

EXPORT INSTABILITY AND ECONOMIC  
DEVELOPMENT - A SURVEY. PART 2:  
THE EMPIRICAL WORK

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No.111

**WARWICK ECONOMIC RESEARCH PAPERS**

DEPARTMENT OF ECONOMICS

UNIVERSITY OF WARWICK  
COVENTRY

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May, 1977

Once again thanks are due to my supervisors Alec Ford and Norman Ireland; and also to Alan Roe and Dennis Leech for reading preliminary drafts of this paper. Any remaining errors are my own.

This paper is circulated for discussion purposes only and its contents should be considered preliminary.

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## 1. INTRODUCTION

In Part I of this survey (52) we suggested that the problem of export instability had not been satisfactorily formulated, principally as a result of a failure to clearly specify the particular sequence or transmission mechanism (TM) envisaged, despite recognition of the diversity of ways in which fluctuations in exports might be transmitted to the domestic sector. Moreover, there has been a failure to link a particular view of the TM to testable structural and behavioural hypotheses grounded in economic theory, in particular the theory of choice under uncertainty adopted. We also suggested that recent developments in economic theory might provide a more precise definition of the problem and of its associated costs, and the basis for a clearer distinction between a 'pessimistic' view emphasising the dynamic uncertainty-creating effects of unstable exports within a 'structuralist' framework, and alternative hypotheses which deny the general seriousness of the problem and even suggest that export instability might be positively associated with growth.

In this paper we will review the more important results of the empirical literature<sup>1/</sup> and evaluate the utility of relying overwhelmingly on a highly aggregative cross-section and 'crude' multiplier methodology, and question whether it provides the degree of sensitivity required for the problem in hand.

A relatively large amount of empirical research has now been carried out in this area, and it is important to consider whether this provides sufficient justification for the generally agnostic stance of the textbooks, or whether the international organisations and governments of

'lesser-developed countries' (LDCs) are justified in their belief that export instability constitutes a sufficiently serious problem to warrant action at the national and international level.

## 2. THE EMPIRICAL RESULTS

In Part I we identified two general schools of thought on the problem of export instability, from which a number of empirical propositions were subsequently derived and tested in a series of studies. These studies focused on the following general questions:

- (a) Is the degree of export instability greater for LDCs than developed countries (D. Cs) ?
- (b) What is the degree of dispersion around the mean for both groups?
- (c) What is happening to export instability over time?
- (d) Are the causes related to structural parameters associated with the level of development of an economy?
- (e) Are the consequences more serious for LDCs?
- (f) How sensitive are the conclusions to the selected measure of instability?
- (g) How important is export instability per se, in contrast to other sources of instability?

There is much that is unsatisfactory about this empirical work, both in terms of the inconclusiveness of its results, and as a result of the conceptual stance which it adopts - typically employing a linear or log-linear 'instability' index as the dependent variable or one of the independent variables in a cross-section regression analysis. Moreover, direct comparison of the results is extremely difficult in view of the

proliferation of different instability indexes. But before considering the nature of these indexes and their statistical deficiencies in more detail, we will briefly summarise the findings of these studies in relation to the characteristics, causes, and consequences of export instability; and contrast them with studies carried out on a country basis.

(i) The Characteristics of Export Instability

The pessimistic view that primary commodities were significantly more unstable than manufactures gained early support from two United Nations studies (47); (48); an International Monetary Fund project (9); and some calculations by Ady (2). However, Coppock (6) for the post-1945 period found that primary proceeds were not more unstable and that the difference in price instability between primary and manufactured goods was not significant. Breakdown into SITC categories produced no simple generalisation; it depended on the particular commodity and its weight in the trade of a particular country. Moreover, Askari and Weil (3) confirmed that manufactures were more unstable when the proceeds of LDCs were analysed separately. \* A common conclusion, however, was that price and quantity movements tended to reinforce rather than offset each other (48)<sup>2/</sup>; (6); (13).

This assumption that LDCs were synonymous with primary producers was strongly denied by Macbean (28) who claimed that LDCs did not suffer significantly larger fluctuations in export proceeds than DCs, although the variance within the two groups was large. This study has been influential in the textbook interpretation of export instability and was a severe blow to the pessimistic case. However, the latter has subsequently been confirmed

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\* This conclusion is puzzling, since it contradicts the conventional wisdom that LDCs are more unstable because they specialise on primary exports.

by Glezakos (13) for export prices, quantities, and proceeds; for Asian countries' quantities and proceeds by Naya (36);<sup>3/</sup> and for proceeds by Erb and Schiavo-Campo (7). This last work represents an attempt to allow for structural differences between LDCs and DCs by relating export instability to an Adleman and Morris (1) index of socio-economic development. Although they could find only a weak relationship, further work along these lines might prove fruitful as there is no reason to suppose that per capita income by itself is systematically related to instability, and LDCs may be more unstable when GDP is disaggregated, see (33).

That instability is tending to decline over time is generally supported by the literature: (48); (9); (2); (7);<sup>4/</sup> (22); (36); although (7) and (36) thought that instability may have increased relatively for LDC's.

The exception again is the study by Askari and Weil (3) which shows an increase in earnings instability when both groups are taken together.<sup>5/</sup> Moreover, Lawson (22) argues that it depends upon which instability index is used. Confirmation of these trends is important because, as we argued in Part I, one might expect a post-war independent nation to portray greater instability via a vis its 'colonial' counterpart, although it may be better equipped to deal with the problem. If, in fact, the reduction in instability is due to national or international policy, then we want to know the costs involved.

The utility of these results is severely limited unless more is done to ensure comparability of measure, sample, and period. A start here would be to contrast the pre-war and post-war periods with respect to the characteristics of export instability along U.N./I.M.F. lines. One also feels that an excessive amount of time has been spent in an attempt to answer



the more polemical question whether LDCs are more or less unstable than DCs at the expense of answering the equally important question whether a given amount of export instability is more serious in its consequences for LDCs; and for what type of LDC.

