Chapter 1
INTRODUCTION

This chapter introduces the study undertaken in this thesis and commences with a historical overview of the study area. The identification of the research problem (the lack of empirical evidence to support stabilisation policies, export growth and economic growth, causes and/or sources of commodity export revenue variability and causes of export sector performance in South Pacific island nations) follows. Background considerations on commodity export revenue variability, and why they are important to the South Pacific island nations are briefly reviewed. The rationale of the study, which includes the objectives and hypotheses, is then given as the main justification for undertaking this particular study. Methods used to test the hypotheses are briefly previewed. The means by which the tested hypotheses contribute to problem solving are briefly discussed. The structure of the thesis completes the chapter.

1.1 A Historical Overview

Four countries – Fiji, Papua New Guinea (PNG) Solomon Islands (SI) and Vanuatu, commonly known as the Melanesian countries – were selected from among the South Pacific island nations (SPINs) as the study area (see location of selected SPINs in Appendix 1.1). The selection criterion was based partly on geographic size and economic diversity and partly on historical legacy of the sampled nations. For instance, by SPIN standards, PNG is regarded as relatively large with a diversified economic base. Fiji is of medium size with a fairly diverse economy. SI is small with a fairly concentrated economy, while Vanuatu is also small with a highly dualistic economy (Fallon 1994).

From a historical perspective, Fiji, PNG, SI and Vanuatu are young, developing and small open economies which achieved political independence in 1970, 1975, 1978 and 1980, respectively. Fiji and SI were a British colony and protectorate, respectively, for nearly a century. One part of PNG (Papua) was initially under British rule, and the other part (New Guinea – the North–Eastern part of the same island) was under German rule until after the First World War and an Australian protectorate thereafter. Following the Second World War, Papua and New Guinea were amalgamated as PNG and placed under the Australian territorial governance by a United Nations charter. Formerly called New Hebrides, Vanuatu was governed jointly by the British and French until 1980 when political independence was given (Fallon 1994). The economies of these selected SPINs have been greatly influenced by European politico–economic models which have emphasised the expansion of primary commodities for export as major policy initiatives for economic growth.

Like many less developed countries (LDCs), the SPINs are good examples of small open economies which suffer from high commodity concentration (Fleming and Piggott 1989), high geographical (export market) concentration, remoteness from international markets, inability to influence export prices and poorly–developed marketing institutions and infrastructure. These are some of the prevailing economic characteristics for those LDCs where commodity export revenue variability (CERV) is commonly observed.

The major current socioeconomic indicators in the selected SPINs are summarised in Appendix 1.2 (Rutherford 1994). The main points are:

- **Fiji's** land area is about 18 272 sq km with about 750 000 inhabitants, and a per capita gross domestic product (GDP) of US$2 010 in 1992. Agriculture, mining, manufacturing and the service sector are the major sectoral components of the national income. The principal export commodities are sugar and molasses, fish, gold, copra, lumber and coconut oil.

- **PNG** has a total land area of about 462 243 sq km or 46 million hectares (including about 600 small individual islands and archipelagos). It is approximately the same size as France but larger than Japan. Its population is about 4 055 000. Per capita GDP was about US$1 098 in 1992 and the national income is derived mainly from agriculture, mining, manufacturing, fishing, forestry and the services sectors. PNG's principal export commodities are gold, copper, coffee, cocoa, logs, palm oil, coconut, copra and marine products. Coffee, cocoa, coconut products and palm oil together accounted for some 40 per cent of the total domestic export earnings (or 30 per cent of total exports) and 90 per cent of all agricultural exports between 1980 and 1985 (Kiele 1987).

- **Solomon Islands** has a land area of about 27 556 sq km and a population of about 335 000. Its per capita GDP was about US$710 in 1992. The major components of the national income by sector are agriculture, fishing, forestry, manufacturing and services. Principal export commodities include timber, fish products, palm oil and kernel, cocoa and copra.

- **Vanuatu** has a land area of about 12 190 sq km and a population of about 155 000. Its per capita GDP was about US$1 220 in 1992. The major components of the national income by sector are agriculture, fishing, manufacturing and services. Principal export commodities include copra, cocoa, meat (beef) and timber.

Economic growth in the SPINs is heavily reliant on external markets which are major outlets for primary commodities (Fleming and Piggott 1985). In LDCs, including the SPINs, exports from primary commodities account for up to 80 per cent of total export earnings (Adams and Behrman 1982). The importance of export markets in the SPINs cannot therefore be over–emphasised (see, for example, Table 1.1).

Table 1.1: Percentage share (decade averages) of total exports in GDP for selected SPINs

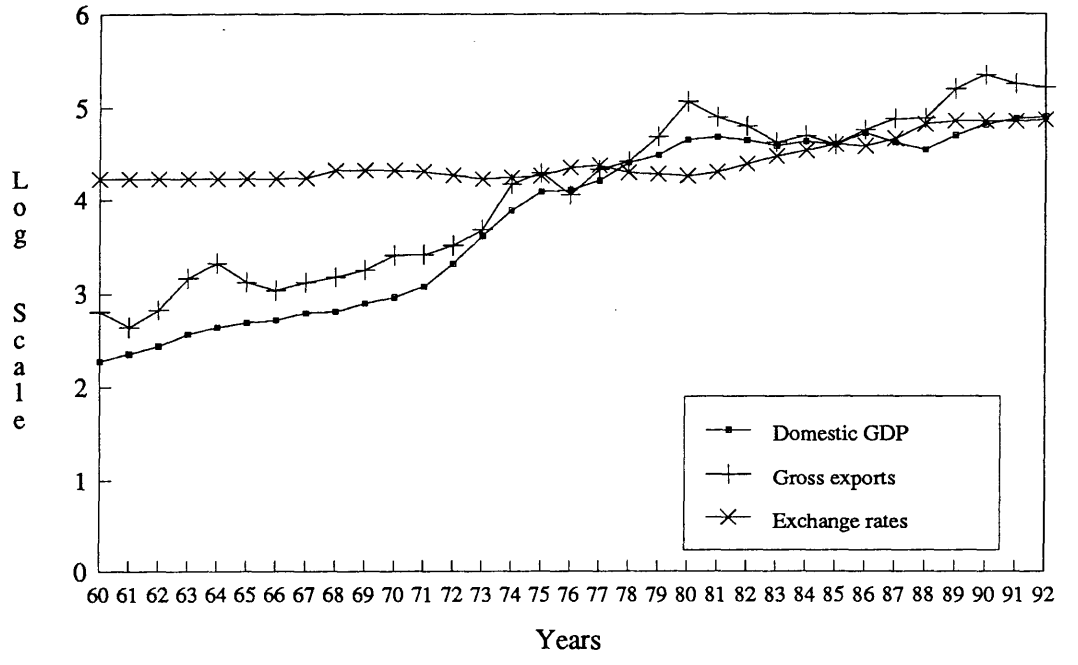
	The selected SPINs			
Period	Fiji	PNG	Solomon Islands	Vanuatu
1960s	32	17	23	na
1970s	25	35	36	na
1980s	26	37	45	24

Note: na = not available.
Sources: Computed from Appendix 6.2.

As indicated in Table 1.1, the export share of GDP for the selected SPINs has been quite substantial and variable over time. For instance, during the 1960s the export shares of GDP for Fiji, PNG and SI were, on average, about 32, 17 and 23 per cent, respectively. Export shares changed to 25, 35 and 36 per cent in the 1970s; and 26, 37, 45 and 24 per cent in the 1980s for Fiji, PNG, SI and Vanuatu, in that order. Therefore, over the past three decades, export share of GDP was on an increasing trend for PNG and SI while decreasing for Fiji. Since data were not available for Vanuatu in the 1960s and 1970s, its export shares were not computed (Table 1.1).

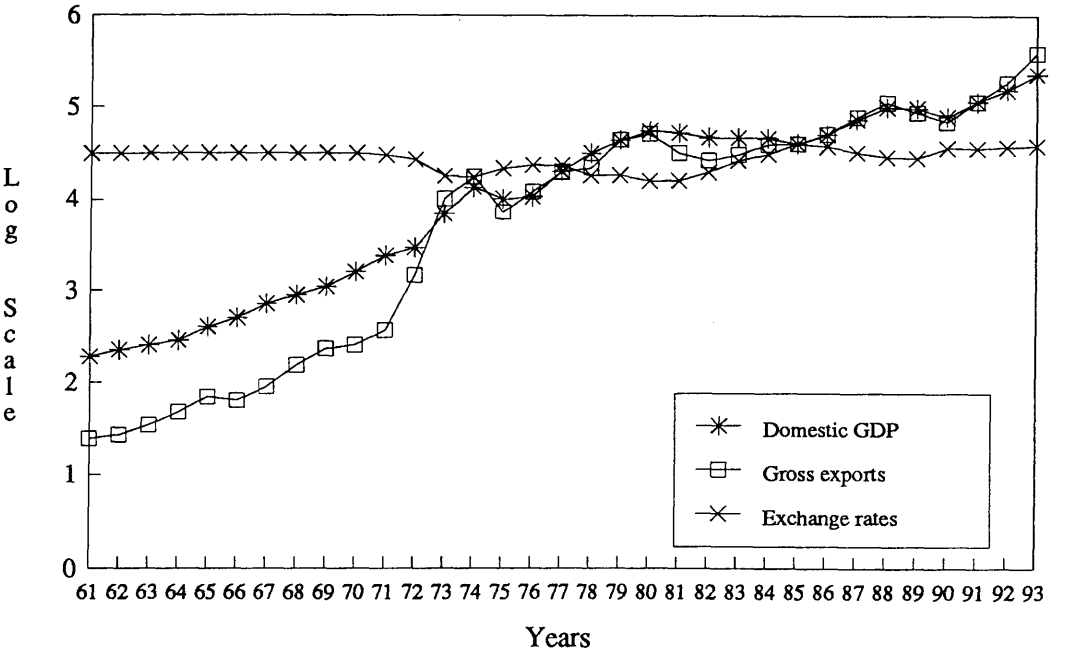
Evidence presented in Figures 1.1a, 1.2a and 1.3a shows a marked export expansion which became particularly conspicuous around 1975, just after, during and before independence of the selected SPINs. Despite annual variations in domestic market factors, real GDP and real exports (EXP) have grown over time in the selected SPINs. This growth seems to have been more significant from the late 1960s to the early 1970s than in the latter half of 1970s and the 1980s.

Figure 1.1a: Domestic factor trends in relation to exports, 1985 constant prices, Fiji



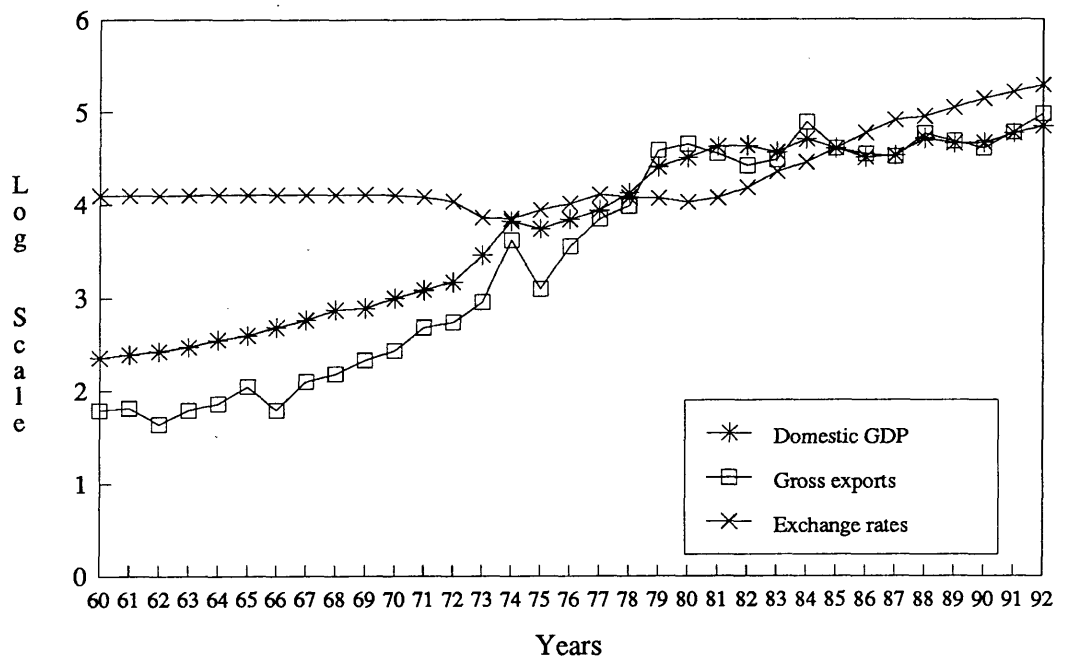
Source: Chapter 5.

Figure 1.2a: Domestic factor trends in relation to exports, 1985 constant prices, PNG



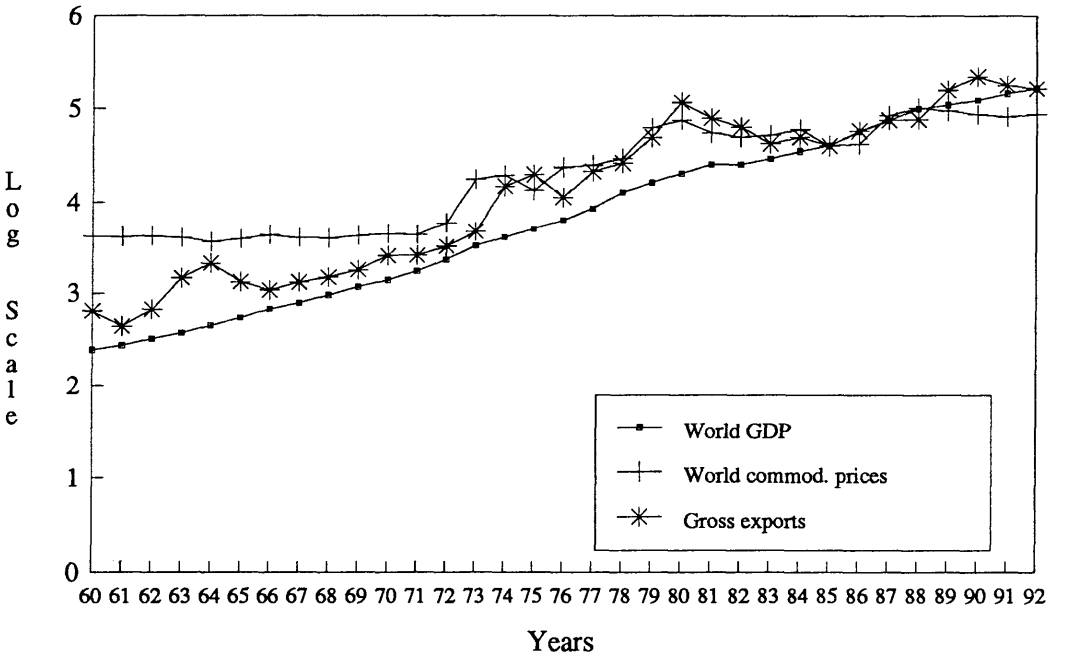
Source: Chapter 5.

Figure 1.3a: Domestic factor trends in relation to exports, 1985 constant prices, SI



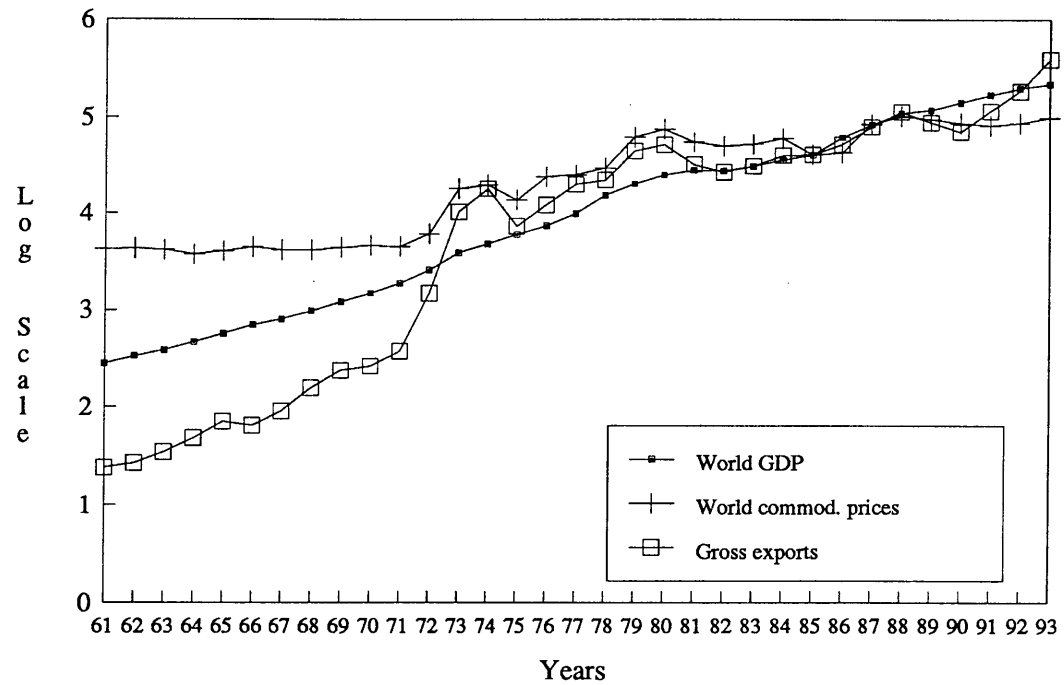
Source: Chapter 5.

Figure 1.1b: External factor trends in relation to exports, 1985 constant prices, Fiji



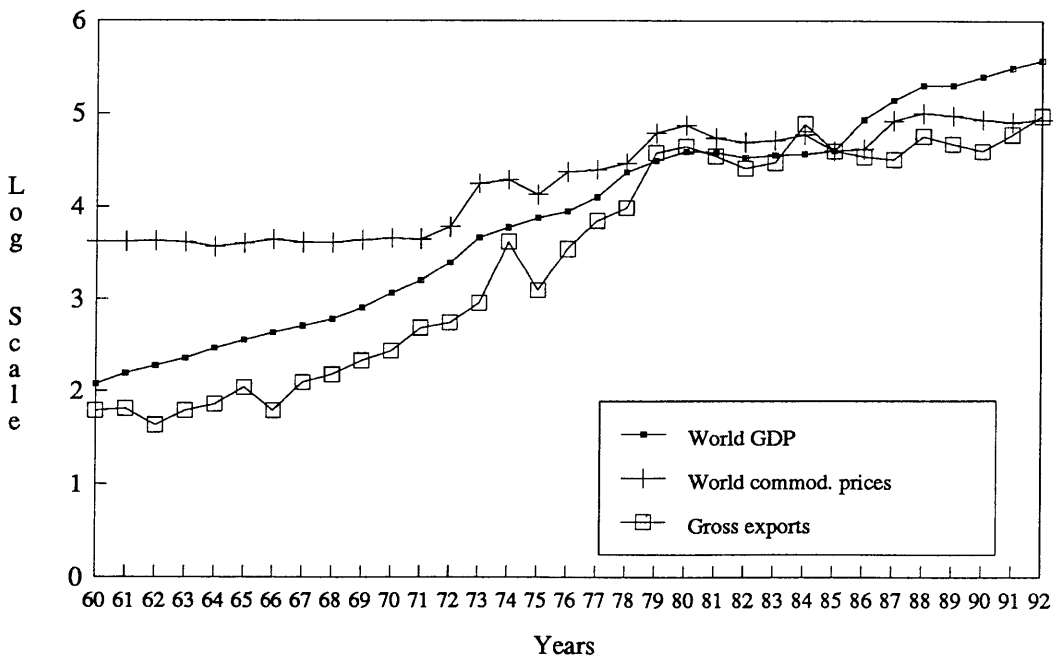
Source: Chapter 5.

Figure 1.2b: External factor trends in relation to exports, 1985 constant prices, PNG



Source: Chapter 5.

Figure 1.3b: External factor trends in relation to exports, 1985 constant prices, SI



Source: Chapter 5.

The slow–down in this growth, particularly toward the mid 1970s and the early to mid 1980s, could be attributed partly to shocks from transition to political independence and unfavourable world market positions. The domestic nominal exchange rates (EXR) for these nations were largely fixed until the mid 1970s when the fixed exchange rate regimes were relaxed. Generally, the real growth of exports seem to have parallelled that of GDP over the past three decades (see Figures 1.1a, 1.2a and 1.3a), suggesting possibilities of cointegration[1].

Further, as witnessed from Figures 1.1b, 1.2b and 1.3b, the real export growth seems to have moved along with the real weighted world GDP (WGDP) of the major trading partners of the selected SPINs and the real world commodity prices for agricultural raw materials (WCPI), also implying that cointegration could be possible. In general, though the periodic fluctuations in exports were expected, these were not matched by similar fluctuations in WGDP, WCPI, GDP and exchange rates, especially towards the mid 1970s. This, however, could also work against the possibility of the variables moving together toward the long–run equilibrium (or cointegration).

1.2 Background Considerations on CERV

CERV is prevalent in all countries (both LDCs and developed countries (DCs)) whose trade is mainly based on primary commodities for export. CERV can be either intertemporal or spatial. Intertemporal fluctuations, measured over time, can be short–term (from season to season) or long–term (over several years). Fluctuations are regarded here as variances from the general trend in export earnings. Spatial fluctuations are measured over distances in space. This thesis is focused mostly on intertemporal variability.

The demand for, and supply of, most primary commodities, both in the international and domestic markets, have been characteristically unstable with high magnitudes of price and quantity instability (MacBean 1966). MacBean observed that the persistent export price and revenue instability for most primary commodities are more transparent because of their low price elasticities. CERV is regarded as having substantial repercussions in LDCs where exports of the primary products form a large proportion of the total exports (Love 1992a, Maizels 1994, Hallett 1994, Morgan and Sapsford 1994).

There has been a long–running debate as to what consequences CERV has produced in the LDCs over the years. One school of thought has argued that frequent and sharp revenue

1 While the concept of cointegration is defined technically in Chapter 4, cointegration simply means the existence of long–run, steady–state equilibrium among economic variables.

changes affect national income of the developing countries, in turn affecting the individual incomes, consumption and investment. Thus, total economic development is hindered (Balassa 1978, Brainard and Cooper 1968, Glezakos 1973, Kenen and Voivodas 1972, Lam 1980, Lim 1972 1976, Maizels 1968, Michaely 1977, Voivodas 1974). The opposing school of thought asserts that CERV has no or little impact on the economies of the LDCs so long as there are alternative strategies to circumvent the heavy reliance on export incomes (Erb and Schiavo–Campo 1969, Khalaf 1979, MacBean 1966, Stein 1979). Yet a third school of thought alleges that CERV is good for the economies (MacBean 1966, Lam 1980, Savvides 1984) in that, for example, it provides signals indicating a need for changed production priorities. Some important issues which have emerged from the debate between these opposing schools will be dealt with in detail during the course of this study.

