POLICY RESEARCH WORKING PAPER 2426

Commodity Price Uncertainty in Developing Countries

Jan Dehn

Commodity price uncertainty in developing countries exhibits considerable time variation. In some countries, low uncertainty is punctuated by extreme, temporary increases (a pattern not exclusive to oil producers). For others, uncertainty appears nonstationary. High persistence in uncertainty prevails.

The World Bank
Development Research Group
Rural Development
August 2000

Summary findings

Uncertainty about commodity export prices is important to developing countries—both governments and producers—that export primary commodities.

Commodity export price uncertainty is typically measured as the standard deviation in the terms of trade. There are three problems with this approach:

- Terms of trade indices are unsuitable as proxies for commodity price movements per se.
- The shortness of terms of trade time series makes them inappropriate as a base for constructing time-varying uncertainty measures.
- Simple standard deviation measures ignore the distinction between predictable and unpredictable elements in the price process, so they risk overstating uncertainty.

Dehn examines commodity price uncertainty in developing countries using new data for quarterly aggregate commodity price indices for 113 developing countries for the period 1957–97. Each index is a geometrically weighted index of 57 commodity prices. He constructs six different measures of uncertainty.

The uncertainty measures confirm the importance of distinguishing between predictable and unpredictable components in the price process. But there is a positive, highly significant relationship between commodity export concentration and commodity price uncertainty for all six measures.

No obvious link is found between a country's regional affiliation and its exposure to uncertainty. Sub-Saharan African countries, for example, are no more prone to commodity price uncertainty than countries in other commodity-producing regions, although to the extent that they depend more on commodities, they will be affected more than countries with more diversified export baskets.

Similarly, there is no apparent relationship between a country's experiences of uncertainty and the type of commodities that dominate its exports—except that oil producers face greater uncertainty (because of discrete, well-publicized oil shocks).

A measure of uncertainty based on generalized autoregressive conditional heteroskedasticity (GARCH) indicates considerable time variation in uncertainty. Uncertainty is sometimes characterized by discrete spikes, although uncertainty in countries exhibits a secular increase over time. Most countries experience uncertainty, which tends to persist. It is unclear what lies behind the time variation in uncertainty.

This paper—a product of Rural Development, Development Research Group—is part of a larger effort in the group to examine the use of risk management tools to address commodity price uncertainty. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Panos Varangis, room MC3-535, telephone 202-473-3852, fax 202-522-1151, email address pvarangis@worldbank.org. Policy Research Working Papers are also posted on the Web at www.worldbank.org/research/workingpapers. The author may be contacted at jan.dehn@economics.ox.ac.uk. August 2000. (58 pages)

Produced by the Policy Research Dissemination Center

Commodity Price Uncertainty in Developing Countries

By

Jan Dehn[1]
Centre for the Study of African Economies, University of Oxford

Author's email address: jan.dehn@economics.ox.ac.uk

[1] I benefited from very helpful discussions, comments, and advice from Christopher L. Gilbert, Panayotis N. Varangis, Richard Mash, Paul Collier, and Jan Willem Gunning.

1. Introduction

It is widely recognised that commodity export price uncertainty is important to primary product exporting developing countries, both for the governments and for the producers themselves. For governments, unforeseen variations in export prices can complicate budgetary planning and can jeopardise the attainment of debt targets. This is a particularly serious problem for the highly indebted poor countries (HIPCs), all of which are highly dependent on commodity exports. For exporters, price variability increases cash flow variability and reduces the collateral value of inventories; both factors work to increase borrowing costs. Finally, smallholder farmers, often with poor access to efficient savings instruments, cope with revenue variability through crop diversification with the consequence that they largely forego the potential benefits obtainable through specialisation (International Task Force on Commodity Risk Management in Developing Countries (1999)).

It is a common practice to measure uncertainty simply as the standard deviation of the terms of trade. This approach encounters at least three objections. First, terms of trade indices are inappropriate as indicators of a country's exposure to commodity price volatility *per se*, because they contain various non-commodity price components. Secondly, terms of trade indices tend to be fairly short, which makes them unsuitable as a basis for constructing time varying uncertainty measures. Finally, simple standard deviation measures ignore the distinction between predictable and unpredictable elements in the price process, and therefore risk overstating uncertainty.

The key objective of this paper is to examine the main features of the commodity export price uncertainty faced by developing countries, while taking account of these concerns. The paper does so in two ways: Firstly, a new quarterly data set of country specific commodity export price indices is constructed for 113 countries over the period from 1957Q1-1997Q4. Each country's index is a geometrically weighted index of 57 individual commodities, and the uniqueness of each country's index is ensured by virtue of country specific weights. Secondly, the paper constructs uncertainty measures as the GARCH conditional variance of one-step ahead forecast errors. This methodology purges the price series of predictable components while not imposing an assumption of homoskedasticity on the residuals.

Meanwhile, in recognition of the fact that there is no consensus on how to measure uncertainty, a total of six uncertainty measures are constructed. These form the basis for the compilation of a set of stylised facts about the pattern and severity of commodity export price uncertainty as faced developing countries over the past 41 years.

The key findings of the paper are the following: First, the importance of distinguishing between predictable and unpredictable elements in the price process when measuring uncertainty is confirmed. Secondly, uncertainty displays considerably variation over time. Uncertainty in some countries is thus characterised by discrete spikes, while other countries appear to have experienced a secular increase in uncertainty over time. The majority of countries appear to have experienced uncertainty, which displays considerable persistence. Thirdly, there appear to be no obvious link between a country's regional affiliation and its experience of uncertainty. Sub-Saharan African countries, for example, are not prone to greater commodity price uncertainty than other commodity producing regions, although to the extent that Sub-Saharan African countries are more dependent on commodities they will obviously be more affected than countries with more diversified export baskets. Similarly, there is no apparent relationship between a country's experience of uncertainty and the type of commodity, which dominates its exports. The exception is oil producers. This category of exporters faces greater uncertainty than other regions although the greater uncertainty can be attributed exclusively to well known discrete oil shocks. Fourth, a strong and highly significant relationship between commodity export concentration and commodity price uncertainty is confirmed. This relationship does not, however, explain the considerable time variation found in the uncertainty measures; future work might profitably pursue the task of unpacking the causes of this variation.

This paper is structured as follows. Section 2 discusses issues surrounding the construction of a suitable commodity export price index for developing countries. Section 3 explores various approaches to measuring uncertainty. In Section 4, the main features of commodity price uncertainty in developing countries are presented, while the relationship between uncertainty and export concentration is examined in Section 5. Section 6 presents our findings about the time variation of uncertainty, and Section 7 concludes.

2. Constructing a suitable commodity price index

A prerequisite for a study of commodity price uncertainty and shocks is a measure of commodity price movements, which, in turn, is based on an appropriate index of prices. With a few exceptions (notably Deaton and Miller (1995)), studies of commodity price movements in developing countries have been undertaken using either prices of individual commodities, terms of trade indices, or indices of aggregate commodity price movements (not country specific). However, neither of these approaches is satisfactory for the following reasons:

First, only a few oil producing countries are specialised to the point of exporting only a single commodity, so for the majority of developing countries the full ramifications of being a commodity exporter cannot be determined with reference to just a single commodity price series.

Secondly, while individual commodity prices typically capture the movements of too few commodities, broad terms of trade indices arguably capture too much information, including various non-commodity and non-export price influences such as the prices of manufactures and import prices. The inclusion of these non-commodity components means that it is not possible to determine if the measured uncertainty is due to the commodities in the index, to the non-commodity components, to the export price movements or to changes in import prices.

Finally, aggregate commodity price indices are likely to be unrepresentative of the particular exposure to uncertainty of individual commodity exporting countries. Until recently, this problem was not recognised. For example, Pindyck and Rotemberg (1990) showed that the prices of commodities displayed 'excess co movement', even if those commodities were completely unrelated. This implies that is little to gain from constructing country specific commodity price indices compared to using broad aggregates of commodity prices. However, recent work by Cashin, McDermott and Scott (1999) suggests that much of the co movement in commodity prices can be accounted for by extreme outliers and structural breaks, which have powerful influences on the correlation based measures of co movement used by Pindyck and Rotemberg (1990). Using a concordance measure, which is insensitive to outliers, Cashin, McDermott and Scott (1999) show that unrelated commodities do not display co movement as hitherto thought. Broad aggregate indices of commodity prices are therefore likely to behave very differently from indices based on the export baskets of individual developing.

This suggests that there may be substantial gains to constructing country specific indices, which reflect the prices of the commodities exported by individual developing countries. The geometrically weighted index first used by Deaton and Miller (1995) is such an index. The index is structured as follows:

$$DM = \prod_i P_i^{W_i} \qquad [1]$$

where W_i is a weighting item and P_i is the dollar international commodity price for the commodity i. Dollar prices measure *cif* border prices. Historical *fob* prices, which give a preferable measure of the value of a commodity to the exporting country, are not generally available. The weighting item, W_i, is the value of commodity i in the total value of all commodities, n, for the constant base period j :

$$W_i = \frac{P_{ji}Q_{ji}}{\sum_n P_{jn}Q_{jn}}. \qquad [2]$$

Since W_i is country specific, each country's aggregate commodity price index is unique. The index uses constant base year weights, wherefore it does not cope well with shifts in the structure of trade. In particular, the index does not capture resource discoveries and other quantity shocks after the base period. Nor does it capture temporary volume shocks other than those, which happen to occur in the base year itself. However, since the purpose is to capture price rather than quantity movements, it is desirable to hold volumes constant. This also avoids possible endogeneity problems arising in the event of a volume response to price changes. Nevertheless, the index will understate income effects of a given price change.

As an average of the prices of exported commodities exported, the index is primarily suited to the study of macroeconomic rather than sectoral effects. The geometrical weighting scheme is useful for two reasons. After taking logs a geometric index provides the rate of change of prices in first differences, which is a useful property. Also, geometrically weighted indices avoid the numeraire problem which affects deflated arithmetically weighted indices.

Our index is identical in structure to that of Deaton and Miller (1995), but differs from their index in several regards. First, this index uses quarterly data instead of annual data. Quarterly data is more appropriate in the context of measuring uncertainty, because the GARCH methodology requires relatively large samples of data.

Secondly, the data set covers a larger number of countries over a longer time period and is based on a broader range of commodities. In particular, the data set covers 113 countries for the period 1957Q1-1997Q4, totaling some 18,532 observations. Of the 113 countries, 44 are Sub-Saharan African, 16 are from the Middle East and North Africa, 19 are from Latin America, 7 are from South Asia, 9 are from East Asia, 5 from the Pacific, and 12 are from the Caribbean. The final country is South Africa. Each individual country's commodity price index is constructed using international commodity price indices for 57 commodities. Appendix 1 provides further details on the construction of the index, basic descriptive statistics on each country's structure of trade and regional affiliation, as well as indicating the sources of all data.

3. Approaches to measuring uncertainty

Unpredictability clearly lies at the heart of any notion of uncertainty. Clements and Hendry (1998) define unpredictability by relating a random variable, v_t, to a set of information available prior to its realisation, $\Im_{t-1}$; the random variable, v_t, is said to be unpredictable with respect to the information set when the conditional and unconditional distributions of the random variable coincide:

$$D_{v_t}\left(v_t \middle| \Im_{t-1}\right) = D_{v_t}\left(v_t\right) \qquad [3]$$

where $D_{v_t}(\bullet)$ denotes conditional and unconditional distributions of v_t respectively. Unpredictability means that knowledge of $\Im_{t-1}$ does not improve prediction nor reduce any aspect of the uncertainty about v_t. Note that the information set $\Im_{t-1}$ is complete in the sense that it contains the full history of the variable v_t as well as any out-of-sample information which can inform a guess about the value of v_t, although $\Im_{t-1}$ can only be fully known if the agent is omniscient. Hence, $\Im_{t-1}$ denotes the absolute maximum information, which exists about process, all of which may or may not be available to agents.

It seems reasonable to suppose that producers have the ability to detect regular features in the price process, and on the basis of these generate probabilistic assessments about the predictable and unpredictable components of the process from one period to the next. Uncertainty is essentially a summary measure of the unpredictable elements of the price process. It is an *ex-ante* notion in the sense that it constitutes an assessment of unpredictability of future price movements, and it differs from variability, which also reflects the movements of the predictable components in the price process.

The stochastic components, which give rise to unpredictability in price processes, may be transitory or permanent. Consider the following stochastic trend process:

$$p_t = p_0 + \varphi t + \sum_{t=0}^{t} \varepsilon_t^P + \varepsilon_t^T \qquad [4]$$

This process has two stochastic components; namely permanent innovations, ε_t^P, and the transitory disturbances, ε_t^T. In addition, it has a deterministic growth trend with a constant growth rate. Permanent innovations can be thought of as drawings from a new distribution in the sense each draw signals a permanent change in the parameters of the process. Transitory disturbances, on the other hand, can be thought of as drawings from a known distribution.

The feature both transitory disturbances and permanent innovation can occur at any point in time raises the question whether uncertainty is best thought of as a transitory or a permanent phenomenon, or indeed as a combination of transitory disturbances and permanent innovations. The view that all stochastic components in the process contribute to unpredictability wherefore they should all be taken into account in measures of uncertainty has a strong intuitive attraction, because the strict distinction between predictable and unpredictable components is maintained. The alternative view that uncertainty is inherently a stationary concept, which is perhaps less intuitively appealing because it excludes stochastic permanent innovations from the resulting measures of uncertainty.

Which of these two approaches is more appropriate? This paper takes the position that uncertainty is best thought of as a stationary concept for three reasons. First, the effect of transitory disturbances is an interesting object of research in their own right. Secondly, the permanent innovations may turn out to dominate the uncertainty measure, such that this simply reflects the tendency of a random walk to wander far from its starting point. As pointed out by Mash (1995), this may lead to the conclusion that the major determinant of outcomes under volatility is good or bad luck. Thirdly, to the extent that there are short-term changes in uncertainty, these are more likely to be caused by transitory events such as weather and business cycles, while permanent innovations, which are caused, by technical innovations and changes in tastes are likely to be less dramatic in the short run.

Purging the price series of its permanent innovations is complicated by difficulties in determining if such innovations are deterministic or stochastic. The usual way to determine whether a non-stationary process is trend stationary or difference stationary is to carry out parametric unit root tests[2]. Unfortunately, these tests are far from decisive when applied to data with structural breaks and less than 250 observations. This is due to their low power against competing alternatives (Hendry and Neale (1991), Rudebusch (1993), Perron (1989), Leon and Soto (1995), Cochrane (1988), Cochrane (1991)). Instead of testing, we therefore proceed by favouring a differencing on the following two *a priori* grounds. First, the long and largely inconclusive debate over the long run trend in commodity prices relative to manufacturing prices indicates that commodity prices display features which place them in the borderline region between trend and difference stationary processes, and in this region a differencing transformation has been shown to generate smaller

[2] E.g. Dickey and Fuller (1981), Phillips (1987), Phillips and Perron (1988), and Lo and MacKinlay (1989).

forecast errors (Enders (1995)). Secondly, since the aggregation of a I(0) process and an I(1) process produces an I(1) process, the commodity export prices indices used here are likely on the balance of probabilities to be I(1).

Uncertainty measures are conditional upon a model of the price process, which must encapsulate what agents might reasonably regard as predictable components in the price process. Unfortunately, the 'true' model is unobservable, and is in any case likely to be highly subjective. In light hereof, we consider three broad alternative approaches to modeling the predictable element. The naïve approach treats all price movements as unpredictable, and the uncertainty measure is therefore simply the standard deviation each country's aggregate commodity price index. This approach is unsatisfactory on a number of counts: It does not control for the predictable components in the price evolution process. Both Ramey and Ramey (1995) and Serven (1998) have shown and argued that this distinction is important in other contexts. Secondly, since many price series exhibit trends the naïve measure may exaggerate the extent of uncertainty if it does not control for trend.

The second approach distinguishes between predictable and unpredictable components of the price series, but remains time invariant. The measure is based on the principles proposed by Ramey and Ramey (1995), namely that the predictable components of the price series can be modeled using a selection of explanatory variables. The variance of the residuals can then be thought of as uncertainty. In contrast to Ramey and Ramey (1995), we do not regress commodity prices on a series of explanatory variables, but instead adopt a time series approach, whereby the first difference of real commodity prices (in logs) is regressed[3] on its first lag, the second lag in levels (making the regression akin to an error correction specification) plus a quadratic trend, and quarterly dummies:

$$\Delta y_{i,t} = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \beta_1 \Delta y_{i,t-1} + \beta_2 y_{i,t-2} + \gamma_1 D_t + \varepsilon_{i,t};$$
$$t = 1\ldots,T; \qquad [5]$$

[3] Using Ordinary Least Squares (OLS).

The three quarterly dummies, D_t, take the value of 1 for the second, third, and fourth quarters, respectively, zero otherwise. The constant captures the base period intercept. This approach treats as predictable the parameters on the trend, quarterly dummies, and lagged differences and levels of the dependent variable, which can be justified by thinking of past values and trends as being accumulated as knowledge by agents, wherefore uncertainty estimates must purge these known priors. The final uncertainty estimate obtains as the standard deviation of the remaining unpredictable element over the sample period for each country as captured in the error term, $\varepsilon_{i,t}$.

