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ABSTRACT

This study proposes to analyze the degree of success of export diversification programs across markets and the regional distribution of their benefits using the portfolio (mean-variance) approach first developed by Harry Markowitz. The methodology developed in this work suggests that the true measure of success of an export diversification program is the ex-post efficiency of the export portfolios across exports markets and the non-dominance of regional export portfolios. The Brazilian export diversification program is then analyzed under this perspective. The results are in contrast with those obtained with the use of more traditional methods of evaluation of export diversification programs.

BIOGRAPHICAL NOTES

- RAUL GOUVEA NETO is a Doctoral Candidate in Economics at the University of Illinois at Urbana-Champaign. A Brazilian, Mr. Gouvea Neto worked for the Getulio Vargas Foundation, a research and graduate institution headquartered in Rio de Janeiro.

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MARKET PERFORMANCE AND REGIONAL IMAPCT OF EXPORT DIVERSIFICATION STRATEGIES: A PORTFOLIO APPROACH

1. Introduction

Export diversification and promotion policies have been undertaken by many less developed countries (LDCs) in an effort to reduce their dependency on a few commodities and to decrease the attendant variability of their export earnings. In order to implement their policies, LDCs frequently rely on multinational enterprises (MNEs), state companies and private companies, as well as joint ventures of MNEs with domestic private or state-run businesses. In the case of MNEs, the inducements utilized by the government include tax breaks and subsidies, as well as promised improvements in infrastructure. In addition, the threat that some competitor will accept the deals is a negative inducement.

In exchange, MNEs are typically required to direct a substantial proportion of their production to export markets. Moreover, their particular target markets will also be of interest to the LDC's government. Another common requirement is that the new production facilities are to be located in a particular region of the country, in some cases a backward region away from markets and skilled labor force. That requirement is rationalized as a means of reducing the unequal distribution of fruits of the process of development.[1]

To the extent that this effort to diversify across export markets and to spread out the export industries in several regions of the country is successful, MNEs can benefit twice. First, they strengthen their position in the host country. Second, they receive a helping hand from

the government in their effort to open new markets for their products. If, however, the choice of target markets is poor and/or the drawbacks of locating in less dynamic regions of the host country cannot be overcome, the MNE will be stuck with costly and unprofitable investments.[2]

This study proposes to analyze the degree of success of export diversification programs across markets and the regional distribution of their benefits using the portfolio approach first developed by Markowitz (1952, 1959) and then refined over the next two decades by many Finance theorists and exhaustively tested in the context of financial markets.

In particular, we will direct our attention to the Brazilian case and will test two major hypotheses derived from the expected outcomes of an export diversification strategy:

H1: Major export markets in the post-diversification period are more "efficient" than secondary markets in a portfolio sense; and

H2: Regional export portfolios converge in their level of efficiency or, in other words, there is no dominance.

This paper will develop as follows. Section 2 addresses the rationale behind the undertaking of export diversification programs as a means of reducing the instability of export earnings. The section also reviews briefly the literature, especially recent contributions which use the portfolio approach. Section 3 presents a brief review of the Brazilian program of export diversification, which is the target of our empirical investigation. Section 4 explains our methodology. In Section 5 we present and discuss our empirical results. Finally, Section 6 contains our conclusions.

One of the tasks that we set out to accomplish in this study was to show that the portfolio approach to the investigation of export diversification is a good example of a topic to which we can bring together contributions in areas of inquiry, such as economic development and financial economics, which at first impression may be seen as far apart. In the next section, we present the case that this is not only possible but rational in the problem at hand. We also review some of the contributions of those who preceded us in this line of investigation.

2. Export Diversification and the Stability of Export Earnings

The instability of export earnings observed in LDCs has been attributed to the high degree of concentration of their export portfolios in a few primary products. That view has been held at least since Brainard and Cooper (1968), Mac Bean (1966) and Michaely (1962) and continues to enjoy widespread acceptance to this day.

That view implies that diversification of the LDC's export portfolio is an appropriate policy to address the problem of export earnings instability. Not surprisingly, it quickly won supporters in many LDC governments. The most important empirical problem which that view presents is how to measure the degree of export diversification. One widely accepted yardstick is the Gini-Hirschman concentration index, introduced by Hirschman (1969:98). The index can be expressed as follows, with the result being interpreted as a percentage:

$$C = 100 \sqrt{\sum_{i=1}^{k} \left(\frac{c_i}{X_j}\right)^2} \qquad (1)$$

where i = commodity index;

j = country index;

c_i = value of export earnings from commodity c;

X = total export earnings; and

k = number of items in the export portfolio.

Decreases in the concentration index, therefore, are interpreted as proof of the success of the export diversification programs. Notice, however, that the index says nothing about the covariance between the export earnings of different commodities. It is possible that, if those streams of export earnings are highly correlated, the resulting variance of earnings of the export portfolio may not decrease substantially. Thus, according to the Gini-Hirschman index, diversification would have been accomplished when in actuality export earnings would still experience a high degree of variability.

We content that the appropriate measure of the success of export diversification policies is the development of diversified export portfolios (across markets and regions) which dominate the pre-diversification portfolios in a Markowitz (or mean-variance) sense. Accordingly, our empirical estimates will be produced with the use of the Markowitz model and the single index model (SIM), developed initially by Sharpe (1963, 1964).