(ii) The Causes of Export Instability

Turning to the causes of instability, one bone of contention lies in the allocation of blame between the demand and supply sides. The Transmission Hypothesis (see Part I), the U.N. (47); and Ady (2); all stressed the importance of cyclical demand in DCs, particularly in the United States. Coppock (6) proceeded to show that the U.S.A. did not contribute much to world instability, <sup>6/</sup> and MacBean (28) concluded that one should look more to the supply side in LDCs. Porter (39); (40); qualified the naive view that earnings instability could be attributed to demand if there was a positive correlation between average price and quantity and vice versa, and he derived conditions for the a priori allocation of blame. He finds from his empirical study on primaries that supply is more often the cause but that more detailed knowledge of short-run price elasticities is required to be sure. Paradoxically, confidence in the distribution of blame requires acceptance of large short-run price elasticities which is contrary to the conventional wisdom on the characteristics of primary commodities.

The first systematic attempt to analyse the relationship between export instability and the factors suggested by the theoretical debate was that of Coppock (6). Trying out a large number of explanatory variables he found little support for the pessimistic case. High instability was associated with various combinations of structural characteristics and

there was no single explanatory factor. Michaely (35) suggested that primary export price instability was due, not to primary specialisation per se, but to commodity concentration <sup>7/</sup> and because the dissimilarity in imports and exports in LDCs ensured that their prices were not offsetting each other in the terms of trade. Massell (30); however, failed to confirm this for proceeds; and Khalaf (20) found no relation between either export or income instability and commodity concentration.

Attempts to relate earnings instability to a measure of geographic concentration also met with little success: (30); (36); (28). Kingston (21) suggested that these negative results might reflect the diversity of experience in the sample with respect to the magnitude, variability, and longer-run trend of geographic concentration. But even though he attempted to allow for changes in geographic concentration over time, his results gave no support to the pessimistic case. Khalaf's insignificant results were also replicated for geographic concentration .

Similar attempts to relate export instability to primary product dependence (28); (30); (36); a food export dependence measure (36); or a raw materials dependence ratio (36) failed to achieve significant results. The lack of explanatory power of the food variable is particularly interesting, since Massell (31) had suggested that dependence on food exports might stabilise receipts net of the other variables and explain the poor showing of the commodity concentration variable. In other words, LDC receipts were destabilised insofar as they were commodity concentrated, but stabilised if they concentrated on food exports. An alternative explanation suggested by Brainard and Cooper (5) was that LDCs often appeared diversified on these measures by producing a range of goods, but were not in fact diversified because these goods exhibited similar characteristics in terms of covariances.

Several a priori reasons can be derived from the theoretical debate suggesting that country size<sup>8/</sup> and export instability are related. Small countries may depend more on international trade and reflect destabilising forces in the international economy (as the Transmission Hypothesis implied), or be less able to adjust to, or retaliate against, external events. Size may also be a proxy for commodity concentration, i.e. a small country may be less diversified. However, it is also possible that small countries may be more stable if they have a high marginal propensity to import in line with a 'damped' multiplier model. Erb and Schiavo-Campo (7) found absolute income - as a measure of size - significant such that small countries were more unstable, but this was denied by Mathieson and McKinnon (33); and Khalaf (20) also found no relationship between country size and either income or export instability.

Coppock (6) had hinted that the more open an economy the less unstable it might be (using trade as a ratio of national product), which was confirmed by Mathieson and McKinnon (33); (34); for export proceeds instability, and by Khalaf (20) for income instability. Naya (36) also found an inverse relationship between export instability and the value of exports, which was supported by Lawson (22), but only for LDCs and only in a later period.<sup>9/</sup>

These issues are clearly important and raise a number of crucial policy questions. For example, the relationship between openness and export instability has a bearing on the question whether diversification is worth the cost if it leads, in the short-run at least, to more 'inward-looking' policies and an increase in export and income instability. Similarly, Naya (36) discusses his finding of a positive link between export instability and an intra-regional export ratio, which has implications for

policies designed to increase trade between blocs of LDCs. The effects of diversification on export instability are also likely to be considerably more complex than the early literature maintained (see Part I) and, as we shall argue below, greater disaggregation and sensitivity of measurement may be required before any unambiguous conclusions can be reached.

(iii) The Consequences of Export Instability

If the causes of export instability are somewhat ambiguous, then the consequences appear to be equally deceptive. In the first comprehensive attempt to examine the implications of unstable exports for LDCs, MacBean (28) found little evidence to support the pessimistic case. With regard to its short-run effects, he found no relationship between fluctuations in export proceeds and fluctuations in national income, investment, prices, or the quantity of exchange reserves; although there was a positive one with imports. In terms of growth, LDCs with relatively unstable receipts did not tend to invest less, and instability was not related to the ratio of construction investment or stocks to total investment, or to the marginal capital-output ratio. The only glimmer of hope for the pessimistic view was the discovery of a weak inverse relationship with the rate of growth of GNP, and a positive one with the average rate of increase of domestic prices.

Kenen and Voivodas (19) replicated most of MacBean's cross-section results for his time-period, but discovered a strong inverse relationship with the level of investment for a later period. Further evidence of the harmful effects of export proceeds instability was subsequently supplied by Glezakos (13). The latter discovered an inverse relationship with both the real per capita growth of GDP, and the rate of growth of exports for

LDCs only. In addition, export price instability was similarly related to both export growth and growth of GDP in DCs. The implication here is that price stability should be the goal of LDCs.<sup>10/</sup>

MacBean's negative results have had a significant impact on the textbook interpretation of export instability, so it is clearly of considerable importance to critically evaluate his results in relation to those of subsequent researchers who reverse his conclusions. In Section 3 we shall review not only the statistical validity of his findings, but also elaborate on the question raised in Part I, namely whether he really tested the pessimistic case at all, rather than a poorly specified collection of ad hoc propositions. In fact a major weakness of the empirical literature as a whole has been the failure to correctly specify the null hypothesis, which not only leaves room for spurious correlation, but also leaves the empirical testing of the problem of export instability very much an open field.<sup>11/</sup>

In an attempt to focus more directly on the structuralist hypothesis that foreign exchange availability in LDCs constrains imports of 'essential' inputs and hence investment and income, so that fluctuations in such receipts upset development plans; Massell et al (32) disaggregated the foreign exchange market. They found support for the hypothesis, but surprisingly perhaps, current effects proved to be more significant than lagged. An important conclusion was that the components of foreign exchange varied significantly in their effects in both magnitude and timing. This is another reminder of the likely fruits of disaggregation.