It is possible that agents may initially have perceived the commodity price increases in the early 1970s as persistent, if not permanent level effect rather than a manifestation of increased uncertainty. In 1972, the old Malthusian debate over 'Limits to Growth' had been re-ignited by Meadows (1972) suggesting that the supply of commodities critical to industrial production was being exhausted through over-exploitation. This was followed shortly afterwards by large increases in the prices of many basic commodities lending an air of prophecy to the 'Limits to Growth' story. Around the same time, the world was witnessing calls for a New International Economic Order (NIEO) culminating in the UNCTAD IV resolution by UN's General Assembly. In accordance with the rationale that the instability of commodity prices was bad for development, UNCTAD IV commenced the setting up of stabilisation arrangements for ten key commodities (Cocoa, Coffee, Copper, Cotton, Jute, Rubber, Sisal, Sugar, Tea and Tin) with a view to providing similar arrangements for a further eight commodities (Bananas, Bauxite, Iron Ore, Meat, Rice, Wheat, Wool, and Timber). Against this background, the first oil shock occurred. The early success of the OPEC cartel is likely to have lent considerable credibility to the International Commodity Agreements (ICAs) for other commodities where none otherwise would have existed. It is also important to note that many developing countries viewed ICAs as a means of increasing prices rather than simply keeping them stable (Colman and Nixson (1986)). To take account of the possibility that the early 1970s signaled a permanent step and/or trend increase in commodity prices, a version of [5] was also constructed which additionally included intercept and trend breaks in 1973Q3.

The alternative interpretation of the price rises in the early 1970s is that they marked the start of a period of greater uncertainty as has been argued by Cashin, Liang and McDermott (1999). The third approach to measuring uncertainty therefore distinguishes not only between predictable and unpredictable components in the price series, but also allows the variance of the unpredictable element to vary with time. This measure is therefore more general than the Ramey and Ramey measures which assume homoskedasticity. Time varying conditional variances can be obtained by applying a Generalised Autoregressive Conditional Heteroskedasticity (GARCH) model to each country's aggregate commodity price index (Bollerslev (1986)). We use a univariate GARCH(1,1) specification similar to that adopted by Serven (1998), which we apply, uniformly across countries. Hence, we estimate, for each country,

$$\begin{aligned} &\Delta y_{i,t} = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \beta_1 \Delta y_{i,t-1} + \beta_2 y_{i,t-2} + \gamma_1 D_t + \varepsilon_{i,t}; \\ &t = 1\ldots,T; \\ &\sigma_{i,t}^2 = \gamma_{i0} + \gamma_{i1}\varepsilon_{i,t-1}^2 + \delta_i \sigma_{i,t-1}^2 \end{aligned} \quad [6]$$

where σ_t^2 denotes the variance of ε_t conditional upon information up to period. The fitted values of $\sigma_{i,t}^2$ constitute the measure of uncertainty of y_{it}. Quarterly dummies, D_j, were included to remove possible deterministic seasonal influences on the conditional variance. The quarterly dummies take the value of 1 for a particular quarter, zero otherwise, and the final quarter is catered for by the constant term.

Equation [6] is estimated using conditional maximum likelihood methods on the basis of a set of assumed initial values of the squared innovations and the variances. It is occasionally difficult to obtain convergence to the global maximum using the default initial values. In order to increase the chances of locating the global maximum, each country's GARCH model was run using a two-step procedure. In the first step, the lagged conditional variance parameter (which must be non-negative) was constrained to 0.5. The resulting coefficient estimates were then used as initial values for a second unconstrained run. In most cases, this resulted in well-behaved GARCH models, although in a few cases a different initial value of the lagged conditional variance parameter was required to secure convergence to a credible maximum[4].

[4] In the end, the Malaysian commodity price index was the only one which did not converge to credible coefficient values. This was only the case for the base case GARCH model.

As mentioned above, uncertainty measures may be strongly affected by outliers. This possibility raises deeper conceptual issues about how agents form expectations of future uncertainty, particularly whether agents give equal weight to all current observations when they form their expectations. To control for the effect of current shocks on estimates of future price uncertainty, two additional versions [6] are also produced which respectively 'dummy out' the four quarters 1973Q3, 1973Q4, 1974Q1 and 1974Q2 to remove the effects on the conditional variance of the first OPEC shock, and the 2.5% most extreme outliers in either tail of the distribution. In the latter case, the argument is that agents may regard extreme outliers as sufficiently infrequent and atypical to discount them heavily when forming estimates about future price uncertainty.

The features of the six uncertainty measures are summarised in Table 1.

4. Commodity export price uncertainty in developing countries

This section presents descriptive statistics on commodity price uncertainty, notably averages of uncertainty across different regions and producer types.

Table 2 shows average uncertainty across different regional groupings of countries and across different time periods. The column labels 'I' to 'VI' refer to the six different uncertainty measures summarized in Table 1. The first line shows the average commodity price uncertainty for all 113 countries in the sample. Uncertainty does not differ greatly between the Ramey and Ramey and GARCH based measures, which both record a standard deviation in the range of 0.6-0.8. In contrast, the simple standard deviation measure, which does not control for predictable elements from the price series, is several times larger than either of the measures, which do remove predictable elements. This underlines the point made by both Ramey and Ramey (1995) and Serven (1998) that the distinction between uncertainty and variability is an important one; much of the movement in the price series reflects purely predictable movements and failure to account for these leads to considerably exaggerated uncertainty estimates.

The second block of statistics in Table 2 shows average uncertainty by broad regional grouping calculated over the full sample period (1957-1997). The regional groups are defined as Sub-Saharan Africa, Middle East and North Africa, Latin

America, East Asia, South Asia, and, additionally, Pacific economies, Caribbean economies, and South Africa[5]. According to those uncertainty measures, which do not control for shocks ('I', 'IV' and 'VI'), the region, which faces by far the greatest commodity price uncertainty, is the Middle East and North Africa. Among the remaining regional groups, there are few differences in commodity price uncertainty. This includes Sub-Saharan African countries, which do not appear to experience more uncertainty on average than other developing countries.

After controlling for shocks, the difference in uncertainty between Middle Eastern and North African countries on the one hand and other regional groups on the other diminishes considerably for the GARCH measures ('II', 'III'). The Ramey and Ramey measure does not change with the inclusion of a trend break ('V'), however, which suggests that the breaks are a poor control for the effects of the price increases in the early 1970s.

The third block of data in Table 2 groups all countries together but disaggregates by sample period in accordance with key oil price movements (1958-1972; 1973-1985; 1986-1997). On all measures, uncertainty is higher in the 1973-1985 and 1986-1997 periods than in the period from 1957-1972, often by as much as 100%. Interestingly, there is no consistent evidence of a fall in uncertainty in the 1986-1997 period compared to the 1973-1985 period. Indeed, depending on the measure used, uncertainty is in some cases higher in the 1986-1997 period than in the 1973-1985 period. Since this increase is also evident in the measures, which specifically control for outliers, the rise in uncertainty cannot be attributed exclusively to a few extreme outliers.

The last eight blocks of data in Table 2 show uncertainty measures by regional group and by time period. Except for South Africa, uncertainty increased in all regions after 1973 and increased further in East Asia and the Caribbean after 1986. In Sub-Saharan Africa, South Asia, and the Pacific economies uncertainty fell slightly after 1986, while in the Middle East and North Africa and in Latin America the outcome depends on the specific uncertainty measure used.

[5] South Africa's level of industrialisation makes this economy very unlike its less industrialised neighbours in Sub-Saharan Africa. Moreover, adequate data on gold exports were not available for South Africa, wherefore we chose to treat this country separately.

An alternative way of classifying countries is by the type of commodity, which they produce. Producers of different types of commodities may be prone to uncertainty for different reasons, and their experience of uncertainty may therefore be different. For example, agricultural commodities are widely regarded as being more susceptible to weather shocks, while non-food products by virtue of not being consumer goods may be more prone to business cycle effects. Oil is often best treated on its own. On these grounds, it may be insightful to split the sample into agricultural food producers, agricultural non-food producers, non-agricultural non-oil producers, and oil producers. Countries are labeled as exporters of a particular type of commodity if their exports of that particular type of commodity constitute 50% or more of their total commodity exports. If no single commodity type accounts for 50% of exports the country is labeled a 'mixed' exporter. Table 3 shows how commodities are classified by type.

Table 4 shows average uncertainty by producer type. It is evident that oil producers face by far the most uncertain prices on most measures. The exception is the GARCH measure ('III'), which controls for all shocks, although the other measures which partly control for shocks ('II', 'III', and 'V') also indicate that uncertainty is considerably reduced by controlling for outliers.[6] The implication is that the bulk of uncertainty in these countries is accounted for mainly by discrete shocks. Meanwhile, there is very little to separate uncertainty measures for the remaining three producer types, although it is noticeable how mixed producers appear to have equivalent or lower uncertainty than all other non-oil producers in the 1973-1985 and 1986-1997 periods according to those measures which do not control for shocks ('I,' 'IV' and 'VI'). Over the full sample period, the uncertainty faced by mixed producers is equal to or lower than uncertainty in all other regions. Finally, uncertainty was higher during the 1973-1985 period than in the preceding period, and in many cases remained at this higher level into the 1986-1997 period. Hence, regardless of whether we disaggregate by region or by commodity producer type there appears to have been a sustained increase in uncertainty since the early 1970s.

[6]Since the oil producers are primarily from the Middle East and North Africa, this explains why this group of countries faced the greater uncertainty in Table 2.

5. Export concentration and uncertainty

In general, the greater the diversification of a country's export basket, the more stable is its export price index. How strong is this relationship between uncertainty and export diversification in developing countries' commodity export price indices, and does the link depend on the choice of uncertainty measure? To answer this question, Herfindahl export concentration statistics were calculated for the aggregate commodity export price indices of each country in accordance with the following formula:

$$H_j = \sum_{i=1}^{y} \left(\frac{x_i}{X} \right)^2 \qquad [7]$$

where x_i is the share of commodity i (where $i = 1,\ldots,y$ are the commodities in the commodity export price index) in the total commodity exports, X, of country j. The Herfindahl index, which takes into account both the number of commodities and their shares, takes a value of 1 when a country exports only a single commodity and tends towards 0 when there are more commodities and/or greater equality in the shares of the commodities in total commodity exports. Table 5 shows Herfindahl Index values for each of the countries in the sample.

Tables 6 and 7 compare concentration indices across regional groups. The difference between Table 6 and Table 7 is simply one of sample composition. The numbers in Table 6 are based on the full 113-country sample, which includes a substantial number of countries which export only a single commodity, and which therefore have Herfindahl scores of unity. Since these countries tend to be oil producers (although there are a number of island economies whose exports are also extremely specialised), it is wise to also consider the strength of the uncertainty-concentration link when these countries are excluded. The results in Table 7 are therefore based on a sample, which excludes fully specialised commodity exporters. The tables are organised as follows. The top panel in each table shows the average Herfindahl concentration index value for the countries in each of the eight regional grouping along with its standard deviation and the number of countries in each regional group. The lower panels show the results of t-tests of the null hypothesis that the Herfindahl export concentration statistics are identical across groups. Reading down the columns in the lower panels, a positive (negative) number in a column indicates that the region shown at the top of that column has a more (less) concentrated commodity export price index than the region in the corresponding row. For example, considering the first column in the lower panel of Table 6, the commodity export price indices for Sub-Saharan African countries are, on average, much less concentrated than the price indices of Middle Eastern and North African countries. In this particular case, the difference of 0.17 is significant at the 1% level according to a t-test. By the same token, Sub-Saharan African commodity exports are more concentrated than those of both Latin American and East Asian countries; this time with significance levels of 1% and 10%, respectively.

It is clear from Table 6 that Middle Eastern and North African countries have the most concentrated commodity export price indices followed by Caribbean and Sub-Saharan African countries. This pattern is unchanged when fully specialised economies are dropped (Table 7). Note also that the differences in concentration are in some cases very large indeed. Middle Eastern and North African, Caribbean, and Sub-Saharan African exports are in some cases close to twice as concentrated as the exports of Latin American and East Asian economies. These large differences tend to be statistically significant. Tables 8 and 9 repeat this exercise for producers of different commodity types. Oil economies have the most concentrated export price indices, followed by producers of inputs to industry, food producers, and mixed producers. The pattern is unchanged with the exclusion of specialised producers (Table 9).

The relationship between a country's commodity price uncertainty and the concentration of its export price can be estimated by means of simple regression analysis. Hence, fits through the cross-plot of Herfindahl scores and average uncertainty were generated for each of the different uncertainty measures, and for different samples, including sample compositions which exclude countries the most diversified and undiversified economies[7]. The full list of regression results is shown in Table 10. The table shows that regardless of the choice of uncertainty measure, the

[7]The most and least diversified countries were defined as those countries with the 5% most extreme Herfindahl index values.

relationship between uncertainty and diversification is unambiguously positive and highly significant (1% level).

For illustration purposes, Figure 1 depicts the line fitted through the cross-plot of Herfindahl scores on the horizontal axis and the base case measure of conditional variance on the vertical axis for the full sample of countries. The positive upwards trend is evident in the plot indicating that as exports become more concentrated country export price indices become more uncertain. We can therefore verify that a strong positive correlation exists between uncertainty and export concentration, as indeed one would expect.

6. Time varying uncertainty

Time, regional, and producer type averaged uncertainty measures inevitably gloss over considerable cross-country variation as well as potential time variation in the data. As a supplement to the summary statistics just reported, we therefore also graph the conditional variances against time for the base case GARCH measure ('I') based on equation [6]. The conditional variances of the one-step ahead forecast error for the full sample of countries are shown in Figures 2-16 for the full sample of countries. For illustrative purposes, countries have been classified according to the pattern of their conditional standard deviations as determined by visual inspection.

Figures 2 to 4 show countries with extremely sharp distinct upward spikes in uncertainty in specific periods and otherwise very stable uncertainty schedules. Countries whose uncertainty schedules conform to this pattern all have oil as an important (and in some cases the only) commodity export. The largest spike is clearly identifiable as the first oil shock, and the lesser spikes indicate that the second oil shock in 1979, the drop in oil prices in 1986, and the shock associated with the Gulf War in 1990.

Large discrete spikes in uncertainty are not confined to oil producers, however. A second group of countries also exhibit clearly defined discrete episodes of large increases in uncertainty (Figures 5 and 6). There is not much to distinguish this group from the oil producers in Figures 2-4 except that the spikes are less extreme and prices less stable and less homogenous outside the spikes. The commodities, which dominate the exports in this group of countries, are coffee, phosphates, sugar, and oil. Coffee and sugar in particular are perishable commodities and therefore prone to large positive shocks as suggested by Deaton and Laroque (1992).

As a group, the countries in figures 2-6, whose uncertainty schedules display these discrete spikes, constitute 33% of the 113 countries in the sample, although the proportion drops to 13% when pure oil exporters are excluded. For this group of countries, it clearly makes more sense to think of their price environment as one characterised by discrete shocks than uncertainty more generally.

A third group of countries exhibit uncertainty schedules with the dual features of a secular increase since approximately mid-sample and a marked absence of large spikes. This pattern characterises 10 countries, mainly from Latin America and the Caribbean (Figures 7 and 8). Other than reflecting a genuine trend of increased uncertainty, there are two potential explanations why uncertainty appears to have risen for these countries. First, it may be that the sample size is not long enough to capture what may eventually turn out to be mean reversion in the conditional standard deviation. This can only be verified by awaiting the arrival of additional data. The second possibility is that not all the unit roots in the data have been removed by first differencing the data. A non-zero frequency unit root in the data would cause the variance to increase with time, and could therefore account for the observed increase in the conditional standard deviation. To examine if this is the case, the seasonal filtering methodology proposed by Hylleberg (1992) was applied to the ten series exhibiting this pattern of increasing uncertainty. The appendix to this chapter describes how the Hylleberg filtering method works, and presents graphical depictions of the frequency decompositions. It is clear from the plots of the half-yearly and the quarterly components of each of these series that they are in fact mean reverting, which suggests that the secular rise in the conditional variance of these ten series is either a genuine feature of uncertainty, or the result of the shortness of the time series.

A fourth group of countries have conditional variances which display a pattern of high frequency changes from one period to the next (Figures 9-10). It is not clear why uncertainty should change so substantially from one period to the next in every period. This pattern characterises some 18 countries. Finally, the conditional variances of the remaining 46 countries are a somewhat motley crew, which do not fit neatly into either of the preceding categories. Countries in this category do have in common, however, that changes in their conditional variances appear to be quite persistent, although they are also clearly stationary (Figures 11 to 16). This is probably the pattern, which most closely matches the prior expectations of the author. Note, however, that the uncertainty schedule for Malaysia (in Figure 16) did not lend itself to modeling using [6]. In particular, the coefficient on the lagged conditional standard deviation term was negative, and it was not possible remove this anomaly by specifying different initial values for the optimisation[8].

Regardless of the differences in patterns of uncertainty, it is clearly evident that uncertainty displays considerable time variation for most countries. Export concentration cannot explain the frequent changes in uncertainty displayed in these graphs, because export concentration only changes very slowly with the structure of the economy as a whole.

