THE IMPACT OF THE FOREIGN SECTOR ON THE STRUCTURE-CONDUCT-PERFORMANCE MODEL OF CANADIAN MANUFACTURING INDUSTRY: A SIMULTANEOUS APPROACH

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ABSTRACT

In this study six equations are specified which explain the determinants of profitability, advertising intensity, concentration, exports, imports, and foreign ownership. These equations are incorporated into a simultaneous system and estimated using a sample of fifty-four Canadian industries. The system is then used to examine the effect of the foreign sector upon the structure, conduct and performance of Canadian manufacting industry.

Particular attention is given to the econometric problems of simultaneity and multicollinearity and two stage ridge estimation is used to deal with them. The study emphasises the consequences of inappropriate estimation techniques by comparing these results with the ordinary least squares and two stage least squares estimates obtained from the same sample.

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CHAPTER 1

INTRODUCTION

A. Rationale and Methodology

This study presents an analysis of the impact of the foreign sector on the performance of Canadian manufacturing industries. More particularly, the study seeks to specify equations explaining the determinants of foreign trade and foreign ownership, and to incorporate these equations into a simultaneous system which explains the structure, conduct and performance of domestic industry.

The rationale for this study is threefold. First, any study of Canadian industry would simply be remiss if it did not take into account the influence of foreign factors. In spite of this relatively few studies have done so.[1]

Second, most multivariate models in industrial organisation have been of the single equation ordinary least square (OLS) type. However, if the equation is only one of a number belonging to a system, as is the case in a properly specified model, then the use of OLS will lead to simultaneous equation bias.[2] If this problem is to be avoided, then an alternative technique such as two stage least squares (2SLS) must be used.

Third, the complexity of interaction between variables in the system, and the large number of factors deemed

theoretically relevant in the profitability and foreign sector equations, result in an over-identified system. This, and the limitations imposed by a relatively small sample of fifty-four Canadian industries, suggest that multicollinearity may pose a problem.[3] Many studies which have encountered this problem have attempted to rectify it by removing the suspected 'problem' variables,[4] however the decision over which variable to remove can be distinctly arbitrary and may result in the exclusion of a theoretically important factor. Other studies have chosen to ignore the problem altogether. Neither method is satisfactory, and here ridge estimation techniques are suggested as an alternative method of dealing with the consequences of multicollinearity.

B. The Model

The model to be estimated in this study is the following:

(1) PROF = f[CON4, ES, AKR, D, RD, A/Q, M/Q, X/Q, RISK]

(2) A/Q = f[PROF, CON4, CD/S, D, FS]

(3) CON4 = f[RD, A/Q, ES, AKR, PROF, FS]

(4) X/Q = f[K/L, (RPR-RLC), CRU, NTBUS, DS, AWPH, CON4, FS]

(5) M/Q = f[K/L, (RPR-RLC), CRU, NTBCAN, DS, AWPH, CON4, FS]

(6) FS = f[(RPR-RLC), CRU, CRUSQD, A/Q, NTBCAN, CON4, DS]

where:[5]

PROF	= rate of profitability
CON4	= four firm concentration ratio
ES	= absolute economies of scale
AKR	= absolute capital requirement
D	= growth of demand
RD	= regional concentration dummy
A/Q	= a ratio of advertising to output
M/Q	= a ratio of imports to output
X/Q	= a ratio of exports to output
FS	= a ratio of shipments by foreign controlled firms to total shipments, a proxy for foreign ownership
RISK	= profit variability over time, a proxy for risk
CD/S	= the share of total sales going to consumers, a proxy for advertising effectiveness
K/L	= capital-labour ratio
(RPR-RLC)	= labour productivity in Canada relative to labour productivity in the United States, minus labour costs in Canada relative to the United States
CRU	= crude resource intensity
CRUSQD	= a squared term of CRU
NTBUS	= the level of nominal tariff barriers in the United States

NTBCAN = the level of nominal tarrif barriers in Canada

DS = a measure of economies of scale in Canada related to economies of scale in the United States

AWPH = average wage per hour, a proxy for skill intensity.

In each instance, it is the linear form of (1)-(6) which will be estimated.

Although the model is large, containing six endogenous variables and fourteen exogenous variables, it is not definitive. Arguments may be put forward in favour of 'endogenizing' a number of other variables included in the system, however, given the aims of this study, the variables and equations examined here are the most relevant ones.

C. The Data

The model will be tested using a cross-section sample of fifty-four Canadian three digit SIC manufacturing industries. As can be seen from Appendix C, not all of the data come from the same time period. Some variables are averaged for the years 1965-1967 and some are for individual years between 1961 and 1972. This is not a matter of choice, but is due to the lack of available Canadian data. The size of the data sample was determined by how well the variables could be matched across industries.

D. The Study Outline

In chapter two, the specifications of the six structural equations will be discussed with reference to previous studies in the industrial organization and international trade literature. Chapter three explores the application of two estimation techniques (two stage least squares [2SLS], and two stage ridge regression [2SLSR]) which deal with the econometric problems of simultaneity and multicollinearity. The results obtained from estimating the above system under OLS, 2SLS, and 2SLSR are then discussed.

Footnotes

[1]Studies that do consider the influence of foreign factors are Khalilzadeh-Shirazi (1974), Jones et al. (1977), Esposito and Esposito (1971), Pagoulatos and Sorenson (1976a), Marvel (1980), McFetridge (1973), and Round (1978).

[2]For a discussion of this point and its empirical consequences for industrial organization models, see Phillips (1976), Strickland and Weiss (1976), and Intriligator (1978).

[3]For a discussion of multicollinearity and its consequences, see Farrar and Glauber (1967).

[4]Usually variables which are highly correlated with other variables.

[5]For a more detailed list of variable definitions, sources, and data, see Appendices B and C.

CHAPTER 2

THE MODEL SPECIFIED

The object of this chapter is to discuss the specification of the model outlined in chapter one.

A. Profitability

(1) PROF = f[CON4, D, ES, AKR, RD, A/Q, M/Q, X/Q, RISK]

The structure-profitability relationship has been extensively analyzed in the literature.[1] It is generally assumed that the ability to collude (implicitly or explicitly) increases with concentration (CON4), and that more successful collusion will result in a tendency towards joint maximization of profits. With the exception of Stigler (1963), most studies have provided empirical support for this concentration-profits hypothesis; that is, given demand, cost, and entry conditions, the average rate of domestic profit will be higher in more concentrated industries. Hence one would expect a positive sign for CON4.

In a fully specified model however, these 'given conditions' must be included. A number of other variables have therefore been added to single equation studies of this relationship, namely demand growth (D) and various proxies for barriers to entry. As far as barriers to entry are

concerned, consider product differentiation (A/Q). In order to establish brand loyalty, new firms entering an industry conducive to heavy advertising will incur large advertising costs.[2] In addition, absolute capital requirements (AKR) are included in the profitability equation to account for the fact that the high initial working capital required by new firms constitutes a significant barrier to entry. Industries in which productivity rises (or average production costs fall) as plant size increases are said to possess scale economies (ES). Such a cost advantage of large size, having been acquired by existing firms in the industry over time, also represents a barrier to new entrants. The final entry barrier variable is a dummy variable (RD) set equal to one where it is evident that the relevant market is regional, and zero otherwise. The theory of oligopolistic markets suggests that the higher the barriers to entry in an industry, the higher is the price the producers are able to charge without inducing entry. We anticipate then that AKR, RD, A/Q, and ES[3] will exert a positive influence upon profitability. With regard to demand conditions, economic theory suggests that growth in industry demand (D) should be positively related to industry profitability through increased prices or reductions in unit costs due to improved capacity utilization.

In addition to these traditional variables, we have also added a proxy for risk and two variables covering the

foreign sector. The theory regarding the relationship between risk and profit[4] customarily assumes that firms are risk averters and require a premium for taking on more risk. Above average profit then may be justified in part on the grounds of 'high risk' as well as market structure. Profit variability (RISK) is therefore included in the profitability equation as a proxy for risk and we expect a positive coefficient.[5]

The two foreign sector variables included in equation (1) are exports (X/Q) and imports (M/Q) as ratios of output. The competition of foreign firms, by increasing the number of sellers in the domestic market, reduces seller concentration and should result in greater competition and lower profits. However, the relationship may not be so straightforward. Pagoulatos and Sorenson (1976a, 1976b) stress the effect of 'potential' competition, since the mere threat of foreign imports may be all that is necessary to restrict domestic firms to near-competitive prices. Consequently, the coefficient of M/Q need not be negative. The empirical evidence is mixed: Pagoulatos and Sorenson (1976a, 1976b), Marvel (1980), and Khalilzadeh-Shirazi (1974) obtained significant negative signs but Round (1978) and Jones et al. (1977) found the sign to be positive. The latter study suggests two reasons for the atypical result; that increases in demand may result in simultaneous increases in both imports and profitability; and that foreign competition may

induce more efficient methods of production. Later in chapter three, we will examine whether this result is a possible consequence of multicollinearity or of simultaneous equation bias as has also been suggested.[6]

With regard to X/Q, Caves and Jones (1973) argue that export opportunities expose the domestic monopolist to world prices, inducing him to expand output. If we assume that price discrimination is impossible, he can then no longer exploit the downward sloping domestic demand curve by charging a different price in domestic markets than the world price. Caves (1974b) has also argued that under ologopoly, export opportunities may lessen the importance of mutual interdependence between domestic firms and consequently leads to profits closer to competitive levels. However, the high level of Canadian tariffs, particularly in concentrated industries, may allow firms to price discriminate and if so, then export opportunities may be merely another outlet for increased profitability. Little can therefore be said *a priori* about the sign of the export variable. Empirically, there is support for both lines of argument. Khalilzadeh-Shirazi (1974) reported a significant positive coefficient on the export variable for the United Kingdom, and Pagoulatos and Sorenson (1976b) found a negative relationship in a number of Common Market countries.

At this juncture, it should be mentioned that two other foreign sector variables could have been included in this

equation but were not. Tariff barriers and foreign direct investment have been unsuccessful when included in single equation studies in Canada. However their influence on other aspects of the structure-conduct-performance model is considered. Here tariffs are included in the foreign sector equations (4), (5), and (6), while foreign ownership is added to the advertising intensity and concentration equations (2) and (3).

The relationship between foreign factors and domestic industrial performance is complex, and though Pagoulatos and Sorenson conclude that these factors represent a significant extension of industrial organization models, their single equation studies may not provide a sufficient explanation of the interaction of all relevant variables.

B. Advertising Intensities

(2) $A/Q = [f\ PROF, CON4, CD/S, D, FS]$

The starting point for this specification is the work of Comanor and Wilson (1974). In their examination of the impact of advertising on profit rates they emphasize the possible problem of a two-way relationship between the two variables. To allow for this they proposed a simultaneous equation model which includes not only a profitability equation, but also equations explaining concentration and advertising intensities. A profit variable entered the

advertising equation for two reasons; first, it was argued that advertising is often viewed by firms as a deduction from profit and hence is dependent on it; and second, it was suggested that profitability acts as a proxy for factors determining product differentiability which are otherwise unquantifiable.[7] For either reason, PROF is therefore expected to be positively related to advertising-output ratios in an industry.

Comanor and Wilson also argue that since consumer experience is inversely related to advertising effectiveness, a high level of advertising will be associated with newer products which are characterized by high rates of demand growth. Strickland and Weiss (1976) argue for the inclusion of CD/S (the share of total sales going to consumers) as a proxy for advertising effectiveness, on the grounds that product differentiation is especially prevalent among consumer goods and that advertising is considered to be an effective method of selling differentiated products where the number of consumers is large. Both D and CD/S are therefore expected to have positive coefficients in equation (2).

The advantages accruing to the firm from advertising however, depend not only on its effectiveness, but also on how the firm will benefit *vis-à-vis* its competitors. The more heterogeneous the product, the greater advertising will benefit a firm at the expense of its competitors. In this

way advertising provides a form of non-price competition considered preferable by firms in oligopolistic markets characterized by a high degree of mutual interdependence. However, at higher levels of concentration, advertising intensities may decline as the recognition of mutual interdependence gives way to tacit or overt collusion in advertising. The total effect of concentration in the advertising equation is therefore not only ambiguous, but also possibly non-linear.[8]

Finally, a foreign ownership variable (FS) is added to the specification of the equation. Caves (1974a) argues that foreign direct investment often occurs when a firm possesses a unique advantage through "product differentiation."[9] To fully exploit this advantage, the subsidiaries will engage in extensive advertising and hence it might be expected that the coefficient of FS will be positive. However, American firms indirectly expose many Canadians to advertisements directed at their market in the United States. These 'spill-over' effects are a result of an overlap of the North American media network, particularly television and radio, into Canada. This suggests that the greater the degree of foreign ownership, the smaller will be the amount of advertising actually undertaken in Canada. Consequently the sign of FS in equation (2) may be either positive or negative.

C. Concentration

(3) CON4 = f[RD, A/Q, ES, AKR, PROF, FS]

The specification of this equation owes a considerable amount to Strickland and Weiss (1976). The variables ES[10] and A/Q are included since economic theory suggests that economies of scale in production and advertising will lead to increased concentration. In addition, the advertising variable can be viewed as a proxy for product differentiation and is therefore included with RD and AKR as a barrier to entry. All four variables are expected to have positive coefficients.