We argued in Part I that the reserve demand behaviour of LDCs was a crucial link in the pessimistic TM, yet that there appeared to be a yawning gap between the relatively sophisticated research being carried out on the demand for reserves and the standard debate on export instability. The essence of the problem is to examine the impact of fluctuations in exports in line with other components of total foreign exchange receipts on reserve behaviour, in both a normative and a positive context. Do LDCs have a more serious liquidity problem insofar as their reserves are inadequate in relation to their needs, so that they might require proportionately more reserves than are held by DCs? Do they use reserves as a cushion against fluctuations in a compensatory fashion? Or do they adjust in some other way?

MacBean argued that LDCs held about 20% higher reserves than DCs (using the reserves over imports measure); and although they were generally compensatory in direction, they did not fluctuate closely with exports, and there were no other important sources of compensatory funds. Hence, reserves were 'adequate' and payments adjustment depended more on 'automatic stabilisers'. However, whether reserves are adequate depends on the purpose to which they are put, and in relation to macroeconomic policy in general. Maizels (29), for example, reverses MacBean's conclusion by recomputing his figures with the trade balance in the denominator. This recognises that reserves are used to finance deficits not trade, so if LDCs portray greater export instability, they might require more reserves. Even this modification does little to reduce the inherent crudity of the approach. For a review of these problems and of recent work on the demand for reserves, see Williamson (50). Williamson traces developments in the literature from these simple approaches to more sophisticated stochastic models based on rational optimising behaviour. Relatively little work has been done on LDCs specifically, but the following is particularly relevant to our present context.

Frenkel (11) found the demand for reserves behaviour of LDCs to be different from that of DCs, both insofar as they were required to hold higher reserves, and in their behavioural response to payments variability - LDCs were more likely to resort to direct controls on imports than DCs where it might be politically less feasible. Support for this behavioural distinction is provided by Hipple (16) who finds that his variables which were significant for DCs were only partially so for LDCs, and the latter were significantly influenced by his proxy for the cost of expenditure-switching adjustment. The most recent analysis for LDCs is that of Iyoha (17) who tests a theoretical model based upon an intertemporal stochastic framework and a distributed lag/partial adjustment mechanism. He finds a positive connection between reserve demand and expected export earnings, variance of export earnings, and degree of openness. He also found a significant positive relationship with the domestic interest rate and concluded that this demonstrated the predicted link between reserve demand and its opportunity cost, but Williamson (51) argues that this may be a perverse result. <sup>12/</sup>

The uniformity of results in the literature on the demand for reserves lies in marked contrast to the results of the more ad hoc cross-section analyses of the export instability school. In practically all of the former empirical studies, export instability seems to be significant as an explanatory variable. Despite the simplicity of the theoretical models, there is scope for the infiltration of such insights into the export instability literature, possibly utilising a macro-simulation framework to allow for an intertemporal stochastic dimension and varying assumptions about macro policy behaviour and the structural characteristics of the particular economy in question.

(iv) Country Studies

In his case-studies (which consisted of Uganda, Tanganyika, Puerto Rico, Chile, and Pakistan) MacBean argued that these countries, on the whole, displayed no serious ill-effects from export instability per se. This served to reinforce his conviction that the problem of economic instability found in many LDCs is due more to political or other non-economic factors. MacBean did not directly test his own 'damped' multiplier hypothesis with these countries and one would like to strengthen his casual empiricism with more detailed studies, possibly making some attempt to include explicitly the net effect of the government in reducing or exacerbating fluctuations stemming from the external sector, since although MacBean did confirm low values for the trade multiplier for a sample of countries taken from Fleming et al (10), one wonders whether it is realistic to assume the government remained neutral in these countries. There may be a relation between export instability and growth even with a low multiplier if the stabilisers are not automatic and government counteractive policy involves administrative costs.

A particularly interesting case is that of Chile. Reynolds (42) suggested that instability was transmitted from copper export earnings to the domestic economy through destabilising government spending which varied with the cycle and tax receipts. Expatriate firms appear to have acted as an automatic stabiliser along the lines suggested by MacBean, and the Caine/Hirschman hypothesis of proportionately higher investment in the boom than in the slump is also confirmed. Although the government's role in transmitting instability from the export to the domestic sector would appear to support the pessimistic case, MacBean argues that this link may have been exaggerated by Reynolds.



Lim (26) set out to test MacBean's model directly for West Malaya, and although he found a positive correlation between variations in export earnings and GNP, his study confirms MacBean. Leith's analysis of Ghana (by commodity and destination) (25) suggests that instability might not be serious for a country often cited as portraying the classic instability features. Cocoa, he claims, has been a stabilising crop; there is no connection between export instability and geographic concentration; and the positive one with commodity concentration is offset by its tendency to increase slowly as commodity concentration increases. Leith did not examine the effects of cocoa instability, and one wonders whether a more detailed time-series analysis might modify his conclusions. One would also do well to extend the analysis to Ghana's neighbour Nigeria, where Helleiner (15) at least believes that export instability is a serious problem. Stern (44) also takes issue with MacBean over the causes of export instability for Pakistan. Stern confirms Michael's contention that it is commodity rather than geographic concentration which is the causal influence.

Hence, these studies do little to reduce the inconclusiveness of the cross-section results. One would like to see more complex models particularly in view of our reappraisal of the problem in Part I, although this in no way underestimates the data problems involved. One study which gives rise to optimism on this score is the recent attempt by Rangarajan and Sundararajan (41) <sup>13/</sup> to apply more sophisticated econometric techniques on a cross-country basis. They tested a simple structuralist model and found export and investment multipliers to be larger for LDCs, particularly in the medium and long-run. Similarly a comparison of simulation runs for ex-post fluctuations in exports and a steady-state export growth path revealed a significant link between export instability and fluctuations in GNP; although

even this level of aggregation might be misleading insofar as the effect on income growth was adverse for only half the sample.