It is clear from the literature (e.g. MacBean 1966) that any degree of export growth or instability may have different effects in different countries as a result of different economic structures and policy regimes. However, for the SPINs included in this study, there has been a relatively high degree of similarity in the evolution of economic structures and policy regimes, as described in section 1.1. This means that the impacts of CERV in these countries are more likely to have been similar, permitting some generalisation of the results of analysis across the countries.

It was pointed out by Fleming and Piggott (1989) that exports from the SPINs are narrowly based on agricultural commodities (commodity concentration), but that the actual product mix varies widely across countries and over time. For example, in recent years, the relative importance of agricultural exports has declined with the emergence of new products from the fishery, forestry, mining and tourism industries. Fleming and Piggott also indicated that there have been substantial fluctuations in agricultural export earnings (both in aggregate and on an individual commodity basis) in all of the SPINs for the past two decades or so. These export fluctuations have affected various countries and export market participants in different ways. The existence of CERV has prompted various governments in the LDCs to consider, formulate and implement a diversity of stabilisation schemes for various export commodities with an aim to reducing the perceived undesirable effects.

1.3 The Research Problem

CERV is greater in, and affects much more severely, LDCs than it does DCs (Coppock 1962, Massell 1970, Michaely 1962, Murray 1978, Erb and Schiavo–Campo 1969, Glezakos 1973). One reason for this (as stated earlier) is that the LDCs' exports are destined mainly for

unstable international markets and the composition of these exports is made up of disproportionately large shares of the primary commodities of which the price elasticities of demand and supply are quite low. It is further claimed that CERV affects the economic growth of the LDCs even to the extent of causing the economies of some of these countries to become vulnerable to political instability (Massell 1970, Balassa 1978, Brainard and Cooper 1968, Glezakos 1973, Kenen and Voivodas 1972, Lim 1976, Maizels 1968).

During the past three decades or so, the perceived deleterious consequences of CERV on the small open developing economies of the SPINs have resulted in stabilisation programs becoming major policy concerns in the export sectors of these countries (Fleming and Piggott 1989, Piggott et al. 1986). One of the perceived problems examined in this study is that the governments of these countries have generally accepted that CERV has affected both the macroeconomic and microeconomic variables of their countries, with little or no formal empirical evidence. Macroeconomic fluctuations, especially those induced through export trade instability, have become a major policy concern in many LDCs because of the belief (again without much evidence) that fluctuations in the economies are undesirable.

For instance, PNG's economy is heavily reliant on exports of primary products (which contribute about 40 per cent of the country's total GNP) whose prices are at the mercy of unstable forces of international trade. This makes the economy susceptible to export price fluctuations which in turn affect incomes and, consequently, perhaps the welfare of residents. On the macroeconomic front, fluctuations in commodity prices might have a significant impact on aggregate export earnings. For example, a fall in commodity prices might lead to a call for devaluation measures, it is claimed, unless adequate foreign exchange reserves are available (which is normally not the case). Devaluation may in turn lead to inflationary trends and then wage increases through indexation; hence, the problem of unemployment may well be compounded. At the microeconomic level, export price instability could conceivably cause serious poverty problems for the smallholder farmers who are heavily dependent on earnings of commodity exports to maintain their living standards. In other words, stable prices provide a continuous flow of cash income to meet the daily cash obligations of these small producers. The effects of CERV on the plantation sector are likely to differ from those on smallholders given that large–scale farmers have different consumption and investment behaviour (Kiele 1987, Beck and Dalton 1987, Fleming and Piggott 1989).

The crux of the research problem, therefore, is that CERV is claimed to have deleterious effects on the economies of the SPINs, but empirical evidence on the nature and

extent of the causes and sources of CERV[2] is lacking. In particular, the actual causes and/or sources of CERV, the relationships between export growth, performance, economic growth and CERV, and the directions of these relationships, are unknown pertinent issues which affect export sector policy–making decisions in today's contemporary SPINs. Despite the foregoing, claims that CERV has adverse effects on the economies have prompted the authorities in SPINs to formulate and put into practice some supposedly remedial policies through commodity–specific price stabilisation schemes. These schemes were intended to insulate the commodity producers, particularly the smallholder farmers[3], from price variability of certain commodities. In principle, funds from the stabilisation schemes were to be used to even out price peaks and troughs. In this manner, it was hoped, incomes or revenues would also be stabilised over time, thus alleviating the poverty problems of the smallholder producers. Specifically, income stabilisation would be achieved through the price–bounty and levy mechanisms and through production or buffer stock stability (Kiele 1987). Unfortunately, there is now an increasing concern that these price stabilisation schemes may not be the appropriate approaches for dealing effectively with the perceived deleterious problems of CERV. In most cases, the stabilisation schemes have ended up as subsidy schemes.

Closely related to the CERV problem is a strong a priori assumption, and some econometric evidence (mainly from past conventional regression analyses), of positive relationships or correlations between export expansion and economic growth in most commodity–exporting economies (see, for example, Balassa 1978, Feder 1983, Giles, Giles and McCann 1992). A lot of interest has recently been generated as to the actual direction of these relationships. That is, before asking what the sources and perhaps the economic impacts of commodity export revenue variability are, it is desirable to find out if causal relationships exist between export revenue expansion and instability and the economic growth and instability of these economies. This implies that the question of whether export growth causes economic growth or whether economic growth causes export growth should be addressed first. Studies on causal relationships between export growth and economic growth have only been started recently for some developing countries (Jung and Marshall 1985), newly industrialised countries (NICs) (Chow 1987), Africa (Ahmad and Kwan 1991), and Canada

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[2] Causes refer to how well a dependent variable can be predicted by the explanatory variable(s). Besides predictability, causes may also refer to contributions and responses from decompositions and shocks, respectively. On the other hand, sources refer strictly to contributions from decompositions.

[3] The price stabilisation schemes were targeted mostly to smallholders because the majority of them did not have bank accounts and tended to spend windfall incomes on imported goods, beer, feasts, and related goods and services. Hence, by themselves, they could not fill in the income troughs with their own reserves: someone had to do it for them (G. Antony 1995, pers. comm., Temu 1995).

(Serletis 1992). It is therefore also worth extending the analysis of causality between exports and economic growth to the selected SPINs since most of them largely depend on commodity exports. As an outcome of this analysis, the assumption mentioned above will either be validated or refuted.

Once the linkages between export sector and economic growth are established, it could be possible to formulate appropriate export policies that enhance and ensure sustainable economic growth. It is important to study the export–economic growth relationships separately for different LDCs because these relationships could take different directions for different nations. Consequently, two major aims of this thesis are to determine:

(a) the causal relationships between export growth and economic growth and

(b) the causes and sources of CERV in the selected SPINs, including determining performance of the export sectors of the respective SPINs.

Therefore, the first important question to be addressed in this study is whether adequate and relevant information can be gathered and analysed to help in the determination of appropriate policy guidelines regarding CERV–related issues.

1.4 The Rationale of the Study

It has been suggested that CERV induces a multiplicity of problems and policy initiatives (Oladeji 1976, Brook and Grilli 1977, Moran 1983, Gyimah–Brempong 1991, Love 1992). Some people (Oladeji 1976, Lim 1980, among others) claim that CERV causes producers and other market participants of primary export commodities to move into savings and other investments, thus diversifying the economies. Others (see, for example, Lim 1976, Bird 1978, Killick 1981) suggest that CERV which could be transmitted from price fluctuations may encourage producers and potential investors to plan ahead of time by either reinvesting in their production processes in terms of new plantings, replantings and regular maintenance activities or by looking for alternative investment opportunities to stabilise their earnings. The alternatives could be either off–farm operations or some other means (e.g., various retail businesses).

Many others (for example, Rangarajan and Sundarajan 1976, Bigman and Reutlinger 1979, Guest 1985) hold the view that CERV is a real problem of economic instability. It initiates all types of instability problems ranging from macroeconomics to microeconomics and political instability. In the macroeconomy, for example, CERV could slow down

economic growth by creating uncertainties and reducing the confidence of investors (including the governments themselves). Government fiscal policies could be disrupted by temporary shocks to revenue generation, thus resulting in the suspension of government expenditures for some programs. At times, CERV could also lead to decreased money supply such that the demand for money becomes quite competitive, thereby forcing up interest rates. As one consequence, this could affect the operations and growth of businesses and industries. One of the worst consequences which could emerge as a result of CERV, however, may involve some extreme cases where serious macroeconomic instability could translate into political instability.

In other cases, it is claimed that CERV has the potential to cause resource allocation distortions (Fleming 1992). For example, when the negative effects of CERV result in a prolonged period of low producer incomes from a specific commodity, producers tend to shift their investment into alternative opportunities (e.g., to commodities which, according to the producers, might have better prospects). On the other hand, if the former commodity returns to earning higher net incomes, producers could switch their investments back to that commodity. Thus, such behaviour stems from the uncertainties created by CERV's undesirable effects which could bring about resource misallocation.

It has long been realised (in fact from the colonial times) by the governments of the SPINs that CERV could produce undesirable effects in their economies (Kiele 1987). Policy makers and producers assumed that CERV could be induced mainly through commodity price fluctuations. It was also assumed that these price fluctuations were mainly transmitted from external sources because the commodities were traded in unstable international markets. As a result, the first pilot commodity–specific price stabilisation scheme for copra was formulated and implemented as early as 1946 in PNG. As the objectives of the pilot scheme were achieved, the copra price stabilisation scheme appeared to have become a success story (Kiele 1987, Gimbol 1992). This led to the establishment of several other commodity–specific stabilisation schemes. One for cocoa was established in 1974, for coffee in 1975 and oil palm in 1983 (Gimbol 1992). Within this period and later, several similar price stabilisation schemes for various specific commodities were established in other SPINs. Given that the major thrust of this thesis is to address the problem of lack of empirical evidence to support the establishment and sustainable operations of the commodity–specific price stabilisation schemes in the selected SPINs, a more detailed historical overview of them is given in Chapter 2. As time went by, these schemes became so fashionable in the SPINs that, in the early 1980s, there was a proposal for the establishment of regional commodity price stabilisation schemes (South Pacific Commission (SPC) 1980).

Whether these price stabilisation schemes continue to meet the objectives of their establishment, as with the PNG copra scheme of the early years, has now become a subject of debate. This is because some people (for example, Ilala 1992) are in favour of price stabilisation for various reasons, if only for 'pragmatic policy implementation'. In fact, that these schemes have continued to increase in number and cover more commodities implies that they have the support of the policy makers as well as of their financiers. Others (for example, Fleming 1992) have strong doubts about the effectiveness of these schemes. Their view is that evidence has not been established to show the efficacy of the schemes, and they argue that there are alternative approaches which might stabilise the economies more effectively. In any case, according to Fleming, stabilisation is costly. Scarce financial assets are tied up in stabilisation funds, and skilled and experienced personnel who have high opportunity costs are deployed in stabilisation programs.

Based on some of the arguments presented above, it would appear that CERV induces instability–related problems in the economies. It is therefore the purpose of this thesis to study the causes and sources of CERV in the SPINs as well as to study the export/economic growth nexus and establish the factors that determine the export sector performance of the selected SPINs.

1.4.1 Objectives

The overall objective of this study is to conduct an empirical economic analysis of CERV for some selected SPINs.

The major specific research objectives are, in the context of SPINs, to:

(a) Undertake a descriptive historical overview of the commodity–specific price stabilisation schemes.

(b) Determine the causal relationships between export expansion and instability and economic growth and instability.

(c) Establish the causes (referring mainly to predictability) of CERV.

(d) Examine the determinants of export sector performance.

(e) Determine the sources (referring mainly to contributions) of CERV.

(f) Examine the emerging policy implications and attempt to prescribe some policy alternatives for stabilising commodity export revenue–related problems.

1.4.2 Hypotheses

(a) Commodity export revenue growth and instability in selected SPINs have no significant causal relationship to economic growth and instability.

(b) CERV in SPINs is mainly caused by external and not domestic factors.

(c) Neither external factors (world demand) nor domestic factors determine export sector performance in SPINs.

(d) CERV in SPINs largely comes from demand sources and not from supply and supply–demand interaction related sources.

1.5 The Hypothesis Testing

Two analytical approaches are applied in testing the stated hypotheses. Hypotheses (a), (b) and (c) are tested by employing a time–series econometric model, while a variance decomposition method (VDM) is used to test hypothesis (d). A later chapter (4) is dedicated to an in–depth discussion of some theory and analytical framework. The following are brief overviews of the approaches.

1.5.1 Time series model approach

A time series econometric approach is used to estimate: (a) causal relationships between exports and economic growth, (b) causes of CERV from external and domestic perspectives, and (c) the determinants of export sector performance.

(a) The estimation of causal relationships is based on the ordinary least squares (OLS) version of the standard Granger causality test (Granger 1969). Thus, a bivariate system of exports and GDP for each selected SPIN is tested for Granger causality after unit roots and cointegration properties of these series have been taken into consideration. In addition to the cointegration analysis which is used to test for long–run relationships, short–run dynamic investigations of Granger causality are conducted in various models of vector autoregression (VAR) and error correction mechanisms (ECMs), forecast error variance decomposition analysis (FEDA) and impulse response analysis (IRA).

(b) In analysing the causes of CERV from the external and domestic perspectives, various models are specified and estimated using the same methods as in (a). From the domestic side, GDP and EXR series are used to test for the causes of

CERV while from the external side WGDP and WCPI are utilised to test for the same causes.

(c) The testing of export sector performance, also from the external and domestic perspectives, is conducted using similar methods as in (a) and (b). Before using the methods mentioned in (a) and (b), the cointegration technique is applied for the long–run analyses, after the unit roots properties are also established.

1.5.2 Variance decomposition method approach

Initially proposed by Piggott (1978, 1981) and used by Piggott et al. (1986), Fleming and Piggott (1985, 1989) and Myers and Runge (1985), the variance decomposition method (VDM) is employed to test for the sources of CERV. VDM is a direct way of determining the relative importance of the sources of CERV from demand, supply and demand–supply interaction variability. Decomposition of the key export market variables (price, quantity and revenue) into components due to demand and supply variability and supply–demand interaction for each commodity is the key element in this technique.

1.5.3 How the tested hypotheses would solve the problem

The results of the analyses, especially those from the causes and sources of CERV, should contribute to the bases for assessing the validity of commodity–specific price stabilisation policies in the SPINs. Further, as a result of establishing the causes and sources of CERV, other policy issues (e.g., fiscal and monetary) could be assessed for their benefits and costs, appropriateness and effectiveness and perhaps be adopted. If adopted, the latter policies could either replace or be used in conjunction with the commodity–specific price stabilisation schemes.

Another policy area which could be exploited concerns the tested hypotheses of the exports and economic growth nexus and export sector performance. Results obtained from the tested hypotheses could guide decision–making processes on whether to diversify, expand or contract the export sectors in the SPINs.

1.6 Outline of the Study

The remainder of this thesis is organised as follows. A historical overview of the stabilisation policies in the selected SPINs is presented in Chapter 2. Chapter 3 offers a review of literature on the nature, causes, sources and effects of CERV. Considerations of theory and analytical framework, including the specification tests of the cointegration models and analytical methods (VAR, ECMs, FEDA and IRA and VDM) are discussed in Chapter 4. Data and data sources are discussed in Chapter 5. Analytical results and discussions on export expansion and economic growth relationships are presented in Chapter 6. The results and discussions on the causes of CERV are presented in Chapter 7. Results and discussion on the determinants of export sector performance are given in Chapter 8. The main empirical results and discussion on VDM are presented in Chapter 9. In Chapter 10, conclusions and policy implications are presented.

Chapter 2

COMMODITY STABILISATION ISSUES IN THE SPINS: A HISTORICAL PERSPECTIVE

The main commodity stabilisation issues are discussed in this chapter. They include the rationale for, objectives and justification of types of stabilisation policies, their historical development and operations, and the emerging stabilisation issues in the SPINs.

2.1 Introduction

Instability of agricultural prices and revenues complicates farmers' decision making and may lead to inefficient allocation of resources. For the governments of those countries dependent on primary commodity export trade, instability in prices and revenues has been of great concern. In recent years, the problems associated with primary commodity price and revenue instability have led many governments, especially those in LDCs heavily dependent on export trade in primary commodities to take steps to mitigate some of the undesirable effects of this instability. Government interventions affecting farmers' prices and incomes mostly began after the Great Depression of the 1930s. Such interventions originated in North America and Europe, and later spread to Australia and New Zealand and to former European colonies in LDCs (Campbell and Fisher 1982).

Government intervention to influence agricultural prices and incomes has been implemented using various methods, the two most prominent being the price and/or income stabilisation and support schemes. Price support often involves supply management schemes (including destruction of a proportion of supply, marketing quotas, input restrictions and import regulations) and financial methods (taxation, subsidies, deficiency payments and exchange rate adjustments). Stabilisation schemes have often involved the use of buffer funds, buffer stocks and international commodity agreements. These measures have usually been implemented by government agencies such as Commodity Marketing Boards.

Even before governments began to support and stabilise agricultural prices and incomes, in some countries farmers themselves had already taken steps to organise the marketing of their produce. This was done in order to secure better returns. So it was often the farmers who initiated creation of marketing cooperatives, some of which ended up as Agricultural Commodity Boards, to try to stabilise domestic prices of individual export commodities. In turn, stabilisation of prices was aimed at stabilising outputs and incomes.

Pressures to coordinate the marketing of agricultural commodities often arose during periods of declining incomes when it became apparent that individual farmers were weak, uncoordinated and mutually damaging. Hence farmers appealed for some orderly marketing arrangements through the creation of Commodity Marketing Boards (Campbell and Fisher 1982, Falvey 1985).

The pertinent issues concerning stabilisation schemes most relevant to this thesis are discussed in this chapter and include: the rationale for stabilisation policies, discussed in section 2.2; the types of the stabilisation policies, briefly reviewed in section 2.3; some historical developments of stabilisation schemes in the SPINs, using PNG as a case study, reviewed in section 2.4; the operation of stabilisation schemes, discussed in section 2.5; and some of the emerging issues on stabilisation policy in the selected SPINs, presented in section 2.6. Some concluding remarks are made in section 2.7.

2.2 The Rationale for Stabilisation Policies

Price stabilisation schemes can be defined as including programs aimed at reducing the dispersion of prices (Newbery and Stiglitz 1981). Stabilisation as a policy goal has been described by Houck (1974) as any conscious public effort to decrease or regulate the variability of commodity export market prices, quantities and incomes.

In broad terms then, the overall idea behind the establishment of stabilisation policies is to mitigate excessive variability in the micro– and macroeconomies of some given countries. It is expected that variability could originate from various sectors of the economy, but it is perceived that many export–dependent countries are most vulnerable to variability originating from commodity export markets.

For most LDCs, and the SPINs in particular, stabilisation policies are designed primarily to address the problem of variability accruing from commodity export markets. Discussion in this subsection is therefore mainly centred on those policies which are meant to reduce variability associated with commodity export markets. Rationalisation for the stabilisation policies is discussed in two parts: objectives and justification.

2.2.1 Objectives of the stabilisation policies

Objectives of stabilisation policies are often not stated succinctly. Newbery and Stiglitz (1981) have, however, given the broad objective for the establishment of most stabilisation policies as improving the welfare of primary commodity producers or, more generally, of commodity producing countries.

One likely reason for the lack of clarity of the objectives of stabilisation schemes could be that various interest groups – industries, farmers, government authorities and their respective agencies – have different and perhaps conflicting objectives. The consequence is that there is a lack of consensus regarding the nature of objectives. Moreover, objectives may change over time. It may also be the case that objectives differ between countries. However, given the many economic similarities in the selected SPINs, especially in the production and trade of commodity exports, differences between them in stabilisation objectives are unlikely.

In describing possible stabilisation objectives, it is useful to distinguish between international and national schemes.

(a) Objectives of international stabilisation schemes

Based on McNicol (1978), Sturgiss, Wong and Borrell (1987), Herrmann, Burger and Smit (1993), Morgan, Rayner and Ennew (1994) and Maizels (1994), some of the most frequently stated objectives of international commodity stabilisation schemes are to:

- raise and stabilise and/or maintain prices within agreed ranges.
- improve export earnings of LDCs.
- reduce debt indebtedness as a result of attainment of the above two objectives.
- encourage the flow of financial resources from the consuming developed countries to commodity–dependent exporting countries, as a result of the attainment of the first objective.

International commodity stabilisation policies often involve agreements between producing and consuming countries where agreed prices are to be kept within a certain range. Over the past decade, however, several major difficulties about some of the international agreements have arisen. For instance, as explained by Hirashima and Kuchiki (1988), some of the international arrangements have failed to stabilise prices. This has resulted mainly from some fundamental disagreements between producers and consumers

over the objectives of the price stabilisation agreements (Maizels 1994). For example, producers believe that floor prices should be protected as prices fall, while consumers believe that floor prices should be reduced in such situations.

(b) Objectives of national stabilisation schemes

Such disagreements and the perceived failure of international agreements led to the establishment of price stabilisation schemes which were to be managed by the producing countries themselves. These schemes have been established in many commodity–producing countries, including the SPINs for whom some of the changing commodity–specific price stabilisation objectives (Kiele 1987, Fleming and Piggott 1989) have been to:

- stabilise farmers' incomes (initial primary objective).
- stabilise prices received by farmers.
- contribute toward improved management of aggregate demand for domestic and imported tradeable goods and services, thereby helping to maintain macroeconomic stability.
- achieve revenue stabilisation at the national level, through stabilisation of exports (mainly using Stabex funds).

As observed earlier, objectives have changed over time. At least in PNG, the initial objective of stabilising incomes was to ensure that costs of production were covered. On reviewing the PNG schemes, Wheeler and Wyatt (1978) recommended that the schemes be aimed at stabilising prices. A historical moving average price was adopted to compute the threshold prices on which the payments of levies and bounties would be determined. More recently, as stabilisation funds became depleted, income stabilisation based on production costs was again adopted as the main stabilisation objective. Later on, stability for the general economy was added as one of the objectives. Stabilising revenues at the national level can enable governments to plan better on the basis of fairly certain levels of earnings.

2.2.2 Justification for the stabilisation schemes

Justification for stabilisation schemes has been based on various arguments. The arguments used also differ according to whether the stabilisation schemes are internationally– or nationally–based.

