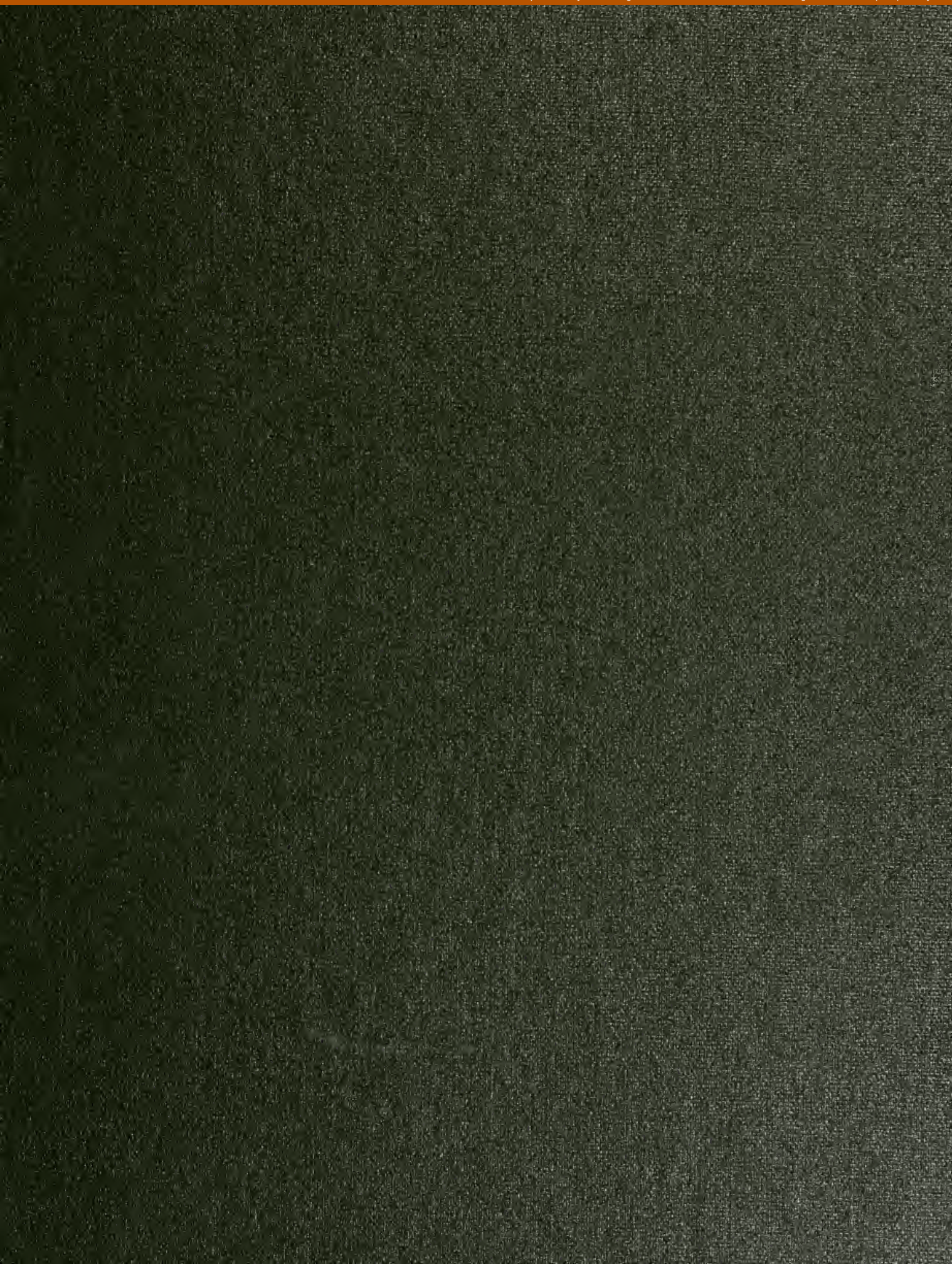

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Do Export Diversification Policies Survive the Portfolio Test?

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ABSTRACT

This work examines the portfolio effects of export diversification and promotion programs. We study the portfolio of a country's exports in order to assess the effectiveness of those programs. Unlike more traditional measures of the degree of diversification attained by a country's exports, we focus on the mean-variance properties of the export portfolio. This methodology is applied to the Brazilian program in the period 1964-1985.

DO EXPORT DIVERSIFICATION POLICIES SURVIVE THE PORTFOLIO TEST?

1. INTRODUCTION

This work examines the portfolio properties of export promotion schemes. In particular, we would like to bring portfolio theory to bear on the problem and to study the extent to which those policies are successful in transforming the export portfolio of the respective country in such a fashion that the new portfolio dominates the old, in a sense that will be explained below.

Export diversification and promotion policies have been adopted by a number of less developed countries (hereafter LDCs) as a means of furthering development. The economic development literature discusses the welfare merits of export-led growth extensively; for a review see, for example, Meier (1976). But that is not the issue that concerns us here.

Our objectives are twofold: first, we want to demonstrate that it is not only possible but logical to look at export diversification in a portfolio context. As a consequence, we will develop a measure of success of export diversification.

Secondly, we demonstrate empirically that, in the Brazilian case, the export diversification program undertaken in the 20-year period between 1964 and 1983 did in fact produce a new export portfolio that dominated the one in existence at the inception of the program.

In particular, this paper will test two hypotheses related to the expected outcome of an export diversification strategy:

H1: The post-diversification export portfolio is more efficient than the pre-diversification portfolio in a mean-variance sense; and

H2: An export portfolio comprised of manufactured goods is more efficient than a portfolio of primary commodities.