### 3. EXPORT INSTABILITY RECONSIDERED

#### (i) A Statistical Review

The inconsistency of the empirical results reviewed above does not give rise to much optimism, particularly in view of the problem of comparability. Moreover, confidence that more research along these lines will produce greater consistency is not increased when one considers how easy it was for Sundrum (45) to reverse nearly all of MacBean's results and those of Coppock, and demonstrate the dependence of their results on the choice of instability index. Similarly, both Maizels (29) and Ady (2) were strongly critical of the statistical basis of MacBean's results, yet his work continued to command authority in the texts. On the general validity of MacBean's findings Maizels concludes:

'The author's attitude toward policy ... is heavily influenced by the generally negative results of his statistical analysis ... The statistical analysis, which thus constitutes the core of the book is, however, generally not convincing'.

On the short-run consequences of export instability in Chapter 3:

'The author uses both cross-country comparisons and time-series for individual countries but neither approach is used convincingly while at crucial points in the argument, the statistical evidence adduced appears to be in direct contradiction with the author's conclusions'.

On the consequences for growth and development in Chapter 4:

'...none of the regressions presented in this part of the book can be accepted as meaningful, and the author's conclusions are equally suspect'.

Finally, on his case-studies, Maizels comments:

'Useful though these country studies are, they do not constitute a systematic analysis of the problem at hand'.

Despite this early reminder of the problems involved, many of the mistakes pointed out in MacBean's work by Maizels reappeared in subsequent studies. Obviously there is no room here for a detailed discussion of these statistical problems but they may be sufficiently serious to undercut much of the credibility of the findings outlined above. The following is representative of the more apparent pitfalls.

In addition to the odd careless slip, for example Coppock (6) fails to state the level of significance used in his tests, and Rangarajan and Sundararajan (41) omit mention of their time-period; there is the perennial problem of data. Many studies fail to differentiate between exports of goods and services and merchandise exports alone, yet there is reason to believe that these two series behave differently over time. See Erb and Schiavo-Campo (7). Maizels (29) points to measurement error in his review of MacBean; for example, when he relies on Coppock's data he includes services but omits them later on when using other sources. Also, whilst it may be true that it is annual data which influences decisions and is the indication whether instability is serious enough to warrant action (and less than annual data would require painful seasonal correction), it should be borne in mind that this already introduces an element of smoothing into the analysis. <sup>14/</sup>

The choice of sample and time period has also raised problems.

Lack of justification for choice of sample has recently been raised by Lim (27) and is reinforced by the significantly different results which were obtained by Sundrum (45) and Maizels (29) when minor changes were made. There is no rigid criteria for inclusion, but some justification is required, even if only to facilitate comparability between studies; and there is a danger of biasing the results if countries are included which are not relevant to the hypothesis or for which data is extremely unreliable.

Selection of time-period presents a trade-off between sufficient degrees of freedom and over-rigid trend correction, particularly if the instability index is linear or log-linear. There has also been controversy over MacBean's time-period and the charge that he chose a particularly unstable period. On the latter, see Maizels (29) and Ady (2); and for a more general discussion, Naya (36). Finally, there is the question of the validity of intertemporal comparisons. For example, Erb and Schiavo-Campo (8) point to the influence of extreme results in Leith's comparison of instability over two periods. Their application of a Chow test shows that Leith's assumption that the trend was similar in both sub-periods to enable the comparison to be made is rejected.

An important question refers to the derivation and specification of the estimating equations. In Part I we suggested that the relationship between export instability and growth is likely to be a complex and indirect one, with considerable room for variety between countries depending on the assumptions one made about the structural and behavioural characteristics of the given country. A priori, growth could be positively, negatively, or independent of fluctuations in exports; and a given statistical relationship

might be compatible with a number of sequential relationships. These sentiments have been forcefully echoed in a very recent paper by Lim (27). Lim points to the lack of systematic derivation of the equations in the empirical studies and their inconsistency with the hypotheses intended. Referring specifically to the work of MacBean,<sup>15/</sup> Kennen and Voivodas (19); and Voivodas (49), he argues that there is ample scope for problems of identification and spurious correlation. He contrasts these studies with the work of Glezakos (13) and some of his own calculations which confirm the pessimistic case. Lim's work reiterates the necessity of correctly specifying the null hypothesis and the substantial problems which are likely to be faced when trying to isolate the partial impact of export instability on variables which depend on a wide range of factors.

Another key area of dispute is over weights. Most studies use unweighted means. But when, for example, comparing LDCs and DCs; it is patently obvious that if group means are derived from a set of individual country indices, then they may be influenced by extreme observations. For a discussion of this problem and possible remedies, see Lawson (22) and Naya (36). The problem of 'misplaced aggregation' has also been raised with respect to Coppock's work by Ady (2) and Sundrum (45).<sup>16/</sup> Sundrum's reversal of the MacBean and Coppock results is partly achieved by his attempt to distinguish between that part of the variation which affects a whole group of countries or commodities and that which affects an individual country or commodity. He defined a measure of that part of total variation affecting a whole group by utilising analysis of variance techniques, and these 'g' factors include any nonlinearities insofar as they are common to the whole group.

The need for more disaggregation is gradually being recognised and this is likely to be particularly important in the concentration literature.

Massell, (31) for example, assumed that the earnings of individual exports were independent of each other. We have already indicated the need to allow for covariances, and for a discussion of these problems in relation to geographic and commodity concentration, see Leith (24) and Kingston (21). This literature might also benefit from the more sophisticated measures of concentration being developed in the area of industrial concentration, see Hart (14); and may be all the more necessary in view of the recent criticism of the Hirschman index by Ho Dac Tuong and Yeats (46).