The profit variable is added because of the argument advanced by Comanor (1971) that high profits may attract new firms into an industry, thereby reducing concentration. However, high profits may also help expansion and acquisition policies and lead to an increase in concentration. Indeed, Intriligator (1978) obtained a positive coefficient on profits in his concentration equation.

The most significant difference between the equation specified here and those in other studies, is the addition of a foreign ownership variable. In the previous section it was argued that foreign direct investment largely occurs in industries characterized by product differentiation. Further, the total costs involved in setting up or acquiring a foreign subsidiary requires the potential investing firm

to be of large absolute size. Their large size means that foreign producers can overcome entry barriers more easily than potential domestic entrants. As a result one would suspect that their very entry will increase the number of sellers and reduce concentration.

However the Gray Report (1972) interpretation of the mini-replica hypothesis argues the opposite. They assert that "foreign investment generally constitutes an extension of market dominance by foreign firms into the Canadian marketplace. . . ."[11] Reinforcing this, the Gray Report further adds that "foreign takeovers have constituted a larger part of total merger activity than have domestic mergers."[12] This suggests that foreign subsidiaries are active in acquiring their competitors, resulting in higher levels of concentration. Though Rosenbluth (1970) has questioned the 'mini-replica' hypothesis with reference to the correlation between the percentage of output of any given industry by foreign owned firms and the extent to which industry is concentrated, Jones et al. (1978) using multivariate analysis provide empirical support for the hypothesis in Canada. They obtain a significant and positive coefficient for FS in their concentration equation.

D. Exports and Imports

Here, we deal with the specifications of the import and export equations together, since similar arguments apply to both equations.

(4) X/Q = f[K/L, (RPR-RLC), CRU, NTBUS, DS, AWPH, CON4, FS]

(5) M/Q = f[K/L, (RPR-RLC), CRU, NTBCAN, DS, AWPH, CON4, FS]

The traditional explanations of patterns of trade by international trade theorists fall into two main categories: the factor proportions arguments [13] and the technological difference arguments.[14] The former leads to the conclusion that a country will export goods which employ its relatively abundant factors relatively intensively, while simultaneously importing goods which employ intensively, factors which are relatively scarce. The volume of exports and imports can then be explained by the relative intensity with which factors are used. The factor proportions arguments will be represented by the inclusion of the capital-labour ratio (K/L), skilled labour intensity (as proxied by average wage per hour, AWPH), and crude resource intensity (CRU). Postner (1975) found Canada to be a net exporter of natural resources, physical capital, and unskilled labour, hence one would expect K/L and CRU to have positive (negative) coefficients and AWPH to have a negative (positive) coefficient in the export (import) equation.

The technological difference argument is based upon the relationship between relative factor productivity and relative factor cost, with particular attention given to the

productivity and cost of labour. The larger (smaller) is the productivity (cost) of labour in an industry relative to that in other countries, the greater the cost advantage (the less the cost disadvantage) a country will have over producers in the same industry in other countries. To represent these effects, the difference between relative labour productivity and relative labour cost (RPR-RLC) is included as a variable in both of the trade equations, and it is expected that its coefficient will be positive in the export equation and negative in the import equation.

In addition to these general explanations, it is apparent that tariff barriers, economies of scale, and foreign ownership can also affect the volume of exports and imports. According to trade theory, tariffs raise the domestic price of commodities, reducing imports and stimulating domestic production in import competing industries. This is particularly relevant since tariff levels in Canada are high in comparison with its major trading partners. As one might expect, Baumann (1976) found that tariffs in Canada were inversely related to the import-output ratio and that U.S. tariffs reduced Canadian exports. We therefore expect to obtain negative coefficients for the Canadian nominal tariff variable (NTBCAN) in the import equation and the U.S. nominal tariff variable (NTBUS) in the export equation.

Plant economies of scale may also have an important influence upon comparative advantage. Indeed, it is often

argued that the small size of the Canadian market leads to relatively high production costs. Here, the average size plant in Canada as a ratio of the average size plant in the United States (DS)[15] is employed as a proxy for realized economies of scale in Canada relative to its major trading partner. The expectation is that the sign of the DS coefficient will be positive in the export equation and negative in the import equation.

Two other variables, concentration (CON4) and foreign ownership (FS) are also included. White (1974) compared the incentives and behaviour of monopolies and perfectly competitive industries with respect to exports and imports, and provided theoretical reasons to expect a connection between market structure and trade flows. The smaller output and higher price charged by the monopolist provides greater opportunity for import competition, hence one would expect concentration to be positively related to the import-output ratio. On the other hand, the size and abilities of firms in concentrated industries may make them better able to withstand foreign competition, thus also raising the possibility of a negative sign for CON4 in equation (5).

Similarly, to the extent that domestic firms are able to charge a higher price and restrict output, they will export less and a negative sign for CON4 in equation (4) would be expected. However, the size and abilities of firms

in more concentrated industries may give them an advantage in penetrating foreign markets. This suggests a positive sign. Consequently, there is little that one can say *a priori* about the sign of the concentration coefficient in the export equation. Empirically Marvel (1980) in generating import and export instruments for use in the profitability equation, found CON4 to be significantly positive in the import equation and insignificantly positive in the export equation. Similarly Baumann (1976) obtained significantly positive coefficients in specifications of both equations.[16]

Although much of the literature concerning foreign ownership discusses its effects upon export and import volumes, little attention has been paid to empirical analysis. With regard to exports, Safarian (1973) concluded that in aggregate, the foreign-owned sector in Canada is more oriented to export than other sectors. In contrast, Britton and Gilmour (1978) argue that American firms in Canada are not more active in exports and that they merely "tend to be more heavily represented in export-oriented industries."[17] Furthermore, they point out Safarian's failure to realize that foreign firms in certain industries do not take advantage of the export potential available to them because of their size. Their access to the technological and promotional resources of large corporations should enable foreign subsidiaries to out-perform domestic firms. However, as

the Gray Report (1972) asserts, export restrictions exist in many cases as part of the parent company's marketing strategy. The issue is therefore complex and we must conclude *a priori* that the relationship between foreign ownership and exports is ambiguous.

With regard to imports, the Gray Report found that foreign controlled companies import their inputs primarily from the home country of the parent company (mostly from the parent company itself). To the extent that these imports are classified to the same industry as the firm itself, it is to be expected that the coefficient of FS will be positive in the import equation.

Finally, there are two further issues which deserve comment. First, separate equations are used for exports and imports rather than combining them to form a single net export equation. This formulation recognizes that product differentiation implies that exports and imports, although classified to the same industry, are different commodities and that they have distinct determinants.

Second, exports and imports have been expressed as ratios of total shipments rather than as absolute amounts, or as ratios of something else, such as total trade in the industry. The justification for this is in part theoretical[18] and in part simply a matter of adopting the same form as that used elsewhere in the literature.

E. Foreign Ownership

(6) FS = f[K/L, CRU, CRUSQD, A/Q, (RPR-RLC), CON4, NTBCAN, DS]

Two complementary approaches[19] have been offered by economic theory to explain which industries are likely to be characterized by foreign direct investment. One is microeconomic and originates in the industrial organization literature, while the other is macroeconomic and based on traditional trade theory. The former has been developed by Caves (1974a, 1974b) and examines foreign investment in terms of horizontal and vertical integration. He argues that in order to successfully invest horizontally in production abroad, a firm must possess some asset whose productivity and cost is largely unaffected when moved across national boundaries. This asset may be a technological superiority from which a firm wishes to extract a return before its distinctiveness is lost to imitation and technical progress by other firms; monopoly control of inputs or the product market; or possession of a resource or skill limited in supply. Each of these assets is usually associated with product differentiated oligopoly. The advertising to output ratio (A/Q) is therefore included as a measure of product differentiation and is expected to have a positive coefficient.

Direct investment of a 'vertical type' has taken place in raw material extraction and we therefore include a crude resource intensity variable (CRU). It is entered in polynomial form in recognition of the fact that foreign ownership has taken place on two levels; at a high level of CRU where foreign firms desire secure access to raw materials (vertical integration), and at a low level of crude resource intensity where technological, managerial, and marketing factors dominate (horizontal integration). We can therefore hypothesize that CRU will have a negative coefficient and that the squared term (CRUSQD) will have a positive coefficient.

As an alternative to large scale vertical integration, firms can negotiate long term marketing contracts at pre-established prices, however the costs of negotiation and monitoring the terms of such a contract are significant, particularly where one party holds a degree of market power. As with horizontal foreign direct investment, the incentive to set up production in a foreign country is greatest in oligopolistic markets where firms entering the market face barriers to entry. Concentration (CON4) and relative economies of scale (DS) are therefore expected to enter the equation with positive coefficients.

Trade theory contributes to the overall view of the situation by examining the implications of comparative advantage particularly in new and differentiated products.

The product cycle theory developed by Vernon (1966) stresses the innovation and development of new products and their contribution to comparative advantage. Here, the argument is considered in the context of differences between relative labour productivity and relative labour costs.[20] Rapid development of an innovation in the country of origin suggests that initially the labour employed there is more efficient than labour in alternative production locations. Vernon argues that this is because location in the innovating country facilitates communication between consumers, suppliers of potential inputs, and those concerned with the marketing and production of the new product. This is particularly important in order to solve the many adjustment problems associated with the early stages of innovation and development. However, as the product becomes standardized there is less need for flexibility in operation. Production will therefore tend to be located in countries with an inherent advantage in the production of the good; where the productivity (cost) of labour is high (low) relative to other locations.[21] We therefore expect (RPR-RLC), the difference between relative labour productivity and relative labour cost, to have a positive coefficient in the foreign ownership equation.

Finally the decision whether to service the Canadian market through exports or through a branch plant depends upon the relative costs of production in Canada, compared

with the costs of producing in the home country and transporting to Canada. Hence, tariff barriers and transportation costs,[22] by raising the cost of servicing Canadian markets by exports, provide incentives for direct investment as an alternative.

F. Summary

In summary, the six equations of the model and the expected signs of the coefficients of all variables in the model are specified below. A +- indicates that the expected sign was found to be ambiguous.

(1) PROF = f[CON4, D, ES, AKR, RD, A/Q, M/Q, X/Q, RISK]
(+) (+) (+) (+) (+) (+) (+-) (+-) (+)

(2) A/Q = f[PROF, CON4, CD/S, D, FS]
(+) (+-) (+) (+) (+-)

(3) CON4 = f[RD, A/Q, ES, AKR, PROF, FS]
(+) (+) (+) (+) (+-) (+)

(4) X/Q = f[K/L, (RPR-RLC), CRU, NTBUS, DS, AWPH, CON4, FS]
(+) (+) (+) (-) (+) (-) (+-) (+-)

(5) M/Q = f[K/L, (RPR-RLC), CRU, NTBCAN, DS, AWPH, CON4, FS]
(+) (+) (+) (-) (-) (-) (+-) (+-)

(6) FS = f[(RPR-RLC), CRU, CRUSQD, A/Q, NTBCAN, CON4, DS]
(+) (-) (+) (+) (+) (+) (+)

Footnotes

[1]A survey of these studies can be found in Weiss (1971).

[2]The advertising to output ratio can also be seen as a proxy for the product differentiation entry barrier.

[3]A common problem with these variables has been multicollinearity, particularly amongst AKR, ES, and CON4. A discussion of this problem will be met later in Chapter three.

[4]See Fisher and Hall (1969), Shepherd (1975), and Hurdle (1974), for example.

[5]Hurdle (1974) and others have argued that a firm's risk and profit rate are both likely to be influenced by market structure. A more thorough analysis of the relationship should also include profit variability as an endogenous variable, however this approach has not been adopted here.

[6]Weiss (1974, p. 220) suggests that the positive effect of imports in the profit equation may be due to simultaneity and proposes a simultaneous equation system where imports depend on profit rates.

[7]Both reasons for the inclusion of profits in the advertising equation are questionable. As a proxy for differentiation, PROF is extremely suspect because it is not clear exactly what effects it may be picking up. Furthermore, PROF's inclusion in equation (2) means that the usual assumption of profit maximization does not apply. Nevertheless, the variable has been included for direct comparison with results obtained elsewhere in the literature. See for example, Comanor and Wilson (1974), Intriligator (1978), and Strickland and Weiss (1976).

[8]For empirical support for a quadratic relationship between advertising intensities and concentration, see Greer (1971) and Cable (1972).

[9]For a more detailed discussion of this, see the section on foreign ownership.

[10]In most studies of the determinants of industrial concentration, the ES variable has dominated. It should be

noted that this could be due to the fact that it is picking up the effect of plant concentration (a consequence of the construction of the variable). For a discussion of this and general inadequacies of ES as a measure of economies of scale, see Davies (1980).

[11]The Gray Report (1972, p. 217).

[12]The Gray Report (1972, p. 216).

[13]See for example, Caves and Jones (1973), Baldwin (1971), Harkness (1978), and Leontief (1956).