This study has particular relevance for international businesses, insofar as LDCs rely frequently on multinational enterprises (MNEs), state enterprises, and on joint ventures of local firms and MNEs for their export promotion schemes. It is organized as follows. Section 2 presents the case for looking at export promotion schemes in a portfolio context. Section 3 explains the methodology used in this study. Section 4 applies the methodology to the Brazilian export diversification program. Section 5 presents the empirical results. The final section contains our concluding remarks.

2. EXPORT DIVERSIFICATION: THE PORTFOLIO APPROACH

Two strands of literature are important for the development of our approach. One is the macroeconomic view generally associated with the economic development writers. The other is the microeconomic portfolio view developed by Finance theorists. The study of export diversification provides a good opportunity for bringing both of them to bear on a specific problem.

a. The Macroeconomic View

At least since the 1960s, the conventional macro wisdom accepted the view that the concentration of LDC exports on a few commodities was a major contributing factor to the excessive short-term fluctuations observed in their export earnings. The arguments about concentration and earnings instability can be summarized as follows. The more highly concentrated a country's exports are, the lower the probability that fluctuations in one direction in some of its exports will be offset by counter-fluctuations or stability in others.

Moreover, another reason for the expressed concern about high commodity concentration of exports is that it is usually associated with one or more possible adverse developments which lie outside the scope of control of the LDC policymakers. These may be classified, for simplicity, into three categories:

(1) A country with highly concentrated exports may feel that further development of its traditional export portfolio would result in a substantial price decline of those exports;

(2) It is sometimes expected that, regardless of what the country itself may be doing, the prices of its major existing export goods are likely to fall in the future;

(3) Violent fluctuations in the price level of the LDC's exports may interfere in numerous ways with the process of economic development.

Thus as MacBean (1968:489) pointed out: "...for individual underdeveloped countries, fluctuations may very well be important at various times. Indeed, it may be possible to demonstrate that short-term export instability has seriously reduced the ability of some underdeveloped countries to achieve high rates of economic growth." In addition, as Brainard and Cooper (1968:257) emphasize: "'Diversification' has become a commonplace goal of economic policy in less developed countries. They seek to escape their heavy dependence on one or two products for the bulk of their export earnings, and thus to avoid the costs in human welfare and to development objectives of sharp fluctuations in export receipts."

The above reasoning has provided the rationale for the export diversification programs undertaken by LDCs, which have tended to be equated with expansion of manufactured exports, on the grounds that export earnings

from manufactured goods would be less volatile than those from primary goods. This is so because, the argument goes, the correlation between earnings from manufactured products and primary commodities is likely to be less positive than between earnings from pairs of primary commodities.

It follows that, by means of export diversification, LDC policymakers may be able to reduce fluctuations in total export earnings below the levels experienced by individual products, provided that earnings from the different products which comprise the export portfolio are not perfectly positively correlated. The formalization and empirical testing of this proposition is the central issue of this paper.

The case for export diversification has been formulated without a corresponding effort to quantify the risk-return tradeoffs of the old and new portfolios, let alone attempts at quantifying the contribution of new products to the riskiness of the existing portfolio. Its lack of formalization notwithstanding, the argument provided an understandable attraction for policies aimed at diversification of exports. Some authors, such as Michaely (1962:78) concluded that the relationship between export instability and the primary-product ratio "is solely due to the strong association between commodities concentration and the extent of specialization in primary goods." Michaely (1962:78) states "the fact that a country is an exporter of primary goods does not tend, per se, to increase the amplitude of fluctuations of the country's export prices. It is only because exporters of primary goods are usually countries with highly concentrated exports that they appear to be more vulnerable to violent price fluctuations." According to this view, the reduction in the instability of export earnings would be achieved by increasing the number of products in the export portfolio, paying some

attention to their pairwise correlations. A theoretically defensible analysis of the risk-return tradeoffs was not attempted.

More recently, other authors in the development literature, such as MacBean and Nguyen (1980) and especially Love (1982, 1983, 1984) incorporated the portfolio-theoretic view developed by Finance theorists (see the following subsection) into the analysis of the export diversification and promotion programs. They added a cautionary note to the previous view. Export diversification strategies, they found, do not always eliminate or reduce the problem of fluctuation in total export earnings. Pursuing such a strategy may cause the degree of fluctuation in total export earnings to increase again, in some cases. Moreover, the reduction in the variability of export earnings may be accompanied by a decline in expected export earnings.

This study attempts to add some findings to that growing body of evidence. Now let us look at the other major strand of literature whose contributions we have considered.

b. The Microfinance View

During the 1950s and 1960s, Finance theorists developed rigorously the underpinnings of portfolio theory and the Capital Asset Pricing Model (CAPM). The landmark works of Markowitz (1952, 1959), Tobin (1958), Sharpe (1963, 1964), Lintner (1965), and Mossin (1966), among others, helped to shape the theory which, enriched by posterior contributions, remains one of the cornerstones of Finance thinking to this day. For the purposes of this study, it suffices to notice a few important points which will provide a justification for the methodology used here.

The starting point is that the different products which comprise the exports of a given country are treated as a portfolio of earning assets. The

increase in expected export earnings is desirable. Increasing the variance of those earnings is undesirable. The corollary is that, as new products are added to the export portfolio, the contribution of a given new product for portfolio risk should be measured by the covariance of its earnings pattern with the existing portfolio, rather than the variance of its own earnings.

