THE IMPLICATIONS OF ECONOMIC VULNERABILITY FOR THE GROWTH AND MACROECONOMIC DYNAMICS OF SMALL STATES

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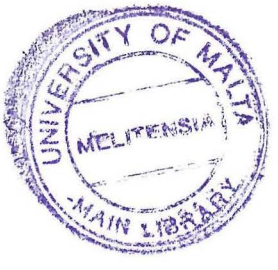

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Abstract

The notions of economic vulnerability and resilience are among the main issues studied within the context of the economics of small states. This thesis tests two principal hypotheses within this area, namely that: different levels of economic development can at least in part be attributed to the effects of vulnerability, defined as an inherent proneness to shocks, and to resilience, defined as the nurtured ability to withstand the effects of such shocks, and; economic vulnerability can lead to higher aggregate demand volatility and to more persistent macroeconomic imbalances.

These hypotheses are tested by firstly obtaining stylised facts regarding vulnerability and resilience from the literature and out of empirical observation. Subsequently, the thesis develops theoretical models to explain such facts. An underlying theme in these models is that vulnerability may be expressed in terms of asymmetric responses to shocks, whereby the effects of negative shocks outweigh those of positive ones due to diminishing marginal product and utility. Finally, the thesis conducts econometric tests of the relationships derived from the theoretical models.

The stylised facts regarding long term growth patterns include: economic vulnerability is a relevant concept, especially for small states; small states on average do not exhibit low per capita incomes but have greater cross-sectional dispersions as well as higher fluctuations in income growth rates, and; small vulnerable economies tend to invest a larger share of their output. The stylized facts concerning short run aggregate demand fluctuations include that small states: have larger fluctuations in the growth rates of aggregate demand components; tend to experience more persistent

deficits on their external current account; depend to a greater extent on government expenditure but exhibit no marked tendency towards higher fiscal deficits.

Towards explaining the stylised facts concerning growth, the neo-classical growth model is extended to decompose the effects of vulnerability into those originating from exogenous shocks and those attributable to the economy's specific susceptibility to the effects of such shocks, the latter reflecting economic resilience. The lack of resilience emanates out of diminishing marginal productivity which causes negative shocks to have relatively larger effects than positive ones. This leads to the conclusion that it is possible for the more vulnerable economies to achieve a higher capital stock and output at the cost of lower consumption. This happens as the vulnerable economy saves and invests, if appropriate structures exist, to build its resilience.

From an aggregate demand perspective, vulnerability is modelled to introduce uncertainty in consumption decisions. This causes economic behaviour to be better explained by the Keynesian rather than by the rational expectations paradigm. The income multiplier process is more relevant under conditions of vulnerability while negative shocks to income would induce a lower marginal propensity to consume than positive ones. This runs counter to the supply-side reactions identified in the model of economic growth, leading to excess aggregate demand situations often reflected in pressures on the current account. The modelling of import expenditure highlights the effects of trade openness and of dichotomies between export- and domestically-oriented productive sectors as potential sources of both vulnerability and resilience. The modelling of government consumption indicates an enhanced role for demand management policies in vulnerable economies.

Econometric analyses based on an error-correction specification applied to panel data in general appear to confirm the hypotheses derived from theoretical models. The findings of the thesis point to the importance of national and supranational efforts towards developing resilience. Among the avenues for further research, there is the need to incorporate vulnerability and resilience more widely in economic models and to extend these concepts to other dimensions of economic development.

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Chapter 1:

INTRODUCTION

Vulnerability and the Economics of Small States

There is an established body of literature exploring the special characteristics of small economies and their implications for economic behaviour and development. This literature can be traced back to at least 1960, in the proceedings of a conference organised by the International Economics Association (Robinson, 1960; Kuznets, 1960). The interest in the consequences of economic size and in the disadvantages of economic smallness in particular focused primarily on a development perspective, as emphasised by Demas (1965), Chenery (1968) de Vries (1973), Pant (1974), Abbot (1975), Holmes (1976) and Streeten (1993) among others, particularly in terms of the overall viability of states which do not achieve a minimum critical mass. This issue continued to attract research interest more recently by, for example, Frankel and Romer (1999) and Alesina and Spolaore (2003). An often crucial consideration in this debate is the role played by international trade patterns in the development of small states, as highlighted amongst others by Srinavasan (1986) and Worrell (1992).

The principal defining characteristics, often viewed as handicaps, of small economies, as reviewed in Butter (1985) and Briguglio (1993) include a high degree of dependence on international trade, a high concentration of exports and imports, limited diversification possibilities, the proneness towards current account deficits, a large public sector within the economy and a high variability in output growth. These characteristics are considered to constrain the economic viability of small states and to

impede them from effectively participating and benefiting from international trade to foster economic growth and development (Scitovsky, 1960).

On the other hand, from an empirical perspective, there appears to be no consistent pattern for smaller economies to be relatively underdeveloped (Briguglio, 1993; 2002). The special characteristics of small economies do not appear to impinge on their average levels of per capita income but rather on the dispersion of their income levels, both from a cross sectional perspective as well as over time. Indeed, it is often observed that small economies do not form a homogenous group.

There is a body of literature that interprets these observations in terms of the fact that small economies, especially if insular, tend to face higher level of risks to their economic growth and development, engendered by their exposure to shocks and possibly, by their endogenous reactions to such shocks. This phenomenon was studied for the first time by Briguglio (1993), who initiated the concept of economic vulnerability of small and island economies. This served as a seminal contribution that resulted in further development in the study of small economies by the United Nations and by the Commonwealth Secretariat among others. Essentially, these studies focus on the measurement of the factors which are likely to result in vulnerability, to show that small states are especially prone to this phenomenon. An inherent difficulty in this approach is to identify the issues which genuinely constitute vulnerability without falling into the trap of merely measuring factors which characterise small states.

The different degrees of success achieved by small states in achieving economic development has more recently been analysed not merely in terms of exposure to shocks but also to depend on policy-induced, or nurtured, resilience factors which allow countries to absorb, withstand and rebound from the effects of negative shocks (Briguglio, 2004). Thus, the issue of the negative impact of the special characteristics of small states on their economic growth and development essentially hinges on the extent to which such states are vulnerable to adverse exogenous shocks and the presence or otherwise of nurtured resilience to withstand such shocks. These concepts were strongly reiterated in the "Gozo Statement on Vulnerable Economies" which was issued following the Commonwealth Heads of Government Meeting in 2005 (Commonwealth Secretariat, 2005).

It can be further construed that the notion of vulnerability of small states can also be used to explain certain patterns in their macroeconomic behaviour, particularly as regards the observed volatility in their aggregate demand growth and persistence of external deficits.

Research Objectives and Hypotheses

The concepts of economic vulnerability and resilience have to date been developed and studied mainly on the basis of intuition and empirical observation (as in, for example, Briguglio, 1993; Guillaumont, 1999; Briguglio, 2004). The main objective of this thesis is to formalise these concepts into mainstream theoretical economic modelling from the fields of economic growth and macroeconomics and to test

empirically the principal relationships obtained therefrom. It is envisaged that this work yields the following benefits:

i. it provides a clearer understanding of the nature and effects of economic vulnerability and resilience, particularly as they impinge on the economic behaviour and development of small states;

ii. it helps to improve the measurement of vulnerability and resilience by providing a clearer understanding of the factors which genuinely give rise to these phenomena, as well as unravelling the inter-relationships between them;

iii. it helps to better integrate the concepts of vulnerability and resilience within mainstream economic models, helping to diffuse the appreciation of the importance of these concepts;

iv. it contributes to enhance mainstream economic models through the explicit consideration of vulnerability and resilience, which can be key determinants of economic behaviour and growth in small economies;

v. from a policy perspective, it helps to better focus the debate on the critical issues which impinge on the development of small countries and on their macroeconomic performance.

Towards this end, this thesis uses economic modelling and empirical analysis to test the following research hypotheses:

i. from the perspective of long term economic development, different levels of attainment in small states can at least in part be attributed to the effects of vulnerability, defined as inherent proneness to shocks, and to resilience, defined as the nurtured ability to withstand the effects of such shocks – a

corollary of this hypothesis is that the success in economic development of certain vulnerable economies is attributable to the building of resilience;

ii. from the perspective of short run macroeconomic fluctuations, economic vulnerability can lead to higher output volatility and to more persistent macroeconomic imbalances, particularly as reflected in external deficits – a corollary of this hypothesis is that the achievement of macroeconomic balance which is essential to long term economic growth presents greater challenges in countries subject to vulnerability.

The formulation of these hypotheses reflects the consideration that although vulnerability and resilience are distinct concepts, they are best studied together in order to analyse their effects on economic activity. In this respect, focusing on only one concept is likely to give a partial and incomplete assessment.

Methodology and Layout

The above hypotheses are tested by means of a methodology based on three steps. The first is to establish a number of stylised facts regarding the phenomena of vulnerability and resilience in the context of small economies. As explained by Boland (1994), this is a standard approach that often proves useful in the construction of economic models, and it indeed is still the basic foundation of many models of economic growth. Furthermore, the stylised facts would constitute a first test of the research hypotheses presented in this thesis.

Following the establishment of the stylised facts, the thesis develops theoretical models attempting to explain such facts. These models are based on mainstream approaches towards explaining long run growth and short-run macroeconomic fluctuations and provide a conceptual proof of the research hypotheses presented in this thesis. An underlying theme in the derivation of these models is the notion that the effects of vulnerability may be expressed in terms of asymmetric responses to symmetric shocks, whereby the effects of negative shocks would outweigh those of positive ones. The concepts of diminishing marginal product and utility, which are fundamental to economic theory, form the basis of modelling asymmetric responses to symmetric shocks.

The final step of the thesis consists of the econometric testing of a number of the conceptual relationships derived from the theoretical models. These would serve as further tests of the validity of the research hypotheses. The econometric methodology used is based on equations in the error-correction model specification applied to panel data, which allows the derivation of short- and long-run relationships between macroeconomic variables and economic vulnerability.

It is worthwhile to note that the study of issues concerning small states is often conducted via a case study approach, as in, for example, a number of papers in Briguglio and Kisanga (2004) and McElroy and Sanborn (2005). This is justified by the fact that small states, though heterogeneous and influenced by different factors, can learn from the best practices and experiences of each other. The approach adopted here does not require a case-study approach as its aim is to seek the common influences which characterize small states, including those which give rise to

heterogeneity, and to derive explanations for these through positive economic modelling and econometric testing.

The thesis is structured as follows. Following this introduction, Chapter 2 presents a number of stylised facts, based on a survey of the literature and statistical observation, regarding the economic growth and macroeconomic behaviour of small states which may be attributable to the phenomena of vulnerability and resilience. This chapter also presents an assessment of the various approaches adopted towards the measurement of economic vulnerability.

Chapter 3 develops an economic growth model for vulnerable economies by adapting the neo-classical growth modelling approach to include stochastic shocks to the capital stock. This aim of the model is to assess the effects of vulnerability and resilience on the long-run supply capabilities of an economy. Chapter 4 re-interprets mainstream macroeconomic models of consumption and other induced variables to include stochastic shocks to expenditure and incomes. The aim of this modelling exercise is to assess the effects of vulnerability on short term fluctuations in aggregate demand.

Chapter 5 presents panel data econometric estimation of the principal testable relationships coming out of the models developed in the previous two chapters. The concluding chapter synthesises the results obtained from the stylised facts, theoretical models and econometric estimation in order to assess the research hypotheses presented in this thesis. It derives a number of practical implications of the findings and suggests avenues for further research.

Chapter 2:

THE EFFECTS OF VULNERABILITY ON THE MACROECONOMIC AND GROWTH DYNAMICS OF SMALL STATES: STYLISED FACTS BASED ON A SURVEY OF LITERATURE AND STATISTICAL OBSERVATION

Introduction

This study aims to derive theoretical and empirical paradigms regarding the macroeconomics of short term aggregate demand fluctuations and long term growth of small states, as influenced by their inherent vulnerability. This is motivated by the fact that although these states do not strictly constitute a homogenous group, they are characterized by a number of common factors which are significant enough to impinge on their economic behaviour and which require a reconsideration of the application of mainstream economic theory to these states. The first step in this direction is to identify such characteristics which will subsequently form the foundations for modelling the macroeconomic and economic growth behaviour of small states. These common characteristics are here listed as stylized facts, bringing together empirical observations and various contributions to the literature, in order to establish tendencies and relationships typically characterising small states.

In deriving the stylised facts, a review of the relevant literature concerning the likely effects of vulnerability and resilience within the context of the economics of small states is here presented. The literature on the economics and special issues of small states is extensive and covers a multitude of issues. The review presented here

represents a selection of the literature which is considered to be relevant in the context of the effects of vulnerability and resilience, which is the focus of this thesis.

The utilization of stylized facts as a first step towards developing positive theories in growth and development economics probably owes its origin to Kaldor (1961). It is recognized that this contribution set the bases for economic growth theories by observing, for example, that during the process of growth, output and capital per capita tend to rise while the returns to capital tend to remain stable. This eventually led to the formulation of theories based on endogenous and exogenous growth approaches, as elaborated upon in Chapter 3 of this study. This use of stylized facts as a method of deriving theories has recently been used not merely as a way to develop theories but has also been extended to evaluate the empirical relevance of models (see for example Defalvard, 1996).

The use of stylized facts in developing economic theories and evaluating models has its limitations. As Kaldor (1961) argues, observations are typically subjective and can be interpreted in various ways. They are also subject to qualifications, including special circumstances which may have prevailed during the observation period but which may not apply in general. It is important to interpret stylized facts as broad tendencies rather than as strong and definite laws. Furthermore, it is often true that stylized facts would explain limited or specific aspects of a phenomenon. This stated, it is also true that stylised facts are an effective means to cause empirical and theoretical evaluations of a phenomenon in a methodically controlled way (Boland, 1994). To synthesise, stylized facts may be used as a tool to evaluate the extent to which a model captures aspects of reality, but in a flexible manner, taking into

account the fact that stylized facts may be reinterpreted or may actually need to be changed in the light of new evidence.

In order to obtain a useful set of stylized facts which can serve as a basis for deriving theories and models, this chapter starts by presenting a review of the definitions of smallness as applied to the size of economies. It is shown that there is a number of different, and at times contrasting definitions, and that this question is best addressed by considering economic size as a continuous rather than as a discrete concept. The chapter proceeds by reviewing the salient characteristics of small states arising out of their inherent vulnerability, so as to derive therefrom a number of stylized facts.

Measures of Economic Size

Small country issues have been analysed in the literature for over four decades (de Vries, 1973; Kuznets, 1960; Scitovsky, 1960; Crowards, 2002), but a general agreement on the precise definition of a small economy remains elusive. In general, the definitions may be categorized into two classes: (a) *quantitative*, which depend upon some directly measurable and observable variable or variables, and; (b) those which relate to one or more *behavioural* characteristics of the economy. Typically, while definitions under the latter category are more interesting in exposing the special characteristics of small economies, they are not as straightforward to understand and apply as definitions under the former one.

An example of a behavioural definition of smallness can be found in Briguglio (1995) and Briguglio (2002), who argues that ideally, smallness should be associated with

'price taker' economies and the consequent inability to influence international prices, thus corresponding with the concept of a small firm in microeconomics. Other behavioural definitions of smallness are given by, amongst others, Jalan (1982) and Briguglio (1995), who argue that small countries can be discerned through limited natural resource endowments and high import content, limited diversification possibilities and dependence on a narrow range of products without necessarily enjoying economies of scale, and limited domestic competition. These definitions, while useful to explain the characteristics of small countries, cannot be considered to be practicable in distinguishing small countries from large. Furthermore, certain behavioural definitions may at times apply for small countries as well as large ones.

The most frequently-used measures of country size found in the literature are of a quantitative nature and are based on population size, size of the land area and the output of a country. These variables have been analysed separately as well as in the form of composite indexes, with some authors assigning equal weights (Jalan, 1982) and others obtaining weights through econometric techniques (Downes, 1988). A quantitative definition of economic size which is somewhat related to the behavioural definition proposed by Briguglio (1995) was advanced by Davenport (2001), who focused on the share of world trade taken up by a country.

In practice, the most-widely used measure of economic size is population size, following Srinivasan (1986). Land area may be a misleading indicator of economic size, as witnessed by examples such as Surinam, Guyana, Iceland and Greenland. Moreover, the size of total GDP may be strongly dependent upon a country's state of development which is a different concept from economic size – for example, the GNP

of China is not larger than that of Italy and France in commensurate measure to the disparities in the sizes of these countries. On the other hand, the population size index is intuitively appealing from an economic point of view as it reflects the size of the labour force, and therefore the constraints associated with human resources and the potential number of consumers. Thus, it conveys a measure of size based on the suppliers and the buyers of goods and services produced. Also, from a statistical point of view, the index is less ambiguous than others associated with land area and GNP. For the purposes of the analysis of stylized facts presented in this chapter, economic size is proxied by population size and the two terms are used interchangeably.

Quantitative approaches towards measuring economic size need to be complemented by threshold values so as to distinguish the smaller countries from the larger ones. This is often problematic as the cut-off point is arbitrary. Some authors prefer a relatively high cut-off point (Kuznets, 1964; Chenery and Taylor, 1968), while other authors such as Jalan (1982), Commonwealth Secretariat and World Bank (2000) and UNCTAD (1997) use lower ones. The Commonwealth Advisory Group (1997) classifies small economies as those having a population of one million or less because 'almost all states within this limit tend to experience the special problems particularly those associated with small size', thereby obtaining some form of reconciliation between the quantitative and behavioural measures of economic size.

It is here considered that the choice of a cut-off point to distinguish between small and large countries may result in the classification of a rich continuum of behavioural characteristics into an insufficiently small number of categories. Countries do not

automatically graduate from small to large, and hence change a number of fundamental economic characteristics, simply by passing a threshold value for the population or some other economic indicator. It is furthermore obvious in the literature that such cut-off points are subjective and are often chosen to satisfy the requirements of the hypothesis being analysed. It is for these reasons that this study shall not rely on a cut-off point for size, but uses a continuum of population values across countries large and small so as to derive stylized facts regarding the differences in economic behaviour emanating from size.

Data Issues

The stylized facts which follow are in part based on the analysis of data for 166 countries as found in statistics published by the World Bank, the United Nations Conference for Trade and Development, or the International Monetary Fund, unless otherwise constrained by data limitations as indicated. The analysis of vulnerability indexes is based on the countries covered by each individual index. For a large majority of countries, the period covering 1990 to 2002 was used, but this coverage was not available for all countries in the database.

The countries present in the database constitute a wide spectrum on a global scale, and are representative of countries of different sizes and in different states of development, with an unavoidable bias in the form of under-representativeness of less developed countries for which data is typically less easily available. Another unavoidable bias is that the quality of the data available may vary between countries and comparability may be hampered by the use of different statistical methodologies.

Table 1 provides an indication of the main development and size characteristics of the countries present in the sample. The Annex at the end of this thesis details the full list of countries together with the relative 2002 GDP and population data. The entire database of the source data together with workings performed to derive the stylized facts in this chapter are appended to this thesis in CD-ROM medium.

Table 1: Main characteristics of countries in database

Annual per capita GDP in 2002 (US dollars) up to...	Cumulative number of countries	Population (persons) in 2002 up to...	Cumulative number of countries
1,000	64	1 million	30
5,000	121	5 million	66
10,000	134	10 million	96
20,000	147	50 million	144
50,000	166	1.5 billion	166

Source: IMF, UNCTAD, World Bank

Before proceeding with the presentation of the stylised facts, a short comment on the possible use of regression analyses in this context is in order. The aim of this chapter is to establish broad trends in the economic behaviour of small states relative to larger ones as conditioned by vulnerability. This precludes the use of rigorous statistical analysis which is based on formal economic theory. It is for this reason that econometric analysis of the trends presented in this chapter is not undertaken, with the analysis being based on graphical exposition and basic descriptive statistics. Econometric analysis of the effects of vulnerability on economic behaviour is presented in Chapter 5, on the basis of the formal economic modelling undertaken in Chapters 3 and 4.

Smallness and Vulnerability

A primary objective of this thesis is to explain the implications of economic size and vulnerability for macroeconomic performance and economic growth that have been documented in the literature or which emerge from statistical observation. The basic stylized fact which is the foundation of this study relates to economic size and economic vulnerability.

Stylised Fact 1: Vulnerability is a relevant concept and small states, especially if insular, are likely to exhibit higher degrees of economic vulnerability than larger countries, either by being relatively more exposed to shocks and/or by being more susceptible to the effects of such shocks.

As argued in the introduction to this thesis, small economies, especially if insular, tend to face higher level of risks to their economic growth and development, engendered by their inherent exposure to shocks and/or by their endogenous reactions which makes them more susceptible to the effects of such shocks.

The issue of vulnerability, studied for the first time by Briguglio (1993), has in the literature been approached mainly from a measurement approach, resulting in the compilation of a number of vulnerability indices. The starting point in the discussion of this stylized fact is therefore to review the various approaches towards the measurement of the concept of vulnerability used in the literature.

The construction of a vulnerability index was first formally proposed by the Maltese Ambassador to the United Nations in 1990. It was then stated that "such an index is important because it reiterates that the per capita GDP of island developing countries is not by itself an adequate measurement of the level of development of these countries as it does not reflect the structural and institutional weaknesses and the several handicaps facing island developing countries" (Malta Government, 1990, p.7). Since the early 1990s, there have been several attempts at constructing vulnerability indices. These mainly focused on quantifying the special characteristics of small states using indicators such as economic openness, export concentration, dependence on imports of energy and peripherality. These may be construed to be the *causes* of and to proxy the incidence of exogenous shocks or the extent of their propagation. Other approaches attempt to measure vulnerability in terms of the *effects* of the phenomenon, namely the variability of output and similar indicators.

Major Vulnerability Indexes

The first vulnerability index was developed by Briguglio (1993) and was composed of three variables, namely exposure to foreign economic conditions, insularity and remoteness, and proneness to natural disasters. Exposure to foreign economic conditions was measured by calculating a composite index of size made up of three variables, which are population size, size of GDP and land area, as it was then argued that the degree to which an economy depends on foreign trade is closely related to size. Remoteness and insularity was measured by taking the ratio of transport and freight debits to export proceeds, and disaster proneness was proxied by an estimate of damages in relation to GDP derived from a 1990 report published by United

Nations Disaster Relief Organisation, and refined to exclude disasters of a political nature. It was hypothesised that the higher the incidence of these variables in a given country, the higher the degree of vulnerability in the same country, everything else, including GDP per capita, remaining constant. The assumption that Small Island Developing States (SIDS) tend to be more vulnerable than other countries was confirmed since in general SIDS registered higher vulnerability scores than other groupings of countries.

A modified index was presented in 1995, where the variable measuring exposure to foreign economic conditions was changed from a composite index of size to the ratio of exports and imports to GDP. As argued by Briguglio (1997), this change was necessary as using size as a factor of vulnerability is methodologically incorrect because this amounts to assuming what needs to be proven. The general finding that SIDS tend to have higher vulnerability scores was reconfirmed.

Briguglio (1997) further modified the index by including three new variables, excluding one and modifying another. The new variables were introduced to measure export concentration, dependence on strategic imports and dependence on foreign sources of finance. Briguglio also excluded the variable measuring proneness to natural disasters and changed the measure of peripherality from the ratio of transport and freight costs to export proceeds to the ratio of transport and freight costs to imports. Briguglio (1997) argued that export concentration is observed in both trade in goods as well as in trade in services. As the export concentration index devised by UNCTAD covers just merchandise, Briguglio devised a concentration index of exports of goods and services by considering tourism and financial services. Export

concentration was taken to be the percentage of the three highest export categories in total exports of goods and services. Dependence on imported commercial energy was measured as imports of commercial energy as a percentage of imports plus the production of commercial energy, while dependence on foreign sources of finance was taken to be remittances, capital and financial inflows as a percentage of GDP.

An updated computation of Briguglio (1997) was presented in Briguglio and Galea (2003). The main difference was the inclusion of dependence on food imports as an additional indicator to measure the extent to which a country's livelihood depends on imports. These refinements further reaffirmed the relatively high vulnerability scores of SIDS.

Chander (1996) employed a methodology similar to that used by Briguglio. The sub-indices used attempted to measure dependence on external markets by taking the ratio of exports to GDP, while costs arising from remoteness and insularity were measured by the CIF/FOB ratio. Chander also introduced two additional variables, which were the export concentration (UNCTAD index), to highlight dependence on a narrow range of products and the ratio of long term capital flows to gross domestic investment, to reflect dependence on external funds to finance development. Chander's results showed that in general, small states had larger vulnerability scores than larger countries. The study was based on the premise that countries with a diversified export and production base were less vulnerable.

Wells (1996) produced a composite index made up of six sub-indices namely: a trade openness index, measuring the ratio of exports and imports to GDP, similar to the one

used in Briguglio (1995); a remoteness index, measured by the ratio of insurance and freight credits to total imports; an export diversification index as compiled by UNCTAD; a capital openness index, measured by the resource gap in the balance of payments; an index of energy dependence, measured by the net imports of commercial energy as a percentage of energy consumption; and an index of tourism dependence, measured by net tourism receipts as a percentage of GDP. The results confirmed that the highest vulnerability scores pertained to small developing states. Wells' most important contribution to the study of vulnerability was the introduction of a sub-index measuring energy dependence.

Wells (1997) used a different approach by focusing on vulnerability as manifested in instability in economic growth and subsequently using regression analysis to identify the causes of vulnerability. The study argues that volatility is related to the terms of trade (measured by an export diversification index), instability in net capital flows (measured as the resource gap in relation to GDP) and vulnerability to natural disasters (measured by the proportion of the population affected by natural disasters during 1970-96). Economic volatility is shown to be related to these three variables, although the correlation coefficient is very low.

The Committee for Development Policy (CDP) of the United Nations developed a composite index for the purpose of identifying vulnerability of the Least Developed Countries (CDP, 2000; United Nations, 2001). In line with Wells (1997), this approach focuses on instability as the manifestation of vulnerability and makes use of five variables, namely the share of manufacturing and modern services in GDP, merchandise export concentration ratio, instability of agricultural production,

instability of exports of goods and services and population size to derive a composite index. The weights were drawn from an econometric exercise reflecting the estimated impact on growth of the different index components.

Output volatility was also used as the basis for the index developed by Atkins et al (1998) and for determining the factors that might lead to vulnerability. The model, which was constructed for the Commonwealth Secretariat, explains output volatility as being a function of the export dependency ratio, merchandise export diversification, share of agriculture in GDP, capital openness, freight and insurance costs and vulnerability to natural disasters. A preferred model based on three variables found to be statistically significant – export dependency ratio, merchandise export diversification and vulnerability to natural disasters – was then used to predict levels of output volatility for individual countries. The latter were interpreted as scores in the composite vulnerability index. The index suggests that small states are especially prone to vulnerability as small states were reported as having relatively high index scores when compared to large states.

The variables in an index of economic vulnerability for developing countries, proposed by Crowards (2000) are freight and insurance costs for imports as a percentage of total import costs; imports net of exports of energy as a percentage of total energy consumption; product and destination concentration of exports of goods and services, combined with information on the openness of the economy measured as total export earnings as a percentage of GDP; reliance upon external finance and capital, measured as a combination of the annual disbursement of concessionary overseas development assistance and annual foreign direct investment, as a proportion

of annual gross fixed capital formation, and; susceptibility to natural disasters, measured as a combination of cumulative number of persons affected by natural disasters between 1950 and 1988 and cumulative number of deaths caused by natural disasters between 1950 and 1998, each as a proportion of total population. The index results suggested a negative non-linear relationship between economic vulnerability and country size, as measured by total population. The results indicated that small countries and islands are particularly vulnerable, while landlocked countries tend to be relatively vulnerable.

Cordina and Farrugia (2005) argue that trade openness per se is not necessarily a source of vulnerability. If a country is significantly engaged in international business, through imports, exports and investment flows, it could benefit from a possible attenuation of the effects of exogenous shocks thanks to diversified markets or by dealing in stable external markets. Rather, vulnerability would ensue if a country is significantly exposed to trade with other countries which are themselves unstable, or in commodities with prices which are highly volatile. This approach employs an index based on the extent, concentration, direction and price volatility involved in a country's export, import and foreign investment transactions.

Desirable Characteristics of Vulnerability Indexes

The suitability of different approaches towards measuring vulnerability may be assessed in terms of the desirable characteristics for a vulnerability index proposed by Briguglio (1992). According to the author, a vulnerability index should be made up of a composite of a small number of variables chosen for their: (a) relevance in

explaining vulnerability; (b) simplicity; (c) ease of comprehension, and; (d) suitability for international comparisons. It should have an intuitive meaning and produce plausible results and be based on variables which are measured in a homogenous manner internationally with data being available for all or most countries of the world.

Briguglio also proposed criteria for rejecting variables from use in a vulnerability index (Briguglio, 1997). *A piori* correlation with country size is, on its own, an unsuitable criterion for the inclusion of a variable in the index as this would bias the results in favour of the hypothesis that vulnerability depends upon size. In the same spirit, it is here suggested that vulnerability should not be a direct measure of poverty or underdevelopment, or of competitiveness or the lack of it. Furthermore, for a variable to be relevant towards the measurement of vulnerability, it should reflect inherent features of an economy which render it more susceptible to exogenous shocks and which cannot be influenced by economic policy.

Briguglio (1997) also suggested that correlated variables and variables which do not measure economic vulnerability or a facet of it should be excluded from the index. Moreover, variables measuring the effects rather than the causes of vulnerability should not be included in a composite vulnerability index. It is here suggested that the reason for this is the fact that output volatility, which is often taken as the manifestation of vulnerability, may be the result of factors such as short term fluctuations in aggregate demand. The latter are affected by economic policy and hence are inconsistent with the definition of vulnerability which emanates from inherent features in the economy. In other words, volatility in economic variables may not necessarily adequately reflect the inherent exposure of an economy to exogenous

shocks, as it may reflect other factors, including policy measures to manage the effects of exposure to inherent vulnerability.

From the analysis in the preceding section, it would appear that the vulnerability measurement approaches that are closer to satisfying these criteria are Briguglio (1997, 2003), Chander (1996) and Cordina and Farrugia (2005). This is because these indexes are based on relevant variables that measure the causes rather, than the effects, of shocks experienced by countries that are inherently vulnerable. Furthermore, the components of these indices do not include variables that are *a priori* correlated to size or insularity. This is essential so as not to prejudice results regarding the size of vulnerability faced by islands and small states.

Vulnerability, Population Size and Insularity

A general conclusion of the literature on vulnerability indexes is that small states, especially if insular, are inherently more vulnerable, which emerges despite the differences in the parameters and methodologies employed in the construction of the various indexes described earlier on. However, as Gonzales (2000) points out, "A comparison of the various vulnerability classifications reveals a large amount of inconsistency. While small developing states on average emerge as being comparatively vulnerable, rankings of individual countries can differ substantially between alternative indices."

Perhaps even more importantly, it may also be pointed out that vulnerability indexes are in general based on intuition rather than constructed on formal approaches regarding what constitutes, or could at least act as a proxy of, the inherent exposure of countries to exogenous shocks. This is an issue that is not addressed in vulnerability indexes in general, and is only somewhat superficially touched upon in Briguglio (1997) through the issue of the relevance of variables to be measured. This issue implies that efforts at measurement have tended to precede a proper understanding of what is to be measured, and is thus an important criticism of the vulnerability literature in general. The conceptual modelling approaches towards explaining vulnerability presented in this thesis are an attempt at filling this lacuna.

Within the context of these shortcomings, it is nevertheless a fact that the literature on vulnerability has so far focused on the construction of indexes and therefore merits to be reviewed as such in order to obtain an understanding of the state of knowledge in this subject area so far. In order to obtain a better understanding of the results of various approaches towards measuring economic vulnerability and of the relationships between them, this section reviews the results of eight approaches towards the construction of vulnerability indexes. These are the following, together with their respective acronyms as used in tables:

i. Briguglio (1993) – BRG93

ii. Briguglio (1997) – BRG97

iii. Chander (1996) – CND96

iv. Wells (1997) – CWS97

v. Commonwealth-World Bank (1999) – CWB99

vi. Committee for Development Policy (2000) – CDP00

vii. Crowards (2000) – CRW00

viii. Cordina and Farrugia (2005) – CAF05

The indexes produced in Atkins (1998), Briguglio (1995, 2003) and Wells (1996) are not reviewed because their characteristics are considered to be reproduced by one or more of the eight approaches listed above. The works of Briguglio (1995, 2003) are considered to be well reflected in Briguglio (1997), while that of Atkins (1998) and Wells (1996) is considered to have significantly influenced or been influenced by Wells (1997) and Commonwealth-World Bank (1999).