[14]See for example, Caves and Jones (1973), Johnson (1975), and MacDougall (1951). For a discussion of how the neo-technology theories of Vernon (1966), Posner (1961), and Hufbauer (1970) can be incorporated into a framework paralleling the familiar Ricardian one, see Ferguson (1978, 1979).

[15]Used in Caves (1974a).

[16]Baumann, however, includes the concentration variable as a proxy for firm level economies.

[17]Britton and Gilmour (1978, p. 105).

[18]See Harkness (1978).

[19]See Johnson (1975).

[20]See Ferguson (1978, 1979) as an example of how Vernon's approach to direct investment can be incorporated into a Ricardian type framework.

[21]Vernon (1966) argues that the principal differences in cost between any two locations are likely to be labour costs.

[22]The reliability of transportation costs data available is questionable, since the distances between Canadian cities are often greater than between a Canadian city and an American city. In this way, Baumann (1976) points out that the influence of transportation costs is difficult to encompass. Not surprisingly, it was never significant in his analysis and is not included in the regressions presented here.

CHAPTER 3

THE EMPIRICAL ESTIMATES

In this chapter we estimate the parameters of the equations specified in Chapter two and focus on the problems of simultaneous equation bias and multicollinearity.

A. Simultaneous Equation Bis and the Application of 2SLS

Previous studies have generally been of the single equation, ordinary least squares type.[1] In Table I, OLS estimates for fifty-four Canadian industries are reported to allow comparison with these studies. However, an examination of the specifications reveals a number of statistically significant two way relationships.[2] This and the *a priori* arguments about the specification of the equations which were advanced in the previous chapter, mean that the equations should be treated as a simultaneous system. In this context OLS gives rise to simultaneous equation bias. To avoid this problem 2SLS[3] can be used and the results from doing so are reported in Table I with the OLS results. T-ratios are included in parentheses below the coefficient.

In previous multi-equation studies of this kind, the differences between OLS and 2SLS estimates have led to different conclusions. Intriligator (1978) reports that results obtained from 2SLS estimated simultaneous systems

Table I

Ordinary Least Squares (OLS), Two Stage Least Squares (2SLS), and Two Stage Ridge (2SLSR) Estimates

The Profit Equation

	CON4	ES	AKR	D	RD	A/Q	M/Q	X/Q	RISK	CONSTANT
OLS	0.02	-0.15	0.09	0.15	0.73	0.33	2.13	1.19	-0.16	4.56
(t-values)	(1.09)	(1.30)	(2.39)	(0.32)	(0.93)	(4.34)	(2.88)	(0.91)	(1.98)	(4.8)
$R^2 = 0.55$ $\bar{R}^2 = 0.46$ $F = 6.05$ Haitovsky Test Statistic = 3.1924 with 45 degrees of freedom										
2SLS	0.09	-0.51	0.09	-0.36	0.08	0.40	3.31	-1.50	-0.04	3.01
(t-values)	(1.43)	(1.49)	(1.84)	(0.46)	(0.07)	(2.46)	(1.87)	(0.48)	(0.25)	(1.75)
2SLSR	0.01	0.01	0.04	0.42	0.59	0.17	0.81	-0.19	-0.11	4.57
(pseudo t-values)	(2.08)	(0.38)	(2.09)	(1.31)	(1.05)	(2.47)	(1.31)	(0.17)	(2.13)	(6.40)
$K = 0.4$										

Table I continued

The Advertising Intensity Equation

	PROF	CON4	CD/S	D	FS	CONSTANT
OLS	0.54	-0.05	1.15	0.46	0.05	-3.22
(t-values)	(2.70)	(2.20)	(1.51)	(0.61)	(3.09)	(2.19)
$R^2 = 0.41$	$\bar{R}^2 = 0.35$	$F = 6.61$	Haitovsky Test Statistic = 27.1979 with 15 degrees of freedom			
2SLS	0.44	-0.05	1.12	0.56	0.07	-3.74
(t-values)	(0.98)	(1.48)	(1.33)	(0.63)	(1.79)	(2.17)
2SLSR	0.39	-0.01	1.10	0.35	0.03	-2.69
(pseudo t-values)	(2.20)	(0.93)	(2.12)	(0.67)	(2.51)	(1.92)
$K = 0.4$						

Table I continued

The Concentration Equation

	RD	A/Q	ES	AKR	PROF	FS	CONSTANT
OLS	11.79	-1.76	4.09	-0.08	1.17	0.24	10.42
(t-values)	(2.03)	(2.70)	(6.34)	(0.28)	(1.19)	(3.52)	(1.85)
$R^2 = 0.75$	$\bar{R}^2 = 0.72$	F = 23.40	Haitovsky Test Statistic = 10.3485 with 21 degrees of freedom				
2SLS	10.18	-1.25	4.03	-0.02	1.94	0.17	8.19
(t-values)	(1.65)	(1.26)	(5.37)	(0.05)	(0.99)	(0.99)	(0.87)
2SLSR	3.95	-0.33	2.13	0.38	1.60	0.20	12.51
(pseudo t-values)	(0.94)	(0.66)	(6.80)	(2.79)	(1.97)	(3.40)	(2.24)
K = 0.5							

Table I continued

The Exports Equation

	K/L	(RPR-RLC)	CRU	NTBUS	DS	AWPH	CON4	FS	CONSTANT
OLS	1.94	0.37	0.34	-0.48	0.001	-0.05	0.001	-0.001	0.10
(t-values)	(1.37)	(0.05)	(3.26)	(1.51)	(1.59)	(0.58)	(0.72)	(1.13)	(0.62)
$R^2 = 0.38$	$\bar{R}^2 = 0.27$	$F = 3.41$	Haitovsky Test Statistic = 6.1805 with 36 degrees of freedom						
2SLS	1.62	-0.11	0.34	-0.49	0.001	-0.06	0.001	-0.0007	0.09
(t-values)	(0.97)	(0.13)	(3.21)	(1.52)	(1.57)	(0.63)	(0.66)	(0.30)	(0.49)
2SLSR	0.91	-0.03	0.27	-0.34	0.0007	-0.001	0.0008	0.00001	0.003
(pseudo t-values)	(1.17)	(0.55)	(3.44)	(1.56)	(1.55)	(0.03)	(0.82)	(0.01)	(0.03)
$K = 0.3$									

Table I continued

The Imports Equation

	K/L	(RPR-RLC)	CRU	NTBCAN	DS	AWPH	CON4	FS	CONSTANT
OLS	-6.26	-0.31	-0.31	-0.002	0.0005	0.28	0.003	0.003	-0.26
(t-values)	(2.40)	(1.99)	(1.61)	(0.51)	(0.38)	(1.83)	(0.99)	(1.38)	(0.85)
$R^2 = 0.29$	$\bar{R}^2 = 0.16$	$F = 2.30$	Haitovsky Test Statistic = 5.5564 with 36 degrees of freedom						
2SLS	-8.65	-0.43	-0.29	-0.0005	-0.0003	0.34	0.0003	0.008	-0.53
(t-values)	(2.52)	(2.19)	(1.33)	(0.13)	(0.26)	(1.88)	(0.07)	(1.66)	(1.33)
2SLSR	-2.20	-0.14	-0.22	-0.002	0.0002	0.10	0.001	0.002	0.04
(pseudo t-values)	(1.91)	(1.65)	(1.70)	(1.32)	(0.32)	(1.62)	(1.00)	(1.24)	(0.24)
$K = 0.5$									

TABLE I continued

The Foreign Ownership Equation

	(RPR-RLC)	CRU	CRUSQD	A/Q	NTBCAN	CON4	DS	CONSTANT
OLS	-17.31	-57.11	97.35	4.79	-0.06	0.71	-0.02	15.4
(t-values)	(1.43)	(1.52)	(1.87)	(4.03)	(0.31)	(4.79)	(0.31)	(1.30)
R^2 = 0.54 $\bar{R}^2$ = 0.47 F = 7.7 Haitovsky Test Statistic = 2.5049 with 28 degrees of freedom								
2SLS	-13.5	-59.87	102.75	4.46	-0.10	0.6	-0.01	20.81
(t-values)	(0.87)	(1.58)	(1.95)	(2.06)	(0.52)	(3.33)	(0.16)	(1.61)
2SLSR	2.5	- 2.89	17.15	1.97	-0.12	0.4	-0.01	32.31
(pseudo t-values)	(0.45)	(0.41)	(1.75)	(2.53)	(1.00)	(3.74	(0.27)	(4.00)
K = 0.6								

conflict with results obtained from single equation studies using OLS techniques. However, in general the empirical results presented here are consistent with the conclusion of Strickland and Weiss (1976) in that there appears to be little difference between the size and sign of OLS coefficient estimates and 2SLS coefficient estimates. Nevertheless, differences do exist. The demand variable (D) and the export variable (X/Q) are both negative when 2SLS is applied, but both are positive with the OLS technique. In the trade equations, (RPR-RLC) in equation (4) and DS in equation (5) are both positive using OLS, but negative using 2SLS. The demand coefficient in the profit equation and the (RPR-RLC) coefficient in the export equation are particularly surprising since the signs obtained with 2SLS are opposite to the signs hypothesized in Chapter two. However, there are two problems with the OLS estimates; first, they are asymptotically biased; and second in every equation except equation (2), the Haitovsky test statistic[4] suggests that multicollinearity is a problem. Furthermore, there is no reason to suspect that the problem is any less serious when 2SLS is used to estimate the system. The 2SLS anomalies may therefore be a consequence of multicollinearity, and it is to this matter we now turn.

B. Multicollinearity and the Application of Ridge Techniques

Multicollinearity has been a common problem in cross-section empirical studies. The immediate consequence of multicollinearity is imprecise coefficient estimates which often result in peculiar point estimates and signs which are contrary to those hypothesized. Frequently the problem is dealt with by excluding variables, however the increase in the standard errors of the coefficients which is caused by multicollinearity often assures that variables are incorrectly excluded. Removing variables that are inconveniently signed or statistically insignificant can lead to an inappropriately small number of explanatory variables. Hence, though multicollinearity does not bias estimates (when the model is correctly specified), by generating imprecise estimates it does result in a tendency towards incorrect model specification. As Farrar and Glauber (1967) note, "data limitations rather than theoretical limitations are primarily responsible for a persistent tendency to underspecify (or oversimplify) econometric models."

In specifying the model in Chapter two, particular care was taken *not* to exclude variables on the basis of suspected collinearity with other variables, or simply to ensure that the Haitovsky test for multicollinearity is satisfied. As a result the Haitovsky test fails to reject the hypothesis of perfect multicollinearity in five of the six equations (see Table I). The question then is, how can this problem

be rectified?

The approach taken in this study is to use ridge regression[5] to correct for multicollinearity and its consequences. The ridge technique increases the precision of the regression coefficient estimates by introducing a degree of bias into the estimates.[6] Though the ridge technique therefore produces a biased estimator, the variance of the estimates is reduced and this raises the possibility that the mean squared error (MSE) of ridge estimates may be less than the mean squared error of the 2SLS estimates.

Recently a number of criticisms have been levelled at the mechanical use of ridge estimation, because of its implicit use of prior information and its invariance to linear transformations.[7] Nevertheless, as shown by Hoerle and Kennard (1970), it remains true that ridge estimates can lead to overall reductions in mean squared error [8] and on instrumental grounds, this alone provides a justification for its use. Moreover, in Monte-Carlo experiments[9] ridge regression has almost always been found superior to OLS in terms of the size of MSE.

This is not as comforting as it might seem, however, since the use of ridge entails the choice of a parameter K. and the value selected is critical in determining whether the MSE is in fact reduced. No simple rule has as yet been put forward which guarantees that the ridge estimates are always better than least squares (in terms of MSE). One

method suggested by Hoerle, Kennard and Baldwin (1975) uses the ridge trace. The ridge trace is a graphical analysis of the coefficient estimates as functions of K. Large movements in parameter estimates with small additions to K suggest that the 2SLS estimate is unstable and suffers from multicollinearity. Furthermore, a large correlation between the two regression coefficients can be seen as a trade-off on the ridge trace. Lines moving in the same direction as K increases illustrate a positive correlation, while lines moving in an opposite direction as K increases illustrate a negative correlation. Hoerle, Kennard and Baldwin (1975) propose a number of guides, based on their own experience, to enable one to choose an appropriate K. The value of K chosen should produce stable, correctly signed, and 'reasonable'[10] valued parameter estimates with a 'reasonable'[11] value for the residual sum of squares. The definition of stability, however, has always been somewhat imprecise. Though it is recognized that this rule is far from ideal, the more complex heuristic approaches[12] are either unavailable or beyond the scope of this study.

The value of K chosen after applying Hoerle, Kennard and Baldwin's criteria, and the regression estimates obtained for the fifty-four Canadian industry sample (2SLSR) are shown in Table I. The 'pseudo' t-ratios given in the output of the SHAZAM computer programme [13] are reported in parentheses below the corresponding coefficient. Comparing

the ridge stimates with the OLS and 2SLS estimates, it is clear that the size of the coefficients differs considerably. Most of the ridge estimates are smaller in magnitude than the 2SLS estimates. In most cases the sign obtained by 2SLSR is the same as that obtained by OLS and 2SLS; however there are a number of exceptions and it is to these that we now turn in order to indicate the consequences of applying the techniques used here.