Recent contributions in the economic development literature such as those by Mac Bean and Nguyen (1980) and Love (1983, 1984) have explored this view to the analysis of export diversification programs. Most recently, this approach was applied by Gouvea Neto and Vasconcellos (1987)

to the investigation of Brazilian case, focusing primarily on the performance of the most important products, as well as the portfolio performance of manufactured goods versus primary products.

We will present our methodology in some detail below. First, however, it is necessary to present in brief strokes an overview of the Brazilian case.

3. Overview of the Brazilian Export Diversification and Promotion Program

The Brazilian effort towards export diversification is relatively recent, since it dates back to 1964. Before that year, for a period of roughly three decades, Brazil followed a model of industrialization based on import substitution (ISI). As a result, little attention was paid to the development of export markets and to the diversification of the export portfolio.

Since 1964, however, there has been a concerted effort directed to the development of external markets. The Brazilian program was primarily based on a combination of policies such as a) real devaluations of the currency, b) the creation of a broad range of export subsidies and tax incentives, and c) a reduction in protectionism.

By some measures, the Brazilian strategy has been remarkably successful. The total dollar value of exports rose from US $1.214 billion in 1962 to US $1.881 billion in 1968 and US $25.126 billion in 1982. Furthermore, the participation of manufactured goods in the export structure rose from 6.41% in 1968 to 28.59% in 1983.[3] The estimates of the Gini-Hirschman concentration index corroborate these results. That

measure, which stood at 51.3% in 1962,[4] decreased to 33.5% in 1970 and to 14% in 1982.[5]

Some researchers take issue with those measures, however. Gouvea Neto and Vasconcellos (1987) found that a portfolio formed by the ten most important items in the 1985 Brazilian export portfolio did seem to outperform its 1964 counterpart in a Markowitz sense. However, they also found that not only the portfolio of manufactured exports does not dominate a portfolio made of food products and ores (primary products), but the contrary may actually have happened, since the minimum variance portfolio (MVP) of primary products dominates a correspondent one formed by manufactured goods. Furthermore, the composition of optimum portfolios suggests that, for some commodities which were part of the export portfolio during the period, the optimal policy seemed to be one of importing them while freeing resources for the support of other products. These results add a cautionary note to the bright picture painted by the more traditional measures. This study investigates the Brazilian program with regard to export markets and the regional export portfolios. We now devote our attention to a brief description of our method and data.

4. Methodology[6,7]

a. The portfolio approach

We seek to apply the portfolio approach developed by Finance theorists to the export diversification problem. Our analog to the securities portfolio is the export portfolio. Accordingly, the different items comprising the foreign trade of a country are the equivalent of individual securities. They can be "held long" (i.e., exported) or "sold short" (imported). Thus, long positions in an optimal portfolio

means that the country should be exporting the good or service; short positions means that it should have been imported. The same reasoning applies to export markets.

We use export earnings, as opposed to prices or quantities. Variations in prices and volumes are both sources of export earnings instability. We do not attempt to dissociate the two.[8] Thus, this study defines return and risk in terms of export earnings.

Our measure of return is the rate of change in annual dollar earnings from the commodity. This can be expressed as $(X_t - X_{t-1})/X_{t-1}$, where the X's are exports earnings measured in current U.S. dollars.[9] We then construct time series of rates of return, from which we extract the expected values and build a covariance matrix.

We proceed to use the Markowitz and the single index model (SIM) to construct the minimum variance set.[10] These two models are conceptually different. The Markowitz model uses a precise formula to compute the portfolio variance, which can be expressed as

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

where the x's are the proportions invested in each asset (i.e., good or commodity) and N is the total number of items in the portfolio. Notice that as the size of the portfolio increases, the covariance matrix becomes very large. This is a major problem with the Markowitz model, which led to the development of the SIM.[11]

To circumvent this problem, the single index model assumes that a common market factor explains the observed covariances. It follows that the residuals for the different securities are assumed to be uncorrelated. Then, the computation of the portfolio variance reduces to

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

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

Notice that the number of covariances to be computed is drastically reduced. However, the SIM produces approximate results; the estimated minimum variance set will only coincide with the true minimum variance set when all residuals are uncorrelated. More important, it introduces the problem of choosing a proxy for the market index. Richard Roll (1977, 1978) discussed the problem at length in what became known as Roll's critique. In this work, the chosen index is comprised by the nominal dollar value of all Brazilian exports for the years under study.

Using both the Markowitz and the SIM, we estimate several portfolios which belong to the minimum variance set. We propose that the correct measure of success of an export diversification program is the extent to which the export portfolio, both in general and disaggregated across products markets and exporting regions, moves towards the efficient set. At a minimum, the post-diversification portfolio should dominate the pre-diversification portfolio in a Markowitz sense. We now proceed to describe our data.

b. The data

We obtained the data from the "Yearbook of Trade Statistics," published by the United Nations. We used three levels of the Standard International Trade Classification (SITC), namely, the three, four, and five digit levels. Our purpose here was to obtain the most accurate

description possible of the different export portfolios which form the basis of our empirical work. The Appendix presents a description of SITCs broken down according to major items, primary goods vs. manufactures, and regional exports.

From those data, we computed the time series of rates of change in exports earnings for each SITC category. As explained above, we interpreted them as our series of rates of return. We then proceeded to build covariance matrices according to export markets and regional exports.

The data encompass for the most part the period 1970-1985. That time frame was primarily dictated by data availability and our desire to work with a consistent source of data. The next section presents the results of our empirical investigation.