The analysis is carried out in two steps: firstly, the rank correlation index between pairs of the above-listed indexes is computed. This is done in order to gauge the extent of consistency of results between different indexes, thus assessing the criticism by Gonzales (2000), and to understand which of the indexes are most representative of the literature in this field. Secondly, for each index, rank correlation coefficients between country vulnerability and country size rankings are produced, together with an analysis, for each index, of the impact of insularity on the average vulnerability ranking. These analyses are intended to show whether the indexes indicate higher vulnerability for countries which are small or insular. The reason behind the use of rank correlation coefficients in this analysis is the fact that the more interesting information in this case is not so much the values of the vulnerability indexes and the population size, but rather the information which such indexes contain regarding the relative ranking of countries in terms of their vulnerability.

The rank correlation coefficient analysis between the different indexes is carried out in the following manner. Firstly, for each index, countries are ranked in the order of their vulnerability, with the first rank being given to the most vulnerable country. Secondly, the rank correlation coefficient[1], which assesses differences in the ranks attributed to countries by a pair of indexes, is computed, with the results being reproduced in Table 2 below. The results are based on a sample of 72 countries, for which results are available for all indexes.

Table 2: Rank Correlation Coefficients of Vulnerability Indexes*

Index	BRG93	BRG97	CND96	CWB99	WLS97	CDP00	CRW00	CAF04
BRG93	1.00							
BRG97	0.77	1.00						
CND96	0.45	0.64	1.00					
CWB99	0.39	0.75	0.75	1.00				
WLS97	-0.45	-0.21	-0.19	-0.09	1.00			
CDP00	0.38	0.45	0.75	0.46	-0.47	1.00		
CRW00	0.75	0.71	0.64	0.61	-0.42	0.46	1.00	
CAF05	0.31	0.64	0.64	0.66	-0.02	0.39	0.35	1.00
Average	0.37	0.54	0.53	0.50	-0.26	0.35	0.44	0.42

*The critical value, in absolute terms, for the correlation coefficients presented in this table to be statistically significant from zero at the 95% level is 0.23.

The Table shows that with the exception of the Wells (1997) index, all indexes have positive and statistically significant rank correlation coefficients, implying that in general, the indexes tend to agree on which countries should be assigned high vulnerability ranks, and which countries are less vulnerable. In general, it may be stated that this is not a surprising result, since the indices share a number of common characteristics in their construction, as discussed earlier on. The Committee for Development Policy (2000) index has positive rank correlation coefficients with other indexes, in spite of it being based on a similar methodology as Wells (1997).

[1] See Freund and Walpole (1987), p. 546-9.

It is however also noted that rank correlation coefficients between different indexes vary between relatively high values of over 0.6 to others with values below 0.4. Perhaps the index which is most representative of the overall work done in this field is Briguglio (1997), which presents the highest average rank correlation coefficient with other indexes, estimated at 0.54. The Chandler (1996), the Commonwealth-World Bank (1999) and the Cordina and Farrugia (2005) indexes are also well-representative of the results of other indexes.

The rank correlation coefficient for each index relating vulnerability with country size is computed as follows. For each index, countries are ranked in the order of their vulnerability, with the first rank being given to the most vulnerable country, and in the order of their size, with the first rank being given to the smallest country. *A priori*, it would be expected that the rank correlation coefficient would be positive if smallness and vulnerability are positively associated. The rank correlation coefficient between these two variables is then computed for each index, with the results being reproduced in Table 3 below together with the relative t-statistic for the significance of the correlation coefficient. The table also shows, for each index, the average vulnerability ranking of island states as compared to that of other states, as well as a t-statistic for the statistical significance of the difference between them.

The hypothesis that vulnerability is higher for small countries is clearly supported. Seven out of the eight indexes considered show rank correlation coefficients which support this hypothesis, whereas the other, Wells (1997), returns a negative rank correlation coefficient with a value that is not statistically different from zero at the 95% confidence level. The hypothesis that vulnerability is heightened for island states is also generally supported but somewhat less strongly. Of the eight indexes, six show

islands having a statistically significantly lower average vulnerability rank than non-island states. On average, island states have a vulnerability ranking of 45, compared to 63 for other states. These statistical findings, generally corroborating the literature on vulnerability indexes, forms the basis behind the first stylised fact presented in this chapter.

Table 3: Analysis of Vulnerability Indexes, Country Size and Insularity

Index	Rank correlation coefficient between vulnerability score and country size*	Average vulnerability ranking of islands... and of other states*	Sample size
BRG93	**0.49 (5.16)**	40...65 (4.07)	112
BRG97	**0.69 (7.33)**	35...68 (5.60)	113
CND96	**0.67 (5.76)**	30...42 (2.69)	74
CWB99	**0.76 (8.02)**	40...64 (3.91)	111
WLS97	**-0.05 (0.57)**	51...54 (0.58)	108
CDP00	**0.46 (5.19)**	61...65 (0.53)	127
CRW00	**0.65 (6.16)**	28...54 (5.35)	92
CAF2005	**0.52 (6.91)**	74...93 (2.19)	175

*Figures in parenthesis represent t-statistics for the significance of the relative coefficient. The 95% critical value is 1.96.

However, it should also be observed that there is a strong correlation between size and insularity in that the average difference in the size rank between islands and other states is 43 with a t-statistic of 4.75 (the 95% critical value for the acceptance of a null hypothesis that the difference is not significantly different from zero is 1.96). This to be expected *a priori*, in that non-island states historically tended to not experience geographical constrains to their expansion to the same extent as island states. This however also implies that statistical analysis cannot adequately distinguish between insularity and smallness as being more closely associated with vulnerability. Although statistical results appear to indicate a stronger correlation between vulnerability and size, it is to be considered that whereas size is measured by a ranked variable allowing for variability in the data, insularity is measured by a binary variable reflecting the

geographical condition of the state, which may not adequately capture differences in the degree of economic insularity to which different island states may be subject to.

Primarily for this reason, this thesis focuses on size rather than insularity as being closely associated with vulnerability for the purposes of the derivation of stylised facts, also because size can be considered to be a good instrumental variable for insularity. It is also considered that from a theoretical perspective, there are more valid reasons to expect size rather than insularity to influence the proneness to external shocks.

Overall, it may be concluded that the indexes produced by Briguglio (1993, 1997), Chandler (1996), Crowards (2000) and Cordina and Farrugia (2005) are the most representative of the hypothesized results regarding vulnerability, country size and insularity. The Commonwealth-World Bank (1999) index also produces statistically significant results, but this may in good measure be ascribed to the inclusion in the index of variables which reflect the results of vulnerability rather than its causes. It is overall noted that the indexes which follow most closely the criteria for the optimal approach towards the construction of a vulnerability index described above point to the increased vulnerability of small and island states.

In the discussion of the results of these indexes, however, there is always the consideration that the index components are not being chosen on the basis of a rigorous theoretical approach regarding the determinants of vulnerability, but rather on an intuitive approach, which may result in a bias towards measuring those factors which typically characterise small and island states, as discussed earlier on. This

would also in part explain the correlation between different indexes. The results presented in this section should thus be interpreted within the context of this consideration.

In spite of these limitations, it is considered that the concept of vulnerability is sufficiently relevant as to merit an analysis of the consequences that it induces on economic growth and macroeconomic dynamics. In line with the general findings of vulnerability indexes, the remainder of this thesis focuses on vulnerability as being a primary determinant of the special economic behaviour and circumstances of small states. Reiterating the earlier discussion on the measurement of economic size, the latter is best, albeit imperfectly, proxied by population size, following Srinavasan (1986).

The stylised facts presented next thus relate facets of economic behaviour to population size from a cross-sectional perspective, which facets of economic behaviour are considered to emanate out of the concept of vulnerability. It is preferred to relate the stylised facts to a measure of country size rather than to a vulnerability measure so as to obtain results based on a more objective indicator than any one vulnerability index could produce, while at the same time using a variable which is can be considered to be a good instrument for the vulnerability phenomenon. The relationships between vulnerability and the aspects of economic behaviour presented in the stylised facts are studied further through formal economic modelling presented in subsequent chapters.

For the purposes of facilitating these economic modelling exercises, the stylised facts are categorized into those pertaining to the supply side of the economy, and which would be explainable through long-term economic growth modelling approaches, and those related to aggregate demand, which require theorizing from a short-run macroeconomic perspective.

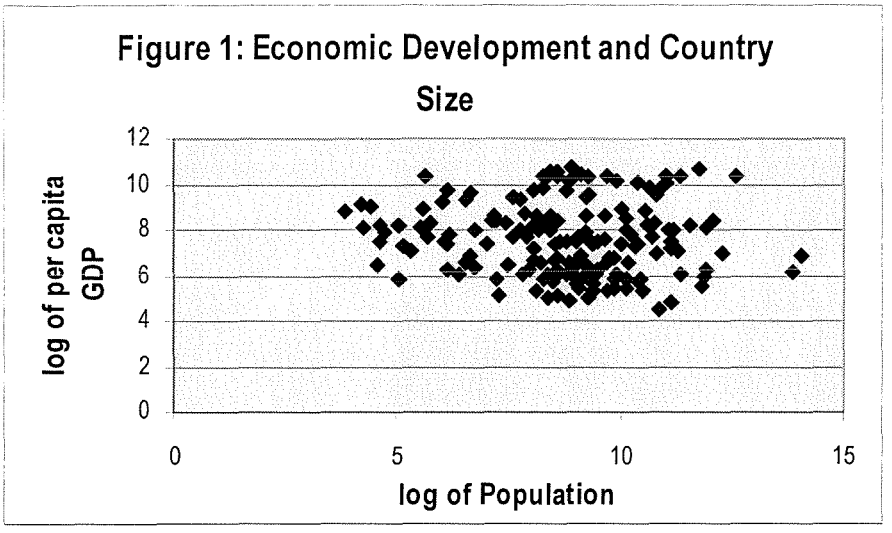
Economic Vulnerability and Economic Growth: Paradigms Concerning the Supply-Side of the Economy

Stylised Fact 2: Economic smallness and vulnerability is not associated with under-development. However, small vulnerable countries tend to exhibit a wider dispersion in their per capita incomes from a cross-sectional perspective.

There is no consistent pattern whereby small population size is associated with under-development, as can be discerned from Figure 1. This is in spite of certain permanent handicaps which are associated with small economies (Bhaduri et al, 1982), including limited resources, constraints to reap the benefits of economies of scale and diversification, proneness to natural disasters and environmental problems to mention of few. This is a conclusion which is corroborated in the literature, for example by Briguglio (1995).

Underlying this result is the fact that countries with a smaller population size tend to have larger dispersions in their per capita income levels from a cross-sectional perspective. In other words, smaller economies tend to be associated with extremes in per capita GDP to a higher extent than larger ones, such that instances of poverty in

small states are offset by instances of advanced development within the same category of countries. These variations call for further analysis.

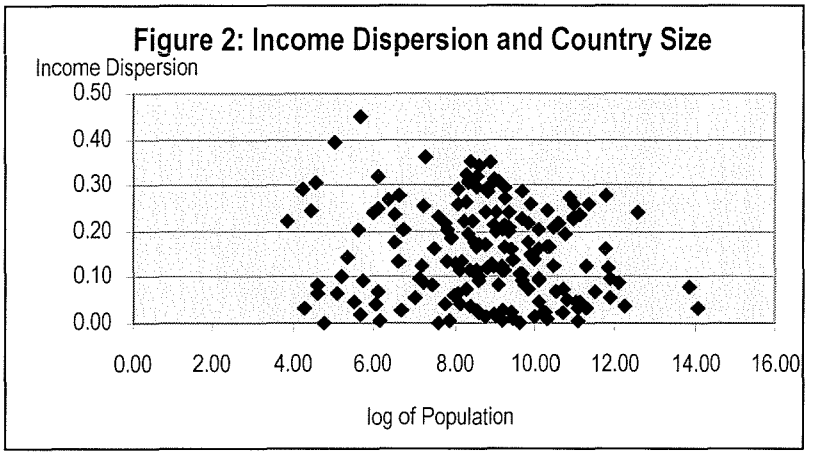


Source: IMF, UNCTAD, World Bank

Estimates of cross-sectional dispersions in per capita income levels at different population sizes are obtained as the residuals from a trend line between per capita income level and population size, expressed in absolute values as ratios of the predicted values from the same line. This gives an indication of the relative dispersions in per capita income levels around a trend. This trend line is merely a statistical indication of the average per capita income at each population size, intended to serve as a reference point against which dispersions can be computed. As it has no economic meaning, and there is no valid interpretation that can be given to it from the standpoint of econometric analysis, the parameters of this and similar trend lines estimated for the purposes of this chapter are not reported here. The full workings on the derivation of the data used in presenting the stylised facts are

however given in the attached CD-ROM. This approach is followed throughout this chapter in the analysis of differences in cross-sectional dispersions among countries.

As can be discerned from Figure 2, the dispersion in per capita incomes between countries drops for economies with larger populations.



Source: IMF, UNCTAD, World Bank

Thus, there are small states which are successful at development in spite of the handicaps that typically characterize small economies, while there are others that are lagging behind. The implication is that there is not only a significant degree of heterogeneity in the economic development levels attained by small states, but also a slower speed of convergence between them. There could be various explanations behind this observation, including differences in the incidence of positive and negative shocks between small countries, as well as in the policy orientations within individual countries.

Briguglio (1995) documents the success of certain small states in attaining high levels of economic development in spite of the inherent disadvantages that they face,

terming this phenomenon as the 'Singapore Paradox'. The success of policy measures in small states in mitigating the effects of shocks and of handicaps to development is described by Briguglio (2004) to constitute economic resilience.

Thus, vulnerability is defined as the proneness of a country to shocks outside its control. It arises out of inherent features of the economy, such as the exposure to foreign trade engendered by smallness and limited resources. Resilience is the ability of a country to withstand the effects of such shocks, and is viewed to be strongly dependent on policy orientations. Briguglio (2004) discusses four scenarios resulting out of the interaction of vulnerability and resilience, involving low values for both factors, high values for both factors, low vulnerability and high resilience, and high vulnerability with low resilience. The first two scenarios imply a neutral role for vulnerability in terms of its effects on development. The third scenario features adequate policy orientations in countries which are inherently not handicapped by vulnerability. The fourth scenario implies inadequate policy responses in countries that are inherently characterized by vulnerability. Small states typically fall into the second and fourth of these scenarios, where inherent vulnerability is high but their success in economic development can be distinguished in terms of their policy orientations.

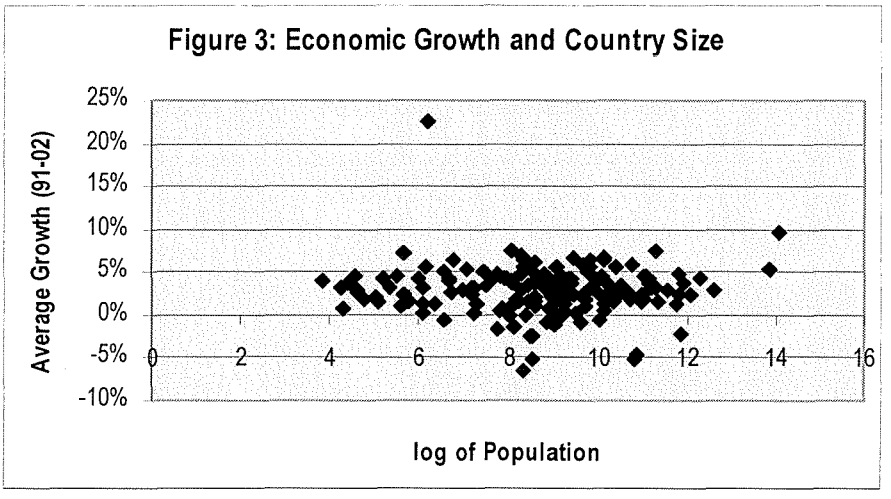
Briguglio et al (2005) suggest a framework for assessing the determinants of resilience by focusing on four broad policy areas namely: (a) macroeconomic stability, and primarily fiscal and external imbalances; (b) microeconomic efficiency, emphasizing the role of properly functioning markets; (c) adequate governance, involving issues such as security of property rights and the rule of law, and; (d) social

development, focusing on social cohesion and collective action. They generally find a strong association between these resilience factors and the economic development of vulnerable countries.

Stylised Fact 3: On average, small vulnerable countries do not exhibit different medium term growth rates compared to larger states. However, economic smallness and vulnerability tend to be associated with an increased volatility in per capita income growth over time.

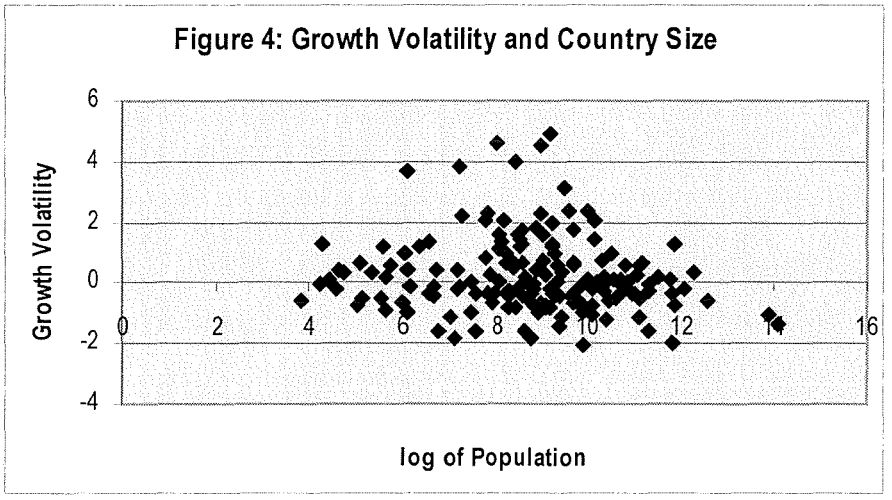
Stylised Fact 2 discusses on the relationship between economic size and the level of per capita income whereas this stylised fact focuses on patterns in the growth of income. There exists no evidence of any significant association between country size and economic growth. This conclusion is borne by a number of cross-sectional studies, including Chenery and Taylor (1968), Kuznets (1971), Blazic-Metzner and Hughes (1982), Milner and Westaway (1993), Armstrong et al. (1998), Easterly and Kraay (2000) and Milner and Weyman-Jones (2003). On the other hand, Frankel and Romer (1999) indicate that increasing a country's size and area by one percent raises income per capita growth by one-tenth of a percent or more. However, this kind of conclusion is not corroborated when limiting the sample size to small countries. Indeed, Milner and Westaway (1993) show that there is no significant relationship between attributes of size and economic growth in the long term. In other words, it is likely that the effects reported by Frankel and Romer (1999) arise out of other determinants of growth which would be correlated to size in a sample of economies large and small.

The analysis of average growth rates over the period 1991 to 2002 against population size shown in Figure 3 indicates that there is no marked tendency for small states to experience growth rates that are markedly different from those recorded by larger states. This confirms the finding of Stylised Fact 2 that on average, economic smallness need not be associated with under-development.



Source: IMF, UNCTAD, World Bank

On the other hand, the growth rates of per capita income in small states are observed to be more volatile over time than those in larger states, as documented in the literature by Easterly and Kray (2000) amongst others. Utilising the same data set as that described for Stylised Fact 2, the volatility in the growth rates of per capita income for 166 countries is calculated considering the period between 1991 and 2002. This is done by considering, for each country, the standard deviation of GDP growth rates over that period as a ratio of the average rate of growth. This is subsequently correlated against the log of population of the countries in the dataset, as shown in Figure 4.

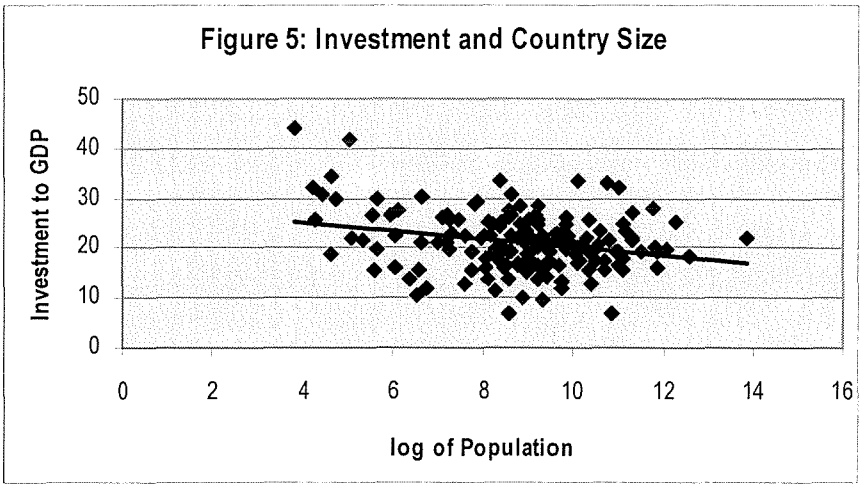


Source: IMF, UNCTAD, World Bank

Figure 4 indicates the existence of a negative correlation between the volatility of income growth over time and population size. There thus appears to emerge a trend pointing to an increased output growth volatility over time for small countries.

Stylised Fact 4: Small and by implication vulnerable countries typically allocate a larger portion of their output to investment than larger countries.

Developments in output growth typically mirror the evolution of investment. It is therefore interesting to compare trends in investment behaviour between large countries and small ones. Figure 5 presents a scatter diagram of the ratio of investment to GDP against the log of population for the 166 countries present in the data set. The diagram indicates the presence of a negative correlation between the investment to GDP ratio and population size.



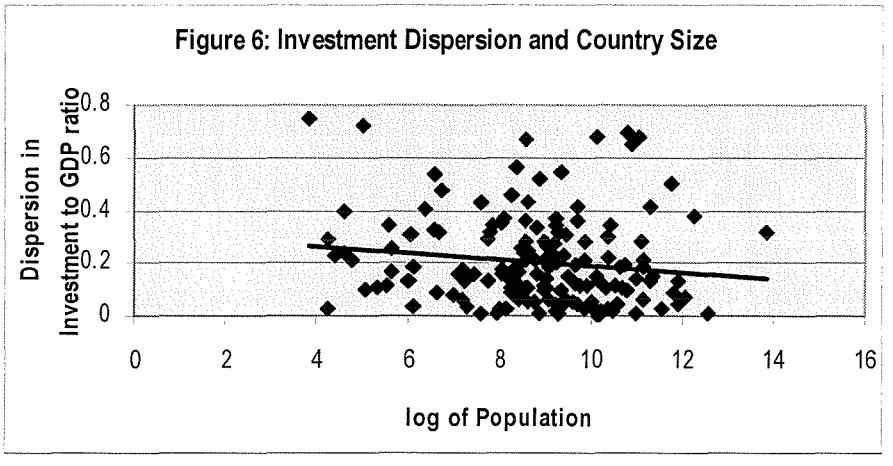
Source: IMF, UNCTAD, World Bank

There is thus a tendency for small countries to dedicate a larger share of their output to investment. However, from the analysis presented in Figure 3, this is not resulting in smaller countries achieving higher rates of growth. There could be at least two explanations furnished for these observations. One is that the investment being undertaken in large countries is more productive than that undertaken in small countries, on account perhaps of different returns to scale or different technological conditions. This could reflect the problem of indivisibility, in that some investment projects cannot be downscaled in proportion to a country's size, resulting in higher investment expenditure to GDP, and a relatively lower return from such investment in small countries. Another possibility is that small countries must invest more in order to overcome certain inherent disadvantages – the additional investment therefore does not result in increased output levels. In particular, investment could be undertaken by small countries in order to protect them against the effects of exogenous shocks, such as the construction of protection against natural disasters, or the accumulation of assets to be used as buffers against unforeseen circumstances.

Stylised Fact 5: Small vulnerable countries typically have larger cross-sectional differences in investment to GDP ratios than large countries.

The data observed in Figure 5 also indicates the dispersion between countries in investment to GDP ratios falls for larger countries. Following the same approach for income dispersion outlined in the discussion on Stylised Fact 2, dispersions in investment ratios are calculated on the basis of the absolute value of the residuals from the regression with investment to GDP ratio as the dependent variable relative to the predicted level of the investment to GDP ratio. This is subsequently correlated to the log of population size in Figure 6.

Figure 6: Investment Dispersion and Country Size



Source: IMF, UNCTAD, World Bank

The divergencies in investment ratios between small and large countries may be considered to in part account for the increased dispersion in output growth present in small states discussed in Stylised Fact 3. They also reveal the non-homogeneity between small states regarding the presence of the crucial determinants of investment activity, including resource availability and appropriate economic and institutional structures.

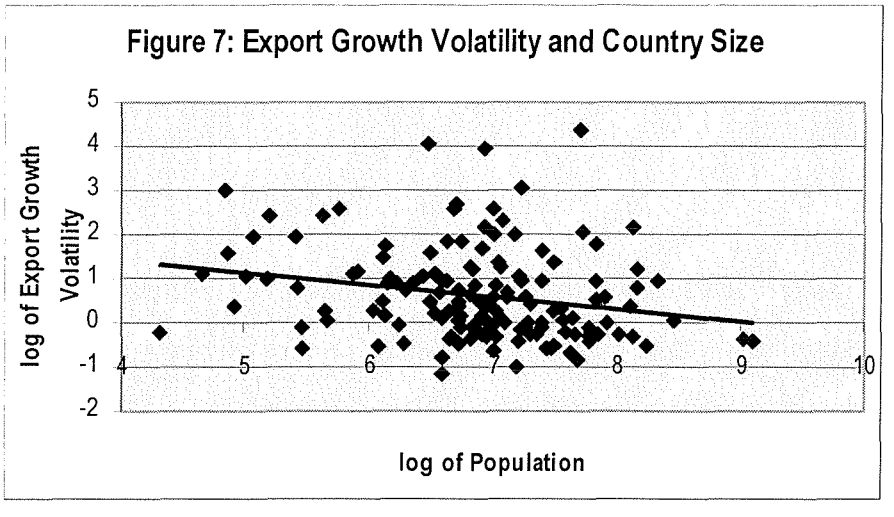
Economic Vulnerability and Macroeconomic Fluctuations: Paradigms Concerning the Aggregate Demand Side of the Economy

Stylised Fact 6: Economic smallness and by implication, vulnerability is associated with higher fluctuations in aggregate demand and its components over time.

The heightened volatility of output growth over time for small states is discussed within the context of Stylised Fact 3. The higher fluctuations in aggregate demand over time, as reflected in the variability of gross domestic product, can be observed to emanate both from exogenous as well as induced components of total expenditure. In this context, it is interesting to identify the main sources of such exogenous shocks and to study the extent to which these may be being magnified by endogenous reactions within small economies.

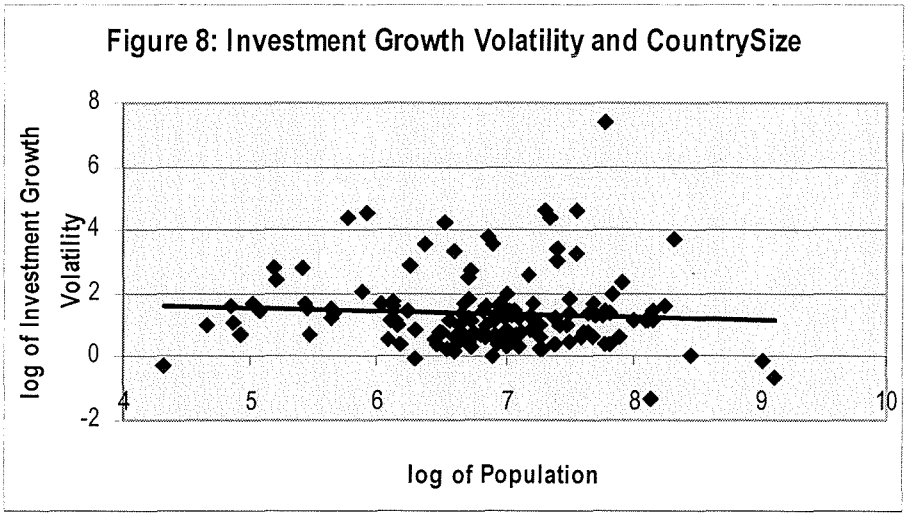
This stylized fact can be discussed on the basis of an analysis of the volatility in the growth rates of expenditure components in relation to country size. In line with the approach adopted in discussing Stylised Fact 3, volatility is defined as the coefficient of variation of growth - that is the ratio of the standard deviation of growth to the average growth rate - over the period 1991 to 2002 of the main expenditure components of aggregate demand for the countries present in the database. It should be noted that the number of countries for which sufficient data was available to conduct this analysis was 144.

Examining first the more exogenous components of aggregate demand, Figure 7 indicates that the volatility of export expenditure is significantly more pronounced for smaller countries. This may in good part be explained by the fact that smaller states typically have highly concentrated export sectors specializing in a few key niches as small size restricts the country's ability to diversify its exports and renders the country dependent on a very narrow range of goods and services (Briguglio, 1995, 1997; Atkins et al, 1998; United Nations, 2001). Kuznets (1964) states that 'if economies of scale are important, specialisation is a pre-condition for efficiency ... so, for a small economy, competitive exports are incompatible with highly diversified exports'. Such dependence on a few niches may expose smaller countries to significant external demand shocks, especially if exports are concentrated on products which have high demand volatility (Farrugia, 2004; Cordina and Farrugia, 2005). The concentration of export activity may also be in relation to trading partners, as argued by Crowards (2000), Farrugia (2004) and Cordina and Farrugia (2005). This exposes small countries to specific shocks within their relatively few trading partners, especially if such trading partners are themselves highly vulnerable to shocks.



Source: IMF, UNCTAD, World Bank

In the case of investment expenditure, which is typically the most volatile of all expenditure components, there is a slight tendency for increased volatility in small countries which is certainly not as pronounced as for the case of exports, as Chart 8 indicates.

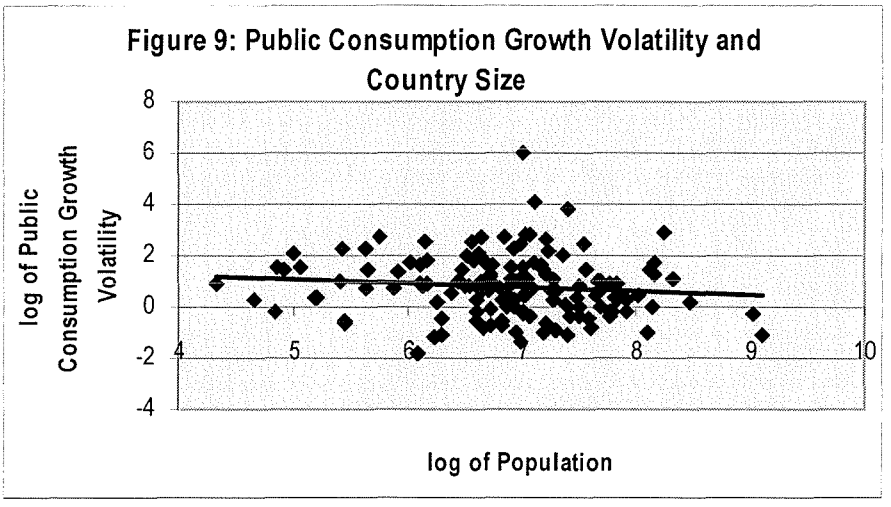


Source: IMF, UNCTAD, World Bank

A similar conclusion can be derived from an analysis of public consumption expenditure, which is presented in Chart 9. In this case, there appears to be hardly any tendency for an increased volatility in this component of aggregate demand in smaller states.

It may thus be concluded that the principal source of exogenous shocks which generates instability in aggregate demand in small states is the external sector. Increased volatility in aggregate demand in small states does not appear to be generated by autonomous, domestically-generated shocks to fiscal policy, nor to a

greater degree of exposure to fluctuations in investment expenditure. Fluctuations in export demand thus appear to be the main source of vulnerability for small states.