OLS estimates of equations similar to (1) by Jones et al. (1977) have found an inexplicable negative coefficient for ES. Both the OLS and the 2SLS results obtained here are consistent with their finding, however, ES has a positive coefficient in the ridge regression results.[14] This, the high sample correlation coefficients between ES and AKR, and between ES and CON4,[15] and the low Haitovsky statistic for equation (1) suggest that the 2SLS estimate of the ES coefficient suffers from multicollinearity. Furthermore, on the ridge trace (see Fig. 1, Appendix A) the coefficients on both CON4 and AKR fall as K increases, while ES increases dramatically. This trade-off implies that the 2SLS estimated coefficient on ES is seriously underestimated as a result of negative correlations between ES and CON4, and between ES and AKR. The strong negative correlation between ES and AKR also shows up in equation (3). On the ridge trace, as K increases, the ES coefficient falls while AKR rises and becomes positive as hypothesized (see Fig. 3 in

Appendix A).

There is a similar appropriate sign reversal for the coefficient of (RPR-RLC) in equation (6) which is negative with 2SLS but positive with 2SLSR. Examination of the simple correlation matrix reveals a positive correlation coefficient of 0.54 between (RPR-RLC) and A/Q, and indeed the ridge trace (see Fig. 6 in Appendix A) suggests a trade-off between the size of the two coefficients.

The only other sign reversals have occurred in the trade equations. DS has become positive in equation (5) and FS has become positive in equation (4). The DS result is particularly surprising since it has a sign opposite to that hypothesized. With respect to FS, little can be said since its hypothesized sign was either positive or negative. However, it must be noted that both coefficients were close to zero with 2SLS and neither changed very much as a result of the application of ridge estimation (see Figs. 4 and 5 in Appendix A). There is therefore insufficient evidence to suggest that the signs of the 2SLS estimates for these coefficients are incorrect due to multicollinearity and thus little can be satisfactorily concluded from these sign changes.

C. Some Comments on the Results

In light of the discussion in Chapter two, most of the 2SLSR results in Table I are self-explanatory. There are,

however, two features which deserve particular attention. First, given the emphasis which this study has placed on the role of the foreign sector in determining the performance of Canadian industry, some comments on this matter are in order. Second, there are some results which do not fit into the relations hypothesized in Chapter two and these should be noted.

Recall that in the previous chapter it was argued that the coefficients of M/Q and X/Q in the profitability equation (1) could be either positive or negative depending on the relative strength of various forces at work. The results here (positive coefficients for M/Q and negative coefficient for X/Q) support the arguments advanced by Jones et al. (1977) in the case of imports, and Caves (1974b) in the case of exports. Imports may induce greater efficiency (and higher profits) among domestic firms, and/or both profits and imports may increase as domestic demand increases.[16] Exports expose domestic firms to world markets and the prices established, there lessening the firms' ability to collude and control domestic prices.

The foreign ownership variable (FS) does not enter the profitability equation directly but does have an effect indirectly through its role in determining the other endogenous variables. From the signs of FS in the advertising, import and concentration equations and the signs of these variables in the profitability equation, it follows that

profitability varies directly with the extent of foreign ownership. Foreign ownership then, appears to act as an anticompetitive force in Canadian manufacturing.[17]

The coefficients, the signs of which do not correspond to those hypothesized, are those of RISK in equation (1), A/Q in equation (3), (RPR-RLC) in equation (4), and DS in equation (6). Little can be said in the way of explanation other than that these results may reflect limitations in the amount and quality of the data, or limitations due to the specification of the model as a whole. With respect to the latter, Hurdle (1974) and Shepherd (1975) have argued that risk should be treated as an endogenous variable and, as discussed by Jones and Laudadio (1980), it may be possible to then explain the sign of RISK in (1).

D. Summary and Conclusions

In the above, we have specified and estimated a model which allows us to assess the impact of the foreign sector upon the performance of Canadian secondary manufacturing industry and we have done so using techniques which take into account the problems of simultaneity and multi-collinearity which have plagued industrial organization models. In the process we have also noted some of the errors which could arise from the use of inappropriate estimators.

Perhaps the most important application of models such as the one considered here is in the formulation of anti-trust policy and related policies concerning foreign ownership. The evidence provided by the positive sign of CON4 in the profit equation and the indirect effects of the foreign ownership on profit support the traditional policy view of how industry structure affects performance and the view expressed in the Gray Report (1972) that foreign ownership is an anti-competitive influence.

Footnotes

[1]See Weiss (1971) for a survey of these studies.

[2]CON4 with A/Q and FS; A/Q with FS and PROF.

[3]For an explanation of two stage least squares, properties and applications, see Dhrymes (1970). The most appropriate functional forms for the equations were obtained by the extended Box-Cox technique (see White 1972). The test led to a rejection of the logarithmic form, and the non-rejection of the linear form.

[4]The Haitovsky test statistic is chi-square, and tests the hypothesis that the determinant of the population correlation matrix is zero. Large values result in a rejection of the null hypothesis of perfect multicollinearity. See Haitovsky (1969).

[5]See Vinod (1978) for a good survey of the ridge literature.

[6]For an explanation of the ridge estimator see Hoerle, Kennard and Baldwin (1970).

[7]For a highly technical discussion of these problems, and how crucial they are to ridge estimation, see Smith and Campbell (1980a; 1980b), Thisted (1980), Marquardt (1980), Van Nostrand (1980), Lindley (1980), Obenchain (1980), Peele and Ryan (1980), Vinod (1980), and Gunst (1980).

[8]Since MSE = $(\text{Bias})^2$ + Variance.

[9]See for example, Lawless and Wang (1976), Hoerle, Kennard and Baldwin (1975), Dempster, Shatzoff and Vermouth (1977), and MacDonald and Galarneau (1975).

[10]According to Hoerle and Kennard (1970, p.65), coefficients should have reasonable absolute values "with respect to the factors for which they represent rates of change".

[11]"Reasonable" values for the residual sum of squares (RSS), requires RSS ". . . not to be large relative to the minumum RSS or relative to what would be a reasonable variance for the process of generating the data" (Hoerle and Kennard 1970, p.66).

[12]For example, see Hoerle, Kennard and Baldwin (1975 and Lawless and Wang (1976).

[13]For a discussion of SHAZAM, see White (1978).

[14]Prescott and Tapon (1980) also find that the value of the coefficient on ES in the profit equation turns positive with the application of ridge estimation and ordinary least squares.

[15]The zero-order correlation matrix for the fifty-four industry sample is:

	AKR	ES	CON4
AKR	1.0		
ES	-0.46	1.0	
CON4	0.08	-0.66	1.0

[16]Note that in light of the use of 2SLR, the positive coefficient for imports in the profit equation cannot be explained by the presence of multicollinearity, or simultaneous equation bias as suggested by Weiss (1974). See footnote 6 in Chapter two.

[17]While the coefficients of FS in the advertising, concentration and import equations (equations (2), (3) and 5) respectively), support the argument that profitability varies directly with the extent of foreign ownership, the coefficient of FS in the export equation (4) does not. The coefficient X/Q is positively related to FS, and from equation (1) it can be seen that exports are negatively related to profitability. The total impact of FS on PROF will therefore depend on the strength of the relative forces at work.

To obtain the total effect of FS on PROF, the reduced form coefficients were obtained from the 2SLSR coefficients of structural equations (1) through (5), treating FS as one exogenous variable. The impact multiplier of FS on PROF was found to be 0.009, supporting the conclusion that foreign ownership has an anti-competitive effect on profitability.

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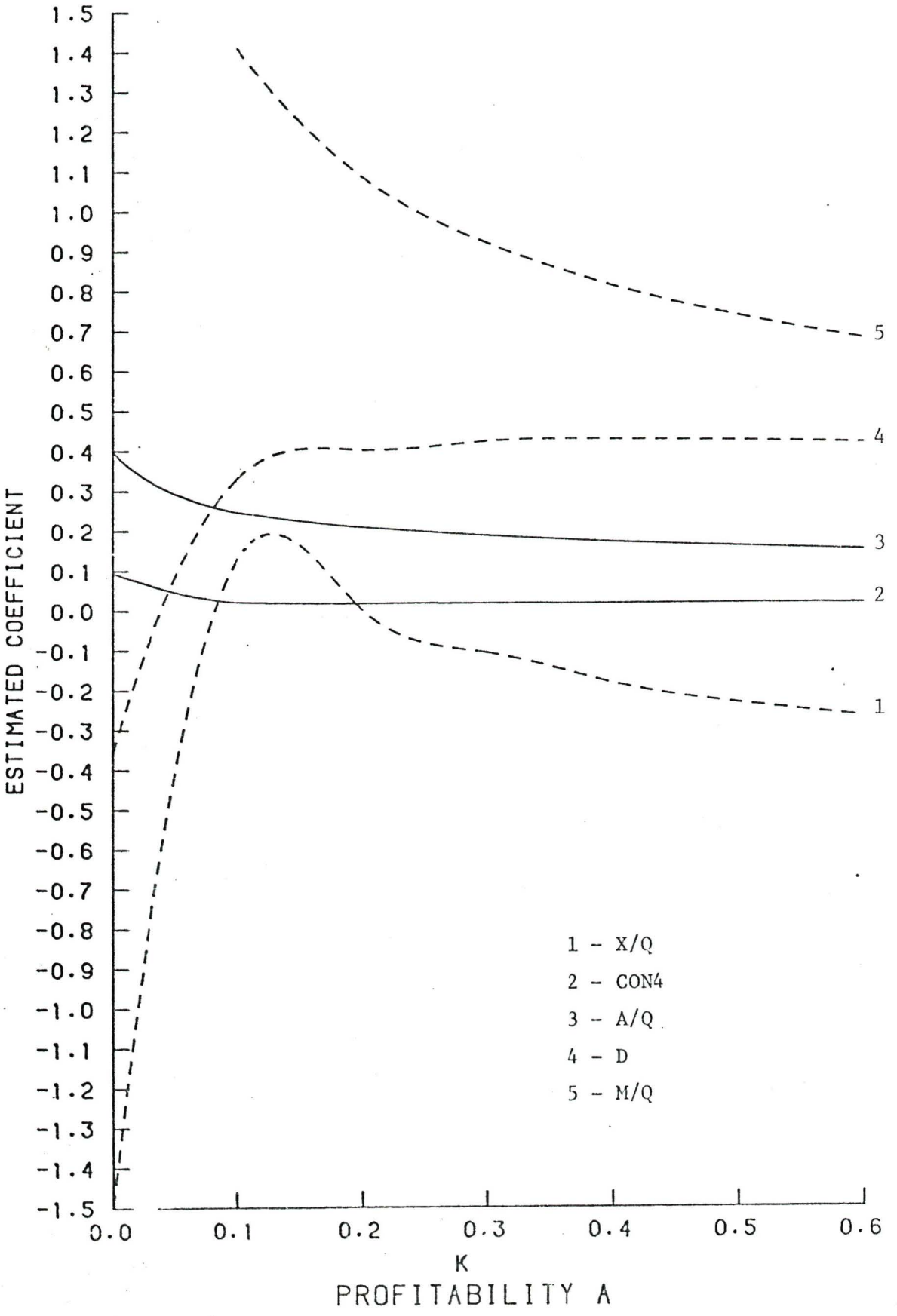
APPENDIX A

