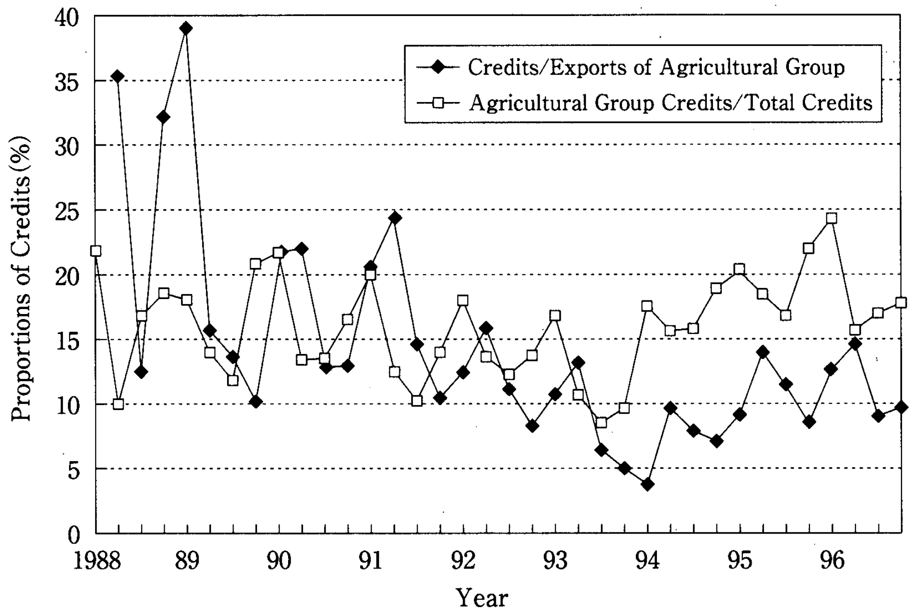


Figure 4.3(B) Proportional Changes in Credits of Agricultural and Natural Resources Industries

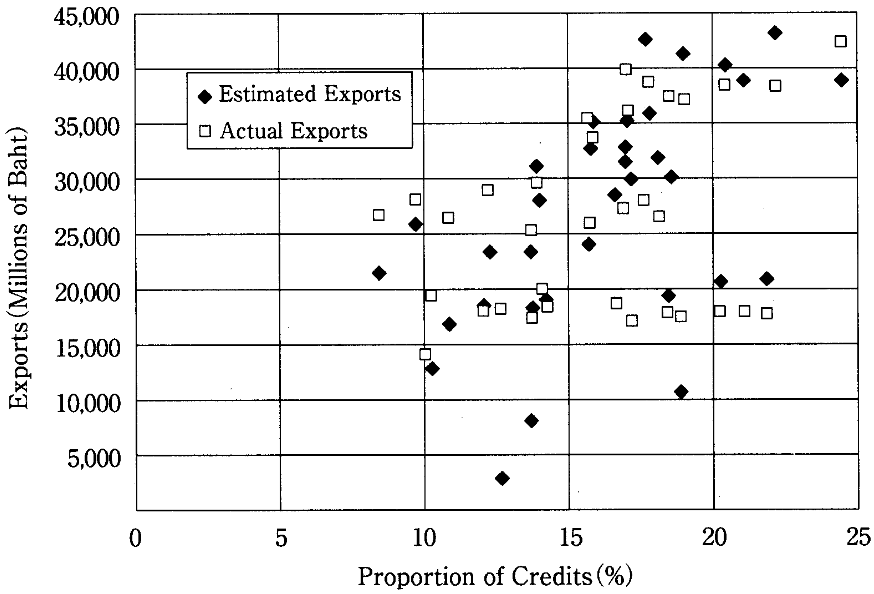


Figure 4.3(C) Estimated and Actual Exports of Agricultural and Natural Resources Industries

Table 4.4 Regression Output of Manufacturing Industries

LS//Dependent Variable is Exports of Manufacturing Products
Sample: 1968: 2 1996: 4
Included observations: 35
Excluded observations: 0 after adjusting endpoints

Variable	Coefficient	Std. Error	T-Statistic	Prob.
constant	42493.51	4390.399	9.678737	0.0000
(% x/y Manufacture) 3	−82.89455	20.53899	−4.035961	0.0003
(% x/y Manufacture) 4	5.546625	1.645531	3.370721	0.0020
(% x/X Manufacture) 2	71.30083	6.983036	10.21058	0.0000