Three important implications follow. The first is that switching to manufactured exports is not a panacea that guarantees the success of an export diversification program. Granted, in the initial stages, manufactured export earnings are likely to have a low correlation with a portfolio based on a few primary commodities. However, as more and more manufactured products are added to the existing portfolio, the covariance of any new product with the existing portfolio is likely to increase.

Second, the development of an export diversification program is a costly undertaking. Several possible additions to the export portfolio compete for relatively meager resources. Therefore, a normative criterion for selecting the next addition is the contribution of the new product for the improvement of the risk-return tradeoff of the export portfolio.

The third implication is of paramount importance for the policymakers developing those programs and for the businesses affected by them. Different countries should in principle be able to choose how to position their export portfolio on the efficient frontier. That is, by carefully selecting new products, they could move to a point where, given their resources and preferences, expected export earnings would be maximized for a given level of variability or, alternatively, the variability of export earnings would be minimized for a given level of export earnings. Knowing their resources, endowments and markets, as well as their ability to attract foreign capital,

different countries could possibly choose very different strategies for their export diversification programs. Yet they would be equally sound if they attempted to position ex ante the export portfolio on the efficient frontier. The ex post performance of the portfolio, of course, could be an entirely different story.

The discussion above suggests the possibility of formulating criteria for the selection of new products to be added to the export portfolio as well as estimating ex post the degree of success of export diversification programs. One such methodology is developed in the next section.

3. METHODOLOGY

a. The Traditional Method

By way of comparison, it is useful to start this section with a brief description of a more traditional method used for analyzing the development of a country's export performance. That technique, called constant-market-share analysis (CMS), starts from the assertion that the factors which affect export performance can typically be classified into those attributable to growth of market demand, to changes in the country's competitive standing and to diversification of the composition of the export portfolio. Thus, CMS attributes favorable or unfavorable export growth to a country's export structure or to its competitiveness.

For example, consider the case of the Brazilian export diversification program. As explained above, this study focuses on the two-decade interval between 1964 and 1983. During that period, according the CMS approach, the growth rate of Brazilian exports can be explained by four main components: the growth effect of international trade, the composition effect, the market share effect and competitiveness effect.

Doellinger and Cavolcanti (1973) and Horta (1983) applied CMS in order to analyze the performance of Brazilian exports. Doellinger covered the period 1964-1970, while Horta looked into the period 1970-78. Doellinger found that the Brazilian export growth in manufactured goods in that period was strongly related to gains in competitiveness (66.9%) and to the growth effect of international trade (33.1%). However, he estimated that the effect of the composition of exports was negative, reflecting the fact that, in his understanding, the structure of Brazilian exports did not present a close correlation with the structure of world demand. Consequently, he concluded that the growth rate of Brazilian exports was below world growth rates.

Horta performed CMS studies for manufactured exports and total exports. With regards to manufactured exports, her results are in line with Doellinger's. She estimated the competitiveness effect and the growth effect in international trade to have accounted for 73.8% and 30.2% of manufactured export growth in the 1970-78 period, respectively. In addition, she also found that composition effect and the market share effect were negative but small, on the order of -1% and 3.9%, respectively. Horta's results are strikingly reversed when total exports are examined (i.e., manufactured plus primary products). Her estimates show that the competitiveness effect accounted for only 39.1% of the growth in exports, while the growth effect of international trade responded for 71.4%.

Thus, the traditional CMS method concerns itself with the factors affecting the overall growth of a country's exports. In contrast, our approach does not address this problem; rather, it applies itself to estimating the ex post efficient export portfolios in a mean-variance (E-V) framework.

b. The Portfolio Management Approach[1]

Let us begin by stating the scope of our approach. Factors affecting the demand for any particular product are outside the scope of this study. Demand and supply forces will combine to cause changes in prices and quantities.

In this paper, we work with export earnings, as opposed to prices or volumes. For LDCs in particular, not only variations in price but also changes in volume constitute sources of export earnings instability. Thus this paper defines "return" and risk in terms of export earnings.

The rate of change in the annual dollar earnings of the commodity will be our measure of return. Thus we have,

$$\frac{X_t - X_{t-1}}{X_{t-1}} \tag{1}$$

where Xs are export earnings measured in current U.S. dollars, and the relevant period of measurement is one year.[2]

From here, we can proceed to build a time series of "rates of return." The next step is to obtain the mathematical expectations, variances, and covariances for the different commodities which comprise the export portfolio.

In our empirical measurements of portfolio efficiency, we will make use of both the Markowitz model and the single-index model (SIM). As Haugen (1986:122-137) explains, both models can be used to build the minimum variance set, their major differences being the formula used to compute the variance of the portfolio.

The expression for portfolio variance used in the Markowitz model

$$\sigma^2_{(r_p)} = \sum_{J=1}^{N} \sum_{K=1}^{N} x_J x_K \, \mathrm{Cov}(r_J, r_K) \tag{2}$$

where the xs are the proportions of the portfolio invested in each particular asset and N is the total number of securities in the portfolio. In our case, they mean the proportion of the export portfolio value accounted by each commodity and the number of commodities, respectively.

The Markowitz formula is precise; its major drawback is that the number of covariances to estimate becomes extremely large when the number of items in the portfolio grows large. This problem is not of major concern for us, insofar as an export portfolio has a relatively small number of items.

