

**ON THE ECONOMIC VULNERABILITY
OF LOW INCOME COUNTRIES (*)**

by

Patrick GUILLAUMONT
CERDI -CNRS, Université d'Auvergne

Summary()**

This paper examines the relevance of the economic vulnerability concept for low income countries, a topic of recent concern in several international bodies. It first considers some conceptual clarifications and a method to build internationally comparable indicators. Three factors of vulnerability are distinguished: shocks, exposure and resilience or capacity to react (the first two ones being more structural, the third one more related to policy). To measure the two main kinds of shocks (natural and external), proposed proxies are respectively the instability of agricultural production and the instability of the purchasing power of exports, while the (smallness of) the population size can be used as a proxy for (structural) exposure. To aggregate the various possible indicators in a composite index of (structural) economic vulnerability, weights can be drawn from their estimated impact on growth.

Then selected issues related to the impact of vulnerability on growth are considered: "primary" instabilities (climate, terms of trade, political troubles) are found to slow growth, more by their effect on the total factor productivity growth than on the rate of investment, to do so through «intermediate » instabilities (of the rate of investment and of the real rate of exchange), and in agricultural economies through the impact at the farmer level. Besides its negative effects on growth, vulnerability is assumed to increase aid effectiveness: the more the recipient country is vulnerable the more aid contributes to growth. Implications are drawn for aid allocation and aid design.

(*) Prepared for the International Task Force on Commodity Risk Management in Developing Countries, World Bank. This paper partly relies on the work done by the author within the UN Committee for Development Policy and on discussions with other CDP members as well as with the members of a working group he chaired on that topic and with the UN Secretariat. But it only reflects the personal views of the author. Another acknowledgement is to Catherine Araujo Bonjean, Jean Louis Combes and Pascale Combes Motel, who wrote a complementary paper «The Economic Consequences of Export Instability in Developing Countries : a Survey » and for their comments, as well as to Sylviane Guillaumont Jeanneney for her own comments.

(**) A longer summary of this paper is available under the title "Why and How Vulnerability Matters".

1 – INTRODUCTORY REMARKS: SOURCES OF THE RECENT INTEREST ON ECONOMIC VULNERABILITY

Vulnerability is not really a new concept in economics, but it has recently become a fashioned one, noticeably because of the concern of several political bodies and the "turmoil" of international economy.

First, small island developing states (SIDS) have expressed their concern about their presumed high level of vulnerability. Following the 1994 Barbados Conference on the Sustainable Development of Small Island Developing State which asked for "the development of vulnerability indices and other indicators that reflect the status of small island developing countries and integrate ecological fragility and economic vulnerability", the United Nations General Assembly (UNGA), at its 51st Session in 1997, requested the Secretary General to prepare a report on the vulnerability index and the Committee for Development Planning (CDP) to examine this index.

The report presented in February 1998 took note of the work done on that matter by an ad hoc expert group and a working group of CDP held in December 1997 (both considering several indicators and concluding that further work was needed). In mid 1998, the UN Commission on Sustainable Development urged the CDP to present its conclusion and other UN bodies to accord priority to work on vulnerability of SIDS. In May the CDP gave consideration to the vulnerability index but requested more statistical backward work in order to formulate its advice at its next session (1999). Advice was actually given by the Committee for Development Policy (new CDP) which considered but did not retain the available indicators and proposed a new and relatively simpler one. In the meanwhile, several meetings were held on such topics, noticeably on the initiative of the Commonwealth Secretariat or of UN Secretariat.

Second, in its 52nd Session (December 1997), the United Nations General Assembly requested the CDP, in accordance with the own suggestions of the Committee in May 1997, to consider "the usefulness of the vulnerability index as a criterion for the designation of the Least Developed Countries" (LDCs). As CDP in May 1998 postponed its conclusions pending on the additional work needed on the vulnerability index, ECOSOC (in July 1998) again

urged CDP to assess the usefulness of a vulnerability index as a criterion for the designation of LDCs (and to consider the work of all other international agencies on the vulnerability of Small States)¹. It was done by the new CDP, which met in April 1999: the new "economic vulnerability index" referred above was proposed as one of the criteria to be used for the identification of LDCs, instead of the former "economic diversification index"^{2 3}.

Thirdly, an international task force has been requested at the initiative of the World Bank to make proposals on the ways by which commodity dependent economies can manage the risks they face in a market based approach: such proposals are directly intended to cope with the vulnerability of these economies and so involve to assess this vulnerability.

At the same time the Asian crisis made it clear that not only small island developing States, LDCs, and/or commodity dependent economies, might be vulnerable. Many comments and analyses of the causes of this crisis have underlined the vulnerability of some emerging countries that recently registered high level of capital inflows with weak financial structures.

Thus in various contexts the concept of vulnerability appeared to be a relevant one, leading to a need for a broad definition likely to cover the specific vulnerability of different kinds of countries. Indeed the previous examples evidence the need for a clear concept of economic vulnerability that could be measurable according to largely acceptable methods and be used for different purposes. We here limit our considerations to the low income countries and focus both on the LDCs (to be identified partly through their vulnerability) and on the commodity dependent economies (which often evidence a high vulnerability)⁴.

The present paper first analyses the concept of economic vulnerability and examines how it can be measured (section 1). Then it considers the several issues about the link between vulnerability and growth and their policy implications (section 2).

¹ This issue was rendered more acute by the 1997 CDP proposal to graduate Vanuatu of the list of LDCs in application with the present graduation criteria. UNGA in its 52nd session (December 1997) postponed its decision regarding Vanuatu, asking the CDP to reassess the graduation of Vanuatu according to its examination of criteria and the possible inclusion of a vulnerability index.

² The other two criteria are the level of GDP per capita and an indicator of human resources, the APQLI (Augmented physical quality of life index).

³ On all the previous points, see the last reports of the Committee for Development Planning (1998) and of the Committee for Development Policy (1999).

⁴ Of course other categories of countries may evidence a high vulnerability, noticeably the small islands.

2 – THE CONCEPT AND MEASUREMENT OF ECONOMIC VULNERABILITY

2.1 – Definition of vulnerability

Vulnerability means the risk of being harmed, wounded (negatively affected) by unforeseen events, in general and in economics as well. In economics, these unforeseen events are often called "shocks": economic vulnerability is a vulnerability to shocks of any kind, a susceptibility to exogenous shocks. As such the concept of economic vulnerability needs several kinds of clarification, first about its consequences which are referred to (static or dynamic), second about its sources (what kind of events?) and then about its difference from other more or less proximate notions.