5. Results and Discussion

As a background to the discussion of our results, we start by presenting some recent trends and prospects of Latin American foreign trade and the Brazilian position in particular. This helps to put the Brazilian quest for new markets in perspective. Table 1 shows the recent value growth rates of Latin American and Brazilian exports, as well as projections until the turn of the century. Growth rates for some major commodities in the Brazilian export portfolio are also presented.

INSERT TABLE 1 HERE

The figures in Table 1 show marked optimism with respect to the projected increase in value of Latin American exports, as well as Brazil's, despite the poor showing of recent years. The Table also highlights some extreme changes in values in major export commodities.[12]

The volume growth rates presented in Table 2 show a more subdued picture. Brazil's export volume is expected to grow by a lower percentage than Latin America's. Taken together, the aggregate data of Tables 1 and 2 seem to suggest that the projected value growth of exports from Latin America and Brazil in particular will come from price appreciation. Table 2 also indicates that, with respect to major commodities exported by Brazil, some of the wild swings in value growth rates observed in the previous Table were accompanied by equally extreme variations in volume exported.

INSERT TABLE 2 HERE

Given projections in Tables 1 and 2, the figures shown in the next table are of particular relevance for the objectives of this study. Table 3 shows recent growth rates and projections for major markets for Latin American exports. It is important to note that Latin American exports, and Brazil's in particular, will face strong competition for market share, given the relatively low projected growth rates of their major export markets for the rest of this century. This point is especially relevant in the context of our portfolio analysis of the Brazilian export diversification program across markets.

INSERT TABLE 3 HERE

We now proceed to report the results of our empirical investigation of the Brazilian export diversification program. As mentioned before, our analysis was performed in two levels, namely, relating to the diversification of export markets and to regional export portfolios.

a. Export markets

We specify two sets of export markets, which can be distinguished due to their unequal weight in the present composition of Brazil's foreign trade. The first set is comprised of the major markets, i.e., markets to which Brazil sent a comparatively larger share of its exports in the year of 1985. These markets include Latin America (ALADI), the U.S., Eastern Europe, the EEC, Asia, and Africa. The second set is comprised by markets to which Brazilian exports have not been quite as substantial as those to major markets. We call this set secondary markets; it includes the Caribbean (CACM), Canada, the EFTA, the Middle East, and Oceania.

We obtained estimates for ten optimum unlevered portfolios, each of them mapping one point on the efficient set. However, mindful of space limitations, we report the results with respect to only three of them, including the minimum variance portfolio (MVP - portfolio A), and the portfolio which is farther along on the efficient set, called for simplicity the high return/high risk portfolio (portfolio C).[13]

Table 4 presents parameter estimates--expected return and standard deviation of return--obtained for the major markets (part A) and secondary markets (part B), in the period 1979-1985. These estimates were obtained with the use of the single index model (SIM), thus the column "residual standard deviation."

INSERT TABLE 4 HERE

An examination of the results in Table 4 reveals that exports to developed countries or areas have lower systematic risk than exports to LDCs and Eastern Europe. The exception is Asia, but Japan is included there. This makes sense, since LDCs tend to have a comparatively higher variability in their export earnings, which effects their ability to import. Three export markets should be singled out because of their high expected returns but low betas: among the major markets, Asia (which includes Japan); among the secondary markets, Canada and Oceania (primarily Australia and New Zealand). These results have implications for the future orientation of Brazil's export diversification efforts.

We now turn to the optimum unlevered portfolios. Recall that, in our approach, long (i.e., positive) positions means that the particular markets would indeed be part of the efficient portfolio. Conversely, a short (i.e., negative) position means that during the period Brazil should have, on balance, imported from that particular market, not exported to it, to attain portfolio efficiency in the Markowitz sense. First we present the evidence relating to major export markets, as estimated by the Markowitz and the single index models. We then do the same for the secondary markets. Notice that portfolios A, B, and C represent different choices made by the policymakers. In particular, the choice of portfolio A (the MVP) amounts to a desire of minimizing the overall portfolio variance of export earnings; likewise, portfolio C translates the choice of a portfolio leading to high expected export earnings but also high variability of earnings.

INSERT TABLE 5 HERE

Table 5 shows the results for the major markets. The estimates from the two models converge for the most part. They suggest that, in the period 1970-1983, in order to attain an efficient portfolio across major markets Brazil should have run trade deficits with the rest of Latin America, Eastern Europe and Africa and concentrated its export incentives in the EEC area. Notice, in addition, the comparatively small participation of the U.S. market in the optimal portfolios. These findings seem to indicate that the substantial efforts made by Brazil to gain new markets were not necessarily conducive to a more efficient export portfolio. The major discrepancy between the estimates from the two models is found for Asia; since the SIM relies on assumptions which were discussed above, we tend to have a higher degree of confidence in the estimates obtained with the Markowitz model.

The evidence relating to secondary markets is presented in Table 6 below. The results from the Markowitz model (part A) and the SIM (part B) are similar. In order to attain portfolio efficiency, regardless of the preferred mean-variance tradeoff of the policymakers, Brazil would have directed resources towards enlarging its markets in the EFTA, Canada and Oceania, while actually running deficits with the Caribbean and the Middle East.

INSERT TABLE 6 HERE

Taken together, the evidence seems to indicate that the deliberate Brazilian effort to penetrate the Latin American, Caribbean, African and Middle Eastern markets cannot be justified on efficiency grounds.