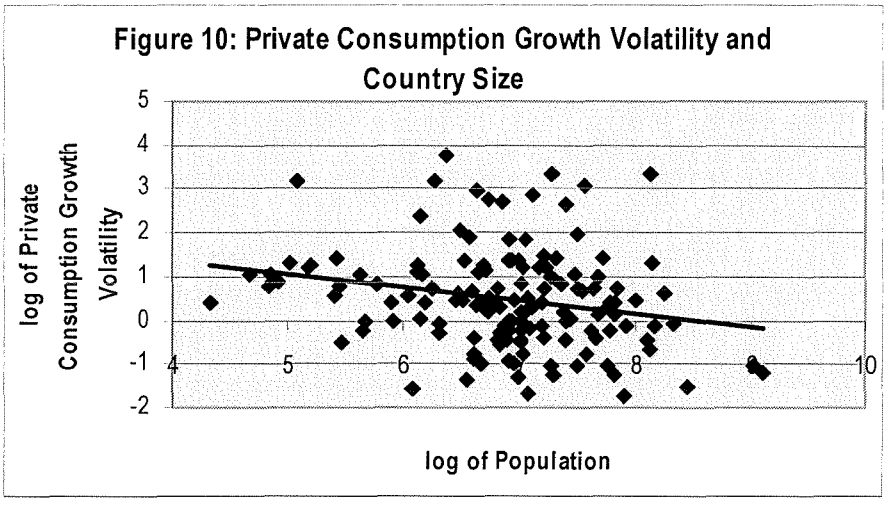


Source: IMF, UNCTAD, World Bank

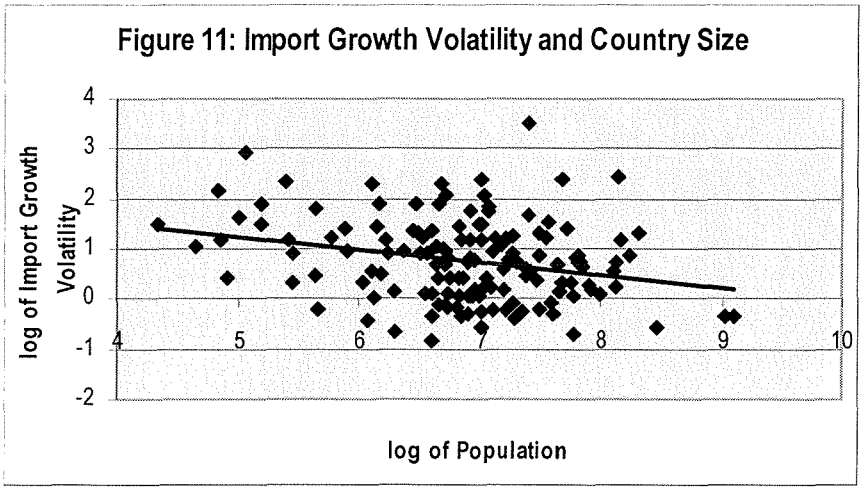
Turning next to analyse the more endogenous components of aggregate demand, it can be observed that there are marked differences between the volatility levels in the growth of private consumption expenditure of small and large countries, as shown in Figure 10. Thus, the paradigm that private consumption expenditure is a relatively stable component of aggregate demand appears to hold more for large countries than for small ones.

This kind of behaviour is also strongly reflected in import expenditure, as shown in Figure 11. The volatility in the growth of import expenditure in significant part typically mirrors that of the growth rates of consumption expenditure and of exports, both of which have a significant import content, especially in small states. This would to an extent contribute to dampen the overall effects on the volatility of the growth

rate in aggregate demand, although this still tends to be more volatile in the case of small states, as argued in Stylised Fact 3.



Source: IMF, UNCTAD, World Bank



Source: IMF, UNCTAD, World Bank

These observations indicate that exports are the main source of exogenous volatility in aggregate demand in small countries. A closer inspection of the graphical results indicates that the volatility of growth rates of endogenous components of demand,

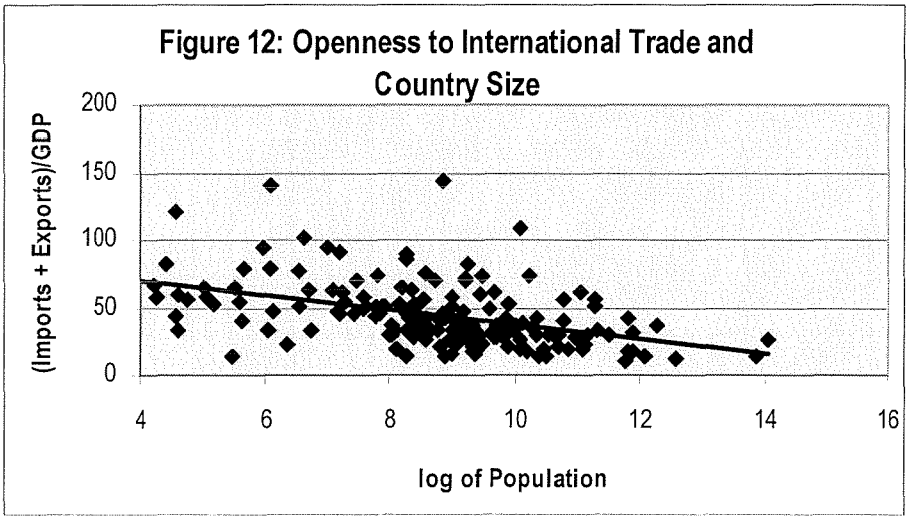
namely private consumption and imports, are even more sensitive to changes in country size than that of exogenous expenditure elements including exports. This appears to indicate that the endogenous reactions of induced expenditure components may tend to magnify the effects of exogenous shocks. This is particularly so in the case of imports, which may explain why the overall sensitivity of aggregate demand growth to country size is less pronounced, and somewhat less statistically significant than that pertaining to exports and private consumption.

It is of course recognised that these observations do not constitute a rigorous analysis on which to base firm conclusions, but are here presented to make the point that the data appears to indicate that exports are the main source of volatility of aggregate demand for small states, and that endogenous expenditure components appear to be more volatile than endogenous ones. This would form a basis for formal economic modelling of macroeconomic behaviour in relation to vulnerability presented in Chapter 4.

Stylised Fact 7: Economic smallness and vulnerability is associated with a higher reliance on imports to satisfy expenditure needs and on exports to service import expenditure.

This is an observation which is well-documented in the literature (for example, Robinson, 1960; Butter, 1985; Briguglio, 1995; Carter, 1997). This stylized fact is demonstrated in Figure 12, which relates the degree of openness to international trade, defined as the sum of imports and exports relative to GDP, to population size. Data

for the degree of openness represent period averages for the time covered by the database.

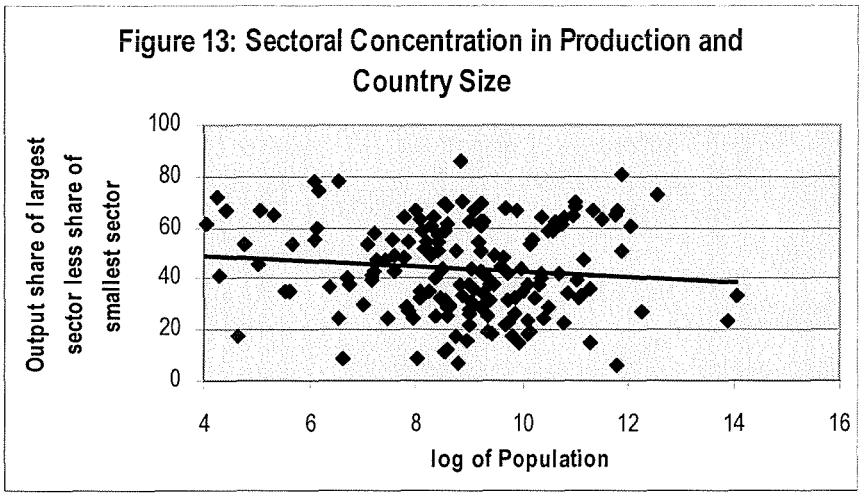


Source: IMF, UNCTAD, World Bank

There are a number of reasons for the increased dependence of small countries on imports, most notably limited domestic markets, a lack of natural resource endowments, low inter-industry linkages and dependence on imports for strategic commodities as food and energy. There are equally compelling reasons for small countries to devote a significant part of their production to exports, including the need to service import payments and to acquire a measure of economies of scale in production.

Farrugia (2004) shows that production in small states tends to be more highly concentrated in a few key niches and that as the country size increases, sectoral concentration declines, as shown in Figure 13. The Figure shows a negative relationship between the output share of the largest sector in each country less that of the smallest sector, which is a measure of sectoral concentration of output, and

population size. This is consistent with the significant needs in small states for imports in those areas of production which do not meet domestic demand, and a consequent export activity in the production niches where output exceeds domestic demand.



Source: Farrugia (2004)

The reasons for such high sectoral concentration in small countries are once again related to the limited size of the domestic market, which constrains diversification into different activities, if any advantages of economies of scale are to be exploited. There thus appears to be a trade-off between economies of scale and diversification, implying that the reaping of the former will expose a country to a higher degree of sector-specific shocks which are not adequately diversified. On the other hand, it may be argued that the gaining economies of scale may enable a country to better manage sector-specific shocks through the building of competitive strengths in that area. This issue is treated in further detail in Chapter 4.

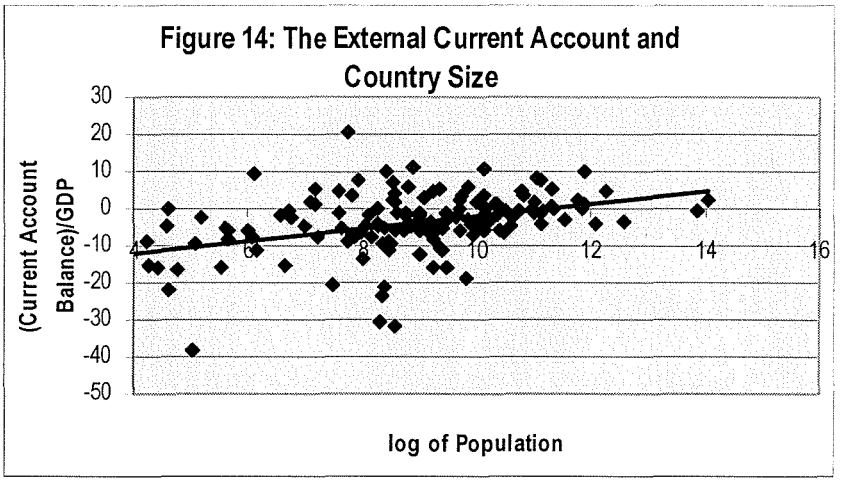
The foregoing discussion indicates that there may be two way causal relationships between trade openness and vulnerability. On one hand, exposure to international trade is a main source of the vulnerability of small states, as highlighted by Briguglio (1995) amongst others. On the other hand, specialization in production, with the consequent dependence on imports and exports, may be a way in which small states may attempt to overcome their inherent vulnerability. For instance, Alesina and Spolaore (2003) debate the extent to which participation in international trade allows small countries to overcome constraints of size. Thus, trade openness may be viewed to be both a cause as well as an effect of the vulnerability of small states.

It is to be further observed that a number of contributions to the literature actually view openness to international trade as a source of economic strength for small countries. Such openness would compensate for the limited size of the domestic market, give access to factors of production and allow a safety valve for unemployed resources to find productive employment outside national borders (see, for example, Edwards, 1993; Armstrong and Read, 1998; and Edwards, 1998).

Stylised Fact 8: Economic smallness and by implication, vulnerability is associated with a higher likelihood of persistence of deficits on the external current account.

Small countries are more prone to have persistent deficits on their current account of the balance the balance of payments, as indicated in Figure 14, which shows for the countries present in the database, the average current account to GDP ratios for the periods covered in the data. In theory, current account deficits are in the medium term to be reversed for an economy to be sustainable. For want of sufficient data regarding

the speed of adjustment of current account deficits in various countries, the persistence of the external deficit is here measured through the average current account balance to GDP ratio over the period covered by the database. The utilisation of period average current account to GDP ratios also eliminates the need to consider short-term cyclical influences on the data.



Source: IMF, UNCTAD, World Bank

The external current account deficit represents the extent to which a country is unable to satisfy its expenditure requirements through domestic production, either in the manner of self-sufficiency or by exporting to finance import expenditure. The proneness to current account deficits may thus be analysed in terms of either the domestic demand for goods and services or of the supply side of the economy, or both.

From the point of view of demand, especially for imports, it has already been observed that the imports of small states are of a relatively inelastic nature, while their exports are volatile and often conditioned by weaknesses in the productive base.

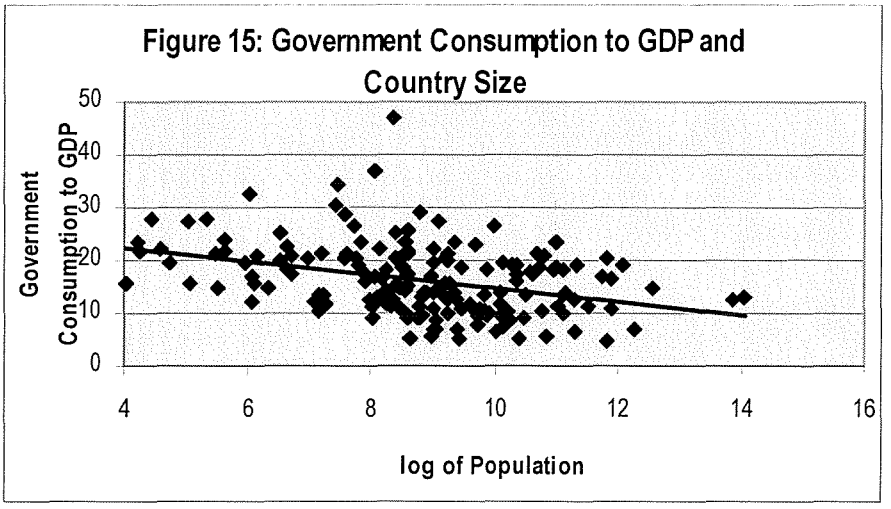
Moreover, small economies are generally price-takers and have virtually no control on the prices of the products they export and import.

From the point of view of supply, the literature cites a number of examples which may hinder exports from small states. Transport costs are higher in small states than in larger ones, and are even higher in small island developing states (SIDS), as emphasized, by amongst other, Briguglio (1995, 1997), Wells (1997) and Crowards (2000). Small size also limits the advantages of economies of scale, mostly due to indivisibilities and limited scope for specialisation. Indivisibilities exist in infrastructural requirements. There is often overcapacity as many facilities are too large to be fully used by a small country. Research and development activities are also characterised by large economies of scale and smallness therefore has consequences on the development of local technology. These factors give rise to high per unit costs of production, high costs of infrastructural development, and a high degree of dependence on imported technologies.

A corollary of the persistence of external current account deficits in small states is the dependence of such states on net capital inflows from abroad. This would imply that small states have a higher openness to international capital flows compared to larger states. Farrugia (2004) proves this point by showing that capital and other transfers from abroad are negatively related with the size of the population. These inflows often permit small states to sustain high standards of living and to finance trade deficits. Another possible reason for the dependence of small states on foreign sources of funds is the possible underdevelopment of their internal financial markets.

Stylised Fact 9: Economic smallness and by implication, vulnerability is associated with a larger share of government expenditure within aggregate demand.

This stylized fact is demonstrated in Figure 15, which relates the average share of government consumption in GDP over the time period covered in the database for the countries for which data is available to the size of the population of those countries.



Source: IMF, UNCTAD, World Bank

This stylized fact is corroborated in a number of instances in the literature on the characteristics of small states. Butter (1985) notes that the number of agencies, institutions and bureaus present in a country do not decrease proportionately with size, and that given the fact that a government department requires a minimum size to operate and the number of clients per government department is relatively low, this gives rise to a high average cost per client. Briguglio (1995) also suggests that the large size of government in small states is attributable to the fact that many government functions are not divisible in proportion to the number of users. This

factor is also emphasized by Alesina and Spolaore (2003) in debating the optimum size of countries.

Chander (1996) highlights the problem of limited employment opportunities in small states, which may be met by underemployment in the public sector. Workers would be employed in the public sector in excess of optimal capacity, leading to inefficiencies. This would in turn lead to higher government consumption shares in GDP in small states.

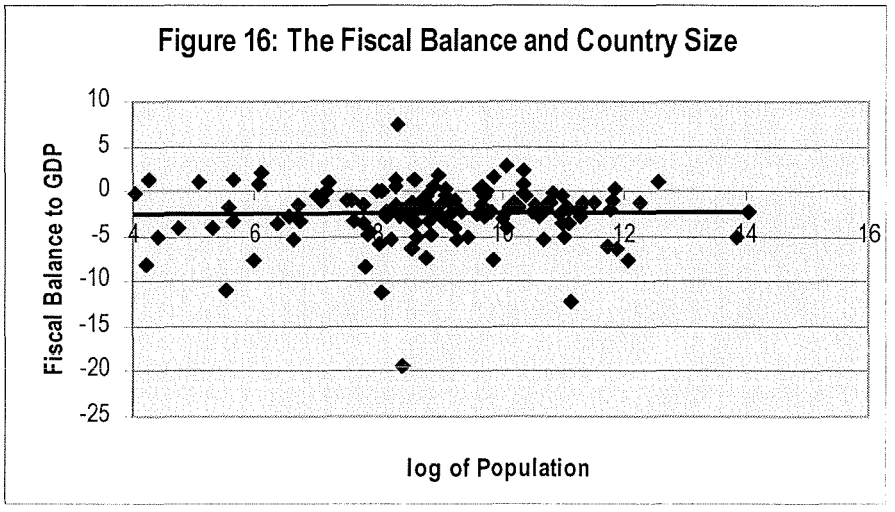
Another reason behind this stylized fact could be the higher incidence of institutional failure in small states, as observed by Farrugia (2004). In small states, everyone knows each other's political party affiliations and is often related to each other. This may lead to inefficiencies in the management of public resources, where efficiency and merit considerations would come second to political expediency, with public consumption absorbing a higher share of economic resources as a result.

Another explanation for this stylized fact is provided by Meilak (2004), who argues that market failure also has a higher tendency of occurrence in small states, creating an economically justifiable tendency for the public sector to be larger. Meilak (2004) indicates that small states are more likely to experience instances of monopolized markets, externalities and asymmetric information. By proxying these factors through various variables, Meilak (2004) shows that governments of smaller states have a larger role in correcting market failure, but this in turn may lead to problems of government failure.

As with the case of trade openness, the relatively high dependence of small states on government expenditure may be viewed to be both a consequence and a propagator of the effects of vulnerability. To the extent that such dependence results in waste and inefficiencies, as highlighted for example by Butter (1985), Briguglio (1995), Chander (1996), Farrugia (2004) and Meilak (2004), the high share of government expenditure in GDP would unproductively absorb resources which could have been better utilized to meet the effects of a country's inherent vulnerability. On the other hand, a higher government expenditure to GDP ratio may be justified as a means to stabilize aggregate demand in an economy where there is a volatile private sector demand, and thus, to be a consequence of vulnerability. This argument is expounded further in Chapter 4.

Stylised Fact 10: There is no increased tendency for small states to register higher fiscal deficits in spite of the more pronounced dependence of such states on government expenditure and their overall proneness to current account deficits.

Stylized Fact 8 indicates that small economies are more prone to persistent deficits on the current account of the balance of payments, which is a symptom that they are in general tending to fail to generate sufficient resources to meet their expenditure needs. Furthermore, Stylised Fact 9 indicates that government consumption expenditure tends to absorb a larger share of GDP in small economies. These two trends, however, do not result in a tendency towards higher fiscal deficit to GDP ratios in small economies, as Figure 16 shows.



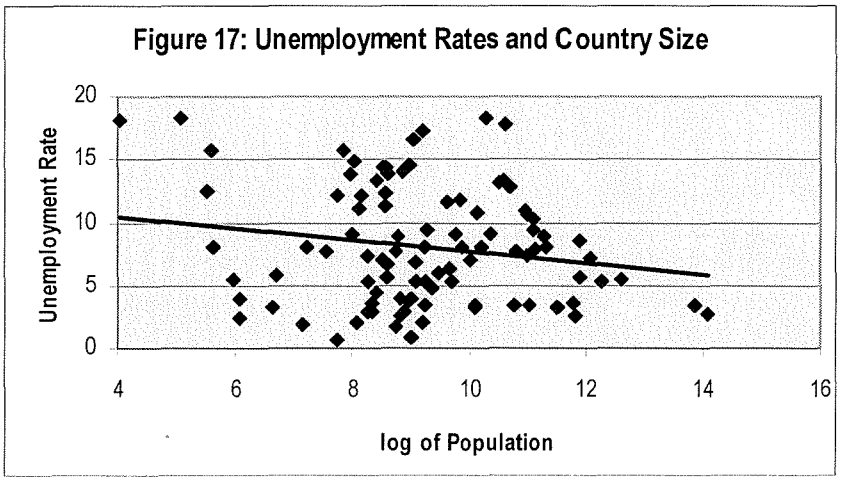
Source: IMF, UNCTAD, World Bank

This finding could have various explanations, including the dependence on overseas budgetary assistance, higher tax pressures or lower levels of capital expenditure by governments in small countries. An adequate assessment of this phenomenon would require in-depth analysis of government revenues on a country-by-country basis which lies outside the scope of this chapter.

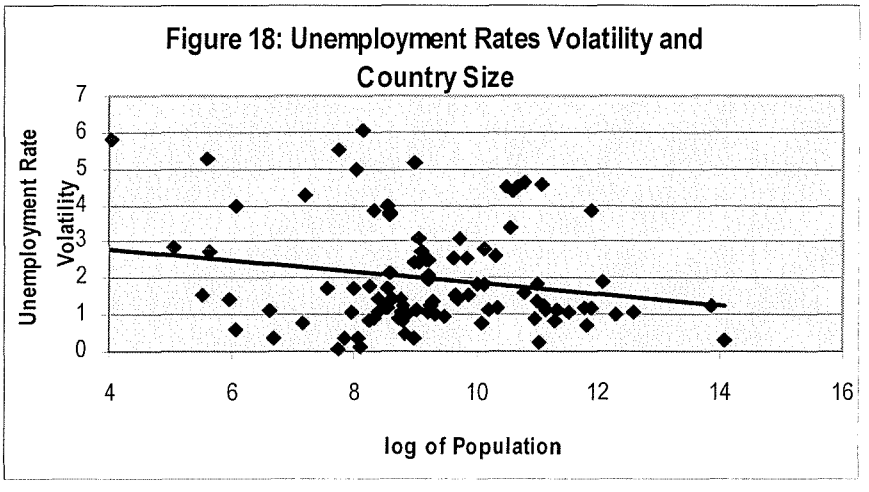
What is however relevant from this analysis is the fact that in general, fiscal imbalances are not more prevalent in small countries than in large ones. Therefore, fiscal mismanagement cannot in general be identified as the source of shocks to aggregate demand and economic activity in small states examined in Stylised Fact 6, nor can the proneness to persistent external current account deficits in small states be ascribed to overly expansionary fiscal policies.

Stylised Fact 11: Small vulnerable countries tend to have unemployment rates that are higher and more volatile over time than larger countries. There appear to be no marked differences in inflation rates and in their volatility over time between countries of different size.

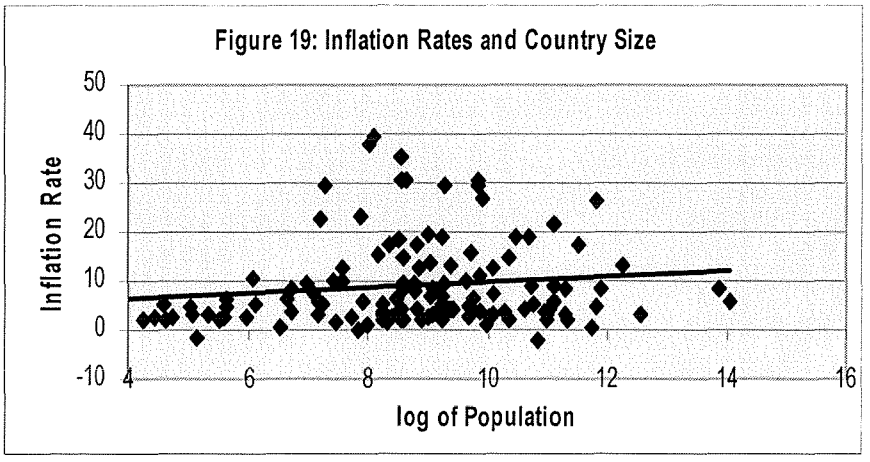
In order to complete the analysis of stylized facts concerning macroeconomic dynamics in small states, an assessment of trends in the rates of price inflation and unemployment between countries of different size is undertaken.



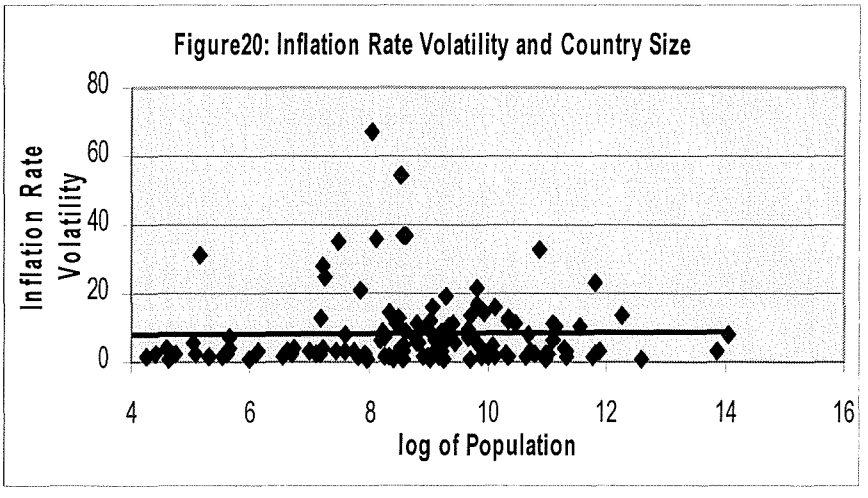
Source: IMF, UNCTAD, World Bank



Source: IMF, UNCTAD, World Bank



Source: IMF, UNCTAD, World Bank



Source: IMF, UNCTAD, World Bank

This assessment is presented in Figures 17 through 20. The analyses of unemployment and inflation rates are based on period averages for the countries in the database. The analyses of volatilities over time in the same variables is based on coefficients of variation, defined as the ratio of the standard deviation to the average over the available sample periods, for each country in the database. Figures 17 and 18 indicate that small countries tend to have unemployment rates which are higher and more volatile over time than large countries.

These observations fit in with the fact that small countries tend to operate fixed exchange rate mechanisms, as documented by Worrel (1992) and Bugeja (2004) amongst others. For small countries affected by exogenous shocks, a fixed exchange rate regime is attractive in that it enhances the credibility of monetary policy through the provision of a nominal anchor and provides added impetus to prudent fiscal management. It shields the economy from external monetary shocks and prevents excessive exchange rate volatility especially in countries where financial markets are not well-developed. In this way, it lends the country an added degree of credibility which is essential to attract investment and engender economic growth. Indeed, small countries often have no real choice between exchange rate regimes in that they are compelled to refrain from flexible arrangements in order to avoid undue volatility in exchange rate values, which could be particularly harmful in view of the inherent openness of such economies to international trade.

The downside of fixed exchange rate regimes is that, unlike flexible systems, they do not automatically adjust to real shocks via price movements, thereby resulting in larger fluctuations to real economic activity. In situations of insufficient wage flexibility, fixed exchange rate regimes may also result in higher rates of unemployment.

Ghosh et al (1997) analyze the inflation and growth performance across currency regimes for a sample of 136 countries during the 1960-1990 period. They find that inflation is both lower and more stable under pegged regimes as a result of a greater degree of monetary discipline. Economic growth varies only slightly across regimes

but growth volatility is higher under pegged regimes. Domac et al (2001) find similar results from a sample of transition countries.

Bugeja (2004) reports that within a sample of 43 small states, around 33 operated exchange rate regimes of a fixed type. This 76% incidence of fixed exchange rate arrangements within small states compares with a ratio of 48% on a global level (International Monetary Fund, 2003). The prevalence of fixed exchange rate systems would explain why in small states, shocks to economic activity do not result in higher or more volatile rates of inflation than in larger states. This comes at the cost of persistent disequilibria in the real economy, most notably in the external current account of the balance of payments, as discussed in Stylized Fact 8. It tends to result in added volatility in economic activity, and particularly exports, consistent with Stylised Fact 6, as well as in unemployment rates. The relatively high rates of unemployment in small states may be ascribed to the application of fixed exchange rate regimes in the context of insufficient flexibility in wage setting mechanisms. This is a factor which is well-documented in the literature on currency unions, for example, in de Grauwe (2000).

Thus, the utilization of fixed exchange rate regimes is often essential in small states with underdeveloped financial markets in order to deliver a credible anchor for monetary policy (Blackman, 1998). Fixed exchange rate regimes are generally effective at insulating small states from relatively high and volatile rates of inflation. They however are not effective at insulating the economy from the effects of real shocks, particularly where the wage setting mechanism is not sufficiently flexible. Fixed exchange rate regimes may thus contribute to higher and more volatile rates of

unemployment in small states, to persistent external deficits and to higher volatility in exports and aggregate demand (Corden, 1984).

The Causes and Consequences of Vulnerability and Resilience

The stylized facts presented in this chapter involve analyses on three dimensions, namely: (a) the volatility of variables over time; (b) the relative shares of variables in the economy, and; (c) the dispersions of variables from a cross-sectional perspective, that is between countries. With regards to the first, it is shown that vulnerability, defined as the inherent proneness of small states to experience exogenous shocks, results in an increased volatility of economic variables over time, particularly in real aggregate demand components and in the unemployment rate.

In terms of the relative shares of variables in economic activity, it is shown that small vulnerable countries tend to have higher ratios to GDP for investment, exports, government expenditure and imports, with a consequently lower ratio of consumption expenditure to GDP. Small vulnerable economies are also shown to have higher external current account deficits and unemployment rates. These conditions can be viewed to be both as sources as well as consequences of inherent vulnerability and/or insufficient resilience. For instance, higher ratios of imports and exports to GDP expose a country to external shocks outside its control. However, these high ratios may also be the result of the reaction of a country to manage outside shocks by increasing its resilience through specialization. Similarly a high ratio of government expenditure to GDP may reduce a country's resilience through the unproductive

absorption of resources. However it can also arise out of the need for fiscal policy to stabilize shocks in private sector demand. The proneness of small countries to high external deficits may enhance their vulnerability to external shocks via the accumulation of foreign debt. On the other hand, a country may resort to foreign debt in order to avoid excessive instability, created by insufficient breadth and depth, in the domestic financial markets. A relatively high level of investment may be a country's response to meet the shocks causing its vulnerability. On the other hand, it may itself be a source of vulnerability because of the uncertainties associated with the outcome of such investment that may give rise to unpredictable shocks over which the country cannot exert much control. Likewise, the use of fixed exchange rate systems is a result of attempts to create resilience in the financial markets, but would typically enhance the effects of shocks in the real markets, magnifying the proneness to high unemployment rates.

In terms of cross-sectional dispersions, it is shown that small vulnerable countries as a group tend to exhibit higher dispersions in per capita output and investment compared to larger states. This is a direct consequence of asymmetries in the nature of shocks to which different countries are exposed, that is their vulnerability, as well as to differences in resilience factors.

Conclusion

The aim of this chapter is to establish a number of stylized facts regarding the dynamics of growth and macroeconomic fluctuations of small states arising out of

their proneness to exogenous shocks. A total of eleven stylized facts are stated, derived from a review of relevant literature and from the indications which can be obtained out of statistical observation.

First and foremost, it is established that vulnerability, that is the proneness to exogenous shocks, is a relevant concept especially for small states. Thus, small countries tend to be vulnerable and vulnerable countries tend to be small. Vulnerability is thus the focus of the other stylized facts presented in this chapter and indeed of the rest of this thesis. It should however be pointed out that small states may have other characteristics which are not strictly related to vulnerability, and which are therefore not the subject of this study. These other characteristics of small states may fall under other analytical issues, such as under-development or peripherality, and may not be strictly speaking factors which are exclusively connected with small states.

With regards to the stylized facts concerning economic growth, it is shown that small vulnerable states on average show no tendency towards under-development. On average, small states show similar levels of per capita income levels and growth rates as larger ones. However, there tend to be greater cross-sectional dispersions in per capita incomes among small states as well as higher fluctuations in growth rates within individual small states over time. It is also shown that small vulnerable economies tend on average to devote a larger share of their expenditure to investment, but this does not lead to higher rates of economic growth, possibly indicating that such investment is undertaken to counteract the effects of inherent disadvantages associated with vulnerability. It is also noted that there are wide discrepancies

between investment levels in small states, contributing to the heterogeneity in economic performance within the group.

With regards to the stylized facts concerning short run macroeconomic fluctuations, it is established that small vulnerable states experience more pronounced fluctuations over time in the growth rates of aggregate demand and its components. This is the result of shocks to the exogenous components of aggregate demand, but it is found that the endogenous components are even more volatile, suggesting that their volatility is compounded by the internal workings of the economy. Another important stylized fact concerning small vulnerable economies is their dependence on external trade, caused primarily by their specialization in a limited number of productive activities, necessitating imports in sectors where output falls short of domestic demand, and exports in productive activities whose output exceeds domestic demand. On balance, however, small vulnerable economies tend to experience more persistent deficits on their external current account.

It is also shown that small vulnerable economies depend to a greater extent on government expenditure, particularly in view of indivisibilities in certain government functions and of a higher incidence of market failure. However, there is no marked tendency for small vulnerable economies to have higher fiscal deficits, indicating that fiscal shocks are not a likely source of the volatility in aggregate demand in small states. Finally, it is shown that unemployment rates tend to be higher and more volatile in small states. However, there are no marked differences in the patterns of inflation between small and large states. This is attributable to the prevalence of fixed exchange rate regimes in small states.

It is important to recall that the stylized facts are established on the basis of a review of the literature and statistical observation. The latter in part relied on regression analysis between economic indicators and population size. In general, such analyses give low values for the correlation coefficient, indicating that the dependent variables are influenced by other factors apart from population size. This is consistent with the establishment of stylized facts, because such facts do not claim that size is the only determinant of the variables being investigated. Rather, the stylized facts indicate that size is a relevant factor, perhaps amongst many others.