(a) Justification for internationally–based stabilisation

For internationally–based stabilisation, Behrman (1977) argued that there could be potential economic gains to both producers and consumers from stabilisation schemes. The magnitudes of the gains were, however, dependent on specific conditions of individual commodity markets.

The benefits of more certain prices for both producers and consumers could alone justify the setting up of price stabilisation schemes. More certain prices would be beneficial to producers in that planning uncertainties are reduced and investment rates raised. To consumers in industrial countries, more assured prices would help smooth planning in their expenditures, and would also ensure continuous flow of intermediate goods to commodity exporting countries.

It has also been argued that price stabilisation could enhance the humanitarian goals of security and mutual advantage between producers and consumers as well as stimulate economic growth (McNicol 1978). International stabilisation schemes can be gestures of goodwill by consuming industrial countries aimed at helping development of LDCs, some of which were their former colonies.

More recently, Maizels (1994) has argued that, rather than providing aid to LDCs, it could be better to stabilise and raise commodity prices in the long run. This could create a situation where a flow of financial resources from rich consumers in the industrial countries is directed to poor producers in the LDCs. Directing incomes from developed to developing countries through improved commodity prices by stabilisation was thought to be a way of redistributing income globally.

(b) Justification for nationally–based stabilisation

The justification for price stabilisation schemes in the SPINs appears to have been originally based on concerns about the welfare of smallholder producers. Depending on the extent to which smallholders rely on export earnings to maintain their living standards (Fleming and Piggott 1989), it is argued that export instability causes poverty problems for

smallholder producers in the SPINs (Wheeler and Wyatt 1978, SPC 1980). Using coffee as an example, it has been observed (Jolly, Beck and Bodman 1990), albeit with little empirical evidence, that smallholders become reluctant to maintain and invest in coffee production when unstable prices are experienced.

As suggested by Fleming and Piggott (1989), the justification for price stabilisation schemes was generalised to encompass both micro– and macro–level elements of the SPIN economies. At the micro–level, the schemes were meant to improve the welfare of small, poor producers so as to enable them to raise their output as well as incomes. At the macro–level, the schemes would enable better government planning and reduce the destabilising effects of export prices on domestic prices.

Subsequently, the SPIN governments further justified the existence of price stabilisation schemes as important financial reserves to be drawn upon to fund the costs of stockholding whenever required by international commodity organisations (Jolly et al. 1990). But this has not been observed as a frequently used alternative, and thus not a sufficient justification for the stabilisation schemes.

2.3 Types of Stabilisation Policies

There are many types of stabilisation schemes in existence, including cartels, supply contracts, international commodity agreements, buffer stocks, buffer funds, International Monetary Fund (IMF) compensatory financing facility and Stabex. Only the last five are discussed here since they are judged to be most relevant to export instability situations in the SPINs.

2.3.1 International commodity agreements

International commodity agreements (ICAs) have been in existence since the 1930s. They evolved from the regulatory schemes of the 1920s which were initiated by individual governments or groups in the private sector. About 18 major ICAs had been registered in the past half–century (McNicol 1978). Normally, ICAs are more concerned with macro– rather than micro–stabilisation issues. Some ICAs have involved specific agreements on export quotas which were drawn up by international commodity organisations of which both producing and consuming nations were members. Supply quotas based on output in some base period were used to limit quantities traded. Restrictions on trade between members and non–members have also been used to maintain a minimum price level. The aim is to keep

prices below a specified ceiling price and above a specified floor price (McNicol 1978). The major instrument of ICAs is supply restriction in order to maintain competitive prices.

Limiting quantities of commodity exports usually entails some form of stock management such as buffer stock. The buffer stocks are then managed by either the international organisation itself or by the exporting countries. The International Cocoa Organisation (ICCO) and International Sugar Organisation (ISO) are classic examples of the former method while the International Coffee Organisation (ICO) was an example of the latter (Falvey 1986).

2.3.2 Buffer stocks

Individual countries maintain buffer stocks for various reasons including protection against crop failures, strategic stockpiling and maintenance of prices (McNicol 1978). However, in this thesis the concern is with buffer funds as a means of stabilising commodity export prices and revenues.

The management of buffer stocks entails the buying, storing and selling of commodity stocks. Buying and storing are conducted when prices are low while selling is done when prices are high. Thus, buffer stockpiling is a supply control strategy directed to price stabilisation. In sum, buffer stock schemes stabilise prices by transferring commodity supplies from one sale period to another (Campbell and Fisher 1982).

Buffer stocks are managed by both international commodity organisations and commodity producing countries. For instance, the ICCO has authority for stockpiling retained cocoa while coffee stocks are retained mainly by the producing countries.

2.3.3 Buffer funds

Buffer funds have been more common than buffer stocks and are the basis of currently operated schemes in the SPINs. Buffer funds usually involve a deduction of producer prices when export prices are high and a supplementation of producer prices when export prices are low. Given that most SPINs are 'price takers' in commodity export markets, buffer funds are used to account for fluctuating prices received for their commodity exports. The aim is to ensure that the prices paid to export commodity producers are less variable than the export prices.

While the primary objective of the buffer funds is fundamentally the same as that of the buffer stocks (i.e., stabilising prices to producers), buffer fund schemes mitigate price variability by transferring money from one period to another (Campbell and Fisher 1982). Many of the commodity–specific price stabilisation schemes, such as those for copra in PNG, Fiji and SI, cocoa in PNG and SI and coffee in PNG, are typical examples of buffer fund schemes.

2.3.4 IMF compensatory financing facility

The IMF compensatory financing facility is an international arrangement designed to give commodity–exporting countries relief from exogenously generated and temporary shortfalls in export revenue. The main focus is macroeconomic stabilisation. The IMF finance facility began in 1963 as a low conditionality (soft loan) method for giving temporary loans to support countries suffering from balance–of–payment problems as a result of shortfalls in export receipts (Falvey 1986, Fleming and Piggott 1989, Maizels 1994).

Countries are eligible to draw up to 100 per cent of their fund quotas. This facility applies to all exports in general and, since 1981, the facility has been expanded to cover even exports in cereals. In the past, Fiji, PNG, SI and Western Samoa (by virtue of being members of the IMF) have utilised funds from the IMF financing facility (Falvey 1986). Since the early 1980s, the IMF facility has become highly conditional on IMF approval of the domestic adjustment policies of borrowing LDCs (Maizels 1994). Actual operations of the IMF financing facility in the SPINs have been discussed in detail by Reddy (1984), Guest (1985) and Falvey (1986), among others.

2.3.5 European Union Stabex

The Stabex scheme, operated under the Lome Convention, is financed by the European Union (EU), and is aimed at reducing revenue variability at the macroeconomic level. Stabex started in 1975 as part of the first Lome convention cooperation treaty between the EU and the African, Caribbean and Pacific (ACP) countries. Hence, Stabex benefits only countries from the ACP region which export to the European Union (Hewitt 1983).

ACP countries are compensated for the shortfalls[4] in commodity revenues from specific products or product groupings destined for EU markets. Countries are eligible to ask for compensation if the commodity in question represents at least 2 per cent of total exports for the previous year. At the same time, the drop in revenue should be at least 2 per cent of average exports to EU over the same period (Falvey 1986, Fleming and Piggott 1989) which, according to Hewitt (1983), is the previous four years.

One advantage of Stabex is that compensation is repayable either on concessional terms (as has been done for Fiji) or not repayable at all (as is the case in many SPINs). The latter means that the Stabex funds are paid grants (Hewitt 1983). Thus, Stabex is a highly concessional, low–conditionality aid fund to ACP countries which suffer from severe balance–of–payment difficulties due to earning shortfalls from commodity exports to EU (Hewitt 1983). Stabex also gives a form of insurance coverage or guarantee by compensating for any shortfall. Most of the SPINs which have exported to the EU have, at one time or another, drawn funds from Stabex.

2.4 Historical Development of Stabilisation Schemes in SPINs

Given that PNG has probably had greater experience in operating stabilisation schemes than other SPINs, it is fitting that most examples used in reflecting on the history of stabilisation policies in the selected SPINs are drawn from PNG. In fact, one of the earliest SPINs stabilisation schemes was in PNG whence the concept and usage of the schemes spread to other SPINs.

The first SPINs' stabilisation scheme was established under colonial administration in 1946 in PNG. Its primary objective was to stabilise copra farmers' incomes. Due to its apparent success, similar schemes were established in PNG for cocoa (in 1974), coffee (in 1975) and oil palm (in 1983). The objectives of the latter three stabilisation schemes emphasised the stabilisation of prices rather than of incomes (Kiele 1987, Beck and Dalton 1987).

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4 According to Hewitt (1983), a shortfall in the EU sense is defined as a fall in export revenues, by product, in current prices measured against the annual average sales to EU markets over the previous four years.

2.4.1 Copra

Funds were first set aside for a newly introduced copra stabilisation scheme in 1946. To administer the funds, a Copra Industry Stabilisation Board was instituted in 1954. This scheme followed the model set up by the 1948 Australian Stabilisation Bill (Beck and Dalton 1987).

In 1959, producer contributions to the fund were discontinued as the held balance was found to be sufficient to sustain operations. The first bounties were paid out to producers in July 1966. Contributions from producers remained at zero level until the early 1970s. In 1972, substantial world price declines compelled the Board to abandon its policy of preserving the principal and paying bounties from interest earnings only (Beck and Dalton 1987).

In 1974, the Copra Marketing Board took over the functions of the Copra Industry Stabilisation Board and it has been running the stabilisation funds since then. Declining world prices from 1972 to late 1983, with some brief recoveries in 1974 and 1979, led to a depletion of fund resources. For the first time, this made it necessary for the Copra Marketing Board to apply for government guaranteed loans which were granted in 1982. Fortunately, prices boomed in 1983 and the loans were repaid (Beck and Dalton 1987).

Subsidised vegetable oil exports from the EU and the United States of America (USA) led to a price slump of copra in 1985. This prompted the Copra Marketing Board, in conjunction with the PNG Government, to arrange for another loan to be received during the 1987 period when funds were expected to be exhausted (Beck and Dalton 1987). In fact, by 1991, the Copra Marketing Board had borrowed up to K17 million or 75 per cent of the 1991 projected value of coconut oil and copra exports (Fleming and Coulter 1992).

2.4.2 Cocoa

The concept of a cocoa stabilisation fund first grew out of the Cocoa Industry Act of 1974. The cocoa stabilisation fund was to ensure that smallholder producers received returns for their cocoa comparable to the going minimum rural wages. Plantations were also expected to receive returns slightly higher than the average plantation cost of production (Beck and Dalton 1987).

Without payments of bounties, cocoa stabilisation funds continued to increase with time. It was not until June 1980 that, due to a rapid decline in world cocoa prices, the Board started to pay out bounties. Since then, cocoa prices have generally remained low and the

Cocoa Board has been paying out bounties more often than it has collected levies (Beck and Dalton 1987).

In 1989, the cocoa stabilisation funds were depleted. To bail out the industry, the government stepped in and guaranteed an interest–free loan. Thereafter, some grants and more loans guaranteed by government were provided to the industry (Gimbol 1992). By 1991, up to K31 million, representing about 80 per cent of one year's export value at the 1989/90 prices and volumes, had been borrowed by the Cocoa Board in order to support the bounties paid to producers (Fleming and Coulter 1992).

2.4.3 Coffee

According to Beck and Dalton (1987) and Jolly et al. (1990), the PNG coffee industry fund originated from the Coffee Marketing Board's reserve fund. The coffee stabilisation fund started in 1975 (Kiele 1987, Mitio and Bodman 1987). The initial purpose of the fund was to meet obligations to finance stock accumulations as set out by the ICO. Because of the deteriorating market situation from coffee over–supply, the Coffee Marketing Board decided to increase levies to allow equalisation of returns to producers who had exported to both member and non–member countries of the ICO.

During 1971/72, the coffee market situation continued to deteriorate further. This obliged the Coffee Industry Board to negotiate a loan to finance a major stockholding and disposal program. No major problem was encountered in selling the coffee stocks, particularly to states which were not ICO members, and the loan was repaid in the following year (1973/74).

Frosts in Brazil in 1975 affected coffee production in that country with the result that coffee prices improved dramatically. This led the PNG Coffee Industry Board to increase the levy to the maximum allowable rate without undue difficulties, so that the fund grew considerably. The high prices further prompted the government to change the legislation which imposed a variable levy based on fob coffee export prices. The resulting 1976 Coffee Industry Act then stated that (Jolly et al. 1990):

The main purpose of the Fund is to stabilise the coffee industry by giving the board the financial ability to implement schemes relating to –

(a) stabilisation and equalisation of prices, and

(b) stockholding of coffee.

This was taken to imply that the fund could be used to finance a stockholding scheme when quotas were in force and to support prices when they fell below the cost of production. The fund continued to grow and by 1981 the fund was at K59 million. During the next four years, the amount provided K14.5 million and K32.5 million for bounties and subsidies, respectively[5]. At the end of 1986, the coffee industry fund stood at its highest level at around K120 million. Ever since, bounties have been declared, leading to a steady decline of the balance which reached only K24 million in late 1989. With the failure to negotiate a new International Coffee Agreement in 1989, the trend of depleting the coffee funds continued until early 1990s when the funds were exhausted (Jolly et al. 1990, Fleming and Coulter 1992).

2.4.4 Oil palm

Under the umbrella of the Oil Palm Industry Stabilisation Funds Act of 1983, three separate stabilisation funds were set up in June 1983. These stabilisation funds, administered by the Oil Palm Industry Stabilisation Board, were to cover three separate settlement schemes (Hoskins, Bialla and Higaturu), thereby exempting the estate producers. Oil palm thus became the first industry to practise selective stabilisation. Following the setting up of the funds, oil palm prices rose to record levels in PNG (Beck and Dalton 1987).

As world oil palm production expanded, however, world prices for palm oil fell, and 1986 saw the beginning of bounty payments from oil palm stabilisation funds. As prices remained low, bounties continued to be paid. The same trend has continued into the early 1990s up to the point of exhausting virtually all the funds (Jolly et al. 1990, Fleming and Coulter 1992).

2.4.5 Lessons learned

From this review, it appears that substantial amounts of resources have been devoted to price stabilisation in the SPINs. This is a process which has been going on for at least the past four decades, which implies that variability of commodity export prices and revenues is

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5 Bounties are payments made from stabilisation funds to increase the producer prices of export commodities while subsidies are financial assistance by governments (usually given as direct payments to producers as a way of raising their incomes) to support particular industries or services. At one time, subsidies were paid to PNG coffee exporters to sell coffee to countries that were not members of the International Coffee Agreement (Jolly et al. 1990).

familiar problem in the SPINs and that much time and effort have been expended in industry policy–making decisions regarding price and revenue stabilisation schemes.

Over time, the objectives and operations of the schemes have changed. While the current objectives appear to involve both macro– and microeconomic elements, they are not defined clearly by either the government or the respective industries. Although the schemes were supposed to be self–financing, they often ended up relying on grants as well as loans on government guarantee to maintain their operations, thereby ending up mostly as subsidy schemes. As a consequence, it is evident that, unlike the experience in some other countries, price stabilisation schemes in the SPINs have generally not been used as sources of tax revenues for governments.

Rather than rely on empirical evidence, the establishment of the schemes was based on faith in their effectiveness as well as on assumptions about the external causes and sources of variability. Hence, the schemes were guarding against instability from only one (the external) side rather than from both the external and domestic sides.

2.5 The Operations of Stabilisation Schemes in the SPINs

Although there are some minor operational differences between one stabilisation scheme and another within and across the SPINs, the basic operational framework is similar amongst these schemes. Their modus operandi is to deduct levies from producer payments when the prices are above a threshold level. The collected levies are deposited in stabilisation funds which are usually held in banks. During periods of below–average prices (when export prices fall below the threshold levels) bounties are paid out to producers. The levies and bounties are based on some kind of moving average export prices, and are determined by the movement of prices around the threshold levels. In effect, levies are akin to ad valorem taxes while bounties are akin to subsidies (World Bank 1986, Mitio and Bodman 1987, Opa 1991).

For computing the threshold prices, different stabilisation schemes have adopted similar formulae which, however, have tended to vary across the schemes in the width of the band around threshold price where levies and bounties are not applicable. Initially, most of these schemes used the cost of production as the basis for computing the threshold prices. But with the passage of time, that basis has changed within and across the schemes.

For instance, over the past 40 years or so, the PNG Copra Stabilisation Scheme authorities have tried a number of strategies as a basis for determining threshold prices. First, a survival strategy (using the cost of production of the plantations) was adopted; a short–term

moving average price strategy involving a six–month moving average price was introduced in 1959. In 1974, a cost–plus strategy was introduced. This involved selecting a margin over the cost of production as the benchmark for collecting levies or paying bounties. A long–term (seven–year) moving average strategy, meant for smoothing out price fluctuations around the long–term trend, was then enforced. With a view to maintaining producer prices at around K200 per ton and sustaining the fund longer, a support–price strategy was introduced. This was not based on the cost of production but, rather, was based on a support level of around K200 per ton below which it was expected that producers would substantially cut back production (Bai 1987).

2.6 Emerging Issues on Stabilisation Policies in the SPINs

Price stabilisation schemes in the SPINs have generated considerable controversy as to objectives, rationale, effectiveness, management and relative benefits and costs. These issues are discussed in two parts: effectiveness and other emerging issues.

2.6.1 Effectiveness of the price stabilisation schemes in the SPINs

Over the years, questions have been raised about the effectiveness of the price stabilisation schemes in the SPINs. More recently, however, the debate on the efficacy of the schemes has intensified.

Critics of the price stabilisation schemes (Piggott, Fleming and Kunert 1986, Fleming and Piggott 1989, Jarrett and Anderson 1989, Mwesigye 1989, Fleming 1992) argue that they have not been effective in offsetting fluctuations in the macroeconomy. In addition, it is argued that the schemes have largely been ineffective and inefficient in reducing commodity price variability and are a poor justification for the existence of marketing organisations in the SPINs. On the macroeconomy, it is argued that export prices produce responses too lagged to be of immediate use, and that changes in fund deposits have been too small to exert any impact on money supply. More importantly, it is alleged that, from the microeconomic viewpoint, price stabilisation has in fact led to negative effects for producers – net income transfers from smallholder to largeholder producers have been noticed in the past. Further, it is contended that forced savings earning low rates of interest have been imposed on producers, resulting in depressed private rural investments.

Advocates of the price stabilisation schemes (SPC 1980, Garnaut and Baxter 1984, Shaw 1985, Manning 1987, World Bank 1988, Gumoi 1989, Ilala 1992) have maintained that

the schemes have been effective in reducing variability in prices and consequently incomes at both the micro– and macroeconomic levels. Further, it is claimed that, because of this decreased instability, there have been improvements in planning and increased investment in the rural areas. Some evidence to support these assertions can be deduced from the fact that production of many of these commodities has increased over time. It is further argued that, due to lack of financial institutions in the rural areas, price stabilisation schemes have served the important role of helping rural people save their windfall incomes which otherwise would have bent spent.

2.6.2 Other emerging stabilisation issues in the SPINs

The current schemes have suffered from other problems such as underwriting by governments of the depleted stabilisation funds. Further, the current schemes seem not to have been self–financing, not balancing (for example, gross levies collected not well accounted for) and not predictable over time. Rather than being price stabilisation schemes in the real sense, the schemes are moving towards price support schemes. Such problems create further grounds for attacks by critics of price stabilisation schemes.

It is also claimed that price stabilisation schemes have been quite expensive, especially in terms of resource use. Scarce financial resources, whose opportunity cost is substantial, are tied up unnecessarily in stabilisation funds which earn lower than normal market interest rates (the funds are usually deposited in central rather than commercial banks). The schemes have also allegedly led to intersectoral resource use distortions. Skilled and experienced administration personnel are deployed in running the schemes. Alternative stabilisation strategies (especially through fiscal and monetary policies) have been suggested (Fleming 1992).

Lastly, but perhaps most importantly, price stabilisation schemes in the SPINs have been implemented without substantive empirical evidence to suggest the causes/sources of export market variability. This lack of empirical evidence for the price stabilisation schemes in the SPINs is the underlying motivation for this thesis which is designed to address some of the emerging issues on the existence of the commodity–specific price stabilisation schemes in the selected SPINs.

2.7 Concluding Remarks

While many resources of SPINs has been devoted to price stabilisation, operation of price stabilisation was based on faith in their effectiveness – rather than on empirical evidence. Given that the schemes were to reduce variability in commodity export markets, the causes and/or sources of this variability were assumed, again, with little empirical evidence to be externally–induced. Gathering the evidence of the causes and/or sources of this instability forms the basis for this thesis. Subsequent chapters contain the description of the analysis.

Chapter 3

THE NATURE, EFFECTS, CAUSES AND SOURCES OF CERV

In this chapter an attempt is made to put together related post–1950 work on export instability. From the literature reviewed, it is evident that a large amount of work has been devoted to this subject. How this thesis fits into the overall body of knowledge on economic instability is demonstrated in this chapter which is divided into four broad sections: (a) export instability in general; (b) underlying causes and sources of instability; (c) export growth, instability and economic growth; and (d) export growth and instability in the South Pacific region.

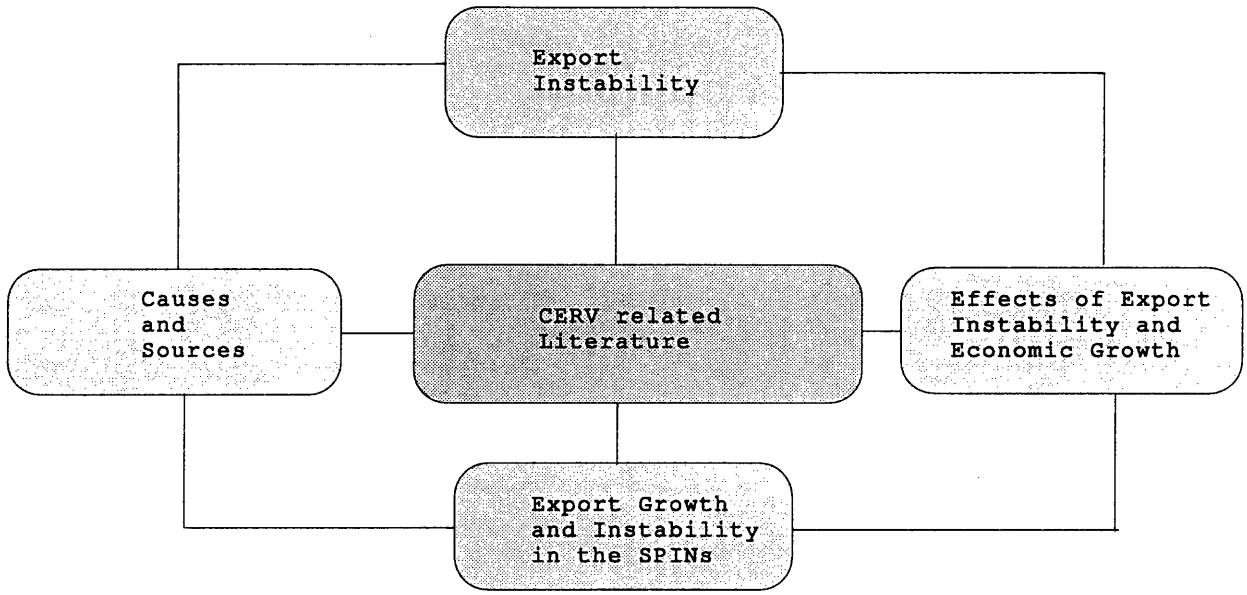
3.1 Introduction

In order to place this thesis in perspective, there is a need to be familiar with previous related research. The literature review enhances the exposition of this thesis into the mainstream studies on commodity export growth and instability. As well, some of the strengths and weaknesses of previous studies are also pin–pointed. Consequently, the present thesis has tried both to overcome some of the weaknesses and to benefit from some of the strengths. It is also envisaged that this literature review might help in assessing the relevance of the material to the purpose and scope of the present thesis.