INSERT TABLE 7 HERE

Table 7 summarizes and compares the estimates of expected return and standard deviation of return for major and secondary markets. The Markowitz model estimates suggest that the risk-return trade-off of the secondary markets is more favorable than that of the major markets, while the SIM estimates are inconclusive. The only case of portfolio dominance occurs when the high return/high risk portfolio of the secondary markets dominates its counterpart in the major markets, according to the Markowitz model estimates.

These results are corroborated by the correlation matrices in Table 8 below. The number of correlations above 0.5 in the major markets matrix is nine, while in the secondary markets matrix is only five.[14] While in our approach we don't give primary emphasis to the number of correlations per se, this result does confirm the notion that those markets which are presently secondary in the distribution of Brazilian exports should be given more attention by the policymakers.

INSERT TABLE 8 HERE

We now turn to the empirical evidence relating to the second major objective of this study, namely, the assessment of the efficiency of regional export portfolios made of the ten most important commodities expected by the South, Southeast, and Northeast regions of Brazil. Table C in the Appendix presents a description of those items according to their SITCs.[15]

b. Regional exports

As we discussed in previous sections, one of the declared objectives of export diversification and promotion programs in general and certainly of the Brazilian program in particular has been to ease regional disparities by providing incentives to firms geared to export markets to locate in backward regions of the country. Thus, we would expect that, if those programs are successful in this regard, the regional export portfolios would show similar levels of efficiency in the Markowitz sense.

In Table 9 below we present the estimated parameters obtained with the use of the SIM for the ten most important goods and commodities from the South, Southeast, and Northeast regions, respectively.[16]

INSERT TABLE 9 HERE

Our primary interest lies with those items which produce better expected returns than the index but whose betas are lower than unity or negative. Among the ten most important commodities from each region, the evidence shows that, in the South, five of them (011, 121, 851, 85102, and 652) fit this description. In the Southeast, we also find five (011, 0535, 671, 673 and 7328), but only three (0612, 0723, 5122) in the Northeast. Notice also the large negative betas estimated for soybean oil (4212-South) and steel products (675-Southeast). Since the export earnings of those commodities move against the index, they offer a useful counterweight, despite their high earnings variability. No such items exist in the Northeast's export portfolio.

In the following three tables, we look into the optimal portfolios estimated of each region under study, both with the use of the Markowitz model and the SIM. Again, we report the results for three out of the ten portfolios that we have estimated, including the MVP (portfolio A) and the high return/high risk portfolio (portfolio C).[17]

Table 10 presents the results for the South region. For the most part, the Markowitz model and the SIM produce consistent estimates, with the notable exception of footwear (851) and leather footwear (85102). For reasons already explained, we tend to rely more on the Markowitz model estimates. The MVP and portfolio B suggest long positions in footwear (851), tobacco (121) and coffee (071), while "selling short" (i.e., importing) leather footwear (85102). The high return/high risk portfolio reverses the results for footwear and leather footwear.

INSERT TABLE 10 HERE

In addition, an interesting result produced by both models are the very low (and frequently negative) proportions suggested for soybeans (2214) and soybean oil (4212). These are major cash exports not only for the region, but for Brazil as a whole.[18] Looking back to their betas in Table 9, we see that the beta for soybeans is high and positive, which might explain the above result, but the beta for soybean oil is extremely high and negative, which would tend to reduce the portfolio's variance. One explanation for this result might be the choice of the index, since we did not compute regional indexes. However, the Markowitz model does not need an index. Yet the two models produce

similar results. For lack of a better explanation, we take this result as anomalous.[19]

The results for the Southeast region are presented in Table 11. Notice that three commodities, namely, fresh and frozen meat (011), coffee (071), and soybeans (2214) figure among the ten most important for both the South and the Southeast regions.

INSERT TABLE 11 HERE

Here the estimates from the Markowitz model and the SIM are widely different. While for consistency we report both, we would like to focus on the Markowitz model estimates. The results suggest that, regardless of the preferred risk-return tradeoff of the policymakers, an optimal export portfolio for the Southeast region will be long in iron ore concentrates (281), coffee (071), iron and steel shapes (673) and road motor vehicles, while pig iron (671), motor vehicles parts (7328) and fresh and frozen meat (011) should actually be imported (i.e., "sold short"). In particular, resources channeled to the latter should be switched to supporting more heavily the exports of iron ore concentrates. In addition, notice that the role of soybean flour (2214) is also relatively minor in the optimum portfolios. This is not surprising for the Southeast region, however, since the earnings from that commodity do not weight as heavily in the region's export portfolio as they do in the South region.

INSERT TABLE 12 HERE

In Table 12 we present the optimum unlevered portfolios estimated for the Northeast region. Again, we will restrict our comments to the Markowitz model estimates. They show that an optimum export portfolio from the Northeast would be long in nuts coco, Brazil cashew (05171), transistors and other electronic components (7293), shell fish fresh and frozen (0313), while "selling short"--i.e., redirecting resources from and importing--sugar and honey (061) and cocoa butter and paste (0723). This is a tough policy assignment, since many of the established agricultural interests in that region are related to sugar and cocoa, which implies political clout and resistance to change.

The final and most important measure of the accomplishments of export diversification programs across regions of the exporting country is how those regional portfolios stack against one another. A successful program produces regional export portfolios which converge in their level of efficiency. In other words, we do not expect to observe dominant and dominated portfolios. If we find that some regional portfolios dominate others, however, we consider that prima facie evidence of the failure of the export diversification program to distribute internally the fruits of export earnings growth.