7. Conclusion

This chapter has presented a new commodity export price index for 113 developing countries over the period 1957-1997. The paper then examined the features of commodity price uncertainty using six different uncertainty measures. Developing countries' experiences of uncertainty do not conform neatly to any obvious regional classifications. For example, Sub-Saharan African countries are not particularly more prone to commodity price uncertainty than other regions. Similarly, there does not appear to be a clear relationship between the type of commodities produced by a country and the uncertainty experienced by that country, despite arguments that some commodity types may be more prone to weather shocks and others to business cycles. The exception to this rule is oil. Oil producers experience more uncertainty than other countries. Yet, the positive correlation between average commodity price uncertainty and export concentration is strong and significant across a range of uncertainty measures.

The paper has shown that uncertainty displays time variation with very distinct patterns. In some cases, uncertainty is low but punctuated by periods of

[8] One solution is to specify a different model of the 'predictable' component for Malaysia, but we did not do this in order to ensure comparability of the results across countries.

extreme but temporary increases, a pattern not exclusive to oil producers. For another group of countries, uncertainty appears non-stationary, at least within the sample period and particularly since the mid-1970s. In the majority of cases, however, uncertainty is stationary but with changes which appear to be highly persistent. It is not clear what drives the differences in uncertainty over time. Export concentration is an unlikely candidate in explaining these differences. Further research might profitably attempt to cast additional light on the time series properties and determinants of uncertainty now that long time series on uncertainty can be constructed.

Table 1: Uncertainty and variability measures

No.	Nature of uncertainty variable	Description	Predictable elements in the process	Shocks 'dummied out' of residuals and conditional variance
I	Time varying uncertainty	Garch conditional standard deviation of one step ahead forecast error	LDV, T, T^2, QD	
II	Time varying uncertainty	Garch conditional standard deviation of one step ahead forecast error dymmying out first oil shock	LDV, T, T^2, QD	First oil shock only (1973Q3-1974Q2)
III	Time varying uncertainty	Garch conditional standard deviation of one step ahead forecast error dummying out all shocks	LDV, T, T^2, QD	All 2.5% positive and negative shocks
IV	Time invariant uncertainty	Ramey & Ramey unconditional standard deviation	LDV, T, T^2, QD	
V	Time invariant uncertainty	Ramey & Ramey unconditional standard deviation	LDV, T, QD	Trend break and intercept break in 1973Q3
VI	Time invariant variability	Simple unconditional standard deviation		

(Note: 'LDV', 'T', 'T^2', and 'QD' denote lagged dependent variable, linear time trend, trend squared, and quarterly dummies)

Table 2: Commodity price uncertainty, by region

Region (Group number)	Time period	n	I		II		III		IV		V		VI	
All 113 countries	*1957-1997*	113	**0.08**	*(0.03)*	**0.07**	*(0.02)*	**0.06**	*(0.02)*	**0.08**	*(0.03)*	**0.08**	*(0.03)*	**0.30**	*(0.13)*
Sub-Saharan Africa	*1957-1997*	44	**0.08**	*(0.03)*	**0.07**	*(0.02)*	**0.06**	*(0.02)*	**0.08**	*(0.03)*	**0.08**	*(0.02)*	**0.27**	*(0.11)*
Middle East and North Africa	*1957-1997*	16	**0.12**	*(0.04)*	**0.08**	*(0.02)*	**0.06**	*(0.01)*	**0.11**	*(0.04)*	**0.11**	*(0.03)*	**0.45**	*(0.18)*
Latin America	*1957-1997*	17	**0.07**	*(0.02)*	**0.07**	*(0.02)*	**0.06**	*(0.01)*	**0.07**	*(0.02)*	**0.07**	*(0.02)*	**0.27**	*(0.09)*
South Asia	*1957-1997*	5	**0.07**	*(0.02)*	**0.07**	*(0.02)*	**0.07**	*(0.03)*	**0.07**	*(0.02)*	**0.07**	*(0.02)*	**0.35**	*(0.15)*
East Asia	*1957-1997*	11	**0.08**	*(0.03)*	**0.07**	*(0.03)*	**0.07**	*(0.03)*	**0.08**	*(0.03)*	**0.08**	*(0.03)*	**0.26**	*(0.06)*
Pacific	*1957-1997*	5	**0.07**	*(0.02)*	**0.07**	*(0.02)*	**0.07**	*(0.02)*	**0.07**	*(0.02)*	**0.07**	*(0.02)*	**0.29**	*(0.11)*
Caribbean	*1957-1997*	14	**0.08**	*(0.04)*	**0.08**	*(0.03)*	**0.07**	*(0.03)*	**0.09**	*(0.03)*	**0.08**	*(0.03)*	**0.25**	*(0.14)*
South Africa	*1957-1997*	1	**0.03**	.	**0.03**		**0.03**	.	**0.03**	.	**0.03**		**0.15**	
ALL	*1957-1972*	113	**0.07**	*(0.04)*	**0.05**	*(0.02)*	**0.05**	*(0.02)*	**0.05**	*(0.02)*	**0.05**	*(0.02)*	**0.10**	*(0.06)*
ALL	*1973-1985*	113	**0.09**	*(0.03)*	**0.08**	*(0.02)*	**0.07**	*(0.02)*	**0.10**	*(0.04)*	**0.10**	*(0.04)*	**0.24**	*(0.11)*
ALL	*1986-1997*	113	**0.09**	*(0.04)*	**0.09**	*(0.04)*	**0.08**	*(0.03)*	**0.09**	*(0.04)*	**0.09**	*(0.04)*	**0.15**	*(0.07)*
Sub-Saharan Africa	*1957-1972*	44	**0.06**	*(0.03)*	**0.05**	*(0.02)*	**0.05**	*(0.02)*	**0.05**	*(0.02)*	**0.05**	*(0.02)*	**0.11**	*(0.06)*
Sub-Saharan Africa	*1973-1985*	44	**0.09**	*(0.03)*	**0.08**	*(0.02)*	**0.07**	*(0.02)*	**0.10**	*(0.04)*	**0.09**	*(0.03)*	**0.22**	*(0.09)*
Sub-Saharan Africa	*1986-1997*	44	**0.08**	*(0.03)*	**0.08**	*(0.04)*	**0.07**	*(0.03)*	**0.08**	*(0.03)*	**0.08**	*(0.03)*	**0.16**	*(0.08)*
Middle East and North Africa	*1957-1972*	16	**0.12**	*(0.04)*	**0.05**	*(0.02)*	**0.04**	*(0.01)*	**0.04**	*(0.01)*	**0.03**	*(0.00)*	**0.06**	*(0.02)*
Middle East and North Africa	*1973-1985*	16	**0.13**	*(0.04)*	**0.09**	*(0.03)*	**0.05**	*(0.01)*	**0.16**	*(0.05)*	**0.15**	*(0.05)*	**0.37**	*(0.12)*
Middle East and North Africa	*1986-1997*	16	**0.12**	*(0.04)*	**0.12**	*(0.05)*	**0.09**	*(0.03)*	**0.12**	*(0.04)*	**0.11**	*(0.04)*	**0.13**	*(0.02)*
Latin America	*1957-1972*	17	**0.06**	*(0.03)*	**0.05**	*(0.02)*	**0.05**	*(0.02)*	**0.04**	*(0.02)*	**0.04**	*(0.02)*	**0.09**	*(0.06)*
Latin America	*1973-1985*	17	**0.08**	*(0.02)*	**0.07**	*(0.02)*	**0.06**	*(0.01)*	**0.09**	*(0.03)*	**0.08**	*(0.03)*	**0.20**	*(0.09)*
Latin America	*1986-1997*	17	**0.08**	*(0.03)*	**0.08**	*(0.03)*	**0.07**	*(0.02)*	**0.08**	*(0.03)*	**0.08**	*(0.03)*	**0.13**	*(0.05)*
South Asia	*1957-1972*	5	**0.06**	*(0.03)*	**0.06**	*(0.03)*	**0.06**	*(0.03)*	**0.06**	*(0.03)*	**0.06**	*(0.03)*	**0.12**	*(0.05)*
South Asia	*1973-1985*	5	**0.08**	*(0.02)*	**0.08**	*(0.02)*	**0.08**	*(0.03)*	**0.08**	*(0.02)*	**0.08**	*(0.03)*	**0.27**	*(0.15)*
South Asia	*1986-1997*	5	**0.08**	*(0.02)*	**0.07**	*(0.03)*	**0.08**	*(0.03)*	**0.07**	*(0.02)*	**0.07**	*(0.02)*	**0.15**	*(0.07)*
East Asia	*1957-1972*	11	**0.06**	*(0.02)*	**0.06**	*(0.02)*	**0.06**	*(0.02)*	**0.05**	*(0.02)*	**0.05**	*(0.02)*	**0.13**	*(0.07)*
East Asia	*1973-1985*	11	**0.08**	*(0.03)*	**0.07**	*(0.03)*	**0.07**	*(0.03)*	**0.09**	*(0.03)*	**0.08**	*(0.03)*	**0.21**	*(0.07)*
East Asia	*1986-1997*	11	**0.09**	*(0.05)*	**0.09**	*(0.05)*	**0.08**	*(0.05)*	**0.09**	*(0.05)*	**0.09**	*(0.05)*	**0.15**	*(0.10)*
Pacific	*1957-1972*	5	**0.06**	*(0.02)*	**0.06**	*(0.02)*	**0.06**	*(0.02)*	**0.05**	*(0.01)*	**0.05**	*(0.01)*	**0.12**	*(0.05)*
Pacific	*1973-1985*	5	**0.08**	*(0.02)*	**0.08**	*(0.02)*	**0.08**	*(0.02)*	**0.09**	*(0.02)*	**0.09**	*(0.02)*	**0.24**	*(0.06)*
Pacific	*1986-1997*	5	**0.07**	*(0.03)*	**0.07**	*(0.03)*	**0.07**	*(0.03)*	**0.07**	*(0.03)*	**0.07**	*(0.03)*	**0.15**	*(0.06)*
Caribbean	*1957-1972*	14	**0.06**	*(0.04)*	**0.05**	*(0.03)*	**0.05**	*(0.03)*	**0.05**	*(0.03)*	**0.05**	*(0.03)*	**0.11**	*(0.06)*
Caribbean	*1973-1985*	14	**0.09**	*(0.04)*	**0.08**	*(0.02)*	**0.07**	*(0.02)*	**0.10**	*(0.04)*	**0.10**	*(0.04)*	**0.20**	*(0.11)*
Caribbean	*1986-1997*	14	**0.10**	*(0.05)*	**0.10**	*(0.05)*	**0.09**	*(0.04)*	**0.10**	*(0.05)*	**0.10**	*(0.04)*	**0.16**	*(0.07)*
South Africa	*1957-1972*	1	**0.03**	.	**0.02**	.	**0.02**	.	**0.02**		**0.02**	.	**0.03**	.
South Africa	*1973-1985*	1	**0.04**	.	**0.04**	.	**0.03**	.	**0.04**		**0.04**		**0.08**	.
South Africa	*1986-1997*	1	**0.03**	.	**0.03**	.	**0.03**	.	**0.03**	.	**0.03**	.	**0.07**	.

(Note: Figures in **BOLD** *are averages, while smaller figures in* italic *are standard deviations across group members)*

Key:

I-Average conditional standard deviation (GARCH base case)
II-Average conditional standard deviation (GARCH controlling for 1973/74 shock)
III-Average conditional standard deviation (GARCH controlling for all shocks)
IV-Unconditional standard deviation (Ramey and Ramey)
V-Unconditional standard deviation (Ramey and Ramey w. 1973Q3 break)
VI-Simple unconditional standard deviation

Table 3: Commodities, by broad product category

Agricultural food stuffs	*Agricultural non-food stuffs*	*Non-agricultural non-oil commodities*	*Oil*
Coffee(Brazil)	Tobacco	Iron	Crude Petroleum
Coffee(Colombia)	Cotton	Copper	
Coffee(Other milds)	Wool	Aluminium	
Coffee(Uganda)	Linseed Oil	Silver	
Maize	Jute	Tin	
Wheat	Hardwood	Tin (Bolivia)	
Beef	Rubber	Zinc	
Sugar	Rubber (Malaysia)	Lead	
Sugar EU imports	Newsprint	Nickel	
Rice	Copra	Manganese	
Rice (Thailand)	Sisal	Gold	
Tea	Hides	Phosphate Rock	
Tea (Sri Lanka)	Fishmeal	Coal	
Palm Kernels		Superphosphates	
Palm Oil (Malaysia)		Urea	
Cocoa (Brazil)			
Cocoa (ICCO)			
Groundnuts			
Groundnut Oil			
Soybeans			
Soybean Meal			
Soybean Oil			
Bananas			
Shrimps			
Sorghum			
Lamb			
Coconut Oil (Philippines)			
Coconut Oil			

Table 4: Commodity price uncertainty, by commodity type

Commodity type	*Time period*	*n*	*I*	*II*	*III*	*IV*	*V*	*VI*
All 113 countries	*1957-1997*	113	**0.08** *(0.03)*	**0.07** *(0.02)*	**0.06** *(0.02)*	**0.08** *(0.03)*	**0.08** *(0.03)*	**0.30** *(0.13)*
Agricultural food stuffs	*1957-1997*	52	**0.07** *(0.02)*	**0.07** *(0.02)*	**0.07** *(0.02)*	**0.08** *(0.02)*	**0.08** *(0.02)*	**0.25** *(0.09)*
Agricultural non-foods	*1957-1997*	18	**0.06** *(0.02)*	**0.06** *(0.02)*	**0.06** *(0.02)*	**0.07** *(0.02)*	**0.07** *(0.02)*	**0.24** *(0.08)*
Non-agro non-oil	*1957-1997*	17	**0.07** *(0.02)*	**0.06** *(0.02)*	**0.06** *(0.02)*	**0.07** *(0.02)*	**0.07** *(0.02)*	**0.23** *(0.06)*
Oil	*1957-1997*	23	**0.13** *(0.03)*	**0.09** *(0.02)*	**0.06** *(0.01)*	**0.12** *(0.02)*	**0.12** *(0.02)*	**0.50** *(0.10)*
Mixed	*1957-1997*	3	**0.06** *(0.01)*	**0.05** *(0.01)*	**0.05** *(0.01)*	**0.05** *(0.01)*	**0.05** *(0.01)*	**0.24** *(0.03)*
Agricultural food stuffs	*1957-1972*	52	**0.06** *(0.02)*	**0.06** *(0.02)*	**0.06** *(0.02)*	**0.05** *(0.02)*	**0.05** *(0.02)*	**0.11** *(0.05)*
Agricultural food stuffs	*1973-1985*	52	**0.08** *(0.02)*	**0.08** *(0.02)*	**0.07** *(0.02)*	**0.09** *(0.02)*	**0.09** *(0.02)*	**0.20** *(0.08)*
Agricultural food stuffs	*1986-1997*	52	**0.08** *(0.04)*	**0.08** *(0.04)*	**0.08** *(0.04)*	**0.08** *(0.04)*	**0.08** *(0.04)*	**0.17** *(0.09)*
Agricultural non-foods	*1957-1972*	18	**0.05** *(0.02)*	**0.05** *(0.02)*	**0.05** *(0.02)*	**0.04** *(0.02)*	**0.04** *(0.02)*	**0.09** *(0.05)*
Agricultural non-foods	*1973-1985*	18	**0.07** *(0.02)*	**0.07** *(0.02)*	**0.07** *(0.02)*	**0.08** *(0.02)*	**0.07** *(0.02)*	**0.19** *(0.06)*
Agricultural non-foods	*1986-1997*	18	**0.08** *(0.02)*	**0.08** *(0.02)*	**0.07** *(0.02)*	**0.08** *(0.02)*	**0.08** *(0.02)*	**0.16** *(0.05)*
Non-agro non-oil	*1957-1972*	17	**0.06** *(0.03)*	**0.05** *(0.03)*	**0.05** *(0.03)*	**0.05** *(0.03)*	**0.05** *(0.03)*	**0.15** *(0.09)*
Non-agro non-oil	*1973-1985*	17	**0.07** *(0.02)*	**0.07** *(0.02)*	**0.07** *(0.02)*	**0.08** *(0.03)*	**0.08** *(0.03)*	**0.20** *(0.07)*
Non-agro non-oil	*1986-1997*	17	**0.07** *(0.02)*	**0.07** *(0.02)*	**0.06** *(0.02)*	**0.07** *(0.02)*	**0.07** *(0.02)*	**0.14** *(0.05)*
Oil	*1957-1972*	23	**0.12** *(0.03)*	**0.05** *(0.02)*	**0.04** *(0.00)*	**0.04** *(0.01)*	**0.03** *(0.00)*	**0.05** *(0.01)*
Oil	*1973-1985*	23	**0.14** *(0.03)*	**0.09** *(0.02)*	**0.05** *(0.01)*	**0.17** *(0.03)*	**0.17** *(0.03)*	**0.40** *(0.09)*
Oil	*1986-1997*	23	**0.14** *(0.02)*	**0.13** *(0.04)*	**0.10** *(0.02)*	**0.13** *(0.02)*	**0.13** *(0.02)*	**0.12** *(0.02)*
Mixed	*1957-1972*	3	**0.05** *(0.01)*	**0.04** *(0.01)*	**0.04** *(0.01)*	**0.04** *(0.01)*	**0.04** *(0.01)*	**0.09** *(0.03)*
Mixed	*1973-1985*	3	**0.06** *(0.00)*	**0.05** *(0.01)*	**0.06** *(0.01)*	**0.07** *(0.01)*	**0.07** *(0.01)*	**0.16** *(0.03)*
Mixed	*1986-1997*	3	**0.05** *(0.01)*	**0.05** *(0.01)*	**0.04** *(0.00)*	**0.05** *(0.01)*	**0.05** *(0.01)*	**0.11** *(0.04)*