Within this chapter, therefore, related literature on past research and development in export growth and instability and economic growth and instability relationships is reviewed. The focus is particularly on literature surrounding the nature, extent, impacts, causes, and sources of commodity export instability since the 1950s. Literature on commodity export growth in relation to economic growth is similarly reviewed. The way this literature review is organised is presented in Figure 3.1, where joining lines depict links and overlaps between the sections in the boxes.

As reflected by the complexity of the reviewed literature, a diverse and large amount of research has been undertaken on the commodity export–instability–growth nexus. To reduce this complexity, related literature is grouped together into broad sections (shown in Figure 3.1) and, in most cases, reviewed chronologically within the sections.

Figure 3.1: Organisational structure of the literature review



In spite of all this literature, it is noted that thus far there has not been much general consensus as to the nature, extent, impacts, causes and sources of export instability. It is also noted that the analytical methods used to study the commodity export–related problems have been changing with time. For example, from the 1950s to almost beyond the mid 1980s, the research was dominated by correlation analyses of various types involving inter– or cross–country data. From the 1980s, causal analyses utilising time series data started appearing. The results of all these methods applied to various data have not only been mixed and contradictory, but they have also remained controversial and inconclusive, leading to numerous and perhaps misleading policy implications. Hence, questions related to commodity exports and the economic growth and instability nexus still remain unresolved.

3.2 Export Instability

Economists have studied the problems associated with export price, quantity and earnings instability for some four decades (see, for example, UN 1952, Caine 1954, Coppock 1962, Glezakos 1973, Knudson and Parnes 1975, Yotopoulos and Nugent 1976, Rangarajan and Sundararajan 1976, Brook and Grilli 1977, Lancieri 1978, Piggott 1978, Stein 1979, Love 1979a, Glezakos and Nugent 1983, Lloyd and Procter 1983, Moran 1983, Savvides 1984, Myers and Runge 1985, Fleming and Piggott 1985, Piggott et al. 1986, Falvey 1986, Habeck, Brown and Abbott 1988, Fleming and Piggott 1989, Smith and Lapp 1993). Much of this work has been devoted to defining, measuring and determining the causes and effects of export earnings instability.

For instance, Glezakos (1983) defined export instability as a measure of the unexpected or unpredictable fluctuation in export revenues. Hence, instability is a measure of uncertainty and not a shortfall of export earnings. This definition reinforced an earlier idea of Yotopoulos and Nugent (1976, Ch. 8) that the welfare losses from instability are associated with 'uncertainty' rather than with 'shortfall' effects. Most of these studies also argued that LDCs suffer more from export earnings instability than DCs. In fact, according to Erb and Schiavo–Campo (1969), Lawson (1974), Coppock (1977) and Love (1984), this difference has widened over time, although the absolute level of instability has declined for both groups.

3.2.1 General views on export instability

In spite of lengthy debates on the consequences of export price, quantity and revenue variability for LDCs, many unresolved issues still remain as subjects for investigation and discussion in the development economics literature. The traditional view regarding the consequences of export variability on the domestic economies of LDCs has been that of pessimism – pessimism because export variability is often thought to affect adversely the short–run stability and long–run growth of incomes (Love 1992b).

Brook and Grilli (1977) noted that, even if it may not seem to pose an insurmountable obstacle to economic growth, it appeared clear that export instability made the management of the economies of the LDCs more difficult. Brook and Grilli further explained that export revenue instability causes difficulties at the macroeconomic level, particularly in fiscal revenue and government spending. In addition, fluctuations cause serious economic inefficiencies at the microeconomic level. Periods characterised by tight supply and high prices exert strains on the resources of both producers and consumers. Similarly, periods of

low demand and low prices lead to unused or underutilised capacity resulting in reduced profits and lower incomes in producer countries. Moreover, export fluctuations complicate investment planning and often cause unjustified investment booms and slumps.

Love (1992a) employed a Granger/Sims reduced form approach and found that export variability induced short–run macroeconomic instability in many of the 20 trade–dependent countries studied. One of Love's conclusions supports the conventional view that export variability induces short–run domestic instability largely through an initial impact on producers' incomes and government revenues, which are important components of aggregate demand.

The foregoing implications are claimed to be more serious where the productive structure of the economy is composed of small–scale holdings, where producers' cash incomes are determined primarily by receipts from exports and where producers have low (or zero) marginal propensity to save out of current incomes. Under these conditions, export instability reduces consumption expenditure, thereby spreading the impact to other domestic sectors. The impact on the government sector arises primarily from the impact on total government revenues. These effects are transmitted mainly by the impact of instability on the proceeds from taxes on export trade. In effect, the variability problem generates uncertainty and imperfect knowledge, exerting adverse effects on two main fronts. First, uncertainty about government revenue availability further complicates the difficult task of economic planning. Second, uncertainty may affect private sector investment as well. Thus, the internal allocation of resources may deviate substantially from the optimum. As a result, investors may find it difficult to make long–term planning decisions as their ability to import needed machineries, equipment and other material inputs depends on the performance of the economy's export markets (Olayemi and Olayide 1976, Oladeji 1976, Fleming and Piggott 1989, Love 1992a b).

In fact, according to Oladeji (1976), a change in total export earnings will have a direct effect on export producers' incomes. The multiplier effect of this will in turn have an impact on producers' consumption and investment expenditures and so affect indirectly the incomes of other producers in the economy. In addition, there is also the accelerator effect on the overall investment environment. These two effects (the multiplier and the accelerator) produce changes in GDP in the same direction. In the absence of government intervention, the final changes in GDP and in other related economic variables may become more than proportional to the initial changes in export proceeds.

3.2.2 Impacts of export instability

Studies examining the relationship between export fluctuations and economic growth have had mixed results with no obvious consensus. Past work has almost invariably led to debates that emphasised the negative impacts of export fluctuations on the performance of open economies, especially those of the LDCs (Moran 1983). Adverse impacts were claimed on the grounds that the uncertainty attributed to export instability could diminish the level and efficiency of investment and thus affect economic growth. Empirical evidence supporting the negative impact assertion has come from the works of, for instance, Nurkse (1958), Brainard and Cooper (1968), Kenen and Voivodas (1972), Glezakos (1973), Voivodas (1974), Rangarajan and Sundararajan (1976), Lim (1976), Adams, Behrman and Roldan (1979), and Dick, Gupta, Mayer and Vincent (1983), among others.

The negative impact assertions were argued along different lines of thought from both the theoretical and empirical perspectives. For example, among others, Caine (1958), MacBean (1966), Erb and Schiavo–Campo (1969), Knudsen and Parnes (1975), Knudsen and Yotopoulos (1976), and Yotopoulos and Nugent (1977, Ch. 8) argued, contrary to conventional belief, that uncertainty in export earnings might in fact encourage economic growth. Examples of empirical evidence for this argument were also provided.

For instance, Erb and Schiavo–Campo (1969) found that income per capita was not related to export instability in LDCs, nor was the level of socioeconomic development related to export instability. At the same time, Erb and Schiavo–Campo also found a close positive association between export instability and economic size of LDCs in the period 1954–66.

Adopting a stance different from the traditional treatment of instability, Knudsen and Yotopoulos (1976) attempted to measure uncertainty from export instability in terms of the unexpected or transitory component of export earnings. From a sample of 38 LDCs, their empirical results suggested that instability tended to have effects that were conducive to economic growth. Knudsen and Yotopoulos explained these results by asserting that higher rates of investment were produced than otherwise (i.e., with stability) would have been the case.

Lim (1980) examined the effects of income distribution and export instability on the savings ratio of a group of 12 DCs and 52 LDCs during the period 1968–73. Employing single–equation regression analysis, Lim's results did seem to support the contention that savings rates were positively related to levels of export instability. There was more support for this kind in the LDCs than in the DCs.

In the middle ground, other researchers (for example, Lim[6] 1972, Kenen and Voivodas 1973, Khalaf 1979, Stein 1979, Nziramasanga and Obidegwu 1981, Moran 1983, Demetriades, Al–Jebory and Kamperis 1993) argued that all the relationships between export and economic growth impacts have not proved to be stable through time. In fact, Lim (1972) found that, although there was a fairly high magnitude of economic instability resulting mainly from fluctuations in export earnings of rubber and tin in Malaysia, the transmission of instability from these export industries to the rest of the economy appeared relatively small.

In attempting to provide empirical evidence on the nature of the relationship between country size and the rates of economic growth, Khalaf (1979) showed that: (a) a significant relationship between country size and economic growth did not exist, (b) the relationship between dependence on trade and economic growth was not clear, and (c) a consistent relationship between export concentration and economic growth was not present. Effects of export instability, during the 1960s, on the economies of three East African countries were analysed by Stein (1979). Results pointed to no firm evidence that export instability seriously disturbed the economies of Kenya, Uganda and Tanzania. However, a hint of an adverse relationship between export instability and export growth and production growth rates for some commodities was noticed, particularly for Tanzania and Uganda.

In a study based on cross–section analysis for a sample of 30 countries, 18 belonging to Latin America, covering the period 1954–75, Moran (1983) inferred that instability of aggregate export earnings did not appear to have statistically significant effects on long–run economic growth. However, Moran also indicated that, over the short run (about a decade), economic growth could be affected negatively. In the long run, instability is offset by internal adjustments to the negative impacts. Moran also found that instability in total export earnings was consistently higher than the price and quantity instability, implying that price and quantity fluctuations tended to reinforce each other (Falvey 1986). Of the latter two, price instability was always higher than quantity instability. A negative impact could be expected when price and quantity instability appeared to reinforce each other, but this was not always the case in Moran's study.

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6 In another study, as previously mentioned, Lim (1976) argued that instability was bad for the economies.

3.3 Underlying Causes and Sources of Instability

3.3.1 Causes of export instability

Determinants of export instability have been investigated by a number of researchers (see, for example, Knudsen and Parnes 1975, Sheehey 1977, Lawson and Thanassoulas 1981, Charette 1985, Myers and Runge 1985, Fleming and Piggott 1985, Fleming and Piggott 1989 and Myers, Piggott and Tomek 1990). While most of the previous work attempted to explain inter–country variations in aggregate export earnings instability, a few studies such as Leith (1971) have considered the patterns of export instability. Charette (1985) investigated the determinants of export instability in the primary commodity trade of LDCs and his empirical results pointed to internal fluctuations as a major determinant of export market instability. To accomplish his objectives, Charette used OLS regressions based on a simple market model where fluctuations resulted from shifts in demand and supply. Charette found that existing trade agreements with significant impacts were destabilising, and geographical concentration tended to have a stabilising influence on revenue per unit and, to a lesser extent, on export earnings. Domestic consumption appeared to exert strong destabilising influence on export markets, resulting mostly from domestic demand instability.

Traditional causes of instability have been claimed to be highly dependent on primary commodity exports, geographical and commodity concentrations. Studies done by Massell (1970) and Coppock (1977) have argued that geographic concentration of export trade, an externally–induced problem, results in greater export instability. Murray's (1978) analyses of data from 26 DCs and 75 LDCs showed some existence of closer association between ranks of earnings and quantity instability than between ranks of earnings and price instability.

A comparative study of export instability in DCs and LDCs for the period 1946–1958 was conducted by Coppock (1962). He concluded that mean instability of LDCs was much greater than that of DCs. (Other studies with similar conclusions include Erb and Schiavo–Campo (1969), Massell (1970), Naya (1973), Glezakos (1973) and Murray (1978). This finding explains why many economists have concentrated on studies of instability in the LDCs. Askari and Weil (1974) investigated the stability of export earnings in 70 LDCs during the period 1954–68. They rejected the hypothesis that LDCs exporting high proportions of primary commodities suffered greater export instability. Askari and Weil argued that instability appeared to be a larger problem for exporters of manufactured rather than non–manufactured products.

Commodity and export trade concentrations have also been studied as factors causing export fluctuations (see, for example, Michaely 1962, Massell 1964, Katrack 1973, 1976, Tuong and Yeats 1976, Kingston 1976, Souter 1977, Hock 1977, Love 1979b, Lawson and Thanassoulas 1981, Wong 1986). While most of the empirical evidence from these studies has been mixed and inconclusive, some studies found no significant statistical relationship between export trade (or geographical) concentration and instability (Massell 1964, Naya 1973, Kingston 1976). Therefore, diversification as a means of reducing export instability received little support from these investigations. However, studies done by Michaely (1962), Souter (1977), Hock (1977) and Love (1979b) found some positive and significant statistical relations between export trade and commodity concentration and export instability.

Naya (1973) found that the larger the value of exports, the smaller the magnitude of fluctuations, and that the larger the country's exports to its neighbouring countries, the greater the level of export instability. Mathieson and McKinnon (1974) studied the openness of the economy and stability of export earnings and concluded that the more open the economy, the more stable are export earnings. Khalaf (1976) used regression analysis on data from 83 countries to test, among others, the hypothesis that there existed a negative relationship between country size and export instability. The hypothesis was rejected and it was concluded that no such relationship existed. Sarris (1980) used a decision–theoretic approach to derive excess demand functions for grain for developing countries with food–deficit and foreign–exchange constraints. He found that despite a drive towards self–sufficiency, a country can improve its food security position by reducing the variability in its grain requirements.

In addition to the above studies, Love (1984) conducted a related study which investigated the determinants of export performance and instability of some 27 LDCs. The results obtained for the individual countries and across the sample tended to support the importance of supply–side factors. That is, Love's results suggested that export performance in most LDCs was relatively more sensitive to domestic factors than had hitherto been claimed by the LDCs' 'trade pessimists' (as described by Love 1984).

Similar to Love's study, Athukorala (1991) tested the hypothesis that, while adverse changes in world demand do impede export performance, superior export performance for individual countries comes mostly from active supply–side policies. This hypothesis was tested for seven traditionally agricultural–exporting countries in Asia (Malaysia, Thailand, the Philippines, Indonesia, India, Pakistan and Sri Lanka), over a period from 1960–1986. Although the results suggested in general that world demand was an important determinant of export performance, there was ample support for the hypothesis that individual countries

could achieve superior export performance through active supply–side policies. In other words, the pessimistic view that export prospects are predominantly determined by world demand, leaving little chance for supply–side policies, received limited empirical support. Thus, a country could expand its exports under given world market conditions by improving upon its market share in its traditional exports and diversifying into new export products.

Both Love's (1984) and Athukorala's (1991) findings gave empirical support to policies designed to improve domestic supply conditions for export markets.

On diversification, regarded in the past as an obvious and largely unqualified strategy of development policy to dissipate export instability, Love's (1992b) results led to the conclusions that:

(a) While diversification may result in lower degrees of export instability, that in itself was not sufficient to support such a strategy. Thus, diversification may not necessarily be a desirable policy option.

(b) There were contrasting differences between large and small exporting countries on the impacts of diversification.

3.3.2 Sources of export instability

On examining the mechanisms through which fluctuations in export earnings are generated, Wong (1981, p. 22) found that export earnings' instability originated mainly from foreign sources. Wong concluded that domestic supply fluctuations did not appear to explain many of the differences between countries in export instability, except among countries with very high food ratios in their exports. The instability of New Zealand's income terms–of–trade was decomposed (Lloyd and Procter 1983) into export quantity effect (19 per cent), commodity terms–of–trade effect (95 per cent) and interaction effect (–14 per cent), but about 41 per cent of the commodity terms–of–trade was directly attributable to specific commodity groups (Fleming and Piggott 1985).

Fleming and Piggott (1985), Myers and Runge (1985), Piggott et al. (1986), and Fleming and Piggott (1989) employed a variance decomposition method to investigate the sources of export revenue instability. The variability in the major market variables (price, quantity and revenue) was found to come from underlying factors of demand, supply and demand–supply interactions. The main results from these studies indicate that the sources of variance contributions were variable across the countries, time periods, and commodities.

These results could be used as evidence in guiding policy decisions as to whether or not to operate commodity–specific price stabilisation schemes to reduce CERV in selected countries.

Alternative models in which export earnings' instability was traced to either domestic supply and demand or foreign demand variability were developed by Wong (1986). The relative merits of the models were investigated through multiple regression analysis. Wong used a sample of 50 LDCs over a period covering 1957–1972. The results generated from this investigation confirmed that export instability originated mainly from foreign sources. Specifically, some countries showed greater export instability because of larger variations in shares of their main export commodities in world trade and in major foreign markets. Domestic supply fluctuations explained a small portion of international differences in export instability. This was particularly important among countries with very high ratios of food products in exports. For the same countries, domestic demand fluctuations contributed significantly to export instability. This could be attributed to high ratios of domestic consumption of the food products for export.

Habeck, Brown and Abbott (1988) looked into the role of agriculture as a source of export earnings' instability in 27 countries. Twenty commodity aggregates, more than a half of them agricultural, were used to measure export earnings' instability. Their results showed that some agricultural subsectors were more unstable than others and that no individual sector was universally stable. Overall, agricultural subsectors tended to be among the more stable sectors in the low– and middle–income countries while industrial sectors were more stable in the high–income countries. This is also one of the studies that confirmed the traditionally held view that DCs have more stable export earnings than the LDCs in that nine high income countries had the nine most stable export earnings while five of the nine most unstable countries were low income (Habeck et al. 1988).

More recently, an application of VAR methods was employed in a study undertaken by Myers et al. (1990) in estimating sources of fluctuations in the Australian wool market. This approach was used to analyse relative contributions of supply, demand and policy shocks to unpredictable market fluctuations. VAR procedures were viewed as preferable because the Australian wool market was seen to have a complex and uncertain underlying market structure. With or without historical stockpiling activities by the Australian Wool Corporation, evidence from this study revealed that demand shocks were the dominant sources of wool market fluctuations. Stockpiling appeared to have slowed down the effects of demand shocks, thereby reducing their relative contribution to market fluctuations, reducing market uncertainty and increasing the average level of prices and revenues.

Kugler (1992) analysed the contribution of demand and supply shocks to the variability of output and employment using quarterly data for four DCs (USA, UK, Federal Republic of Germany and Switzerland) covering the period 1966–1988. A restricted long–run VAR modelling framework for output, employment, interest rate and inflation was adopted in this study. The analysis arrived at the following results:

(a) USA output and employment fluctuations seemed to be dominated by supply shocks in both the short and long run, while interest rates and price level fluctuations were dominated by demand shocks.

(b) Analyses for German and Swiss data showed that contributions of demand shocks to output and employment fluctuations were substantial and that price level variations were dominated by supply disturbances.

(c) UK data showed the US pattern of results for employment and price level, but demand and supply shocks were important for output and interest rate movements, respectively.

Clearly, the pattern of these results is mixed across countries and time horizons.

3.4 Effects of Export Growth, Instability and Economic Growth

3.4.1 Export instability and economic growth

Previous research on the relationships between export instability and economic growth in the LDCs has yielded diverse results. Some researchers (Kenen and Voivodas 1972, Glezakos 1973, Mathieson and McKinnon 1974, Oladeji 1976, Adams et al. 1979, Priovolos 1981, Moran 1983, Glezakos 1984, Gyimah–Brempong 1991, Serletis 1992) found a significant negative relationship between export instability and economic growth. Those who found a significant positive relationship between export growth and economic growth include MacBean (1966), Michaely (1977), Balassa (1978), Lam (1980b), Tyler (1981), Feder (1983), Savvides (1984), Chow (1987), Serletis (1992) and Dutt and Ghosh (1994), while those who found no significant relationship between the two variables include Yotopoulos and Nugent (1977), Nziramasanga and Obidegwu (1981) and Habeck et al. (1988).

Mathieson and McKinnon (1974), for example, made a more elaborate examination of the openness of the economy and stability in export earnings and economic growth. They

concluded that there existed a positive relationship between the openness of the economy and the stability of export earnings, imports and investment.

Lam's (1980b, p. 112) findings suggested a positive correlation between export instability and export expansion, i.e., export instability was most likely to be associated with rising rates of expansion of export earnings, particularly in the Western Pacific countries (WPCs). Further, this association implied that merchandise trade fluctuations might also have been correlated to domestic income expansion (Lam 1980b, p. 108). The results were based on statistical analysis which showed significant and positive rank correlations between export instability and export expansion for a sample of 15 WPCs and nine DCs for two time periods, 1961–1972 and 1961–1974.

Lam's results were refuted by Tan (1983, p. 222), and Glezakos (1983) claimed that there was a bias in the calculation of the instability index. They suggested that the positive rank correlation between export instability and export expansion was the result of fitting a linear trend to non–linear data. Indeed, when this bias was corrected, the results showed no significant rank correlations between export instability and expansion. The positive correlation between export instability and domestic income expansion, originally claimed by Lam, was also shown to be non–existent.

Moran (1983) undertook a cross–country analysis to examine the impact of export instability on the domestic economies of some LDCs. No clear generalisation came out of this study, although it showed that a negative impact could be expected when export instability was decomposed into price and quantity instability where they appeared to reinforce each other. This, however, was not always the case as the results were sensitive to particular time periods. Hence, this study was inconclusive.

In explaining the differences in the results of some of the above studies, Gyimah–Brempong (1991) explained that those who found negative relationships justified their results by claiming that export instability affects the supply of output negatively. This came about through the generation of uncertainty in long–term planning as well as through reduction of the availability of inputs at critical times during the production process. In consequence, for some producers, inputs become out of reach. Those who found positive relationships argued that LDCs respond to export instability by reducing consumption expenditures over time, thus increasing savings and investments. Those who did not find significant relationships between export instability and economic growth asserted that LDCs are able to anticipate the fluctuations in export earnings and prepare for them; hence export earning instability has no tangible effects on economic growth.