R-squared	0.870075	Mean dependent var	48248.46
Adjusted R-squared	0.857502	S.D. dependent var	17933.05
S.E. of regression	6769.534	Akaike info criterion	17.74759
Sum squared resid	1.42E+09	Schwartz criterion	17.92564
Log likelihood	−356.2456	F-statistic	69.19990
Durbin-Watson stat	1.134465	Prob(F-statistic)	0.000000

Remarks: number after the apprentice shows an exponential power of explanatory variable terms

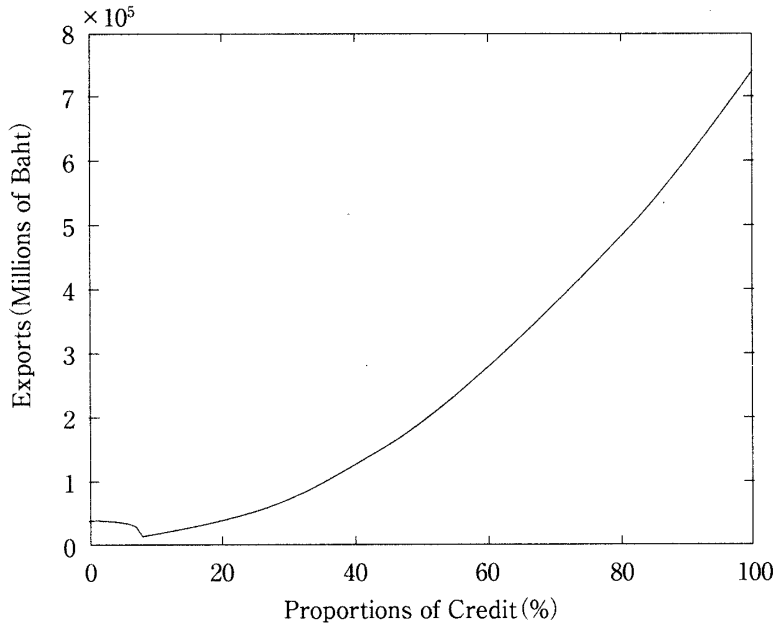


Figure 4.4(A) Maximum Value of Estimated Exports in Manufacturing Group

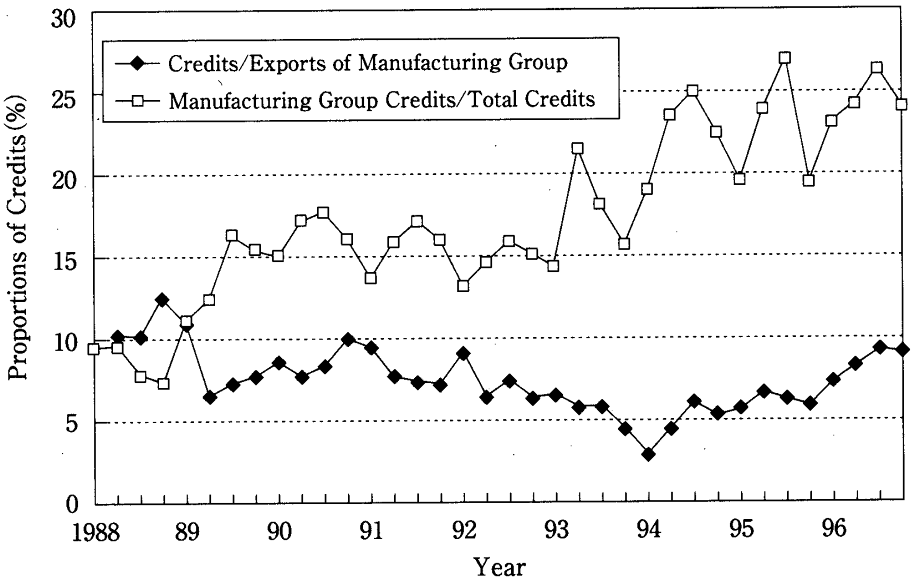


Figure 4.4(B) Proportional Changes in Credits of Manufacturing Industries

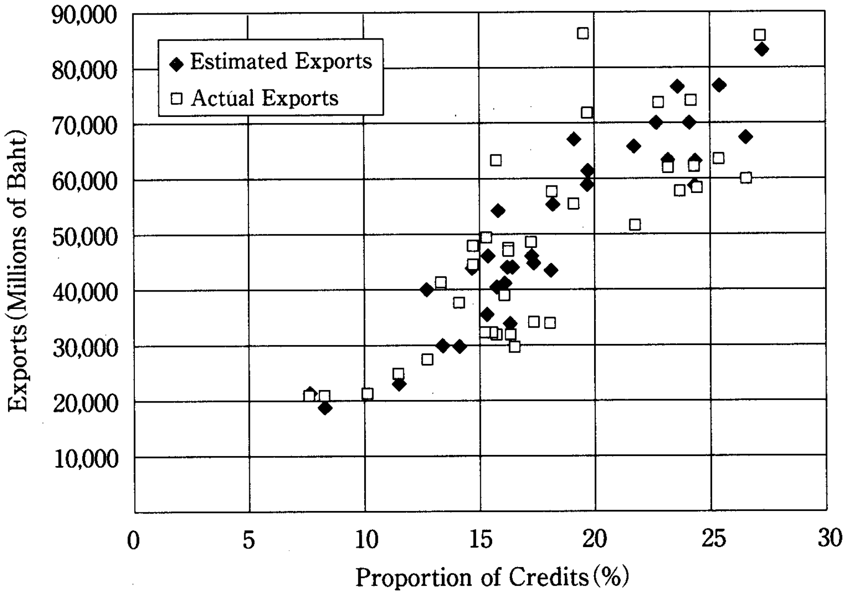


Figure 4.4(C) The Estimated and Actual Exports of Manufacturing Industries

Table 4.5 Regression Output of Other Industries

LS//Dependent Variable is Exports of Other Industries
Sample: 1968: 2-1996: 4
Included observations: 35
Excluded observations: 0 after adjusting endpoints

Variable	Coefficient	Std. Error	T-Statistic	Prob.
(% x/y Other)2	−2632.686	609.3067	−4.320790	0.0002
(% x/y Other)3	163.9891	45.65258	3.592110	0.0012
(% x/y Other)4	−2.79169	0.949831	−2.939145	0.0065
(% x/X Other)	54725.02	4709.297	11.62064	0.0000
(% x/X Other)2	−4708.038	619.0529	−7.605228	0.0000
(% x/X Other)3	148.4376	24.94585	5.950394	0.0000
(% x/X Other)4	−1.530952	0.305422	−5.012585	0.0000

R-squared	0.941611	Mean dependent var	118074.0
Adjusted R-squared	0.929099	S.D. dependent var	55984.31
S.E. of regression	14907.08	Akaike info criterion	19.39604
Sum squared resid	6.22E+09	Schwartz criterion	19.70711
Log likelihood	−382.0935	F-statistic	75.25693
Durbin-Watson stat	0.690971	Prob(F-statistic)	0.000000

Remarks: number after the apprentice shows an exponential power of explanatory variable terms