Finally, there is the problem of choosing a unit of standardisation to facilitate comparability between countries by conversion of the data to a common base. In the absence of any obvious index of internationally traded goods, the U. S. dollar is usually selected; although this will be more appropriate for some countries than for others. For instance, if a country revalues or devalues specifically against the dollar, then the domestic measure of export instability will tend to be higher than the converted one. The problem is particularly serious where exchange rates are liable to frequent alteration. <sup>17/</sup>

#### (ii) The Measurement of Export Instability

The objective has been to construct an 'index' of exports (or any other relevant variable such as income) reflecting the deviations in price, quantity, or proceeds from some 'norm' or trend over a defined time-period, usually a year. For cross-section purposes annual movements are aggregated into an 'average' figure for the period for each country and used as the dependent or one of a number of independent variables in a cross-section regression analysis. The problem, then, is to calculate the 'best' trend and the 'best' summary statistic of instability. We shall review only a

few of the issues arising from the compilation of these indexes and relegate a more detailed discussion of the type of indexes commonly adopted in the literature, and their associated pros and cons, to an appendix.

Firstly, there is the selection of the 'correct' method of trend correction, which introduces a considerable amount of arbitrariness into the debate. Trend correction is necessary to prevent a constant increase/decrease being interpreted as an indication of instability i.e. a country whose exports are growing rapidly, even at a constant rate, will appear unstable. Given the trade-off between the speed and simplicity of simple linear or log-linear models and the flexibility but computational complexity of non-parametric curves, usually the simpler methods have been chosen. Despite the fact that the choice of functional form between for example, linear and log-linear, cannot in general be made on the basis of a goodness-of-fit criteria such as minimisation of  $R^2$ , this has often been cited as justification. For example, Massell (31) and Sundrum (45). This choice should be made a priori, for example, an exponential fit might be justified on the assumption that countries plan in terms of absolute growth rates; <sup>18/</sup> or on the basis of more complex theories of statistical decision-making. See Sargan (43). Neither of these criteria have been used extensively in the literature.

This then raises the question of the theoretical legitimacy of the indexes i.e. how they relate to a priori theories of behaviour under uncertainty and expectation formulation; which as we argued in Part I constitutes a major part of the case that export instability matters for LDCs. In practice, the relationship between the chosen variance statistic and ex ante uncertainty has not been discussed, but instead it has been assumed that the technical removal of the trend factor is sufficient to isolate the relevant residual variance. It is difficult to understand why there has been such a multiplicity of summary variance statistics in view of the minimal amount of time which has



been devoted to a priori justification for their use. Yet the theoretical assumptions underlying these indexes are quite different. For example, using the ordinary least squares criteria of minimising the sum of the squared deviations assumes it is fluctuations of large magnitude which are important rather than their frequency. The decision as to which type of fluctuations are relevant to the particular hypothesis and the weights to be attached to them requires theoretical justification for the reasons discussed in Part I:3.

The problem of the cross-section approach is that, by definition, it is attempting to summarise all the information of a time-series into a single measure to focus on the 'average' experience of the sample. The importance of using weights to deal with exceptional values has already been raised, especially as the time-series for each country is usually quite small. Some aggregation procedure is concomitant with inter-country comparisons of this nature, but it does pose the question whether the methodology employed is really sensitive enough to deal with the problem in hand. One method of trend correction is used for the entire sample but it will describe the growth path of different countries with varying degrees of accuracy. Trend experience differs significantly between countries over the same period and for individual countries over different time-periods. Hence, reliance on one measure runs the danger of missing the subtlety of trend behaviour for individual countries which might require more complex measures. Only one study has explicitly allowed for autocorrelation (19), although this raises problems of its own, (see the appendix). We are also extrapolating away from any policy measures affecting the indices of particular countries.

In view of the proliferation of these instability measures, each generating a different set of residuals, the problem of comparability between studies is compounded. To date there has been little systematic attempt to compare different indexes over a given time-period and sample. Coppock (6) found similar results for a log-variance, a United Nations measure, and an OLS measure; and Massell (30) confirmed this for two conceptually different OLS indexes; but the more systematic studies of Sundrum (45) and Lawson (22) suggested that ~~the~~ choice of index does matter.

A more comprehensive and rigorous attack on the use of these indexes has recently been provided by Gelb (12). Using spectral analysis he finds that they yield highly selective measures of shortrun fluctuations, amplifying and distorting higher frequency components, with considerable imprecision, particularly where data is short. He chides those who believe that there is a way of isolating the 'true' trend. Export revenue series trend strongly and vary considerably across countries, so that extraction of high frequency variance is difficult since an approximation leaves much to 'spill over' into high frequency components, thus destroying the basic pattern.

One could dwell ad nauseam on these problems but Gelb's work, including his derivation of a new instability index, represents the beginning of a more rigorous approach to the measurement of export instability and a more comprehensive comparison of the indexes in common use. What is now needed is to link these developments in the empirical field to the reappraisal of the theory of export instability outlined in Part I of this survey, recognising that the problem and its measurement is considerably more complex than the literature has so far assumed. The choice of instability index does matter insofar as it presumes a decision has been made about what type fluctuations (i.e. amplitude, frequency) are assumed to contribute to measured

instability. Decisions have to be made as to what frequency components are to be included and in what degree i.e. how short a duration to give to unstable components and the weights to be attached to smaller or larger deviations. Considerably more care is going to be needed in the future in the testing of the problem of export instability.

(iii) The Measurement of Export Instability Reconsidered.

Our review of the main empirical results and methodology employed in the testing of the problem of export instability has raised a number of problems. Firstly, there is a need to obviate a number of the more apparent statistical pitfalls outlined in Section 3 (i); and to ensure greater consistency and comparability between the studies, particularly in the choice of instability index. Secondly, one must qualify the findings insofar as it is not always clear what the hypotheses are that are being tested and how they relate to propositions derived from the theory, particularly those which incorporate some notion of expectation formation and behaviour under uncertainty. Finally, there is the fundamental question whether the empirical methods used to date are sensitive enough to capture the inherent complexity of the problem, particularly if interpreted in its dynamic and uncertainty generating dimension. It is possible that there are in fact no systematic cross-country causes or effects, but it is more likely that insufficient allowance has been made for inter-country differences, and insufficient use has been made of economic theory in framing hypotheses. On the former point there are encouraging signs that more disaggregation is being introduced and one hopes that this leads to greater uniformity of findings. On the latter point, we have already reviewed recent developments in the theoretical literature, and it might prove useful to consider some econometric techniques which might be

utilised when testing the resulting hypotheses.