3.4.2 Export growth and economic growth – a general review

A large number of studies has been conducted on the relationships between export growth and economic growth. While it would be a difficult task to list all the studies on the export growth and economic growth links, a reasonable number of studies is reviewed below.

Michaely (1977) examined the correlation between export growth and rate of growth of the economy of 41 LDCs. He concluded that a positive association existed between growth of the economy and export expansion but that factors such as size of the economy, proximity to large foreign markets and export proportions had no apparent bearing on the rate of economic growth.

Relationships between export growth and economic growth in 11 LDCs that had established some industrial base were investigated by Balassa (1978). He found that export growth influenced favourably the rate of economic growth over and above the contributions made by domestic and foreign capital and labour. This study provided some evidence on the benefits of an export–orientation as compared with an import–substitution strategy for economic growth.

Tyler (1981) employed inter–country cross–sectional data from 55 middle–income developing countries for the period 1960–1977. The results revealed that there existed a positive and significant relationship between GDP growth and export growth. Both the Pearson and Spearman correlation coefficients, which were used in this analysis, were found to be significant at the 1 per cent level. This study also found a positive association between GDP growth and the growth of manufacturing exports and the rate of growth of direct foreign private investment.

Feder (1983) developed an econometric analytical framework to examine the sources of growth in relation to exports for a group of semi–industrialised LDCs in the period 1964–1973. The framework entailed a supply–side description of changes in aggregate output where aggregate growth was related through an underlying production function to changes in capital and labour growth. Hence, the average rate of GDP growth was decomposed so as to identify the contributions of aggregate investment, labour force growth and resource shifts into exports. Results suggested that growth could be generated not only by increased levels of aggregate labour and capital, but also by reallocating the existing resources from less efficient non–export sectors to higher productivity export sectors. Feder's study, therefore, provided evidence supporting the view that the success of economies which adopted export–oriented policies was due, at least partially, to the fact that such policies brought economies closer to the optimal resource allocation.

Using Spearman rank–correlation analysis, Kavoussi (1984) investigated further the relationship between export expansion and economic growth in a sample of 73 LDCs, utilising data for the period 1960–1978. The results indicated that export expansion was associated with better economic performance in both the low– and middle–income countries included in the sample. An important cause of this association was found to be the favourable impact of exports on total factor productivity. These results also demonstrated that the positive correlation between exports and economic growth was not limited to middle–income countries only, as was assumed by Tyler (1981).

Using regression analysis, Balassa (1985) studied the exports, policy choices and economic growth of 43 LDCs during the 1973–1978 period of external shocks, particularly after the 1973 oil price shock. Balassa's results indicated that the rate of growth of exports had an important effect on the rate of economic growth of many LDCs. LDCs at lower levels of development were better able to increase total factor productivity than those at higher levels. Further, it was found that higher shares of manufactured exports were also positively associated with economic growth.

Kugler (1991) used Johansen's (1988) multivariate cointegration approach to test for a long–run or cointegrating relationship between GDP, consumption and investment on the one hand, and exports on the other. Quarterly data for six DCs (USA, Japan, Switzerland, West Germany, UK and France) were used. Results indicated that the hypothesis that exports do not enter the cointegrating relationship with GDP, consumption and investment could not be rejected for USA, Japan, Switzerland and UK. It was only in France and West Germany that there seemed to be a strong interrelationship between export trend movement and GDP, consumption and investment. Thus, only modest empirical evidence was found in support of the view of export–led growth.

(a) Export promotion for economic growth – by standard statistical methods

For almost three decades, an export–led economic strategy (export promotion hypothesis) has been proposed and supported as the best medium of economic growth for many LDCs. Empirical work which established mixed and statistically significant positive correlations (associations) between export expansion and output or economic growth includes, among the many, Emery (1967), Maizels (1968a b), Voivodas (1973), Michalopoulos and Jay (1973), Michaely (1977), Williamson (1978), Fajana (1979), Balassa (1978, 1985), Tyler (1981), Feder (1982), Schenzler (1982), Feder (1983), Kavoussi (1984), and Greenaway and Sapsford (1994). Most of these studies have utilised cross–country regressions, using some measure of export performance as a regressor and GDP growth rate

as a regressand of a proxy variable for economic growth, employment and capital–stock growth rates.

The positive association between export expansion and economic growth has often been attributed to some possible externalities of competition in international markets, e.g., resource allocation efficiency, economies of scale and various acquired labour skills effects. However, most of the above studies neglected the importance of exports as a main source of foreign exchange for the much–needed imports of intermediate and capital goods which are responsible for economic growth (Esfahani, 1991). In addition, these studies did not distinguish between statistical association and statistical causality and its direction. In the causality method, knowledge of past export growth (for example) is used to improve the prediction of the future gross national product (GNP) growth beyond predictions that could be based on past GNP growth alone. Developing and using a simultaneous equations model, Esfahani (1991) demonstrated that the contributions of exports to the reduction of import shortages which restrict the growth of output in many semi-industrialised countries were the main reasons for the statistically significant positive correlations between export expansion and GDP/economic growth.

(b) Export promotion for economic growth – by causality statistical methods

More recently, studies on export expansion in relation to economic growth have focussed on causation and its directions (see, for example, Jung and Marshall 1985, Chow 1987, Hsiao 1987, Kwan and Cotsomitis 1991, Ahmad and Kwan 1991, Giles et al. 1992, Serletis 1992, Ghartey 1993, Sengupta and España 1994, Paul and Chowdhury 1995).

In response to the standard methods, Jung and Marshall (1985) used improved methods based on Granger causality tests to analyse the relationships between export growth and economic growth for 37 LDCs. Evidence in favour of export promotion was found in only four of these 37 countries. This strongly suggested that evidence in favour of export promotion was weaker than previous statistical work had suggested. Thus, statistical evidence in favour of export promotion is not as unanimous as it was thought previously since this weak evidence casts doubt on the efficacy of policies designed to enhance growth by pushing the export sector.

With additions from a study by Jung and Marshall (1985) and Greenaway and Sapsford (1994), a summary of the previous empirical studies having testing of the export promotion hypothesis as their main objective is given in chronological order in Table 3.1.

Chow (1987) used data from eight NICs and performed Sims' causality tests. He found evidence of uni–directional causality in only one country, evidence of bi–directional causality in six countries and no evidence of any causality in one country. Hsiao (1987) analysed data from four Asian NICs using both the Sims and Granger causality tests. He found only one case of causality from both tests, running in the opposite direction (economic growth to export expansion). However, the Sims' test indicated a feedback relationship between exports and GDP in the remaining three NICs. Thus, based on Sims' causality tests, Hsiao's (1987) analysis suggested that the rapid economic growth of the Asian NICs was not only achieved via export–promotion policies, but also realised many advantages from the domestically–oriented growth of industries and import–substitution strategies.

Kwan and Cotsomitis (1991), performed Granger causality tests between export size and national income for China for the 1952–1985 period. They found that any causality between export growth and output growth was either bi–directional or absent, depending on the time period chosen for the analysis. Bi–directional Granger causality was found for the 1952–1985 period but this evidence disappeared for 1952–1978. Kwan and Cotsomitis explained that this disappearance coincided with the adoption of an 'outward looking', or open–door, policy by the Chinese government.

Evidence of Granger causality for 47 African countries was examined by Ahmad and Kwan (1991) using total and manufactured real export levels and either real per capita GDP or its rate of growth. Weak support for causation running from economic growth to exports led to a rejection of the export–led growth hypothesis as a vehicle of economic growth in Africa.

Table 3.1: A summary of previous studies on the export–economic growth nexus

Study by	Data set	Main variables used	Technique used	Conclusions reached
Emery (1967)	cross country and current account for 50 countries over 1 time period 1953–1963	GNP on exports	OLS[a]	favoured EPH[b]
Maizels (1968b)	time series for 9 countries over 1 time period 1950–1962	GDP on exports	OLS	favoured EPH
Voivodas (1973)	cross country (22 countries) and time series (12 countries) over 1 time period 1956–1967	GDP growth on export share	OLS	favoured EPH
Michaely (1977)	cross country for 41 countries over 1 time period 1950–1967	per capita GNP growth on export share growth	Spearman rank correlation	favoured EPH
Balassa (1978)	cross country for 10 countries over 2 time periods 1960–1966 and 1967–1973	GNP growth on export growth or real export growth	production function, rank correlation and OLS	favoured EPH
Williamson (1978)	cross country and time series for 22 countries over 1 time period 1960–1974	change in GDP on lagged exports	Linear models and OLS	favoured EPH
Fajana (1979)	time series (20 observations) for Nigeria over 1 time period 1954–1974	GNP growth on export share or export change per output	OLS	favoured EPH

Notes: [a] OLS = ordinary least squares, [b] EPH = export promotion hypothesis. EPH has positive influence on economic growth, implying it is a good policy to pursue in LDCs.
Source: Greenway and Sapsford (1994) plus new additions.

Table 3.1: continued (previous empirical studies)

Study by	Data set	Main variables used	Technique used	Conclusions reached
Tyler (1981)	cross country for 55 countries for 1 time period 1960–1977	GDP growth on export growth	production function and OLS[a]	favoured EPH[b]
Schenzler (1982)	time series (30 observations) for 3 countries over 1 time period 1950–1979	GDP growth on export growth or export share	OLS	favoured EPH
Feder (1983)	cross country for 31 countries over 1 time period 1964–1973	GDP growth on export growth and export change per output	OLS	favoured EPH
Kavoussi (1984)	cross section for 73 countries over 1 time period 1960–1978	real export growth on real GDP growth	production function, rank correlation. and OLS	favoured EPH
Balassa (1984)	cross section for 10 countries	GDP growth on export growth	production function and OLS	favoured EPH
Ram (1985)	cross section for 73 countries over 2 time periods 1960–1970 and 1970–1977	real GDP growth on real exports	OLS	favoured EPH
Jung and Marshall (1985)	time series for 37 countries over 1 time period 1950–1981	real GNP/GDP growth and lagged export growth	maximum likelihood, SLF[c] and Granger causality	limited support for EPH

Notes: [a] OLS = ordinary least squares, [b] EPH = export promotion hypothesis. EPH has positive influence on economic growth, implying it is a good policy to pursue in LDCs. [c] SLF = simultaneous linear functions.
Source: Greenway and Sapsford (1994) plus new additions.

Table 3.1: continued (previous empirical studies)

Study by	Data set	Main variables used	Technique used	Conclusions reached
Darratt (1987)	time series for 4 countries over 1 time period 1955–1982	real GDP growth and real export growth and lagged real export growth	OLS[a] and causality tests	rejected EPH[b] in 3 out of 4 countries
Chow (1987)	time series for 8 NICs[d] over 1 time period in 1960s & 1970s	real export growth and manufactured output	OLS and Granger causality tests	favoured EPH feedback causality in 7 NICs
Hsiao (1987)	time series for 4 Asian NICs over 1 time period	real GDP growth and real export growth	OLS and Sims and Granger causality	favoured EPH feedback causality in 3 out of 4 NICs
Moschos (1989)	inter country for 71 countries over 1 time period 1970–1980	both real & nominal GDP per capita on real export growth	production function and OLS	favoured EPH
Salvatore and Hatcher (1991)	time series for 26 countries over 2 time periods 1963–1973 and 1973–1985	real GDP growth on real export growth	production function and OLS	favoured EPH
Ahmad and Kwan (1991)	time series and cross section for 47 African LDCs over 1 time period 1981–1987	real export growth and per capita GDP or its growth	OLS Granger causality	rejected EPH
Kwan and Cotsomitis (1991)	time series for China over 2 time periods 1952–1978 and 1952–1985	export size and national income	OLS and Granger causality tests	favoured EPH with mixed feedback results

Notes: [a] OLS = ordinary least squares, [b] EPH = export promotion hypothesis. EPH has positive influence on economic growth, implying it is a good policy to pursue in LDCs. [d] NICs = newly industrialised countries.
Source: Greenway and Sapsford (1994) plus new additions.

Table 3.1: continued (previous empirical studies)

Study by	Data set	Main variables used	Technique used	Conclusions reached
Serletis (1992)	time series (116 observations) for Canada over 2 periods 1870–1944 and 1870–1985	real export growth and real GNP growth	OLS[a] and Granger causality tests	favoured EPH[b]
Giles et al. (1992)	annual time series for New Zealand over 1 time period 1963–1991	real export growth and real GDP growth (repeated also in levels)	OLS and Granger causality tests	rejected EPH with mixed results
Gharty (1993)	time series for Taiwan, Japan and USA over 1 time period	export growth and economic growth	step–wise Granger causality tests	favoured EPH with mixed results
Paul and Chowdhury (1995)	time series for (43 observations) for Australia over 1 time period 1949–1991	real export growth and and real GDP growth	OLS and Granger causality tests	favoured EPH

Notes: [a] OLS = ordinary least squares, [b] EPH = export promotion hypothesis. EPH has positive influence on economic growth, implying it is a good policy to pursue in LDCs.
Source: Greenway and Sapsford (1994) plus new additions.

Serletis (1992) investigated empirically the relationship between export growth and GNP growth using annual Canadian data from 1870–1985 (116 annual observations). Granger causality was used as the analytical method of analysis. The results supported the export–led growth strategy in that the expansion of exports was found to have promoted the growth of national income. Strong empirical support also existed for the hypothesis that integrated variables had no inherent tendency to move together over time (i.e., a cointegration relationship between the variables was ruled out).

According to Giles et al. (1992), early attempts to test for causality between export expansion and economic growth had confused statistical causality with statistical association. Several studies used inappropriate data which invalidated the findings of support for export–

led economic growth. More recent studies for various countries have clarified some of these studies where formal Granger causality tests have been performed, and little evidence of export–led growth has been found. Performing such studies for the New Zealand case, Giles et al. drew some important conclusions:

(a) The presumption that the rate of real export growth necessarily causes the rate of real GDP growth could not be sustained. From the New Zealand context, such causality did not hold historically at the aggregate level. Evidence of this presumption was found at disaggregated levels, particularly at the level of exports of minerals, chemicals and plastic materials; exports of metals and metal products; and to a lesser degree, exports of live animals and meat.

(b) In the case of export and GDP levels, rather than growth rates, causality from real exports of manufactured goods, and of meat and live animals, to GDP was found.

Buffie (1992) attempted to gain insight into the causal connection between export growth and aggregate economic growth by developing a three–sector, three–factor dynamic general equilibrium model of a small open economy. He postulated that the expansion of the export sector imparts an expansionary or contractionary impetus to the rest of the economy through its impacts on aggregate capital accumulation (i.e., allowing for endogenous capital accumulation). The main result of this study suggested that there was no presumption that an export boom would act as an engine of growth: much depended on the precise structural characteristics of the economy.

Most recently, a dynamic demand–side macroeconomic model, using the recent econometric methods of cointegration and error correction, and estimated by the three–stage least–squares method, was employed to assess the impact of manufacturing exports on the economic growth and the current account balance for Cyprus, a small island economy (Demetriades et al. 1993). The main finding of this study was that manufacturing exports seemed to provide a very small impetus to economic growth. Besides, manufacturing exports provided only marginal beneficial impact on the current account balance. Demetriades et al. explained that these results were ascribed to the narrow resource base of such a small island economy.

Employing Hsiao's (1979) version of step–wise Granger causality to find the direction of causation, Ghartey (1993) tested the causal relationship between exports and economic growth by using stationary variables for Taiwan, USA and Japan. It was clearly shown that unidirectional economic growth caused export growth in USA and export growth caused

economic growth in Taiwan. In Japan, a causal feedback relationship was found between exports and economic growth. According to Ghartey, this study validated the modern trade theory that economic performance on intra–industry trade is the basis of export growth, as found in USA. Traditional export–led growth theory was found appropriate for Taiwan.

3.5 Export Growth and Instability in the SPINs

Only a small number of studies and reviews on export earning instability and economic growth has been undertaken in the South Pacific region (SPC 1980, Fleming and Piggott 1985, Piggott, et al. 1986, Falvey 1986, Fleming and Piggott 1989). The SPC (1980) study outlined the cases for and against stabilisation measures for this region. While quantity fluctuations had been responsible for some fluctuations in export earnings, the SPC asserted that price fluctuations had played the dominant role. This assertion had no empirical back–up; thus support for either regional or national stabilisation schemes could not be sustained.

Fleming and Piggott (1985) presented results which could be helpful from the point of view of establishing what would not, rather than what would, be effective in stabilising export revenues. It was found that interaction between export revenues from different commodities was positive and therefore worked in the direction of increasing total export revenue variability. Fleming and Piggott contended that, even if the interactions were strongly negative, there would be reluctance to recommend stabilisation programs aimed at stabilising export earnings from particular commodities as this could be destabilising in terms of total export revenue variability.

The results from the analysis by Fleming and Piggott (1985) provided evidence that both quantity variability and price variability could be important contributors to revenue instability. Hence, implementation of price stabilisation schemes alone, without considering quantity stabilisation, would not be sufficient to stabilise effectively overall export revenue variability. It was concluded that it could be extremely difficult to operate a South Pacific regional export revenue stabilisation program simply because the patterns and causes of variability differed among countries. Further, commodity diversification as a means of stabilisation could not be recommended based on the results of Fleming and Piggott.

Falvey (1986) argued that the economic disadvantages of export instability remain unproven. Falvey advanced two reasons to justify the importance of studying instability in the SPINs:

(a) The SPINs have characteristics normally associated with highly variable export earnings (for details of these characteristics, see, for example, Brundell, Horn and Svedberg 1981). The SPINs' exports are basically agricultural, highly concentrated and command only a small share in the world markets. Consequently, if export instability were to be a matter of prime concern anywhere, it should be of primary importance in the SPINs.

(b) The governments of the SPINs have had great interest in instability and this has greatly influenced policy–making decisions in the region.

In his study, Falvey (1986, pp. 12–13) found that, in aggregate, it appeared that price and quantity deviations from the trend were negatively correlated and thus tended to offset each other in total export earnings. He also found that price instability exceeded quantity instability at aggregate levels. Although various instability indexes were used to arrive at the conclusions, the indexes had nothing to do with the sources of instability.

However, one of Falvey's conclusions was that price variations were largely exogenous given that domestic demand for most exports was relatively small, while quantity variations were largely determined by domestic factors on the supply side. Such domestic supply factors included weather conditions (e.g., cyclones) and route variations by migrating fish species (such as tuna). One of the main recommendations for further research emerging from Falvey's work was that further study of the underlying causes and/or sources of instability and low growth should be undertaken before any attempt is made to design and operate stabilisation policies. Otherwise, policies implemented to take advantage of stabilisation schemes may in fact end up being disruptive.

Piggott et al. (1986) were interested in sources of instability in aggregate export earnings which were measured in terms of variance. Individual commodity variances and covariances were considered as part of the sources of aggregate export earning instability. A procedure building on earlier work by Piggott (1978) for analysing the causes of market instability where both supply and demand fluctuate over time was outlined and extended to data from Tonga, Vanuatu and Western Samoa. For the three economies, the results showed that direct contributions of supply fluctuations were generally much less than those directly from demand fluctuations. In other situations, supply–demand interaction effects were much larger than the direct contribution of supply variability. In these cases, both supply and demand factors were equally important sources of market instability.

In a more recent study, Fleming and Piggott (1989) found that sources of export instability differed over time, across countries and across commodities in selected South

Pacific countries. Because of these findings, the authors felt that South Pacific policy makers should turn to more modest approaches to cope with unstable export markets. The effectiveness of highly formalised commodity–specific price stabilisation schemes that have dominated policy to date in the South Pacific countries is now questionable.

3.5 Conclusion

This review of literature covers work done on export instability and related work over the past 40 years. Literature has been reviewed on the nature of instability, underlying causes and sources of instability (relationships of instability with commodity and geographical concentration, openness of economies, size of economies, external and domestic factors and/or demand and supply factors), relationship between export instability and economic growth, export growth and economic growth, and export instability in the South Pacific regions. Results published in this literature are diverse, contradictory and, in many cases, inconclusive. Clearly, this reflects the complexity of this subject.

Chapter 4

SOME THEORY AND ANALYTICAL FRAMEWORK

In this chapter both the theory and framework for analysis are presented. Aspects of demand and supply variability and of export variability are discussed in the theoretical part. In the analytical framework, some aspects of time series econometrics and variance decomposition methods are described.

4.1 Introduction

In this chapter, some theoretical underpinning of commodity price variability is presented and the general analytical framework used in this thesis is outlined. First, the most commonly assumed causes and sources of revenue variability are discussed. Second, the time series analytical econometrics, which is the basis for most of the methods applied, is also described. The analytical framework covers general methods such as univariate and bivariate time series processes, VAR models, cointegration, error correction mechanisms, Granger causality, empirical methods of lag determination, impulse response analysis and forecast error variance decomposition analysis, and the variance decomposition methods of Burt and Finley (1968), Hazell (1982, 1984, 1989) and Piggott (1978, 1981).

This chapter is organised into three main sections: the theory is presented in section 4.2; the analytical framework from time series econometric perspective is presented in section 4.3; while the variance decomposition methods are presented in section 4.4.

4.2 Theory

The widely–held view that prices are the major causes of revenue variability led to the formulation and implementation of commodity–specific price stabilisation schemes in the SPINs and in many other LDCs whose earnings come mainly from primary commodity exports. As a result, the theory about commodity price variability and its causes and impacts has been dealt with far more widely than theory relating to variability in other aspects of market performance.

One assumption usually made in the theoretical analysis of price variability is that it occurs in a setting of competitive markets in open economies. This setting implies that price is determined by the interactions of demand and supply curves. Price variability is then

regarded as movements in prices which are caused by shifts in the demand and/or supply curves. Variability of prices and earnings of a given commodity is affected by the price elasticities of demand and supply. The more inelastic the demand and supply curves and the more frequently they shift, the higher the degree of variability.

What follows is a brief discussion of the known causes and/or sources of variability based on the works by MacBean (1966), Newbery and Stiglitz (1981) and Athukorala and Huynh (1987).

4.2.1 Demand variability

According to Newbery and Stiglitz (1981), demand variability can be either (a) systematic or (b) stochastic.

(a) Systematic demand variability

Systematic demand variability for a commodity occurs when demand varies over time in a systematic and predictable manner. This is attributable to: (i) income variability, and (ii) cross–price variability.