INSERT TABLE 13 HERE

Table 13 above summarizes the evidence in this regard. It presents risk and return estimates produced by both the Markowitz model and the SIM for the South, Southeast and Northeast regions. The results, unfortunately, show that the Brazilian program failed to redistribute internally the fruits of export growth. To put it bluntly, one of the

outcomes of Brazil's export promotion policies seems to have been the perpetuation of regional disparities.

The Markowitz model estimates produce neatly stacked results, regardless of the preferred risk-return tradeoff of the policymakers. The Southeast export portfolio[20] dominates the South's, which in turn dominates the Northeast's. The SIM estimates reverses the order for the Southeast and South portfolios, but both dominate the Northeast portfolio. After two decades of resources poured into export diversification and promotion, and much lip service paid to the need for lifting the Northeast from its backwardness, our results show that the Northeast's export portfolio is not only less dynamic but much less efficient, in the Markowitz sense, than its South and Southeast counterparts. We now proceed to present our concluding remarks.

6. Conclusions

This study has shown that the portfolio approach is a viable and theoretically defensible framework to analyze export diversification and promotion strategies. We have demonstrated that the true measure of success of such programs is the ex-post efficiency of the export portfolios, in a Markowitz (mean-variance) sense.

We used the Brazilian case to exemplify the empirical application of the portfolio approach. In particular, we looked into the degree of diversification and portfolio efficiency achieved across markets and regions of the exporting country. Our results have demonstrated that the much-heralded success of the Brazilian program during the two decades between 1964 and 1983 must be taken with a grain of salt. The

risk-return tradeoffs offered by the secondary markets for Brazilian exports are actually better than those achieved for the major markets, that is, those markets to which the export diversification and promotion efforts have been directed for the most part.[21]

Perhaps more important, our research shows that the Brazilian program failed to produce regional export portfolios which converge in their level of efficiency. This cannot be considered a measure of success for all export diversification programs, since it is conceivable to imagine a country having one or more regions actively engaged in international trade, while others produce primarily for the internal market. In the Brazilian case, however, much has been made from export diversification and promotion as a way of reducing the disparities between the impoverished Northeast and the more developed regions of the Southeast and South. Our results show that, after two decades, the export portfolio of the Northeast is much less efficient than its counterparts of the Southeast and South, despite massive tax incentives and subsidies.

Taken together, the findings in this study suggest that the careful choice of markets and regional location is important for the success of export promotion programs. Moreover, we have in general demonstrated that the portfolio approach lends itself to a more careful analysis than traditional measures of export diversification.

NOTES

[1]For example, in the Brazilian case the impoverished Northeast region and the North (Amazon) region are the most frequent beneficiaries of federal incentives. There is a federal agency in charge of overseeing development programs in the Northeast (SUDENE) and a similar one for the Amazon (SUDAM). Some critics, however, contend that in some cases the technology employed in new industrial projects is capital-intensive, thus contributing little to absorb and educate the abundant but poorly skilled local labor force.

[2]For example, recall the legendary rubber plantations owned by Henry Ford in the Amazon in the beginning of the century. More recently, Daniel K. Ludwig had multibillion dollar losses when he tried for years to turn on a profit in an industrial complex he built in that region. The venture was finally sold to local industrialists.

[3]United Nations, UNCTAD, Handbook of International Trade and Development Statistics, 1985, Supplement.

[4]A measure of 100% in the index means that one single product or market accounts for all export earnings. A result of 0%, of course, means that export earnings are equally distributed across different products or markets.

[5]See footnote 3 above.

[6]For a more comprehensive description, which includes a comparison with constant market share (CMS) analysis, we refer the reader to Gouvea Neto and Vasconcellos (1987).

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

[8]This is analogous to the observation of security returns as opposed to the investigation of the random process generating returns.

[9]This, of course, is a nominal measure. Gouvea Neto and Vasconcellos (1987, footnote 2) discuss this point.

[10]The upper part of the minimum variance set is the efficient set.

[11]This, however, is not a major problem in this study, since the number of items in the export portfolio is comparatively small.

[12]For a comparison of the portfolio performance of primary versus manufactured goods, see Gouvea Neto and Vasconcellos (1987).

[13]The complete set of results is available from the authors upon request.

[14]The choice of 0.5 as a reference point is necessarily arbitrary.

[15]The choice of regions is not accidental. The Southeast and South regions are industrialized; the Northeast is impoverished. Furthermore, much lip service has been paid in Brazil to the need for better distributing the fruits of the industrialization and development process across regions. We set out to investigate the extent to which the regional diversification of exports resists the efficiency test. If it turns out that some regional export portfolios are dominated, this can be interpreted as evidence that those efforts have been misdirected.

[16]Recall that the index is represented by all Brazilian exports, that is, the aggregate of the country's five major regions, not only the three regions under study.

[17]Footnote 13 above applies.

[18]Both are included among the ten most important items in Brazil's export portfolio. See Table A in the Appendix.

[19]These results do not seem to be caused by mistakes in data entry.

[20]The Southeast region includes the highly industrialized state of Sao Paulo.

[21]Those major markets account for approximately 70% of all Brazilian export earnings.