RIDGE TRACES

FIGURE 1 i)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1.4
1.3
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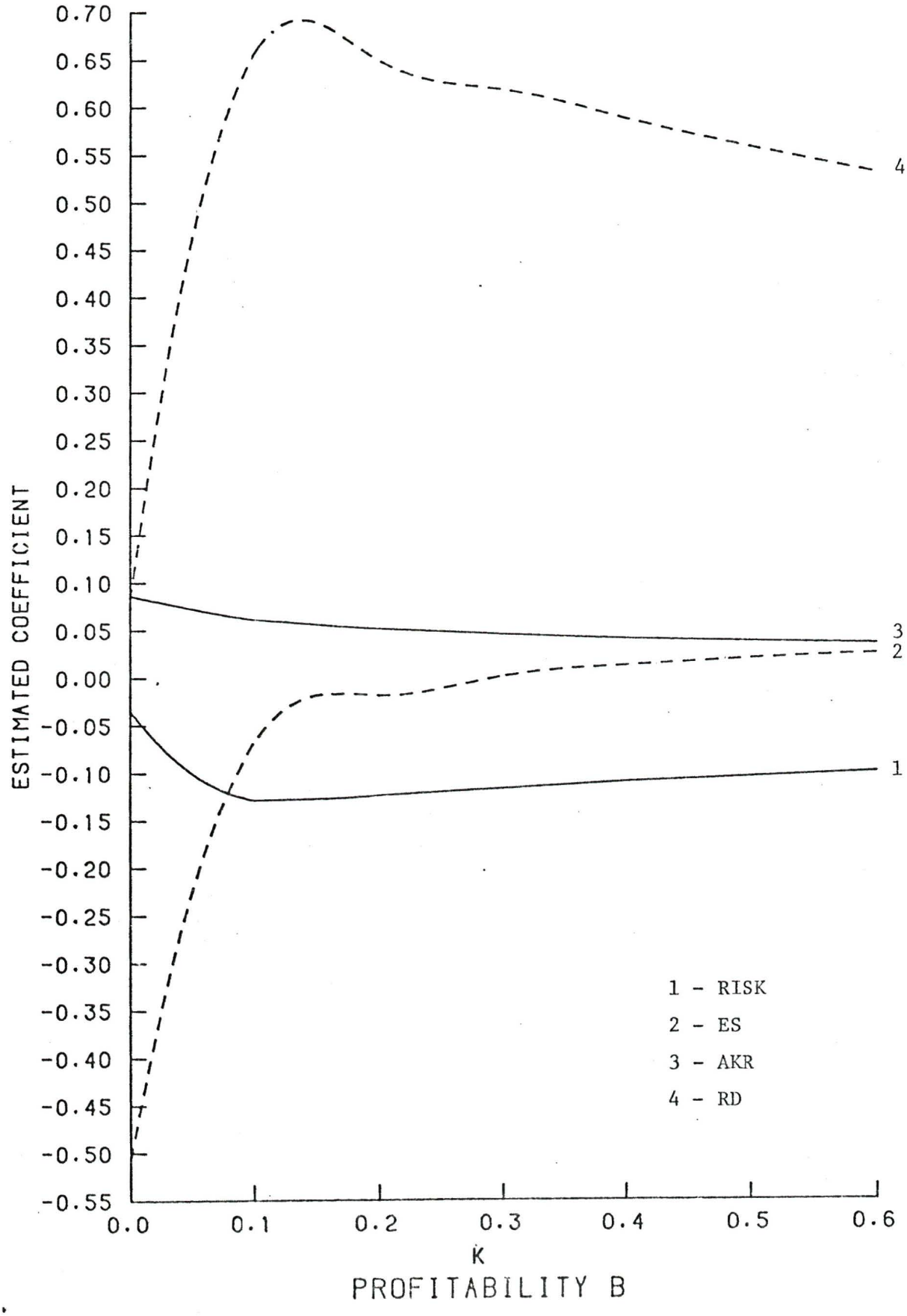
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1.0
-1.1
-1.2
-1.3
-1.4
-1.5
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
PROFITABILITY A
1
2
3
4
5
1 - X/Q
2 - CON4
3 - A/Q
4 - D
5 - M/Q

FIGURE 1 ii)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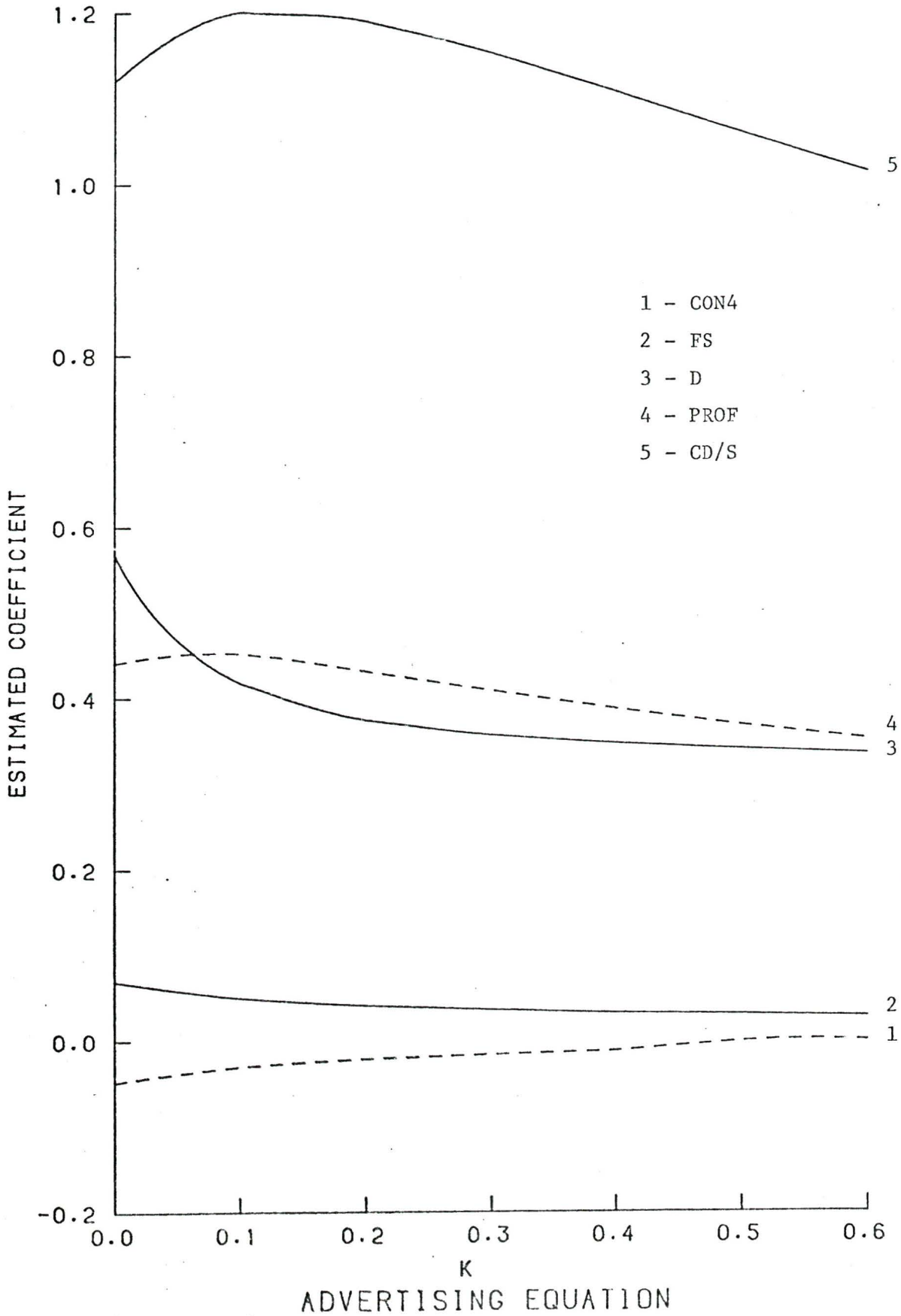
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
-0.30
-0.35
-0.40
-0.45
-0.50
-0.55
ESTIMATED COEFFICIENT
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
PROFITABILITY B
1
2
3
4
1 - RISK
2 - ES
3 - AKR
4 - RD

FIGURE 2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0.8
0.6
0.4
0.2
0.0
-0.2
ESTIMATED COEFFICIENT
1 - CON4
2 - FS
3 - D
4 - PROF
5 - CD/S
5
4
3
2
1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
ADVERTISING EQUATION

FIGURE 3 i)

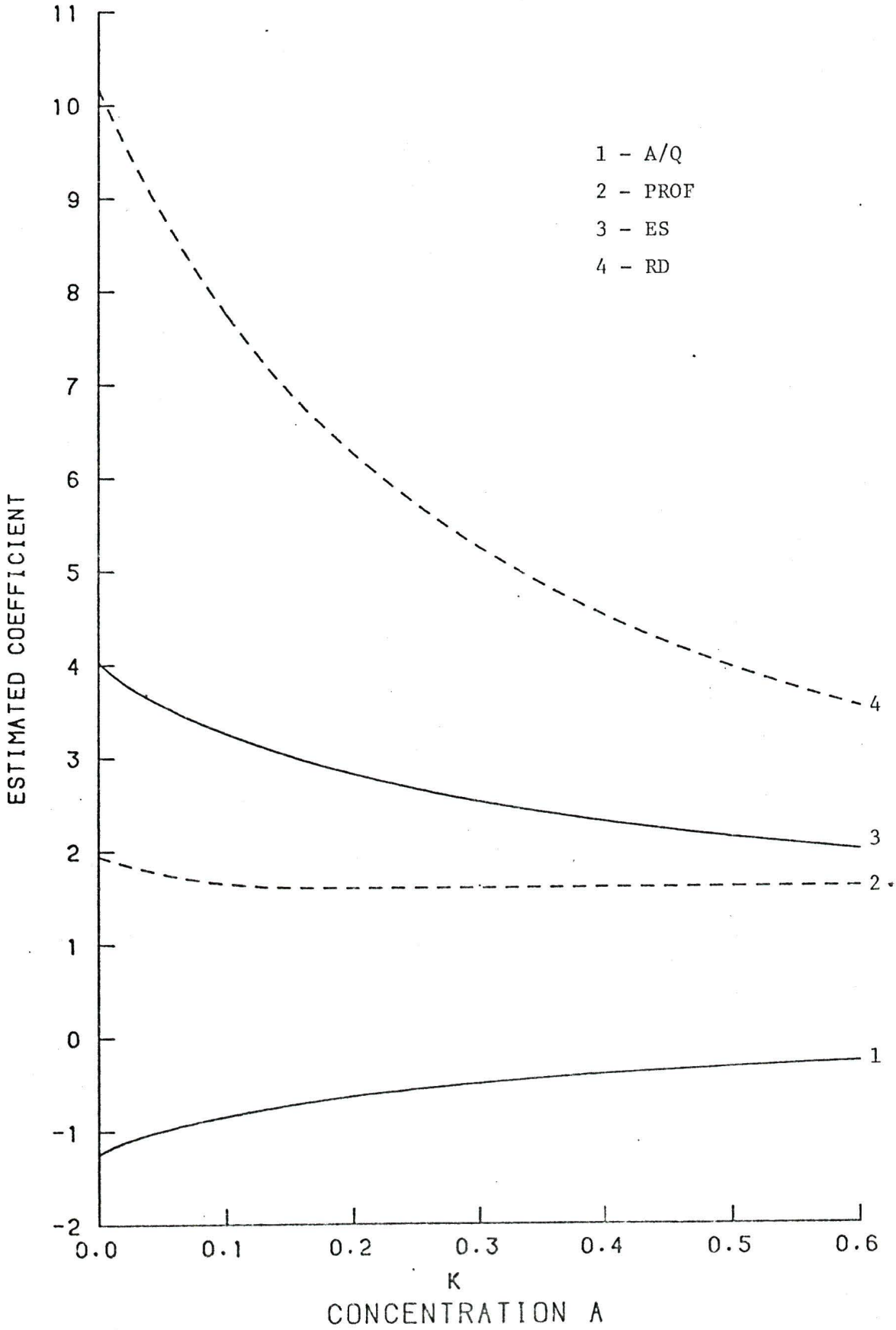
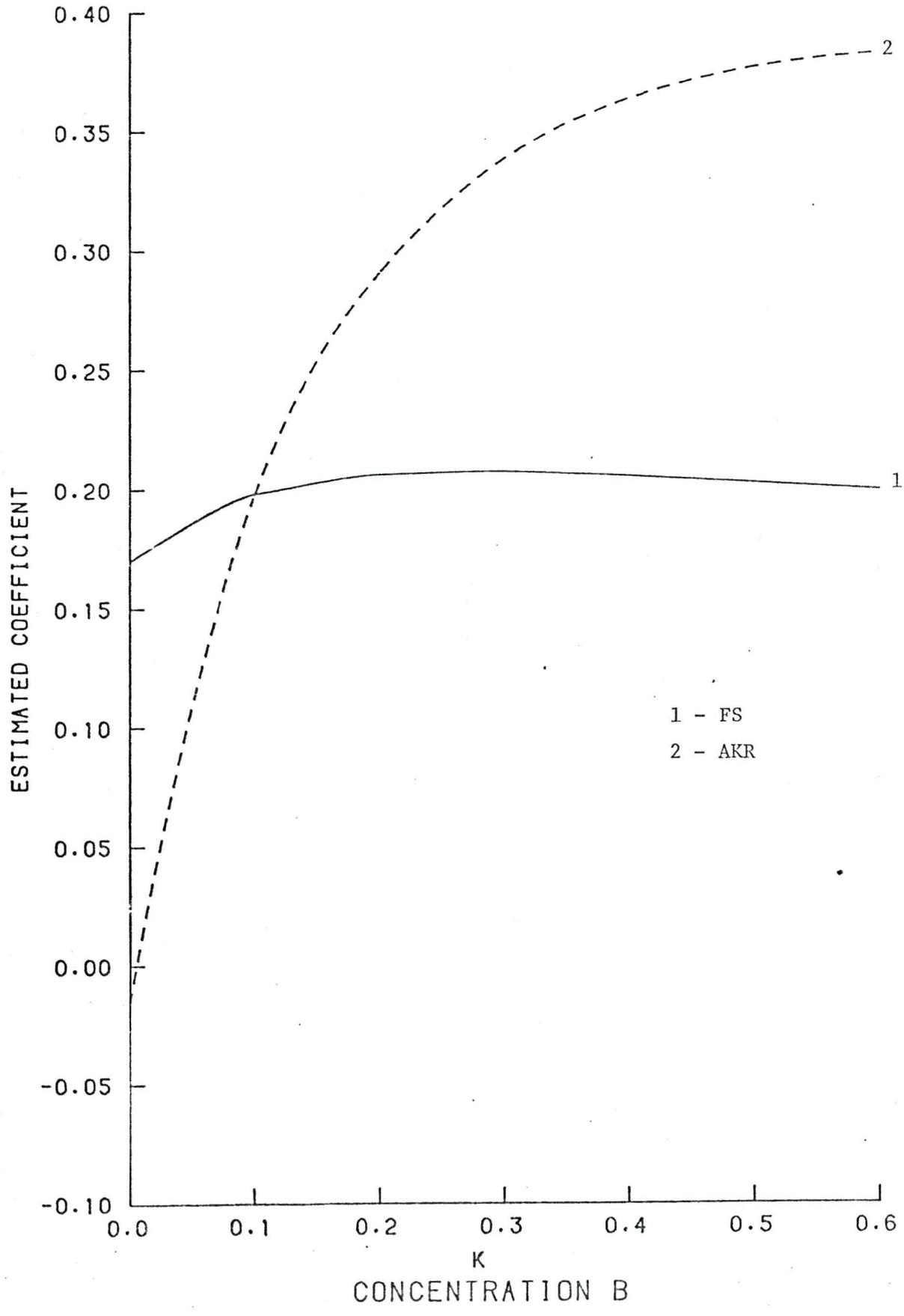