(i) Income variability

Consumer incomes vary over trade cycles. The income fluctuations lead to variability in quantities of the commodities demanded at any given time and given price. When incomes are increasing, quantities demanded at given prices may be high. This will lead to price increases of that commodity. If incomes are decreasing, quantities demanded at particular prices may be low, leading to price decreases. All these dynamics are embodied in demand variability.

(ii) Cross–price variability

Systematic price variability for other commodities such as close substitutes or complements for the commodity in question will lead to some corresponding fluctuations in the quantity of that commodity purchased at any particular price, and hence to price changes.

The other commodities (substitutes or complements) could be produced within the same country or in another competing country.

Income or price variability of substitutes is likely to produce positive correlations between prices of different commodities. Negative correlations are expected in the case of complementary commodities. These correlations are critical because different types of correlations produce different effects among commodities and may require different approaches.

(b) Stochastic demand variability

Stochastic demand variability is referred to as that variability which is unpredictable. Stochastic or non–systematic demand variability is caused mainly by demand shifters such as: (i) changes in consumer tastes and preferences, and (ii) changes in technology.

(i) Changes in consumer tastes and preferences

Changes in tastes and preferences for different commodities occur from time to time. Such changes could be brought about by changing lifestyles, income changes, commodity price changes, commodity advertising, political influences, appeals from environmentalists, appeals or campaigns from lobby or interest groups, and imposition of trade sanctions for particular commodities. The distinguishing characteristic of the changes in consumer tastes and preferences is that they are not predictable *ex ante*. However, they can be analysed *ex post* in terms of the magnitudes of the demand shifts they cause.

(ii) Changes in technology

Demand shifts may be induced by indirect effects of technological changes. In many instances, demand for most primary commodities is not a final but a derived demand. For instance, demand for sugar or copra is a derived demand. Sugar manufacturing technology, for example, could change through time. This could be due to either technology advancement or introduction of synthetic sweeteners as substitutes for sugar. This will induce demand shifts for sugar and, consequently, for sugar cane.

In this study, analysis of both systematic and stochastic variability from external and domestic perspectives is undertaken. As explained in Chapter 1, this variability is measured by variance.

4.2.2 Supply variability

Like demand variability, supply variability can also be either (a) systematic or (b) stochastic (Newbery and Stiglitz 1981).

(a) Systematic supply variability

Systematic supply variability is normally associated with: (i) variability of environmental factors, (ii) input price variability, and (iii) variability in price expectations of output.

(i) Environmental factors variability

Among critical environmental factors, climate, particularly rainfall, is probably the most important source of systematic supply variability. Environmental variability especially affects agricultural commodities. Other environmental factors that affect supply are cyclones, incidences of pests and diseases, and smallness and geographical isolation. While isolation may be an advantage to a country in terms of lying away from many common pests and diseases, more often isolation means increased vulnerability to changes in transportation services or costs to the major market centres (Fleming 1992b).

The extent to which variability in supply affects world prices depends partly on the market share enjoyed by specific commodities. For example, whenever severe frosts affect the Brazilian coffee, the world supply of coffee is depressed and as a result coffee prices escalate. Depending on the severity of the frosts, there could occur coffee booms for countries not affected by the frost. Conversely, good Brazilian weather could result in coffee oversupply and consequently world price slumps. On the other hand, effects of supply variability depend on correlation of weather in different producing areas and the shipping costs between these areas. For instance, commodities such as ginger, whose production is concentrated in small areas, are likely to have greater price variability than, say, tea that is produced in widely–separated geographic areas.

(ii) Input price variability

Systematic variability in the prices of inputs (machinery and equipment, fertilisers, herbicides and pesticides) used in the production process could be accompanied by a corresponding variability in the supply of commodities. For example, variations in the supply

of fertilisers for coffee could induce variations in fertiliser prices which could translate into variations in coffee berry production. In turn, these could trigger variations in the supply of the final drinking coffee and consequently variations in prices. In a well–linked economy, the consequences of price variability in all the most important final outputs would be manifested in other sectors of the economy (Newbery and Stiglitz 1981).

(iii) Price expectations of output variability

The effects of variability in price expectations can be demonstrated by simple cobweb models. For example, a high price of coffee this year leads to a large production of coffee next year and this will result in a low price the year after. In turn, this leads to a low supply the following year and thus a high price. Ultimately, this leads to a simple cobweb. Although oversimplified, the cobweb demonstrates clearly how systematic variations in expectations could lead to systematic price variability.

Conventional cobweb models treat price variability as endogenous to the market. If an exogenous systematic source of variability (such as rainfall) is added to the variability of price expectations, the consequences of price variability are exacerbated. This makes it more difficult for producers to predict correctly and eliminate endogenous variability.

(b) Stochastic supply variability

The major sources of non–systematic supply variability are closely related to those which cause non–systematic demand variability. These are supply shifters such as (i) changes in producer tastes and preferences and (ii) technological changes.

(i) Changes in producer tastes and preferences

Although these may not be as obvious as the changes in consumer tastes and preferences on the demand side, changes in producer tastes and preferences may lead to a shift away from some commodities to new ones. This is brought about because some commodities could be labour– or input–intensive and yet they do not command competitive output prices in world markets commensurate with the costs of production.

(ii) Technological change

New technologies, some ensuing from formal research and development efforts, are a major source of non–systematic supply variability. Improvement of new varieties, for example, which are usually more disease–tolerant and pest–resistant, development of more efficient and cost effective agro–chemicals, better tillage and weeding practices, more efficient and effective irrigation systems, improved harvest and post–harvest technologies, and more efficient, liberalised and competitive market technologies will all work toward improved production and marketing of the primary commodity products.

The extent to which these new technologies will influence the supplies of the commodities depends partly on the degree and rates of their adaptation and adoption by the producers. Consequently, technical change contributes to increased supply of commodities, leading to price decreases under most circumstances. Since technical change, which may take several years, cannot be predicted and measured *ex ante*, its effects on commodity supplies and prices cannot be predicted.

4.2.3 Other sources of variability

In commodity export markets, there exist other market participants who could be potential sources of market variability. These may include (a) marketing intermediaries, and (b) the government (Newbery and Stiglitz 1981).

(a) The marketing intermediaries

Marketing intermediaries such as arbitrageurs and speculators could have a marked effect on the degree of price variability. Although speculators are the least understood market participants, there is widespread belief that they are one of the major sources of price variability (Newbery and Stiglitz 1981).

Buying cheaply and selling dearly (also referred to as spatial and intertemporal arbitrage) transfers resources from regions or periods where they are relatively less valuable to those where they are relatively more valuable. Price differences are thus evened out, and the arbitrageurs make their profits. However, if price fluctuations are exacerbated, they make losses. Arbitrageurs and speculators are able to conduct their business successfully only if they have access to more market information than other market participants. It has in fact been found (Grossman and Stiglitz 1980) that a market with perfect information and

considerable speculation could experience greater price variability than one in a world of no information.

Any firm or individual who stores commodities for future marketing when prices are anticipated to be high is in essence engaging in intertemporal arbitraging. Similarly, producers often engage in speculative storage, albeit, on a limited scale. Intertemporal farmer speculation could be an alternative to government–supported price stabilisation programs (Newbery and Stiglitz 1981).

(b) Government

Changes in government policy are a major source of market variability. Government imposition of and changes to tariffs and taxes, quotas and subsidies distort market behaviour. Changes in taxation or regulations are likely to have effects on both supply and demand, and consequently on market prices. Policies affecting the level of national incomes will indirectly affect the demand for commodities. These policies are difficult to anticipate in advance and therefore should be considered within the framework of stochastic variability.

In addition, government provision and maintenance of production and marketing infrastructure directly influences the costs of primary commodity production and export marketing. More importantly, CERV can be induced by fluctuations in domestic monetary and fiscal policies, by politically motivated investment projects or consumption spending, or by politically inspired excessive wage increases supported by monetary expansion.

4.2.4 Export variability

(a) Causes of export variability

Interactions in variability between export quantities and prices bring about variability in export revenues. These interactions are, in turn, due to shifts in export supply and/or export demand schedules. Two major factors, namely the relative importance of demand and supply shifts and the price elasticities of demand and supply, are central to the determination of the relationship between price and quantity instability and the degree of earnings instability. Prices of primary commodities fluctuate much more sharply from one year to another than do the prices of manufactures. In part this is because, in the short run, the output and demand for primary commodities are less elastic than those for manufactured goods (MacBean 1966, Athukorala and Huynh 1987).

(i) Export variability from the supply–side causes

It takes a long time for changes in the prices of perennial crops to be reflected in output. That is, the short– and medium–term supply responses are very inelastic. Even changes in output of annual crops lag behind market decisions. Important production decisions are generally made the season before planting and harvesting. Thus new prices can affect next season's plantings only.

The supply elasticities (or simply output responses to price changes) for most minerals are also generally low but relatively higher than those of agricultural commodities. Major costs for mineral extraction consist of fixed overheads. As long as the fixed overhead costs are covered, mines will continue to operate even with fluctuating prices. The closure and subsequent re–opening of mining pits involve substantial costs, so it is more profitable for mining operations to continue except through prolonged periods of low prices (Athukorala and Huynh 1987).

Normal hazards of production contribute greatly to the variability problems of primary commodities. In many LDCs, these hazards are exacerbated by low technology, and limited farm inputs such as fertilisers and pesticides and/or the lack of resources to combat catastrophes (e.g., floods, cyclones and droughts). Availability and ease of access to these resources and inputs have helped greatly to reduce output variability in primary commodities in the DCs. Current changes in output of many primary agricultural commodities (particularly for tree crops such as cocoa and coffee) are a result of price conditions of past years. That is, changes in current output of agricultural commodities are influenced by fluctuations in prices over the past years. Compared with primary agricultural commodities, minerals are less subject to output variability. Demand for minerals is closely related to business cycles of industrial activities and speculation which can cause it to fluctuate widely.

(ii) Export variability from demand–side causes

Demand elasticities (or consumption responses to changes in the prices) of most primary commodities are quite low. Factors contributing to this include consumer habits, customs and lifestyles. Other factors include the nature of derived demand for many of these primary commodities and the availability of close substitutes such as synthetics. As a result of these other factors, costs of raw primary commodities form only small fractions of the total costs of the final products. Examples are sugar and copra in the commodity export sector. Thus, a substantial change in the price of raw primary products may not be reflected

in the price of the final products. This could imply that CERV may be influenced by both direct and indirect causes.

Low supply elasticities imply that changes in demand for commodities resulting from factors such as changes in consumer incomes, technology or speculation will induce disproportionately large fluctuations in prices. If the price elasticities of demand are low, changes in supply as a result of exceptionally bad climatic conditions, pests and diseases will induce sharp changes in prices. These situations are aggravated by the characteristically unstable supply of, and demand for, most primary commodities, making high magnitudes of price variability inevitable (MacBean 1966, Athukorala and Huynh 1987).

(ii) Summary and other causes of export variability

To summarise so far, low price elasticities and uncontrollable variability in demand and supply explain the variability in both price and revenues of primary commodities.

Other traditional causes of export instability are that primary commodities form large proportions of exports for most LDCs where specialisation of primary commodities contributes greatly to variability in exports in the LDCs. In other words, concentration on a small range of commodities and a limited number of export destinations (or export market concentration) reduces a country's ability to gain from alternative commodities or markets and thereby to offset losses in revenue from some exports with gains in revenue from others (MacBean 1966, Athukorala and Huynh 1987).

Overall, variability in supply and demand, low price elasticities of supply and demand, specialisation and commodity concentration, and geographical concentration are arguably some of the most important factors leading to high magnitudes of export variability in most LDCs.

(b) Consequences of export variability

As argued above, the economies of many LDCs are vulnerable to export variability, yet, in most cases, LDCs are dependent on foreign trade. They lack the facilities, techniques and experience to counteract the variability in exports and depend on the production of a few primary commodities which are almost completely exported. The share of the national income generated by exports also usually exceeds that which is generated from private domestic investment or government expenditure.

The ramifications of export variability are manifested in the sensitivity of the national incomes of LDCs to fluctuations in export revenues. A change in total export revenues directly impacts on the incomes of export commodity producers. In turn, this tends to affect their consumption and investment expenditures. Repercussions will be felt on the incomes of other related industries which rely on primary commodity earnings. The direct and indirect impacts on incomes will ultimately impinge on the willingness and ability of the producers and other industrialists to maintain investment levels and undertake new investment. Unless offset by prudent government policies, the combination of the multiplier and accelerator effects will produce changes in the national incomes which are in the same direction and more than proportionate to the initial changes in export revenues (Athukorala and Huynh 1987).

The export–induced variability in national monetary income may also have repercussions on employment and price levels. Usually, the effects on employment are adverse. Fluctuations in export incomes affect prices as well. Increased export revenues will tend to raise incomes. This could lead to increased demand for domestic goods and services. Since most of these domestic goods and services are agriculture–related, their short–run supply elasticities are generally low. Increased demand for these goods will thus produce sharp increases in domestic price levels. Put differently, sharp decreases in export revenues will tend to contract domestic demand and thus reduce domestic price levels. It is also possible that export fluctuations could stimulate inflationary pressures in the long run. This is more likely where LDCs are concerned with countering deflationary changes in demand (MacBean 1966, Athukorala and Huynh 1987).

Incapacity to deal with export–induced internal instability increases the LDCs' vulnerability to export variability. Prudent monetary and fiscal policy measures are either lacking or are not followed strictly or are limited by underdeveloped financial markets. These policies are usually compromised for fear that they may endanger economic growth and/or political stability. Social security systems, if they do exist in the LDCs, are so small as to do little to offset sudden decreases in incomes. In general, LDCs lack the built–in stabilisers which are important features in the DCs.

Unprecedented and persistent income fluctuations could have undesirable socio-political effects. A boom in export revenues from an important agricultural commodity may enrich some farmers from one region. This could result in a rise in domestic price levels making other groups, perhaps from different regions in the same country, worse off. Conversely, a slump in export revenues could create tensions since the purchasing power of those who depend on export receipts would diminish. More importantly, export revenue

variability could impact directly on those groups of farmers whose earnings are almost wholly dependent on export earnings. In most cases, these are mainly the small farmers or poor peasants. Certainly, under an assumption of diminishing marginal utility of income, fluctuating cash incomes yield less economic welfare to these poor farmers than would a stable income. For the poor, negative fluctuations could mean hardship and under–nutrition. For all these reasons, variability of export earnings may adversely affect LDCs' prospects for economic growth.

4.3 Analytical Framework

Time series econometrics and variance decomposition methods are discussed in sections 4.3 and 4.4, respectively. Given that the analytical framework adopted in this research is quite wide in coverage, general aspects are dealt with in this chapter and specific aspects in the analytical chapters, particularly in Chapters 6 and 9.

4.3.1 Time series econometrics

According to Harvey (1990) and Griffiths, Hill and Judge (1993), time series model approaches relate the current value of an economic variable only to its own past values and to the current and past values of random disturbance. These models are useful for short–run forecasting. Normally, time series techniques do not rely on building economic and statistical models that relate the values of the economic variable of interest to a set of explanatory or control variables. A major difference between time series models and those of standard econometrics is that the former do not consider, as much as do the latter, the conceptual frameworks provided by economic theory. These concepts specify, a priori, expected relationships between economic variables.

As a result, behavioural or technical equations may not be taken into account in time series models. Time series models lay emphasis on utilising information about the history (i.e., past values) of the variable in question. The past values are then used to predict the future values of the same variable. This prediction may make use of simple to very sophisticated extrapolation techniques. Used carefully, time series models offer opportunities of making accurate predictions, even when the underlying structural relationships are unknown.

4.3.2 Univariate time series autoregressive processes

To operationalise the concept that information of the past values of an observable economic variable, Y_t, is useful in predicting future values of the same variable, Harvey (1990) and Griffiths et al. (1993), among others, have developed some statistical models reflecting the characteristics of lagged dependence. These characteristics are also referred to as the stochastic processes of the variable Y_t. The model is referred to here as an autoregressive process of order 1. This is denoted as an AR(1) time series model, or AR(1) process. Harvey and Griffiths et al. represented this process as:

$$Y_t = \delta + \theta_1 Y_{t-1} + e_t \qquad t = 1, 2, \ldots, T \qquad (4.1)$$

where: δ is an intercept parameter, θ_1 an unknown parameter lying between -1 and 1 (or $<|1|$), and e_t is uncorrelated random error with mean zero and constant variance, σ_e^2 or normally and independently distributed (NID) $\approx (0, \sigma_e^2)$.

Equation (4.1) is an AR(1) because Y_t depends only on its value in the previous period, Y_{t-1}, plus a random disturbance. The observations generated by the equation (4.1) process fluctuate around a mean of zero. If $|\theta_1| > 1$, the model becomes explosive while a model satisfying the condition $|\theta_1| < 1$ is said to be stationary. It should be noted that non–stationary time series could be changed into stationary series by simply taking first or second differences of the non–stationary series. Thus, if equation (4.1) was a non–stationary series integrated of order 1 or I(d)[7] (more details of the order of integration are also explained in the cointegration subsection (4.2.5)), it can be made stationary by differencing it at least once. That is:

$$\Delta Y_t = \delta + \theta_1 \Delta Y_{t-1} + e_t \qquad (4.2)$$

where $\Delta Y_t = Y_t - Y_{t-1}$. If $|\theta_1| < 1$, ΔY_t is stationary even though Y_t is not.

Given that the actual nature of the process generating the time series $Y_1, Y_2, \ldots, Y_T$ is usually not known, the process may be more complex than the first–order autoregressive process given in equation (4.1). Usually, Y_t may depend not only on Y_{t-1} but also on Y_{t-2}, Y_{t-}

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7 The concept of stationarity entails that the order of integration is assessed. The order of integration, usually denoted I(d), refers to the number of times a series should be differenced to obtain stationarity. For example, a time series could either be integrated of order 1, i.e., I(1) in which case $d = 1$, or integrated of order 0, i.e., I(0), in this case $d = 0$. Thus, a series which is I(1) should be differenced once to obtain the stationarity condition which is I(0).

$_3$, ..., Y_{t-p}. Hence, a more general formulation of this is introduced as an autoregressive process of order p, or AR(p). This could be represented as:

$$Y_t = f(Y_{t-1}, Y_{t-2}, \ldots, Y_{t-p}, e_t, e_{t-1}, \ldots, e_{t-q})$$

$$= \delta + \theta_1 Y_{t-1} + \theta_2 Y_{t-2} + \ldots + \theta_p Y_{t-p} + e_t \qquad (4.3)$$

where δ is an intercept parameter related to the mean of Y_t, θ_is are unknown autoregressive parameters, and e_t are $\approx$ NID (0, σ_e^2) uncorrelated random errors.

An alternative way of capturing the dependence of Y_t on its past history is by a moving average (MA) model. Based on Harvey (1990), the first order MA process is defined by:

$$Y_t = \varepsilon_t + \phi\varepsilon_{t-1} \qquad (4.4)$$

This is formulated on two unobservable random disturbances, ε_t and ε_{t-1}. Repeated substitution of equation (4.4) gives:

$$Y_t = -\sum_{j=1}^{\infty} (-\phi)^j Y_{t-j} + \varepsilon_t \qquad (4.5)$$

provided that $|\phi| < 1$. Equation (4.4) is thus an autoregressive process lagged infinite times, but the coefficients, θ_1, θ_2, ..., are constrained such that the model (4.4) depends on only one parameter ϕ.

The characteristics of autoregressive and MA processes can be combined in a mixed model called autoregressive–moving average (ARMA) process. This represents one of the most flexible classes of univariate time series models. According to Harvey (1990), an ARMA process may be represented as:

$$Y_t = \theta_1 Y_{t-1} + \ldots + \theta_p Y_{t-p} + \varepsilon_t + \phi_1\varepsilon_{t-1} + \ldots + \phi_q\varepsilon_{t-q} \qquad (4.6)$$

The above discussion can be extended to cover multivariate time series. As a vector of observations, Y_t may also be modelled in terms of its own past history by a multivariate, or vector, ARMA process (Harvey 1990, Griffiths et al. 1993) such as:

$$Y_t = \phi_1 Y_{t-1} + \ldots + \phi_p Y_{t-p} + \varepsilon_t + \theta_1\varepsilon_{t-1} + \ldots + \theta_q\varepsilon_{t-q} \qquad (4.7)$$

These parameters are contained within square matrices, ϕ_1, ϕ_2, ..., ϕ_p, θ_1, θ_2, ..., θ_q, while e_t is a vector of random disturbance.

One of the most flexible models to handle statistically is the pure autoregressive process which according to Harvey (1990) could be represented as:

$$Y_t = \phi_1 Y_{t-1} + \ldots + \phi_p Y_{t-p} + \varepsilon_t \qquad (4.8)$$

The above model (4.8) is called a vector autoregression, commonly abbreviated as VAR. VAR models are discussed in detail below (in subsection 4.3.4).

4.3.3 Bivariate time series models

According to Harvey (1990) and Griffiths et al. (1993), if an economic variable, say X_t, is introduced and jointly considered with another variable such as the previous Y_t, then we have a bivariate time series (Y_t, X_t) model. Additional time series economic variables will result in multivariate time series models.

Bivariate time series can be categorised into two general groups. The first category is the distributed lag models. In a distributed lag model, variations in Y_t are determined by current and lagged values of X_t plus a random disturbance, that is:

$$Y_t = f(X_t, X_{t-1}, X_{t-2}, \ldots) + e_t \qquad (4.9)$$

where X_t is exogenous or predetermined while Y_t is the outcome variable.

The main objective of using distributed lag models is to understand how variations in X_t at one point in time influence values of Y_t in the current and subsequent periods. That is, distributed lag models are used to estimate how changes in X_t, denoted ΔX_t, affect the outcome variable Y_t in the current period ΔY_t and the subsequent n periods (ΔY_{t+1}, ΔY_{t+2}, ..., ΔY_{t+n}).

The second category of bivariate time series models is the VAR. In the VAR models, random variables Y_t and X_t are placed into a vector $Z_t = (Y_t X_t)'$. The vector Z_t is assumed to be a (vector valued) function of its own lagged values plus a vector of random disturbances, that is:

$$Z_t = f(Z_{t-1}, Z_{t-2}, \ldots, Z_{t-p}) + e_t \qquad (4.10)$$

4.3.4 VAR models

The origin and usefulness of VAR methods have been discussed by several researchers; see for example, Turner (1993). In the past, until the 1980s, the methods of the Cowles Commission were dominant in most applied econometric work. These methods centred on the use of restrictions derived from economic theory in identifying parameters of the models. During the 1970s numerous breakdowns of many of the assumed macroeconomic relationships were experienced. These convinced many macroeconomists of the need for alternative modelling strategies which include dynamic relationships.