REFERENCES

William C. Brainard and Richard N. Cooper (1968). "Uncertainty and Diversification in International Trade," Food Research Institute Studies in Agricultural Economics, Trade and Development 8, No. 3, pp. 256-285.

Robert A. Haugen (1986). Modern Investment Theory. Englewood Cliffs, N.J.: Prentice-Hall.

Albert O. Hirschman (1969). National Power and the Structure of Foreign Trade. Berkeley and Los Angeles: University of California Press.

James Love (1983). "Concentration, Diversification and Earnings Instability: Some Evidence on Developing Countries' Exports of Manufactures and Primary Products," World Development 11, No. 9, pp. 787-793.

_____ (1984). "A Model of Trade Diversification Based on the Markowitz Model of Portfolio Analysis," The Journal of Development Studies 20, pp. 233-241.

A. I. Mac Bean (1966). Export Instability and Economic Development. Cambridge, MA: Harvard University Press.

_____ and T. N. Nguyen (1980). "Commodity Concentration and Export Earnings Stability: A Mathematical Analysis," Economic Journal, pp. 354-362.

Harry Markowitz (1952). "Portfolio Selection," The Journal of Finance VIII (March), pp. 77-91.

_____ (1959). Portfolio Selection: Efficient Diversification of Investments. New Haven, Conn.: Yale University Press.

M. Michaely (1962). Concentration in International Trade. Amsterdam: North-Holland.

Raul Gouvea Neto and Geraldo M. Vasconcellos (1987). "Do Export Diversification Policies Survive the Portfolio Test?" Working Paper, University of Illinois, September.

Richard Roll (1977). "A Critique of the Asset Pricing Theory's Tests--Part I: On Past and Potential Testability of the Theory," Journal of Financial Economics 4 (March), pp. 129-176.

_____ (1978). "Ambiguity When Performance is Measured by the Securities Market Line," The Journal of Finance XXXIII (September), pp. 1051-1069.

William F. Sharpe (1963). "A Simplified Model for Portfolio Analysis," Management Science 9 (January), pp. 277-293.

_____ (1964). "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk," The Journal of Finance XIX (September), pp. 425-442.

APPENDIX

MAJOR ITEMS IN THE BRAZILIAN EXPORT PORTFOLIO ACCORDING TO THEIR STANDARD INTERNATIONAL TRADE CLASSIFICATIONS (SITCs)

A. Ten Largest Items 1964 and 1985

1964 Portfolio

061 = Sugar and honey
0611 = Raw beet and cane sugar
051 = Fruit frsh nuts frsh dry
071 = Coffee
072 = Cocoa
121 = Tobacco unmfd
263 = Cotton
2631 = Raw cotton, excl 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

C. Regional Exports Portfolios--South, Southeast and Northeast

South

011 = Meat fresh, chilled, frozen
071 = Coffee
121 = Tobacco unmfd
2214 = Soya beans, excl flour
4212 = Soya bean oil
332 = Petroleum products
851 = Footwear
85102= Footwear leather
651 = Textile yarn and thread
652 = Cotton fabrics

Southeast

011 = Meat fresh, chilled, frozen
071 = Coffee
0535 = Fruit or vegetable juice
2214 = Soya beans flour
671 = Pig iron
673 = Iron and steel shapes
674 = Irn, stl univ, plate, sheet
732 = Road motor vehicles
7328 = Motor vehicles parts nes
281 = Iron ore concentrates

Northeast

0313 = Shell fish fresh, frozen
0517 = Nuts coco, Brazil cashew
061 = Sugar and honey
0612 = Refined sugar
0721 = Cocoa beans raw roasted
0723 = Cocoa butter and paste
332 = Petroleum products
5122 = Alcohols, phenols, etc.
221 = Oil seeds, nuts, kernels
7293 = Transistors, valves, etc.

TABLE 1. Export Value Growth Rates of Latin America's Major Commodities, 1980 - 2000

(Average annual percentage change in dollar values)

	Historical				Projected	
	1980-84	1985	1986	1987	1988-90	1991-2000
Latin America	-0.6	-0.6	9.2	9.0	10.8	10.2
Brazil	5.2	-11.0	-2.5	8.5	12.4	11.0
Sugar	35.8	-55.5	28.5	49.5	10.8	6.4
Coffee	9.7	1.7	-12.5	3.7	14.0	9.3
Cocoa	-9.7	44.4	-3.9	4.3	7.7	6.2
Soybeans	8.5	-47.7	16.7	14.1	11.3	11.5
Cotton	517.4	3.2	32.2	25.9	14.4	15.1
Iron Ore	5.4	3.8	-0.5	7.1	11.9	13.8
Maize	740.7	-15.1	2.6	8.3	5.1	8.1

Source: Commodity Export Prospects of Latin America, Inter-American Development Bank, 1986.

TABLE 2. Latin America: Export Volume Growth Rates of Major Commodities, 1980-2000

(Average annual percentage change)

	Historical				Projected	
	1980-84	1985	1986	1987	1988-90	1991-2000
Latin America	2.2	0.4	-0.4	4.8	5.7	5.1
Brazil	7.4	2.3	-8.0	4.4	5.0	5.0
Sugar	3.7	-28.0	3.3	3.6	3.8	3.5
Coffee	13.6	-1.7	-28.2	1.7	4.7	5.3
Cocoa	-5.7	59.9	-7.5	-6.4	2.0	1.4
Soybeans	9.7	13.2	12.5	10.0	6.2	4.1
Cotton	654.4	29.1	23.9	19.1	10.4	9.8
Iron Ore	4.1	6.0	0.5	3.8	5.4	5.9
Maize	1478.7	1.7	1.9	2.0	2.3	2.7

Source: Commodity Export Prospects of Latin America, Inter-American Development Bank, 1986.