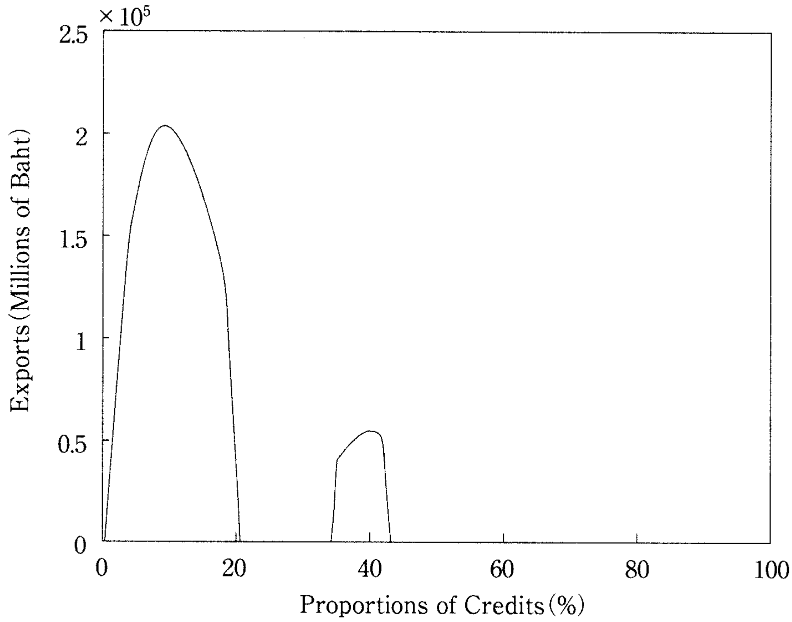


Figure 4.5(A) Maximum Value of Estimated Exports in Other Industries

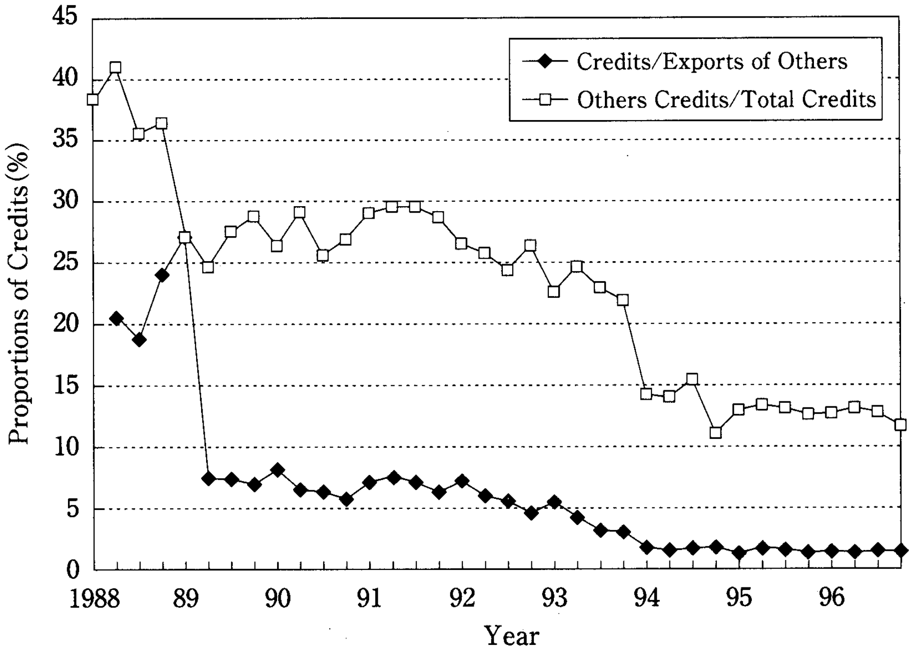


Figure 4.5(B) Proportional Changes in Credits of Other Industries

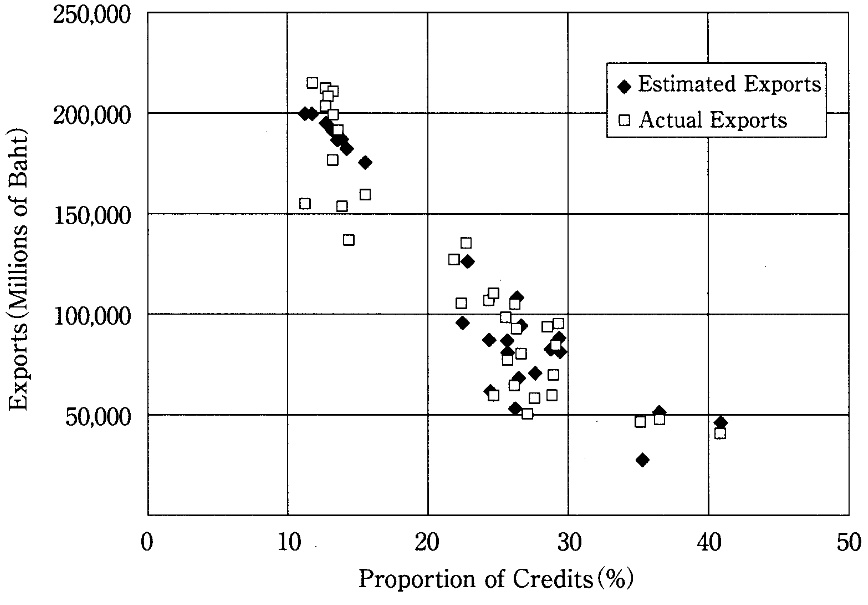


Figure 4.5(C) Estimated and Actual Exports of Other Industries

Table 4.6 Final Results from the Calculation of Absolute Advantages

Group of Industries	Proportion of Credits(%)	Estimated Group Exports (Millions of Baht)
Rice Industry	*2*	*5,992.34*
Food Industries	*7*	*16,612.63*
•Shrimp, fresh and frozen	2	
•Sea food, fresh and frozen	1	
•Frozen fowl	1	
•Canned food	3	
Agricultural & Resources Industries	*32*	*25,479.98*
•Tapioca products	1	
•Rubber	1	
•Furniture and parts	1	
•Precious stones, jewelry	29	
Manufacturing Industries	*50*	*204,006.00*
•Integrated circuits (IC)	1	
•Textile products	1	
•Footwear	1	
•Plastic products	47	
Total Above	91	252,090.95
Others	*9*	*205,146.00*
Total	100	457,236.95

Table 4.7 Final Results from the Calculation of Comparative Advantages

Group of Industries	Proportion of Credits(%)	Estimated Group Exports (Millions of Baht)
Rice Industry	*18*	*8,900.75*
Food Industries	*9*	*17,137.00*
•Shrimp, fresh and frozen	4	
•Sea food, fresh and frozen	1	
•Frozen fowl	1	
•Canned food	3	
Agricultural & Resources Industries	*50*	*33,085.19*
•Tapioca products	20	
•Rubber	1	
•Furniture and parts	5	
•Precious stones, jewelry	24	
Manufacturing Industries	*5*	*41,262.37*
•Integrated circuits (IC)	1	
•Textile products	1	
•Footwear	2	
•Plastic products	1	
Total Above	82	100,385.31
Others	*9*	*205,145.64*
Total	91	305,530.95

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Appendix Derivation of Equation in Reduced Form