A static or dynamic notion of vulnerability

If vulnerability is the risk to be harmed by shocks, a first question is how to measure the harmfulness. It could be the immediate losses of welfare resulting from the shocks. When successive and opposite shocks of equal size occur, the loss associated to the instability of income is due only to the decreasing marginal utility of income.

Our main concern here is the possible negative effects of the shocks on growth and development, i.e. a dynamic definition of vulnerability. Indeed most of the international debate about vulnerability, noticeably the consideration of vulnerability as a main handicap to growth in the search of criteria for LDCs identification, implicitly refers to this dynamic meaning. Another dynamic definition, somewhat broader, would be related to the likelihood of negative effects of shocks on poverty change.

Main kinds of shocks

At first glance, the sources of vulnerability (the shocks) could be classified into three categories:

- environmental shocks, namely natural disaster such as earthquakes, volcanic eruptions, typhoons and hurricanes, droughts...

- other external (trade and exchange related) shocks⁵: slumps in external demand, world commodity prices instability (and correlated instability of terms of trade), international fluctuations of interest rates, etc..

-other (i.e. non environmental) domestic shocks, notably those generated by political instability, or more generally by unforeseen political changes: this kind of shocks cannot be considered in the same way, as far as they are more "endogenous", or less independent from the "country will".

Economic vulnerability and ecological fragility

In the UN initial concern about vulnerability, both economic vulnerability and ecological fragility were considered in an integrated way. But it rapidly became clear that the two notions were to be analysed separately. For instance losses in biodiversity, which reflect ecological fragility and need to be analysed for themselves are not necessarily major elements of economic vulnerability.

This difference was clearly recognised by the ad hoc expert group commissioned by UN about vulnerability (and was reaffirmed by the CDP). But this group also considered that economic vulnerability could be induced by environment ("the relative susceptibility of economics to damage caused by natural disasters"). So the environment induced economic vulnerability can be considered either as a part of economic vulnerability or as a part of ecological vulnerability (the other part of which is the "ecological fragility")⁶.

Economic vulnerability and economic handicaps

Many developing countries suffer from handicaps, not all of which can be considered as vulnerability. Remoteness from large markets, landlockedness, low level of human resources may indeed be serious handicap to growth, but are not as such elements of vulnerability, because they are not unforeseen events. Of course, as any social and economic feature, they may influence the consequences of a given shock. An unjustified extension of

⁵ We suppose the developing countries to be rather small and price taker, so that the instability of prices for the commodities they export be exogenous.

⁶ The most comprehensive attempt to build an "environmental vulnerability index" is due to the SOPAC (South Pacific Applied Geoscience Commission), cf Kaly and alii, 1999.

the concept of vulnerability to structural economic features which is presumed to permanently –and quite foreseeably- affect the rate of growth often appears in the literature⁷.

On being an island: size, remoteness and climatic instability

The discussion on the concept of vulnerability seems to have been often small island driven, as it appears in the UN resolutions and the kind of works written on it. Of course, as far as one intends to enlighten a presumed higher level of vulnerability of SIDS (Small Islands Developing States), the concept has to be applicable to other States as well. But it needs also to capture the specific aspects of islands vulnerability⁸.

Let us consider the three features often presented as the basis of island vulnerability: distance from main markets, small size and climatic instability. The first feature, as we have seen, may be a structural handicap, but not necessarily a vulnerability element, whereas small size may generate vulnerability, as we shall see, and climatic instability is actually a major component of vulnerability. But many countries other than islands evidence one or the other of such features, which in turn may not be found together in all islands.

2.2 – Three vulnerability components: shocks, exposure, resilience

The risk of a country to be wounded by unforeseen events (shocks) can be broken down in three components:⁹

- a - the size and likelihood of the *shocks*
- b - the *exposure* to the shocks
- c - the country capacity to react to the shocks or its "*resilience*"

We note that the concept of resilience is largely used in some works more specifically oriented towards the environmental or natural sources of vulnerability (cf. SOPAC 1998). A distinction close to the previous one can be found in Rodrik (1998) who, looking for the risk

⁷ For instance Briguglio, 1995, 1997, includes the remoteness and the relative importance of transport costs as elements of vulnerability.

⁸ Several attempts to build indicators of vulnerability have been focused on the situation of small islands (Briguglio 1995, 1997, Crowards 1999, Atkins and alii 1998).

⁹ Such a decomposition can be used for various topics, for instance the transmission of US recessions to European countries, during the post-war period or for any expansion or recession transmission from one area to another one (Guillaumont 1985).

of social conflict, considered separately the severity of the shocks, the depth of latent social conflict (likely to increase the impact of the shocks) and the quality of conflict management (related to the institution).

The case of a commodity exporter

Consider for instance a small country that is a primary commodity exporter. Its vulnerability to trade shocks results first from the world prices fluctuations (reflected by the instability of its terms of trade), second from the exposure to the shocks expressed by the ratio of (commodities) export to GDP, and third from the capacity of the country to efficiently manage such shocks.

The size of the shocks for a small countries (price-taker), let us say the level of export price instability, is clearly an exogenous or structural factor of instability. The resilience, let us say for instance the capacity to manage instability, clearly depends on the policy pursued. The exposure to the shocks is more ambiguous: it is mainly a structural factor, but to some extent it is also dependent on policy: for instance the export to GDP ratio mainly depends on the population size, the level of income per capita, the possible landlocked location, the possible mineral exports, factors which do not reflect the present policy, but also on the policy itself (more or less open or outward looking). We come back later to this question, when discussing the measurement of indicators.

Structural vulnerability versus policy related vulnerability

Thus an important distinction concerning vulnerability must be made between structural vulnerability, which results from factors that are durably independent from the political will of countries, and the vulnerability deriving from economic policy, which results from choices made in a recent past, and is therefore conjunctural. The vulnerability of the Asian countries, which has been so often underlined during the past year, is very different from the vulnerability of small economies which export raw materials or of small islands. It is probably less structural and more political or more conjunctural.

If one wants to utilise a vulnerability index for selecting some countries and bringing them to the attention of the international community (especially in the case of identifying

LDCs), it is naturally the structural vulnerability that must be measured, which is itself composed of two elements: the extent of the shocks that can arise and the exposure to such shocks.

Vulnerability at the macro level and at the micro level

We are here mainly concerned by the vulnerability at the macrolevel, i.e. vulnerability of the economy as a whole. But of course what mainly matters is the vulnerability of people, specially of the poor. It is clear that the vulnerability of the global economy in low income countries is associated to vulnerability at the micro-level, depending on how shocks are passed through within the economy and on the features of the people situation. Vulnerability of people, for the whole economy, has three components: the shocks on the people incomes depending on the shocks, exposure and resilience at the macro-level and on the capacity of the people to react, their own resilience. Conversely if people appear to be vulnerable, it will be reflected by a low resilience at the macro-level.