(Note: Figures in **BOLD** *are averages, while smaller figures in* italic *are standard deviations across group members)*

Key:

I-Average conditional standard deviation (GARCH base case)
II-Average conditional standard deviation (GARCH controlling for 1973/74 shock)
III-Average conditional standard deviation (GARCH controlling for all shocks)
IV-Unconditional standard deviation (Ramey and Ramey)
V-Unconditional standard deviation (Ramey and Ramey w. 1973Q3 break)
VI-Simple unconditional standard deviation

Table 5: Herfindahl indices

Country	Herfindahl Index	Country	Herfindahl
Algeria	0.97	Malaysia	0.28
Angola	1.00	Mali	0.88
Argentina	0.13	Mauritania	0.90
Bahamas, The	1.00	Mauritius	0.97
Bahrain	1.00	Mexico	0.73
Bangladesh	0.66	Mongolia	0.58
Barbados	1.00	Morocco	0.28
Belize	0.70	Mozambique	0.50
Benin	0.66	Myanmar	0.52
Bhutan	1.00	Namibia	0.28
Bolivia	0.17	Nepal	0.64
Botswana	0.52	Nicaragua	0.19
Brazil	0.16	Niger	0.50
Burkina Faso	0.83	Nigeria	0.97
Burundi	0.70	Oman	0.97
Cameroon	0.20	Pakistan	0.39
Cape Verde	1.00	Panama	0.30
CAR	0.60	PNG	0.54
Chad	1.00	Paraguay	0.31
Chile	0.69	Peru	0.27
Colombia	0.32	Philippines	0.18
Congo	0.97	Qatar	0.94
Costa Rica	0.36	Reunion	0.93
Cote d'Ivoire	0.30	Rwanda	0.50
Djibouti	0.45	Saudi Arabia	0.99
Dominica	0.99	Senegal	0.34
Dominican Republic	0.35	Seychelles	0.53
Ecuador	0.36	Sierra Leone	0.49
Egypt	0.35	Singapore	0.17
El Salvador	0.50	Solomon Islands	0.37
Ethiopia	0.47	Somalia	0.47
Fiji	0.54	South Africa	0.23
Gabon	0.73	Sri Lanka	0.69
Gambia	0.38	St. Kitts & Nevis	1.00
Ghana	0.30	St. Lucia	0.91
Grenada	0.44	St. Vincent	0.69
Guatemala	0.30	Sudan	0.60
Guinea	0.38	Suriname	0.68
Guinea-Bissau	0.50	Swaziland	0.92
Guyana	0.29	Syria	0.77
Haiti	0.58	Tanzania	0.32
Honduras	0.30	Thailand	0.28
India	0.13	Togo	0.35
Indonesia	0.33	Tonga	0.62
Iran	0.99	Trin. & Tob.	0.79
Iraq	1.00	Tunisia	0.53
Jamaica	0.74	Turkey	0.30
Jordan	0.94	Uganda	0.72
Kenya	0.42	UAE	0.97
Korea, Republic of	0.31	Uruguay	0.29

Kuwait	0.95	Vanuatu	0.37
Laos	1.00	Venezuela	0.74
Lesotho	0.65	Western Samoa	0.36
Liberia	0.32	Yemen, Rep.	0.28
Madagascar	0.29	Zaire	0.42
Malawi	0.60	Zambia	0.92
		Zimbabwe	0.22

Table 6: Commodity export concentration, by regional group (full sample)

	Sub-Saharan Africa	Middle East and North Africa	Latin America	South Asia	East Asia	Pacific	Caribbean	South Africa
Mean	0.59	0.76	0.36	0.50	0.47	0.45	0.72	0.23
Standard deviation	0.25	0.30	0.19	0.24	0.30	0.12	0.24	.
n	44	16	17	5	6	5	14	1

	Sub-Saharan Africa	Middle East and North Africa	Latin America	South Asia	East Asia	Pacific
Middle East and North Africa	-0.17 **					
Latin America	0.23 ***	0.40 ***				
South Asia	0.09	0.26 **	-0.14 *			
East Asia	0.12 *	0.29 ***	-0.11	0.03		
Pacific	0.14	0.31 **	-0.09	0.05	0.02	
Caribbean	-0.13 **	0.04	-0.36 ***	-0.22 **	-0.25 **	-0.27 **

(Note: 'ROW' - rest of the world; 'ACP' - African, Caribbean, and Pacific countries; 'MENA' - Middle Eastern and North African countries)
*(Note: '***' - 1% significance level; '**' - 5% significance level; *" - 10% significance level)*

Table 7: Commodity export concentration, by regional group (restricted sample)

	Sub-Saharan Africa	Middle East and North Africa	Latin America	South Asia	East Asia	Pacific	Caribbean	South Africa
Mean	0.57	0.74	0.36	0.51	0.35	0.45	0.68	0.23
Standard deviation	0.24	0.30	0.19	0.24	0.16	0.12	0.23	.
n	42	15	17	5	9	5	12	1

	Sub-Saharan Africa	Middle East and North Africa	Latin America	South Asia	East Asia	Pacific
Middle East and North Africa	-0.18 **					
Latin America	0.21 ***	0.39 ***				
South Asia	0.07	0.25 *	-0.14 *			
East Asia	0.21 ***	0.39 ***	0.01	0.14 *		
Pacific	0.12	0.30 **	-0.09 ***	0.05	-0.10 **	
Caribbean	-0.11 *	0.07	-0.32 ***	-0.18 *	-0.32 ***	-0.22 **

(Note: 'ROW' - rest of the world; 'ACP' - African, Caribbean, and Pacific countries;
'MENA' - Middle Eastern and North African countries)
*(Note: '***' - 1% significance level; '**' - 5% significance level; *' - 10% significance level)*

Table 8: Commodity export concentration, by producer type (full sample)

	Food	Non-food (agro and mineral)	Oil	Mixed	Non-oil
Mean	0.51	0.54	0.80	0.22	0.52
Standard deviation	0.04	0.04	0.05	0.04	0.03
n	52	35	23	3	90
	Food	Non-food (agro and mineral)	Oil		
Non-food (agro and mineral)	-0.03				
Oil	-0.28 ***	-0.25 ***			
Mixed	0.29 **	0.32 **	0.57 ***		
Non-oil	.	.	0.28 ***		

*(Note: '***' - 1% significance level; '**' - 5% significance level; *" - 10% significance level)*

Table 9: Commodity export concentration, by producer type (restricted sample)

	Food	Non-food (agro and mineral)	Oil	Mixed	Non-oil
Mean	0.47	0.53	0.83	0.22	0.49
Standard deviation	0.03	0.04	0.04	0.04	0.03
n	48	34	17	3	85

	Food	Non-food (agro and mineral)	Oil
Non-food (agro and mineral)	-0.06		
Oil	0.57 ***	-0.25 ***	
Mixed	0.25 **	0.31 **	0.55 ***
Non-oil	.	.	0.29 ***

*(Note: '***' - 1% significance level; '**' - 5% significance level; '*' - 10% significance level)*

Table 10: Simple regressions of export concentration on uncertainty

Regression No.	Uncertainty (dependent variable)	Constant	Coefficient on Herfindahl Index	R squared
1	Conditional variance base case	**-0.001**	**0.018** ***	0.45
		0.001	*0.002*	
2	Conditional variance base case(less +/-5%)	**0.001**	**0.013** ***	0.28
		0.001	*0.002*	
3	Conditional standard deviation base case	**0.036** ***	**0.082** ***	0.44
		0.006	*0.009*	
4	Conditional standard deviation base case (less +/-5%)	**0.042** ***	**0.065** ***	0.30
		0.005	*0.010*	
5	Conditional variance controlling for 1973/1974 shock	**-0.001**	**0.015** ***	0.47
		0.001	*0.002*	
6	Conditional variance controlling for 1973/1974 shock (less +/-5%)	**0.001**	**0.011** ***	0.33
		0.001	*0.002*	
7	Conditional standard deviation less 1973/1974 shock	**0.045** ***	**0.048** ***	0.36
		0.004	*0.006*	
8	Conditional standard deviation less 1973/1974 shock (less +/-5%)	**0.045** ***	**0.047** ***	0.27
		0.004	*0.008*	
9	Conditional variance controlling for all shocks	**0.002** ***	**0.007** ***	0.22
		0.001	*0.001*	
10	Conditional variance controlling for all shocks (less +/-5%)	**0.002** ***	**0.007** ***	0.21
		0.001	*0.001*	
11	Conditional standard deviation controlling for all shocks	**0.006** *	**0.027** ***	0.14
		0.004	*0.048*	
12	Conditional standard deviation controlling for all shocks (less +/-5%)	**0.045** **	**0.035** ***	0.16
		0.004	*0.008*	
13	Ramey and Ramey base case	**0.007** ***	**0.078** ***	0.51
		0.005	*0.039*	
14	Ramey and Ramey base case (less +/-5%)	**0.009** ***	**0.065** ***	0.37
		0.005	*0.043*	
15	Ramey and Ramey with 1973 break	**0.039** ***	**0.073** ***	0.51
		0.004	*0.007*	
16	Ramey and Ramey with 1973 break (less +/-5%)	**0.043** ***	**0.061** ***	0.38
		0.004	*0.008*	
17	Simple standard deviation of commodity prices	**0.146** ***	**0.261** ***	0.29
		0.024	*0.038*	
18	Simple standard deviation of commodity prices (less -/+5%)	**0.175** ***	**0.187** ***	0.17
		0.023	*0.044*	

Figure 1: Simple export concentration-uncertainty regression

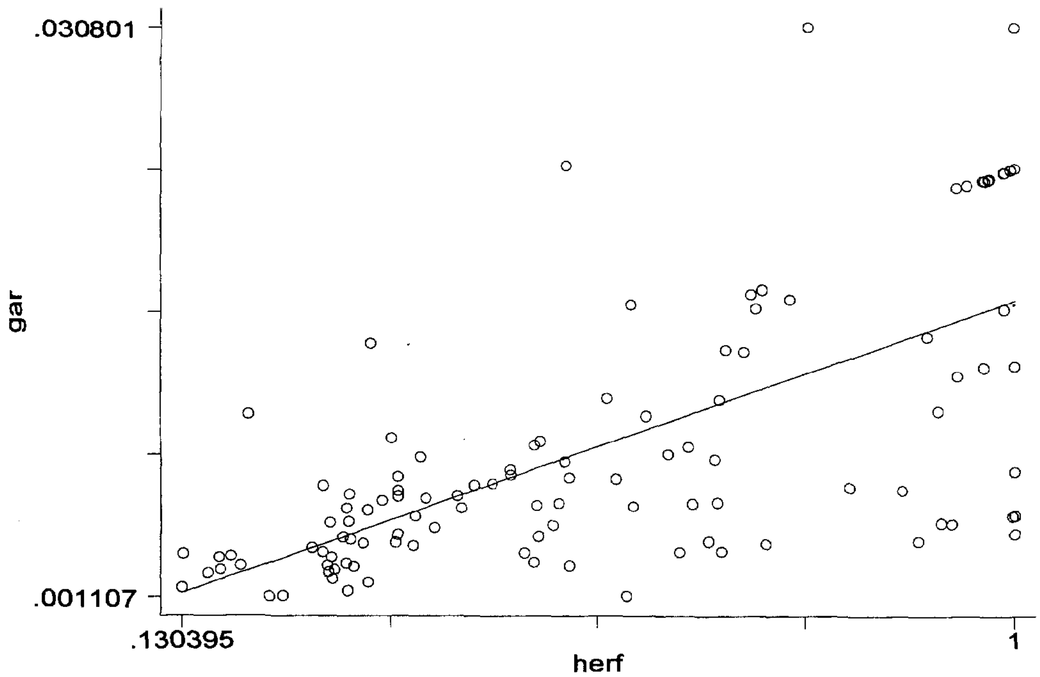


Figure 2: Oil producers (1)

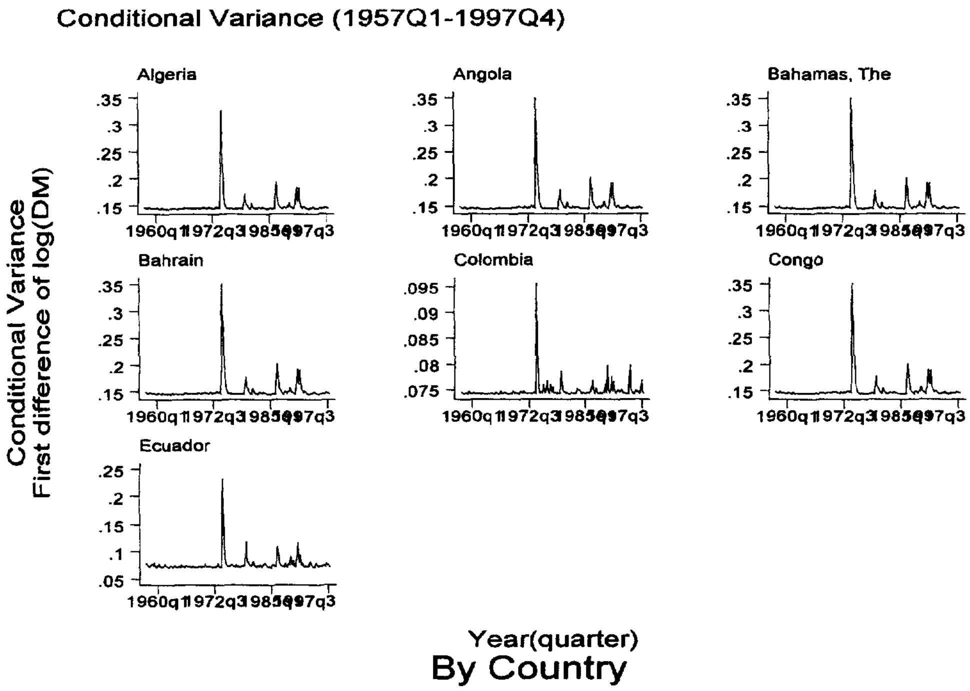


Figure 3: Oil producers (2)

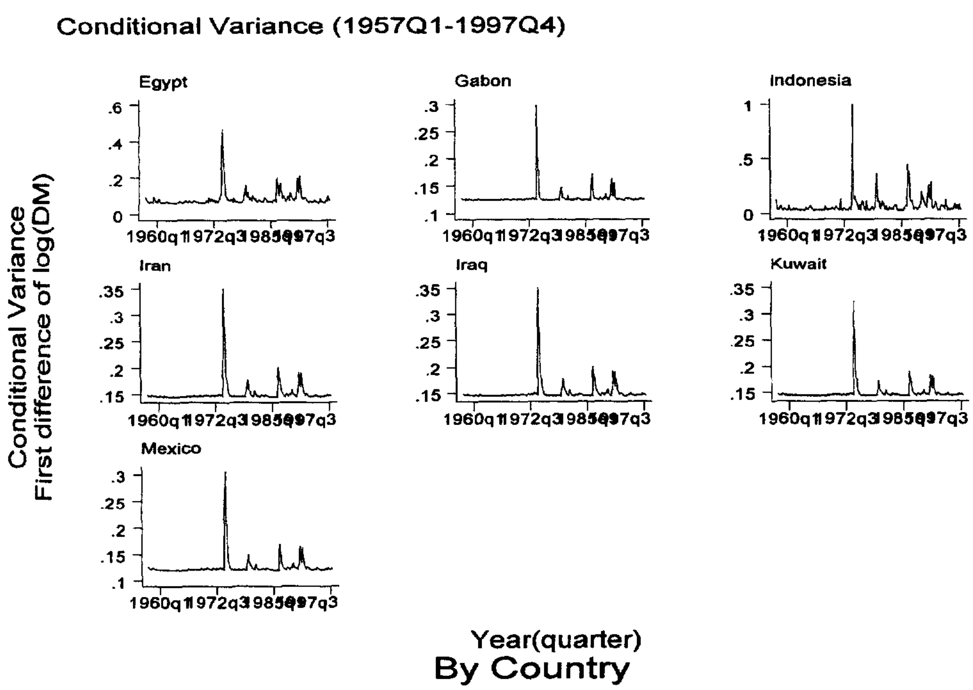


Figure 4: Oil producers (3)