From those symbols used in the third section, we have y_i as export revenues of industry i, while x_i is export credits distributed to this industry. X here represent total credit available which equal 30 billions Baht. And c represent coefficients in each terms. We can derive the general equation as equation (7) in the third section:

$$y_i=c_o+c_{11}\left(\frac{x_i}{X}\right)+c_{12}\left(\frac{x_i}{X}\right)^2+\ldots\ldots c_{1m}\left(\frac{x_i}{X}\right)^m+c_{21}\left(\frac{x_i}{y_i}\right)+c_{22}\left(\frac{x_i}{y_i}\right)^2+\ldots\ldots+c_{2n}\left(\frac{x_i}{y_i}\right)^n \quad (A_1)$$

$$\text{let } \frac{x_i}{X}=\hat{X}_i; \quad \therefore x_i=X\hat{X}_i \quad (A_2)$$

substitute (A_2) in (A_1) ; the following equation can be derived:

$$y_i=c_o+c_{11}\hat{X}_i+c_{12}\hat{X}_i^2+\ldots..c_{1m}\hat{X}_i^m+c_{21}\left(\frac{\hat{X}_i\hat{X}}{y_i}\right)+c_{22}\left(\frac{\hat{X}_i\hat{X}}{y_i}\right)^2+\ldots..+c_{2n}\left(\frac{\hat{X}_i\hat{X}}{y_i}\right)^n \quad (A_3)$$

time (A_3) by y_i^n;

$$y_i^{n+1}=[c_o+c_{11}\hat{X}_i+c_{12}\hat{X}_i^2+\ldots..+c_{1m}\hat{X}_i^m]y_i^n+c_{21}(\hat{X}_i\hat{X})y_i^{n-1}+c_{22}(\hat{X}_i\hat{X})^2y_i^{n-1}+\ldots..+c_{2n}(\hat{X}_i\hat{X})^n$$

which can be rewritten as follows:

$$y_i^{n+1}-[c_o+c_{11}\hat{X}_i+c_{12}\hat{X}_i^2+\ldots..+c_{1m}\hat{X}_i^m]y_i^n-c_{21}(\hat{X}_i\hat{X})y_i^{n-1}-c_{22}(\hat{X}_i\hat{X})^2y_i^{n-1}-\ldots..-c_{2n}(\hat{X}_i\hat{X})^n=0$$

Given that X is 30,000 (million), and substitute into the above equation to find the value of y_i which is correspondent to each $\hat{X}_i$ which is integer number from 1 to 100. By using this method, we can derive the maximum value of potential export of industry i for each proportion of credit to total credits. Optimal allocation of credits can be done by using "Mathlab" program substitute these value and find the combination of 5 group that will lead to the maximum total exports. It is also noteworthy that the econometric part is done by the package program, "Econometric Views."