Let us illustrate that by the example of a fall of the world price of main export crop. The macro vulnerability depends on the size of the fall, on the share of the related crop exports in GDP and on the capacity of the country to manage this shock relatively to GDP. The vulnerability at the micro level, let us say at the farmer level, depends (1) on the size of the world price fall which itself results from the world price fall, the domestic processing of the product and from its public taxation, (2) on the number of farmers concerned and on the share in their total income of the crop the price of which is falling (exposure), and (3) on their capacity to insure, to borrow or to draw on their own assets, in order to compensate the loss of income and maintain their level of basic needs fulfillment.

2.3 – The main sources of vulnerability of low income countries and related indicators.

Indicators of (structural) economic vulnerability must be drawn from the classification of shocks identified as likely to affect low income countries. They of course also need to be largely available and reliable....

Climatic and natural shocks: the instability of agricultural production

Climatic and natural shocks are a main source of vulnerability in many developing countries and cover a large variety of events: earthquakes, typhoons or hurricanes, floods, droughts, insects invasions, etc... An indicator of the risk of natural catastrophes has been drawn up on the basis of an index of the frequency of such events, measured over a long period of time. An alternative indicator is the average proportion of the population affected by the events. These indicators or similar indices have been used by some authors as a component of a vulnerability index (for instance Atkins and alii 1998)¹⁰. Unfortunately these data are not available for a large number of countries and a long enough period of time.

Moreover the potential negative impact of these very different events strongly differ from one to the other, and even within one kind of event (more or less severe droughts, cyclones, etc..). Weighting by the number of people affected –if it is known- does not solve the problem, since people may be more or less severely affected (some will die, others will be displaced for some weeks, ..). Of course, measuring the economic losses resulting from these numerous events in all the developing countries concerned would give a good indicator but is an impossible task¹¹.

For these reasons a proxy of these natural disasters has to be looked for. It can be found in the measurement of the instability of agricultural production with regard to its trend value (and in percentage of this one). Whereas the trend, if significantly measurable (cf. infra), of agricultural production may be supposed to mainly depend on the economic policy pursued and on permanent factors, the fluctuations around the trend may be supposed to reflect the occurrence and severity of natural shocks, which are likely to affect agricultural production¹². For these reasons this indicator has been proposed by the CDP as a component of a new economic vulnerability index to be used for LDCs identification.

¹⁰ The main source of the data is the Emergency Events Data base, compiled by the Center for Research on Epidemiology of Disaster at the School of Public Health, Université Catholique de Louvain.

¹¹ An attempt however is due to UNDRO (1990), a data base used by Briguglio 1995. Indicators relying on these data bases are criticized by Crowards (1999).

¹² We used this indicator in several previous works (cf for instance Guillaumont P. and S. 1988, Guillaumont, Guillaumont, Plane 1988, Guillaumont, Guillaumont Jeanneney and Brun 1999).

Trade shocks: the instability of real export proceeds

Another main source of vulnerability stands in external trade, even if an open trade is in itself a factor of development. An indication of this kind of vulnerability may be given by the instability of the real export proceeds with regard to its trend. We have to consider here all the exports of goods and services, as far as shocks can affect good exports and services exports as well, which are indeed a large part of the export receipts in small (and vulnerable) countries¹³. (Some private transfer, such as migrant remittances could be included as well).

We assume that for such (price taker) countries this instability is structural, i.e. resulting from exogenous events, namely fluctuations in world prices, in external demand and in domestic events not related to policy (climate). Of course, some fluctuations of export volume (with regard to its trend) may be due to the instability of the policy itself, but we can suppose that the effect of policy on export volume is more seizable through its trend than through its fluctuations.

Moreover there may be some problems in the measurement of the volume and price indices of trade at the country level. As it is well known, estimations (for instance by UNCTAD) of the developing countries unit values of exports, of imports and terms of trade are only tentative, and in any case they only cover the export of goods and not the export of goods *and* services. When data available at the country level do not allow one to measure the time series of the import purchasing power of exports, i.e. income terms of trade (export value deflated by the unit value of imports), it is always possible to deflate the value of exports in current dollars by an index of world export prices, giving comparable series of "real" export value, i.e. purchasing power of exports in an identical basket of goods internationally traded.

Long term trend in the terms of trade: is it a shock?

Let us assume that we can use statistics of the countries unit values of export and import (of goods) and measure reliable series of the terms of trade (for goods), which is not

¹³ The importance of services is the reason why instability of goods and services exports is a preferable indicator of vulnerability than the coefficient of export concentration, which could often be considered as an index of the main structural source of export instability: indeed the coefficient of concentration is related only to the exports of goods and cannot be easily extended in order to cover goods *and* services.

the case for many countries. Can the terms of trade trend, adequately measured (cf. infra), be considered as a shock for these small countries which are price takers? Of course the trend value is sometimes considered as a proxy for anticipations... But it is indeed a negative event, which is not really predictable before it occurs. It can conversely be said that the longer the period covered the more able the country is to reallocate its resources so that the structure of trade will be more favourable. Thus depending on those considerations and on the purpose of the analysis of vulnerability, the terms of trade trend is or is not to be included among the components of economic vulnerability.

Other possible shocks: the capital account side

We only considered above the external trade shocks. Of course other kinds of external shocks may occur, mainly due to short-term capital flows, as experienced by Asian countries and Latin American countries as well. But regarding the low-income countries, and more specially commodity dependent economies, we limit our attention to trade shocks. And, as noted above, trade shocks in low income economies are more structural, less induced by policy variables than fluctuations in the short term capital flows of emerging economies.

2.4 - Dealing with instability measurement

The use of instability indices as components of a vulnerability indicator raises measurement problems, which are briefly indicated below.

Instability is always relative to a reference value or a trend value. It will be measured, for instance by the average absolute deviation from a trend, or more often, by variance of this deviation¹⁴. The essential choice is then estimation of the reference or trend value.

Looking for indicators of vulnerability comparable at the international level, we do not need to interpret instability as a risk variable perceived by economic agents, which would involve the specification of a model for forming expectations, possibly differing among countries. Moreover, as it will appear, instability is not damaging only because it engenders risk, but also through the asymmetric reactions to ups and downs it induces. Thus it is simply

¹⁴ When the series are related to values which on average strongly differ from one country to another and are not expressed in log, the deviations are preferably expressed in per cent of the trend value.

needed to measure deviations from a trend observed in the past. But, as it is well known in the literature on instability or volatility, the question is how to measure the trend.