The first possibility, which follows directly from our discussion above, is to explore the potential of spectral analysis. This will enable us not only to derive more rigorous instability indexes for use in cross-section analysis, but also to pinpoint more precisely the nature of the fluctuations in a time-series context which we associate with the costs of export instability. Although this method only provides a proximate decomposition of any given time-series, it should enable the a priori specification of the type of fluctuations relevant to the particular hypothesis, and ensure that only those fluctuations which are relevant are filtered out. For further details on this approach and its problems, see Gelb (12) and his references.

Another possibility is to model the TM within an input-output framework as a logical extension of the work of Brainard and Cooper (5), and incorporate the recent developments in mean-variance analysis. This would serve as a useful heuristic device to identify the type of uncertainty i.e. price, quantity, revenue, or cost, relevant to the particular 'actor' in the TM; and facilitate sensitivity analysis on the key parameters. However, although this approach would lay stress on the interdependence of the system, its linearity might prove operationally restrictive.

An alternative, albeit highly ambitious task, would be to construct a dynamic stochastic nonlinear macroeconomic model (possibly with an independent commodity market model attached) and obtain an appropriate

iterative solution. The object would then be to build into its functions an explicit theory of the TM, including a theory of choice under uncertainty. The formidable problems involved in the building of macroeconomic models for LDCs are receiving increasing attention in recent years. For a flavour of these developments, see Ball et al (4).

In the absence of the appropriate data for such a model the calculation of 'crude' multipliers along the lines of MacBean (28) and Lim (26) may be the only feasible alternative, although as we argued in Part I, this tackles only part of the problem and relies on a fairly naive theory of how transactors react to unexpected fluctuations in a given variable. Certainly, one would want to add a stochastic dimension to these multipliers.

The relationship between ex post variance and ex ante uncertainty is not a simple one, and we referred in Part I to the qualifications required when moving from the expected utility approach to mean variance analysis. However, a number of econometric techniques are available to handle the problem of expectations and uncertainty. For example, one might link past values with expected values through an autoregressive system using, for example, an adaptive expectations model. Alternatively, one might adopt an errors-in-variables method. Although allowance for expectations and uncertainty has a fairly long history (particularly in investment theory) the recent developments in the theory of choice under uncertainty outlined in Part I are likely to generate new empirical studies, and since the problem of export instability centres to a large extent on behaviour in an uncertain environment, the infiltration of these developments into this literature is likely to be of paramount importance.

Finally, and perhaps the most puzzling aspect of the debate, has been the failure to take up the suggestion made by Maizels as far back as 1971 (29) to utilise the technique of simulation in testing the consequences of unstable exports. <sup>19/</sup> Application of such a technique should provide us with relatively detailed information about the dynamic properties of any macroeconomic model we might like to test, and the one attempt to do so using a relatively simple model by Rangarajan and Sundararajan (41) provides grounds for optimism. Simulation would allow us to compare different methods of estimation against appropriate goodness-of-fit criteria, and to apply sensitivity analysis to the key parameters to obtain some kind of feed-back to the original model and some sort of 'feel' for the TM. A major objective would be to estimate dynamic multipliers to test the implications of exogenous shocks in the export sector. Moreover, stochastic simulation allows us to go one stage further to examine the probability distribution of these multiplier values through replicated experiments i.e. comparison of the relative effects of varying each exogenous variable against an initial control solution (the other explanatory variables and error terms constant) and obtain a probability distribution for each exogenous variable by repeating for different error terms. Naturally this approach raises its own problems, including the trade-off between complexity and intractability; and the likely confinement of such models to annual data may result in degrees-of-freedom shortage. For an appraisal of the potential role of simulation vis-a-vis other quantitative methods including spectral analysis, see Naylor (37).

#### 4. CONCLUSIONS

Despite the considerable ambiguity surrounding the concept of export instability, there has been a relatively large number of empirical studies, focusing on a number of propositions relating to the characteristics, causes, and consequences of unstable exports. The majority have utilised a highly aggregative cross-section methodology. The inconclusiveness of the findings might be traced to the following factors :

- (a) Although it is conceivable that there are no significant cross-country generalisations about export instability, especially in view of the variety of possible mechanisms for conveying fluctuations from the export to the domestic sector; it is doubtful whether the empirical literature has exploited the full potential for disaggregation. Moreover, any uniformities have tended to be obscured by the lack of comparability of the studies in terms of sample, time-period, and measurement of the variables. However, there are encouraging signs of a greater allowance for country differences and more explicit weighting procedures.
- (b) Another problem has been the failure to link the empirical work to economic theory, particularly those propositions which implicitly rely on a theory of expectation formulation and behaviour under uncertainty. This reinforces the view that the major hypotheses outlined in part I have not been satisfactorily tested due, in part, to the failure by MacBean and others to adequately set up the null hypothesis.

- (c) A prime reason for the inconsistency of the results and a major obstacle to comparability between studies, is the casual adoption of instability indexes. This reflects not only a lack of a priori justification for their choice, but also underestimation of the amount of 'distortion' which is introduced into the analysis, particularly where the pattern of fluctuations differs significantly between countries and the time-series is short. A more sensitive and clearly defined index is going to be required to capture the inherent complexity of export time-series behaviour.
- (d) Finally, a reconsideration of the problem in line with developments in the theoretical literature summarised in part I will require a clearer specification of the costs of adjustment due to unstable exports, and consequently of the type of fluctuations which are relevant to decisions in the TM. This in turn will demand more sensitive quantitative methods than the cross-section and 'crude' multiplier studies have employed so far. The tools are available (data permitting) for such a re-appraisal, including spectral analysis and stochastic simulation. The issue of export instability is still very much an open one and considerably more research is going to be needed before we can reach any strong conclusions. To parody MacBean, the patient may really be sick but the instruments used for diagnosis not sensitive enough!