The following chapters derive theoretical explanations for the stylized facts established in this chapter by assessing the effects of economic vulnerability on economic behaviour through formal economic modelling and econometric testing. Chapter 3 introduces vulnerability in a model of economic growth to explain the dispersions in per capita income and investment levels within the group of vulnerable economies, as well as their relatively high investment levels. Chapter 4 introduces vulnerability in macroeconomic models so as to explain the increased volatility of aggregate demand and its components, the persistence of external deficits and the relatively high levels of government expenditure, imports and exports to GDP. The proneness of small vulnerable economies to higher rates of unemployment is explainable in terms of their reliance on fixed exchange rate systems within the context of insufficiently flexible labour markets. This result is well-documented in the literature and is not treated any further in this study. Chapter 5 proceeds to econometrically assess the main testable hypotheses established in the preceding two chapters.

Chapter 3:

A Model of the Relationship between Economic Vulnerability and the Supply-Side Dynamics of Economic Growth

Introduction

Economic vulnerability, broadly defined as the proneness of an economy to exogenous shocks, is established in the literature as an important characteristic of small and insular economies (see for example Briguglio, 1995). This chapter seeks to establish the theoretical bases through which economic vulnerability impinges upon the processes of economic growth, building upon the stylised facts regarding the long-term growth patterns of small states discussed in Chapter 2. In particular, it is shown that countries that are highly vulnerable exhibit wider dispersions between themselves in per capita income and in investment when compared to other countries. As indicated in Chapter 2, vulnerability can be consistent with the achievement of high levels of per capita income, provided that it is met by high investment and relatively low consumption levels.

The past two decades have seen renewed interest in the study of supply-side dynamics that impinge on long-term economic growth. The basic analytical framework employed in this context is the so-called growth accounting exercise pioneered by Solow (1957) which utilises a neo-classical, constant returns to scale production function approach to attribute output growth to changes in production factors and to technological development, the latter often referred to as total factor productivity growth. The principal issues dealt with by economic growth theory include: (a) the

extent to which growth is attributable to total factor productivity improvements rather than increases in factor inputs; (b) whether growth is a persistent or a volatile phenomenon; (c) the extent to which poor countries are catching up with richer countries in a process of convergence of per capita output; and (d) the determinants of total factor productivity growth.

Recent comprehensive growth accounting exercises, most notably Senhadji (1999) and Bosworth et al (1995), find that total factor productivity changes are not as important as growth in factor inputs in explaining changes in output, especially in countries where the contribution of physical capital to growth is relatively high compared to that of human capital. These studies also show that total factor productivity growth is generally larger in developed than in developing countries, but it is more volatile in the latter, accounting chiefly for the fact that output growth in developing countries is twice as variable as in developed ones, and that convergence between poor and rich countries is observed, but it occurs at a very slow pace. Among the determinants of total factor productivity growth, the more important ones are found to be positive terms of trade shocks and stable macroeconomic and political conditions. Thus, in terms of the policy debate on economic development, the focus of economic growth literature centres on the degree of convergence of per capita output between countries at different levels of development and on the extent to which strong increases in output could be sustained over the long term, as for example, in Romer (1987).

From a policy viewpoint that places less emphasis on per capita output, Briguglio (1992, 1993) pioneered the research on economic vulnerability that examines the

proneness of countries to risks in their performance. There emerged a strand of literature proposing alternative measurements, and sometimes definitions, of economic vulnerability. An important conclusion of this research is the fact that, owing to their smallness and openness, a number of relatively high per capita income countries can be more vulnerable than countries at a lower level of development. Among the primary examples identified in this regard are the cases of Singapore, Cyprus and Malta. This gave rise to the so-called "vulnerability dilemma".

The stages at which the separate research fields of economic growth and economic vulnerability have arrived call for an exploration of their possible links. On one hand, while acknowledging that per capita output is an incomplete indicator of human welfare, it may be argued that vulnerability per se does not enter the human welfare function at the same level as income and consumption. The usefulness of the vulnerability concept would therefore increase if it were to be shown to have a bearing on the more important determinants of human welfare. On the other hand, the study of economic growth could benefit from the consideration of a possibly important explanatory variable, influencing primarily the development of total factor productivity, taking the form of economic vulnerability.

This chapter contributes to this debate by hypothesizing that the increased economic riskiness implied by vulnerability and the countervailing effects of resilience could have important effects on per capita output levels, economic growth and the dispersion of per capita output levels between countries, and hence on the processes of economic convergence. This builds on the stylised facts concerning long run economic growth patterns presented in Chapter 2.

In order to develop this hypothesis, the workings and conclusions of the neo-classical growth model are reviewed, together with the principal findings of studies on economic vulnerability. A variant of the neo-classical growth model incorporating vulnerability is developed next and its steady state and dynamic results are compared to those of the baseline growth model. On the basis of the findings, the chapter suggests a possible approach towards the resolution of the "vulnerability dilemma" to be tested in further empirically-based research. It also provides possible explanations to empirical observations regarding the development of total factor productivity growth and the heightened economic vulnerability of small states.

The Neo-Classical Growth Model

The basic structure of the general equilibrium neo-classical growth model, based on original work by Cass (1965), Koopmans (1965), Ramsey (1928), Solow (1956) and Swan (1956), features households owning the factor inputs, labour and capital, involved in the production of a homogenous good that can be consumed or invested. Households maximise the sum of discounted future utility under rational expectations by choosing consumption, saving, labour force participation and fertility. Goods and factor markets are assumed to clear. Following Inada (1963), the production function features positive and diminishing marginal products with respect to each input, exhibits constant returns to scale and marginal products approach infinity as factor inputs approach zero and vice-versa. The constant returns to scale assumption allows the production function to be written in intensive, or per capita form. The utility function has the same marginal conditions as the production function.

The process of economic growth can be expressed as a dynamic maximisation problem by means of the Hamiltonian as[2]:

$$H_t = e^{-\theta t} u(c_t) + \lambda_t \frac{\delta k_t}{\delta t} \qquad (1)$$

$$\text{and } \frac{\delta k_t}{\delta t} = f(k_t) - c_t - (n+d)k_t \qquad (1')$$

where $u(\cdot)$ is the representative utility function

$f(\cdot)$ is the production function

c is per capita consumption

k is per capita physical capital

θ is the rate of discount applied to future utility

n is an exogenous time-invariant rate of population growth

d is an exogenous time-invariant rate of physical capital consumption

λ is the shadow price of physical capital

t is a time subscript

Households maximise the sum of future discounted utility over an infinite horizon by deciding, in each period, between consumption giving direct utility and investment which increases the capital stock and thus gives future utility subject to the marginal product of capital. The latter is however subject to diminishing returns in relation to capital intensity and is conditioned by physical capital depreciation and population growth, which reduces the amount of capital available per capita.

[2] see for example, Chiang (1992)

For the sake of simplicity, the effects of total factor productivity growth are at this stage ignored, to be discussed later in the context of the results of economic vulnerability. Moreover, fertility and labour market participation are at this stage assumed to be exogenously determined and constant.

The first order conditions for optimisation require that the derivative of the function with respect to the decision variable c_t must be zero at all t while the time path of the shadow price of physical capital must reflect the effect of physical capital on utility. Thus:

$$\frac{\delta H_t}{\delta c_t} = e^{-\theta t}u'(c_t) - \lambda_t = 0 \qquad (2)$$

$$\frac{\delta \lambda_t}{\delta t} = -\frac{\delta H_t}{\delta k_t} = -\lambda_t(f'(k_t) - (n+d)) \qquad (3)$$

where u` (·) and f`(·) indicate the first derivative of the respective functions. Equation (2) implies that that shadow price of physical capital is at each point in time equal to the discounted marginal utility arising out of the consumption that ensues from a change in physical capital. Equation (3) implies that the shadow price of physical capital declines at a rate equal to the marginal product of physical capital, equivalent to the return on capital, net of the deleterious effects on per capita physical capital emanating from population growth and depreciation.

Differentiating (2) with respect to time and equating to (3), we obtain the optimal time path for consumption as:

$$\frac{\delta c_t}{\delta t} = \gamma_t [f'(k_t) - (n+d+\theta)] \qquad (4)$$

where $\gamma_t = -u'(c_t)/ u''(c_t)$ which is positive.

Equation (4) implies that in the optimal time path, the conditions that would allow for higher consumption growth, which is tantamount to higher initial saving and investment allowing stronger output growth, are:

- a high value for γ_t, which reflects the concavity of the utility function and would rise as the consumption smoothing motive weakens;
- a high marginal product of physical capital, implying high returns to saving;
- low population growth and physical capital depreciation so as to sustain the returns on saving;
- a low discount rate on future utility, so as not to encourage current consumption.

As consumption and physical capital rise in the course of economic growth, the marginal utility of consumption and the marginal product of capital decline, progressively leading to smaller rates of consumption growth. This process goes on until a steady state of zero consumption and output growth is reached, by virtue of our ignoring the effects of total factor productivity growth. This important result yields the notion of convergence whereby poor economies growth faster than rich ones in a process of catching-up, reflecting the fact that poorer economies, with a lower capital per capita, enjoy higher marginal product of capital, thereby resulting in higher output growth out of investment expenditure. The convergence to steady state properties of this model, to be elaborated upon further on, are well-documented in the literature (see for example Barro and Sala-i-Martin, 1995, Chapter 2).

Due to the diminishing marginal product of capital condition, this model will reach a steady state, or equilibrium situation, whereby the marginal productivity of capital

will fall to a level where it will be merely sufficient to maintain the total stock of capital, and hence, output, per capita constant. The steady state for this model can be obtained by setting to zero the dynamic equations for consumption (4) and physical capital accumulation (1'), yielding a steady state physical capital stock such that:

$$f'(k) = n + d + \theta \qquad (5)$$

and a steady state per capita consumption at:

$$c = f(k) - (n+d)k \qquad (6)$$

Equation (5) indicates that the economy would not continue to accumulate physical capital per capita once its marginal product falls to just cover the depreciation rate, the rate of utility discounting and population growth. Equation (6) gives the steady state consumption permitted by the steady state capital stock and which would provide just sufficient saving to keep per capita physical capital constant in view of depreciation and population growth. Thus, according to this model, economies which achieve a high per capita income level and which are consequently expected to grow fast for long periods are those characterised by a low population growth rate, low physical capital depreciation, and a low rate of future utility discounting.

This model is to serve as a baseline case against which the effects of economic vulnerability, including considerations regarding total factor productivity growth, are assessed.

Incorporating Vulnerability in a Neo-Classical Growth Model

As discussed in Chapter 2, various studies have generally concluded that there is very little correlation between vulnerability and per capita output or output growth. Indeed,

Briguglio (1995) finds that certain economies with high per capita income such as Singapore or Malta are subject to a significant degree of vulnerability This is not in conflict with the conceptual basis of economic vulnerability studies, in that per capita output is regarded as an incomplete indicator of human welfare in the context of economies that are prone to significant downside risks.

On the other hand, as already argued, it may be argued that vulnerability per se does not enter the human welfare function at the same level as economic growth or development. The usefulness of the vulnerability concept would therefore increase if it is shown to have a bearing on the more important determinants of human welfare. This can be postulated *a priori* on the grounds that the increased economic riskiness implied by vulnerability would have an effect on economic growth and per capita output levels.

Economic vulnerability implies increased sensitivity to shocks and relatively greater susceptibility to shocks of an adverse nature. It is proposed that economic vulnerability can be incorporated in a neo-classical growth model by considering the physical capital stock and consumption possibilities as being subject to stochastic shocks within concave production and utility functions.

Modelling physical capital stock and consumption as stochastic variables would capture the sensitivity to a number of demand- and supply-side shocks that are typical in vulnerability studies. These would include adverse external demand shocks, which may reduce the effective utilisation of capital by making part of it redundant. Similar considerations would apply to positive technology shocks from which vulnerable countries do not benefit, putting them at a competitive disadvantage. Likewise,

proneness to natural disasters could reduce an economy's capital stock and consumption possibilities. Unsuitable domestic economic policy shocks and political instability could have similar effects.

The concave production and utility functions imply that downside shocks would have relatively stronger effects than positive ones. In a concave production function exhibiting diminishing marginal product, a positive shock to the production factors would increase output by a smaller magnitude compared to the reduction in output from an equivalent reduction in production factors. The nature of the production and utility function would thus serve to determine the strength of the economic effects of shocks in the economy's capital stock and consumption possibilities.

It is to be noted that the use of the neo-classical production function in this modelling exercise, which features constant returns to scale, ensures that there are no *a priori* assumption through which economic size impinges upon economic growth, as could be inferred from certain classes of endogenous growth models such as the Lucas-Uzawa model (Lucas, 1988; Uzawa, 1965). The exercise presented here focuses exclusively on the effects of the proneness to exogenous shocks on economic growth, with the corollary that small countries are typically more prone to such shocks.

Subject to the assumptions set out in the baseline model, the capital stock at time t, k_t, is presumed to be a random variable with expected value k_t and subject to exogenous

shocks κ_t which are identically and independently distributed with zero mean and constant variance[3], thus:

$$k_t = k_t + \kappa_t \qquad (7)$$

where $\kappa_t \sim iid(0,\sigma^2_\kappa)$

Similarly, consumption c_t, is modelled to be stochastic with expected value c_t and subject to exogenous white noise shocks χ_t, thus:

$$c_t = c_t + \chi_t \qquad (7')$$

where $\chi_t \sim iid(0,\sigma^2_\chi)$

Thus, the variances of per capita output and capital are assumed to be constant and independent of the levels of the variables. This is considered to be a neutral assumption. It may be argued that variances may increase with the level of the variables, as shocks might be proportionately stronger in larger economies, or that they could actually decrease, as the avenues for diversification are more abundant in larger economies. In the discussion of the costs of vulnerability further on, it is shown this issue does not alter the nature of the basic results of this modelling exercise, but would of course influence the extent of the incidence of shocks on economic activity.

The capital intensity accumulation function introduced in equation (1) can now be written as:

$$\frac{\delta k_t}{\delta t} = f(k_t) - c_t - (n+d)k_t \qquad (8)$$

Considering, for the purposes of solving the dynamic utility maximisation problem, the expected value of equation (8), we obtain:

[3] To be precise κ_t represents a shock to the capital/labour ratio. Assuming that labour is not subject to stochastic shocks, this can be linearly related to the variability in physical capital.

$$\frac{\delta k_t}{\delta t} = E[f(k_t)] - c_t - (n+d)k_t \qquad (9)$$

which is identical to equation (1') with the exception that the expected value of output is now to be considered in the wake of shocks to the capital stock. Among the methods available to consider the effects of uncertainty on economic activity[4], the expected value of output can be expressed by means of a Taylor-expansion of the production function around the expected value of the capital stock k_t, thus:

$$E[f(k_t)] = E[f(k_t)] + E[f'(k_t)(k_t - k_t)] + E[0.5f''(k_t)(k_t - k_t)^2] + \ldots \qquad (10)$$

Ignoring those parts of the expansion involving an exponent higher than two, on the basis of the assumption that moments for the stochastic variables that are higher than two are zero, we obtain:

$$E[f(k_t)] = f(k_t) + 0.5f''(k_t)\text{var}(k_t)$$

$$= f(k_t) + 0.5f''(k_t)\,\sigma^2_\kappa \qquad (10')$$

Equation (10') implies that due to the randomness of the physical capital stock, the expected output must be adjusted by a term reflecting the extent of shocks to the capital stock, σ^2_κ, and the susceptibility of the economy's output to such shocks, as given by $0.5f''(k_t)$. The negativity of the latter term, inherent in a concave production function, implies that the variability of capital stock is detrimental to the economy's expected output. Thus, shocks in the physical capital stock can be expected to have effects on the rate of return on capital and thereby on the extent of capital accumulation, economic growth and steady state per capita output.

Equation (10') is an important result which delivers a further insight into the concept of vulnerability. This is that the shocks associated with vulnerability are not neutral

[4] See, for example, Machina (1987), Machina (1989) and Hirshleifer et al (1992), Chapter 1.

but have a cost, in that the effects of negative shocks on output would be stronger than those of positive shocks of the same magnitude. This is a direct consequence of the use of a concave production function with diminishing marginal productivity. The latter implies that the increase in output following a rise in capital resources would be smaller than the decrease in output in reaction to a drop in capital of the same size.

In this approach, it is assumed that the variance of the shocks to the per capita capital stock σ^2_κ is constant and independent of the per capita capital stock. By assuming σ^2_κ to depend on per capita capital, the basic result inherent in equation (10'), which is that vulnerability has an output cost, would not be altered. Different relationships between the variance of per capita capital and the level of the same variable would of course imply different patterns of the incidence of the cost of vulnerability. For the purposes of this analysis, a neutral assumption featuring a constant variance of per capita capital is retained.

Furthermore, it may be argued that within the context of a concave production function with output having a constant elasticity with respect to the factor input, multiplicative shocks to the factor input would have a neutral effect on output in terms of percentage changes. In absolute terms, however, this would still imply a lower level of expected output. It is to be further considered that shocks cannot be assumed to be purely multiplicative, otherwise, as the capital stock goes to zero, so would potential shocks. In practice, there would be indivisibilities in shocks, such that small economies would be proportionately exposed to larger shocks compared to larger ones. This would be consistent with the notion that larger economies have better possibilities for diversification. The assumption made here of shocks being

independent of the capital stock can be considered to be neutral towards assessing the costs of such shocks on output.

On the basis of the assumptions inherent in this modelling exercise, equation (10') shows that the susceptibility of the economy's expected output to shocks in the factor inputs, as given by the second derivative of the production function, decreases in magnitude as the capital stock rises. This implies a heightened economic vulnerability for economies having a relatively low per capita capital. Moreover, it is dependent on the marginal productivity of the volatile factor input. Considering a concave production function of the form $f(k)=k^{\alpha}$, where $0<\alpha<1$,

$f''(k) = \alpha(\alpha-1)k^{(\alpha-2)}$

which implies that the magnitude of the f''(k) initially rises with α but subsequently falls to zero as α approaches 1. This happens as initially, an increase in the output share of the volatile factor input would render the economy more susceptible to shocks in that input, as shown in Figure 1. As α continues to increase, however, this effect would be outweighed by the increase in marginal productivity of the factor input which reduces the asymmetric effects between positive and negative shocks, thus rendering the economy's expected output less vulnerable to fluctuations in the factor input. Therefore, the expected output of economies with an intermediate elasticity of physical capital tend to be more susceptible to the volatility of this factor input. It also follows that economies which benefit from endogenous growth, which are typically modelled to have non-diminishing marginal productivity with the α coefficient set at a value of 1 (Aghion et al, 1998; Romer, 1986), would be insulated from the asymmetric effects of exogenous shocks. Economic resilience can thus be equated with endogenous growth properties.

It is thus to be highlighted that the existence of resilience has two benefits, namely the promotion of stability, in the sense of the economy being able to withstand the negative effects of shocks, as well as the engendering of sustained economic growth akin to the conclusions of endogenous growth models.

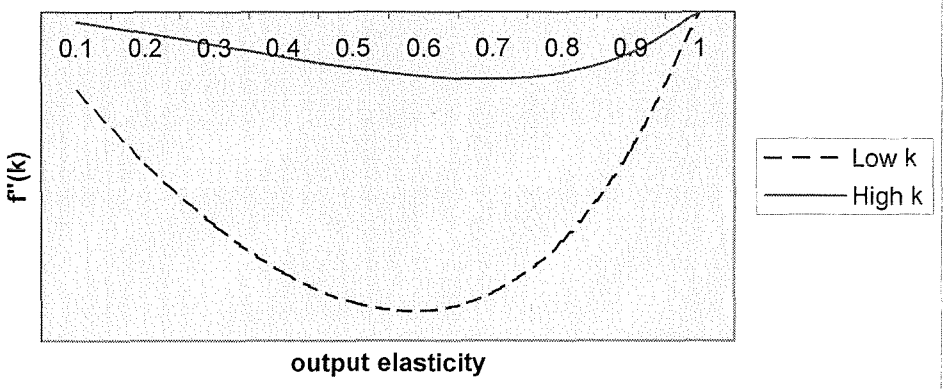
In a similar manner, the expected utility of consumption in a stochastic environment can be expressed as:

$$E[u(c_t)] = u(c_t) + 0.5u''(c_t)\,\sigma^2_{\chi} \qquad (11)$$

Once again, the negative second derivative of the utility function implies that shocks have overall a negative effect on expected utility. The diminishing marginal utility concept implies that an increase in consumption would improve utility to a smaller extent than the drop in utility which would result from an equivalent drop in consumption. This indicates that vulnerability to shocks has a direct cost on the welfare of an economy.

Equation (11) implies that shocks to consumption possibilities reduce welfare in proportion to the concavity of the utility function, which indicates the strength of the consumption smoothing motive. This can be expected to have effects on saving behaviour and consequently on growth patterns. It may be further argued that the second derivative of the utility function and the consumption-smoothing motive are larger in magnitude in economies where consumption levels are relatively low. Thus, the welfare of developing economies would be more likely to be negatively influenced by shocks to their consumption possibilities.

Figure 1: The susceptibility of expected output to factor input shocks



At this juncture, it is worthwhile to note that the application of stochastic methods to the analysis of economic growth already forms part of mainstream literature but not within the context of explaining the phenomenon of vulnerability. King et al (1992) and Fatas (1996), for instance, introduce stochastic trends in the production function so as to model persistent technological shocks, arguing that growth dynamics are an important determinant of business cycle fluctuations. These approaches are however based within the context of endogenous growth modelling, allowing for an endogenous development in total factor productivity growth mainly by assuming non-diminishing returns to the accumulable factors of production. This approach is considered less appropriate for the purposes of modelling vulnerability where the question of endogenous technological progress does not arise, and shocks to production factors are more relevant. It is for this reason that this study focuses on introducing elements within a neo-classical growth framework.

An economy's proneness to the effects of exogenous shocks is in this way broken down into two behavioural components, namely the extent of the shocks affecting production factors and consumption possibilities, and the susceptibility of an economy's production technology and welfare to such shocks. This is in line with Guillaumont (1999), who stresses that the risk of a country being harmed by an external shock is given by the size and the likelihood of the shock, the exposure to the shock and the ability of the country to react to it. This finding is also congruent with the notion of economic resilience put forth by Briguglio (2004) and Cordina (2004a,b), which is constituted by the endogenous behavioural and policy reactions of the economy to exogenous shocks.

It is here shown that while random shocks may be regarded as purely exogenous factors, the economy's susceptibility to such shocks may be viewed to change according to the state of development and to policy responses. In particular, it is found that susceptibility tends to decrease as an economy develops and as the elasticity of output to physical capital becomes sufficiently large. In other words, resilience is built as the economy moves towards a situation where the effects of positive and negative shocks on output would become symmetrical. A lack of resilience would imply that negative shocks would have impacts of a significantly higher magnitude than positive ones.

It is further argued that the utility and output cost effects of shocks emanate primarily from the asymmetry which shocks would have on an economy, arising out of the

concavity of the production and utility functions. Thus, positive and negative shocks have asymmetric effects, in that positive shocks would improve economic activity to an extent which is smaller than the deterioration in activity following negative shocks. This is a direct consequence of diminishing marginal productivity and utility. Indeed, the concept of resilience is here directly related to the rapidity with which the marginal product of capital declines. A higher resilience can be obtained if the marginal product of capital is not declining significantly, implying that positive and negative shocks would be have more symmetrical effects.

The Effects of Vulnerability and Resilience on the Steady-State Equilibrium

In order to gauge the effects of economic vulnerability and resilience on the steady state equilibrium of the economy, we re-formulate the Hamiltonian to account for the expectations of utility and output within the context of stochastic consumption and capital stock levels, using equations (9), (10') and (11), as:

$$H_t = e^{-\theta t}[u(c_t) + 0.5u''(c_t)\sigma^2_\chi] + \lambda_t [f(k_t) + 0.5f''(k_t)\sigma^2_\kappa - c_t - (n+d)k_t] \qquad (11)$$

The first-order conditions for maximisation imply that:

$$\lambda_t = e^{-\theta t}[u'(c_t) + 0.5u'''(c_t)\sigma^2_\chi] \qquad (12)$$

$$\frac{\delta \lambda_t}{\delta t} = -\lambda_t[f'(k_t) + 0.5f'''(k_t)\sigma^2_\kappa - (n+d)] \qquad (13)$$

Equation (12) implies that compared to the baseline neo-classical growth model, the shadow price of k_t is in this model reduced by a factor reflecting consumption-side economic vulnerability. Likewise, the development of the shadow price of k_t is influenced by production-side vulnerability, as shown in equation (13).

Simultaneously solving these two equations, we obtain an expression for the optimal time path of consumption as:

$$\frac{\delta c_t}{\delta t} = \eta_t [f'(k_t) + 0.5f'''(k_t)\sigma^2_\kappa - (n+d+\theta)] \qquad (14)$$

where $\eta_t = \frac{-u'(c_t) - 0.5u'''(c_t)\sigma^2_\chi}{u''(c_t) + 0.5u''''(c_t)\sigma^2_\chi}$

By virtue of the assumptions imposed on the utility function and the non-negative nature of the variance term σ^2_χ, the term η_t is positive. This implies that consumption growth, which reflects the extent of saving in initial periods, responds positively to the marginal productivity of per capita capital and negatively to the population growth rate, the depreciation rate and the utility discount rate. These results conform to those of the baseline model.

Equation (14) however also implies that consumption growth is increased by the magnitude of production-side shocks as the third derivative of the production function is positive. As higher consumption growth requires lower initial consumption, this implies that the economy saves more to accumulate capital to contrast the negative effects of disturbances to the capital stock on output. On the other hand, η_t is lower than the comparable term in the baseline model γ_t, and this in direct relation to the term indicating vulnerability on the consumption side σ^2_χ. Consumption-side vulnerability thus results in lower consumption growth and, consequently lower saving as the economy makes up for volatility-related welfare losses through higher initial consumption.

The saving behaviour of the economy is thus subject to two opposing effects. On one hand, volatility in the capital stock increases saving to allow the economy to accumulate sufficient capital which would allow it to more effectively absorb the effects of such shocks. On the other hand, the welfare losses arising out of consumption volatility are mitigated by higher consumption and consequently lower saving[5].

This is an interesting result which may help explain the wide range of per capita income levels inherent in economies facing vulnerability. The negative effects of vulnerability on saving may be inhibiting low income economies from effecting sufficient saving so as to enable growth and development. As discussed above, the negative welfare effects of shocks to the consumption side of the economy are met by a lower level of saving. However, once that this effect is overcome, and there are sufficient resources to cater for consumption-side vulnerability, saving would increase so as to contrast the effects of shocks to the capital stock, actually leading to faster and more pronounced levels of economic growth.

The consequences of these effects can be assessed by examining the steady state of the differential equations for the time paths of c_t and k_t, equations (14) and (9) respectively. Thus, the steady state physical output per capita is found as:

$$f'(k) + 0.5f'''(k)\sigma^2_{\kappa} = n + d + \theta \qquad (15)$$

On the basis of a comparison to equation (5), equation (15) shows that the steady state level of per capita capital in this model is higher than that in the baseline model, with the consequence that its marginal productivity would be lower. This can be readily

[5] As shocks to consumption may be regarded to be primarily of a demand nature, these issues are further discussed in Chapter 3.

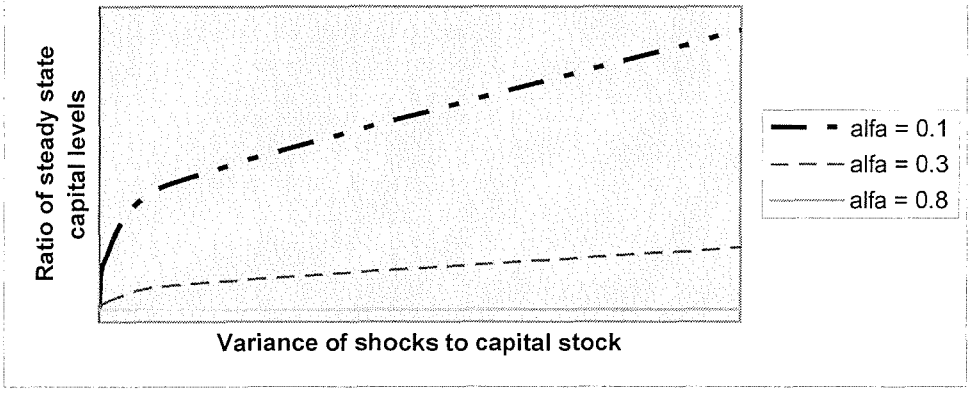
understood from the fact that the third derivative of the production function is positive, implying that the second term of the left hand side of equation (15) is positive as well. Taking this term to the right hand side would imply that the marginal productivity of capital at steady state would be lower than $n + d + \theta$, entailing that the capital stock accumulated in this model would be higher than that of the baseline model.

The steady state level of per capita consumption is derived as:

$$c = f(k) + 0.5f''(k)\sigma^2_{\kappa} - (n+d)k \qquad (16)$$

Thus, in spite of the higher expected value of capital stock per capita, it does not follow that the expected value of per capita consumption in steady state will in this case be higher than that in the baseline model, because of the deleterious effects of shocks to the capital stock as represented by the product of the (negative) concavity of the production function and the volatility of shocks to the capital stock..

Figure 2: Ratio of steady state capital to baseline model results



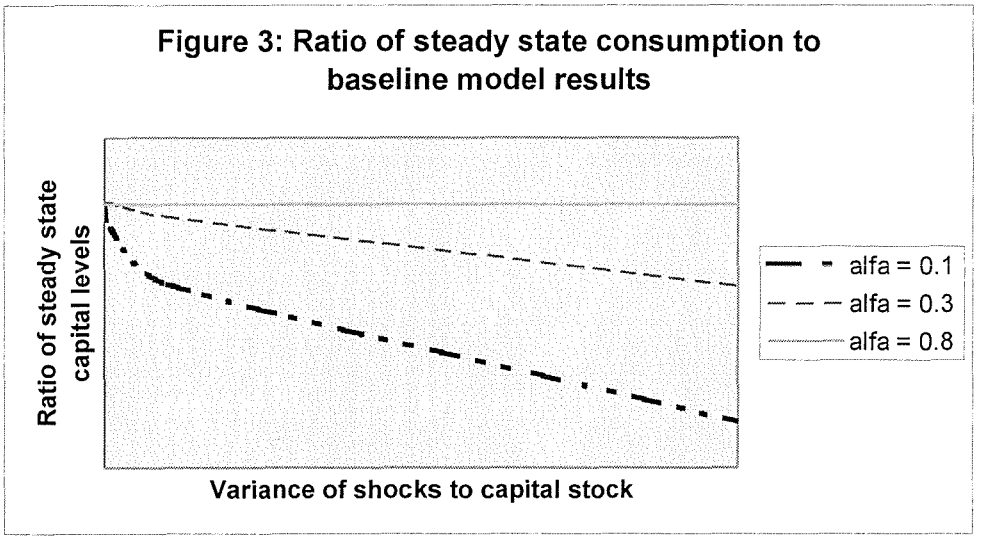
The end result would depend on the relative strength of these opposing effects. It is also noted that the characteristics of the utility function and variability to the

consumption variable are immaterial to the steady state position of the economy, because the η_t in equation (14) is non-zero.

For the purposes of addressing this issue, a numerical analysis is undertaken to evaluate the ratios of consumption and capital values in the economic vulnerability model to those in the baseline model for different values of production function concavity and σ^2_κ on the assumptions that $f(k)=k^\alpha$, $n+d+\theta=0.1$ and $n+d=0.08$. The results are shown in Figures 2 and 3 and indicate that for relatively low vales of α, the capital stock under the vulnerability model is higher than under the baseline model, and it tends to increase with the extent of the shocks to the capital stock σ^2_κ. The divergence in capital stocks and its sensitivity to the shocks tends to diminish with higher values of α. With relation to per capita consumption, this is found to be invariably lower in the vulnerability model compared to the capital stock model, with the difference being principally accentuated at low values of α and high values of σ^2_κ. As the output share and the productivity of the accumulable factor increase, the results of the vulnerability growth model and of the baseline model tend to converge. This happens as in the limit, a value for $\alpha=1$ would neutralise any adverse effects to output arising out of shocks to the production factor.

It is thus concluded that the more economically vulnerable economies, characterised by relatively high volatility in their capital stock and a production technology that is susceptible to such shocks, tend to have a relatively higher per capita capital, and consequently output, but a relatively lower consumption per capita in steady state. Thus, in the long run, the negative effects of vulnerability on consumption overcome

the positive influences. In Chapter 4, it is shown that this results extends to the short-run as well.



Vulnerable economies would need to dedicate a portion of their resources to overcome the difficulties of economic vulnerability and the marginal productivity of their capital would in steady state be lower. These effects are more accentuated in the case of economies where the capital stock and the output elasticity of physical capital are relatively low.