A deterministic trend has long been assumed, that is, series X_t , a function of time t , is adjusted according to a model that is assumed to be either linear or exponential (for instance with the better fit of the two being then retained). In other words, $X_t = a t + c$ (with X_t possibly in log). But the possibility of nonstationarity of the series is to be taken into account. It means that the series do not correspond to a prespecified law [$X_t = f(t)$], but may be influenced permanently by shocks affecting the series, which may lead to a purely stochastic series or to a random-walk process [$X_t = X_{t-1} + \varepsilon$]¹⁵. On the other hand the series may not be purely stochastic. To take the stochastic element into account it is possible to estimate a «mixed» function, combining a deterministic element and a stochastic element:

$\log X_t = a' t + b \log X_{t-1} + c'$ (again with X_t possibly in log). The variance of the residual can then be a convenient measure of instability.¹⁶

Calculations made on very large sample of countries, show that the correlation between the two measures (deterministic and mixed) may be rather high. For instance, for the exports of goods and services in real terms (WDI data) on several periods (1970-1980, 1980-1990, 1975-1985, 1985-1995) and a large sample of countries, the rank correlation coefficient between the two instability indices stands between 0.87 and 0.93.

2.5 - Taking into account the exposure

Adding indicators of exposure (not policy induced)

In a composite indicator of economic vulnerability, the exposure to the shocks can be taken into account besides the indicators of the shocks through one or several supplementary component indicator. For instance it is conceivable to add to the preceding two indices, reflecting shocks, a third one, reflecting exposure, which would be the size of the population (expressed in logarithm), relying on the simple idea, that *ceteris paribus*, countries are the

¹⁵ With X_t in log, it follows that the residual is the (annual) rate of change and the instability is measured by the variance of the (annual) rates of change.

¹⁶ There are also more sophisticated measures.

more vulnerable the smaller they are. The CDP has actually proposed to include among the components of its economic vulnerability index the size (log) of the population.

As noted above, the population size is a better indicator of structural exposure to trade shocks than the export to GDP ratio, since the later depends not only on structural factors such as the population size, but also on policy factors¹⁷. Another more comprehensive way to capture the structural components of exposure to external shocks would be to use a value of the export to GDP ratio estimated (on a cross-section basis) as a function of only structural factors, such as the population size, the initial level of GDP per capita, the export of mineral resources, etc.. (for the decomposition of the exports to GDP ratio into its structural component and its policy component, the later being considered as an indicator of outward looking policy, see Guillaumont P. and S. 1988, Guillaumont, 1989, 1994).

Weighting shock indicators by exposure indicators

But it is also conceivable to use exposure indicator as a multiplicative factor of the shocks indicators. In other words the indication of the size of the shocks could be weighted by an indicator of the exposure to the shocks. For instance the indicator of export instability would be weighted by the average export to GDP ratio: such a weighted index of export instability has been presented as a significant negative factor of growth in several previous studies (Guillaumont and Deméocq 1989, Guillaumont 1994, Guillaumont, Guillaumont Jeanneney, Brun 1999)¹⁸. But if only structural vulnerability is to be measured, the weight to be used should not be the export to GDP ratio, for the reason previously indicated. It might be an indicator of the structural factors of exposure, such as the (low) population size, or better, an adjusted value of the export to GDP ratio, estimated as a function of only structural variables) (the corresponding residual is an indicator of a more or less or outward looking policy, cf. supra 2.2).

By the same way, it should be conceivable to weight the index of instability of the agricultural production by the agricultural value added to GDP ratio: but again this ratio partly depends on some policy factors. Moreover the exposure to the shocks reflected by the

¹⁷ The export to GDP ratio has however been used in several attempts to measure economic vulnerability (cf. for instance Briguglio 1995, 1997, Crowards 1999, Atkins and alii 1998, Easter 1999).

¹⁸ In a paper on the effects of export instability Dawe (1996) retains the instability of the export to GDP ratio itself, which is another way by which to take into account the exposure.

agricultural production instability is not limited to the agricultural sector, which is an argument not to weight the instability of agricultural production¹⁹.

2.6 - Weighting the component indicators: some composite indicators recently proposed.

The component indicators of economic vulnerability, the exposure components being either taken distinctly besides the shocks components or as weights of the others, have to be aggregated in a composite indicator.

Equal weights

The simplest way to aggregate is of course, after measuring each component on a same scale depending on the maximum and minimum values²⁰, to calculate the unweighted average of these components. There is apparently no subjective choice of a weight, but since the actual weight is given by the number of components, a possible subjectivity may result from the choice of the components.

Let us consider the economic vulnerability indicator (EVI) proposed by the CDP (Committee for Development Policy). It is an unweighted average of five component indices:

- the instability of exports of goods and services
- the instability of agricultural production
- the log of the population size
- the concentration of exports of goods, considered as a factor of instability of exports, but which does not cover the exports of services²¹
- the share of manufacturing and modern services in GDP, here taken as another proxy for (less) exposure.

¹⁹ With regard to the risk of social conflict, let us recall that D. Rodrik (1998) takes as an indicator of exposure an index of latent social conflict and uses it as a multiplicative factor of the shock index (and of the indicator of the capacity to manage conflicts as well). Note that the index of shocks used by Rodrik is itself an index of terms of trade instability multiplies by the share of export in GDP, thus to some extent incorporates a major component of "exposure".

²⁰ It is sometimes proposed, but debated, to limit the scale at the highest and the lowest decile values (cf. for instance CDP 1998, Crowards 1999).

²¹ It is a Gini-Hirschman export concentration index, as regularly calculated by UNCTAD.

The three first indices reflect respectively the two main kinds of shocks and the main factors governing exposure. As such they present a simple and consistent selection of components of a vulnerability indicator. The last two elements (export concentration and share of manufacturing), drawn from the components of the previous economic diversification index (EDI), which until now the CDP used instead of the new proposed EVI as one of the criteria for LDCs identification, are intended to show the continuity between the two indices. In the same time, since export concentration is a factor of higher export instability, it apparently leads to give more weight to trade shocks than to actual shocks. But export instability itself partly reflects natural shocks. On the whole the two main kinds of shocks may be considered to be given a similar weight... Regarding the share of manufacturing, it is, for a given GDP per capita, closely linked to the size of the population: introduced side by side, the population size and share of manufacturing indices lead to give 40 per cent of the total weight to the exposure components of vulnerability.