## FOOTNOTES

1. No attempt here will be made to specify the details of sample, time-period, etc. for these studies, in view of their proliferation.
2. Although for the United Nations this was true only for raw materials.
3. Naya also suggested that instability might be a particularly serious problem for Asian countries.
4. Who also reject a criticism by Leith (24) in a reply (8).
5. Although how this conclusion is arrived at is not clear from the article.
6. Coppock found that the 28 countries with the highest trade instability accounted for only 35% of total world trade instability, and the U.S.A. accounted for only 1/8. This implies that one should distinguish between the incidence of high trade instability and high share of world trade.
7. Concentration is usually measured by the Hirschman index.
8. There is no unique measure of country size, but population is usually used to measure it in terms of inputs and GNP in terms of output.
9. Lawson's explanation was that for a given commodity the smaller a country's share the more elastic the demand curve it faces; so if instability is supply induced, the smaller its world market share, the greater the instability. But why was this true only in the 60's? Lawson suggests that instability might have been mainly supply induced in the 60's but demand induced in the 50's, but this is not supported by Porter (40).
10. Owen (38) finds that an increase in cocoa price instability led to a fall in trend demand and as a result, to a fall in quality. The effects were more likely to feed back on producers insofar as consumers were able to substitute more easily in the short-run.
11. MacBean himself is well aware of this statistical procedure, as he states on page 341.

12. Williamson suggests that the return on reserves is not equal to the domestic interest rate as Iyoha claims. The latter could be interpreted as representative of the productivity of investment, so the result is the reverse of that predicted by the theory.
13. Although a weakness here is reliance on the Coppock index. See the appendix.
14. On this problem see Gelb (12) page 8.
15. We referred to an example of this inconsistency on page 11 of part I of this survey.
16. They point to aggregation bias from commodities to countries. The price index for primaries as a whole is 8.4 while the weighted average on a commodity by commodity basis is 20.4 which, as Coppock notes on page 44, is close to the typical for the 83 countries.
17. Maizels (29) points to a valuation discrepancy in MacBean's work whereby his investment data is in constant prices and national currencies, while his export data is in current prices and dollar values.
18. Massell in fact uses both the a priori and goodness-of-fit criteria for justifying his choice of an exponential form.
19. The author is currently engaged on the construction of a macro-simulation model for post-war Ghana to examine the consequences of export instability.

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APPENDIXSOME SELECTED INSTABILITY MEASURES1. The United Nations Index

The arithmetic mean of the percentage deviations based on the larger value.

$$I-I_1 = \frac{100}{n-1} \cdot \sum \left| \frac{x_t - x_{t-1}}{\max(x_t, x_{t-1})} \right|$$

Where  $x_t$  = The value of exports in time t.

n = The number of years.

i.e. absolute differences in values from year to year expressed as a percentage of the larger of the two values and averaged.

Example: The United Nations 1952. (47)

2. The Michaely Index

The arithmetic mean of the percentage deviations from the previous value.

$$I-I_2 = \frac{100}{n-1} \cdot \sum \left| \frac{x_t - x_{t-1}}{x_{t-1}} \right|$$

i.e. absolute differences in values from year to year expressed as a percentage of the previous year and averaged.

Example: Michaely (35)

Indexes 1 and 2 are simple to compute but involve no explicit method of trend correction and can be misleading. For example, if there were steady logarithmic growth 100, 110, 121 ....., this method would indicate instability where none in fact existed. This index is therefore less applicable to export revenue series which exhibits a strong trend and is more useful to, say, price data.

### 3. The log variance index

$$I-I_3 = \text{antilog} \sqrt{V \log} \quad \text{where } V \log = \frac{1}{n-1} \cdot \sum \left( \log \frac{x_{t+1}}{x_t} - m \right)^2$$

example : Coppock (6).      and  $m = \frac{1}{n-1} \cdot \sum \log \frac{x_{t+1}}{x_t}$

This index suffers from the considerable drawback that it is strongly influenced by the choice of initial and terminal values of the series, and hence is very sensitive to the period chosen:

$$m = \frac{1}{n} \cdot \sum_2^n (\log x_t - \log x_{t-1}) = \frac{1}{n-1} \cdot (\log x_n - \log x_1)$$

See Sundrum (45) for further discussion.

### 4. The moving averages index

The arithmetic mean of the percentage deviations from an  $N^{\text{th}}$  year moving average.

$$I-I_4 = \frac{100}{n-(N-1)} \cdot \sum \left| \frac{x_t - MA}{MA} \right|$$

Example : MacBean (28)

where MA = an  $N^{\text{th}}$  year moving average of  $x_t$ .

This method has been heavily criticised insofar as the choice of moving average and weights are arbitrary but control the degree of smoothing. A regular cycle must exist in the data and be of the chosen duration. If the cycle is greater than the moving average, then the series is depressed and instability will be understated. This criticism has been levelled against MacBean's choice of a five-year moving average, see Ady (2). There is also the danger of generating a Yale-Slutsky oscillatory series.

### 5. The ordinary least squares method (linear)

- a) The arithmetic mean of the percentage deviations from a trend line fitted by OLS.

Example : Leith (24)

$$I-I_{5a} = \frac{100}{n} \cdot \sum \left| \frac{x_t - \hat{\alpha} - \hat{\beta}t}{\hat{\alpha} + \hat{\beta}t} \right| \quad \text{where } \hat{\alpha} = \text{the constant coefficient}$$

$$\hat{\beta} = \text{the trend coefficient}$$

i.e. fit :  $x_t = \alpha + \beta t + e_t$  and obtain estimates of  $\alpha, \beta = \hat{\alpha}, \hat{\beta}$

- b) The root mean of the squared deviations from a trend line fitted by OLS expressed as a percentage of the mean of the observations.

$$I-I_{5b} = \frac{100}{n} \cdot \sqrt{\frac{\sum (e_t)^2}{\bar{x}}} \quad \text{where } \bar{x} = \frac{\sum x_t}{n}$$

i.e. the normalised standard error of the estimate. A pure number measure of the variation of the series as a whole.