11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
ESTIMATED COEFFICIENT
1 - A/Q
2 - PROF
3 - ES
4 - RD
4
3
2
1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
CONCENTRATION A

FIGURE 3 ii)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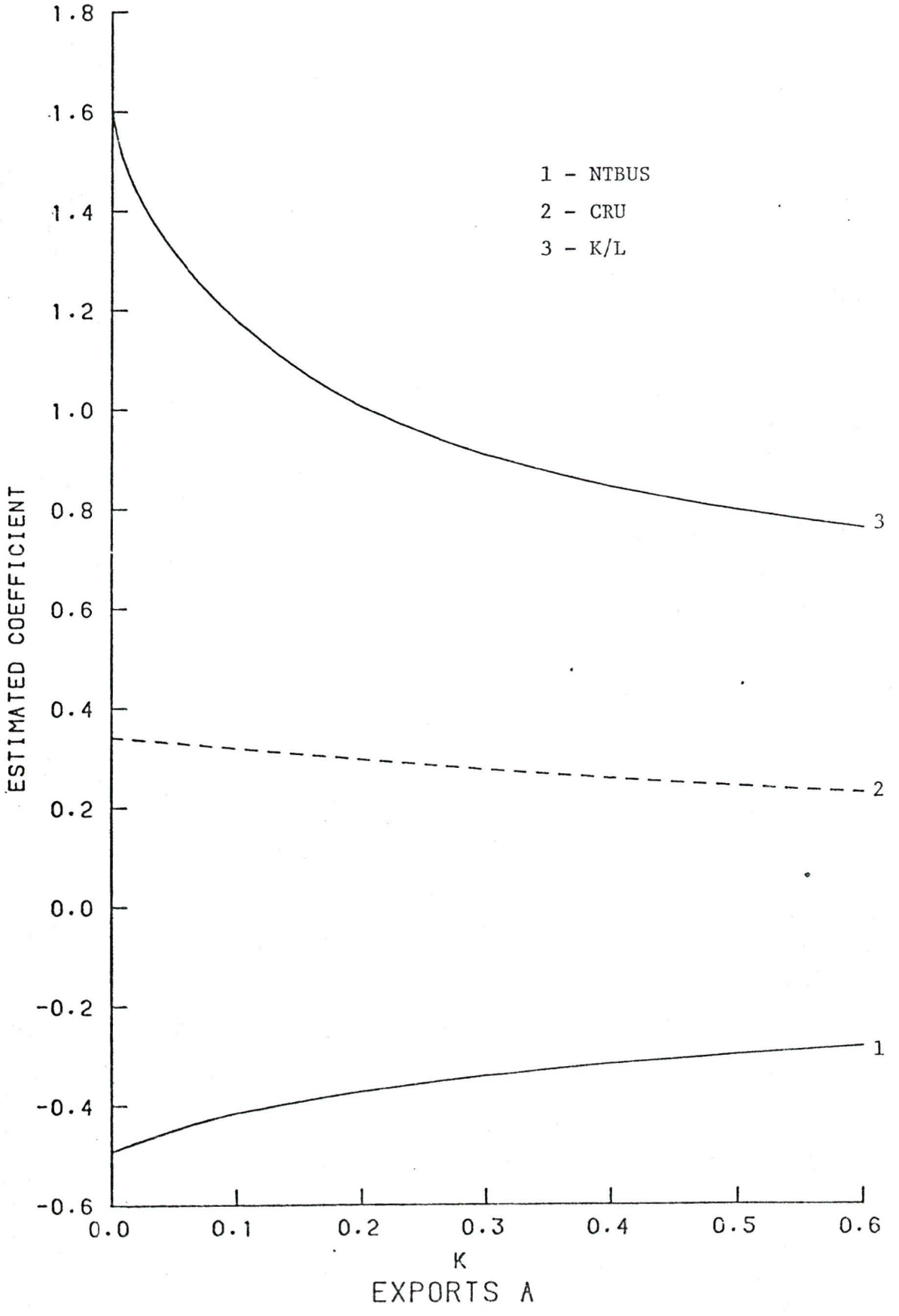
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
ESTIMATED COEFFICIENT
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
CONCENTRATION B
1
2
1 - FS
2 - AKR

FIGURE 4 i)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1.4
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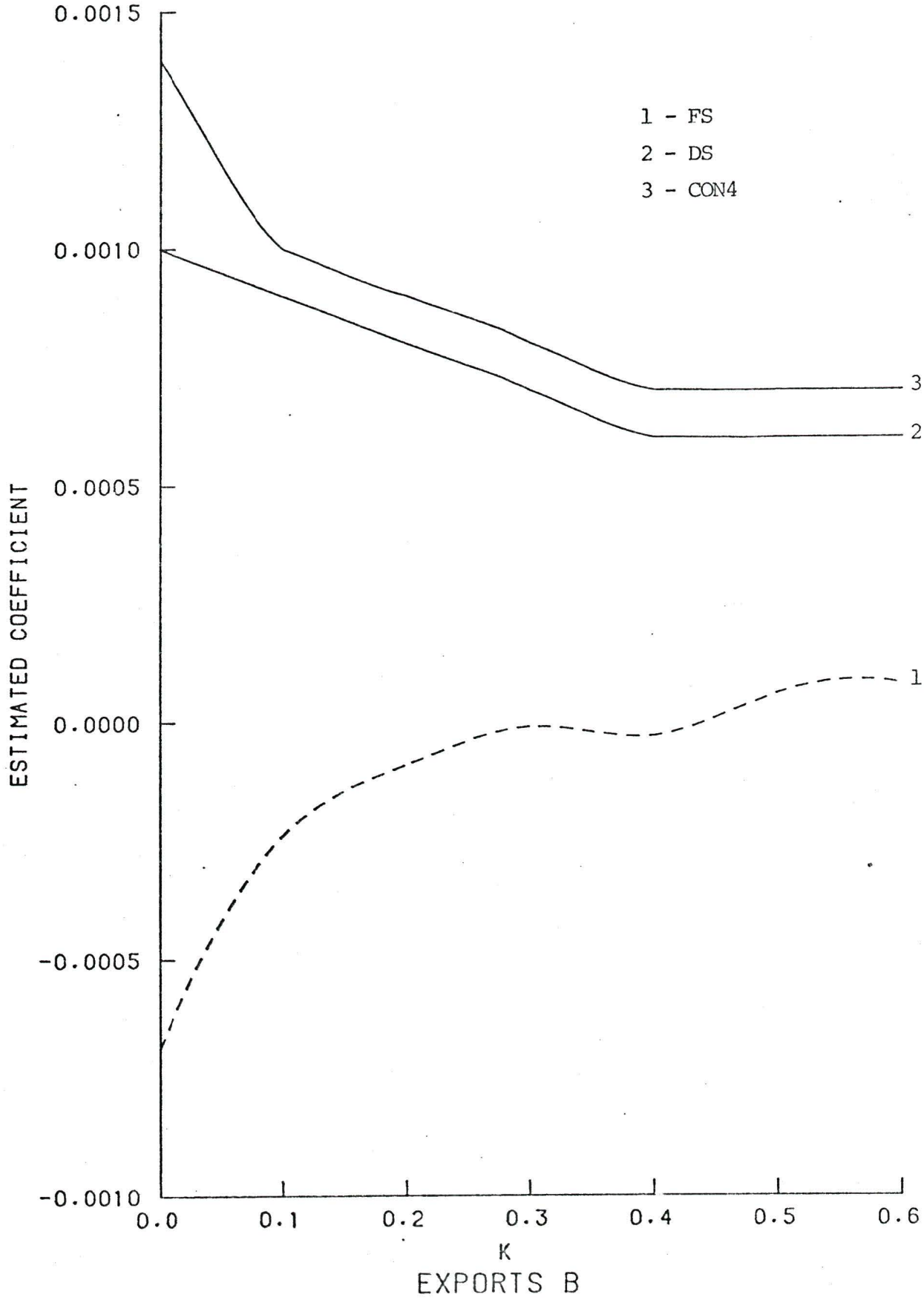
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
ESTIMATED COEFFICIENT
1 - NTBUS
2 - CRU
3 - K/L
3
2
1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
EXPORTS A

FIGURE 4 ii)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0.0005
0.0000
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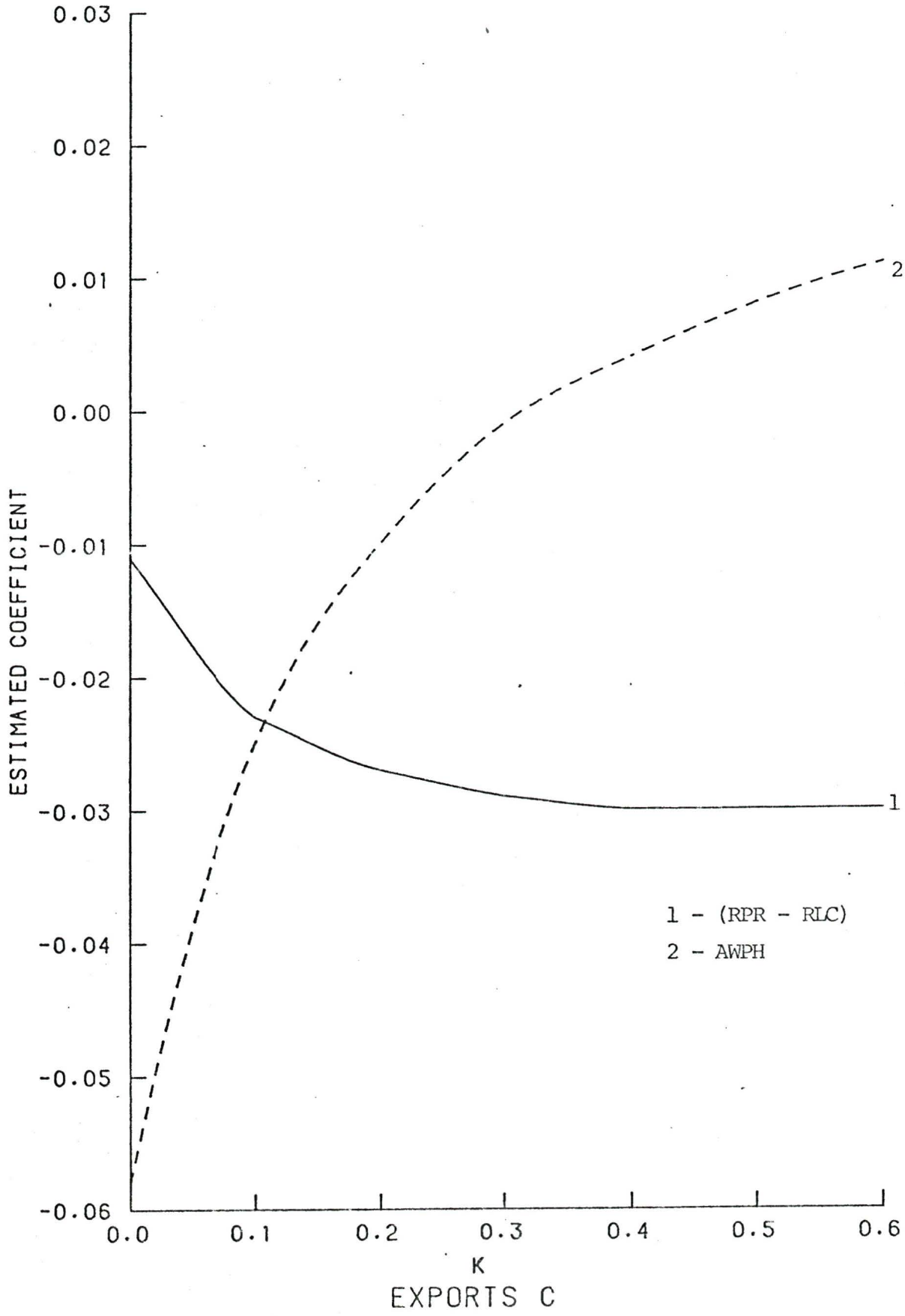
ESTIMATED COEFFICIENT
1 - FS
2 - DS
3 - CON4
3
2
1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
EXPORTS B