Revealed weights

In a recent work (Guillaumont and Chauvet 1999), we have used a close set of component indicators to build a composite indicator of vulnerability, with the weights not chosen a priori, but drawn from an econometric exercise and reflecting the estimated impact on economic growth of the different components indicators, which is consistent with the definition of vulnerability, as a handicap to growth. The components retained are the respective instabilities of real exports (goods and services) and of agricultural production, the population size and also (for the need of the study) the trend in the terms of trade. These four factors appear to be significant, besides some common control variables, in a growth regression, pooling two eleven-year periods and covering 95 observations. The resulting vulnerability indicator can be seen as the ceteris paribus impact of the exogenous shocks and exposure to them on economic growth. Another way to weight the components would be to estimate their impact on poverty change, but comparable statistics of poverty reduction are not available on a very large sample of countries.

Another example of an econometric weighting can be given by the Commonwealth Secretariat index of vulnerability (several versions have been presented including Atkins and Mazzi 1998, Easter 1999). It is an estimated value of instability of the rate of growth, with three explanatory variables empirically chosen among a lot (more than fifty), which reflect

policy factors as well as structural factors.²² The three retained factors are the index of natural disasters²³, the so called UNCTAD index of export diversification²⁴ and the ratio of exports of goods and services to GDP. One main problem with this indicator is that it measures vulnerability with regard to growth volatility, that is less relevant than the average growth itself. Moreover the last of the three factors (export to GDP ratio), as noted above, is partly policy induced, and as such inappropriate to measure structural vulnerability.

Conclusion

To summarize, it is possible to build an indicator of the structural (or exogenous) economic vulnerability of low income countries

- relying on the two main kinds of shocks they face, natural shocks and trade shocks, proxied by the respective instabilities of real exports and of agricultural production
- including in one way or another a consideration of the (not policy induced) exposure to these shocks, primarily through the smallness of the size of the population
- weighting the elementary component indices, either equally or by their respective impact on growth.

Differing from the structural economic vulnerability, the global economic vulnerability also includes policy generated elements which can have an influence on the size of shocks, on exposure, and above all on the capacity to manage or on "resilience".

3 - THE IMPACT OF VULNERABILITY ON GROWTH: SELECTED ISSUES IN BRIEF

Since vulnerability has been defined with regard to growth (as a growth or development handicap) it is useful to clarify the ways by which it is expected to do so. We have selected here three topics which are likely to enlighten on a cross-sectional basis the link between vulnerability and growth and have been considered in some recent works.

²² The index is itself multiplied by an index of the GDP per capita, considered as a proxy of resilience, to give a "composite vulnerability index".

²³ An index taken into account, through a dummy variable, only for the countries with a "small" population size (see above 2.3 a short discussion of this indicator).

²⁴ Differing from the export concentration index, this index is the absolute deviation of the (each commodity) country share from the world structure. As noted by UNCTAD it is hardly used to discriminate between low income countries.

3.1 - Primary instabilities and growth

Let us first consider the effect on growth of the instabilities assumed to be exogenous, as tested by several recent papers. Following the comparative approach adopted in the previous part of the paper, we here mainly consider the effects empirically identified through cross-sectional analyses. An important literature also examines the effects of trade shocks in their theoretical grounds and through country case studies (cf Collier and Gunning 1999).

Some recent tests: assessing the respective effects of shock size, exposure and resilience

For many years the effects of export instability on the growth of developing countries have been discussed in the literature using growth regressions. The results could appear as mixed, partly due to methodological shortcomings. A recent survey shows an emerging consensus among studies to conclude that export instability has a negative effect on growth²⁵. For instance, Dawe (1996) and Guillaumont (1994) have shown a significant negative effect of export instability on growth. Both studies test simultaneously the (positive) effect of export growth, and the (negative) effect of export instability. As noted above the export instability (size of the shocks) is in both cases either weighted by the average export to GDP ratio during the period (Guillaumont 1994) or is an instability of the export GDP ratio itself (Dawe 1996).

Moreover (Guillaumont 1994) the effect of this (weighted) export instability appears to depend on the more or less outward looking character of the policy, as proxied by the residual of a function of the export to GDP ratio where the explanatory variables are only structural ones (population size, initial level of GDP per capita, export of minerals, landlockedness, ...): the absolute value of the (negative) coefficient of the (weighted) export instability in the growth regression is the smaller the more outward looking is the policy. Thus three effects of a more open trade policy are identified and significantly tested: the well known positive effect of the growth of exports, the negative effect of the increase of the exposure to instability, and a positive effect of lessening the impact of a given (weighted) export instability, which means a greater resilience.

²⁵ See as an Annex to the present note the survey presented by C. Araujo Bonjean, J.L. Combes, P. Combes Motel. See also CERDI, 1997, *Evaluation globale du Stabex*. Reviewed studies include Glezakos 1984, Guillaumont and Deméocq 1989, Gyimah-Brempong 1991, Fosu 1992, Guillaumont 1994, Lutz 1994, Dawe 1996.

In a recent paper (Guillaumont, Guillaumont Jeanneney and Brun 1999), we try to estimate the influence of several kinds of "primary", mostly exogenous, instabilities on the rate of growth and argue that these instabilities may have been a major factor of the slow rate of growth in SubSahara Africa during the seventies and eighties, since these instabilities appear to have been significantly higher in Africa South of the Sahara than in other developing countries. The primary instabilities are the instability of the terms of trade, weighted by the average export to GDP ratio, or that of the income terms of trade (real value of exports), weighted by the same way, the instability of the agricultural value added (weighted by the average share of agricultural value added in GDP) and an index of political instability. To be noted, the first and the third instabilities here appear to have a significant effect on growth, but not that of the agricultural value added.

We recall that in another work both the instabilities of real value of exports and of agricultural value added, but unweighted, appear to be significant, besides the log of population, as a proxy for exposure (Guillaumont and Chauvet 1999), which allowed the authors to use these instabilities as components of a composite vulnerability indicator.

The previous tests consider separately the main sources of instability or vulnerability. A comprehensive test of the possible impact of instability, which appears to be simultaneously a test of vulnerability, is that of Ramey and Ramey (1995): they evidence a significant link between the instability of the rate of economic growth and the average rate of growth itself. The exogeneity of the instability of the rate of growth is tested, but this instability can notwithstanding be due to structural factors and to policy factors as well.

Also not trying to separate structural from policy sources of vulnerability, Rodrik (1998) tests significantly the negative influence on the change in the rate of growth between two fifteen-year periods of a multiplicative index of "conflict", which multiplies an index of "shocks" by an index of "latent social conflict" (the ethnologic fragmentation index or a Gini coefficient of income inequality), then by an index of the quality of conflict management institutions (namely the lack of democracy or the quality of governmental institutions as measured by Knack and Keefer 1995). Each of these, introduced alternatively, appears highly significant. Rodrik also tests additively the respective effects of trade "shocks" and of either an exposure index or a capacity to manage index.