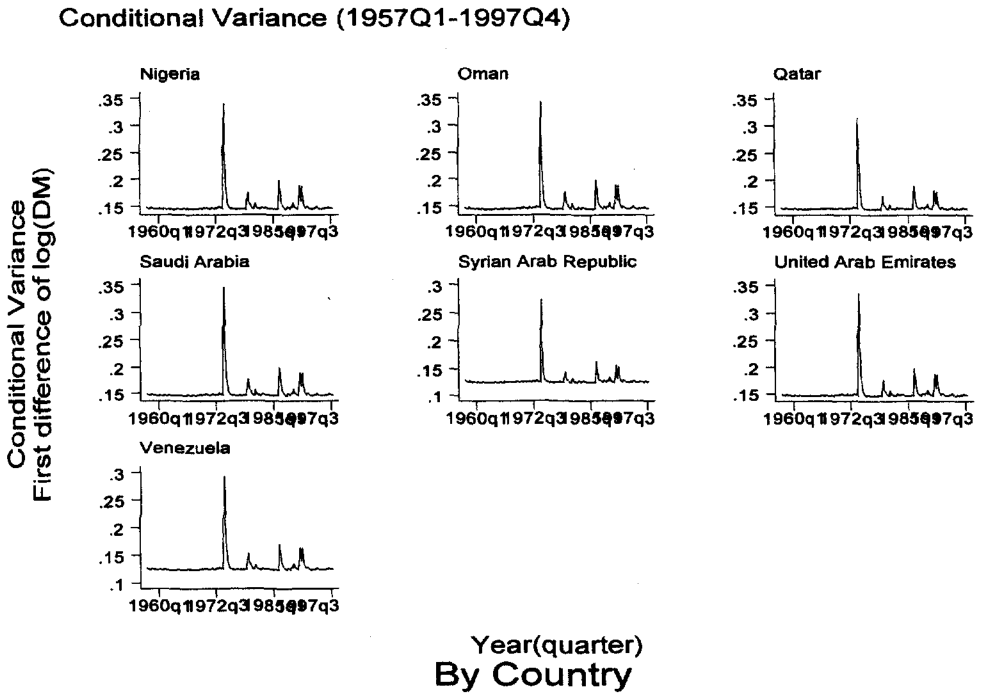


Figure 5: Non-oil countries with spiked uncertainty (1)

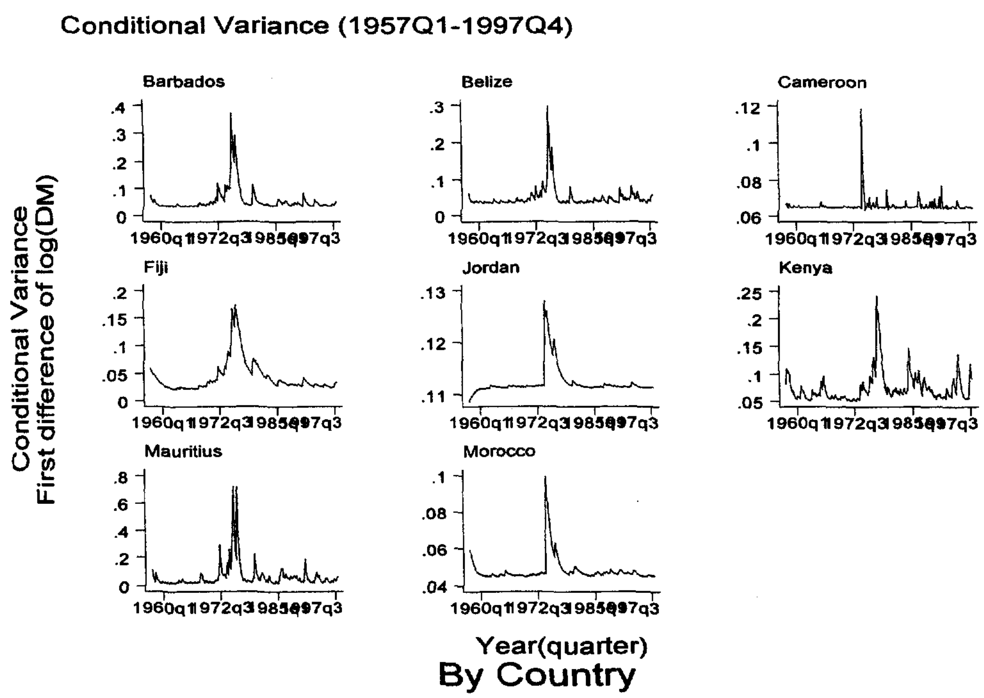


Figure 6: Non-oil countries with spiked uncertainty (2)

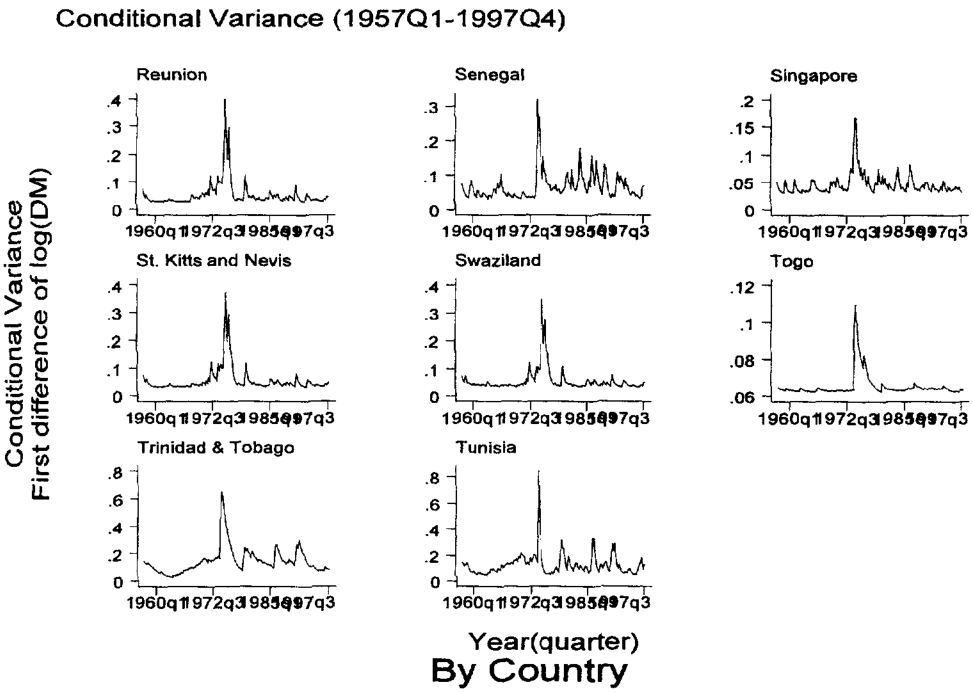


Figure 7: Upwards sloping uncertainty (1)

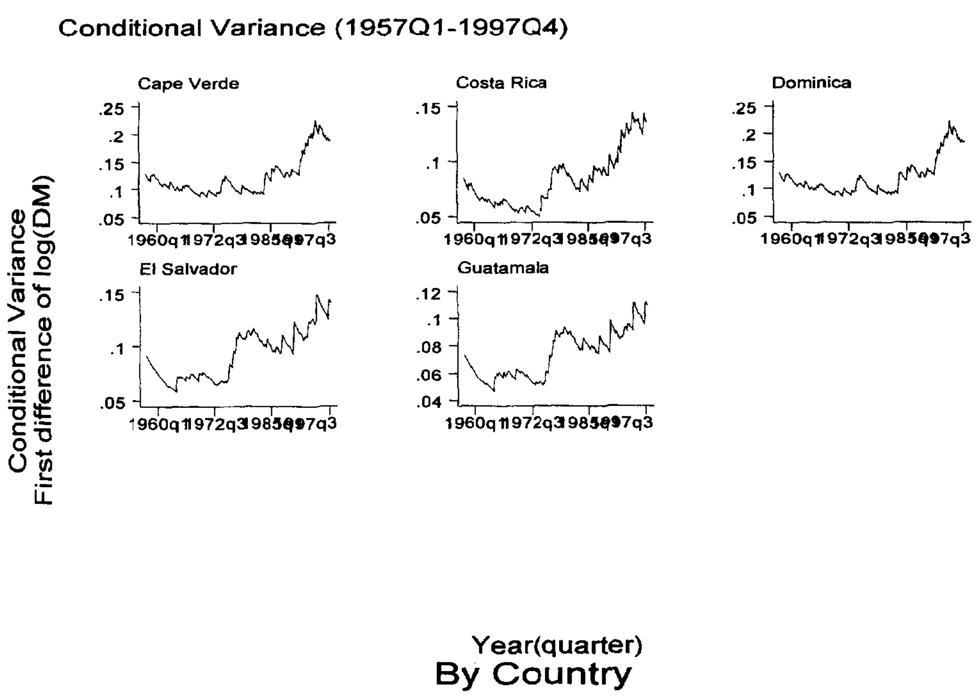


Figure 8: Upwards sloping uncertainty (2)

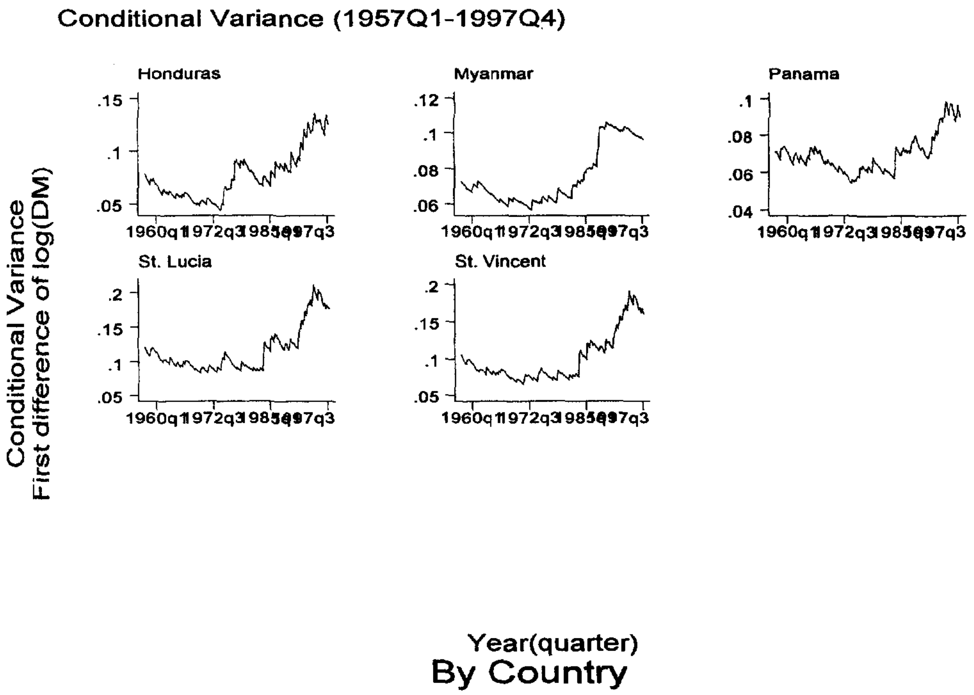


Figure 9: High frequency uncertainty (1)

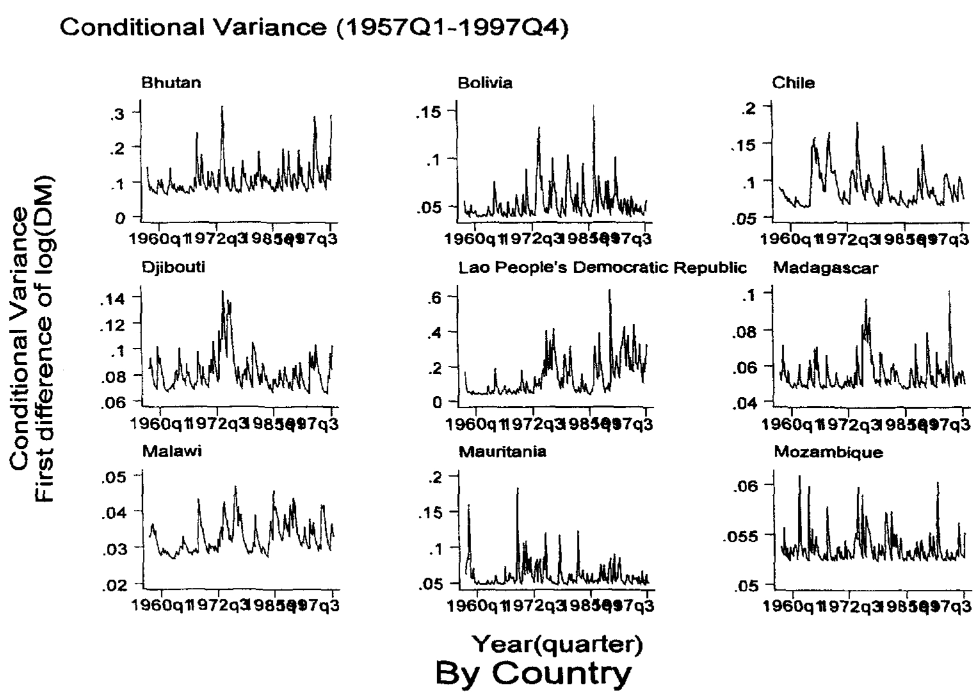


Figure 10: High frequency uncertainty (2)

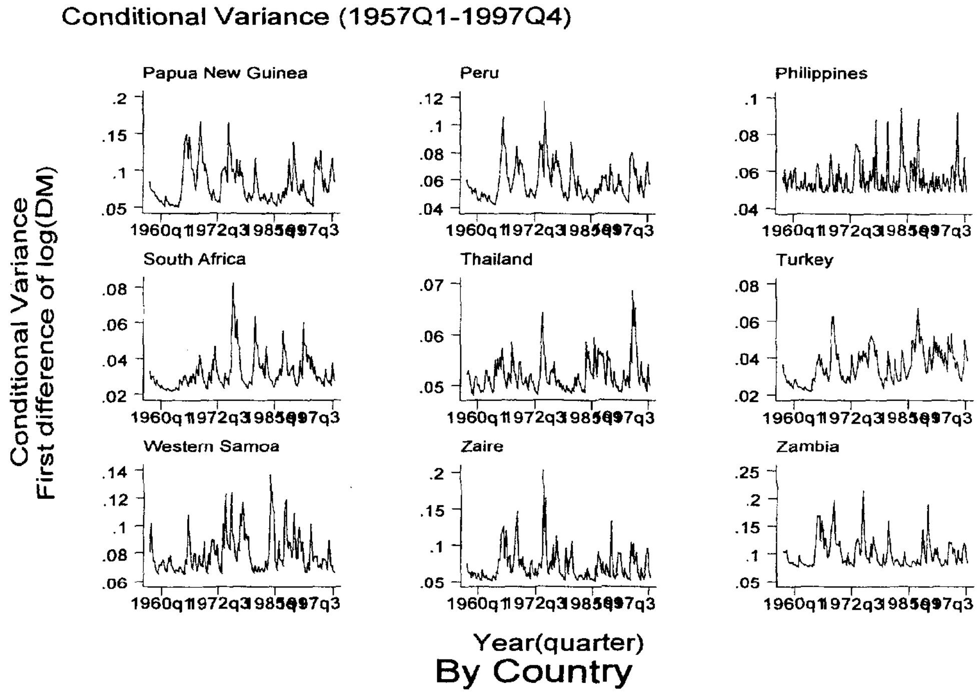


Figure 11: Persistent uncertainty(1)

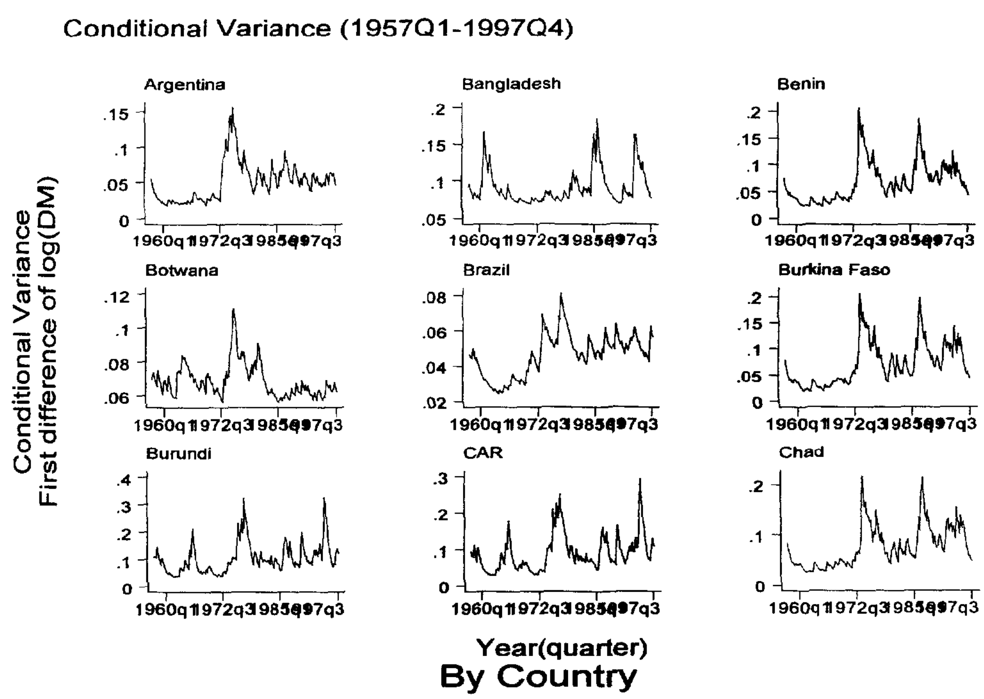


Figure 12: Persistent uncertainty(2)