FIGURE 4 iii)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0.00
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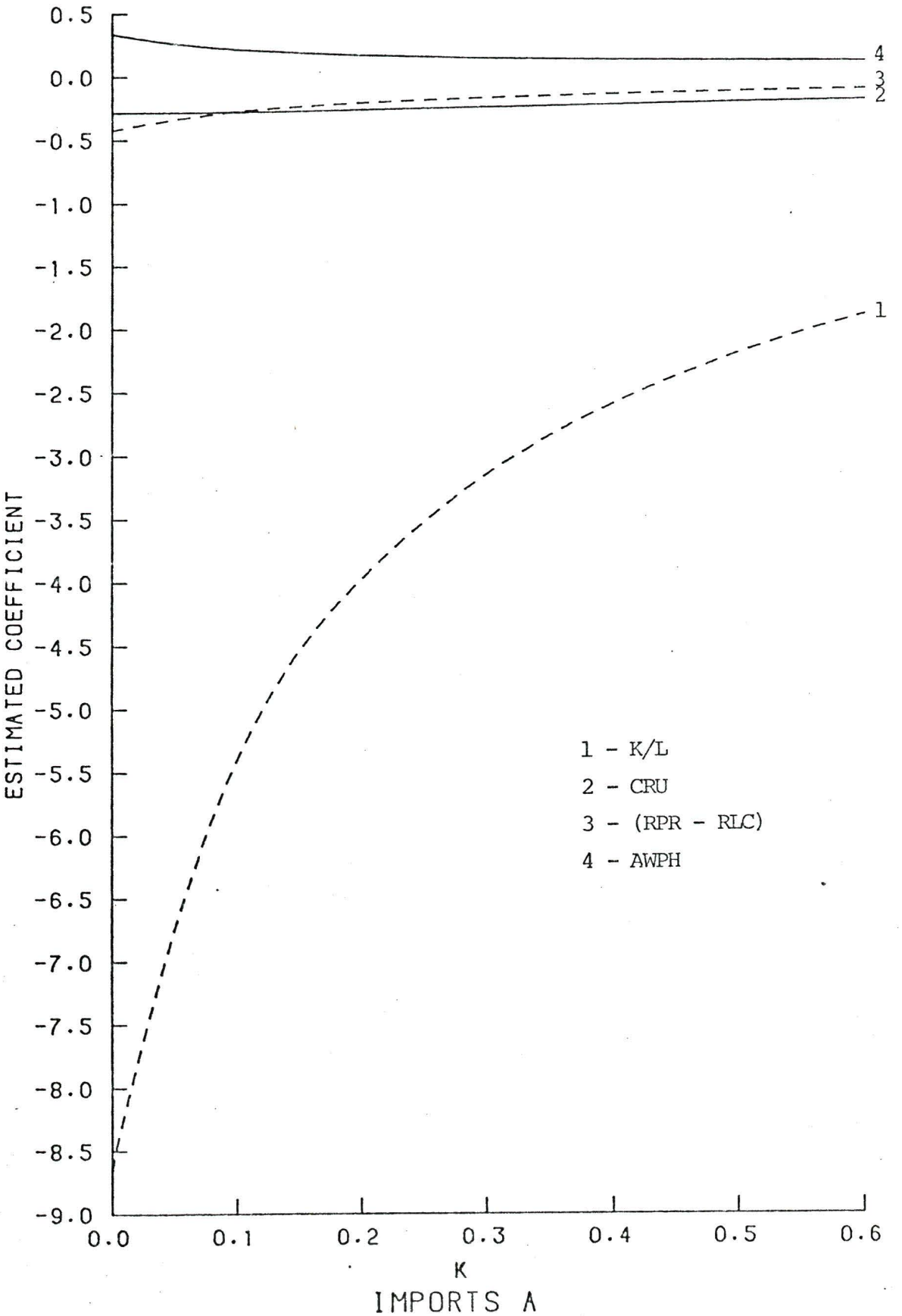
-0.02
-0.03
-0.04
-0.05
-0.06
ESTIMATED COEFFICIENT
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
1
2
1 - (RPR - RLC)
2 - AWPH
EXPORTS C

FIGURE 5 i)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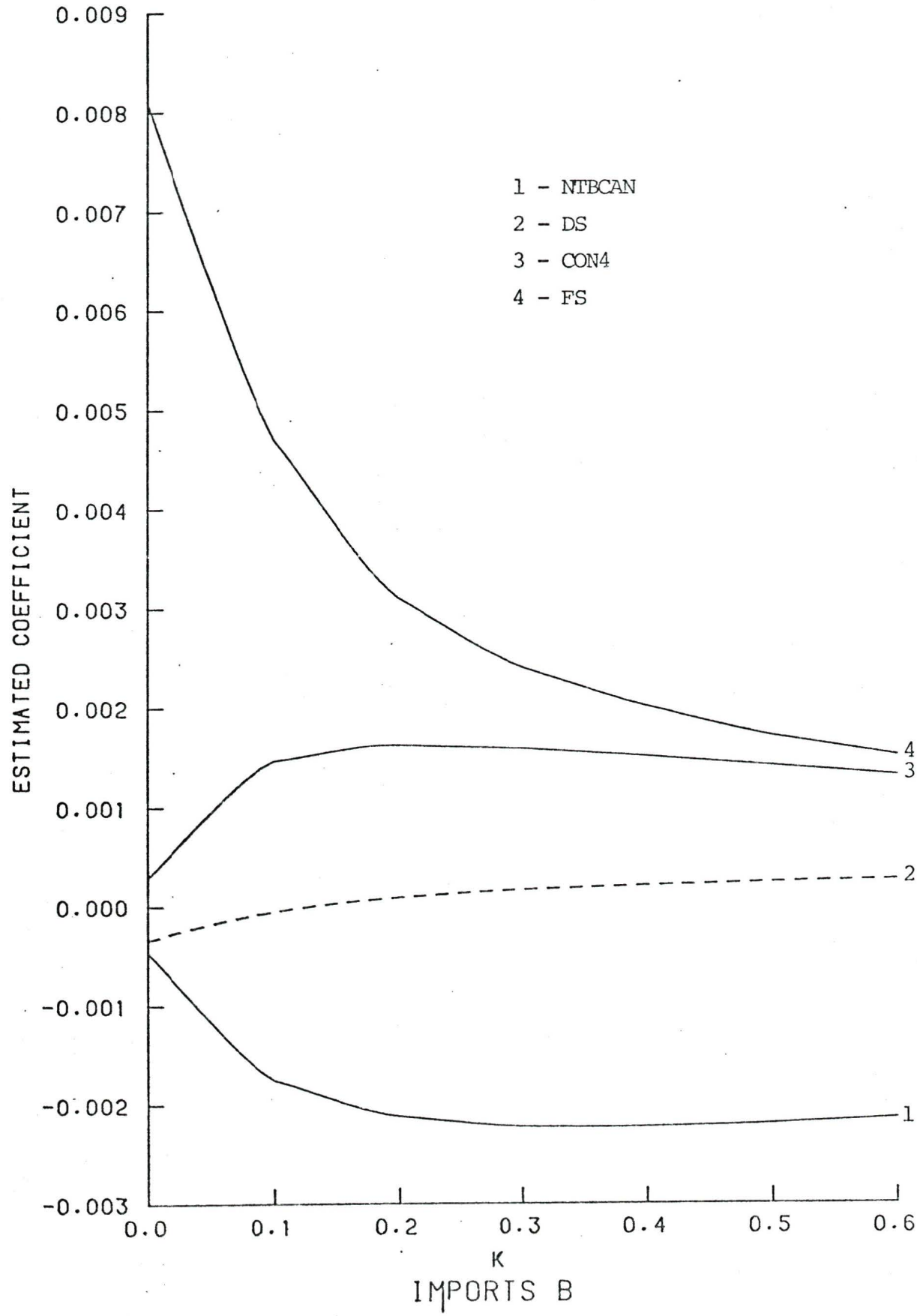
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
ESTIMATED COEFFICIENT
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
IMPORTS A
4
3
2
1
1 - K/L
2 - CRU
3 - (RPR - RLC)
4 - AWPH

FIGURE 5 ii)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0.002
0.001
0.000
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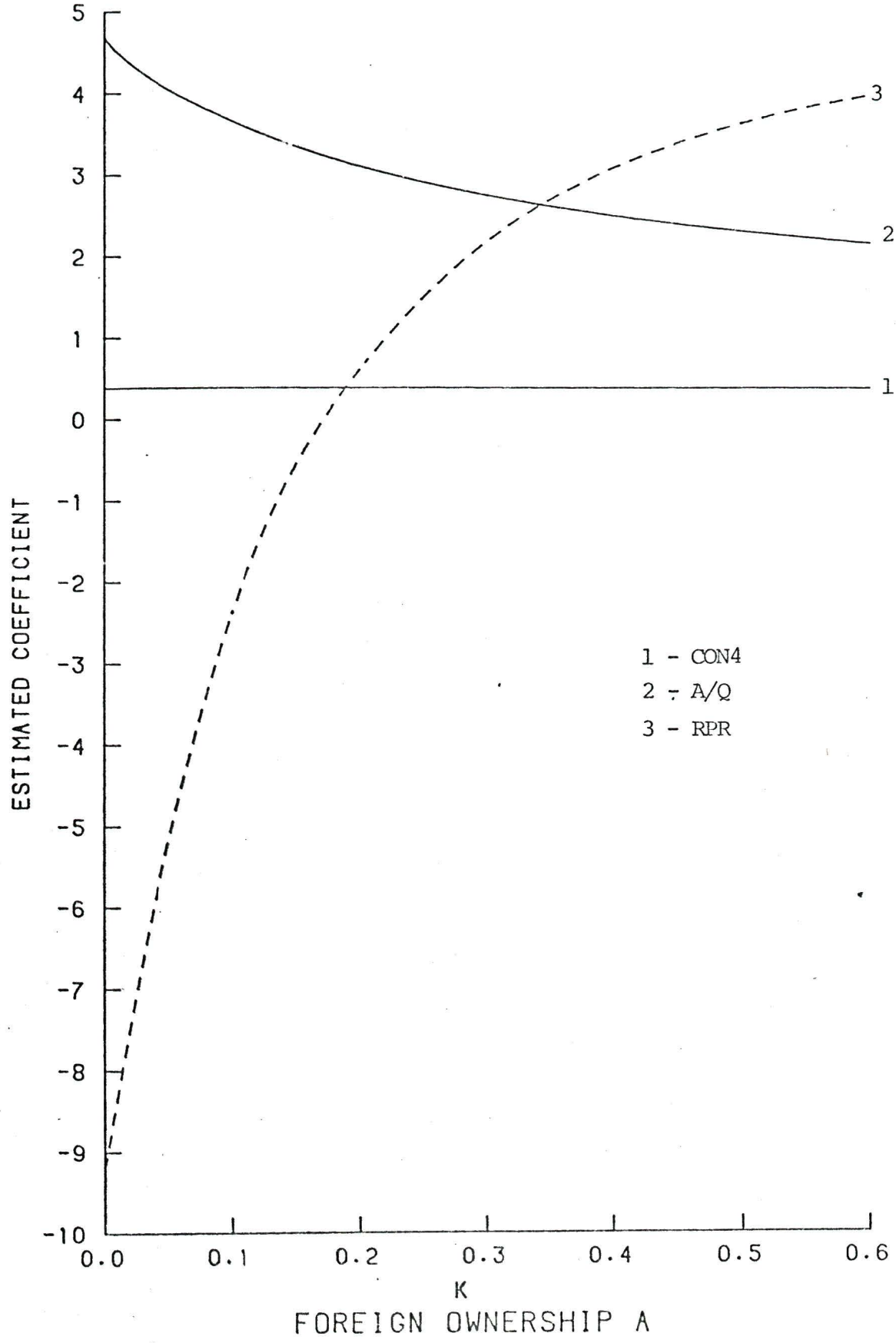
-0.002
-0.003
ESTIMATED COEFFICIENT
1 - NTBCAN
2 - DS
3 - CON4
4 - FS
4
3
2
1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
IMPORTS B