Vulnerability, the rate of investment and the growth residual

Growth regressions on instability or vulnerability indicators either include or not the rate of investment besides the other control variables. When the rate of investment (investment to GDP ratio) is included, the coefficient of the instability or vulnerability indices only expresses their impact on the growth residual, whereas when it is not included, the coefficient is assumed to assess their total effect, both through the rate of investment and the growth of factor productivity.

Although several authors have argued that risk (proxied by instability measures) may be a lowering factor of investment (see for instance Aizenman and Marion 1999), in the quoted previous cross-section growth regressions the effect of the instabilities, either the so-called primary instabilities (Guillaumont, Guillaumont Jeanneney, Brun 1999) or that of rate of growth (Ramey and Ramey 1995), essentially lessen the rate of growth of factor productivity. Actually the weighted instability of the terms of trade appears to increase rather than lower the rate of investment (Guillaumont, Guillaumont Jeanneney, Brun 1999), which makes the effect on the growth residual alone stronger than the total effect on growth. Similar results about the effects of (weighted) export instabilities were found by Guillaumont (1994) and Dawe (1996), who underline the effects through the growth residual rather than through the rate of investment²⁶

3.2 - The channels of vulnerability: vulnerability and economic policy

If economic vulnerability is mainly due to an effect on the growth residual, the way by which it does so needs to be precised.

Two main intermediate instabilities: instability of the rate of investment and of the real exchange rate

In a previous paper above referred to (Guillaumont, Guillaumont Jeanneney, Brun 1999), we test the hypothesis that the primary instabilities (terms of trade, agricultural

²⁶ Arguments about a positive effect of export instability on savings and investment have been presented in the literature for a long time (Knudsen and Yotopoulos 1976, Lim 1980) and discussed in various papers as well.

production, political instability) influence growth through two important intermediate instabilities, namely the instability of the rate of investment and that of the relative prices. These two intermediate instabilities have negative effects on growth and are related to policy.

First the instability of the rate of investment is a factor, curiously neglected in the literature, of a lower average productivity. As a result of the declining marginal productivity of investment, the gain in total output due to a high level of investment is less than the loss due to a low level of investment. This effect, illustrated during the boom periods by the projects oversized, underprepared and weakly productive, mainly concerns public investment.

The second intermediate instability, that of the relative prices, proxied by the instability of the real effective exchange rate (REER) also appear to have a strong negative effect on the rate of growth. It is assumed to blur the market signals and induce a misallocation of investment. This negative effect of the REER instability or volatility has also been evidenced in several recent papers (cf for instance Aizenman and Marion 1999, Ghura and Grennes 1993, Serven 1997). In our paper it appears to have not only an effect on the total factor productivity, but it has also a negative effect on the rate of investment.

Instability at the farmer level

Finally it has to be recalled that, either due to the macro policy through the REER instability or to the passing through to farmers of world agricultural prices fluctuations, the instability of the real producer prices is generally considered as a factor of a lower average agricultural output (as well as a factor of lower welfare), noticeably by its effects on the adoption of new techniques (Newbery and Stiglitz 1981). Time-series studies are related to some specific products and countries (for instance Behrman 1968, Just 1974, Lim 1977, Guillaumont and Bonjean 1991, Araujo 1995). Some others have significantly tested the effects of the real producer prices instability on the growth of agricultural production on a sample pooling several products in many countries (Guillaumont and Combes 1996, Guillaumont and Guillaumont 1994, Boussard and Gérard 1996).

Thus it appears that external instability has negative effects through the instability of the rate of investment and of the real exchange rate either by its impact on public finance when retained at the government level or by its impact at the producer level when passed through.

Instability, policy and performance

The hypothesis that economic vulnerability is linked to government behavior is supported by the inclusion of a vulnerability indicator in a model where the explained variable is a composite indicator of macro policy. We use an index of macro policy, similar to that used by Burnside and Dollar (1997), including as components the ratio of budget surplus to GDP, the rate of inflation, and the Sachs and Warner indicator of openness, weighted by their impact on growth in a cross-section model with other common control variables: the indicator is a measure of the impact on growth of these three identified factors, *ceteris paribus*. This indicator of policy appears itself to be significantly and negatively influenced by the level of economic vulnerability, as measured by the index presented above (Guillaumont and Chauvet 1999)²⁷. Thus vulnerability weakens policy.

This influence of exogenous instabilities on the quality of economic policy has some implications on the measurement of country performances. Performance, a possible criterion for aid allocation, can be defined as outcomes (for instance growth outcomes) adjusted for the impact of the exogenous factors (Collier, Guillaumont, Guillaumont Jeanneney, Gunning, 1997). If exogenous factors, such as external instabilities, have an impact on policy, this impact has to be taken into account in the measurement of performances: outcomes have to be adjusted not only for the direct impact of exogenous factors (including structural vulnerability), but also for their impact on policy (Guillaumont and Chauvet, 1999).

3.3 - Vulnerability and aid

The impact of structural vulnerability on aid effectiveness

It has been argued (Burnside and Dollar 1997) that aid effectiveness depends on policy. When policy is good, aid is efficient in promoting growth, when policy is bad, aid is not efficient, or is counterproductive. Aid is simultaneously supposed to have no effect on policy. In a further step, assuming that the marginal effect of aid on growth is decreasing, and that there is a simple relation between growth and poverty reduction, it has been suggested

²⁷ Another significant explanatory variable is the level of initial human capital (average years of schooling).

how aid could be allocated so as to maximize its effects on poverty reductions (Collier and Dollar 1999)²⁸.

But it can also be argued that growth aid effectiveness depends on structural vulnerability. The more vulnerable the recipient country, the higher is the marginal contribution of aid to growth: in vulnerable countries aid helps to avoid collapses and lasting recessions (Guillaumont and Chauvet 1999). This alternative assumption, tested on a cross sectional growth regression over 1970-1993 divided into two eleven-year pooled periods, with a large sample of developing countries and the traditional control variables, is not rejected. The same model rejects the assumption of an aid effectiveness dependent on policy. The results have been obtained with TSLS, where aid and policy variables (the same that the Burnside and Dollar policy variables) are instrumented. The test variable is a multiplicative variable (Aid x Vulnerability) introduced successively besides and instead of the multiplicative variable of Burnside and Dollar (Aid x Policy). Structural vulnerability lowers growth but is likely to increase aid effectiveness. Policy factors enhance growth but do not seem to clearly influence aid effectiveness.