Alternatively, the single index model introduces the assumption that those covariances can be explained as a response to a common market factor. As a result, it assumes that the residuals for the different items (i.e., commodities and goods) are uncorrelated. The single index model's expression for the variance of the portfolio is

$$\sigma^2_{(r_p)} = \left(\sum_{J=1}^{N} x_J \beta_J\right)^2 \sigma^2_{(r_M)} + \sum_{J=1}^{N} x_J^2 \, \sigma^2(\varepsilon_J) \qquad (3)$$

where

$$\beta_J = \frac{\mathrm{Cov}(r_J, r_M)}{\sigma^2(r_M)} \qquad (4)$$

The number of covariances to be calculated drops dramatically with the use of the single-index model. The price to be paid, however, is that the estimated minimum variance set will not coincide with the true minimum variance set unless all the residuals are perfectly orthogonal.

The next step is to estimate several portfolios which belong to the minimum variance set. The upper portion of this set, of course, is the efficient set. The efficient frontier should be the benchmark measure of

success of an export diversification program. Portfolios located on the frontier dominate the portfolios located below it in a mean-variance sense.

One important implication is that we cannot tell ex ante that adding primarily manufactured goods to a less diversified portfolio will make it more efficient in a mean-variance sense.[3] Alternatively, different countries may feel that they can live with different levels of portfolio variance and still be able to position their export portfolios on the efficient frontier.

c. Data

The data were obtained from the "Yearbook of Trade Statistics," published by the United Nations. Three levels of the Standard International Trade Classification (SITC) were used, namely, three, four and five digit levels. This was done in order to reflect as much as possible the different categories of goods and commodities exported from Brazil. We obtained the time series of rates of change in export earnings for each SITC category and used them as rates of return. The time frame is 1970-1983, reflecting data availability and consistency (same source of data).

4. AN ILLUSTRATIVE EXAMPLE OF EXPORT DIVERSIFICATION: THE BRAZILIAN CASE

From the early 1930s until 1962, the Brazilian economic strategy was directed towards a model of industrialization based on import substitution (ISI), with virtually no attention to export promotion. This emphasis on ISI for approximately 30 years discouraged exports. Moreover, the general absence of incentives to export, combined with overvalued exchange rates and a lack of coordination among the existing agencies responsible for export promotion also contributed to a resulting slow expansion of exports.

In 1964, the Brazilian Government adopted a new growth strategy, which focused on export-led growth.[4] That strategy implied a switch of resources to export promotion, which was accomplished with the use of three major policy measures: a) a real depreciation of the cruzeiro, b) the creation of a wide range of export subsidies, and c) a reduction in protectionism.

Since that year, and as a result of an aggressive implementation of that export promotion policy, Brazil was able to diversify its export structure and increase markedly the number of its trading partners. Total exports rose from U.S. $1.214 billion in 1962 to U.S. $25.126 billion in 1983.

Table 1 shows the result of Brazil's move towards a more diversified export structure in the period 1968-1973. Table A1 in the Appendix spells out the Standard International Trade Classifications (SITCs) for some of the most important items comprising Brazil's export portfolio.

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As we can see, in 1968 the Brazilian exports were heavily concentrated on natural resource based goods (NRBGs). Taken together, food items, agricultural raw materials, as well as ores and metal accounted for about 93% of total export earnings, with manufactured exports responding for only 6.4%. In contrast, the 1983 export structure shows a different picture, with manufactured goods, fuels, ores and metal becoming the leading export products.

The Brazilian move toward a more diversified export structure is also reflected in Table 2. The Hirschman concentration index[5] in 1962 stood at the 0.513 level; by 1982 its value had dropped to only 0.140, indicating that a remarkable progress towards diversification of exports had been accomplished,

according to that measure. Moreover, the number of significant commodities comprising the export portfolio rose from 43 in 1970 to 162 in 1982.

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Put Table 2 here
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Therefore, according to that traditional measure of export diversification, the Brazilian program seems to have succeeded. However, according to our approach, the true measure of success of an export diversification effort is the ex post mean-variance performance of the export portfolio as measured by the Markowitz and the single index models. In the following section, we present the results of our empirical tests and or own evaluation of the Brazilian program.

5. EMPIRICAL RESULTS AND DISCUSSION

Our empirical investigation was concentrated on two major aspects. First, we examined the portfolios represented by the ten most important products in the years 1964 and 1985.[6] Next, we compared export portfolios formed by food items and ores (primary products) with portfolios formed by manufactured exports,[7] between the years 1970 and 1983.

a. Portfolio Analysis of the Ten Most Important Items

Table 3 presents the estimates for the expected return (in percentage terms) and the standard deviation of returns for the ten most important commodities in Brazil's export portfolio in the years 1964 and 1985. Recall that our measure of returns really means the rate of change in export earnings.

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The mean return and standard deviation of return figures for those commodities that were among the ten most important in both in 1964 and 1985 - coffee (071), cocoa (072), iron ore (281) - are, of course, the same. We immediately realize that, after two decades of an active diversification program, the composition of Brazilian exports has been tilted towards manufactured products.

Using the Markowitz model, we combined those commodities into optimum unlevered portfolios, that is, portfolios which lie on the minimum variance set.[8] In so doing, we permitted the existence of short sales. In this study this is interpreted as follows. A commodity held long is exported, while a commodity sold short is actually imported, perhaps with the intention of being reexported later at a more favorable price. The case of coffee is a typical example. In addition, a short position for a commodity in an optimal portfolio means that it should be imported.

We formed ten optimal portfolios, of which we report three, namely portfolios A, B and C. Portfolio A is the minimum variance portfolio (MVP). Portfolios B and C are further along on the efficient set. In particular, portfolio C is the one having the highest expected return of all optimal portfolios computed.