TABLE 3. Growth Rates of Real Imports of Major Latin American Export Markets, 1980-2000

(Average annual percentage change)

	Actual					Projected	
	1983	1984	1985	1986	1987	1988-90	1991-2000
USA	5.4	12.7	1.6	1.3	4.3	3.4	4.1
Japan	-12.3	10.9	7.1	6.0	5.9	3.8	3.8
EEC	-3.8	1.4	4.7	4.6	3.2	3.4	4.0
All major markets	-2.3	4.8	4.1	4.6	4.5	3.5	4.0

Source: Commodity Export Prospects of Latin America, Inter-American Development Bank, 1986.

TABLE 4. Brazilian Export Markets, 1979/1985

A. Major markets

Estimated Model Parameters
(Single Index Model)

Markets	Expected Return (%)	Standard Deviation	Beta	Residual Stand. Dev.
Index	0.11	0.16	1.00	0.00
ALADI	0.10	0.36	1.95	0.17
USA	0.15	0.20	0.76	0.16
E.EUROPE	0.08	0.27	1.34	0.17
EEC	0.08	0.10	0.55	0.04
ASIA	0.16	0.13	0.67	0.07
AFRICA	0.21	0.39	2.03	0.22

B. Secondary Markets

Estimated Model Parameters
(Single Index Model)

Markets	Expected Return (%)	Standard Deviation	Beta	Residual Stand. Dev.
Index	0.11	0.16	1.00	0.00
CACM	0.08	0.45	1.95	0.32
CANADA	0.17	0.19	0.93	0.12
EFTA	0.06	0.18	0.72	0.14
MIDDLE E.	0.26	0.37	1.58	0.28
OCEANIA	0.16	0.24	1.16	0.16

TABLE 5. Export Proportions in Optimum Unlevered Portfolios

- Major Markets -

A. Markowitz Model

Portfolio	A	B	C
ALADI	-23.99	-23.93	-20.53
USA	16.04	15.90	8.13
E.EUROPE	-12.58	-12.95	-33.55
EEC	163.04	161.88	96.39
ASIA	-38.00	-36.51	47.24
AFRICA	-4.51	-4.39	2.33

B. Single Index Model

Portfolio	A	B	C
ALADI	-15.11	-15.33	-21.97
USA	3.27	3.56	12.32
E.EUROPE	-6.16	-6.37	-12.64
EEC	101.12	99.07	37.22
ASIA	26.78	28.72	87.29
AFRICA	-9.90	-9.65	-2.22

TABLE 6. Export Proportions in Optimum Unlevered Portfolios

- Secondary Markets -

A. Markowitz Model

Portfolio	A	B	C
CACM	-58.65	-58.65	-58.64
CANADA	78.84	78.97	81.76
EFTA	64.14	63.90	58.75
MIDDLE E.	-32.40	-32.34	-31.05
OCEANIA	48.07	48.12	49.19

B. Single Index Model

Portfolio	A	B	C
CACM	-10.42	-11.17	-27.30
CANADA	50.01	51.94	93.52
EFTA	53.19	50.18	-14.68
MIDDLE E.	-5.70	-4.40	23.68
OCEANIA	12.91	13.44	24.78

TABLE 7. Brazilian Export Markets, 1979-1985

A. Major Markets			
A1. Markowitz Model			
Portfolio	A	B	C
Return (%)	0.04	0.05	0.12
Stan Dev	0.03	0.03	0.04
A2. Single Index Model			
Return (%)	0.08	0.08	0.15
SIM Stan Dev	0.07	0.07	0.09
True Stan Dev	0.07	0.07	0.08
B. Secondary Markets			
B1. Markowitz Model			
Return (%)	0.12	0.12	0.13
Stan Dev	0.04	0.04	0.04
B2. Single Index Model			
Return (%)	0.12	0.12	0.23
SIM Stan Dev	0.15	0.15	0.22
True Stan Dev	0.13	0.13	0.18

TABLE 8. Correlation Matrix of Brazilian Export Earnings Across Markets

A. Major Markets

	ALADI	USA	E.EUROPE	EEC	ASIA	AFRICA
ALADI	1.0					
USA	.37	1.0				
E.EUROPE	.64	.25	1.0			
EEC	.89	.23	.85	1.0		
ASIA	.66	.31	.91	.88	1.0	
AFRICA	.71	.58	.46	.62	.43	1.0

B. Secondary Markets

	CACM	CANADA	EFTA	MIDDLE E.	OCEANIA
CACM	1.0				
CANADA	.76	1.0			
EFTA	.78	.53	1.0		
MIDDLE E.	.11	.35	.38	1.0	
OCEANIA	.62	.32	.52	.47	1.0

TABLE 9. Regional Exports (1970-1983)

Estimated Model Parameters

A. South

SITC	Expected Return (%)	Standard Deviation	Beta	Residual Stand Dev
011	0.24	0.45	0.89	0.41
071	0.16	0.48	-0.29	0.48
121	0.24	0.18	0.03	0.18
2214	0.66	1.45	4 38	1.18
4212	6.85	22.00	-18.46	21.70
332	0.65	0.75	1.13	0.72
851	0.53	0.68	-0.10	0.68
85102	0.60	0.93	-0.48	0.92
651	0.33	0.46	1.33	0.38
652	0.23	0.82	0.89	0.80
Index	0.21	0.19	1.00	0.00