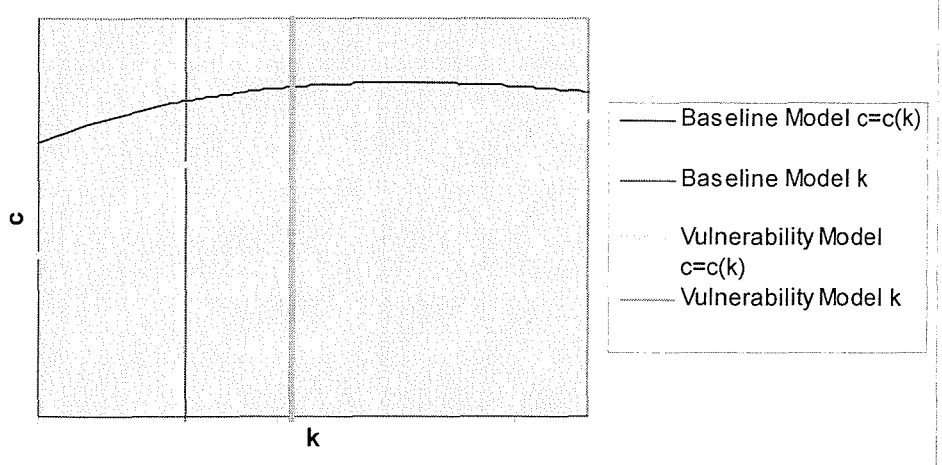
Economic Vulnerability and Resilience and Convergence to Steady State

The comparison between the steady state positions of the baseline economic growth and the vulnerability models, together with an analysis of the behaviour of the models when they are out of steady state, can be undertaken by means of a phase diagram as shown in Figure 4. The Figure shows the relationships between per capita

consumption and per capita capital for the steady state relations of the baseline model, namely equations (5) and (6), and for those of the model incorporating vulnerability, as given in equations (15) and (16).

The phase diagram replicates the results obtained in Figures 2 and 3 in the previous section. In the baseline model, the steady state per capita consumption that can be obtained at each level of steady state per capita capital is equal to the output of that capital less the allowances for physical capital depreciation and population growth that must be made to maintain per capita capital constant in steady state. In turn, the equilibrium steady state level of per capita capital accumulated is at the point where its marginal productivity covers its erosion through depreciation and population growth as well as the cost of postponing consumption as reflected in that rate of time preference. A higher level of marginal productivity would imply that it is profitable to accumulate further capital and vice-versa. The intersection of these two functions gives the per capita steady state capital and consumption.

Figure 4: Steady State and Convergence Properties of the Baseline and Vulnerability Models



It is interesting to note that the level of per capita steady state capital is lower than that which would permit the maximum level of consumption. By differentiating equation (6), the per capita capital that would maximise steady state would be found as $f'(k) = n+d$, while the actual steady state capital is given in equation (5) as $f'(k) = n+d+\theta$. The utility cost of postponing consumption thus results in a lower level of per capita capital than that which would maximise per capita consumption.

In the model incorporating vulnerability, the consumption relation behaves in a similar manner to that in the baseline model, with the important difference that it affords a lower level of steady state per capita consumption. From equation (16), it can be seen that this difference is due to the erosion of consumption possibilities generated by the volatility in the production factor and the effect of such volatility on output. As the latter approaches zero with an increase in k, the difference between the two consumption relations disappears. This indicates that developing economies bear the costs of vulnerability to a larger extent as they would be relatively more exposed to shocks. The steady state per capita capital in the vulnerability model is higher than that in the baseline model. As is shown in equation (15), the higher level of capital accumulated, and its consequent lower marginal productivity, is intended to offset the effects of its volatility. The vulnerability model however also features a steady state per capita capital that is lower than that required to maximise per capita consumption.

The additional usefulness of the phase diagram is to illustrate the behaviour of the models from an out-of-steady-state position. As the shape of the relationships giving rise to the equilibrium are similar in the two models, their out-of-steady-state

behaviour is the same. Out of steady state positions may be grouped into four categories, namely:

i. consumption is higher than that implied by the steady state relationship and capital stock is lower than steady state;

ii. consumption is lower than that implied by the steady state relationship and capital stock is lower than steady state;

iii. consumption is higher than that implied by the steady state relationship and capital stock is higher than steady state;

iv. consumption lower than that implied by the steady state relationship and capital stock is higher than steady state.

The results which apply equally for both models can be described as follows. In case (i) the excessive consumption would tend to reduce the capital stock, which is already below steady state thus producing insufficient output and saving. In this case, the capital stock would deviate further from steady state, with equilibrium not being achieved. In case (ii) the lower-than-steady-state consumption would lead to an accumulation of capital thus remedying for the shortfall of the capital stock from steady state. In this case, equilibrium would be achieved. In case (iii), the excessive consumption would detract from the capital stock, thus reducing its excessive level towards the steady state position. Equilibrium is in this case achieved as well. In case (iv) the insufficient consumption would lead to further accumulation of capital, thus further contributing to its deviation from steady state. This is another disequilibrium situation. Thus, these models have the well-known saddle-point equilibrium property.

The growth processes to steady state under the two models can also be assessed under this framework. Convergence to steady state may be examined under two premises. The first is absolute convergence, which would indicate that an economy with a lower initial absolute value of capital stock would tend to grow faster than another with a higher initial value, irrespective of the final steady-state position of the capital stock. The second is conditional convergence, which states that the economies which grow faster are those with the highest proportional difference between the initial capital stock and the final steady state value.

In terms of absolute convergence, it may be seen from Figure 4 that applying an initial value for k that is lower than steady state while assuming that c lies on the steady-state locus for each of the models, the responsiveness of consumption to an increase in capital under the vulnerability model would be stronger and goes on further than that under the baseline model. This is because the slope of the steady state consumption locus is higher for the model incorporating vulnerability, while the equilibrium steady state capital is larger. In this sense, therefore, it may be possible to account for the relatively higher rates of consumption growth by economies subject to vulnerability, albeit their steady state consumption is lower. It is to be borne in mind that as these economies develop, their consumption can increase at a faster pace as growth tends to not only increase consumption possibilities but also to reduce the effects of vulnerability.

The phase diagram approach is however not so easily amenable to discuss the growth in consumption, the capital stock or output over time, because it lacks a dimension for the latter variable. Nor is it easily applicable to assess conditional convergence

because it lacks a relationship between the capital stock and its steady state value. On the other hand, the mathematical analysis based on the linearalisation of growth around the steady state that is usually employed to study the speed of convergence[6] is unwieldy in this case. This is because of the mathematical complexity introduced in the vulnerability model that involves derivatives of up to the fourth order. Following Barro et al (1995)[7], a numerical solution of the non-linear dynamic systems in the baseline and vulnerability models is presented to analyse conditional convergence under the two models and the relative speeds over time.

An experiment to assess the speed of convergence in the baseline and in the vulnerability models is designed whereby the values of the deep parameters are set at $n + d = 0.08$ and $n + d + \theta = 0.1$. The elasticity parameter of output with respect to the capital intensity, α, is set at 0.4, a value that on the basis of the analysis presented in Figures 2 and 3 produces different steady state values for the two models. The utility elasticity with respect to consumption, which is only relevant for consumption growth in the vulnerability model, is set at 0.5. The values for the variances of the capital stock and consumption possibilities are arbitrarily set at positive values. Starting conditions for the capital stock and consumption are set at one half of the respective steady state values in each model. Figures 5a, b and c show the time paths of the growth rates in the capital stock, output and consumption for the two models under these conditions.

It can be observed that in general, convergence to steady state is slower under the vulnerability model than under the baseline model. This is because the growth rates of

[6] see, for example, Barro et al (1995), Appendix 2A.
[7] pp. 80-87

output, capital and consumption are lower in the initial phases of growth in the vulnerability model. This is attributable to the deleterious effects of volatility in the capital stock on output, which hampers the rate of capital accumulation and therefore, the growth of output and consumption. It is however observed that at later stages of economic development, growth under the vulnerability model persists at a relatively higher level for a longer period of time. This is attributable to the differences between the steady state levels of capital, output and consumption under the two models.

As discussed in the preceding section, the vulnerability model features higher steady state levels of capital and output, which accounts for the persistence of growth in these variables over a longer period of time. Such persistence is however not so evident in the case of consumption, which is in steady state lower in the vulnerability model compared to the baseline model.

Of course, another important reason why countries facing vulnerability may be converging at a slower pace might lie in the fact that they may be subject to different production technologies, causing the marginal productivity of capital to decline at varying speeds. This is, of course, quite an obvious assertion which deserves no further consideration in the study of vulnerability, which is here focusing on the effects of exogenous shocks, keeping production technologies constant between countries.

It can thus be concluded that economic vulnerability does not have a monotonic effect on the rate of economic growth. Rather, it is concluded that vulnerability tends to slow down the output growth of relatively underdeveloped economies, but tends to

accelerate the growth rate of more developed ones. The latter is due to the fact that the steady state output of vulnerable economies is relatively higher, while the damaging effects of vulnerability tend to diminish as the economy grows. In this sense, therefore, vulnerability can be viewed as a factor that retards convergence between developing and developed economies.

Thus, vulnerability may be a reason why within the group of countries which are typically described as vulnerable, there is a significant dispersion of per capita income levels, as documented by Briguglio (1995). This may be an indication that because of vulnerability, such countries are not converging to any measurable degree between themselves or with other countries. The literature in this area is incipient, although there are indications of slow convergence in the case of small economies in Bertram (2003) and Bertram et al (2004).

The Case of An Economy Open to International Capital Flows

The analysis carried so far is based on the fact that the marginal productivity of capital, which can be equated to the real interest rate, is being endogenously determined within the economy depending on the extent of capital accumulation, with the steady state being reached when the capital stock accumulated has a marginal product covering the rate of depreciation and population growth, adjusted, as may be the case, for shocks to the capital stock as per equations (5) or (15). In the case of an economy open to international capital flows, however, it may be argued that the real rate of interest would be exogenously determined in the international capital markets.

Figure 5a: Convergence of Capital Stock to Steady State

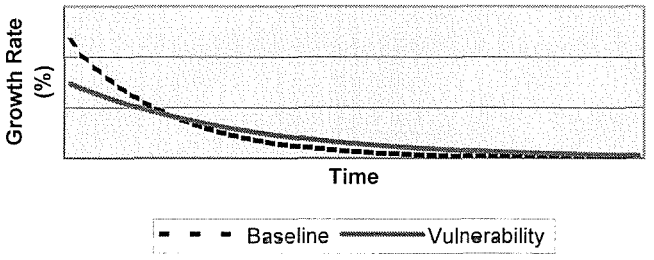


Figure 5b: Convergence of Output to Steady State

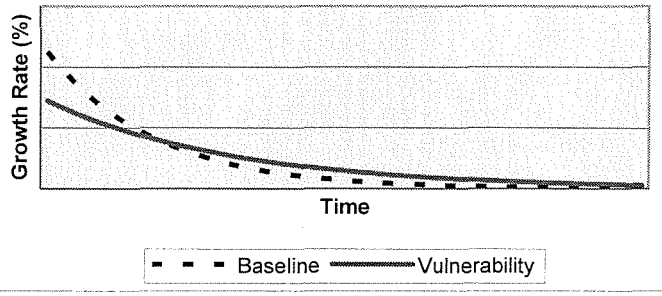
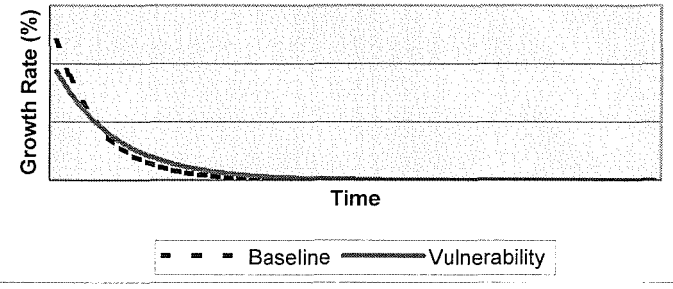


Figure 5c: Convergence of Consumption to Steady State



This is an important consideration because the more vulnerable economies are also typically more open to the international markets (albeit not necessarily to capital transactions). Capital accumulation in the economy would in this case adjust to reflect the international real rates of interest, with population growth and the rate of depreciation being endogenously determined, mainly through movements of physical

capital and population between countries. This would also contribute to render production technologies more similar between countries.

The extent of capital accumulation would then depend on the speed at which the marginal product of capital declines until it eventually reaches the level of the real interest rate on the international markets. The economies accumulating the largest amount of capital would be those with production technologies allowing for the slowest rate of fall in marginal productivity, that is, with the lowest degree of concavity in their production functions.

Thus, in the baseline model, $f'(k)$ may be equated to the real rate of interest in the economy. In the case where the capital stock, and hence its marginal productivity, is subject to exogenous shocks, it can be easily seen that the expected real interest rate can be equated to $f'(k) + 0.5f''(k)\sigma^2_\kappa$, by applying the Taylor-expansion method used in equations (10) and (10'). Denoting the real rate of interest on the international markets as r^*, the steady states in the baseline and in the model incorporating vulnerability can be derived as, respectively:

$$f'(k) = r^* \qquad (17)$$

$$f'(k) + 0.5f''(k)\sigma^2_\kappa = r^* \qquad (17')$$

By virtue of the second term on the left hand side of equation (17') being positive, the extent of capital accumulation in the model subject to vulnerability is higher than that in the baseline model, assuming identical production technologies. This confirms the result obtained earlier on in equation (15) and the intuition behind it and its major consequences have already been explained.

This result may be subject to a number of qualifications, perhaps the chief among which is the fact that the economy subject to vulnerability may require a risk premium on its real rate of interest over and above the level dictated by the international markets. This would entail a higher real rate of interest in the economy subject to vulnerability, with the consequence that capital accumulation would be lower.

Thus, different risk premia applicable to different countries may account for some of the disparity in capital accumulation and per capita output between countries facing vulnerability, if the extent of vulnerability of different countries is perceived in an asymmetric manner by the international markets. In other words, countries which are perceived to be especially vulnerable would have higher risk premia, thereby not curtailing the accumulation of capital and economic growth.

Economic Vulnerability and Resilience and Total Factor Productivity Growth

Vulnerability considerations could thus play a role in explaining observations regarding total factor productivity growth, because the latter is usually cited as the principal factor in growth theory which retards the process of convergence. It is to be noted that since the effects of vulnerability cannot be attributed clearly to the role of factor inputs within a neo-classical production function, they would fall within the nature of the residual typically defined as total factor productivity improvements in growth accounting exercises. Among the more recent and comprehensive of these is Senhadji (1999), who concluded, amongst other things that total factor productivity

growth is larger in developed rather than developing economies, and that it is more volatile in the latter. The study also observed that total factor productivity growth declines with an increase in the share of capital in output. The study also observes a very slow speed of convergence between countries at different levels of economic development.

These observations fit within the results of the economic vulnerability model obtained here. The low total factor productivity growth for underdeveloped economies can be attributed to adverse effects on their output growth of their increased susceptibility to downside shocks demonstrated in the preceding section. The more volatile total factor productivity growth of such economies is another manifestation of their increased susceptibility to shocks discussed earlier on. The lower total factor productivity growth for economies with a higher capital intensity is consistent with the results obtained pointing to an increased susceptibility to downside shocks of economies which increase their capital share in output starting from a relatively low level, as shown in Figure 1. The slow speed of convergence can also be attributed to the effects of economic vulnerability, as discussed in the preceding section.

Testable Hypotheses

The principal testable hypothesis which emerges from this work is the fact that vulnerability induces a lower consumption in steady state and in the growth path towards steady state. This hypothesis is econometrically assessed in Chapter 5 through the estimation of a consumption function based on panel data. The estimated function presented there considers the hypothesis regarding long run consumption

formulated as a result of the work presented in this chapter together with the hypotheses, to be developed in Chapter 4, regarding the short run behaviour of consumption.

Another fundamental hypothesis emerging as a conclusion of this modelling exercise is that vulnerability tends to slow down the rate of convergence between developing and developed countries. For the purposes of empirical estimation, this hypothesis may be considered as a corollary of the hypothesis concerning the long run behaviour of consumption, as it indeed stems out of it. It is thus considered that the estimation of the consumption relation to be presented in Chapter 5 encompasses this hypothesis as well.

Another possible approach towards assessing the convergence hypothesis is to follow the mainstream literature based on estimating beta- and sigma- convergence, as presented, for example, in Barro and Sala-i-Martin (1995). It is however to be considered that such approaches are relatively data-intensive in their attempts to assess conditional convergence, requiring information on aspects such as human capital and technological development. In fact, such approaches rely mainly on studying the growth paths of developed countries for which such data is relatively easily available. In the context of studying issues of vulnerability, it is essential to extend the coverage of countries to include small and less developed economies, for which such data is not available in a meaningful, comparable and consistent form. Therefore, this approach is not considered to be useful for the purposes of this study.

The Vulnerability and Resilience of Small Economies

Studies on economic vulnerability consistently show that this phenomenon is prevalent in small states. Using a vulnerability index based on the volume of trade to GDP ratio as a measure of exposure to foreign economic conditions, transport and freight costs as a percentage of exports as a proxy for remoteness and insularity, and the share of money damage caused by natural disasters in relation to GDP as an indicator of disaster proneness, Briguglio (1995) shows that out of 114 countries including both developed and developing ones, the small island states regularly show a very high vulnerability measurement. The vulnerability index proposed by the Commonwealth Secretariat (1997) composed of export diversification, export dependence and the impact of natural disasters shows that 26 out of 28 most vulnerable countries are small states.

It is interesting to categorise the characteristics of small economies that give rise to their pronounced vulnerability in terms of the extent of their exposure to exogenous shocks and their susceptibility to such shocks, in line with the model developed in this paper. The World Trade Organisation (2002) admits that there is as yet no general agreement on the definition of economic smallness because of the different facets involved in this phenomenon that may be present to different extents in different countries. In this spirit, Srinivasan (1986) proposed that an appropriate definition of smallness should take into account a variety of factors including population and total income. In spite of this, the proxy that has been most widely used in the literature as a measure of country size is population, as in for example Commonwealth Secretariat -

World Bank Joint Task Force (2000). An interesting definition by Davenport (2001) is based on a country's share in world trade.

The results of the model developed here show an increased vulnerability arising out of susceptibility to shocks for countries with a small capital to labour ratio. This could account for the heightened vulnerability of small states if such smallness is defined in terms of a scarcity of other production factors relative to labour, including physical capital, land, knowledge and technology. Definitions of small states based entirely on population size would not however fit within this explanation of vulnerability.

In view of the elusive nature of the causes of smallness, the World Trade Organisation (2002) discusses the consequences of smallness that would have a bearing on vulnerability. These include their proneness to economic and natural shocks, remoteness and isolation and an inability to reap economies of scale. The first of these clearly falls within the class of exogenous shocks contemplated in the model developed in this paper. Remoteness and isolation would merely serve as factors that compound the effects of these exogenous shocks. The inability to reap economies of scale, is not, prima facie, a factor that accounts for increased vulnerability but for lower per capita income. On the other hand, if it is viewed to be tantamount to the existence of constraints that preclude from the sufficient development of the capital stock in an economy, it would constitute a factor that increases an economy's susceptibility to exogenous shocks according to the model developed in this paper.

Indeed, it can be construed, on the basis of the microeconomic theory of production, that diminishing marginal productivity sets in at a more rapid pace in production set-

ups of a limited scale. Extending this argument, it may be concluded that small economies are more prone to diminishing marginal productivity. As is shown in this chapter, it is such proneness to diminishing marginal productivity that generates the asymmetric responses to asymmetric shocks. It can thus be concluded that small economies are more subject to the vulnerability issues as discussed in this chapter. For example, a small economy would suffer significant job losses if it experiences a disinvestment in production. However, a new investment of equal magnitude would not generate benefits to the same extent, due to, for instance, shortages in adequate labour skills.

Other Determinants of Economic Growth of Small States

Following the development of the vulnerability-based model of economic growth presented in this chapter, which would be primarily applicable to small states as they are in the main subject to vulnerability, it is useful to digress to review the principal concepts in the literature regarding the special determining factors of the growth of small states. These factors may in part be accommodated by the model presented here, or may serve as alternative explanations which in their own right may be used to explain the "vulnerability paradox". Armstrong and Read (2003) present a review of the literature regarding the determinants of economic growth of small states, highlighting the critical role played by specialisation in view of their openness to trade, geographical location in proximity of target markets, and optimal policy design.

UNCTAD (1997) finds a positive relationship between sectoral specialisation and growth in small island states. Armstrong and Read (2000) and Armstrong et al

(1998) report that economic development in small states is conditioned by the presence of a rich natural resource base and with the strength of a human-resource-based services sector which is not susceptible to economies of scale. Financial services and tourism are viewed as important sectors fuelling growth in small island states. Specialisation in production may be viewed as a way to maintain the second derivative of the production function closer to zero, by building competitive strengths in production based on approaches which do not allow marginal product to fall at a rapid pace. This concept may thus be accommodated by the model presented here and is further elaborated upon in the next chapter by means of a model which explains the endogenous development of specialisation in production in response to exposure to exogenous shocks.

Armstrong et al. (1998) and Armstrong and Read (2000) suggest that the location of small states in proximity to prosperous and dynamic markets is likely to contribute to their growth. This is a concept which was applied by Cordina and Farrugia (2005) in the adjustment proposed to the vulnerability index to allow for the strength of trading partners. Furthermore, it appears that participation in regional trading blocks by small states is a significant determinant of their economic growth. This is not a consideration which can be accounted for in an outright manner in the model developed here. However, it can be construed to be a factor which reduces the extent of inherent vulnerability and which contributes to fundamental per capita output, thereby improving economic development as explained in equation (10').

Armstrong and Read (2003) further report that the economic growth of small states is also viewed to depend significantly on the optimal design of economic policy, which is regarded as an important element of good governance, as highlighted by, amongst

others, Warrington (1994) and Briguglio (2004). This is dependent upon the local capacity for determining autonomous economic policy and the availability of the requisite human capital, both of which are often severely constrained by the economic size of small states. To some extent, this limitation may be compensated through opportunistic strategic behaviour by small states in the international economy manifested in free-riding and rent-seeking facilitated by their relative insignificance (Kakazu, 1994; Armstrong and Read, 2002). As in the case of geographical location, issues of governance cannot be explicitly accounted for in the model developed in this chapter. They can be viewed to enhance resilience and enhance fundamental per capita output, thereby improving economic development as per the terms in equation (10').

Conclusion

This chapter develops an approach towards incorporating economic vulnerability, defined as the increased proneness of certain economies to downside risks to growth, within an economic growth model framework. The motivations behind this exercise originate from conceptual and empirical considerations. From a conceptual viewpoint, it is presumed that the literature on economic growth could benefit from explicit consideration of vulnerability issues. On the other, the literature on vulnerability, which has up to now been concerned with measurement issues, could benefit from a more solid theoretical framework. From an empirical viewpoint, an explanation to the observation that certain vulnerable economies enjoy high per capita output levels is sought.

Vulnerability is modelled by means of postulating stochastic shocks to an economy's capital stock and consumption possibilities. Its effects on an economy's output and welfare are decomposed into those originating from the exogenous stochastic shocks and those attributable to the economy's specific susceptibility to such shocks. Within the context of concave utility and production functions, the susceptibility to downside shocks would be more accentuated than that to upside shocks. This is an important result of economic vulnerability. Moreover, this implies that susceptibility to downside exogenous shocks is more pronounced for economies having a relatively low per capita capital. This is because a diminution of capital stock would have more significant effects in these economies due to its relatively higher marginal productivity. Similar arguments apply for a diminution in consumption possibilities. The susceptibility to exogenous shocks initially rises with an increase in the output share of the volatile production factor but eventually falls as the rate at which its marginal productivity declines would diminish.

Steady state results indicate that the more vulnerable economy could have a higher per capita capital stock and output but a lower consumption level. Thus, the vulnerable economy saves and invests more in order to overcome the effects of exogenous shocks, with a consequent lower marginal productivity of capital. On the other hand, the steady state consumption of a vulnerable economy is lower, as more resources are devoted towards saving to overcome vulnerability. This result is considered to provide a possible explanation for the fact that a number of vulnerable economies, termed by Briguglio et al (2005) as "self-made", exhibit high levels of per capita income and saving. Among these economies, one can cite Singapore, Cyprus and Malta as major examples. Vulnerability would however still result in reduced

welfare by eroding consumption possibilities as more resources are devoted to investment. In fact, these "self-made" economies are also known to accumulate substantial savings in the form of physical and financial capital, most notably, foreign reserves, which would serve as a cushion against the effects of exogenous shocks.

Dynamic modelling results indicate that the model incorporating vulnerability exhibits the standard saddle-point equilibrium properties of the Neo-Classical growth models. However, they tend to have a lower speed of convergence to steady state. Vulnerability tends to slow down the growth rates of relatively underdeveloped economies but it tends to increase the growth of more developed ones. This occurs primarily because of differences in the way in which such economies react to their vulnerability through their saving behaviour. Economies with sufficient resources and adequate institutional structures which permit the creation of saving to face exogenous shocks would typically experience higher economic growth rates and per capita output, albeit lower per capita consumption levels. On the other hand, in the case of economies with insufficient resources or inadequate structures for saving, vulnerability would act as an additional handicap which restrains their economic development.

Thus, vulnerability can be identified as a factor that reduces the speed of convergence between economies at different states of development. It would also account for the high dispersion in income and investment levels of countries which are usually termed as being vulnerable. These results are confirmed for economies which are open to international capital flows.

The results derived in this exercise provide possible explanations for empirical observations regarding developments in total factor productivity growth and the heightened vulnerability of small economies, especially as small economies could be viewed to be more subject to diminishing marginal productivity, in view of the limited scale of their productive bases. It was also shown that economic resilience to exogenous shocks would be fully obtained in situations of endogenous growth, which would feature non-diminishing marginal productivity to accumulable factor inputs.

There are at least two possible avenues for further research building upon this exercise. First, the model utilised here could be further enriched to capture additional aspects of vulnerability, such as possible correlations between capital stock and consumption possibilities shocks, the possible persistence of shocks or of their effects over time. To further assess the vulnerability characteristics of small economies, models with more than one commodity could be considered to study the effects of excessive concentration, as well as the implications of indivisibilities in the accumulation of capital. Second, the results suggest a new conceptual framework for measuring economic vulnerability, distinguishing between the exposure of an economy to exogenous shocks and the factors that affect an economy's susceptibility to such shocks. The latter are found to be mainly a function of the size of the capital stock of the economy.

It is further recognised that there are potentially important determinants of economic growth in small states, including governance and geographical location, which fall outside of the scope of the model presented here. The principal reason why these are not treated further in this thesis is that these determinants of economic growth do not

emanate out of the concept of vulnerability, although they may contribute to vulnerability by affecting the extent to which countries would be exposed to exogenous shocks. In this context, they are regarded as exogenous factors which are not explained by the modelling exercise presented here.

Chapter 4

MODELLING THE RELATIONSHIPS BETWEEN ECONOMIC VULNERABILITY AND THE BEHAVIOUR OF AGGREGATE DEMAND

Introduction

Volatility in aggregate demand and in its components is one among the more important characteristics of small states identified in the stylised facts developed in Chapter 2. Output volatility is a phenomenon which in part reflects the short run effects of the shocks to which small states are especially prone. Therefore, the long run growth processes examined in Chapter 3 do not explain such volatility. Other important stylised facts within the realm of macroeconomic behaviour described in Chapter 2 relate to the tendency towards external current account deficits and the strong share of imports, exports and government expenditure within aggregate demand in small vulnerable states.

This chapter seeks to provide theoretical explanations to these stylized facts by identifying the implications of economic vulnerability on the short-run macroeconomic dynamics of an economy. As is the standard approach in this branch of literature, the supply side of the economy is taken to be fixed or exogenously determined and the focus is restricted exclusively to the behaviour of the components of aggregate demand, namely the sum of private household consumption, government consumption, gross fixed capital formation and exports net of imports (see for example Blanchard et al, 1989).

The study of macroeconomics is primarily concerned with the effects of market disequilibria on the dynamics of aggregate demand, as Barro (1997), amongst others, emphasizes. Indeed, it can be stated that the inception of macroeconomics may be traced to the ideas of Keynes (1936), which viewed the prolongation and propagation of the Great Depression as the result of markets failing to clear properly, leading aggregate demand to persistently fall short of potential supply. Keynes identified a number of cases of market failure.

Perhaps the most obvious is the rigidity, especially in the downward direction, of prices and particularly of wages, which contributes to unemployment by not allowing the labour market to clear properly. Another important issue concerns the possibility of disequilibrium between saving and investment, causing saving resources to remain idle rather than being productively used. This is because of the presumed low sensitivity of saving and investment to the rate of interest, which is supposed to act as the price factor which leads to their equilibrium. Under this hypothesis, saving would be primarily constrained by the availability of income, while investment would be in the main determined by business expectations. The role of the interest rate is thus relegated from the generation of saving assets to the transformation of available assets into liquid form, thus acting as the price element which clears the demand for and supply of money and bonds. An important implication of the sensitivity of saving to income is the corresponding sensitivity of consumption expenditure to income, with the well-known implication of the existence of a multiplier process, through which a shock in expenditure is subsequently boosted via further expenditure rounds to result in a final change in aggregate demand which is a multiple of the original shock.

The policy implication of Keynesian economics is that the instances of market failure which lead to deficient demand should be met by active policy intervention, mainly through the use of fiscal policy, to smoothen economic fluctuations by maintaining aggregate demand as close as possible to potential supply.

The influence of the principles of Keynesian economics was pervasive and long-lasting. It subsequently met with objections of two principal kinds. The first was that through its emphasis on aggregate demand, it was distorting the attention of researchers and policy-makers from the equally, if perhaps not more important, issues pertaining to long-term economic growth. This was met by the economic growth literature discussed in Chapter 3. Secondly, the underlying assumptions of market failure in describing macroeconomic behaviour were challenged, in that these may have applied reasonably well in periods of recession but not when aggregate demand was close to potential supply. A corollary of this is that Keynesian policy tended to be inflationary.

Macroeconomic literature in the 1970s focused on developing microeconomic foundations by studying the dynamics of aggregate demand in terms of market equilibrium and disequilibrium analysis. A turning point in this literature was constituted by the so-called rational expectations revolution, which created a paradigm whereby macroeconomic behaviour was motivated within the context of rational decision-making agents which take into account all the available information in optimizing their welfare subject to budget constraints (Lucas, 1972). This approach questioned a number of the propositions of Keynesian economics. Most importantly, the close relationship between consumption and current income was challenged by the

permanent income hypothesis. This notion devalued the importance of the multiplier concept and of the effectiveness of active policy intervention to control aggregate demand.

The debate which followed centred on the extent to which agents can be deemed to be rational, in the sense of possessing all the necessary information, particularly in the formation of expectations about the future and in the availability of the computational ability necessary to interpret and process such information. Recent empirical evidence for large developed countries by Aspergis et al (2003) appears to find support for modified versions of the rational expectations hypothesis.

This chapter builds on current mainstream approaches, based on micro foundations of macroeconomics, to the analysis of the behaviour of aggregate demand components and introduces therein the element of vulnerability, which, as discussed in Chapter 2, is mainly associated with small economies. This aim of this exercise is to assess the extent to which shocks influence macroeconomic variables, and particularly the volatility and the relative shares of expenditure components within aggregate demand. This is done by examining the behaviour of endogenous components of aggregate demand, namely household consumption expenditure and public consumption expenditure as well as imports, in the face of exogenous shocks. Such shocks can be postulated to originate from *inter alia*, the demand for exports, the terms of trade and investment expenditure.

Household Consumption Expenditure

This section develops a baseline model for consumption expenditure and assesses the implications of vulnerability as modelled through shocks to the income variable. This approach leads to a number of conclusions regarding the implications of economic vulnerability for the behaviour of household consumption and for macroeconomic policy.