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One interpretation of the results in Table 4 is as follows. In hindsight, depending on the objective of the policymakers, the table shows the proportions to be "invested" in the portfolio comprised by the ten most important commodities in 1964 and 1985. For example, given the 1964 portfolio, if the intention was to minimize the variability of dollar earnings changes, it would have made sense to channel resources to promote fresh

fruits, nuts, etc., (051) and tobacco (121), while actually importing (i.e., "selling short") iron ore (281). If, however, the idea was to maximize the expected export earnings without regard to risk, then raw beet and cane sugar (0611) would be heavily promoted, while at the same time importing sugar and honey (061) from other producers.

Now let us look at the 1985 portfolio. Here one interesting result is obtained by comparing those three commodities (i.e., coffee, cocoa and iron ore) which are present in both 1964 and 1985. The results are very different. For portfolio A (the MVP), for example, the optimal proportion to be "invested" in coffee changes from 15.55% to 45.94%. In portfolio C, i.e., the high expected return/high risk portfolio, these proportions would change from 11.41% to 46.78%.[9]

In Table 5 the estimates for the expected return and standard deviation are summarized. The estimates seem to lend support to the general direction taken by the Brazilian export diversification program.

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In hindsight, over the two decades 1964-1983, the portfolio formed by the ten most important commodities in 1985 seems to have dominated its 1964 counterpart, regardless of the preferences of the policymakers with respect to the expected return-standard deviation tradeoff.

The analysis of the correlation matrix of returns on the ten most important items in 1964 and 1985 corroborates the results above. In Table 6, the number of correlations above 0.5 (positive or negative) dropped from 8 to 4; more important, the number of correlations above 0.33 (positive or negative)[10] drops from 17 to 6. That is, the earnings movements of the ten

most important products in the 1985 export portfolio are much less correlated than their 1964 counterparts. However, we again emphasize that we regard the mean-variance performance of the portfolios, not the evidence from correlations, as the primary measure of effectiveness of an export diversification program.

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Our inquiry now turns to a different question. In Brazil, to what extent has it been efficient (in a E-V sense) to channel a substantial portion, if not most, of the resources invested in the export diversification program to the promotion of manufactured exports, as opposed to primary products? We address this question below.

b. Portfolio Analysis of Primary vs. Manufactured Products[11]

In Tables 7 and 8, we present parameter estimates for the portfolios formed by the ten most important primary products and manufactured exports in the period 1970-1983, respectively. These estimates were obtained with the use of the Single Index Model (SIM). Thus the additional columns labeled "beta" and "residual standard deviation." The index chosen, as mentioned above, is represented by the aggregate of total Brazilian export earnings during that period.

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Put Tables 7 and 8 here
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As Tables 7 and 8 show, most of the ten most important primary products and all of the ten most important manufactured exports outperformed the index (i.e., their earnings increased more on the average). However, the standard

deviation of their returns is also higher, with the exception of tobacco (121). It is on the beta factors, however, that we should focus our attention. We find betas ranging from negative values(coffee, footwear and leather footwear) and low positive values (tobacco), to high positive values (soybeans, sugar and honey, trucks). Thus, we find a range of possibilities for inclusion in optimal portfolio.

We now proceed along the same lines of the previous subsection, with the exception that the estimates presented below were produced using both the Markowitz and the SIM. Again, although we have obtained estimates for ten optimum portfolios, we will present the results for only three, including the MVP and the portfolio which is further along on the efficient set.[12]

In Table 9 we present the estimates obtained with the Markowitz model. Part A shows the optimum unlevered portfolios formed using the ten most important products in the food items and ores category. Part B does the same for the ten most important manufactured exports. Portfolio A is the MVP and portfolio C is the high return/high risk portfolio. All three portfolios are on the minimum variance set.

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The interpretation of Table 9 is similar to that of Table 4. For example, to attain the MVP using the ten most important primary products, we would have to "hold long" (i.e., export) animal feeding stuff (081) at an average value which was more than three times the value of the portfolio during the period, while at same time "selling short" (i.e., importing) vegetable oil residues (0813) in about the same proportions. This pattern repeats itself in all ten portfolios estimated, not only in the three shown here. The message seems to

be that Brazil would do better in a portfolio sense by switching resources from the exports of vegetable oil residues into animal feeding stuff. By the same token, fresh and frozen meat (011) and tobacco (121) would have deserved to be supported.

With regard to manufactured exports, Table 9, part B suggests that footwear (851), motor vehicles (7328), and specialized machinery (718) would have an important role in an optimal portfolio, while leather footwear (85102) should actually be imported, regardless of the preferred risk-return tradeoff of the policymakers.

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The estimates for the optimum unlevered portfolios obtained with the use of the SIM are reproduced in Table 10. The results are disturbingly dissimilar to those of Table 9.[13] The most striking differences are in the results obtained for animal feeding stuff (081) and vegetable oil residues (0813). The SIM estimates suggests that both should be part of the optimum portfolios in relatively low proportions. In the portfolios of food items and ores, in addition, the SIM estimates corroborate the results obtained by the Markowitz model for tobacco, while the proportion for frozen meat (011) comes out much lower.

In the portfolio of manufactured exports, very different results came out for footwear (851) and leather footwear (85102). The results for specialized machinery (718) corroborate in general the Markowitz estimates, while the results for nonelectric machines (719) do not.