Implications for aid allocation

An implication of the previous argument is that the structural vulnerability of the recipient countries has to be taken into account, not only for its direct negative impact on growth (and poverty), but also with regard to aid effectiveness, in order to maximize through its allocation the effect of aid on growth and consequently on poverty reduction. At least partly, aid has to be allocated according to the vulnerability of the country, not only to compensate for the loss of welfare, but mainly to maximize its effects on growth, because aid is more efficient in vulnerable countries. By this way it can also more contribute to poverty reduction as far as the later mainly depends on the rate of growth.

However, in order to also give incentives to policy improvements, it is possible to design aid allocation criteria likely to combine the creation of such incentives and the increase of aid effectiveness as a function of vulnerability (cf Guillaumont and Chauvet 1999). It is to allocate aid according to performances of the countries, as defined above (outcomes, growth or poverty reduction, adjusted for the impact of the exogenous or

²⁸ The various assumptions of these studies have been reviewed in Guillaumont 1999.

environmental factor, i.e. factors not induced by policy, firstly structural vulnerability factors). This proposal (in line with a previous paper by Collier, Guillaumont, Guillaumont Jeanneney, Gunning 1999) is likely both to increase aid effectiveness (since for a given outcome performance is better when vulnerability is high) and also to promote good policy (a good policy leads to a better outcome for a given vulnerability). The political advantage of this approach, compared to an allocation only based on policy criteria, is not only to take into account vulnerability, but also to leave the country free to choose the policy instruments by which it tries to obtain outcomes.

It can be noted that the choice made by the CDP of an economic vulnerability indicator as one of the main criteria of identification of LDCs, a category of country expected to mobilize a relatively larger amount of aid than other developing countries, is consistent with the argument of a higher aid effectiveness in vulnerable countries.

Implications for aid design

The consequences of vulnerability have a second set of implications for aid design. Aid could be designed precisely to lessen vulnerability. We remember that vulnerability has three components: shocks, exposure and resilience. As far as the shocks size and countries exposure are structural, the priority to lessen vulnerability is to lower the countries resilience. Indeed the most efficient way by which aid can contribute to the lessening of vulnerability, and the fastest, is to enhance the capacity of the countries to manage the shocks they face, and at the micro level, the capacity of the farmers to cope with the shocks transmitted to them or occurring at their level. In other words, aid should be targetted to build or enhance "insurance" schemes at the macro or the micro level.

Some kinds of aid are explicitly devoted to face vulnerability problems such as the IMF Compensatory and Contingency Financing Facility and the European Union STABEX and SYSMIN. To illustrate the implications of vulnerability for aid design, we specially refer here to STABEX, because it was designed primarily to help poor farmers to face the consequences of their export crops volume or price instability. In other words it was intended to address the problems of vulnerability at the micro level, as much as at the macro level.

Initially STABEX offered an automatic compensation for shortfalls occurring in ACP countries exports of a limited list of agricultural products, considered independently each from the other. During the successive Lome Conventions, an increasing control has been put on the use of the funds, with consequently more lags and less automaticity. In two recent papers (Collier, Guillaumont, Guillaumont Jeanneney, Gunning 1998, 1999)²⁹, the rationale and the modalities of a reform of STABEX have been considered, in view of the new conventions negotiated between ACP and EU countries. The issue is to conciliate the two initial principles of STABEX, automaticity (for quick disbursements) and agricultural income support and smoothing, which have not been actually satisfied during the past years due to increasing disbursements lags, fungibility and possible dutch disease effects.

The proposed solutions are to set up in advance an agreement between ACP States and the European Commission about the rules of a quick use of STABEX resources, relying on (price or crops) insurance or on new fashioned, i.e. more market based, price stabilization schemes. In case of shortfalls, STABEX funds would then be automatically available to support these insurance or stabilization schemes allowing them to work at a minimum cost for the farmers.

The papers discuss how the insurance schemes could cover both climatic risks as well as price risks, how the self-selection of beneficiaries would not be adverse but beneficial and how moral hazard could be controlled. The papers also indicate in which conditions stabilization schemes could work efficiently with an external support : by conditioning the external support to the location of surpluses outside the State budget or outside the country, to maintaining a link between the producer prices and the trend of the world market prices and, when the State is involved in the scheme, to the limitation of the crop taxation during the boom period .

In other words there is a large room for an external support to various kinds of schemes helping poor farmers to efficiently cope with the risks they face, and at the same time giving to governments incentive to a better management of the instability. Indeed the bad management of the booms has created the bulk of the difficulties encountered in shortfall periods.

²⁹ Relying themselves on a larger study made for the European Commission.

A new facility, as well as STABEX, could offer, according to a menu approach, a support for any of these schemes as far as they fulfil some efficiency principles previously agreed upon.

References

- Aizenman J. and N. Marion (1999), "Volatility and investment: Interpreting evidence from developing countries", *Economica*, vol. 68, N° 26, p. 157-180.
- Araujo C. (1995), "Les producteurs brésiliens et l'instabilité des prix : différences de comportement entre le Nord et le Sud", *Canadian Journal of Agricultural Economics*, 43, p. 443-461.
- Atkins J., S. Mazzi and C. Ramlogan (1998), "A study of the vulnerability of developing and island states: a composite index" (London, Commonwealth Secretariat, August).
- Behrman J.R. (1968), "Supply response in underdeveloped agriculture", North-Holland Publishing Company, Amsterdam.
- Boussard J.-M. et Gérard (1994), "Stabilisation des prix et offre agricole" dans Benoit-Cattin M., M. Griffon et P. Guillaumont (Eds), *Economie des Politiques Agricoles des PVD*, Tome 2, Edition Revue Française d'Economie, Paris.
- Briguglio C. (1995), "The Vulnerability of Small Islands", *World Development*, vol. 23-n°9, p. 1615-1632.
- Briguglio C. (1997), "Alternative Economic Vulnerability Indices for Developing Countries", Report prepared for the United Nations.
- Burnside, C. and D. Dollar (1997), "Aid, Policies and Growth", *World Bank Policy Research Paper*, n°1777, June.
- CERDI (1997), "Evaluation globale du Stabex", Rapport effectué à la demande de la Commission Européenne, Rapport intermédiaire, 343 p.
- Collier P. and D. Dollar (1999b), "Aid Allocation and Poverty Reduction", April 11, processed.
- Collier P., J. Gunning (Eds) (1997), *Trade Shocks in Developing Countries: Theory and Evidence*, Oxford University Press, Clarendon.
- Collier P., Guillaumont P., Guillaumont S., Gunning J. et Buis M. (1997), "Le Stabex comme "fonds de garantie"", Rapport établi à la demande de la Commission des Communautés Européennes, CERDI, avril.
- Collier P., Guillaumont P., Guillaumont S. and Gunning J. (1997), "Redesigning Conditionality", *World Development*, vol. 25, n°9, September, p. 1399-1407.