The Baseline Model

The standard approach, used in the baseline model, towards the analysis of consumption underpinned by proper microeconomic foundations assumes a single representative agent deciding on consumption c_t over a period spanning 0 to T (see for example Hall, 1978). In each period, the agent earns an income y_t and can save or borrow at a real interest rate r subject to the constraint that:

$$\Sigma c_t /(1+r)^t = \Sigma y_t/(1+r)^t \quad (1)$$

where Σ denotes the summation over the period 0 to T and t is a time subscript. In order words, the total consumption over the period is limited by total income in the period, assuming for simplicity, that wealth levels at the beginning and at the end of the problem are zero. This presumes efficient capital markets where it could be possible to borrow against future income to finance current consumption. In this short run analysis, the stock of capital is assumed to be fixed and the relative productivity is reflected in y_t. The marginal productivity of capital is assumed constant at the real interest rate r, under the assumption that saving or borrowing in the short run would

not be sufficiently large as to influence the marginal productivity of capital, or that r is determined exogenously in the international capital markets. Denoting the stock of wealth (or borrowing, if negative) at time t as w_t, the consumption problem can be described as a Lagrangian dynamic optimization problem[8] as follows:

$$\text{Maximise } \Sigma\rho^t u(c_t) \qquad (2)$$

$$\text{subject to } c_t + w_{t+1} = y_t + w_t(1+r) \qquad (2')$$

$$\text{thus } \mathcal{L} = \Sigma\rho^t u(c_t) - \Sigma\lambda_t [c_t + w_{t+1} - y_t - w_t(1+r)] \qquad (3)$$

where ρ is a time discounting factor having a value between 0 and 1

$u(\cdot)$ is a utility function having standard properties

λ_t is the shadow price (utility value) of resources $y_t + w_t(1+r)$ at time t, or the Lagrangian multiplier

Equation (2) is the objective function while equation (2') is the dynamic constraint, entailing that consumption in each period and the resources at the end of that period must not exceed the resources available from income and wealth at the beginning of the period augmented by interest. Equation (3) is the Lagrangian $\mathcal{L}$ formed involving that:

$\lambda_t [c_t + w_{t+1} - y_t - w_t(1+r)] = 0$ at each t.[9]

The first order conditions required for maximisation obtained by differentiating equation (3) with respect to c_t and w_t are, respectively, as follows:

[8] Short run macroeconomic fluctuations are usually analysed by means discrete time mathematics while long run economic growth issues are typically examined by means of continuous time methods.
[9] For proofs of these methods, see, for example, Dixit (1987)

$$\lambda_t = \rho^t u'(c_t) \qquad (4)$$

$$\lambda_t = \frac{1}{(1+r)} \lambda_{t-1} \qquad (4')$$

Equation (4) shows the intuitive result that the shadow price of resources at time t is equal to the discounted value of the marginal utility from consumption. Equation (4') is the dynamic relationship for the shadow price, indicating that it would fall according to the real rate of interest in each period, which is the cost of consumption, either in opportunity terms through the returns foregone from saving, or through the cost of borrowing. Simultaneously solving (4) and (4') we obtain:

$$\frac{u'(c_t)}{u'(c_{t-1})} = \frac{1}{\rho(1+r)} \qquad (5)$$

But the left-hand side of equation (5) can be expressed as:

$$1 + \frac{\Delta u'(c_t)}{u'(c_t)} = 1 + \frac{u''(c_t)\,\Delta c_t}{u'(c_t)} \qquad (5')$$

Replacing (5') in (5), we can obtain a dynamic relationship for consumption, namely:

$$\Delta c_t = \frac{-u'(c_t)}{u''(c_t)} \{1 - 1/[\rho(1+r)]\} \qquad (6)$$

Equation (6) contains the basic results regarding the determinants of consumption growth for this model. The change in consumption basically depends upon the term $\rho(1+r)$. If the real rate of interest is higher than the time discount rate attached to the utility function, then consumption growth would be positive. In this case, the interest rate would be attractive enough, relative to the time discount rate, so as to induce saving at present thereby enabling higher consumption in future. The opposite result would of course be had if $\rho(1+r)$ were to be less than one in value, keeping in mind that the second derivative of the utility function is negative.

In practice, however, $\rho(1+r)$ is bound to have a value which is relatively close to one, implying that the change in consumption would be relatively small. This result is known as consumption smoothing. The extent of such smoothing would in turn depend on the ratio of the first derivative of the utility function to the second. This indicates the degree of concavity of the utility function, or the rate at which marginal utility would be falling. If marginal utility is falling at a fast rate, then the desire for consumption smoothing would be stronger, because the positive effect on utility of consumption increases would be smaller than those of the negative effects of consumption decreases of the same magnitude. In turn, this would be reflected in a low value for the first derivative of the utility function to the second, thereby driving the change in consumption to even lower levels, and reinforcing the consumption smoothing behaviour.

Another important result which derives from equation (6) is that changes in consumption are independent of developments in current income. This is understandable on the basis of the assumption that the representative agent can access capital markets which are operating efficiently. The only effective constraint on consumption in this case is the inter-temporal constraint in equation (1) which limits aggregate consumption over time to aggregate income, but in no way ties consumption at any point in time to income at the same time.

In order to develop this aspect further, we restrict attention to the broad class of utility functions represented by $u(c)=c^{\alpha}$, where α ranges between 0 and 1. As α approaches

0, the concavity of the function increases until the function reaches ln(c) in the limit[10]. This would indicate a strong desire for consumption smoothing. As α approaches 1, the function would approximate a linear form with non-diminishing marginal utility, such that the desire for consumption smoothing would be correspondingly weaker. Applying this form of the utility function to equation (6), we obtain:

$$\frac{\Delta c_t}{c_t} = \frac{\{1 - 1/[\rho(1+r)]\}}{1 - \alpha} \qquad (6')$$

Consumption thus has a constant rate of growth which rises with r and falls with ρ, and whose magnitude increases with α. By virtue of this,

$c_t = \gamma c_{t-1} = \gamma^t c_0$

where $\gamma = 1 + \frac{\{1 - 1/[\rho(1+r)]\}}{1 - \alpha}$ and c_0 is the initial level of consumption.

By utilising the formula for the sum of a geometric progression from period 0 to period T, equation (1), which links aggregate consumption to aggregate income from time 0 to T, can be written as:

$$c_0 \frac{(1-\gamma^T)}{(1-\gamma)} = \Sigma y_t/(1+r)^t$$

such that:

$$c_t = \frac{\gamma^t(1-\gamma)}{(1-\gamma^T)} [y_0 + y_1/(1+r) + \ldots + y_T/(1+r)^T] \qquad (7)$$

Thus, consumption at time t is a proportion, which varies as a geometric progression with t, of the sum of all income streams during the entire planning horizon, that is permanent income. The sensitivity of consumption at time t to the income flows in

[10] Chiang (1984) pg.429.

each and every time period is the same and consequently, relatively small. For example, for plausible values of the deep parameters ρ, r and α, γ would be in the neighbourhood of 1, with the marginal propensity to consume out of permanent income being positive but close to zero. Thus, the reaction of consumption to changes to contemporaneous income would be almost negligible, as the relevant determining factor is permanent income.[11]

Introducing Vulnerability into the Baseline Model of Consumption

These results from the baseline model described above, will be tested for the effects of economic vulnerability by introducing stochastic shocks in the model. This approach builds on a well-developed branch of literature, within which the main contributors were Blanchard et al (1988), Caballero (1991) and Steigerwald (1997). These contributions are primarily based on introducing shocks to the income variable, and in general conclude that this would introduce a role for precautionary saving.

Following a similar approach, we here model the effects of vulnerability on consumption in time t on the basis of the assumption that income streams starting from time t+1 to T are not known with certainty but are stochastic variables and subject to shocks and forecasting errors. In this way, the permanent income term in equation (7) can be substituted for:

$$\Sigma y_t = y_0 + y_1 + \ldots + y_t + (y_{t+1} + \psi_{t+1}) + (y_{t+2} + \psi_{t+2}) + \ldots + (y_T + \psi_T) \qquad (8)$$

[11] Indeed, as γ approaches zero, it can be shown, using L'Hopital's Rule that the marginal propensity to consume out of permanent income, and consequently out of each an every component of it, would approach T^{-1}, that is the reciprocal of the length of time period involved in the planning horizon This means that permanent income would be equally distributed into consumption in all periods.

where the ψ_t terms represent shocks with an expected value of zero and a variance $\sigma_{\psi,t+i}^2$. The variance terms can be presumed to rise with i due to the increasing uncertainty involved in forecasting income further into the future.

The expectation of the above expression for permanent income is the same as that with no stochastic elements, because the expected values of the shocks in each period is assumed to be zero. But the expected value of permanent income cannot be taken to be the correct variable which would be considered in the determination of consumption behaviour. This is because the problem is specified in terms of a limited time horizon T, where there is no guarantee that the sum of the shocks will actually be zero. This would be especially relevant for countries exposed to shocks, with the potential forecast errors increasing into the future, implying a short effective planning horizon. The relevant variable to consider in relation to future income flows is therefore the certainty equivalent of the risky expected value of income in each time period (see for example, Machina, 1987). This is the sure amount of income that would yield an equivalent level of utility to the expected future uncertain level of income.

Adopting the Taylor expansion approach as used in equation (10) in Chapter 3, the certainty equivalent of income at time t+i, or, in other words, the contribution of income at time t+i to permanent income, defined as y^p_{t+i} can be derived as:

$$y^p_{t+i} = u^{-1}(u(y_{t+i}) + 0.5\, u''(y_{t+i})\sigma_{\psi,t+i}^2) \qquad (9)$$

Equation 9 states that the contribution of the expected value of income at time t+i to permanent income is obtained as the inverse of the utility function of the utility of income at time t+i net of the product of the variability of such income and risk aversion. Risk aversion is indicated by the concavity of the utility function which in turn is reflected in its second derivative. By virtue of the negative value of the second derivative of the utility function, the certainty equivalent of future income is bound to be lower than the expected value of such income, reflecting an adjustment for risk aversion in the face of the uncertainty of future income. Identical considerations can be made for all future income expectations up to period T, with the certainty equivalent of income likely to fall further with the increase, further into the future, of uncertainty as reflected by the income variance term $\sigma_{\psi,t+i}^2$.

It can thus be concluded that the perceived permanent income under a regime of uncertain future incomes is lower than that of the baseline model, and that consumption would accordingly be lower[12]. This would imply that the discounted value of total lifetime consumption would be inferior to the discounted value of total lifetime income. The difference in consumption may be interpreted as precautionary saving to meet the effects of the expected shocks. Its results are akin to those of a capital market inefficiency which would preclude borrowing against future income. This is a result which confirms and extends the findings regarding consumption in long run equilibrium presented in Chapter 2 to a short-run dynamic model.

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[12] This can be illustrated by means of an example. Considering, for simplicity, $u(y_{t+i}) = y_{t+i}^{0.5}$ and setting $\sigma_{\psi,t+i} = 2y_{t+i}^2$, we obtain from (9):

$$y^p_{t+i}{}^{0.5} = y_{t+i}^{0.5} - 0.25y_{t+i}^{0.5}$$

which implies that $y^p_{t+i} = 0.56y_{t+i}$, that is the contribution to permanent income of income at time t+1 is 56% of its expected value.

A corollary of this is that changes in the expected value of an uncertain future income are bound to have lower effects on permanent income compared to changes in current income which are certain. Consequently, the reaction of consumption to changes in contemporaneous income will be stronger than the reactions to changes in the expected value of future income. The consumption function in equation (7) would then approximate a linear form:

$$c_t = a + by_t \qquad (10)$$

as postulated by the Keynesian absolute income hypothesis. The intercept term *a* reflects the effects of the certainty equivalent of permanent income, which would not change in the short run but may vary in the long term. This corresponds to some of the earlier explanations of the breakdown of the Keynesian consumption function from the empirical perspective[13].

The Relationship between Consumption and Current Income

The slope term *b* reflects the marginal propensity to consume out of contemporaneous income. So far, it has been shown that *b* is higher than the propensity to consume out of expected future income, which in the short run would be relatively low and is indeed assumed at 0 in equation 10. However, there is also an argument to show that *b* would be higher for economies facing vulnerability, as this would shorten the planning horizon.

From equation (7), the marginal propensity to consume out of current (and indeed all contributions to permanent) income at time t, MPC_t is:

[13] see for example Dernburg (1985) pg 80

$$MPC_t = \frac{\gamma^t(1-\gamma)}{(1-\gamma^T)} \qquad (11)$$

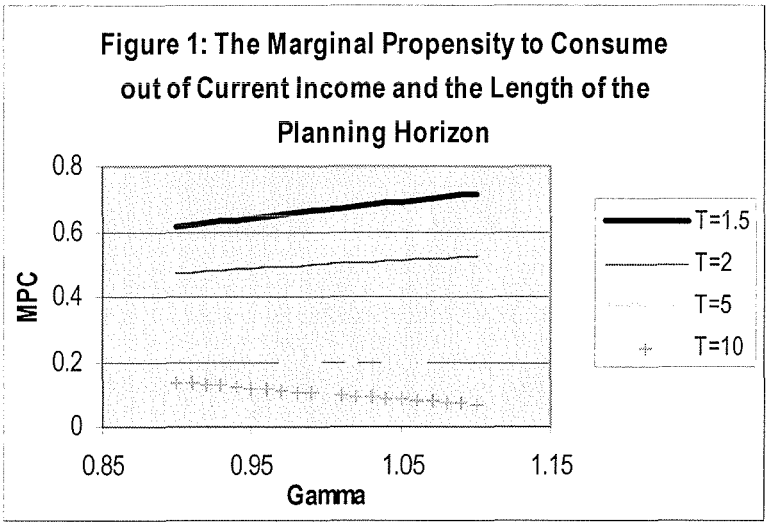
The marginal propensity to consume at time t thus depends on t itself, on γ which incorporates the effects of the consumption smoothing motive, the rate of interest and the rate of time preference and on T, the end of the planning horizon. In particular, the marginal propensity to consume at time t falls with T and with the distance between t and T. This is shown in Figure 1, which presents the results of an experiment effected to compute the value of the marginal propensity to consume assuming t = 1, γ in a range of reasonable values between 0.9 and 1.1 and T set at four indicative values between 1.5 and 10. For T=1.5[14], the values of the marginal propensity to consume range between 0.6 and 0.75. For T=10, the range stands within 0.05 and 0.15.

In the presence of vulnerability where the principal determinant of permanent income is current income, it is reasonable to assume a relatively short planning horizon. This would give rise to a relatively high marginal propensity to consume out of current income, but not to an overall higher level of consumption, which under conditions of vulnerability would be constrained by the fact that permanent income would be lower due to uncertainties surrounding future income.

It thereby follows that because of the increased sensitivity to contemporaneous income compared to the baseline model, vulnerability would give rise to a situation where the multiplier process would be relevant[15]. This would entail that exogenous shocks to aggregate expenditure would have stronger contemporaneous effects on income and expenditure, in part accounting for the volatility of income in countries

[14] These values for T are assigned purely for illustrative reasons and have no bearing in terms of time periods in practice.
[15] In its simplest form, the income multiplier is $1/(1-MPC_t)$

which are vulnerable to shocks. In other words, it is not only the shocks themselves which render income more volatile, but it is also the endogenous reaction of the economy in the presence of such shocks which ultimately magnifies their effects.



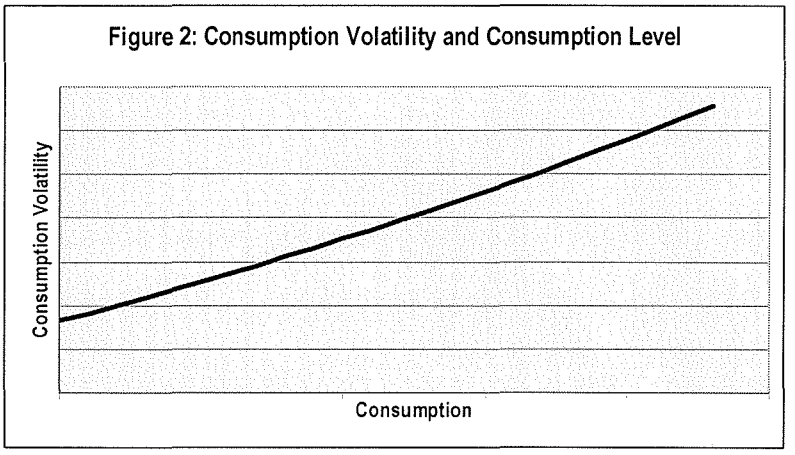
The baseline model for consumption present in equation (6) can be modified using the results from equation (14) in Chapter 3 which included the effects of exogenous shocks to consumption with variance σ^2_χ to read:

$$\Delta c_t = \eta_t \{1 - 1/[\rho(1+r)]\} \qquad (12)$$

where $\eta_t = \dfrac{-u'(c_t) - 0.5u'''(c_t)\sigma^2_\chi}{u''(c_t) + 0.5u''''(c_t)\sigma^2_\chi}$

In Chapter 3, it is discussed that this term implies a stronger degree of consumption smoothing than the corresponding term in the baseline model, and this in direct relation to the size of the variance of the shocks σ^2_χ, indicating the desire to offset the effects of shocks on utility.

Applying the standard utility form $u(c_t) = c_t^{\alpha}$, equation (12) implies that the rate of consumption growth would no longer be constant as in equation (6') but would decrease at lower levels of consumption, as shown in Figure 2. In other words, at higher levels of consumption, the consumption smoothing motive increases as the degree of asymmetry between positive and negative shocks on utility would increase.



Thus, negative shocks to consumption would induce consumption to remain relatively stable while positive shocks to consumption would lead to a lesser degree of stability in consumption. A lower degree of stability in consumption, as indicated by a higher value for γ, results in a higher marginal propensity to consume in vulnerable economies with a short planning horizon, as shown in Figure 1. It thus follows that in a vulnerable economy, a positive income shock is likely to lead to a higher marginal propensity to consume and consequently, a higher multiplier, compared to a negative income shock.

This is another manifestation of the fact that such economies are constrained in their level of consumption out of permanent income and have to rely primarily on their

current income. They would hence attempt to reach an optimum level of inter-temporal consumption in periods of temporary positive shocks but would not reduce their consumption commensurately in periods of negative shocks, in their efforts to maintain a relatively stable value for consumption or, at the least, a subsistence level. Of course, the precautionary saving which they effect by constraining their consumption below the possibilities afforded by permanent income would enable them to effect this asymmetric response to income shocks.

It follows that in the presence of symmetric shocks, aggregate demand has an asymmetric reaction, increasing more in times of positive shocks and falling by relatively less in the presence of negative shocks of the same magnitude. This runs counter to the supply-side reactions derived in Chapter 3, where negative shocks had a stronger impact on the economy's production capabilities than positive ones. The demand side reaction represents an endogenous smoothing of consumption levels in the face of constraints on the consumption out of permanent income.

Being a demand phenomenon, however, it can only be short-lived and would in the medium term be dominated by supply-side considerations (see for example Barro, 1997, Chapter 2). In the presence of both negative and positive shocks, there are factors which induce aggregate demand to exceed supply. In the presence of negative shocks, supply falls relatively strongly while demand attempts to remain relatively constant. In the presence of positive shocks, aggregate demand expansion would be relatively strong while supply growth would be mitigated. The adjustment of excessive aggregate demand pressures can take place through two mechanisms, either higher price inflation or, more likely in the case of open economies, balance of

payments outflows (Holder et al, 1985). It is thus contended that vulnerable economies, which are typically also very open economies, are more prone to suffer from adverse pressures on their external balance of payments.

Principal Results with regard to Consumption

To summarise the main conclusions of this section, the incorporation of vulnerability within the baseline model for consumption, incorporating microeconomic foundations, indicates that the unpredictability of future income renders permanent income primarily dependent on current income. The latter would thus be the main determinant of consumption expenditure. This implies that permanent income, and hence consumption, would be lower in the presence of vulnerability than otherwise, demonstrating a precautionary saving effect which is in line with the findings presented in Chapter 3. Further, it is found that the relatively short planning horizon engendered by the presence of significant shocks to income would increase the marginal propensity to consume out of current income. This would render the income multiplier process relevant for an economy facing vulnerability. Thus, it is not only the shocks which render income volatile in a vulnerable economy: the endogenous reaction of the economy itself in the presence of such shocks magnifies their effects.

Finally, the theory of diminishing marginal utility in general engenders a consumption smoothing behaviour. This implies that positive shocks to income would induce a higher marginal propensity to consume than negative shocks would. Consumers would tend to strongly resist reducing consumption in the case of negative income shocks, but would be more prone to enjoy temporary increases in consumption in the

event of windfall income gains. Hence aggregate demand would, in the presence of a positive shock, rise by more than it would fall in the wake of a negative one. As this runs counter to the supply side reactions identified in Chapter 3, vulnerability would lead economies to be prone to excess aggregate demand situations. Excess aggregate demand would lead to adverse pressures on prices in closed economies and to balance of payments pressures in the case of open ones.

Import Expenditure

Mainstream approaches within international economics view imports as the gap between the economy's expenditure and domestic output, assuming a high degree of substitutability between domestic and imported sources of supply (Krugman et al, 1988, Chapter 2). Imports are thus viewed to be generated as a residual between the economy's production capabilities and expenditure needs, without being necessarily closely related over time to either one these variables. Within a rational expectations framework featuring a smooth development in consumption, a rise in import demand could be equally occasioned by a temporary set-back in the economy's output as well as by an increase in other components of aggregate demand, such as investment and exports (Salvatore, 2001, Chapter 4).

This mainstream approach towards the behaviour of import expenditure is not generally applicable in situations of economic smallness and vulnerability. This is because small, vulnerable economies are typically highly dependent on imports in a structural manner and have very limited possibilities for import substitution (de Vries, 1973; Encontre, 1999; Grynberg, 1999; Winters et al, 2005). This section develops a

model based on the notion that import dependence is a fundamental requirement to allow economic specialisation in small states. This leads to a close relation between imports and aggregate expenditure. The analysis presented in the previous section for household consumption expenditure, in terms of the close association between consumption expenditure and aggregate demand in vulnerable economies, thus extends to imports. To an extent, this would help mitigate the effects of exogenous shocks on domestic value added by restraining the value of the income-expenditure multiplier, albeit contributing to a tendency towards deficits on the external current account.

An important corollary to this finding is that the specialisation in export activity in small states would lead to a dichotomy between domestically- and export-oriented activities. In other words, the economy would be made up of a sector which is almost completely export-oriented and of another producing non-tradeable goods and services which cannot be substituted by import expenditure. This narrow specialisation in production in each sector would potentially prevent shocks experienced in any one sector from being met by changes in activity in the other.

Imports and Specialisation

From the point of view of the structure of the economy, it can be argued that the dependence of an economy on imports is a direct consequence of specialization in key sectors of production. Such specialisation would prevent the economy from being self-sufficient in all areas of expenditure, thus requiring imports to satisfy domestic

demand. Moreover, it is likely that specialisation would require export activity in order to generate a sufficient scale of operations. It follows that the higher the degree of specialization of an economy, the larger would be the dependence of that economy on imports and exports. In this context, it is useful to recall that in the long run, an economy must be able to meet its import demand through export activity in order to be sustainable from the external balance of payments perspective. Hence, an increased dependence of imports necessarily implies an overall heightened degree of openness to international trade.

The dependence on international trade and the consequent exposure to exogenous shocks forces an economy to choose between diversification, with the attendant benefit of shocks in different sectors potentially off-setting each other, and specialisation, which would allow the development of resilience within a sector to its specific shocks. In other words, the economy would be facing a dilemma on the extent to which it is optimal to spread its risks by diversifying the range of its productive activities, given that an excessive diversification would lead to fragmentation in production, whereby each sector of activity would consequently suffer from insufficient competitiveness and lack of resilience to meet shocks. Thus, attempts at managing vulnerability through diversification between sectors could enhance the effects of vulnerabilities within sectors. This is a dilemma that is typically faced by small economies where the possibilities to exploit economies of scope and of scale simultaneously are hampered by resource constraints.

The optimisation of this trade-off can be investigated by means of a model, where, for the sake of simplicity and without loss of generality, it is assumed that production can

take place in two sectors. The objective would be to maximize the real value of output from the function:

$$Q = f_1(k_1+s_1) + f_2(K-k_1+s_2) \quad (13)$$

where Q is the total value of real output

f_i is the production function of sector i

k_1 is the expected value of the amount of resource used in sector 1

K is the total amount of resources available in the economy

s_i represents sector specific-shocks to the utilization of resources in sector i

Following the same approach as in Chapter 3, the sector-specific shocks represent shocks either to the supply side, that is the availability of resources and their cost, or to the demand side which would influence the effective utilization of resources. Within the context of a concave production function exhibiting the standard properties, this would imply that a negative shock to the resource has an effect of a larger magnitude on output than a corresponding positive shock, due to diminishing marginal productivity. This can also capture the asymmetric effects of resource allocation to shocks in output prices, in that the response of resources to a fall in output prices is likely to be more rapid and stronger than would be the case in response to a rise in output prices.

This model is thus characterised by asymmetric responses to shocks, even when the shocks are symmetric, with the effects of negative shocks dominating over those of positive ones, as implied in a standard production function. It is further assumed that each shock has an expected value of zero and a variance σ^2_i, with the covariance between shocks being ρ.

Following the approach adopted in Chapter 3 to approximate the expected value of the real total output using the Taylor expansion approach, we obtain:

$$E(Q) = f_1(k_1) + f_2(K-k_1) + 0.5f''_1(k_1)\sigma^2_1 + 0.5f''_2(K-k_1)\,\sigma^2_2 - f''_2(K-k_1)f''_1(k_1)\rho \qquad (14)$$

Equation (14) indicates that the expected output depends on the expected utilization of resources in the two productive sectors (as indicated by the first two terms on the right hand side). The variance of shocks in the two sectors however reduces the value of expected output, depending upon the magnitude of the second derivative of each production function, which indicates the extent at which marginal product is falling, and consequently, the degree of asymmetry of the effects of shocks (as indicated by the second pair of terms on the right hand side). The last term on the right hand side of equation (14) indicates that expected total output is also influenced by the covariance between the shocks in the two productive sectors.

The magnitude of the influence of the covariance on expected output depends on the product of the second derivatives in the two productive sectors, which is indicating the extent to which an increase in the resource used in each sector impacts on the marginal productivity of the other. A balanced use of resources would imply a significant impact of the covariance on expected output and vice-versa. As can be expected, this situation would impact favourably on expected output in the case that the covariance is negative, such that it would pay to diversify between the two productive activities. In the case of a positive covariance, expected output would be affected favourably if one of the second derivatives is close to zero, implying a relatively high degree of specialization.

The optimal solution to equation (14) would be found by setting the derivative with respect to k_1 to zero. The resulting expression is not algebraically tractable to derive an optimal solution of for k_1, as it involves a number of terms in the same variables with derivatives up to the third order. The solution is thus best discussed in terms of its qualitative nature.

In a model with no shocks, the optimal solution would be reached where the marginal productivity in the two productive sectors would be equal, given the implicit assumption of equal relative prices in the two sectors. The introduction of shocks in the model would call for consideration of the relative variances as well as the covariance between the two shocks. In particular, an increase in the use of k_1 would reduce the effects of shocks in sector 1 and magnify those of shocks in sector 2, as indicated by the second derivative terms involving variances. It would also impact on expected output via the covariance, tending to increase output if the covariance is positive and it is relatively already abundantly used and vice-versa.

If the covariance is zero therefore, there would be a tendency for increased specialization in the sector where shocks are stronger so as to reduce the effect of these through a reduction in the second derivative of the relative production function. In other words, specialization in the sector affected by shocks would reduce the impact of such shocks by abating the asymmetry of their effects. This result would be reinforced in the case of a positive covariance between shocks. It would tend to be mitigated in the case of a negative covariance, where the benefits of specialization would become relevant.

Import Dependence and Vulnerability

It can be therefore concluded that the effect of vulnerability in the production sectors of countries which are subject to shocks could be to introduce increased specialization rather than diversification in production. The latter effect could become relevant only in the case of significant negative covariances between shocks in different sectors of activities.

In the case of small states, it would be probable that the range of available activities would be small and perhaps somewhat related, by for example using similar inputs, thereby increasing the likelihood of the existence of positive covariances between shocks in different sectors of production. This could be reinforced by the prevalence of a narrow range of trading partners. In other words, the number of activities with negatively correlated shocks which can be undertaken in small states would be relatively few. It is therefore probable that the exposure of small economies to shocks would tend to increase their degree of specialization in production, leading them to focus on a few key sectors. The optimisation condition associated with the model (equation 14) indicates that these key sectors not be affected by a given shock in the same direction. In order to attain specialisation, a relatively high investment would be required in each key sector. This would inhibit self-sufficiency across the entire range of needs of the economy, and in turn would tend to increase their dependence on imports for servicing expenditure requirements, and on exports to maintain a sustainable balance of payments position. Specialisation in production in a few key

sectors would also imply that the output of such sectors cannot be absorbed by the relatively small domestic market, hence necessitating a focus on export activity.

Another interesting issue on the dependence of small countries on exports is that fact that the productive base in small countries is often by necessity dichotomous. Because of the small size of domestic markets, part of the productive base would be entirely export oriented, with little scope for selling in the domestic markets, while another part would service a perhaps-captive domestic market with little involvement in the export market. This renders these two distinct productive activities entirely dependent on their target markets, with virtually no possibilities of switching between domestic and export markets to mitigate the effects of shocks in each of these two. This may be an important contributor to the observed volatility in aggregate demand in small countries, where the possibilities for the productive base to switch between internal and external markets is virtually inexistent. Large countries would typically enjoy a greater degree of flexibility in this respect. Indeed, the larger countries in the world are actually relatively closed, treating their export markets as a venue where to sell their surplus production, at times also through dumping at below cost prices.

There are no precise quantitative measures of this phenomenon, although it is quite typical of small states, as documented in, for example, various contributions contained in Briguglio and Kisanga (2004). Further corroboration of this phenomenon can be obtained from the high concentration of production in a few sectors of activity in small states, as shown in Figure 13 of Chapter 2, which makes it likely the major sectors of activity would be servicing specialized export niches which would not be met by commensurate demand within the relatively small domestic markets.

Principal Results with regard to Imports

To summarise the main conclusions of this section, the consideration of vulnerability in the study of the behaviour of imports leads to the result that in small states having productive sectors exposed to exogenous shocks, there would typically be a fundamental and strong reliance on imports arising out of the need to specialize in a few and unrelated productive sectors in order to be better able to manage the effects of risks. Imports would thus be essential to undertake output and expenditure in the different sectors of activity, as these sectors would not allow the economy to achieve any degree of self-sufficiency.

Import demand would thus be conditioned by the same variables as household consumption expenditure, in addition to the effects of exogenous shocks in exports and investment. This would imply a relatively high dependence of imports on current income, to an extent attenuating the value of the income-expenditure multiplier effects prevalent in vulnerable economies. It is also however true that by virtue of the close association between imports and consumption expenditure, positive shocks to income would induce a higher marginal propensity to import than negative shocks would. This is a channel through which the proneness to adverse pressures on the balance of payments, identified in the section on household consumption expenditure, would materialise.

Government Consumption Expenditure

The economic objectives of government consumption expenditure in an economy are to improve the allocation of resources and to stabilize aggregate demand (Musgrave et al, 1989). Utility can be derived from goods and services which can be efficiently provided by the market, and from public goods and services, whose consumption is non-rival and non-excludable and which require government intervention for their efficient provision. It is in the former case that government consumption is required to play a stabilization role; in the latter case, government expenditure is needed to improve the allocation of resources.

This section develops a model of the effects of vulnerability on government expenditure by focusing on the role of government intervention aimed at smoothening the effects of shocks to private sector consumption. On the basis of the findings presented earlier on, the economy's proneness to exogenous shocks is here proxied by the extent of shocks to private consumption. Other motivations behind the nature and size of government intervention, including the provision of public goods, in economically vulnerable economies are also reviewed.

Government Consumption as a Stabiliser of Aggregate Demand

The economy allocates its resources between private and public consumption so as to maximize a social welfare function. This is subject to the constraint that over the medium term, the economy's total private and public consumption must not exceed its consumption possibilities. This constraint is not binding in single time periods, as the

economy, and especially government, can borrow to finance consumption levels higher than income levels, provided that such borrowing is repaid in the future (Barro, 1997). Ignoring, for simplicity, issues of interest rates in an inter-temporal budget constraint framework in order to focus on the stabilization and resource allocation functions of public consumption, the choice between private and public consumption in an inter-temporal setting can be modelled as follows:

$$\text{Maximise } \mathcal{L} = \Sigma\rho^{t}[u(s_t+p_t+\pi_t) + v(a_t)] - \lambda\Sigma(s_t+p_t+a_t)-y \qquad (15)$$

where $\mathcal{L}$ is an inter-temporal Lagrangian

ρ is a rate of time preference parameter

s_t is government expenditure aimed at stabilization objectives

p_t is the expected value of private sector expenditure

a_t is government expenditure aimed at improving the allocation of resources

π_t represents shocks to private sector expenditure

u() is a utility function for rival and excludable consumption

v() is a utility function for non-rival and non-excludable consumption

λ is the Lagrange multiplier, or the shadow price of the economy's aggregate consumption possibilities over time

y represents the economy's aggregate consumption possibilities over time

Equation (15) represents an inter-temporal resource-allocation problem where the economy's resources are to be allocated between private expenditure, public expenditure aimed at stabilising aggregate demand and public expenditure aimed at improving the allocation of resources, so as to maximise social welfare.

The utility functions are assumed to have standard properties, while the shocks π_t are assumed to have an expected value of zero, constant variance σ^2_π and zero auto-covariance. In the specification of the utility function, government expenditure of a stabilisation nature is considered to be complementary to private sector expenditure, while government consumption of an allocative nature is considered as a substitute to private expenditure.