Since the SIM uses a formula for portfolio variance similar to the Markowitz model, with the important difference that in order to produce the

SIM estimates we need to produce an index, we suspect that the results above demonstrate the problems which can occur because the choice of an index is arguably an arbitrary decision.[14] We chose to report both set of estimates exactly to make this point clear to the reader. Although the estimates produced with the use of the SIM seem to be "better behaved," we have serious reservations to accepting them as more accurate.

Finally, with these caveats in mind, we present in Table 11 the estimates of expected return and standard deviation for the portfolios formed by primary and manufactured products, obtained with the use of both the Markowitz model and the SIM.

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The results in Table 11 support the assertion that, at least in the Brazilian case, a policy of export diversification which is biased towards the inclusion of manufactured products in the export portfolio may not be the most efficient. While both the Markowitz model and the SIM show that the portfolios of manufactured products had higher expected returns in the period 1970-1983, the standard deviations of those returns were uniformly higher. Thus, in a mean-variance sense, the choice of one or the other is a matter of personal preference. In fact, the only case of a dominated portfolio in Table 11 occurs when the MVP of primary exports dominates the MVP of manufactured exports, according the the Markowitz model estimates. We now present some concluding remarks.

6. CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

This study attempted to contribute to a growing body of literature which examines the export structures of countries in general, and the LDC attempts

at export diversification in particular, in a portfolio context. We have demonstrated that this approach is not only sound but eliminates some of the inconsistencies existent in traditional approaches such as the constant market share (CMS) approach and the Hirschman measure of concentration.

We focused our empirical investigation on the Brazilian export diversification and promotion program, which took effect mostly in the two decades from 1964 to 1983. We sought to test two major hypotheses, the first being whether or not the post-diversification export portfolio dominated the pre-diversification portfolio in a mean-variance sense, and the second relating to the relative efficiency of a manufactured-goods based export portfolio versus a portfolio comprised mainly by primary commodities. Our findings support the first hypothesis, but the evidence with respect to the second hypothesis is inconclusive.

One possible extension of this study is to examine the relative performance of export portfolios grouped according to their different markets, in an effort to examine the question as to whether or not the scarce resources used to encourage exports have been aimed at appropriate targets.

Another possible extension is to disaggregate the export portfolios according to regions of the exporting country in order to study the extent to which regional export diversification has been accomplished, which regions benefitted the most from incentives, and whether or not regional imbalances have been addressed.

ENDNOTES

[1]This section relies heavily on Haugen (1986), especially chapters 4, 5, and 7.

[2]This, of course, is a nominal measure, since no effort is made to convert end-of-period figures into constant numbers. Choosing a nominal measure is equivalent to choosing the lesser of two evils, since deflating end-of-period dollars would immediately present the problem of choice of deflator. In addition, the measurement of returns employed in the empirical studies with use of the mean-variance approach is also done in a nominal basis.

[3]However, in an normative sense, we will argue that our approach serves as a guide to policymakers which must deal with finite resources. In particular, possible additions to the export portfolio ought to be examined in light of the covariance of their returns with the existing portfolio. One problem is how to estimate the returns and covariances, since those products weren't previously in the export portfolio. This problem is akin to estimating returns to a stock that wasn't publicly traded before. One solution is to look at the stream of returns produced by the commodity in the international market. Then, we are left with problems relating only to products that have never been internationally traded before or for which there are no data.

[4]Export-led growth was not a new idea in Brazil. Throughout the history of that country, there were periods of growth centered on the production and export of a single commodity, e.g., sugar, gold, rubber, coffee. This time the challenge confronting the policymakers was the diversification of the export portfolio.

[5]See Albert O. Hirschman, National Power and the Structure of Foreign Trade, University of California Press, 1969, p. 98.

[6]For a description according to SITCs, see the Appendix, Table A1, part A.

[7]Table A1, part B, in the Appendix describes the different items.

[8]Recall that the efficient set is the upper portion of the minimum variance set.

[9]Of course, in actuality the importance of coffee in both the total export portfolio and among the ten most important commodities declined steadily between 1964 and 1985.

[10]We admit that the choice of these values for purposes of comparison is arbitrary.

[11]Table A1, part B in the Appendix shows the description of the SITCs for food items and ores and manufactured products.

[12]The export proportions for all ten optimum unlevered portfolios are available from the authors upon request.

[13]These differences do not seem to be caused by mistakes in data entry.

[14]In the Finance literature, what came to be known as Roll's critique identifies the problems which can occur with the empirical tests of the CAPM because of the choice of the index. See Roll (1977 and 1978).

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TABLE 1. EXPORT STRUCTURE BY MAIN CATEGORIES

	1968	1983
Total Value (Millions of dollars)	1,881.3	25,126.8
By main categories of export		
A. All food items (0+1+22+4)[1]	68.77%	43.85%
B. Agricultural raw materials (2-22+27+28)	14.92%	3.51%
C. Fuels (3)	0.03%	6.31%
D. Ores and metals (27+28+67+68)	9.25%	15.84%
E. Manufactured goods (5 to 8 less 67+68)	6.41%	28.59%
E.1 Chemical products (5)	1.44%	4.96%
E.2 Other manufactured goods (6+8)-(67+68)	2.79%	11.55%
E.3 Machinery and equipment (7)	2.10%	12.08%
F. Unallocated	0.62%	1.89%

Note: [1]SITC classifications.

Source: Handbook of international trade and development statistics, UNCTAD, 1985 Supplement.