B. Southeast

SITC	Expected Return (%)	Standard Deviation	Beta	Residual Stand Dev
011	0.24	0.45	0.89	0.41
071	0.16	0.48	-0.29	0.48
0535	0.42	0.46	0.17	0.46
2214	0.67	1.45	4.38	1.18
671	0.29	0.36	0.71	0.33
673	0.33	0.56	0.68	0.55
674	0.91	2.14	-3.00	2.06
732	0.57	0.84	1.58	0.78
7328	0.31	0.46	0.90	0.43
281	0.20	0.24	0.36	0.23
Index	0.21	0.19	1.00	0.00

C. Northeast

SITC	Expected Return (%)	Standard Deviation	Beta	Residual Stand Dev
0313	0.19	0.31	-0.25	0.31
05171	0.18	0.17	0.11	0.17
061	0.35	0.87	2.03	0.77
0612	0.23	0.82	0.89	0.80
0721	0.18	0.50	0.34	0.50
0723	0.27	0.50	0.29	0.49
332	0.64	0.75	1.14	0.71
5122	0.35	0.69	0.84	0.67
221	0.80	1.43	4.42	1.14
7293	0.12	0.29	0.34	0.29
Index	0.21	0.19	1.00	0.00

TABLE 10. Export Proportions in Optimum Unlevered Portfolios - South

A. Markowitz Model

Portfolio	A	B	C
SITC			
011	6.23	5.57	-1.45
071	14.17	15.31	27.33
121	40.27	41.87	58.78
2214	-8.60	-7.44	4.90
4212	-0.11	-0.13	-0.28
332	2.02	3.30	16.78
851	80.75	72.52	-14.51
85102	-55.27	-48.65	21.38
651	13.83	11.12	-17.49
652	6.71	6.52	4.56

B. Single Index Model

Portfolio	A	B	C
SITC			
011	8.30	8.04	5.64
071	9.45	9.14	6.31
121	63.03	62.29	55.53
2214	-0.60	-0.47	0.74
4212	0.03	0.04	0.14
332	2.44	2.91	7.25
851	4.50	4.91	8.61
85102	2.70	2.99	5.64
651	7.98	8.05	8.71
652	2.18	2.11	1.44

TABLE 11. Export Proportions in Optimum Unlevered Portfolios - Southeast

A. Markowitz Model

Portfolio	A	B	C
SITC			
011	-15.26	-15.97	-21.82
071	54.55	55.34	61.95
0535	3.45	3.53	4.20
2214	12.22	12.52	14.98
671	-140.44	-143.16	-165.66
673	49.22	49.95	56.03
674	5.53	5.64	6.54
732	33.83	34.56	40.60
7328	-31.83	-32.55	-38.46
281	128.74	130.13	141.64

B. Single Index Model

Portfolio	A	B	C
SITC			
011	8.39	8.15	5.80
071	12.17	11.85	8.75
0535	10.57	11.24	17.85
2214	-1.90	-1.72	0.03
671	15.27	15.37	16.29
673	5.62	5.79	7.42
674	1.41	1.57	3.12
732	1.02	1.41	5.15
7328	7.87	8.01	9.39
281	2.18	38.33	26.19

TABLE 12. Export Proportions in Optimum Unlevered Portfolios - Northeast

A. Markowitz Model

Portfolio	A	B	C
SITC			
0313	28.45	28.76	32.65
05171	40.35	39.96	35.15
061	-35.71	-36.09	-40.71
0612	10.99	11.27	14.72
0721	6.99	6.77	3.98
0723	-14.29	-13.97	-10.01
332	1.78	2.22	7.57
5122	14.80	15.10	18.83
221	12.66	12.86	15.35
7293	33.98	33.11	22.46

B. Single Index Model

Portfolio	A	B	C
SITC			
0313	17.26	17.37	18.81
05171	50.04	49.73	45.58
061	0.71	0.74	1.11
0612	1.59	1.58	1.45
0721	5.36	5.31	4.60
0723	5.53	5.68	7.73
332	1.75	2.17	7.84
5122	2.36	2.50	4.35
221	-0.63	-0.50	1.33
7293	16.03	15.42	7.20

TABLE 13. Comparison of Regional Export Portfolios

A. South			
A1. Markowitz Model			
Portfolio	A	B	C
Return (%)	0.24	0.24	0.31
Stan Dev	0.06	0.06	0.07
A2. Single Index Model			
Return (%)	0.27	0.28	0.33
SIM Stan Dev	0.14	0.14	0.16
True Stan Dev	0.10	0.10	0.15
B. Southeast			
B1. Markowitz Model			
Return (%)	0.30	0.30	0.32
Stan Dev	0.06	0.06	0.06
B2. Single Index Model			
Return (%)	0.26	0.26	0.31
SIM Stan Dev	0.16	0.16	0.17
True Stan Dev	0.12	0.12	0.17
C. Northeast			
C1. Markowitz Model			
Return	0.20	0.21	0.26
Stan Dev	0.08	0.08	0.09
C2. Single Index Model			
Return (%)	0.18	0.19	0.24
SIM Stan Dev	0.12	0.12	0.14
True Stan Dev	0.16	0.16	0.18