Considering private sector expenditure p_t to be the residual between total consumption possibilities y and aggregate government consumption s_t+a_t, and maximising equation (15) with respect to the government expenditure variables, while assuming for simplicity that $\rho=1$, the following first-order conditions are obtained:

$$u'(s_t+p_t+\pi_t) = v'(a_t) = \lambda \qquad (16)$$

Equations (16) state that for the economy to maximize its utility, the marginal utilities for rival/excludable and non-rival/non-excludable consumption must be equal to each other at all time and must be constant over time. This implies that the role of s_t is to move in the opposite direction of π_t with the objective of maintaining a stable level of rival/excludable consumption. The consumption of a_t, consisting mainly of public goods, is optimally constant, thereby conforming to the consumption smoothing hypothesis.

Applying a Taylor-expansion to the utility function for rival/excludable consumption, we obtain the standard result:

$$u(s_t+p_t+\pi_t) = u(s_t+p_t) + 0.5u''(s_t+p_t)\,\sigma^2_\pi \qquad (17)$$

that is, utility from rival/excludable consumption is negatively affected by the extent of the variance of shocks to private consumption. This effect can be mitigated by decreasing the magnitude of the second derivative of the utility function, so as to contain the asymmetric effects of symmetric shocks on utility. But this would in turn require higher levels of rival/excludable consumption, calling for increased levels of government expenditure aimed at stabilizing this type of consumption. This result can be confirmed by substituting equation (17) into the first-order conditions (16) to obtain:

$$u'(s_t+p_t) + 0.5u'''(s_t+p_t)\,\sigma^2_{\pi} = v'(a_t) \qquad (18)$$

With the third derivative term being positive, an increase in the susceptibility of private sector expenditure to shocks, as measured by σ^2_{π}, would require a compensating drop in the marginal utility of rival/excludable expenditure. This implies an increase in consumption levels via higher government consumption aimed at stabilizing aggregate demand.

Therefore, this modelling exercise yields an important result in that it shows that economies which are subject to heightened shocks would need to rely to a higher degree on government expenditure aimed at stabilizing the effects of such shocks. In practical terms, this may imply government absorbing a relatively large share of employment in the economy so as to minimise fluctuations associated with private sector activity. It would then be likely that the economy becomes dependent on government for labour demand, and consequently it would be difficult for government to rescind this role, even in the wake of positive shocks to activity in the private sector. Alternatively, government could actually spend money on goods and services

so as to sustain demand in the private sector in the wake of negative shocks, with similar results. Such dependence on government intervention could have negative supply-side effects (Datta-Chaudhuri, 1990; Krueger, 1990; Carment, 2003), the study of which goes beyond the scope of the model presented here.

Other Motivations for Government Consumption

The literature presents other motivations behind the relatively high levels of government consumption expenditure in small states. Briguglio (2002) discusses the problem of indivisibilities, in that a number of government functions are characterized by fixed-cost overheads which would not be spread on a per capita basis in small economies to the same extent as in large economies. For instance, the construction of infrastructural projects by the public sector would tend to have higher per capita costs, and occupy a larger share of the output of small countries. Furthermore, Meilak (2004) argues that government expenditure is higher in small states because of a heightened proneness to market failure. This would arise from environmental vulnerabilities, including the relatively small land area and relatively long coastal zones, as well as from economic considerations such as the incidence of natural monopolies (Downes, 2006) and expenditure required to improve human capital so as to prevent structural unemployment from arising due to insufficient diversification of economic activities.

In each case, there would be a relatively high level of government expenditure devoted to improve the allocation of resources. This would imply relatively lower expenditure levels on rival/excludable consumption, thereby exposing to an increased

extent the economy to shocks in private consumption. Perhaps this effect is even stronger under the explanation provided by Briguglio (2002), because unlike that of Meilak (2004), it does not contemplate the existence of a utility maximizing equilibrium as per the first order conditions in equation 16. Indivisibilities represent waste and hence a deadweight loss, reducing the resources available to the public sector for the purposes of stabilising aggregate demand.

Conclusion

From the perspective of short term macroeconomic fluctuations, the stylized facts regarding the economic behaviour of small vulnerable states point to an increased volatility in aggregate demand and in its components, the persistence of external current account deficits and the strong share of imports, exports and government expenditure within aggregate demand.

This chapter develops current mainstream approaches to the analysis of the behaviour of aggregate demand components by introducing the element of vulnerability in order to derive theoretical explanations of these phenomena. The behaviour of endogenous components of aggregate demand, namely household and public consumption expenditure as well as imports, in the face of exogenous shocks to exports and investment expenditure is modelled.

The consideration of vulnerability in a standard model of household consumption based on microeconomic foundations indicates that the unpredictability of future income renders permanent income primarily dependent on current income which

would thus be the main determinant of consumption expenditure. This implies that permanent income, and hence consumption, would be lower in the presence of vulnerability, demonstrating a precautionary saving effect which is in line with the findings presented in Chapter 3, which may also be interpreted as a way to build resilience in consumption. Further, it is found that the relatively short planning horizon which would be relevant in the face of shocks to future income would increase the marginal propensity to consume out of current income. This renders the income multiplier process relevant for an economy facing vulnerability. Thus, it is not only the shocks to the exogenous expenditure components which cause heightened volatility in aggregate demand in a vulnerable economy: the endogenous reaction of the induced expenditure components in the presence of such shocks magnifies their effects.

Moreover, it is found that positive shocks to income would induce a higher marginal propensity to consume than negative shocks would. The maintenance of a low consumption level would be undertaken so as to minimise the deleterious effects of negative shocks on consumption, while not precluding from windfall gains to be enjoyed as a result of positive shocks. Hence aggregate demand would, in the presence of a positive shock, rise by more than it would fall in the wake of a negative one. As this runs counter to the supply side reactions identified in Chapter 3, vulnerability would lead to a tendency for excess aggregate demand situations, and consequently, to adverse pressures on the balance of payments in open economies.

The consideration of vulnerability in the study of the behaviour of imports leads to the conclusion that in small states having productive sectors exposed to exogenous

shocks, there would typically be a stronger reliance on imports and on exports arising out of the need to specialize in a few productive sectors in order to be better able to manage the effects of risks. The high degree of trade openness of small states is thus not only a source of vulnerability but also a result of the phenomenon as it would allow better management of the risks faced by productive sectors in their attempts to build resilience to shocks. However, export dependence could induce a dichotomy between domestic- and export-oriented production, preventing shocks in one of the sectors from being absorbed through changes in activity in the other.

Imports are thus identified to be essential to maintain expenditure activities and would therefore closely follow the behaviour of household consumption expenditure, apart from being conditioned by the effects of exogenous shocks in exports and investment. This would imply a relatively high dependence of imports on current income, with positive shocks to income inducing a higher marginal propensity to import than negative shocks would. This is the mechanism through which the proneness to adverse pressures on the balance of payments in vulnerable economies would materialise.

Finally, it is shown that economies which are subject to heightened shocks would need to rely to a higher degree on government expenditure aimed at stabilizing the effects of such shocks. There could also be a tendency for small economies to allocate a larger share of their output to public goods, due to the problem of indivisibilities and an increased proneness towards instances of market failure. This could introduce inefficiencies in resource allocation in vulnerable economies, possibly negatively affecting their resilience.

The main hypotheses established in this chapter are tested through econometric methods in Chapter 5.

Chapter 5:

AN EMPIRICAL INVESTIGATION INTO THE EFFECTS OF ECONOMIC VULNERABILITY ON MACROECONOMIC PERFORMANCE

Introduction

The aim of this chapter is to test econometrically a number of hypotheses presented in Chapters 3 and 4. These hypotheses relate to the behaviour of private and public consumption expenditure, as well as of import expenditure, in the face of economic vulnerability. Panel data is used to estimate error-correction models which would allow the derivation of short- and long-run reactions of the dependent variables to vulnerability.

The methodology employed here differs substantially from contributions to the literature aimed at empirically identifying and studying the effects of economic shocks based on time series models (see, for example, Blanchard and Quah, 1989 and Evans and Marshall, 2005). These approaches typically utilise Structural Vector-Autoregressive and related methods to identify shocks on the basis of information contained within time series data, to explain the main factors contributing to macroeconomic fluctuations in an economy over time. It is considered that these approaches are not appropriate to test the type of hypotheses specified in this thesis. This is because the hypotheses to be tested here require comparisons between different countries to identify the effects of different vulnerability levels on growth and macroeconomic performance. Thus, the appropriate approach for the purposes of

this study entails the use of panel data, to capture a cross section of countries of different sizes and different exposure to shocks.

It is also to be considered that the hypotheses tested in this thesis are backed by the theoretical modelling frameworks developed in Chapters 3 and 4. This would render a time series-based approach to econometric estimation inadequate, as structural econometric modelling is more appropriate in the case where theory allows the imposition of restrictions on equations (Fair, 1989). Furthermore, within the testing of the hypothesis specified in this study, the presence of shocks can be reasonably represented by an explanatory variable, namely a vulnerability index. It therefore does not require the presence of shocks to be identified from time series data. On the other hand, in the literature proposed by Blanchard and Quah (1989) and Evans and Marshall (2005), the identification of shocks is typically not backed by *a priori* theoretical explanations but is attempted via data-mining.

The Hypotheses to be Tested

This exercise involves econometric testing of six hypotheses, two each for private consumption, imports and government consumption expenditures. One of the hypotheses under each expenditure component relates to the short run effects of vulnerability, while the other is associated with the long run effects of the phenomenon.

With regards to private consumption expenditure, the principal hypotheses which are to be tested are the following.

Hypothesis C1: vulnerability to an extent disturbs consumption smoothing, increasing the sensitivity of consumption expenditure in the short run, due to the uncertainty which it introduces in the forecasting of future income and the consequent inability to appropriately assess permanent income – a corollary hypothesis is that vulnerability increases the responsiveness of private consumption to upside shocks relative to that to downside shocks in the short run, as households in vulnerable economies utilize temporary increases in income to approach their optimal long run smooth consumption levels.

Hypothesis C2: vulnerability reduces the ratio of consumption to income in the long run, as the effects of the shocks introduced by vulnerability are met by higher precautionary saving intended to maintain consumption on a path which is as smooth as possible in the face of exogenous shocks to income.

Hypothesis C2 is also the testable hypothesis that emerges from the modelling of long run economic growth processes in conditions of vulnerability presented in Chapter 3. The main conclusion that is derived from the incorporation of vulnerability in a Neo-Classical growth model is that vulnerability is consistent with high per capita incomes provided that it is met by increased saving and investment. Vulnerability would however still produce lower consumption in steady state, as resources are directed to overcome the shocks associated with vulnerability.

With regards to import expenditure, the principal testable hypotheses which are derived in Chapter 4 and assessed here are the following.

Hypothesis M1: vulnerability increases the sensitivity of imports to shocks in income in the short run, partly mirroring the behaviour of private consumption expenditure, and in part to allow a degree of stability in the path of output in the face of exogenous expenditure shocks.

Hypothesis M2: vulnerability increases the share of import content within an economy's expenditure, due to the need for specialization in production aimed at increasing an economy's resilience to shocks.

With regards to government consumption expenditure, the principal testable hypotheses which are derived in Chapter 4 and assessed here are the following.

Hypothesis G1: in the short run, vulnerability exacerbates the negative correlation between private and public expenditure, as government attempts to stabilize shocks in private expenditure to maintain a degree of stability in total consumption in the economy;

Hypothesis G2: in the long run, vulnerability leads to a higher proportion of government expenditure in total expenditure, reflecting the greater stabilization role which government would play in the economy, as well as the possible increased incidence of market failure and need for income redistribution induced by vulnerability and by other economic characteristics of small economies.

The Panel-Data Econometric Approach

The econometric testing of the hypotheses specified in the preceding section requires the use of panel data. As Sayrs (1989), amongst others, observes, panel data analysis permits a sophisticated type of regression analysis in both spatial and temporal

dimensions. When the data are from various sites and the time series are too short for separate time series analysis, panel data analysis may provide the only way to longitudinally analyze the data. Even if the series are long enough for separate analysis, panel data analysis provides techniques with which to examine change over time common to a particular type of cross-sectional unit. The combination of time series with cross-sections can enhance the quality and quantity of data in ways that would be impossible using only one of these two dimensions (Gujarati, 2003).

For the purposes of this study, the hypotheses set involve intra-country comparisons of their responses over time to dynamic shocks, distinguishing between short- and long-term effects of shocks depending upon the degree of vulnerability of different countries. It is thus clear that both spatial and temporal dimensions of information are required for this analysis, in this case involving time series macroeconomic data across different countries.

Yafee (2003) summarises the methods on which panel data econometrics is founded into three classes of models, namely constant coefficients model, the fixed effects and the random effects models. Constant coefficients and fixed effects models are appropriately used when differences between individual agents may be viewed as parametric shifts in the regression function itself. This approach would be reasonable when the cross-section within the data set is a reasonably exhaustive sample of the population. If this is not the case, however, differences between individual agents in the data set would have to be considered as outcomes of randomly distributed effects out of the entire population of agents. This would require the use of random effects models (Woolridge, 2002).

For the purposes of this analysis, the panel data set used covers 142 countries for which data is available from sources of the International Monetary Fund, the World Bank, and the United Nations, and which are included in the Cordina and Farrugia (2004) vulnerability index. The data thus contains a reasonably exhaustive sample, which is probably insignificantly short of a census of all the countries in the world. It is for this reason that random effects models are not considered for use in this exercise.

In turn, the choice between constant coefficients and fixed effects models depends on whether the model should reasonably allow for changes between the different elements in the cross-section and over the time series. If such an allowance is to be made, then the fixed effects class of models should be utilized, essentially entailing the inclusion of dummy variables so as to capture effects dependent on cross-sectional or time series attributes.

For the purposes of this analysis, however, the consideration of such effects is not deemed to be worthwhile. Indeed, fixed effects of a cross-sectional nature are accounted for by the inclusion of the vulnerability variable in the models, as is specified in the next section. Furthermore, there appears no reason to believe that the reactions of macroeconomic variables to vulnerability would be changing over time. Thus, no fixed effects emanating from the time series dimension would need to be accounted for.

Yaffee (2003) elaborates upon the dangers of inappropriate use of fixed effects models in panel data econometric estimation. The fixed effects models may frequently require too many dummy variables for their specification. This may result in an insufficient number of degrees of freedom for statistical testing. Moreover, a model with many dummy variables may suffer from multicollinearity, which increases standard errors and results in biased estimates. There is also the danger of cross-sectional heteroskedasticity or autocorrelation over time that would further reduce the power of statistical testing.

Thus, the estimation approach adopted in this panel-data study is based on the simplest approach, namely the constant coefficients model, known also as the pooled regression model. Thus, all the parameters characterising the error-correction models specified in the previous section are estimated by means of Ordinary Least Squares regression of pooled data, involving time series information for the different countries in the data set. To reiterate, the motivations behind this approach are three. The first is that the data set contains an exhaustively representative cross-section of countries, eliminating the need for random effects models. The second is that country-specific fixed effects are considered to be adequately represented by the vulnerability variable, not requiring the inclusion of dummy variables of this type. The third is that time-related fixed effects are not considered to be relevant to this study.

The Specification of Functional Form

The hypotheses tested in this exercise require the consideration of short- and long-run responses of macroeconomic variables to exogenous shocks over time, and an

examination of how vulnerability influences such behaviour. For the purposes of conducting the dynamic analysis, the most appropriate model to use is the error-correction model. Hamilton (1994), amongst others, presents an extensive treatment of the nature and properties of the error-correction model.

In its most basic form, an error correction model would relate an endogenous variable y_t to an exogenous variable x_t by means of the following functional specification:

$$\delta y_t = a_0 \delta x_t + a_1(y_{t-1} - b_0 - b_1 x_{t-1}) + u_t \qquad (1)$$

where u_t is a normally distributed residual term with zero expected value and constant variance, and the a and b terms are behavioural parameters in the model.

This presumes that y_t is related to x_t by means of a long run equilibrium condition:

$$y_t = b_0 + b_1 x_t + v_t \qquad (2)$$

where v_t is a normally distributed residual term with zero expected value and constant variance and the b terms are behavioural parameters determining the long run relationship between y_t and x_t. The term v_t thus represents the extent of disequilibrium of y_t at time t, and by virtue of the assumption imposed on the residual term, it is stationary such that equation (2) represents an equilibrium condition.

The error correction model shown in equation (1) thus implies that changes in y_t are determined by contemporaneous changes in x_t and by the extent of the disequilibrium

of x_t in the previous period. Thus, a_0 can be interpreted to represent the short run reaction of y_t to x_t, while a_1 represents the speed of adjustment of y_t to clear disequilibrium in the previous period. Thus, the value of a_1 would be expected to lie between 0 and -1, the latter representing the case of full adjustment towards the clearing of a previous period disequilibrium.

The statistical foundations of the error-correction model are found in the theory of co-integration. Reliable econometric estimation can only be achieved through models containing only stationary variables, in order to avoid problems of spurious correlation (Box and Jenkins, 1976). As most economic time series are non-stationary and integrated of order 1, this implies that economic data would have to be used in econometric models in a differenced form. This would result in the potential loss of useful long run information (Fuller, 1985). Long run information can however be incorporated in an econometric model through the inclusion of a co-integrating vector in an error correction model. The co-integrating vector would take the form of equation (2) provided that the residual term v_t is stationary. Following the pioneering work by Engle and Granger (1987) on the use of co-integration and error-correction models, these approaches have become standard functional forms in econometric analysis.

An element of the hypotheses being tested in this exercise relates to the possibility of asymmetric responses to symmetric shocks, as indicated in the corollary to Hypothesis C1. This can be done through the specification of a logarithmic model which estimates a non-linear function with constant elasticities, that is percentage changes, rather than constant absolute changes. Error-correction models with

logarithmic variables also tend to better capture the time series properties of macroeconomic data (Harvey, 1991). It is for these reasons that the error-correction models used in this exercise utilize variables in natural logarithms.

The Variables and the Data

The econometric testing of the hypotheses specified earlier on in this chapter requires variables of three types. The first type consists of endogenous variables, that is those variables whose behaviour is to be analysed by the models. In this case, the endogenous variables would relate to the time series behaviour of private and public consumption and of imports across different countries.

The second type of variable is required to proxy the extent of exogenous shocks taking place over time in different economies. For this purpose, it is decided to utilize the sum of exports and investment, as these variables are strongly exogenous to the economy and can be considered to be correlated to the external and internal shocks which affect an economy.

The third type of variable relates to the measurement of vulnerability. As vulnerability emanates from inherent features of a country, this is a variable which changes across countries but not over time. For the purposes of this analysis, vulnerability is being proxied by the index proposed by Cordina and Farrugia (2005). The principal motivating factor behind this choice is the fact that this index provides the most extensive coverage of countries out of all available indexes. As Table 3 in Chapter 2 indicates, the Cordina and Farrugia (2005) index covers 175 countries. This factor is

crucial in simplifying the undertaking of panel data econometric estimation, as discussed earlier on. The use of this index is permitted by the fact that conceptually, it is essentially a refinement on mainstream vulnerability indexes, such as Briguglio (1997), by considering, apart from the usual variables, the relative vulnerabilities of trading partners. As discussed in Chapter 2, although the Briguglio (1997) index is probably the most representative of the various strands of work done in this area, the Cordina and Farrugia (2005) index also produces conclusions which are akin to those inherent in mainstream vulnerability indexes, in terms of the increased incidence of vulnerability in small and island states. Thus, the index may be considered to be representative of vulnerability studies, with the advantage that it covers the most extensive range of countries.

In this context, the econometric estimation strategy could consider the utilisation of different vulnerability indices in order to assess the consistency of the results. This approach may be conceptually appealing, although the degree of correlation between different indices, as discussed in Chapter 2, would suggest that *a priori*, significant differences between estimation results using different indices are not to be expected. More importantly however is the issue that the practical relevance of such an exercise would be marred by the fact that the different vulnerability indices cover different sets of countries, which vary not only in number but also in their characteristics, as discussed in Chapter 2. It may thus be concluded that a comparison of estimation results based on different vulnerability indices cannot be meaningfully undertaken. The approach adopted here is to use the index with the widest coverage of countries and data so as to maximise the information content in the regression analyses. The

index used furthermore presents a reasonable degree of correlation with other indexes of vulnerability.

It is relevant to point out that economic resilience is not construed to be relevant for inclusion as an explanatory variable for the purposes of the hypotheses being tested. As argued in Chapter 2, resilience could attenuate the effects of inherent vulnerability. However, resilience would arise out of appropriate policy orientations and behavioural patterns in consumption, imports and government expenditure amongst other variables. Thus resilience would be explained by, rather than explain, developments in the dependent variables in the models developed in this chapter. Hence, the causal relationships being envisaged here run from vulnerability to policy and macroeconomic behaviour to resilience.

The final data set is made up of a balanced panel with 11 years of data for 142 countries for which all the data required for analysis was available. The sample of 142 countries used is considered to be sufficiently representative of the entire population of countries so as to eliminate the need for random effects models in panel data econometric estimation, as discussed earlier on. The sample represents around two-thirds of the countries in the world, representing around 95% of world GDP and just under 95% of the world population. While the sample is constructed to be as representative as possible, it contains an unavoidable bias against countries for which the required data set is not available. These are mainly very small, underdeveloped economies.

It is possible to conduct panel data analysis with a different time series coverage for different elements in this cross-section, but this would introduce complications in estimation associated with an unbalanced data set (see for example, Davidson and McKinnon, 1993) which are better avoided. It is for this reason that the time series coverage starts in 1992 and is stopped in 2002. Data within this time range is available for all countries in the data set. The sources and characteristics of the data used in this exercise are similar to that used in deriving stylized facts in Chapter 2. The data file and detailed model estimation results are appended in CD-ROM.

It is furthermore to be pointed that the data used is by no means guaranteed to be strictly comparable and of homogenous quality. The results reported here are likely to be conditioned by this unavoidable drawback.

The Equation for Household Consumption Expenditure

The model for private consumption expenditure is intended to test the principal hypotheses that vulnerability induces an increased sensitivity of consumption to income shocks (Hypothesis C1) and creates a more important role for precautionary saving (Hypothesis C2). The sensitivity of consumption to income shocks is viewed as a short run phenomenon, as the shocks themselves would be of a short run nature and because in the long run, consumption behaviour would tend to approximate more the patterns indicated by the permanent income hypothesis which entails consumption smoothing. The role of precautionary saving is a long run issue, whereby the level of long run consumption would be lower so as to generate savings necessary to meet

short run income shocks, particularly of an adverse nature. These hypotheses may be represented by the following error-correction model:

$$\delta \ln(c_{i,t}) = (a_1 + a_2 v_i)\delta \ln(y_{i,t}) + a_3[\ln(c_{i,t-1}) - b_0 - b_1 \ln(y_{i,t-1}) - b_2 \ln(v_i)] + u_{i,t} \quad (3)$$

where i and t represent country and time subscripts respectively

ln represents the natural log

$c_{i,t}$ represents private consumption expenditure of country i at time t

$y_{i,t}$ represents the sum of expenditures on investment and exports of country i at time t

v_i represents the vulnerability score of country i

$u_{i,t}$ is a residual term

The variable $y_{i,t}$ represents the effects of exogenous shocks influencing country i at time t. As such, on a country by country basis, the model is akin to a reduced form equation relating consumption expenditure to exogenous investment and export expenditure. This would tend to address problems associated with simultaneity bias which may arise in the estimation of macroeconomic consumption functions (Gujurati, 2003). The variable v_i represents inherent characteristics of country i which are - by virtue of the definition of vulnerability - construed to be time invariant (Briguglio, 2004), at least for the time frame included in the sample. The vulnerability score is a standardized variable with values ranging from 0 to 1, with these polar values representing the least and most vulnerable countries in the world respectively.

The model postulated in equation (3) states that growth in consumption, $\delta \ln(c_{i,t})$, is in the short run affected by the percentage changes in the variables constituting

exogenous shocks to the economy, $\delta \ln(y_{i,t})$. The base short-run elasticity to these shocks is a_1, which may however be influenced by vulnerability through the $a_2 v_i$ term. From an *a priori* perspective the elasticity a_1 is expected to have a value between 0 and 1. A value 0 represents a situation of smooth consumption which is not responsive to short run shocks, as would be predicted by the permanent income hypothesis. A value of 1 represents a situation where short run shocks dominate movements in consumption. According to Hypothesis C1, the elasticity a_2 is expected to have a positive value, as vulnerability would increase the sensitivity of consumption to short run shocks.

The term in squared brackets represents the extent of disequilibrium of consumption from its long term relationship. In the long term, consumption is presumed to depend on the level of exogenous expenditures, which are here used as instrumental variables of permanent income, with an elasticity b_1. *A priori*, the elasticity term b_1 can be presumed to approximate the value of 1, because consumption cannot in the long run deviate substantially from a constant ratio to other expenditure components in the economy. The other important influence on long run consumption presumed in this model is vulnerability, through the elasticity b_2. According to Hypothesis C2, the elasticity b_2 is expected to have a negative value, as vulnerability would decrease the level of consumption by inducing a precautionary saving motive.

The term a_3 represents the speed of adjustment of consumption expenditure to clear a previous period disequilibrium of the variable from its long run relationship. By virtue of the definition of this variable within an error correction model, its value is *a priori* expected to lie between 0 and -1, representing polar situations of no and total clearing

of disequilibrium respectively. To the extent that the short-run effects tend to dominate in the equation, the speed of adjustment to long run equilibrium would be expected to be lower.

The parameter b_0 represents a scaling effect between consumption and the other variables in the long term relationship. It has no useful economic interpretation and is therefore not discussed further.

The parameters of the model shown in equation (3) were estimated using the Ordinary Least Squares Procedure, in line with the pooled regression approach in panel data analysis. Initial estimates showed that the parameters a_1 is not significantly different from zero. This means that the base short run response of consumption to expenditure shocks, before introducing the effects of vulnerability, is inexistent. The model was re-estimated excluding the a_1 term, giving results as shown in Table 1.

Table 1: Results of the Consumption Expenditure Model

Parameter	Estimate	t-statistic	p-value
a_2	0.164	5.14	0.000
a_3	-0.014	-2.87	0.004
b_1	0.926	2.95	0.003
b_2	-0.706	-1.83	0.072

r-bar squared: 0.024 F-statistic: 10.03 (p-value: 0.000)
Durbin-Watson: 1.95 (5% critical value: 1.73-1.81)
Augmented Dickey-Fuller test for long run equation: -10.81 (95% critical value: -2.86)
Augmented Dickey-Fuller test for error correction model: -27.76 (95% critical value: -2.86)

The a_2 parameter, indicating the effect which vulnerability exercises on the short run reaction of consumption to exogenous shocks, has a value of 0.164. This implies that whereas countries with a zero vulnerability would exhibit no significant response of consumption to short term shocks, countries with a vulnerability score of 1 experience an elasticity of 0.164 in this respect. This indicates that the higher the vulnerability

score of a country, the more relevant would short run multiplier effects become. As the elasticity value increases with vulnerability, the responses of consumption to positive relative to negative symmetric shocks would also rise, increasing the multiplier in the upward direction relative to that in the downward direction. These findings are in conformity with Hypothesis C1. A corollary implication is that because the multiplier becomes more relevant under conditions of vulnerability, the observed volatility in consumption expenditure in vulnerable economies cannot be attributed solely to their inherent exposure to shocks but also to the endogenous reactions of vulnerable economies to such shocks.

It is however observed that the estimated elasticity, though strongly statistically significant at the 5% level, is not of a large magnitude. Although vulnerability renders consumption more responsive to short term shocks, such a response remains inelastic even for the most vulnerable countries in the world. This is a finding which may be challenged through the use of proxies of exogenous shocks other than that used in the estimation of this model.

The a_3 parameter, indicating the speed of adjustment of consumption expenditure to its long run equilibrium condition, is statistically significant but small, at -0.014.

The b_1 parameter, indicating the long run ratio of consumption to the proxy for permanent income has an acceptable value close to unity and is statistically significant. Furthermore, consumption expenditure is found to be affected by vulnerability in the long run. The value of -0.702 found for the elasticity b_2, which is almost significant at the 93% level, implies that the consumption to exogenous

expenditure ratio is reduced by 0.5 (50 percentage points) in the case of a country with a vulnerability score of 1 relative to a country with a vulnerability score of zero[16].

The diagnostic statistics show a relatively low r-bar squared statistic, at 0.024. While it would have been desirable to obtain a higher value for the adjusted coefficient of correlation, this result is typical of error-correction models which are not affected by the problem of spurious correlation. The estimated relationship can however be interpreted to be overall significant, as indicated by the value of the F-statistic, which is significant at a confidence level of almost 100%.

Furthermore, the existence of the postulated long term relationship, or cointegrating vector, is confirmed through the high significance level of the Augmented Dickey-Fuller test statistic for the long run equation. The Augmented Dickey-Fuller test is also significant for the error-correction model, indicating that the relative residual is stationary, and thus free of heteroskedasticity. The value obtained for the Durbin-Watson statistic rejects the hypothesis of autocorrelation in the residual term of the error-correction model.

The Equation for Import Expenditure

The model for import expenditure is formulated to assess the hypotheses that vulnerability increases the sensitivity of imports to shocks in other expenditure components in the short run (Hypothesis M1) and that vulnerability increases the

[16] This result is derived by taking the antilog of the elasticity value.

equilibrium share of import content within an economy's expenditure (Hypothesis M2). The postulated increased sensitivity of import expenditure to shocks induced by vulnerability is by definition a short-run phenomenon, describing the behaviour of the dependent variable in response to temporary effects. It partly mirrors the behaviour of private consumption expenditure and it also allows a degree of stability in the path of private consumption expenditure in the face of shocks to domestic output. The higher import content within expenditure induced by vulnerability is a concept which is relevantly assessed as a long run equilibrium phenomenon, and reflects the need for specialization in production aimed at increasing an economy's resilience to shocks. These hypotheses may be represented by the following error-correction model:

$$\delta \ln(m_{i,t}) = (a_1 + a_2 v_i)\delta \ln(y_{i,t}) + a_3[\ln(m_{i,t-1}) - \ln(y_{i,t-1}) - b_0 - b_2 \ln(v_i)] + u_{i,t} \quad (4)$$

where i and t represent country and time subscripts respectively

ln represents the natural log

$m_{i,t}$ represents import expenditure of country i at time t

$y_{i,t}$ represents the sum of expenditures on investment and exports of country i at time t

v_i represents the vulnerability score of country i

$u_{i,t}$ is a residual term

As explained in the previous section, the variable $y_{i,t}$ represents the effects of exogenous shocks influencing country i at time t and v_i represents time invariant vulnerability characteristics of country i.

The import function specified in equation (4) is similar in structure to the consumption equation in equation (3) and may thus be considered as a reduced-form model for imports when viewed from a country-by-country perspective. Growth in imports, $\delta\ln(m_{i,t})$, is in the short run affected by the percentage changes in the variables constituting exogenous shocks to the economy, $\delta\ln(y_{i,t})$. The base short-run elasticity to these shocks is a_1, which may however be influenced by vulnerability through the $a_2 v_i$ term.

From an *a priori* perspective the elasticity a_1 is expected to have a value between 0 and 1. A value 0 represents a situation where imports are is not responsive to short run expenditure shocks. According to Hypothesis M1, the elasticity a_2 is expected to have a positive value, as vulnerability would increase the sensitivity of imports to short run shocks.

The term in squared brackets represents the extent of disequilibrium of import expenditure from its long term relationship. In equilibrium, import expenditure is presumed to depend on the level of exogenous expenditures, which are here used as instrumental variables of total expenditure in the economy, with an imposed elasticity of 1. This assumption is made a *priori* because in equilibrium, the import content of total expenditure can be presumed to be independent of the level of expenditure itself. The other important long run influence on import expenditure in this model is vulnerability, through the elasticity b_2. According to Hypothesis M2, the elasticity b_2 is expected to have a positive value, as vulnerability would increase the share of imports in total expenditure.

The term a_3 represents the speed of adjustment of import expenditure to clear a previous period disequilibrium of the variable from its long run relationship while b_0 represents a scaling effect. The interpretations of values for these parameters are explained in the previous section.

The parameters of the model shown in equation (4) were estimated using the Ordinary Least Squares Procedure, in line with the pooled regression approach in panel data analysis, giving results as shown in Table 2 (with the scaling parameter b_0 being found to be not significantly different from zero).

Table 2: Results of the Import Expenditure Model

Parameter	Estimate	t-statistic	p-value
a_1	0.876	22.52	0.000
a_2	0.101	3.41	0.001
a_3	-0.080	-9.08	0.000
b_2	0.122	1.75	0.081

r-bar squared: 0.482 F-statistic: 378.8 (p-value: 0.000)
Durbin-Watson: 1.90 (5% critical value: 1.73-1.81)
Augmented Dickey-Fuller test for long run equation: -11.71 (95% critical value: -2.86)
Augmented Dickey-Fuller test for error correction model: -29.74 (95% critical value: -2.86)

The a_1 parameter indicates that on average for the countries in the sample for the time period in the database, a 1% shock to autonomous expenditure components is met by a 0.88% change in import expenditure. This sensitivity is enhanced by vulnerability. The a_2 parameter, indicating the effect which vulnerability exercises on the short run reaction of imports to exogenous shocks, has a value of 0.1. This implies that countries with a polar vulnerability score of 1 experience a total short run elasticity of imports with respect to expenditure shocks of almost 1. These effects are relatively strong and found to be statistically significant.