TABLE 2. EXPORT CONCENTRATION INDICES - BRAZIL

	1962	1970	1982
Number of Commodities Exported[1]		43	162
Concentration Index[2]	0.513	0.335	0.140
Concentration Factor (1982/1970)		0.417	

Notes:

[1]Number of products exported at the three digit SITC level; this figure includes only those products whose earnings are greater than U.S. $50,000 in 1970 or U.S. $100,000 in 1982 or represent more than 0.3 percent of the country's total exports.

[2]Hirschman index normalized to yield values ranging from 0 (no concentration) to 1 (maximum concentration) according to the following formula:

$$C = \sqrt{\sum_{i=1}^{k} \left(\frac{c_i}{X_j}\right)^2}$$

where:

j = country index;
c_i = value of earnings from export commodity i;
X = total export earnings; and
k = number of products at the three-digit STIC level.

Source: Handbook of international trade and development statistics, UNCTAD, 1985 Supplement.

TABLE 3. EXPORT PORTFOLIOS - 1964 and 1985

TEN LARGEST ITEMS

1964

SITC	EXPECTED RETURN (%)	STANDARD DEVIATION
0.61	0.35	0.87
0611	0.36	0.93
051	0.14	0.17
071	0.16	0.48
072	0.18	0.50
121	0.24	0.18
263	0.60	1.41
2631	2.30	5.99
281	0.20	0.24
422	0.11	0.45

1985

SITC	EXPECTED RETURN (%)	STANDARD DEVIATION
071	0.16	0.48
072	0.18	0.50
0535	0.42	0.46
281	0.20	0.24
4212	6.85	22.00
732	0.57	0.84
851	0.53	0.68
2214	0.67	1.45
332	0.64	0.75
674	0.91	2.14

TABLE 4. EXPORT PROPORTIONS IN OPTIMUM UNLEVERED PORTFOLIOS (MARKOWITZ MODEL)

	1964		
Portfolio Commodity (SITC)	A	B	C
061	-5.78	-10.09	-63.77
0611	-0.63	3.59	56.04
051	53.21	51.11	24.95
071	15.55	15.25	11.41
072	-6.04	-6.55	-12.82
121	51.74	53.68	77.89
263	0.64	0.79	2.65
2361	1.35	1.31	0.76
281	-14.34	-13.71	-5.80
422	4.29	4.62	8.69

	1985		
Portfolio Commodity (SITC)	A	B	C
071	45.94	46.03	46.78
072	-1.59	-1.56	-1.26
0535	-51.87	-52.11	-54.17
281	33.37	33.16	31.39
4212	-0.49	-0.49	-0.48
732	6.03	6.03	6.04
851	42.40	42.60	44.28
2214	-11.28	-11.30	-11.45
332	40.23	40.37	41.62
674	-2.73	-2.73	-2.75

TABLE 5. EXPORTED PORTFOLIOS - TEN LARGEST ITEMS

EXPECTED RETURN AND STANDARD DEVIATION

		1964	
Portfolio	A	B	C
Return (%)	0.20	0.20	0.23
Standard Deviation	0.06	0.06	0.06
		1985	
Return (%)	0.30	0.30	0.31
Standard Deviation	0.04	0.04	0.04

TABLE 6. CORRELATION MATRIX OF BRAZILIAN EXPORTS

1964 Portfolio

SITC	061	0611	051	071	072	121	263	2631	281	422
061	1.0									
0611	.996	1.0								
051	.302	.300	1.0							
071	.118	.144	-.664	1.0						
072	.134	.124	.343	-.300	1.0					
121	.002	-.061	.355	-.506	.528	1.0				
263	.395	.435	.019	.076	.012	-.443	1.0			
2631	.640	.671	-.140	.435	-.276	-.488	.739	1.0		
281	.141	.093	.421	-.230	.296	.620	-.367	-.113	1.0	
422	.192	.166	.114	.093	.421	.075	-.125	-.162	.174	1.0

1985 Portfolio

SITC	071	072	0535	281	4212	732	851	2214	332	674
071	1.0									
072	-.145	1.0								
0535	-.291	-.060	1.0							
281	-.279	.232	-.178	1.0						
4212	-.123	-.209	-.060	.505	1.0					
732	-.192	.206	-.156	.113	.097	1.0				
851	-.247	-.167	.699	-.018	-.037	.135	1.0			
2214	.192	.001	-.154	-.040	-.051	.589	.154	1.0		
332	-.591	.077	-.344	.008	.243	.069	-.161	-.025	1.0	
674	-.163	-.043	.087	-.130	-.069	.058	-.040	-.167	.333	1.0

TABLE 7. PORTFOLIO OF FOOD ITEMS AND ORES EXPORTS

1970-1983

ESTIMATED MODEL PARAMETERS
(SINGLE INDEX MODEL)

SITC	EXPECTED RETURN(%)	STANDARD DEVIATION	BETA	RESIDUAL STAND.DEV.
Index	0.21	0.19	1.00	0.00
011	0.25	0.44	0.85	0.41
0535	0.42	0.46	0.17	0.46
061	0.35	0.87	2.02	0.77
071	0.16	0.48	-0.29	0.48
072	0.20	0.46	0.41	0.45
081	0.38	0.46	1.29	0.39
0813	0.39	0.47	1.36	0.39
121	0.24	0.18	0.04	0.18
2214	0.67	1.45	4.38	1.18
281	0.20	0.24	0.36	0.23

TABLE 8. PORTFOLIO OF MANUFACTURED EXPORTS

1970-1983

ESTIMATED MODEL PARAMETERS
(SINGLE INDEX MODEL)