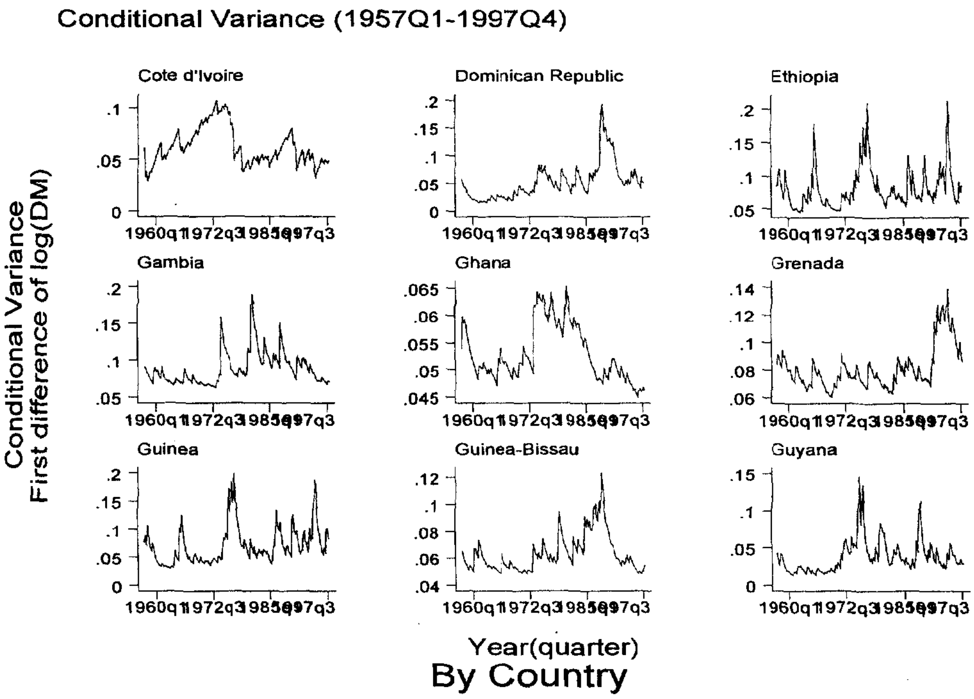


Figure 13: Persistent uncertainty(3)

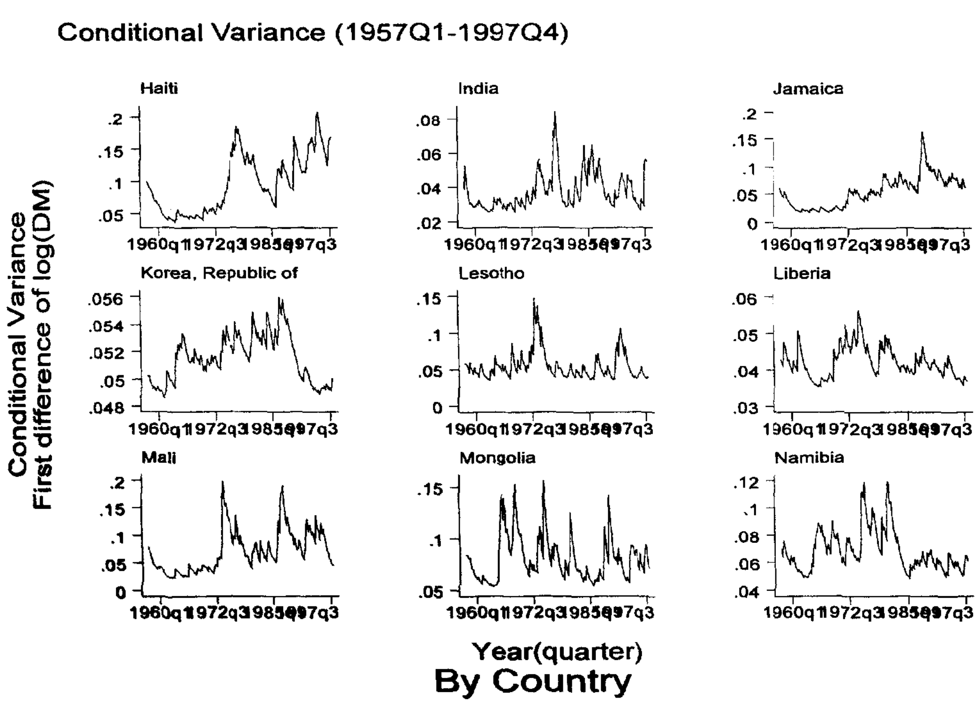


Figure 14: Persistent uncertainty(4)

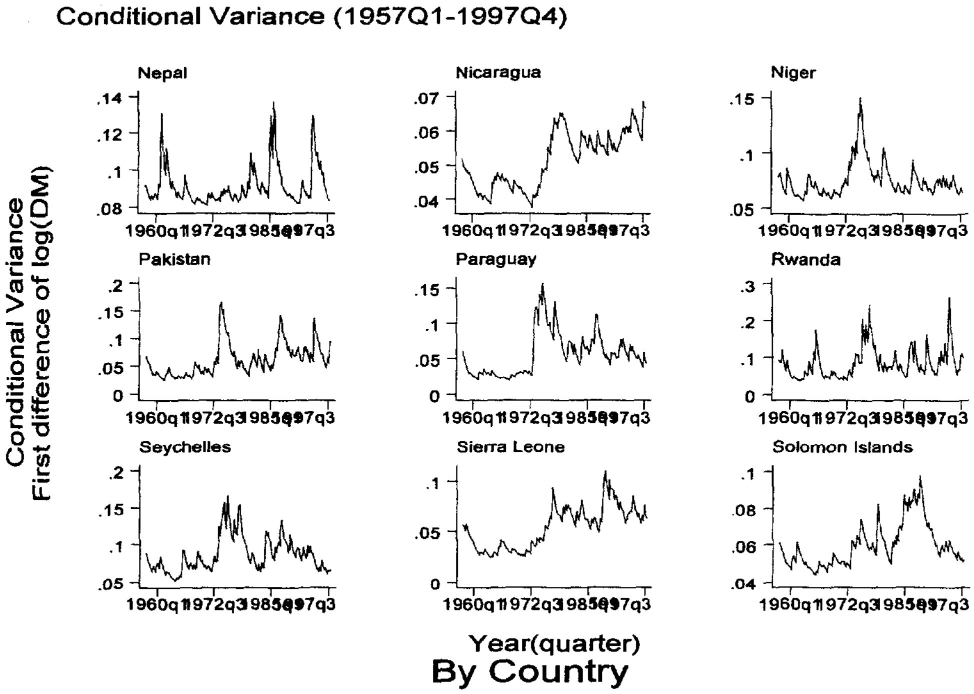


Figure 15: Persistent uncertainty (5)

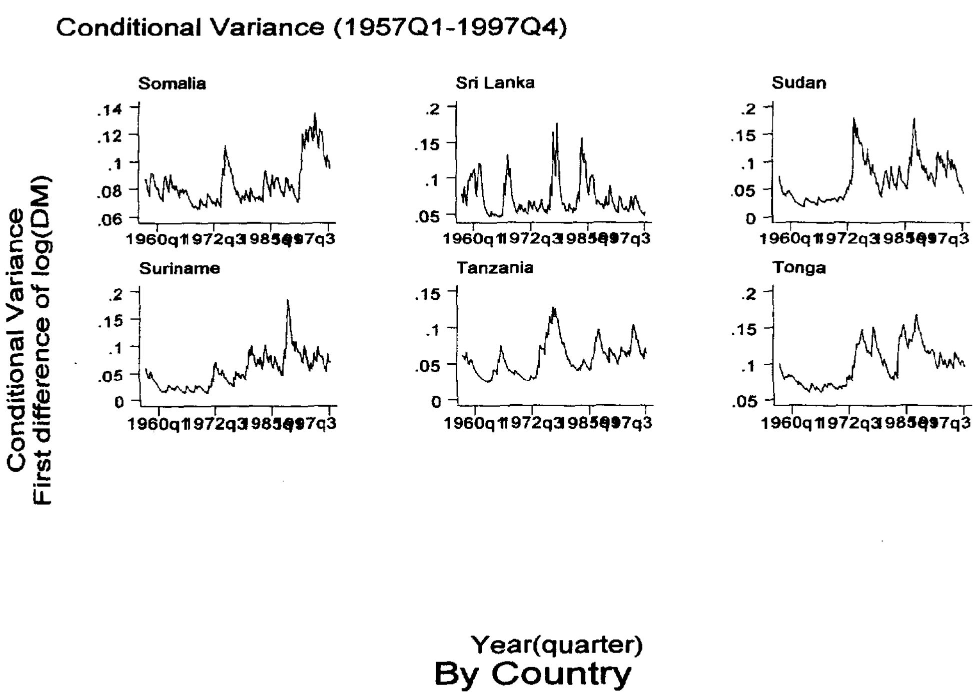
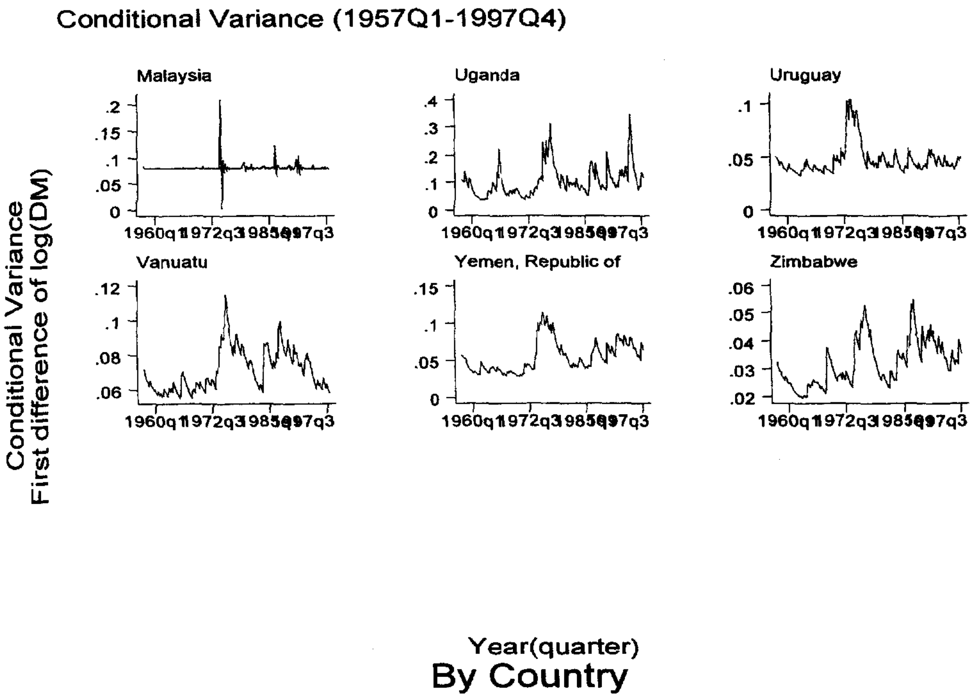


Figure 16: Persistent uncertainty (6)



Appendix 1: Data Sources and Coverage

Uncertainty was estimated using quarterly indices, because high frequency data is necessary in order to obtain convergence for the GARCH models used to estimate uncertainty. The indices are constructed with constant 1990 base year weights, wherefore they do not cope well with shifts in the structure of trade. In particular, they do not capture resource discoveries and other quantity shocks after the base period. Nor do they capture temporary volume shocks other than those, which happen to occur in the base year itself. However, since the purpose is to capture price rather than quantity movements, it is desirable to hold volumes constant to avoid possible endogeneity problems arising in the event of a volume response to a price change. This means that the indices will understate income effects of a given price change. This constitutes an error on the side of caution.

Table A1 provides basic descriptive statistics on each country's structure of trade and regional affiliation. Table A2 lists the commodities used. Price data are mainly from *International Financial Statistics (IFS)*. The single exception is the price of cocoa used for African countries, which is from *International Cocoa and Coffee Organisation (ICCO)*, because the Ghanaian Cocoa series in *IFS* is not credible, and has major gaps. A few important commodities have not been included in the index due to lack of adequate data. These are natural gas and uranium ore. The indices for countries whose exports are dominated by one or both of these commodities, such as Niger, which is a major uranium producer, should therefore be interpreted with caution.

Unfortunately, it was not possible to obtain *IFS* data starting in 1957Q1 for all commodities. Since identical sample length is an important consideration when measuring uncertainty (especially using time invariant measures), it was decided to generate the missing observations. This was done using a combination of methods. For series with missing values at the start of the series for which other highly correlated series were available, the missing values were generated using a partial adjustment regression equation:

$$\ln\left(\frac{X_t}{Y_t}\right) = \beta_0 + \beta_1 \ln\left(\frac{X_{t-1}}{Y_{t-1}}\right) + \beta_2 \ln(Y_{t-1}) + \varepsilon_t \qquad [A1]$$

where X_t is the series with the missing early values and Y_t is a highly correlated series with a full set of observations. The regression was run on overlapping observations, and the coefficients were then used to 'backcast' the missing observations. This method was used to 'fill' the initial gap of 12 observations in the Palm Kernels and African Cocoa series where the *IFS* series began only in 1960Q1. The close correlates were *IFS* Palm Oil prices and Brazilian Cocoa prices, respectively. For the following series with missing early values where no obvious correlates were available, the early gaps were filled using annual data as far as possible: Hardwood (1958Q1-1969Q4), Lead (1957Q1-1963Q4), Manganese (1957Q1-1959Q4), Rubber (1957Q1-1961Q4), Silver (1957Q1-1967Q4), Sorghum (1957Q1-1966Q4) and Sugar to US ports (1957Q1-1962Q4). Finally, for the following few commodities there were no annual observations to indicate the movements of the quarterly series, wherefore the real price was held constant at the value of the first available observation: Coal (1957Q1-1966Q2), Superphosphates (1957Q1-1962Q4), and Tobacco (1957Q1-1967Q4). The nominal Gold price was held constant over the period of its missing observations (1957-1962q4). A few commodities had occasional missing observations in mid-sample. These included Colombian coffee (1994q1-q4), Manganese (1963q2-1964q4; 1967q3-1968q4), Palm Kernels (1967q2-1967q4), Shrimps (1995q2), and Silver (1970q3). The gaps were all very short and were filled by linear interpolation.

The biases introduced by filling early gaps in the data using annual data and holding real prices constant are likely to be small for the following reasons. First, the GARCH based time varying uncertainty measures allow the uncertainty to vary with time, so biases early in the index have less of an effect in subsequent periods. Secondly, the problem of missing data mainly affects observations in the very early part of the indices, which is generally outside the sample range used in the core regressions. Finally, the observations affected number only 332 out of a total sample of 9348 observations[9], thus affecting only 3.46% of the observations.

The data on export values used to construct weighting item are exports (*fob*) in current US$ in 1990. It was not possible to obtain quarterly weights, but this may be

[9] 57 commodities times 164 observations per commodity.

blessing if quarterly weights reflect seasonal patterns of production. The weights data are variously from UNCTAD's *Commodity Yearbook 1994* and the UN's *International Trade Statistics Yearbook* (1993 and 1994). In some cases, the weights differed considerably across different sources for no obvious reason. In such cases, the most reasonable figure was chosen with reference to total exports data from alternative sources such as individual countries' own national accounts statistics. In a few cases, it was not possible to obtain weights for the year 1990. In those cases a different base year was used for the weights. An effort was made to select alternative base years, which were as close to 1990 as possible. The cases with different base year weights are: 1994 (Aluminium, St. Vincent and Grenadines), 1984 (Beef, Haiti), 1994 (Jute, Rice and Hardwood, Myanmar); 1989 (Sugar, Dominica). For South Africa, weights used were those of the Southern African Customs Union (SACU) because data on individual member countries were unavailable.

Given the different availability of price and weight data across commodities, there is a trade off between including additional commodities in each country's index and losing observations in the time series dimension. For this reason, the final specification of the index for most countries does not include all the commodities exported by that country. In deciding whether to drop or retain a commodity, the cost in terms of lost observations from including that commodity was weighted informally against the possible gain in terms of a more representative index. To ensure consistency and to minimise distortion to the final index, commodities were only dropped if they constituted less than 10% of the commodity exports of the country question, and if the number of available observations for the variable constituted a data constraint. Only one exception was made to this rule. Woodpulp was dropped from the index, because data was only available from 1983Q1 onwards. Only Uruguay and South Africa produce this commodity in moderate amounts (5 and 10% of sampled commodity exports, respectively), so while its omission is unlikely to affect most indices, it may have a minor impact on the indices for these particular countries.

Both the quarterly and annual indices for all the countries are deflated by the unit value index (1990=100) of industrial country exports from the *International*

Financial Statistics. This index ('MUV') has been used as a deflator of commodity prices in other recent work, e.g. Cashin, Liang and McDermott (1999).