FIGURE 6 i)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4
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2
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-4
-5
-6
-7
-8
-9
-10
ESTIMATED COEFFICIENT
0.0
0.1
0.2
0.3
0.4
0.5
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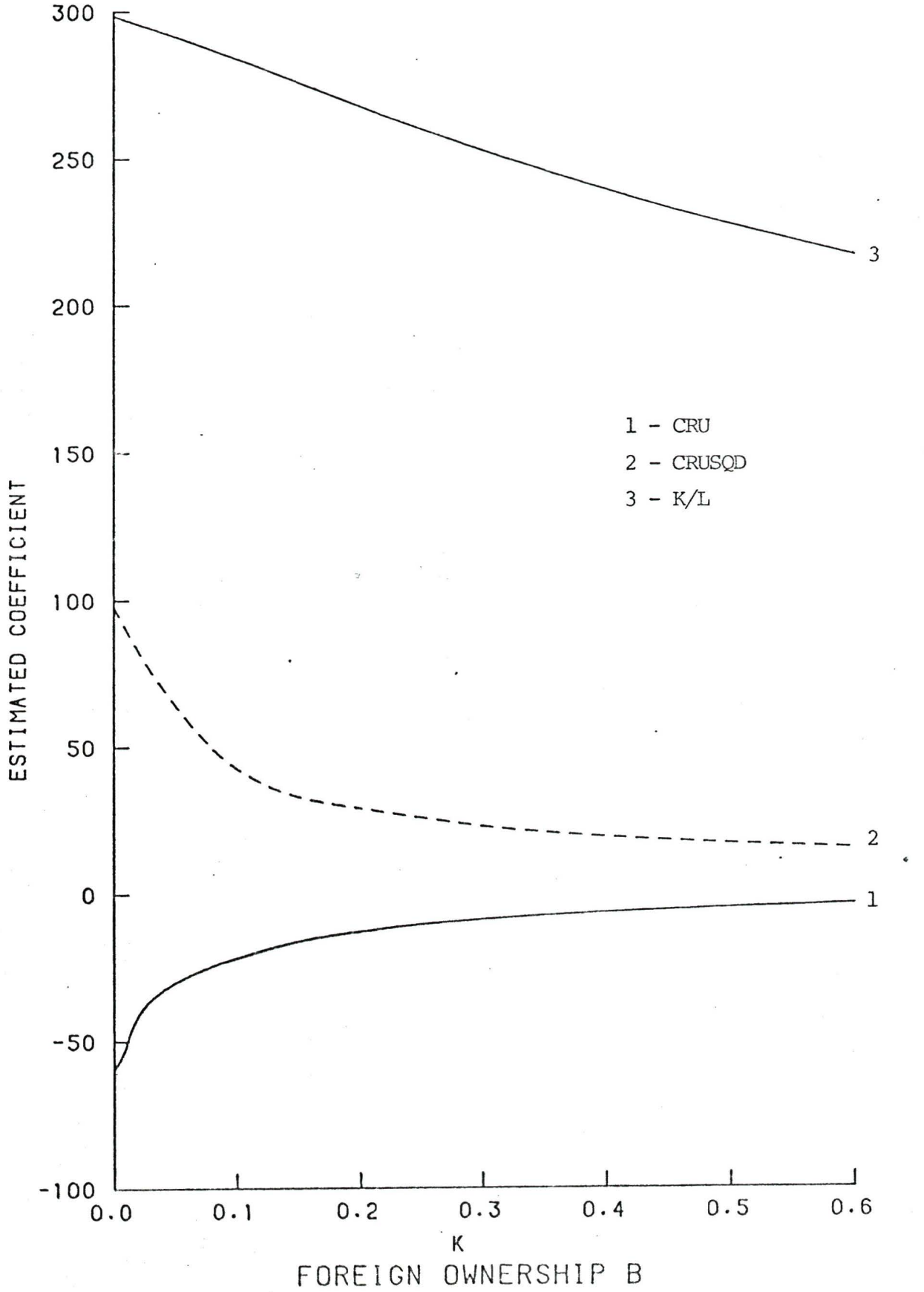
K
1
2
3
1 - CON4
2 - A/Q
3 - RPR
FOREIGN OWNERSHIP A

FIGURE 6 ii)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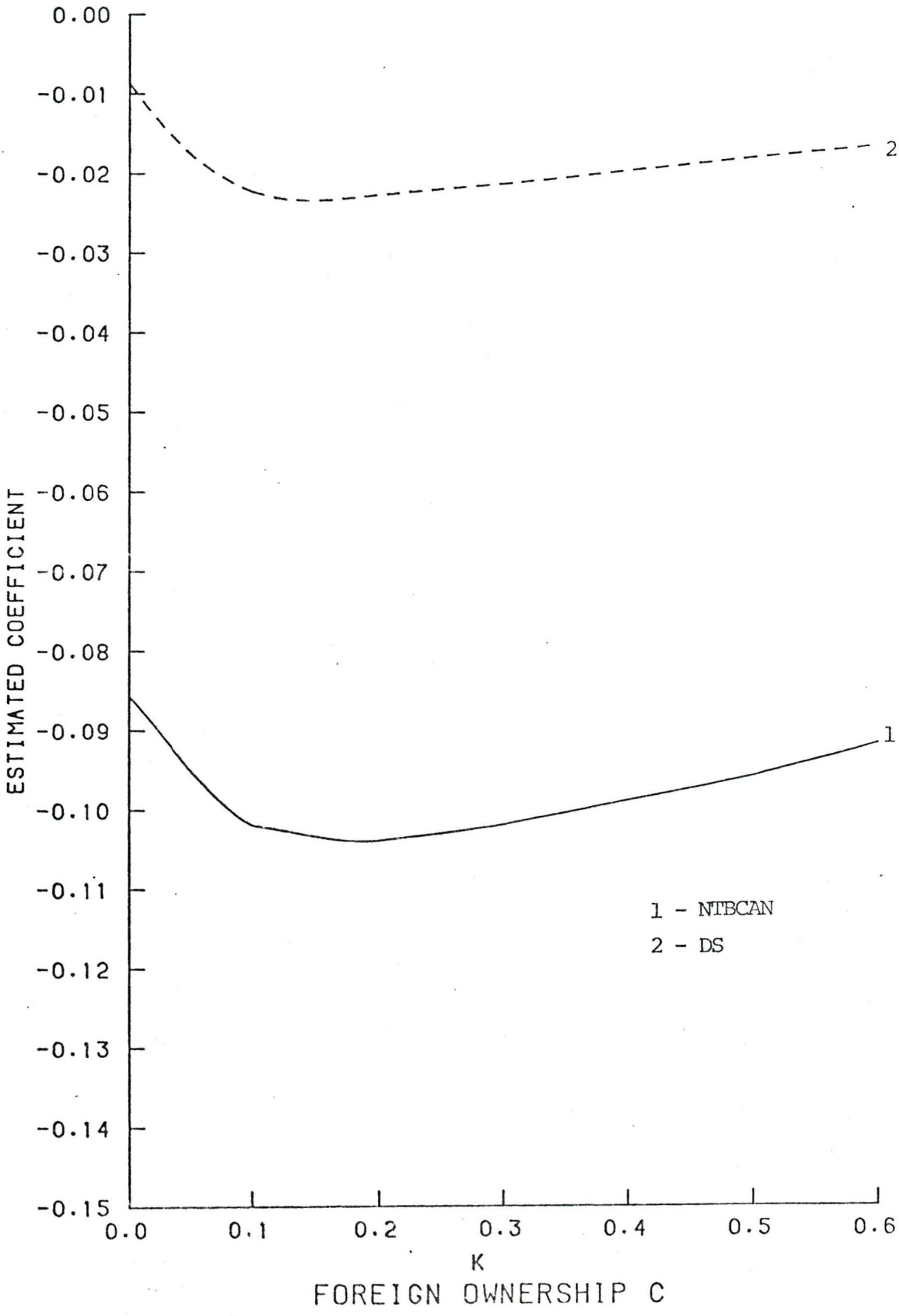
250
200
150
100
50
0
-50
-100
ESTIMATED COEFFICIENT
1 - CRU
2 - CRUSQD
3 - K/L
3
2
1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
FOREIGN OWNERSHIP B

FIGURE 6 iii)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-0.10
-0.11
-0.12
-0.13
-0.14
-0.15
ESTIMATED COEFFICIENT
0.0
0.1
0.2
0.3
0.4
0.5
0.6
K
FOREIGN OWNERSHIP C
1
2
1 - NTBCAN
2 - DS

APPENDIX B

THE SAMPLE

The Standard Industrial Classifications follow those given in *Corporate Financial Statistics* (1968). They are:

CONSUMER GOODS:

Meat products; dairy products; fruit and vegetable preservers; bakeries; confectionary and miscellaneous food; soft drinks; leather products; hosiery mills; knitting mills; men's clothing; women's clothing; foundation garments; household furniture; miscellaneous furniture; small electrical appliances; household radio and television receivers; communications equipment; electrical industrial equipment; batteries; pharmaceuticals and medicines; soap and cleaning compounds; instruments and related products; brooms, brushes and mops; toilet preparations; Major Appliances, children's clothing.

PRODUCER GOODS:

Shingle mills, sawmills, and planing mills; sash, door, and other millwork plants; publishing and printing; ornamental and architecture metal; hardware, tools, and cutlery; heating equipment; miscellaneous machinery and equipment; fish products; feed and flour; wool, yarn and cloth mills; synthetic textiles; veneer and plywood mills; miscellaneous paper converters; cartons, boxes, and bags; iron and steel mills; iron foundries; metal rolling, casting and extruding; fabricated structural metal; metal stamping, pressing, and coating; wire and wire products; agricultural implements; commercial refrigeration and air conditioning; electrical wire and cable; cement; clay products; stone products and abrasives; other petroleum and coal products; paints and varnishes.

APPENDIX C

VARIABLE DEFINITIONS AND DATA SOURCES

1. PROF — Ratio of profits plus interest to total assets. The three components are averaged over the years 1965, 1966, and 1967.
SOURCE: Dominion Bureau of Statistics (DBS), *Corporation Financial Statistics* (1968, 1969, 1969).

2. AKR — Absolute capital requirements of the minimum efficient size plant: average output level of minimum efficient size multiplied by total assets to gross sales for the industry.
SOURCES: DBS, *Corporation Financial Statistics* (1968, 1969, 1969) and *Concentration in the Manufacturing Industries in Canada* (1971).

3. CON4 — Four firm concentration ratio, the sales of the largest four firms in the industry as a percentage of industry sales.
SOURCE: *Concentration in the Manufacturing Industries of Canada* (1971).

4. ES — Average plant size of the largest plants that account for 80 per cent of industry output, as a percentage of shipments.
SOURCE: *Concentration in the Manufacturing Industries of Canada* (1971).

5. M/Q — Ratio of imports to industry output.
SOURCE: *The Input-Output Structure of the Canadian Economy, 1961* (1961).

6. X/Q — Ratio of exports to industry output.
SOURCE: *The Input-Output Structure of the Canadian Economy, 1961* (1961).

7. A/Q — Ratio of advertising to sales.
SOURCE: DBS, *Advertising Expenditures in Canada, 1965* (1968).

8. D — Growth of demand expressed as the ratio of industry sales, 1965 to industry sales, 1956.
SOURCE: for 1956, Department of National Revenue, *Taxation Statistics* (1958), and assorted DBS industry publications; for 1965, *Corporation Financial Statistics* (1968, 1969, 1969).

9. RD — Regional concentration dummy with a value of 1.0 for industries with identifiable regional markets--dairy products, bakeries, soft drinks, breweries, and cement.

10. FS — Foreign ownership, ratio of shipments by foreign controlled firms to total shipments.
SOURCE: *Domestic and Foreign Control of Manufacturing Establishments in Canada, 1969-70* (1976).

11. CD/S — Consumer demand, ratio of "other final demand" to output.
SOURCE: DBS, *The Input-Output Structure of the Canadian Economy, 1961* (1969)

12. RISK — The average absolute deviation in annual profits over a ten year period.
SOURCE: DBS, *Corporation Financial Statistics.*

13. K/L — The dollar value of net fixed assets per man.
SOURCES: DBS, *Corporation Financial Statistics* (1968, 1969, 1969) and Statistics Canada, *Industrial Organization and Concentration in the Manufacturing, Mining and Logging Industries, 1968* (1973).

14. CRU — Direct requirements of crude materials per dollar value of gross output for 1961.
SOURCE: DBS, *The Input-Output Structure of the Canadian Economy, 1961* (1969).

Crude materials are defined to include all shipments arising from the primary sector of the Canadian economy.

15. NTBCAN — The Canadian nominal rate of tariff protection for 1961.
SOURCE: Wilkinson and Norrie (1975, Table A-1).

16. NTBUS — The U.S. nominal rate of tariff protection, 1964.
SOURCE: Baldwin (1970).

17. DS — Average size of plant in Canada divided by the average size of plant in the U.S. for 1972.
SOURCE: Department of Industry, Trade and Commerce, *Comparative Tables of Principal Statistics and Ratios for Selected Manufacturing Industries, Canada and the United States 1972, 1967, 1963* (1975).

18. RPR-RLC — Relative Productivity (RPR), value added per worker in a Canadian industry divided by value added per worker in the U.S. counterpart, 1963. Relative labour costs (RLC), the average hourly wage in the Canadian industry divided by the average hourly wage in the U.S. counterpart, 1965.
SOURCE: Department of Industry, Trade and Commerce, *Comparative Tables of Principal Statistics and Ratios for Selected Manufacturing Industries, Canada and the United States, 1972, 1967, 1963* (1975).

19. AWPH — Average wage per hour in Canada, 1963.
SOURCE: Statistics Canada, *Industrial Organization and Concentration in the Manufacturing, Mining and Logging Industries* (1973).

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WORCESTER COLLEGE OF HIGHER EDUCATION, ENG.	1978	to	1979
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	____	to	____

Degrees, Diplomas, Etc., Awarded,
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Author: [redacted]

Signature

PAUL JOHN COXON

Name

29th August, 1980

Date