As discussed in the section on consumption expenditure, the higher the vulnerability score of a country, the more relevant would short run multiplier effects become. But it

is here being found that higher vulnerability would also accentuate the marginal propensity to import in the short run, tending to overall dampen the value of domestically-induced multiplier effects, leading changes in aggregate demand to be reflected in the external account of the economy.

As the import elasticity value increases with vulnerability to a value quite close to unity, the responses of imports to positive relative to negative symmetric shocks would also rise. For a less vulnerable economy, the marginal propensity to import is lower in the upper than in the downward direction. Downward shocks would be met by lower imports but upward shocks of the same magnitude result in a proportionately lower increase in imports. For the more vulnerable economy, the marginal propensity to import is almost symmetric, giving no alleviation to balance of payments pressures in the case of upward shocks. The frequent unavoidable reliance on fixed exchange rate systems by vulnerable economies removes a potential channel for the alleviation of balance of payments pressures through a rapid adjustment of relative international prices via nominal exchange rate movements.

The a_3 parameter, indicating the speed of adjustment of import expenditure to its long run equilibrium condition, is statistically significant and acceptable, at -0.08.

In the long run, the ratio of imports to exogenous expenditure is found to be significantly affected by vulnerability. The value of 0.122 found for the elasticity b_2, which is significant at the 92% level, implies that the ratio of imports to exogenous expenditure increases by 1.13 (113 percentage points) in the case of a country with a vulnerability score of 1 relative to that of a country with a vulnerability score of zero.

Diagnostic results for the model for imports show a high degree of significance of the estimated relationship. As in the consumption model, the existence of the estimated long run cointegrating vector is confirmed through the high significance level of the Augmented Dickey-Fuller test statistic for the long run equation. The absence of heteroskedasticity and autocorrelation in the residual term of the error-correction model is confirmed through the values obtained for the relative Augmented Dickey-Fuller test and Durbin-Watson statistic.

The Equation for Government Consumption Expenditure

The model for government consumption expenditure is specified to assess the hypotheses the vulnerability creates a greater role for public expenditure to stabilize short-run shocks in private expenditure (Hypothesis G1) and that in equilibrium, vulnerability leads to a higher proportion of government expenditure in total expenditure (Hypothesis G2). The first of these hypotheses reflects the objective of maintaining a degree of stability in total consumption in the economy in the face of shocks, which by their very nature are a short run phenomenon. The second hypothesis emanates out of the enhanced role which, in equilibrium, government would need to play in a vulnerable economy so as to fulfil its functions relating to aggregate demand stabilization, improvement in the allocation of resources and income redistribution. These hypotheses may be represented by the following error-correction model:

$$\delta \ln(g_{i,t}) = (a_1 + a_2 v_i)\delta \ln(c_{i,t}) + a_3[\ln(g_{i,t-1}) - b_0 - b_1 \ln(c_{i,t-1}) - b_2 \ln(v_i)] + u_{i,t} \quad (5)$$

where i and t represent country and time subscripts respectively

ln represents the natural log

$g_{i,t}$ represents government expenditure of country i at time t

$c_{i,t}$ represents private consumption expenditure of country i at time t

v_i represents the time invariant vulnerability score of country i

$u_{i,t}$ is a residual term

The model for government expenditure specified in equation (5) differs in an important aspect from those of private consumption expenditure and imports described in the preceding sections. The latter models are based on the premise that the dependent variables respond to exogenous shocks. The model for government expenditure, on the other hand, is based on the fact that the dependent variable adjusts to smoothen shocks in the endogenous private consumption expenditure variable in the short run. In the long run, a stable ratio of public to private consumption is postulated.

Thus, the growth in government expenditure, $\delta \ln(g_{i,t})$, is in the short run affected by the growth in private consumption expenditure, $\delta \ln(c_{i,t})$. The base short-run elasticity to these shocks is a_1, which may however be influenced by vulnerability through the $a_2 v_i$ term.

From an *a priori* perspective the elasticity a_1 is expected to have a negative value, as government expenditure is used to offset shocks in private consumption expenditure. According to Hypothesis G1, the elasticity a_2 is also expected to have a negative

value, as vulnerability would increase the need for government to stabilize the economy against shocks.

The term in squared brackets represents the extent of disequilibrium of government expenditure from its long term relationship. In equilibrium, government expenditure is presumed to follow the development of private consumption expenditure, with the parameter b_1 thus being expected to approach the value of 1. The relative ratio between public and private consumption is presumed to depend upon the vulnerability of the economy. According to Hypothesis G2, the elasticity b_2 is expected to have a positive value, as vulnerability would increase the share of government expenditure to private consumption expenditure.

The term a_3 represents the speed of adjustment of government expenditure to clear a previous period disequilibrium of the variable from its long run relationship while b_0 represents a scaling effect. The interpretations of values for these parameters are explained earlier on.

The parameters of the model shown in equation (5) were estimated using the Ordinary Least Squares Procedure, in line with the pooled regression approach in panel data analysis, giving results as shown in Table 3 (with the scaling parameter b_0 being found to be not significantly different from zero).

Table 3: Results of the Government Expenditure Model

Parameter	Estimate	t-statistic	p-value
a_1	-0.214	-2.46	0.014
a_2	-0.223	-3.10	0.002
a_3	-0.022	-3.59	0.000
b_1	0.959	3.14	0.002
b_2	0.493	1.44	0.170

r-bar squared: 0.014 F-statistic: 5.04 (p-value: 0.000)
Durbin-Watson: 1.961 (5% critical value: 1.73-1.81)
Augmented Dickey-Fuller test for long run equation: -9.83 (critical value: -2.86)
Augmented Dickey-Fuller test for error correction model: -26.75 (critical value: 2.86)

The estimate for the a_1 parameter indicates that the information contained in the dataset confirms the fact that government expenditure tends to be used counter-cyclically in trying to stabilize against shocks to private consumption expenditure. However, such stabilization is far from complete, as a 1% shock to private consumption expenditure is met by an opposite adjustment in government expenditure of the order of 0.21%. Also as expected, this sensitivity is enhanced by vulnerability. The a_2 parameter, indicating the effect which vulnerability exercises on the short run reaction of government expenditure to private consumption shocks, has a value of -0.223. This implies that in countries with a polar vulnerability score of 1 the role of government expenditure in clearing short run shocks to private consumption is around double that in countries with a vulnerability of zero. All these effects are found to be statistically significant.

The a_3 parameter, indicating the speed of adjustment of government expenditure to its long run equilibrium condition, is statistically significant though somewhat low, at -0.022.

In the long run, the ratio of government consumption to private consumption is found to be almost stable, with the elasticity between these two variables at 0.959 and

indeed not far from unity. The value of 0.493 found for the elasticity b_2, implies that the ratio of government to private consumption expenditure increases by 1.63 (163 percentage points) in the case of a country with a vulnerability score of 1 relative to that of a country with a vulnerability score of zero. It is however to be noted that this estimate is only significant at the 83% level of confidence, and cannot be therefore construed to constitute strong evidence in favour of Hypothesis G2.

As with the model for private consumption expenditure, diagnostic tests indicate a low value for the adjusted coefficient of correlation but a high significance level for the F-statistic, the latter indicating that the estimated relationship is overall significant. The values obtained for the Augmented Dickey-Fuller tests confirm the existence of the postulated long run relationship and the absence of heteroskedasticity from the residual in the error-correction model. The Durbin-Watson statistic indicates the absence of autocorrelation from the residual in the error-correction model.

Conclusion

This chapter presents econometric analyses of a number of theoretical hypotheses on the macroeconomic dynamics of vulnerable economies which are developed in earlier chapters. These hypotheses relate to the short- and long-run behaviour of private and government consumption expenditure, as well as of import expenditure, and focus on the way in which vulnerability influences an economy's reaction to short term shocks. A pooling regression panel data approach is used to test the hypotheses, utilising data spanning 11 years until 2002 for 142 countries. An error-correction model specification is used in order to distinguish between short- and long-run effects as

postulated by theory, and to obtain a measure of estimation robustness which is usually associated with this kind of model. This however does not compensate for problems in the data, which, as stated above, may not be strictly comparable or of homogenous quality between countries and over time. The results reported here are thus to be viewed in the light of this unavoidable limitation.

Estimation results appear to indicate that vulnerability generates a positive response of consumption expenditure to exogenous expenditure shocks in the short run. Thus, vulnerability enhances the short-run multiplier effects on aggregate demand in an economy. As explained in Chapter 4, this would be due to the uncertainty which vulnerability introduces in the forecasting of future income and the consequent inability to appropriately assess permanent income, thereby disturbing optimal consumption smoothing. This would confirm that the observed volatility in consumption expenditure in vulnerable economies cannot be attributed solely to their inherent exposure to shocks but also to the endogenous reactions of vulnerable economies to such shocks. The corollary hypothesis that vulnerability tends to increase the strength of upward multiplier effects relative to downward ones appears to be also borne out by the estimation results. These effects, though statistically significant, are not of a large magnitude such that the short-run response of consumption to exogenous shocks is found to be inelastic even for the most vulnerable countries. This is a finding which may potentially be altered through the use of proxies of exogenous shocks other than that used in the estimation of this model. The estimated model for private consumption expenditure also produces evidence for the hypothesis that vulnerability reduces the ratio of consumption to income in the long run by inducing higher precautionary saving.

Estimation results for the import expenditure model indicate that vulnerability enhances the short run sensitivity of imports to expenditure shocks. This is explained in terms of the increased sensitivity of consumption expenditure to such shocks. Furthermore, it would allow a degree of output stability if such shocks are met by corresponding movements in imports rather than being allowed to be more strongly reflected in changes in domestic value added. It would thereby follow that the increased relevance of aggregate demand multiplier effects in vulnerable economies would be more likely to translate into balance of payments pressures. The import expenditure model produces evidence in favour of the hypothesis that vulnerability increases the import content of exogenous expenditure, reflecting an endogenous reaction of the economy to reduce its vulnerability by specialization in production.

Estimation results for the government expenditure model confirm the hypothesis that in vulnerable economies, government expenditure plays a stronger role in stabilizing fluctuations in private consumption expenditure. The hypothesis that in the long run, the ratio of government expenditure to other expenditure is higher in vulnerable economies does not find a statistically significant corroboration in the estimation results.

Overall, estimation results appear to indicate that economic vulnerability tends to render the short-term multiplier process more relevant in an economy, thereby amplifying the effects of exogenous shocks in terms of the resulting volatility in endogenous expenditure components. Results also indicate that these multiplier effects tend to be asymmetric and would be more likely to result in balance of

payments pressures, also in view of the dependence of vulnerable economies on imports and their reliance on fixed exchange rate regimes. Econometric analysis also reveals a greater role of fiscal policy stabilization in a vulnerable economy, but there is only weak evidence in favour of the hypothesis of a more significant share of government expenditure in the economy.

Chapter 6:

CONCLUSION

This chapter synthesises the principal findings of the theoretical and empirical research work presented in this thesis, and derives therefrom a number of practical implications and avenues for further research. At this juncture, it is worthwhile to reiterate that the subject area of this study, namely the effects of vulnerability and resilience on macroeconomic behaviour, is still an incipient one. The conclusions and results derived from this research work, albeit based on rigorous economic and econometric analysis, are therefore at this stage deemed to be tentative and indicative in nature, to be verified and extended by further work within this field of study. It is however considered that the results obtained from this research have sufficient weight to constitute an element of the foundation for a reassessment of the thinking regarding the conceptualisation and building of formal economic and econometric models of small vulnerable economies.

Objectives and Research Hypotheses

The main objectives of this thesis are to formalise the concepts of vulnerability and resilience, which are typically associated with small island states, within mainstream theoretical economic models of economic growth and macroeconomic dynamics and to empirically test the results therefrom. The research hypotheses underlying the study are that vulnerability and resilience have important implications for the growth patterns and the macroeconomic dynamics of small states. Consequently, the analysis

of growth and macroeconomic behaviour of small states should take into account issues of vulnerability and resilience.

Stylised Facts

Towards obtaining a better understanding of the conditions characterizing vulnerable economies, which would then form the basis of further theoretical and empirical modelling, a number of stylized facts regarding the dynamics of growth and macroeconomic fluctuations of vulnerable economies were established. These were based on findings from the literature and on an analysis of available statistical indicators. This is a typical initial step in the conceptualization of theoretical economic models.

First and foremost, it was established that vulnerability, that is the proneness to exogenous shocks, is a relevant concept especially for small island states. It is recognised that small island states have other special characteristics which impinge on their economic development but that may not be strictly related to vulnerability. These issues however fall outside the scope of this study.

With regards to the stylized facts concerning economic growth, it was shown that small vulnerable states on average do not exhibit low per capita income when compared to the rest of the world. However, small states were observed to have greater cross-sectional dispersions in per capita incomes as well as higher fluctuations in growth rates within individual economies over time. It was also observed that vulnerable economies tend to invest a larger share of their output, but this does not, in

general, lead to perceptibly higher rates of economic growth compared to less vulnerable countries. This possibly indicates that such investment may be counteracting the effects of inherent disadvantages brought about by vulnerability.

With regards to the stylized facts concerning short run macroeconomic fluctuations, it was observed that small vulnerable states experience larger fluctuations in the growth rates of aggregate demand and its components over time. This is in part a result of shocks to the exogenous components of aggregate demand, such as exports. However, it was observed that the endogenous components of aggregate demand, such as consumption expenditure and imports, are even more volatile than the exogenous ones, suggesting that their volatility is compounded by the internal workings of the economy.

Another important stylized fact concerning small vulnerable economies is their dependence on external trade, caused primarily by their specialization in a limited number of productive activities. Furthermore, small vulnerable economies tend to experience more persistent deficits on their external current account.

It was also observed that small vulnerable economies depend to a greater extent on government expenditure. This may be attributed to indivisibilities in government functions and a higher incidence of market failure. However, there is no marked tendency for small vulnerable economies to have higher fiscal deficits, indicating that fiscal policy is not a likely source of the observed volatility in aggregate demand in small states.

Finally, it was shown that unemployment rates tend to be higher and more volatile in small states. However, there are no marked differences in the patterns of price inflation between small and large states. This is in part attributable to the prevalence of fixed exchange rate regimes in small states.

A number of these observations call for more in-depth theoretical analysis and empirical testing.

A Theoretical Model of Vulnerability and Long-Term Economic Growth

In order to explain the stylized facts concerning economic growth, presented above, the thesis develops a theoretical model which incorporates economic vulnerability within a neo-classical economic growth modelling framework. This approach allows for the consideration of two fundamental factors associated with vulnerability. The first is that the effects of vulnerability on an economy's output and welfare can be decomposed into (a) those originating from exogenous stochastic shocks and (b) those attributable to the economy's specific susceptibility to the effects of such shocks, which is dependent on the economy's resilience. The second is that the susceptibility to downside shocks would be more accentuated than that to upside shocks of equal magnitude. This result was obtained through the use of standard concave utility and production functions featuring diminishing marginal utility and product respectively.

This approach yielded a number of results. Firstly, it was shown that it is possible for the more vulnerable economies to achieve a higher per capita capital stock and output, albeit a relatively lower consumption level compared to less vulnerable ones. This

happens as the vulnerable economy saves and invests more, provided that appropriate structures exist, in order to overcome the effects of exogenous shocks. Saving and capital formation are thus viewed as a main contributor to the development of resilience. Vulnerability would however result in reduced consumer welfare by eroding consumption possibilities.

Secondly, it was shown that vulnerability tends to slow down economic convergence between low income countries which lack the capacity and structures to generate saving and investment, and higher income countries. As already explained, economies with sufficient resources and adequate institutional structures which permit the creation of saving to face exogenous shocks could experience higher economic growth rates and per capita output. On the other hand, in the case of economies with insufficient resources or inadequate structures for saving, capital formation, and the development of resilience, vulnerability would act as an additional handicap which restrains their economic development. Thus, from a supply side perspective, vulnerability could result in high dispersion in income and investment levels of small states.

It was also argued that small economies are likely to be more prone to diminishing marginal productivity, which typically sets in at a faster pace within production set-ups of limited scale. Hence, the asymmetric effects from symmetric shocks identified to emanate from diminishing marginal productivity are likely to impinge more strongly on small economies. Likewise, it was shown that there is a strong positive relation between resilience to exogenous shocks and the existence of the conditions

which permit endogenous growth, typically featuring non-diminishing marginal productivity.

Theoretical Modelling of Vulnerability and Short-Term Aggregate Demand Fluctuations

From the perspective of short term aggregate demand fluctuations, the stylized facts regarding the economic behaviour of small vulnerable states point to (a) an increased volatility in aggregate domestic expenditure and in the external sector, (b) persistence of external current account deficits and (c) strong share of imports, exports and government expenditure within aggregate demand. The extension of mainstream macroeconomic models to incorporate economic vulnerability indicate that the principal exogenous shocks lead to a heightened degree of uncertainty, affecting economic behaviour, and to the endogenous reaction of stepping up specialization in the export sector, in order to develop some degree of resilience.

The principal implication of vulnerability for household consumption behaviour relates to the unpredictability of future income, such that permanent income would be almost totally determined by the current income stream. This was shown to have three main effects.

Firstly, consumption would in the long run be on average lower in the presence of vulnerability. This reinforces the argument already expressed in the model for long term economic growth, and gives rise to a higher degree of precautionary saving in vulnerable economies.

Secondly, current income would be the principal determinant of consumption expenditure, implying a higher marginal propensity to consume out of current income in vulnerable economies when compared to less vulnerable ones. This renders the income multiplier process more relevant in vulnerable economies. Thus, it is not only the shocks to the exogenous expenditure components which cause heightened volatility in aggregate demand in a vulnerable economy: the endogenous reaction of the induced expenditure components in the presence of such shocks magnifies their effects.

Thirdly, it was found that positive shocks to income would induce a relatively higher marginal propensity to consume than negative shocks would. This may be interpreted in terms of the finding, already discussed, that a vulnerable economy maintains a relatively stable but low average level of consumption such that it would not need to reduce consumption in the face of a negative disturbance to the same extent that it would be able to increase consumption in the wake of a positive shock. In other words, the maintenance of a low average level of consumption is undertaken to minimise the deleterious effects of negative shocks on utility.

Hence aggregate demand would, in the presence of a positive shock, rise by more than it would fall in the wake of a negative one. This response of aggregate demand runs counter to the supply side reactions earlier identified in the modelling of economic growth: negative shocks were viewed to exercise comparatively stronger effects on aggregate supply than positive shocks of equal magnitude. Thus, vulnerability would lead to a movement towards excess aggregate demand situations, and consequently, to

adverse pressures on the external current account of the balance of payments in open economies.

The dependence of vulnerable countries on imports in the long run was viewed to result directly out of the typically high concentration in the range of products produced and exported. This concentration, in turn, was shown to be the result of efforts to build resilience within production activities, which would not otherwise be obtained at smaller (and fragmented) output levels, and would be especially exacerbated in countries with relatively limited resources. The high degree of trade openness of small states is thus not only a source of vulnerability, given that it increases exposure to foreign shocks, but also a result of the phenomenon, as it would allow better management of the risks faced by productive sectors.

Because of the specialisation in a few unrelated sectors that is typical of small vulnerable economies, imports were shown to be essential to maintain expenditure activities and would therefore closely follow the behaviour of household consumption expenditure, apart from being conditioned by the effects of exogenous shocks in exports and investment. This would imply a relatively high dependence of imports on current income, with positive shocks to income inducing a higher marginal propensity to import than negative shocks would. This is the mechanism through which the proneness to adverse pressures on the balance of payments in vulnerable economies would take place.

The results of a conceptual model for government expenditure developed in this thesis indicate that economies which are subject to higher shocks would need to rely to a

larger extent on government expenditure aimed at stabilizing the effects of such shocks in the short-run. This factor would contribute to a higher share of government expenditure in the economy in the long run, potentially introducing inefficiencies in resource allocation in vulnerable economies and hence complicating the development of resilience.

Econometric Results

A number of findings described above were empirically tested through econometric modelling by means of a pooling regression panel approach, utilising data spanning 11 years until 2002 for 142 countries. An error-correction model specification was used in order to distinguish between short- and long-run effects, and to benefit from the desirable statistical properties of this model. This however does not compensate for problems in the data, including lack of comparability and of homogeneity across countries and over time. The results reported here are thus to be viewed in the light of this unavoidable limitation.

Estimation results appear to confirm the principal conclusions obtained from the conceptual modelling of consumption expenditure. It was found that vulnerability generates a positive response of consumption expenditure to exogenous expenditure shocks in the short run, confirming that vulnerability enhances the short-run multiplier effects on aggregate demand in an economy. The hypothesis that vulnerability tends to increase the strength of upward multiplier effects relative to downward ones appears to be also borne out by the estimation results. These effects, though statistically significant, are not of a large magnitude such that the short-run response

of consumption to exogenous shocks is found to be inelastic even for the most vulnerable countries. The estimated model also confirms that vulnerability reduces the ratio of consumption to income in the long run by inducing higher precautionary saving.

In the case of import expenditure, evidence supported the hypothesis that vulnerability increases the short run sensitivity of imports to expenditure shocks. This may in part reflect the unavoidable dependence of vulnerable economies on fixed exchange rate regimes. Estimation results also confirm that vulnerability increases the import content of exogenous expenditure, reflecting an endogenous reaction of the economy to reduce its vulnerability by specialization in production.

Estimation results for the government expenditure model confirm the hypothesis that in vulnerable economies, government expenditure plays a stronger role in stabilizing fluctuations in private consumption expenditure. The hypothesis that in the long run, the ratio of government expenditure to other expenditure is higher in vulnerable economies finds a relatively weak statistical corroboration in the estimation results.

Overall, the econometric analysis provides evidence to indicate that vulnerability, in the sense of high exposure to exogenous shocks, tends to render the multiplier process more relevant in an economy and to exacerbate adverse pressures on the balance of payments. Moreover, the estimation results indicate a higher degree of saving in vulnerable economies in the long run, which is the basis of the theoretical findings from the model of economic growth. As discussed in the course of the development of the conceptual model, however, this does not necessarily imply that higher saving

translates into improved economic performance, as such saving may be merely utilized to counteract the effects of exogenous shocks.

Practical Implications

It is considered that the conceptual modelling and empirical research presented in this thesis provides evidence pointing to the existence of relevant effects arising out of the inherent vulnerability of certain economies to exogenous shocks. The findings of this study can thus be used to strengthen the arguments of vulnerable economies regarding the special attention that they require to assist their economic development.

These arguments are primarily based on the premise that vulnerable countries find that adverse shocks tend to have stronger impacts that positive ones, even though such shocks may be symmetric in nature. The situation would of course be even more serious if adverse shocks were to be more frequent or intense than favourable ones. Another practical implication is that the achievement of relatively high per capita incomes by certain small vulnerable economies should not lead to the conclusion that vulnerability implies an inherent strength. This study shows how the development of resilience to vulnerability may actually lead vulnerable economies to achieve high per capita incomes at the cost of lower consumption. Furthermore, vulnerability is associated with wide dispersions in development levels, such that one finds examples of economically successful as well as unsuccessful vulnerable countries.

From the perspective of short-term macroeconomic fluctuations, a more important role for fiscal policy in economic stabilization is identified for vulnerable economies.

This is because vulnerability is found to result in more relevant multiplier effects and a consequent higher volatility in aggregate expenditure components.

Vulnerability is also associated with more persistent pressures on the balance of payments, calling for particular attention to policies promoting the international competitiveness of vulnerable economies, primarily through fundamental supply-side measures. The improvement of access to target markets is an example of such measures, which may be pursued through enhanced international economic integration within regional trading blocks. Another key consideration in this respect is the need to effectively increase the productivity of saving in vulnerable economies so as to enhance the contribution of capital formation to the development of resilience and consequently, to the generation of economic growth.

These results overall point to the crucial role of domestic and international economic policy in developing the resilience of small states to withstand, absorb and rebound from the adverse effects of inherent vulnerability. The building of resilience can be viewed to be not merely an issue of national economic policy, but to extend to international institutions and initiatives aimed at promoting global economic development. The building of resilience may also be viewed to be a central objective in processes of international economic integration by small countries, as happened recently with the enlargement of the European Union and with ongoing efforts to deepen economic integration in other regions, especially within the Caribbean. International integration could indeed be a vehicle through which small countries access a wider pool of resources through which to enhance their resilience to shocks (Pace, 2006).

Further Research

The findings of this thesis suggest a number of avenues for further research. The study of vulnerability and resilience is relatively recent and presents a number of promising areas for conceptual and empirical analysis.

The formal disaggregation of the effects of vulnerability on per capita output into those emanating from the strength of shocks and the degree of resilience to such shocks indicates that the measurement of vulnerability should better focus on proxying the magnitude of shocks to which an economy is subject, rather than including considerations which would be more akin to resilience. At the same time, this analysis suggests the need to better measure the resilience of countries in terms of their ability to minimise the effects arising from negative shocks. It is furthermore likely that the measurement of resilience would benefit from the consideration of factors typically included in the study of endogenous growth. This would be followed by further research aimed at providing practical solutions towards the development of resilience in vulnerable economies.

The incorporation of vulnerability in the model for economic growth suggests the need to reconsider conclusions regarding total factor productivity growth and convergence between countries in different states of development in the light of the possible influences of exogenous shocks. Such modelling can be further extended, on a conceptual level, to consider shocks which are autocorrelated over time and which are asymmetric in nature. The research presented here also strongly suggests that

vulnerability would not be a source of concern for countries experiencing endogenous growth. This can be further examined through conceptual modelling of the relationship between country size, prevalence of exogenous shocks and the likelihood of existence of endogenous growth conditions.

From the viewpoint of macroeconomic and econometric modelling, the results of this study indicate the need for considering economic vulnerability as an important factor in determining the extent to which an economy would be expected to behave in accordance with the rational expectations paradigm. An interesting notion in this regard is that the failure of rational expectations would be caused by market failure, in this case especially due to increased uncertainty, which would render economic behaviour better explainable by Keynesian economic approaches. The relationship between economic smallness and vulnerability on one hand and the incidence of market failure on the other is thus another potential area for further research.

The failure of the rational expectations model calls for further research into the increased importance which aggregate demand management policies could have in vulnerable economies. In particular, such policies could play a more important role in these economies by smoothening the volatility in aggregate demand caused by the dependence of expenditure on current rather than permanent income. This is akin to the Keynesian paradigm on the role of economic policy in the economy.

Another important consideration in this respect is the lack of suitability for small states of macro-econometric models based on the assumption of a single representative commodity. The econometric modelling of small states which are

highly specialised in their export sectors and thus feature significant dichotomies in their export- and domestically- oriented sectors would require the specific modelling of these different sectors of activity. Such modelling could be more onerous and less practicable from the viewpoints of equation specification and estimation, requiring more intensive use of data at the sectoral level which may be difficult to obtain.

It is furthermore recognised that this thesis focuses on the concepts of economic vulnerability and resilience exclusively from the perspectives of long-term economic growth and short-term aggregate demand fluctuations. It is likely that vulnerability and resilience would be relevant to study other fundamental dimensions within the wider context of development, including: (a) social cohesion; (b) governance, political and institutional issues, and; (c) environmental considerations. The results of this thesis suggest that the issue of vulnerability within these dimensions could manifest itself in the asymmetric effects of symmetric shocks influencing their evolution. For example, it could be argued that external influences on a society's culture, to which small states may be particularly prone, are more likely to undermine rather than build social cohesion. Likewise, negative shocks to the governance structure of a country, arising from, say, external or internal political instability, may do more harm than a commensurate positive development. The environment is another area where negative shocks, emanating say from global influences on climate change, are bound to have stronger effects than positive shocks. The asymmetric influences on the various dimensions of development constitute potentially important applications of the concepts of vulnerability and resilience which merit further research.

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Annex: List of Countries and Basic Data

Country	GDP per capita, 2002, US dollars	Population, 2002, 000s of persons
Albania	1278	3150
Algeria	1665	31320
Antigua and Barbuda	9312	69
Argentina	6842	36480
Armenia	761	3068
Australia	24455	19663
Austria	34044	8048
Azerbaijan	638	8172
Bahamas, The	4220	314
Bahrain	10889	698
Bangladesh	396	135684
Barbados	7850	269
Belarus	2096	9925
Belgium	31094	10333
Belize	3231	253
Benin	443	6552
Bhutan	580	851
Bolivia	940	8809
Botswana	4102	1712
Brazil	4642	174485
Bulgaria	1720	7965
Burkina Faso	281	11831
Burundi	143	7071
Cambodia	416	12487
Cameroon	700	15769
Canada	23621	31362
Cape Verde	1585	458
Central African Republic	332	3820
Chad	232	8341
Chile	5433	15589
China	944	1280400
Colombia	2282	43733
Comoros	436	586
Congo, Dem. Rep.	90	51580
Congo, Rep.	700	3657
Costa Rica	3938	3942
Cote d'Ivoire	776	16513
Croatia	5440	4465
Cyprus	14799	765
Czech Republic	5690	10210
Denmark	39661	5374
Djibouti	734	693
Dominica	3146	72
Dominican Republic	2254	8613
Ecuador	1796	12818
Egypt, Arab Rep.	1250	66372
El Salvador	1787	6417

Country	GDP per capita, 2002, US dollars	Population, 2002, 000s of persons
Equatorial Guinea	2444	482
Eritrea	160	4297
Estonia	4315	1358
Ethiopia	124	67218
Fiji	2840	823
Finland	32284	5199
France	30790	59485
Gabon	4323	1315
Gambia, The	356	1389
Georgia	763	5177
Germany	32826	82495
Ghana	429	20271
Greece	14162	10631
Grenada	3565	102
Guatemala	1552	11992
Guinea	633	7744
Guinea-Bissau	162	1447
Guyana	950	766
Haiti	338	8286
Honduras	712	6797
Hong Kong, China	25456	6787
Hungary	5743	10159
Iceland	31385	284
India	493	1048641
Indonesia	1060	211716
Iran, Islamic Rep.	1801	65540
Ireland	30551	3920
Israel	16676	6566
Italy	21396	57690
Jamaica	2104	2617
Japan	45029	127150
Jordan	1660	5171
Kazakhstan	1930	14875
Kenya	322	31345
Kiribati	667	95
Korea, Rep.	14280	47640
Kuwait	11598	2328
Kyrgyz Republic	457	5004
Lao PDR	477	5530
Latvia	3029	2338
Lebanon	2868	4441
Lesotho	648	1777
Liberia	197	3295
Lithuania	2947	3469
Macao, China	17119	439
Madagascar	215	16437
Malawi	157	10743
Malaysia	4806	24305
Maldives	2263	287
Mali	309	11374

Country	GDP per capita, 2002, US dollars	Population, 2002, 000s of persons
Malta	10235	397
Mauritania	503	2785
Mauritius	4538	1212
Mexico	3717	100819
Moldova	413	4255
Mongolia	442	2449
Morocco	1455	29641
Mozambique	223	18438
Namibia	2203	1985
Nepal	241	24125
Netherlands	31287	16144
New Zealand	18947	3939
Nicaragua	496	5342
Niger	209	11425
Nigeria	248	132785
Norway	40043	4538
Oman	6147	2538
Pakistan	518	144902
Panama	3419	2940
Papua New Guinea	870	5378
Paraguay	1701	5510
Peru	2380	26749
Philippines	1209	79944
Poland	3769	38626
Portugal	13034	10177
Romania	1615	22300
Russian Federation	3257	144071
Rwanda	295	8163
Samoa	1502	176
Sao Tome and Principe	355	154
Saudi Arabia	7562	21886
Senegal	618	10006.8
Seychelles	8071	84
Sierra Leone	165	5235
Singapore	27254	4164
Slovak Republic	4620	5379
Slovenia	12513	1964
Solomon Islands	535	443
South Africa	4020	45345
Spain	18050	40917
Sri Lanka	899	18968
St. Kitts and Nevis	6561	46
St. Lucia	3579	160
St. Vincent and the Grenadines	2666	117
Sudan	330	32791
Suriname	1859	433
Swaziland	1553	1088
Sweden	33665	8924
Switzerland	46554	7290
Syrian Arab Republic	832	16986

Country	GDP per capita, 2002, US dollars	Population, 2002, 000s of persons
Tanzania	207	35181
Thailand	3000	61613
Togo	320	4760
Tonga	1800	101
Trinidad and Tobago	5525	1304
Tunisia	2574	9781
Turkey	2942	69626
Uganda	359	24600
Ukraine	1024	48717
United Arab Emirates	17520	3218
United Kingdom	22974	59229
United States	31891	288369
Uruguay	5495	3361
Uzbekistan	693	25271
Vanuatu	1174	206
Venezuela, RB	2979	25090
Vietnam	413	80424
Yemen, Rep.	330	18601
Zambia	422	10244
Zimbabwe	521	13001

Source: IMF, UNCTAD, World Bank