Table A1: Country characteristics

id	country	Region	Producer type	1990 Value of Indexed Commodities (US$m)	1990 Value of Total Exports (US$m)	1990 Indexed Commodities as a Share of Total Exports	1990 Total Exports as a Share of GDP
1	Algeria	2	4	2,309	14,425	0.16	0.23
2	Angola	1	4	2,800	1,493	1.87	0.39
3	Argentina	3	1	3,733	14,643	0.25	0.10
4	Bahamas, The	7	4	1,525	1,664	0.92	0.61
5	Bahrain	2	4	2,939	4,888	0.60	1.22
6	Bangladesh	4	2	617	1,882	0.33	0.08
7	Barbados	7	1	32	840	0.04	0.49
8	Belize	7	1	53	257	0.20	0.64
9	Benin	1	2	99	402	0.25	0.22
10	Bhutan	4	1	1	92	0.01	0.32
11	Bolivia	3	3	450	978	0.46	0.22
12	Botswana	1	1	116	1,895	0.06	0.56
13	Brazil	3	1	8,844	34,339	0.26	0.07
14	Burkina Faso	1	2	95	352	0.27	0.13
15	Burundi	1	1	68	89	0.76	0.08
16	Cameroon	1	5	1,011	2,275	0.44	0.20
17	Cape Verde	1	1	2	56	0.03	0.18
18	CAR	1	1	54	220	0.25	0.15
19	Chad	1	2	91	234	0.39	0.19
20	Chile	3	3	4,256	10,470	0.41	0.34
21	Colombia	3	1	3,806	8,283	0.46	0.21
22	Congo	1	4	1,103	1,433	0.77	0.51
23	Costa Rica	3	1	682	1,975	0.35	0.35
24	Cote d'Ivoire	1	1	1,667	3,421	0.49	0.32
25	Djibouti	1	1	2	249	0.01	0.55
26	Dominica	7	1	32	70	0.45	0.46
27	Dominican Republic	7	3	571	2,301	0.25	0.34
28	Ecuador	3	4	2,345	3,499	0.67	0.33
29	Egypt	2	4	956	8,647	0.11	0.20
30	El Salvador	3	1	213	892	0.24	0.19
31	Ethiopia	1	1	212	535	0.40	0.08
32	Fiji	6	1	216	879	0.25	0.64
33	Gabon	1	4	2,462	2,740	0.90	0.46
34	Gambia	1	1	13	201	0.07	0.69
35	Ghana	1	5	1,041	993	1.05	0.17
36	Grenada	7	1	8	110	0.07	0.49
37	Guatemala	3	1	651	1,509	0.43	0.20
38	Guinea	1	1	12	870	0.01	0.31
39	Guinea-Bissau	1	2	2	26	0.09	0.11
40	Guyana	3	1	224	249	0.90	0.63
41	Haiti	7	1	21	477	0.04	0.16
42	Honduras	3	1	427	1,108	0.39	0.36
43	India	4	1	3,158	23,026	0.14	0.08
44	Indonesia	5	4	11,515	29,912	0.38	0.26
45	Iran	2	4	17,036	26,476	0.64	0.22
46	Iraq	2	4	8,881	NA	NA	0.27
47	Jamaica	7	3	851	2,207	0.39	0.52
48	Jordan	2	3	215	2,489	0.09	0.62

49 Kenya	1	1	377	2,234	0.17	0.26
50 Korea, Republic of	5	1	781	75,544	0.01	0.30
51 Kuwait	2	4	2,607	8,281	0.31	0.45
52 Lao P.D.R	5	1	12	98	0.12	0.11
53 Lesotho	1	2	7	89	0.08	0.14
54 Liberia	1	2	288	464	0.62	0.43
55 Madagascar	1	1	111	489	0.23	0.16
56 Malawi	1	2	382	447	0.85	0.24
57 Malaysia	5	4	8,548	32,664	0.26	0.76
58 Mali	1	2	218	415	0.52	0.17
59 Mauritania	1	3	232	473	0.49	0.46
60 Mauritius	1	1	358	1,724	0.21	0.65
61 Mexico	3	4	10,460	48,866	0.21	0.19
62 Mongolia	5	3	321	436	0.74	0.21
63 Morocco	2	3	1,179	6,849	0.17	0.27
64 Mozambique	1	1	61	230	0.26	0.16
65 Myanmar	4	2	218	NA	NA	0.03
66 Namibia	1	3	202	1,217	0.17	0.49
67 Nepal	4	2	6	382	0.02	0.11
68 Nicaragua	3	1	279	253	1.10	0.25
69 Niger	1	2	5	420	0.01	0.17
70 Nigeria	1	4	12,754	12,366	1.03	0.43
71 Oman	2	4	4,768	5,555	0.86	0.53
72 Pakistan	4	2	873	5,918	0.15	0.15
73 Panama	3	1	200	4,611	0.04	0.87
74 Papua New Guinea	5	3	1,164	1,309	0.89	0.41
75 Paraguay	3	1	808	1,750	0.46	0.33
76 Peru	3	3	1,549	3,937	0.39	0.12
77 Philippines	5	1	1,326	12,198	0.11	0.28
78 Qatar	2	4	2,872	NA	NA	0.52
79 Reunion	1	1	142	NA	NA	0.05
80 Rwanda	1	1	121	145	0.83	0.06
81 Saudi Arabia	2	4	34,168	48,366	0.71	0.46
82 Senegal	1	1	252	1,512	0.17	0.27
83 Seychelles	1	2	0	256	0.00	0.68
84 Sierra Leone	1	3	41	215	0.19	0.24
85 Singapore	5	5	2,278	73,999	0.03	1.98
86 Solomon Islands	6	2	40	99	0.40	0.47
87 Somalia	1	1	43	90	0.48	0.10
88 South Africa	8	3	3,155	27,327	0.12	0.26
89 Sri Lanka	4	1	601	2,424	0.25	0.30
90 St. Kitts and Nevis	7	1	9	75	0.12	0.59
91 St. Lucia	7	1	78	288	0.27	0.72
92 St. Vincent	7	1	48	128	0.38	0.66
93 Sudan	1	2	253	653	0.39	0.07
94 Suriname	3	3	427	420	1.02	0.43
95 Swaziland	1	1	187	690	0.27	0.83
96 Syrian Arab Republic	2	4	1,690	3,413	0.50	0.28
97 Tanzania	1	1	200	555	0.36	0.13
98 Thailand	5	1	2,828	29,130	0.10	0.34
99 Togo	1	3	225	545	0.41	0.33
100 Tonga	6	1	0	36	0.01	0.32
101 Trinidad & Tobago	7	4	858	2,214	0.39	0.44

102 Tunisia	2	4	738	5,353	0.14	0.44
103 Turkey	2	2	891	20,016	0.04	0.13
104 Uganda	1	1	167	312	0.53	0.07
105 United Arab Emirates	2	4	13,403	22,331	0.60	0.66
106 Uruguay	3	1	656	2,185	0.30	0.26
107 Vanuatu	6	1	11	71	0.15	0.46
108 Venezuela	3	4	10,371	19,168	0.54	0.39
109 Western Samoa	6	1	5	45	0.10	0.31
110 Yemen, Republic of	2	1	40	689	0.06	0.15
111 Zaire	1	3	949	2,758	0.34	0.30
112 Zambia	1	3	1,167	1,180	0.99	0.36
113 Zimbabwe	1	2	830	2,174	0.38	0.32
TOTAL			217,253	714,155		

(Note: Regions: 1-Sub-Saharan Africa; 2-Middle East and North Africa; 3-Latin America; 4-South Asia; 5-East Asia; 6-Pacific; 7-Caribbean; 8-South Africa. Type: 1-Agricultural food stuffs; 2-Agricultural non-foods; 3-Non-Agricultural non-oil commodities; 4-Oil; 5-Mixed; 'NA': not available).

Table A2: Commodities used in country indices

ID	IFS Name	IFS Code	1990 Value of World Exports (US$m)	1990 Share in World Commodity Exports
1	ALUMINUM	15676DRDZF...	4,514	0.021
2	BANANAS	24876U.DZF...	1,993	0.009
3	BEEF	19376KBDZF...	1,360	0.006
4	COAL	19374VRDZF...	1,489	0.007
5	COCOA (Brazil)	22374R.DZF...	992	0.005
6	COCOA (ICCO)	QBCS	1,617	0.007
7	COCONUT OIL (Philippines)	56676AI.ZF...	361	0.002
8	COCONUT OIL New York	56676AIDZF...	163	0.001
9	COFFEE BRAZIL	22376EBDZF...	1,283	0.006
10	COFFEE COLOMBIA	23376E.DZF...	1,473	0.007
11	COFFEE OTHER MILDS	38676EBDZF...	2,539	0.012
12	COFFEE UGANDA	79976ECDZF...	1,357	0.006
13	COPPER UK	11276C.DZF...	8,889	0.041
14	COPRA PHILIPP	56676AGDZF...	68	0.000
15	COTTON	11176F.DZFM40	3,626	0.017
16	FISHMEAL	29376Z.DZF...	768	0.004
17	GOLD	11276KRDZF...	617	0.003
18	GROUNDNUT OIL	69476BIDZF...	222	0.001
19	GROUNDNUTS	69476BHDZF...	172	0.001
20	HARDWOOD	54876RMDZF...	1,850	0.009
21	HIDES	11176P.DZF...	603	0.003
22	IRON ORE	22376GADZF...	4,164	0.019
23	JUTE	51376X.DZF...	743	0.003
24	LAMB	19676PFDZF...	32	0.000
25	LEAD	11176V.DZF...	272	0.001
26	LINSEED OIL	00176NIDZF...	96	0.000
27	MAIZE	11176J.DZFM17	744	0.003
28	MANGANESE	53476W.DZF...	717	0.003
29	NEWSPRINT	17272UL.ZF...	143	0.001
30	NICKEL	15676PTDZF...	939	0.004
31	OIL	00176AADZF...	143,187	0.659
32	PALM KERNELS	54876DFDZF...	0	0.000
33	PALM OIL	54876DGDZF...	1,994	0.009
34	PHOSPHATE ROCK	68676AWDZF...	902	0.004
35	RICE	57874N..ZF...	866	0.004
36	RICE THAILAND (BANGKOK)	57876N.DZFM81	923	0.004
37	RUBBER	11176L.DZF...	2,007	0.009
38	RUBBER MALAYSIA	54876L.DZF...	1,122	0.005
39	SHRIMP	11176BLDZF...	4,643	0.021
40	SILVER	11176Y.DZF...	715	0.003
41	SISAL	63976MLDZF...	54	0.000
42	SORGHUM	11176TRDZF...	24	0.000
43	SOYBEAN MEAL	11176JJDZF...	1,626	0.007
44	SOYBEAN OIL	11176JIDZF...	1,073	0.005
45	SOYBEANS	11176JFDZF...	1,932	0.009
46	SUGAR	22374I.DZF...	1,861	0.009
47	SUGAR EEC IMPORT	11276I.DZF...	1,406	0.006
48	SUPERPHOSPHATE	11176ASDZF...	498	0.002

49 TEA (Sri Lanka)	52474S..ZF...	493	0.002
50 TEA AVERAGE AUCTION	11276S.DZF...	1,262	0.006
51 TIN (Bolivia)	21874Q.DZF...	84	0.000
52 TIN ALL ORIGINS	11276Q.DZF...	2,566	0.012
53 TOBACCO	11176M.DZF...	1,050	0.005
54 UREA	17076URDZF...	445	0.002
55 WHEAT	11176D.DZF...	1,259	0.006
56 WOOL	11276HDDZF...	720	0.003
57 ZINC	11276T.DZF...	733	0.003
TOTAL		217,253	1.000

(Note: 'QBCS' stands for Quarterly Bulletin of Cocoa Statistics)

Appendix 2: Seasonal Unit Roots

The Hylleberg filtering method works the following way: Note that the fourth difference of the quarterly series, y_t, can be written as

$$\Delta_4 y_t = y_t - y_{t-4} = (1 - L^4) y_t \qquad [A2.1]$$

where Δ_4 denotes the fourth difference and L^i is the operator denoting the *ith* lag. [2] can be re-expressed as

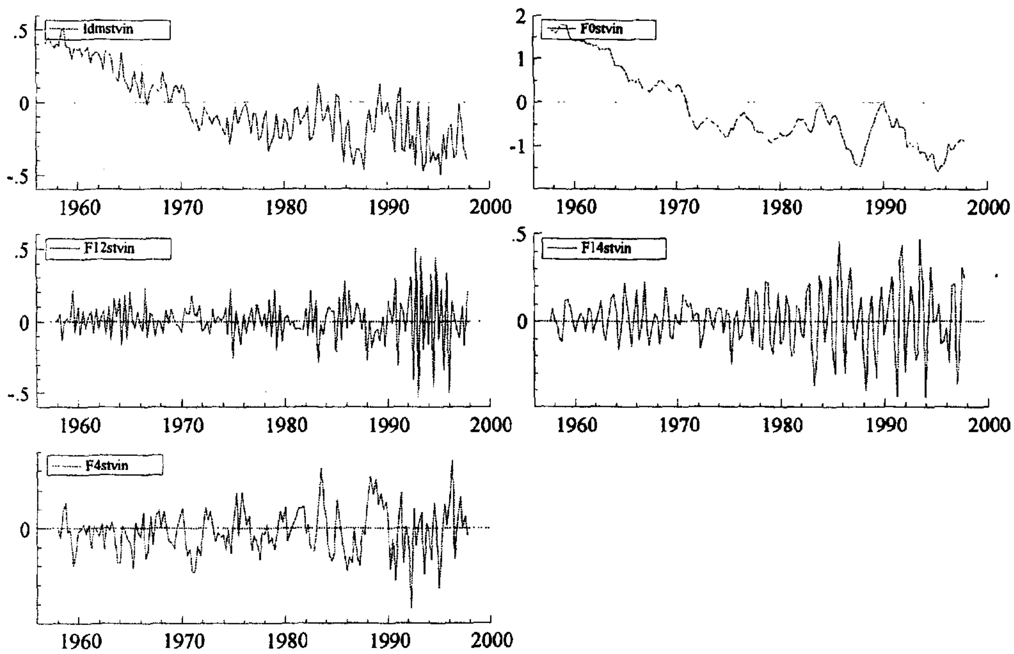
$$\Delta_4 y_t = (1 - L) S(L) y_t \qquad [A2.2]$$

where $S(L) = (1 + L)(1 + L^2) = (1 + L + L^2 + L^3)$ is the seasonal filter. The series y_t can now be decomposed into the zero-frequency component, which strips out all seasonal unit roots, the half-year frequency component, which strips out all but the half-year seasonal component, the first and third quarterly seasonal components, which contains only the quarterly components, and the fourth difference which strips out all unit roots. The respectively transformations of y_t are:

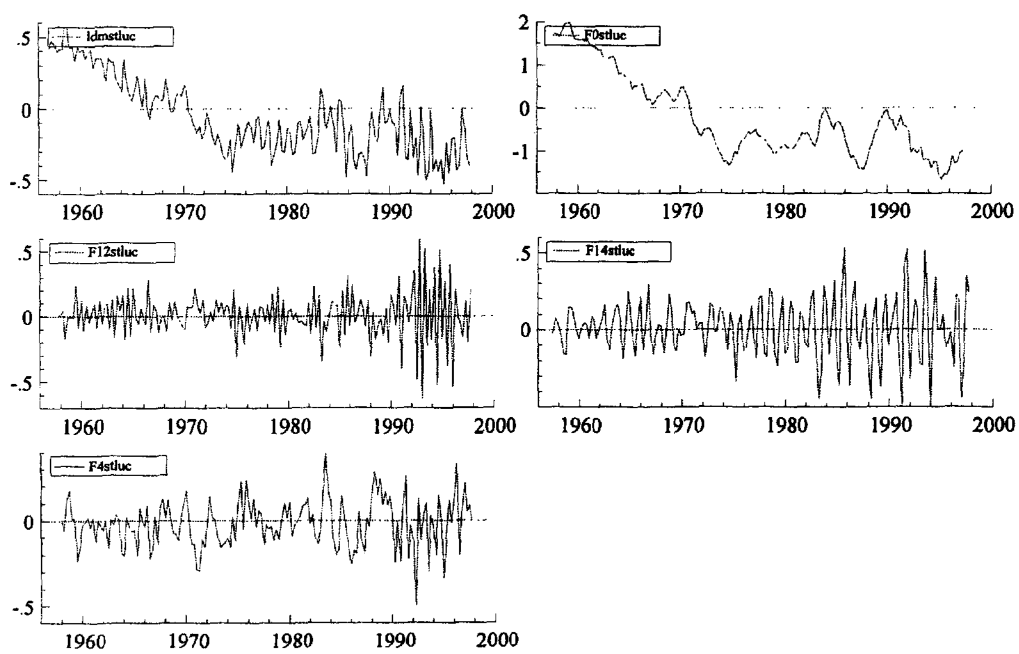
$$\begin{aligned} Y(0) &= (1 + L + L^2 + L^3) y_t \\ Y(1 \sim 2) &= -(1 - L + L^2 - L^3) y_t \\ Y(1 \sim 4) &= -(1 - L)(1 + L) y_t \\ Y(4) &= (1 - L^4) y_t \end{aligned} \qquad [A2.3]$$

Frequency decompositions of the indices for the 10 countries with apparent secular increases in conditional variance are shown below. In the graphs, 'ldm*' denotes the log of the real commodity price index; 'FO*' denotes the zero-frequency underlying component of the series with all seasonal units roots stripped out (leaving only the fundamental unit root); 'F12*' denotes the half-year seasonal component only (strips out fundamental and quarterly unit roots); 'F14*' denotes the first and third quarter seasonal components only (stripping out the fundamental and half year unit roots); and 'F4*' denotes the fourth difference which strips out all unit roots (fundamental, half yearly and quarterly)