In response to some of the criticisms levelled against the prevailing Cowles Commission methods of estimating structural macroeconomic models, VARs were introduced, originally by Sims (1980). Sims argued that the identification restrictions imposed on structural parameters of the macroeconomic models were unrealistically hard. As a result, he suggested VARs as an alternative modelling strategy involving many fewer restrictions. Since the early 1980s, VAR methods have been used by many economists (see, for example, Sims 1982 1986, Bessler 1984a b, Bernanke 1986, Orden 1986a b, Orden and Fackler 1989, Myers et al. 1990, Jennings, Adamowicz and Constantino 1991, Fackler and Parker 1994).

One of the simplest ways of applying the VAR, is to consider, for example, that there exist two time series variables (Y_t X_t) which are random and can be jointly determined (endogenously). A forecasting model of this can be developed which captures their dynamic and interdependent relationships. This model will be an extension of univariate time series models.

For example, consider the macroeconomic time series variables of GDP and exports, designated as Y_{t1} and Y_{t2}, respectively. For reasons of joint determination, it could be appropriate to build a structural simultaneous equations model to explain the behaviour of these variables. For demonstration purposes, exogenous variables are ignored and it is assumed that current GDP (Y_{t1}) depends on current exports (Y_{t2}) and lagged GDP($Y_{t-1,1}$) such that, according to Griffiths et al. (1993), this can be represented as:

$$Y_{t1} = \alpha_1 + \alpha_2 Y_{t2} + \alpha_3 Y_{t-1,1} + e_{t1} \qquad (4.11)$$

Similarly, the same explanation (by Griffiths et al. 1993) could apply to exports (Y_{t2}). Current exports (Y_{t2}) may depend on lagged exports ($Y_{t-1,2}$) and since increased GDP may stimulate export growth, current exports could depend on lagged GDP ($Y_{t-1,1}$) as well, such that:

$$Y_{t2} = \beta_1 + \beta_2 Y_{t-1,1} + \beta_3 Y_{t-1,2} + e_{t2} \qquad (4.12)$$

The two equations (4.11) and (4.12) together represent a system of simultaneous equations that describes some dynamic relationships. The two–stage least squares method could be used to estimate the unknown parameters, α_i and β_i. However, given that the primary objective is to build a forecasting model, reduced form equations are adopted which, according to Griffiths et al. (1993), are:

$$Y_{t1} = \pi_{11} + \pi_{12} Y_{t-1,1} + \pi_{13} Y_{t-1,2} + v_{t1} \qquad (4.13)$$

$$Y_{t2} = \pi_{21} + \pi_{22} Y_{t-1,1} + \pi_{23} Y_{t-1,2} + v_{t2} \qquad (4.14)$$

The reduced form equations (4.13) and (4.14) are a vector autoregressive model of order 1, denoted as VAR(1).[8] Reduced form equations express current endogenous variables in terms of exogenous and predetermined variables, and lagged endogenous variables. The reduced equations are easy to specify once endogenous and exogenous variables in the structural model are specified.

In general, a VAR model expresses the current values of endogenous variables purely as a function of an intercept variable and lagged values of the endogenous variables. Other exogenous variables are not usually taken into consideration. Essentially, the VAR model is an extension of univariate AR(p) models. Hence Griffiths et al. (1993) formulated vector equations of the following form:

$$Y_t = \delta + \phi Y_{t-1} + v_t \qquad (4.15)$$

Equation (4.15) is an AR(1) model for the bivariate representation of (Y_{t1}, Y_{t2}), hence the name vector autoregression. Equation (4.15) can be extended to accommodate more than two endogenous variables and more than one lag. A VAR(p) model has p lags and can be represented (Griffiths et al. 1993) as:

$$Y_t = \delta + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \ldots + \phi_p Y_{t-p} + v_t \qquad (4.16)$$

Because the VAR model is a reduced form, its error assumptions follow those of the structural equation error properties as specified in Griffiths et al. (1993).

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8 The order of the model is determined by the number of lagged values.

An alternative way of handling VARs is when they are represented by dynamic simultaneous equation systems. These could be developed from, for example, a joint behaviour of lagged time periods of a vector, say vector Y of an economic variable. As described by Turner (1993) and Myers et al. (1990) the joint process of the variables of interest can be represented by VAR as:

$$BY_t = \sum_{i=1}^{m} A_i Y_{t-i} + Cu_t \qquad (4.17)$$

where Y_t = nx1 vector of observations at time t, A_i are a sequence of nxn matrices of coefficients defining dynamic relationships among Y_t, u_t is an nx1 vector of disturbance terms, and C and B are nxn matrices of coefficients relating to the disturbance terms to vector Y (i.e., representing contemporaneous interrelationships between Y_t and u_t).

There are no exogenous variables in equation (4.17) which has a flexible lag structure. The reduced form of the above system equation is yielded if the inverse of B is premultiplied by equation (4.17) to give:

$$Y_t = \sum_{i=1}^{m} D_i Y_{t-i} + e_t \qquad (4.18)$$

where $D_i = B^{-1}A_i$ for i = 1, 2, ..., m and $e_t = B^{-1}Cu_t$. The covariance matrix of the reduced form disturbance, e_t, is:

$$\Omega = B^{-1}CC'B^{-1} \qquad (4.19)$$

Equation (4.19) plays a key role in identification, estimation and analysis of VARs. A distinguishing feature of VAR models is that the reduced form equation (4.18) is unrestricted[9]. However, the model is identified by imposing a set of just–identifying restrictions on the contemporaneous interactions between the system variables (the C and B matrices) (Myers et al. 1990). Unrestricted reduced form equations can be estimated easily by OLS as an appropriate estimator applied to each equation.

It should be noted that in equations (4.17) and (4.18), dependent variables are all endogenous and independent variables are lagged observations of all variables in the system. Exogenous (or deterministic) variables, where they are considered important, may be included in the set of independent variables. These exogenous variables would not appear as

9 The word 'unrestricted' was used by Sims (1980) to mean 'without restrictions based on supposed a priori knowledge'.

regressands in the system. Few a priori restrictions are imposed on the parameters in the simultaneous equation system in the VAR modelling. Variables affect each other through the lag systems. This permits the data to represent changes in the system without the zero or one restrictions as required in restricting coefficients of the traditional simultaneous equation techniques (Bessler 1984a, Ford 1986, Jennings et al. 1991).

(a) Intuitive appeals of VARs

VARs are a set of reduced form equations. These are similar to what could be derived from structural econometric models that rely on economic theory. Structural economic models depend on highly restrictive assumptions on the estimated parameter values in their reduced form equations. Most often, these restrictions take the form of excluding variables or lags of variables from the models. In effect, the estimated parameters of the excluded variables are restricted to zero or one. Hence, these variables have little predictive or explanatory power in the models.

VAR models, on the other hand, are relatively simple to specify and estimate. They include some of these variables. Data are allowed to determine the contributions of variables, without relying on a priori economic structure. An example from Fisher (1982), and described by Ford (1986) shows how the supply and demand equations for a commodity could be estimated quite conveniently by the VARs.

In brief, Ford (1986) found it striking that the VAR methodology could be applied in a wide variety of situations. VARs can now be applied to agricultural studies, ranging from individual agricultural commodity markets (this was first introduced by Bessler (1984a b)) to more aggregate sectoral models. VARs can also be used to generate accurate forecasts from large–scale econometric models of the agricultural sector. Though there are still some unresolved controversies regarding the use of VAR in policy analysis, there are potential implications of VAR methodology in policy research (Sargent 1984, Hansen and Sargent 1984).

Given the uncertainty surrounding the underlying economic structure of the commodity markets, unrestricted VAR models in reduced form provide flexibility which permits the model to be consistent with a wide range of alternative economic structures. This is quite important in modelling commodity export markets. Since the structural shocks, u_t, in the VARs are uncorrelated by construction, there are no covariance terms in the forecast error variance decomposition. The sum of the proportional contributions of each shock to the variance of Y_t always adds up to one, or 100 per cent. This greatly simplifies the task of

interpreting the results of variance decomposition analyses. Further, the VAR approach focuses attention on fluctuations that are unpredictable *ex ante* as opposed to the use of conventional simultaneous equations models (Myers et al. 1990).

(b) Disadvantages of the VAR methods

VAR models could have problems related to model size as well as the dimension of the lag lengths. The simplicity of VARs could be lost if VAR models contain many variables with long lag lengths. These could result in a problem of lack of degrees of freedom. On the other hand, small VAR models are highly aggregated in that the impact of large numbers of 'exogenous' variables must be captured and accommodated in the small number of structural shocks.

Put differently, VARs may suffer from specification problems depending on the number of variables and lags which may result in the available data getting depleted quickly in terms of degrees of freedom. This problem is especially serious when data availability is restricted. Over–parameterisation may also result in difficulties if unnecessary variables and/or lags are included in the VAR models. If multicollinearity and loss of degrees of freedom are present in the VAR models, overparameterisation may lead to large out–of–sample forecasting errors (Shoesmith 1992).

The type of identification restrictions used on VARs could also bring potential problems. It is commonly assumed that parameters C and B in VAR equation (4.17) are diagonal and lower triangular, respectively. This is equivalent to assuming a recursive representation of the VAR models. It would seem unlikely that a simple recursive structure is capable of identifying structural disturbances such as aggregate supply and demand shocks, even though different recursive orderings of the equations are possible.

Nonetheless, these potential disadvantages may not pose serious problems when estimating sources of market fluctuations. This is partly because any systematic variation in market prices, quantities and revenues is captured adequately by the flexible lag structures of the VAR models. Further, it may not be necessary to have large numbers of 'exogenous' variables so as to identify the model (Myers et al. 1990).

4.3.5 The concept of cointegration

The existence of a long–run, steady–state equilibrium among economic variables is an important concept to economists. The concept of cointegration, which was first introduced by Granger (1981), is an important link between non–stationary processes and long–run equilibrium. The idea of cointegration gained popularity after Engle and Granger's (1987) seminal work which laid the foundations for its future development.

Engle and Granger (1987) formalised the definition of cointegration: the components of a vector, X_t, are said to be cointegrated of order d, b, denoted $X_t \approx CI(d, b)$, if all the components of X_t are I(d), and there exists a vector (or linear combination of them) α ($\neq 0$) so that $Z_t = \alpha' X_t \approx I(d - b)$, $b > 0$. Vector α is called the cointegrating vector and Z_t is the disequilibrium (or equilibrium) error.

The theory underlying cointegration can be explained by considering situations where macroeconomic series are thought to be mainly I(1) so that $d = b = 1$. There is plenty of empirical evidence to support this (see Granger 1988). Under such circumstances, cointegration evidence implies that if the components of X_t were all I(1), the disequilibrium error would be I(0). This means that Z_t has zero mean, i.e., it will rarely drift away from zero and will in fact frequently cross the zero line.

Put differently, if equilibrium will occur occasionally, at least to a close approximation, while X_t was not cointegrated, then Z_t could wander widely and zero–crossings could be rare (Engle and Granger 1987). While many economic variables may wander extensively over time, some pairs of series can be expected to move together over the long run towards equilibrium. Due to economic forces identified in theory, certain variables are not expected to drift too far apart over the long run, e.g., capital appropriations and expenditures, household income and expenditures, and short– and long–run interest rates. The underlying long–run relationships between these pairs of series imply equilibrium relationships (Engle and Granger 1987, Shoesmith 1992).

Granger (1981) and Griffiths et al. (1993) have shown that, if an economic time series, Y_t, follows a random walk, its first differences form a stationary series.[10] The series Y_t is said to be integrated of order 1, denoted as I(1). When Y_t is stationary, the integration process is said to be of order zero or I(0). Regressing one I(1) variable on another of the same integration order I(1) results in 'spurious' regressions (Granger and Newbold 1974) because the least squares estimator breaks down (Griffiths et al. 1993).

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[10] According to Lloyd and Rayner (1990), a stationary series is one whose parameters (the mean, variance and covariance) that describe the series are independent of time. The stationary series exhibit constant mean and variance and have covariances that are invariant to the displacement of time.

Granger (1981) identified a situation when a regression of an I(1) process on another process of the same integration order I(1) was not spurious. This was a situation where the variables are cointegrated. In this situation, it was also found that the least squares estimator works better because of its faster convergence to the true parameter. In general, if two time series Y_t and X_t are both I(1), then their linear combination is also I(1). That is:

$$Y_t - \alpha - \beta X_t = \varepsilon_t \qquad (4.20)$$

There is also a possibility that ε_t is stationary or I(0). For this to happen the trends in Y_t and X_t should cancel out when $\varepsilon_t = Y_t - \alpha - \beta_t$ is formed. This way Y_t and X_t are said to be cointegrated and β is called the cointegrating parameter. Therefore, a pair of time series Y_t, X_t are cointegrated if they are each I(1) but there exists a linear combination of them, $\varepsilon_t = Y_t - \alpha - \beta_t$, that is I(0).

The cointegration concept relates to the long–run equilibrium concept. Assume that a long–run relationship is defined by $Y_t = \alpha + \beta X_t$ or $Y_t - \alpha - \beta X_t = 0$. In this case, ε_t in equation (4.20) represents how far Y_t and X_t are away from equilibrium; this could be called 'equilibrium error'. It implies that if Y_t and X_t are cointegrated and the error ε_t is stationary with mean zero, then:

$$Y_t = \alpha + \beta X_t + \varepsilon_t \qquad (4.21)$$

Since $\varepsilon_t \approx NID(0, \sigma^2)$ is stationary, Y_t and X_t variables obey a stable, long–run relationship. Thus, in a case like this where Y_t and X_t are cointegrated, the least squares estimation of equation (4.21) provides, in large samples, an excellent estimator of β. This describes the long–run, steady–state equilibrium relationship between Y_t and X_t.

Based on Lloyd and Rayner's (1990) explanations, what follows is a summary of the concept of cointegration. A cointegration relationship between two variables requires that:

(i) all components of the cointegration relationship be I(*d*), and

(ii) there exists a parameter β ($\neq 0$), such that $\varepsilon_t = Y_t - \alpha - \beta X_t \approx$ I(0).

When variables are cointegrated, OLS should give an excellent estimate of the true long–run parameter β in large samples. This is due to the property of super–consistency which characterises cointegrating regressions. As proved by Stock (1984), under cointegration, not only is the estimate of β consistent but it is also efficient. The estimate is

consistent because it converges to the true value as the sample size becomes bigger, while its efficiency emanates from the fact that its variance (the variance of the estimate) is smaller than in the standard cases where variables are not cointegrated.

Biases coming from correlation between the control variables and the error terms are asymptotically negligible. Thus, the long–run parameters estimated in the static cointegrating regression will be unbiased, particularly in large samples. This is despite misspecification, in this case, of the dynamic relationships.

If all variables are I(1) and cointegrated, then there always exists an error correction model describing the short–run dynamics between the variables. Conversely, the data generated by an error correction formulation must be cointegrated. This is derived from the Granger representation theorem which states that if variables are I(1), their first differences will be stationary or I(0) and thus all the terms in the ECM are I(0) provided that the residuals are stationary. This is true only if the variables in levels are cointegrated. If the residuals are not stationary, then the variables are not cointegrated and hence they could not enter an ECM. Furthermore, if Y_t and X_t are cointegrated, then there must be Granger causality in at least one direction (Granger 1986).

4.3.6 Error correction mechanisms

When the concept of cointegration was presented, it focused only on the long–run or equilibrium properties postulated by economic theory. By itself, economic theory has little to do with dynamic processes by which variables move towards equilibrium (Lloyd and Rayner 1990). However, it has been proved by Engle and Granger (1987) that if two series are I(1) and cointegrated then there must exist an error correction model which describes the short–run dynamics between the series. The concept of error correction implies that, given movements away from equilibrium in one period, a proportion of the disequilibrium is corrected in the next period. For instance, excessive household expenditure relative to income in period t may be followed by reduced spending in the next period (t+1) (Shoesmith 1992).

According to Engle and Granger (1987), cointegrated data estimated by VARs will be misspecified if the data are differenced. At the same time, important constraints will be omitted if the data are estimated in levels. Hence, the only way to estimate cointegrated data is through ECMs. The work by Engle and Granger (1987) provides the foundations for representing, testing and estimating the ECMs. This is supported through theoretical work by Granger (1981, 1986) and Granger and Newbold (1986, Chaps. 7 and 8). More technical

aspects of ECMs are discussed by Stock (1987) and Johansen (1988), while Engle and Yoo (1987) have presented results of a simulation study illustrating the superior long–term forecasting ability of ECMs over unrestricted VARs.

When two series are cointegrated, the joint distribution of the two variables should be verified as an error correction system. Using a VAR example, let Y and X represent GDP and exports, respectively. With their first differences, ΔY_t and ΔX_t, both I(0), $Y_t = AX_t$, $A < 1$ – the cointegrating equilibrium relationship. Under an error correction system, it is expected that if $Y_{t-1} > AX_{t-1}$, then ΔY_t should decline, *ceteris paribus*. That is, there should be a negative relationship between the current change in GDP (ΔY_t) and the equilibrium error in the previous period ($Y_{t-1} - AX_{t-1}$). For the exports, $Y_{t-1} > AX_{t-1}$ should have a positive influence on ΔX_t (Shoesmith 1992).

An alternative example to illustrate ECMs is to form the series of the following nature:

$$Z_t = X_t - AY_t \qquad (4.22)$$

The series in equation (4.22) is formed and used instead of the errors, where constant A is obtained from the cointegrating regression. From equation (4.22), a negative and significant coefficient estimate on Z_{t-1} in the ΔX_t equation illustrates an ECM with respect to X. For the ΔY_t equation, the coefficient estimate on Z_{t-1} should be positive and significant.

Thus, under the conditions of cointegration, the error–correcting class of models allows long–run components of variables to obey equilibrium constraints whereas the short–run components have a flexible dynamic specification. The dynamic relationship between any two variables could more correctly be specified by an ECM representation of the following nature:

$$\Delta X_t = c + \sum_{i=1}^{m} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{n} \beta_j \Delta Y_{t-j} + \theta \varepsilon_{t-1} + e_t \qquad (4.23)$$

where ε_{t-1} is the lagged value of estimated ε_t from the cointegrating regression. In the specification of equation (4.23), the lagged levels of Y_t (in addition to lagged differences in Y_t) are allowed to influence changes in X_t through ε_{t-1}. Intuitively then, X_t and Y_t are cointegrated. That is, a proportion of the current change in X_t reflects the tendency for X_t to be aligned with the trend value of Y_t. Through this type of partial adjustment, a deviation (error) from the long–run association between the two variables that might have existed is corrected or eliminated altogether (Mahdavi, Sohrabian and Kholdy 1994).

If X_t and Y_t are cointegrated, a Granger causal linkage should exist between them in at least one direction. In this case, the coefficient θ in equation (4.23) captures this linkage.

This will be so even if the coefficients of lagged changes of the causal variables are jointly insignificant, implying no causality on the basis of Granger's (1969) work, which is referred to as here as the 'standard Granger causality tests'.

4.3.7 Engle–Granger two–step estimation procedure

One way to estimate cointegrated systems is the two–step estimator proposed by Engle and Granger (1987). This involves estimating and testing parameters of the cointegrating vectors in the first step. If a cointegrating relationship exists, the residuals (which will be I(0) by definition) are then used in the error–correcting part of ECM in the second step. In the second step, the estimated parameters from step one are then used in the error correction form. Both steps require only single equation least squares. The results from this procedure have been shown to be consistent for all the parameters (Engle and Granger 1987, Lloyd and Rayner 1990). Thus, all variables entering the ECM satisfy the condition of stationarity as all are I(0) and the ECM represents a valid description of the dynamic process.

The Engle–Granger two–step procedure is appealing because the dynamics need not be specified, at least not until the error correction structure has been estimated. The regression in the first step is called the cointegrating regression. It is an attempt to fit the equilibrium or long–run relationship without the inclusion of the dynamics of the system. The elements of the cointegrating vector are estimated by the cointegrating regression. These estimated elements are the known parameters used in estimating the ECM form of the system of equations. The estimation procedure is thus substantially simplified by imposing cross–equation restrictions, allowing specification of the individual equation dynamic patterns separately. The two–step procedure has some excellent properties and is just as efficient as the maximum likelihood estimator based on the known value of the cointegrating parameter. In their two-step theorem, Engle and Granger (1987) stated that:

> The two–step estimator of a single equation of an error correction system, obtained from parameters of the cointegrating regression as the true value, will have the same limiting distribution as the maximum likelihood estimator using the same value. Least squares standard errors will be consistent estimates of the true standard error.

According to Inder (1992), one important benefit derived from the two–step procedure in modelling the relationships between cointegrated variables is that the long–run equilibrium relationship can be estimated consistently by a straightforward OLS regression involving the levels of the variables. All dynamics can be ignored. Endogeneity involving any variable has little effect asymptotically. Hence, the OLS estimator is 'super–consistent' because it converges to the true value at a faster rate than in other normal asymptotics. It is

for the foregoing reasons that the Engle–Granger's two–step procedure is popular in applied research. It is particularly useful where interest is focused only on long–run behaviour to eliminate equations with a dependent variable, say Y_t, regressed only on a constant and an explanatory variable such as X_t (Dolado, Jenkinson and Sosvilla–Rivero 1990, Inder 1992).

4.2.8 Granger causality relationships

One of the earliest and most telling criticisms of the conventional rank correlation and regression analyses in statistical techniques was that the statistical association results between or among variables tested were confused, unintentionally perhaps, with statistical causality. Standard (or traditional) correlations and regressions give no indication about direction of the relationship. What these tests say is only that, for example, if X and Y are correlated random variables, then Y can be used to explain the variability in X, but also X can be used to explain Y. For a definition of causation to be valid statistically, an assumption of the direction of such a relationship must be upheld. In reaction to these criticisms, Granger (1969) and Sims (1972) proposed tests of causality between two variables.

Many of these tests between variables have been suggested and discussed by Geweke (1984). They require that the researcher has some prior belief that causation is, in some sense, likely (Granger 1988). Thus, one should start with a degree of belief, for instance, that X_t causes Y_{t1}. This belief can be measured as a probability.

In an attempt to address questions of model specification as to whether one variable is causally related to another, Granger (1969) introduced a concept of causality that has come to be known as Granger causality. A variable Y_{t1} is said to be Granger–caused by Y_{t2} if the current and past information on Y_{t2} improves the forecasts of Y_{t1} (Griffiths et al. 1993). Thus, Granger causality does not imply a cause–effect relationship, but rather is based purely on predictability (Griffiths et al. 1993).