Example : Massell (30).

- c) The arithmetic mean of the absolute values of the yearly changes from a trend line fitted by OLS expressed as a percentage of the mean of the observations.

$$I-I_{5c} = \frac{100}{n} \cdot \sum \left| \frac{x_t - x_{t-1} - \hat{\beta}}{\bar{x}} \right|$$

This index is reversible with regard to time; symmetric with regard to a common trend; multiplicative i.e. allows for the relative importance of variation; and is independent of the size of the trend.

Example : Glezakos (13)



- d) The arithmetic mean of the rate of change of exports from a trend fitted by OLS and expressed as a percentage of the larger value.

$$I-I_{5d} = \frac{100}{n} \cdot \sum w_t \quad \text{where } w_t = \sum \left| \frac{e_{t+1} - e_t}{\max(x_t, x_{t+1})} \right|$$

i.e. a pure number measure of the year to year changes.

Example : Massell (30).

### 6. Ordinary least squares (exponential)

- a) The root mean of the squared deviations from an exponential trend line fitted by OLS.

i.e. the trend in  $x_t$  is given by a constant rate of growth :

$$\hat{x} = \alpha (1+r)^t = \alpha \beta^t$$

$$I-I_{6a} = \frac{100}{n} \cdot \sqrt{\sum (e_t)^2} \quad \text{where } e_t = \log x_t - \hat{\alpha} \hat{\beta}^t$$

i.e. fit the equation  $\log x_t = \alpha + \beta t + e_t$  ; obtain estimates  $\hat{\alpha}, \hat{\beta}$  by taking antilogs of the regression coefficients, or plot on semi-log paper.

It is the exponential equivalent of the standard error of the estimate.

Example : Lawson (22).

- b) The arithmetic mean of the percentage deviations from an exponential trend line fitted by OLS.

$$I-I_{6b} = \frac{100}{n} \cdot \sum \left| \frac{x_t - \hat{x}_t}{\hat{x}_t} \right|$$

Example : Kingston (21).

- c) The root mean of the squared deviations from an exponential trend line fitted by OLS and expressed as a percentage of the mean of the observations.

$$I-I_{6c} = \frac{100}{n} \sqrt{\sum \frac{(e_t)^2}{\bar{x}}}$$

i.e. the exponential equivalent of the normalised standard error of the estimate.

Example : Kingston (21).

The OLS method has been the most popular in the literature, although it will produce a rigid trend unless the Y values are random and normally distributed and the X values are fixed. Hence it is not very useful if the period is split into a number of sub-periods with markedly different rates of growth.

#### 7. A first-order autoregressive index

i.e. the normalised standard error of the estimate using a first-order autoregressive method to correct for trend (a modified random walk).

$$I-I_{7a} = \frac{100}{n} \sqrt{\sum \frac{(e_t)^2}{\bar{x}}}$$

i.e.  $\hat{\beta}_2$  is related to the duration of the disturbances  $U_t$  affecting  $x_t$

where  $e_t = x_t - \hat{\alpha}_0 - \hat{\beta}_1 t - \hat{\beta}_2 x_{t-1}$  and

$$\begin{aligned} \hat{\alpha}_0 &\approx \bar{u} \\ \hat{\beta}_1 &\approx \beta \\ \hat{\beta}_2 &\approx \alpha \\ e_t &\approx u_t \end{aligned}$$

given a model:

$$(1) \quad x_t = \alpha x_{t-1} + U_t \quad \text{with } u_t \text{ independently normally distributed, mean} = 0; \text{ variance} = \sigma_u^2$$

$$(2) \quad U_t = \bar{u} + \beta t + u_t \quad *1$$

Example : Kenen and Voivodas (19).

b) The adjusted first-order autoregressive index.

$$I-I_{7b} = \frac{100}{n} \cdot \sqrt{\frac{\sum (w_t)^2}{\bar{x}}}$$

i.e. adjustment for autocorrelation.

$$\text{where } w_t = \Delta x_t - \hat{\beta}_1 - \hat{\beta}_2 \Delta x_{t-1} \quad *2 \quad \text{and } w_t = e_t - e_{t-1}$$

Example : Kenen and Voivodas (19).

\*1 Substitution of (2) into (1) gives the estimating equation :

$$(3) \quad x_t = \alpha_0 + \beta_1 t + \beta_2 x_{t-1} + e_t$$

$$*2 \quad \text{Estimate : } \Delta x_t = \hat{\beta}_1 + \hat{\beta}_2 \Delta x_{t-1} + w_t$$

This index introduces an element of flexibility into the analysis insofar as it does not reflect any prior notion of the nature of the trend; only if the data shows a pattern will this method capture it. However, equation (3) may exhibit the problem of a lagged dependent variable as an independent variable, i.e.  $x_{t-1}$  might not be independent of  $e_t$  so that  $\hat{\beta}_1$  may be biased. This in itself would not cause much of a problem since the estimates are still consistent and efficient in large samples, but alas the samples utilised in these studies are invariably small (less than twenty observations). In addition, there may be autocorrelation if longer lagged

values of  $x_t$  appear in (1). This alone would imply inconsistent but unbiased estimates. However, if both the lagged dependent variable problem and positive autocorrelation occur simultaneously then the results will be both biased and inconsistent. The coefficients will be biased down so that the t-tests will be over-optimistic and the instability index will be biased up

The adjusted first-order autoregressive index represents the simplest method of solving this problem. Unfortunately, however, the Durbin-Watson test for autocorrelation is invalid in this model (biased towards 2), so that one is unable to tell whether autocorrelation initially existed, or has been removed by the transformation. Moreover, Durbin's large sample test is unlikely to be applicable here given the size of the sample commonly adopted. For more details on this and the danger of assuming no autocorrelation, see Johnston (18).