SITC	EXPECTED RETURN(%)	STANDARD DEVIATION	BETA	RESIDUAL STAND.DEV.
512	0.43	0.52	0.94	0.48
651	0.33	0.46	1.33	0.38
718	0.22	0.33	0.58	0.30
719	0.30	0.34	0.47	0.33
729	0.32	0.44	1.08	0.38
732	0.57	0.84	1.58	0.78
7323	1.03	1.45	2.04	1.39
7328	0.31	0.46	0.90	0.43
851	0.53	0.68	-0.10	0.68
85102	0.60	0.93	-0.48	0.92
Index	0.21	0.19	1.00	0.00

TABLE 9. EXPORT PROPORTIONS IN OPTIMUM UNLEVERED PORTFOLIOS (MARKOWITZ MODEL)

A. PORTFOLIOS OF FOOD ITEMS AND ORES

Portfolio	A	B	C
SITC			
011	24.57	23.46	11.17
0535	7.07	7.02	6.55
061	-1.50	-0.76	7.41
071	9.23	9.10	7.65
072	9.92	8.89	-2.45
081	337.28	338.11	347.34
0813	-334.77	-333.77	-322.67
121	46.37	49.30	81.52
2214	1.66	1.24	-3.33
281	0.17	-2.60	-33.19

B. PORTFOLIOS OF MANUFACTURED PRODUCTS

Portfolio	A	B	C
SITC			
512	1.96	2.64	10.37
651	11.42	10.86	4.42
718	27.57	27.83	30.79
719	-8.35	-9.66	-24.54
729	7.72	7.81	8.75
732	-7.28	-6.58	1.34
7323	-16.21	-15.98	-13.39
7328	36.25	35.64	28.80
851	98.49	99.74	113.93
85102	-51.57	-52.29	-60.47

TABLE 10. PROPORTIONS IN OPTIMUM UNLEVERED PORTFOLIOS
SINGLE INDEX MODEL

A. PORTFOLIOS OF FOOD ITEMS AND ORES

Portfolio	A	B	C
SITC			
011	5.08	4.96	3.70
0535	6.30	6.74	11.38
061	0.00	0.01	0.04
071	7.33	7.19	5.78
072	5.99	5.64	4.07
081	3.60	3.87	6.79
0813	3.18	3.46	6.39
121	46.49	46.47	46.25
2214	-1.24	-1.16	-0.37
281	23.47	22.82	15.98

B. PORTFOLIOS OF MANUFACTURED PRODUCTS

Portfolio	A	B	C
SITC			
512	7.38	7.92	11.99
651	6.03	5.90	4.87
718	26.80	25.20	13.01
719	25.73	25.30	22.08
729	9.51	9.37	8.34
732	0.52	1.00	4.67
7323	-0.36	0.11	3.65
7328	10.00	9.81	8.37
851	8.75	9.32	13.67
85102	5.64	6.07	9.34

TABLE 11. EXPORT PORTFOLIO OF FOOD ITEMS AND ORES AND OF MANUFACTURED PRODUCTS - 1970/1983

A. FOOD ITEMS AND ORES			
A.1 MARKOWITZ MODEL			
Portfolio	A	B	C
Return(%)	0.23	0.23	0.27
Standard Deviation	0.07	0.07	0.08
A.2 SINGLE INDEX MODEL			
Return(%)	0.24	0.24	0.27
SIM Standard Deviation	0.12	0.12	0.13
True Standard Deviation	0.11	0.12	0.13
B. MANUFACTURED GOODS			
B.1 MARKOWITZ MODEL			
Portfolio	A	B	C
Return(%)	0.22	0.23	0.28
Standard Deviation	0.15	0.15	0.17
B.2 SINGLE INDEX MODEL			
Return(%)	0.33	0.34	0.41
SIM Standard Deviation	0.19	0.19	0.22
True Standard Deviation	0.28	0.29	0.36

APPENDIX

TABLE A1. STANDARD INTERNATIONAL TRADE CLASSIFICATION (SITC)

A. Ten Largest Items, 1964 and 1985

1964 Portfolio

- 061 = Sugar and honey
- 0611 = Raw beet and cane sugar
- 051 = Fruit fresh nuts fresh dry
- 071 = Coffee
- 072 = Cocoa
- 121 = Tobacco unmfd
- 263 = Cotton
- 2631 = Raw cotton, exc linters
- 281 = Iron ore, concentrates
- 422 = Fixed veg. oil nosoft

1985 Portfolio

- 071 = Coffee
- 072 = Cocoa
- 0535 = Fruit or vegetable juice
- 281 = Iron ore, concentrates
- 4212 = Soya bean oil
- 732 = Road motor vehicles
- 851 = Footwear
- 2214 = Soya beans, excl flour
- 332 = Petroleum products
- 674 = Irn, stl univ, plate, sheet

B. Food Items and Manufactured Portfolios, 1970/1983

Food Items and Ores

- 011 = Meat fresh, chilled, frozen
- 0535 = Fruit or vegetable juice
- 061 = Sugar and honey
- 071 = Coffee
- 072 = Cocoa
- 081 = Animal feeding stuff
- 0813 = Vegetable oil residues
- 121 = Tobacco unmfd
- 2214 = Soya beans, excl flour
- 281 = Iron ores, concentrates

Manufactured

- 512 = Organic chemicals
- 651 = Textile yarn and thread
- 718 = Machs for spcl industries
- 719 = Machines nes nonelectric
- 729 = Electrical machinery nes
- 732 = Road motor vehicles
- 7323 = Lorries, trucks
- 7328 = Motor vehicles parts nes
- 851 = Footwear
- 85102 = Footwear leather