One way to test this concept is in the context of the VAR models. For example, based on equation (4.13), Y_2 does not Granger cause Y_1 if, and only if, $\pi_{13} = 0$. Considering a VAR(2) model, Griffiths et al. suggested that:

$$Y_{t1} = \pi_{11} + \pi_{12}Y_{t-1,1} + \pi_{13}Y_{t-1,2} + \pi_{14}Y_{t-2,1} + \pi_{15}Y_{t-2,2} + v_{t1} \qquad (4.24)$$

then Y_2 does not cause Y_1 if, and only if, $\pi_{13} = \pi_{15} = 0$. Alternatively, Y_2 does not cause Y_1 if, and only if, lagged values of Y_2 do not appear in the reduced form equation for Y_1 (Griffiths et al. 1993).

Using the asymptotic normality of the least squares estimator, the appropriate t–test for a single hypothesis or F–test for joint hypotheses could be carried out in the usual way.

The original Granger (1969) causality testing between any two variables can be called the 'standard Granger causality tests' (Mahdavi et al. 1994). These tests are based on estimating dynamic equations which are specified in first–difference forms in order to achieve stationarity. These are also referred to as distributed lag regressions between pairs of variables. The tests are based on a pair of variables in two equations which permits a simple way of computing the F–statistics. These equations can take the following form:

$$\Delta X_t = a + \sum_{i=1}^{m} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{n} \beta_j \Delta Y_{t-j} + u_t \qquad (4.25)$$

$$\Delta Y_t = b + \sum_{i=1}^{p} \delta_i \Delta Y_{t-i} + \sum_{j=1}^{q} \gamma_j \Delta X_{t-j} + v_t \qquad (4.26)$$

where (u_t, v_t) are serially independent vectors with zero mean and finite covariance matrix. In equations (4.25) and (4.26) each variable is expressed in the first–difference form. Each variable is regressed on its own history (past values) and the past values of the other variables only. These other variables are the causal variables.

By testing the joint significance of coefficients of the causal variable in each equation, undirectional, bidirectional (feedback) or no causal relationships between X_t and Y_t may be inferred. The important implication of Granger causality tests is that if X_t causes Y_t, then Y_{t1} is better forecast if the information in X_{t-j} is used than if it is not. In the Granger–sense, 'better' means a smaller variance of forecast error, or the matrix equivalence of variance (Granger 1988).

In other studies, Granger (1986) and Engle and Granger (1987) suggested that causality tests should be modified to meet the conditions of non–stationary variables that are cointegrated (i.e., variables whose long–term movements are related to each other). These tests are conducted on the basis of dynamic modelling referred to as ECMs. The ECMs actually incorporate information from cointegration relationships into causality analysis. Essentially, the ECMs focus on short–term dynamics. Hence, depending on whether or not the variables of interest are cointegrated, the specification of the dynamic relationships between them varies.

For example, one can test for cointegration between X_t and Y_t variables, which individually are I(1) processes. The following fitted cointegration equation could then be estimated:

$$X_t = \alpha + \beta Y_t + \varepsilon_t \qquad (4.27)$$

where β is the cointegrating vector and ε_t is the error term.

Since, in practice, either of the two variables X and Y can serve as the dependent variable in cointegration tests, another second equation similar to equation (4.27) with Y as the dependent variable can also be specified as the cointegration equation. In fact, the second cointegration equation with Y as the dependent variable was specified earlier (see equation 4.21).

If X_t and Y_t in equation (4.27) are cointegrated, the estimated residual from this cointegration equation is stationary (i.e., $\varepsilon \approx I[0]$). Using tests of cointegration, the estimated values of ε are formally tested for stationarity. If stationarity of the residuals, ε, is rejected and ε is nonstationary, then the causal relationships between the variables in question (X and Y) can be investigated using the standard Granger causality tests based on equations (4.25) and (4.26) above.

On the other hand, failure to reject the stationarity of ε in equation (4.27) implies that X_t and Y_t cannot drift too far apart and that their long–run co–movements are related to each other. Under this situation, the two variables are involved in some kind of dynamic relationship. A more correct specification of this case would be represented by an ECM formulation as specified in equation (4.23), which is reproduced here for convenience:

$$\Delta X_t = c + \sum_{i=1}^{m} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{n} \beta_j \Delta Y_{t-j} + \theta \varepsilon_{t-1} + e_t \qquad (4.28)$$

If X_t and Y_t are cointegrated, a Granger–sense causal linkage should exist between the two variables in at least one direction. This means that, even if no causality is detected on the basis of the standard Granger causality tests (i.e., when the coefficients of the lagged changes of the causal variables are jointly insignificant), the coefficient θ in the ECM (4.28) captures any causal relationship.

Results of the Granger causality tests have been shown to be quite sensitive to variations in the lag orders of the estimating equations. Prior knowledge of the lag orders is

normally lacking. In the absence of this knowledge, previous researchers have used various methods to estimate the lags. Many of these methods are arbitrary, ranging from intelligent guesses to self–made rules of thumb. This fixing of lags arbitrarily entails trade–offs between bias and efficiency of the estimated parameters. Hence, for the purposes of selecting empirically optimum lag orders, two methods (Akaike 1974, Schwarz 1978) are chosen for use in this study. They are described in the following subsection.

4.3.9 Empirical methods for lag determination

As mentioned above (section 4.3.8), results of Granger causality tests and indeed many other econometric time series techniques (e.g., unit roots, cointegration, VARs, ECMs, FEDA and IRA) are sometimes quite sensitive to variations in the lag orders of the estimating equations. It is therefore important to determine optimal lags empirically for their incorporation into various estimating equations.

Methods of determining appropriate lag lengths, particularly those involved in estimating VARs in the first difference models, are described in the literature (see, for example, Bessler 1984a b and Ford 1986). Results often depend critically on the number of lagged differences included in the estimation equations. Lag lengths which are over–specified (i.e., more lags than the optimum number) lead to biased and inefficient estimates while under–specified lag numbers result in biased estimates with smaller variances (Chowdhury 1991). Subsequent statistical inferences are thus likely to be invalidated if arbitrary lag values are specified (Giles et al. 1992).

Several criteria allowing data to determine empirically appropriate lengths of the distributed lags have been proposed in literature (see for example, Judge, Griffiths, Hill, Lutkepohl and Lee 1985). Many of these criteria involve combining functions of the residual sum of squares (RSS) with a penalty for large numbers of parameters.

Two methods, the Akaike Information Criterion (AIC) by Akaike (1974) and the Schwarz Criterion (SC) by Schwarz (1978), are employed in this study to overcome the problem of misspecified lag lengths. These methods were selected because they are the most commonly used in empirical work of the nature undertaken in this thesis.

For a model of the following general form, for example:

$$Y_t = \sum_{i=0}^{m} \alpha_i Y_{t-i} + \sum_{j=1}^{p} \gamma_j X_{t-j} + e_t \qquad (4.29)$$

where α_i and γ_j are unknown distributed lag coefficients, Y_{t-i} and X_{t-j} are lagged values of the dependent variable and the explanatory variables, respectively, m and p ($< \infty$) represent the optimum lag lengths of the dependent and explanatory variables, respectively, and e_t is an independent white noise.

The appropriate lag numbers are selected by minimising the following function over different choices for the optimum lag:

$$AIC = (RSS + 2K\sigma^2)/T \qquad (4.30)$$

$$SC = (RSS + K\log T\sigma^2)/T \qquad (4.31)$$

where K and T are the number of regressors and observations, respectively.

Given that SC puts a heavier penalty on additional parameters, it almost always chooses lag lengths which are not greater than those chosen by AIC.

4.3.10 FEDA and IRA

Other than forecasting, there are two important uses of VAR models, namely, impulse response analysis and forecast error variance decomposition. These are tools which can be used to analyse data in terms of short–run dynamic relationships among variables in a given estimated system.

The interpretation of the error terms, u_t, in the VAR model of equation (4.17) is crucial in trying to analyse sources of economic fluctuations, particularly market fluctuations. Consider, as Bernanke (1986) did, u_t as a vector of structural economic shocks with no common causes and therefore unrelated. These represent fundamental economic forces which are orthogonal and can affect variables such as Y_t in a system. They cause Y_t to shift over time. It should be noted, however, that even if the elements of u_t are uncorrelated, this does not preclude the elements of Y_t from being correlated. Hence, the elements of Y_t can be correlated if the A matrix is not diagonal and more than one structural disturbance enter each equation (Myers et al. 1990).

According to Orden (1986b), it would be more natural to distinguish between the expected movement of the economy, as represented by the VAR parameters, and the deviations from this movement occurring over time as a result of unexpected shocks. These shocks are measured by the disturbance terms of the VAR equations. Interaction among variables in the VAR models can be evaluated by investigating the effects of the errors on the subsequent movement of all the variables in the model. This is accomplished by

transforming the estimated VAR equations to derive a MA representation of the VAR model. Through the MA representations, the impulse response and forecast error variance decomposition techniques are used to examine how structural shocks influence the endogenous variables in the VAR models.

Impulse response analysis and forecast error variance decomposition analysis are not described further here given that they are treated in Chapter 6. Further exposure of these methods can be found in Litterman (1979), Orden (1982), Hakkio and Morris (1984), Doan and Litterman (1984), Bessler (1984a), Ford (1986), Orden (1986b), Myers et al. (1989 1990) and Tegene (1990), among others.

4.4 Variance Decomposition Methods

Offutt and Blandford (1983) outlined various methods for estimating the magnitudes, sources, impacts and control of instability in economic variables. Most of these methods differ from those described in the foregoing sections which deal with time series econometrics. Many of the methods described by Offutt and Blandford are, however, not discussed here as this thesis focuses on those techniques which enable the estimation of the sources of instability in economic variables such as primary commodity outputs and revenues. For example, output is a product of yield and area whereas the product of price and output is revenue.

Interest in variance decomposition work on random identities dates back to the 1950s (Foote, Klein and Clough 1952, Meinken 1955, Sackrin 1957). However, a formula for decomposing the variance of random identities was first published by Goodman (1960). Some eight years later, Burt and Finley (1968) introduced the method to agricultural economists. This method was specifically used, in the first instance, for decomposing the variance of a multiplicative identity. Afterwards, many researchers either directly applied or modified Burt and Finley's method to suit their specific objectives (see, for example, Borhnstedt and Goldberger 1969, Houck 1973, Harris et al. 1974, Piggott 1978, 1981, Offutt and Blandford 1983, Hazell 1982, 1984, 1989). Since then, the VDMs have received attention because of the importance of their results to both the policy makers and individuals. These decomposition procedures may provide useful information about sources of variability in economic aggregate variables, enhancing understanding and, perhaps, prediction of future economic fluctuations.

4.4.1 Burt and Finley's VDM

Burt and Finley (1968) presented a method for partitioning the variance of random variables (such as revenue and production) into various components. These components are associated with separate random variables in the identity and interactions among them.

Burt and Finley's method is founded on a Taylor's series of expansion about the means of the variable components. This expansion leads to a method of decomposing the variance of multiplicative identities. For example, revenue can be decomposed into price and quantity while production could be decomposed into area and yield. Hence, much of variance decomposition empirical work was driven by the desire to investigate such relationships which are critically important to farmers and policy makers. To illustrate the Taylor's series expansion, it is assumed that there exists a multiplicative identity (Goodman 1960) of the following nature:

$$Y = \prod_{i=1}^{n} X_i \qquad (4.32)$$

A useful version of equation (4.32) is when n takes any integer. For instance, let n = 2, then Y is considered as an identity defined as a product of X_1 and X_2. That is:

$$Y = X_1 X_2 \qquad (4.33)$$

According to Burt and Finley (1968), the Taylor's series expansion of the multiplicative relationship in equation (4.33) is:

$$Y = \mu_1\mu_2 + (X_1-\mu_1)\mu_2 + (X_2-\mu_2)\mu_1 + (X_1-\mu_1)(X_2-\mu_1) \qquad (4.34)$$

where μ_1 and μ_2 denote the arithmetic means of X_1 and X_2, respectively. Taking the expectation of both sides of equation (4.34) results in:

$$E(Y) = \mu_1\mu_2 + \mathrm{cov}(X_1, X_2) \qquad (4.35)$$

where E is the expectation operator. Using equations (4.35 and (4.34), the variance of Y is given by:

$$\begin{aligned} Var(Y) &= E[Y - E(Y)]^2 \\ &= E[(X_1 - \mu_1)\mu_2 + (X_2 - \mu_2)\mu_1 \\ &\quad + (X_1 - \mu_1)(X_2 - \mu_2) - cov(X_1, X_2)]^2 \end{aligned} \qquad (4.36)$$

By writing out the square, equation (4.36) can be reduced to:

$$\begin{aligned} Var(Y) &= \mu_2^2 var(X_1) + \mu_1^2 var(X_2) + 2\mu_1\mu_2 cov(X_1X_2) \\ &\quad + E[(X_1 - \mu_1)(X_2 - \mu_2) - cov(X_1, X_2)]^2 \\ &\quad + 2\mu_1 E(X_1 - \mu_1)(X_2 - \mu_2)^2 \\ &\quad + 2\mu_2 E(X_1 - \mu_1)^2 (X_2 - \mu_2) \end{aligned} \qquad (4.37)$$

Burt and Finley explained the significance of the terms on the right hand side in equation (4.37) as:

- The first two terms are the direct effects of X_1 and X_2.
- The 3rd term is the first–order interaction effect.
- The 4th term is the variance of the covariance product about the covariance parameter, which is necessarily positive, and neutral for the purposes of interpretation.
- The last two terms are the higher order interactions.

Given that the last three terms have their origin in the second–degree terms of the Taylor's series, they are expected to be relatively unimportant but, in some sets of data, they may lead to problems.

For ease of computation, Burt and Finley recommended the use of the first three terms in equation (4.37) in the case of a two–variable decomposition of variance. It was argued that the first–order interaction term (term 3) would dominate the higher order terms in most situations. Following this argument, the last three terms (4, 5 and 6) would be dropped out of the computations. The accuracy of this approximation depends on the size of each variable's mean and variance as well as their covariances.

Burt and Finley's decomposition procedure is most useful where all terms except the first two direct terms in equation (4.37) are small. Further, the third term, the so–called dominant linear interaction term's effects, should be allocated correctly between the variables. For example, Houck (1973) divided the interaction term equally between the two variables. This is difficult to justify, especially in the absence of theory about the nature of the relationships between the two variables. Hence, and at worst, there could be some bias (Offutt and Blandford 1983).

Despite criticisms, it was acknowledged by Offutt and Blandford (1983) that potentially useful information could still be obtained from Burt and Finley's decomposition procedures. Information such as the relative contributions of price and quantity to revenue variability is obtainable and is of particular interest because of its implications for stabilisation policies. However, it tells nothing about the underlying structural relationships. For instance, price variability could be a result of a number of supply–demand relationships which cannot be captured using Burt and Finley's VDM. Hence, among other limitations, the Burt and Finley's decomposition method falls short of providing the full information about the critical underlying structural relationships among the variables.

4.4.2 Hazell's VDM

Hazell (1982, 1984, 1990) was one of the first economists credited with decomposing the variance of a multiplicative identity without necessarily spelling out assumptions about distributions of the relevant variables. He applied variance decomposition to national and global food grain (cereal) production which is the sum of products of area sown and yields of each individual region/country. The development of Hazell's (1982) variance decomposition technique was based on the work of Goodman (1960) and Bohrnstedt and Goldberger (1969). Hazell's method has been used primarily to decompose output variability into sown area and yield components of different crops and regions.

In analysing the components of change in the mean and variance of world cereal production using his variance decomposition model, Hazell (1982, 1984, 1989) let Q, A and Y denote production, area and yield, respectively. He also let subscripts i and j denote crops, and h and k denote regions or countries. The total cereal production for the world was then given by:

$$Q = \sum_{h} \sum_{j} A_{hj} Y_{hj} \qquad (4.38)$$

The average production is:

$$E(Q) = \sum_h \sum_j E(A_{hj}Y_{hj}) \tag{4.39}$$

and the variance of production is:

$$Var(Q) = \sum_h \sum_k \sum_i \sum_j cov(A_{hi}Y_{hi}, A_{kj}Y_{kj}) \tag{4.40}$$

The variance in equation (4.40) can be expanded as

$$Var(Q) = \underbrace{\sum_h \sum_j var(A_{hj}Y_{hj})}_{(A)} + \underbrace{\sum_h \sum_{i\neq j} \sum_j cov(A_{hi}Y_{hi}, A_{hj}Y_{hj})}_{(B)}$$

$$+ \underbrace{\sum_j \sum_{h\neq k} \sum_k cov(A_{hj}Y_{hj}, A_{kj}Y_{kj})}_{(C)}$$

$$+ \underbrace{\sum_{h\neq k} \sum_k \sum_{i\neq j} \sum_j cov(A_{hi}Y_{hi}, A_{kj}Y_{kj})}_{(D)} \tag{4.41}$$

where: A = sum of individual crop variances within regions/countries, B = sum of intercrop covariances within regions/countries, C = sum of interregion/country covariances within crops, and D = sum of covariances between different crops in different regions/countries.

Each component term can be expanded as:

$$E(A_{hj}Y_{hj}) = \bar{A}_{hj}\bar{Y}_{hj} + cov(A_{hj}Y_{hj}), \tag{4.42}$$

and, following Bohrnstedt and Goldberger (1969):

$$\begin{aligned} cov(A_{hi}Y_{hi}, A_{kj}Y_{kj}) &= \bar{A}_{hi}A_{kj}cov(Y_{hi}, Y_{kj}) \\ &+ \bar{A}_{hi}\bar{Y}_{kj}cov(Y_{hi}, A_{kj}) \\ &+ \bar{Y}_{hi}\bar{A}_{kj}cov(A_{hi}, Y_{kj}) \\ &+ \bar{Y}_{hi}\bar{Y}_{kj}cov(A_{hi}, A_{kj}) \\ &- cov(A_{hi}, Y_{hj})\,cov(A_{kj}, Y_{kj}) \\ &+ R \end{aligned} \qquad (4.43)$$

where $\bar{A}$ and $\bar{Y}$ are mean area and yield, respectively, and R is a residual term consisting of higher orders of cross moments.

This analysis partitions the changes in var(Q) and E(Q) between periods 1 and 2 into constituent parts. This entails decomposing the changes in each term in equations (4.39) and (4.41) with the help of equations (4.42) and (4.43). The changes are then summed up in different components over different regions/countries and crops.

Using equation (4.40) – for simplicity, crop and region/country subscripts are dropped – average production in period two is:

$$E(Q_2) = \bar{A}_2\bar{Y}_2 + cov(A_2, Y_2) \qquad (4.44)$$

Each variable in period 2 can be expressed as its counterpart in period 1 plus the change in the variable between the two. Equation (4.44) can be written thus:

$$\begin{aligned} E(Q_2) &= (\bar{A}_1 + \Delta\bar{A})(\bar{Y}_1 + \Delta\bar{Y}) + cov(A_1, Y_1) \\ &+ \Delta cov(A, Y) \end{aligned} \qquad (4.45)$$

The change in average production is then obtained from:

$$\begin{aligned} \Delta E(Q) &= E(Q_2) - E(Q_1) \\ &= \underset{(A)}{\bar{A}_1\Delta\bar{Y}} + \underset{(B)}{\bar{Y}_1\Delta\bar{A}} + \underset{(C)}{\Delta\bar{A}\Delta\bar{Y}} + \underset{(D)}{\Delta cov(A, Y)} \end{aligned} \qquad (4.46)$$

Hazell (1990) explained that there are four main sources of change in $\Delta E(Q)$ of equation (4.46). Two parts, in (A) and (B), emanate from changes in the mean yield and the mean area. These are called pure effects which arise even in the absence of other sources of change. The term in (C) is called an interaction effect, and term in (D) arises from changes in the covariability of areas and yield.

The change in the variance of production can be decomposed in the same way as was done in the average production. Details of the variance of production are provided by Hazell (1989).

4.4.3 Piggott's VDM

The approach suggested by Piggott (1978, 1981) had its genesis in extending and improving on Burt and Finley's method of analysing identities. This was done by incorporating into the formula the underlying structural relationships. Thus, Piggott (1978) demonstrated how a structural simultaneous equation model (SEM) could be used to derive a formula for the exact variance of gross revenue to decompose gross revenue variability into supply and demand components (Offutt and Blandford 1983, Myers et al. 1989, 1990). This was thought to be useful in the formulation and implementation of stabilisation policies. In fact, in reiterating the criticisms of Burt and Finley's method, Piggott (1978, p. 148) emphasised that there could be 'great dangers of implementing price stabilisation policies when the root cause of the fluctuating prices remains unknown'.

In extending and modifying Burt and Finley's method, Piggott (1978, 1981) advanced a method of decomposing the variance of gross revenue into supply and demand rather than the price and quantity components. The most important point to be noted in Piggott's VDM is that it uncovers the historical pattern of supply and demand variability as it underlies a particular pattern of gross revenue instability. Piggott's VDM begins with the formulation and estimation of a product's supply and demand functions, both assumed to be linear with fixed slopes over time. Non–linearity was found to complicate greatly the derivation of the variance expressions. The linearity assumption could be seen as a major limitation in the applicability of Piggott's method (Offutt and Blandford 1983).

Piggott's method entails the application of a simple regression analysis where price is the only explanatory variable to estimate the demand and supply functions. The prices and quantities are then transformed into equilibrium variables by solving for their equilibrium values and are expressed as functions of demand and supply shifts. This is constructed by equating the gross revenue (GR) identity with the product of equilibrium price times

equilibrium quantity. An expression is then developed for the variance of GR and partitioned into a demand effect (DE), a supply effect (SE) and an interaction effect (IE). That is, var(GR) = DE + SE + IE. The DE and SE are the direct effects while IE comprises the demand and supply intercept shifters. The IE is handled in such a way that it is the difference between GR and (DE + SE). GR is computed directly from data and not from the derived formula. Magnitudes attributable to the variance, skewness and kurtosis of the distribution of the historical set of intercepts are included as part of the demand and supply components. Although the implications of skewness and kurtosis distributions with respect to the variance of GR are not explained, these are viewed as a correction to the variance of the intercepts (Offutt and Blandford 1983).

The main advantage of Piggott's VDM over Burt and Finley's is that Piggott's method is useful in the identification of the root sources of GR variability. These root sources are decomposed into demand and supply rather than price and quantity. Thus, Piggott's VDM is more likely to indicate whether price or production stabilisation schemes are appropriate. Partly because of this, Piggott's method is one of the analytical applications adopted in this thesis. Piggott's method has been applied in various studies (see, for example, Myers and Runge 1985, Fleming and Piggott 1985, 1989; Piggott et al. 1986). Full details of Piggott's VDM are presented in Chapter 9.