- Collier P., P. Guillaumont, S. Guillaumont, J. Gunning, "Rénover le Stabex", *Politique Etrangère*, 1998-1, p. 155-170.
- Collier P., P. Guillaumont, S. Guillaumont, J. Gunning (1999), "Reforming Stabex", *World Economy*, July, p. 669-682.
- Committee for Development Planning (1998), *Report on the 32nd Session*, Economic and Social Council, United Nations, New York.
- Committee for Development Policy (1999), *Report on the 1st Session*, April, Economic and Social Council, United Nations, New York.
- Crowards T. (1999), "An economic vulnerability index for developing countries, with special reference to the CARIBBEAN: alternative methodologies and provisional results", *Barbados, Caribbean Development Bank*, February.
- Dawe D. (1996), "A New Look at the Effects of Export Instability on Investment and Growth", *World Development*, vol. 24, n°12, p. 1905-1914.
- Easter (Ch.) (1999), "A Commonwealth Vulnerability Index for Developing Countries. The Position of Small States", *Round Table, The Journal of Commonwealth Studies*, University of London, forthcoming, July.
- Fosu A.K. (1992), "Effect of Export Instability on Economic Growth in Africa", *The Journal of Developing Areas*, Vol.26, N°3, April, p.323-332.
- Ghura D. and Grennes (1993), "The Real Exchange Rate and Macroeconomic Performance in Sub Saharan Africa", *Journal of Development Economics*, vol. 42, p. 155-174.
- Glezakos C. (1984), "Export instability and economic growth : reply", *Economic Development and Cultural Change*, vol. 32, p. 615-23.
- Guillaumont P. (1985), *Economie du développement. Tome III : Dynamique internationale du développement*, Paris PUF.
- Guillaumont P. (1987), "From Export Instability Effects to International Stabilization Policies", *World Development*, vol. 15, n°5, p. 633-643.
- Guillaumont P. (1989), "Stratégie de développement et ouverture sur l'extérieur", *Revue africaine de développement et African Development Review*, Banque africaine de développement, vol. 1, n° 1, juin, p. 40-57.
- Guillaumont P. (1999), "Reducing poverty by aid reallocation: Uncertainties and alternative assumptions", Comment of Collier and Dollar "Aid and Poverty Reduction", given at the European ABCDE Conference, Paris, June, 10 p.
- Guillaumont P., and C. Bonjean (1991), "Effects on agricultural supply of producer price level and stability with and without scarcity : The case of coffee supply in Madagascar", *Journal of International Development*, vol. 3, n° 2, April, p. 115-133.

- Guillaumont P. and J.L. Combes (1996), "The effects of producer price trends and instability on the growth of agricultural exports:a cross-section analysis", in *Economics of agricultural policies in developing countries*, M. Benoit-Cattin, M. Griffon et P. Guillaumont eds., Revue Française d'Economie, p. 287-300.
- Guillaumont P. and L. Chauvet (1999), "Aid and Performance : A reassessment", CERDI, *Etudes et documents*, revised June, presented at the World Bank ABCDE Conference Workshop on Aid, Washington, April.
- Guillaumont P. and Deméocq M. (1989), "Risk and ratchet effects of export earnings instability": A cross-sectional analysis", CERDI, *Etudes et Documents*.
- Guillaumont P. and S. Guillaumont (Eds) (1988), *Stratégies de développement comparées zone franc et hors zone franc*, Economica, specially chap. 2.
- Guillaumont P. and S. Guillaumont (1990), "Why and how to stabilize producer prices for export crops in developing countries", UNDP-World Bank *Trade Expansion Program Occasional Paper*, 6, May.
- Guillaumont P. and Guillaumont S. (Eds) (1994), *Adjustment and Development. The Experience of the ACP Countries (Africa, Caribbean, Pacific*, Economica, chapter 7.
- Guillaumont, P. and S. Guillaumont-Jeanneney, J.F. Brun (1999), "How Instability Lowers African Growth", *Journal of African Economies*, vol. 8 (1), March, p. 87-107.
- Guillaumont P., Guillaumont S. and Plane P. (1988), "Participating in African Monetary Unions: An Alternative Evaluation", *World Development*, vol. 16, n°5, p.569-576.
- Gyimah-Brempong K. (1991), "Export Instability and Economic Growth in Sub-Saharan Africa ", *Economic Development and Cultural Change*, Vol.39, N°4, July, p. 815-828.
- Just R.E. (1974), "An investigation of the importance of risk in farmers' decisions", *American Journal of Agricultural Economics*, February, p. 14-25.
- Kaly U. and others (1999), Environmental vulnerability index (EVI) to summarize national environmental vulnerability profiles", *SOPAC Technical Report 275*.
- Knudsen O. et Yotopoulos P. (1976), "A transitory approach to export instability", *Food Research Institute Studies*, 15, p. 91-108.
- Lim D. (1980), "Income distribution, export instability and savings behavior", *Economic Development and Cultural Change*, 28, n° 2, janvier, p. 359-364.
- Lin W. (1977), "Measuring aggregate supply response under instability", *American Journal of Agricultural Economics*, vol. 5, December, p. 903-907.
- Moran C. (1983), "Export fluctuations and economic growth: an empirical analysis", *Journal of Development Economics*, vol. 12, p. 195-218.

Newbery D. and J. Stiglitz (1981), *Theory of Commodity Price Stabilization*, Oxford, Clarendon Press.

Ramey, G. and V. Ramey (1995), "Cross Country Evidence on the Link Between Volatility and Growth", *The American Economic Review*, 85(5).

Ramey G. and V. Ramey (1995), "Cross Country Evidence on the Link Between Volatility and Growth", *The American Economic Review*, vol. 85, N°5, p. 1138-1151.

Rodrik D. (1998), "Where did all the growth go? External shocks, social conflict and growth collapses", NBER, *Working Paper Series*, 6350, January, 50 p.

Serven L. (1997), "Irreversibility, uncertainty and private investment: Analytical issues and some lessons for Africa", *Journal of African Economies*, Supplement to vol. 6, N°3, p. 229-268.

UNDRO (United Nations Relief Organization) (1990): "Preliminary study on the identification of disaster prone countries based on economic impact", Geneva.