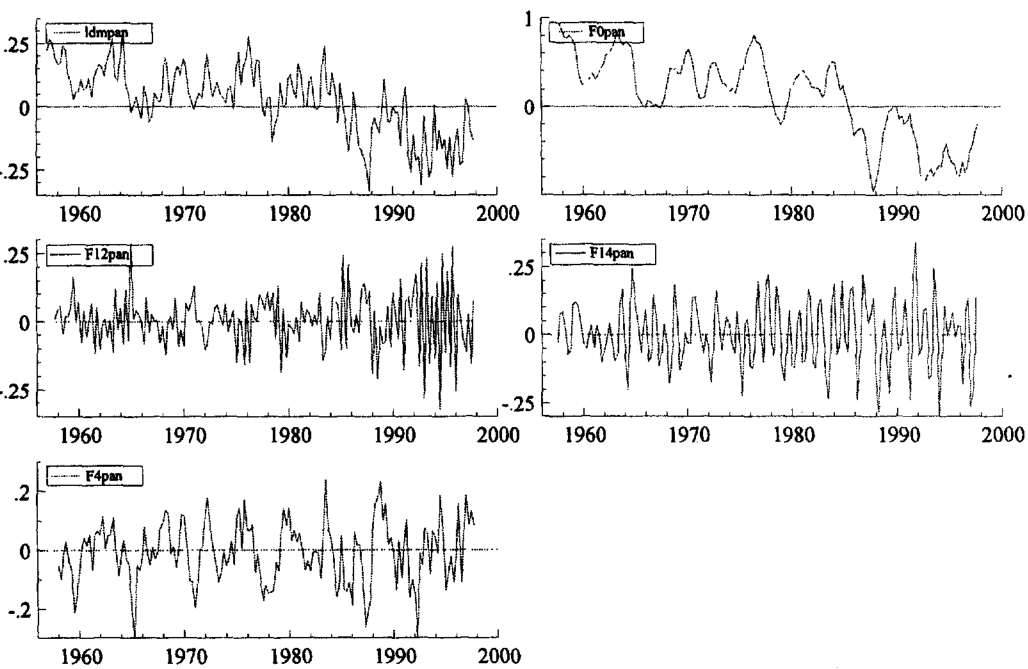
St. Vincent



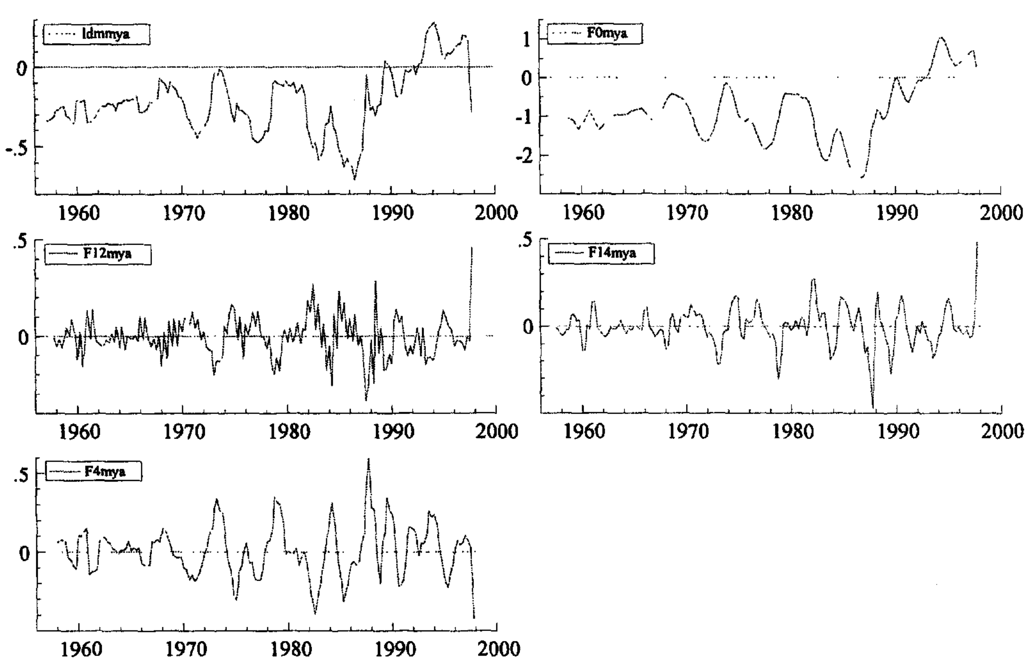
St. Lucia



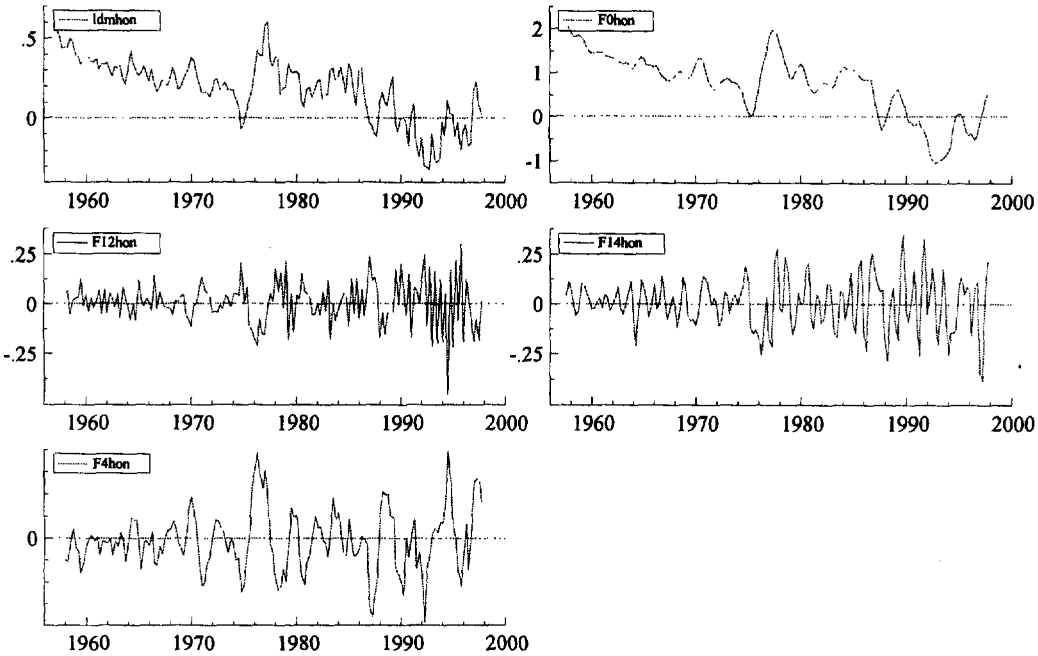
Panama



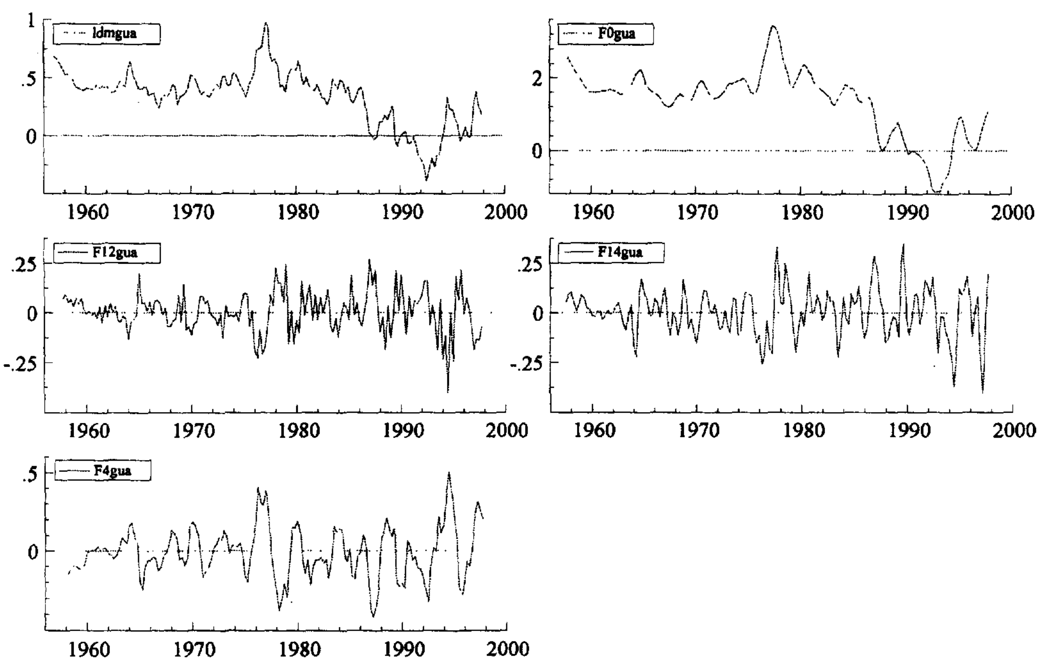
Myanmar



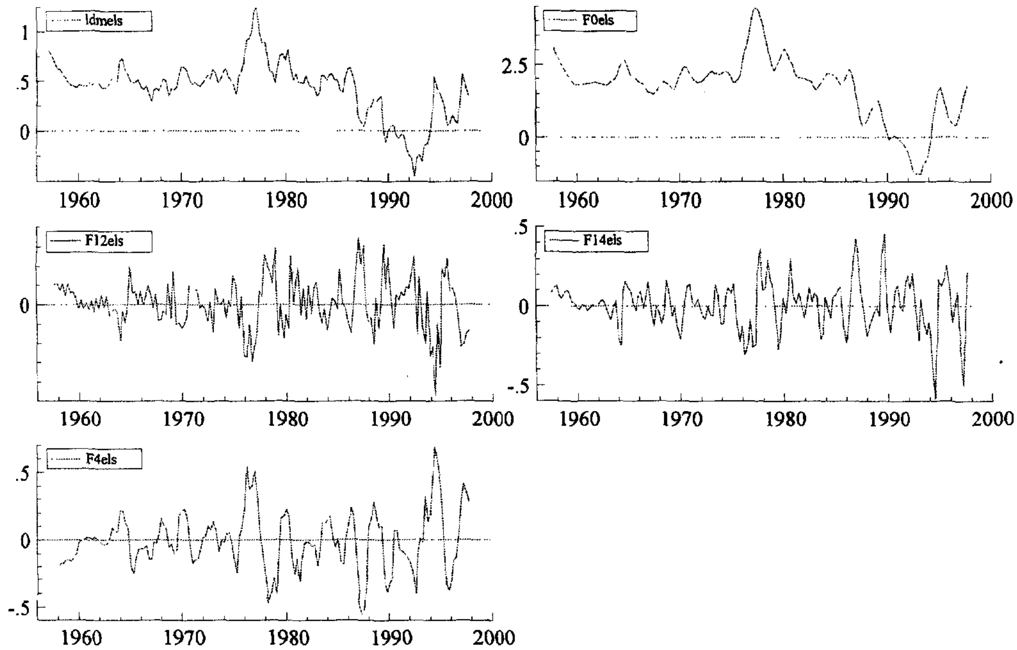
Honduras



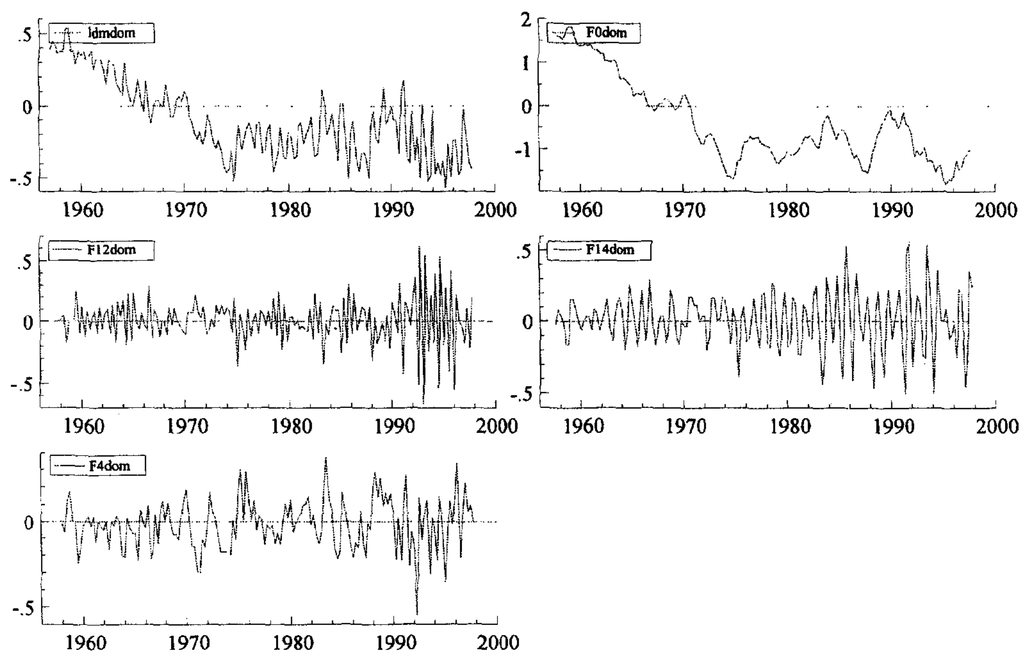
Guatemala



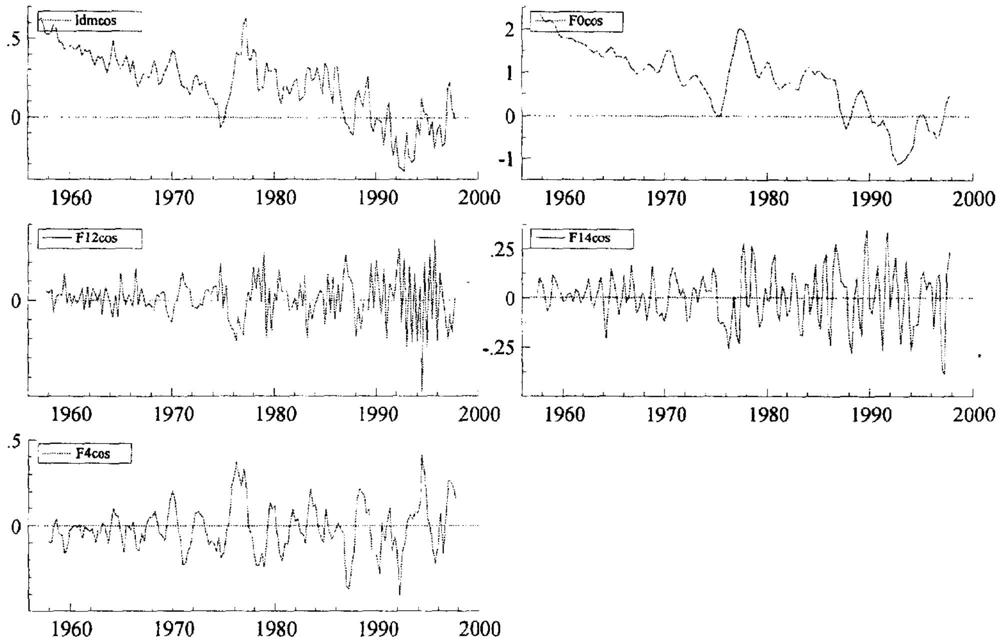
El Salvador



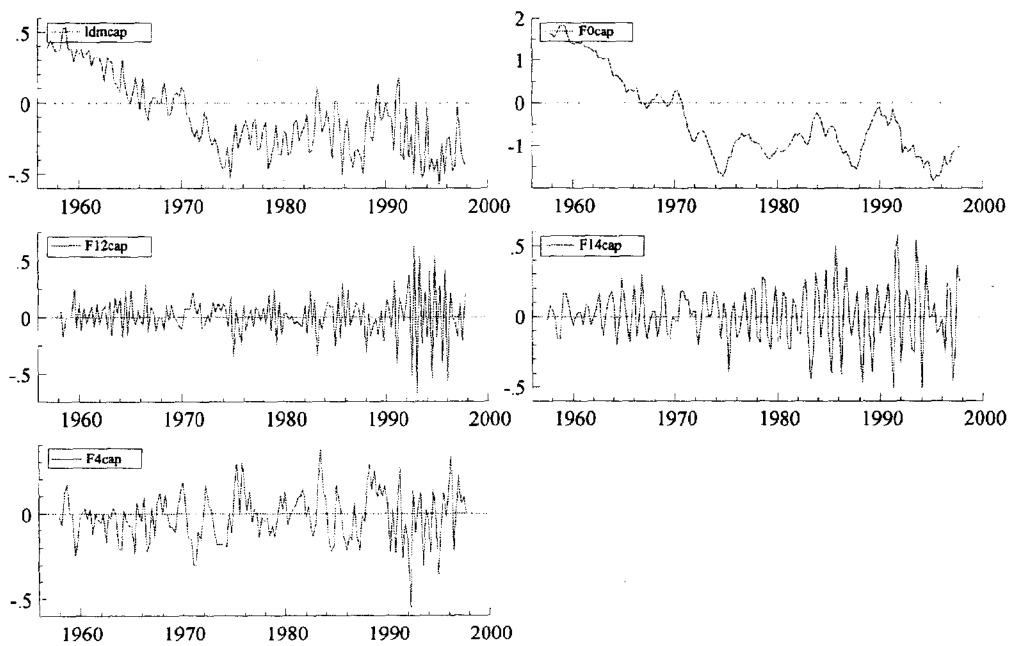
Dominica



Costa Rica



Cape Verde



References

1. **Bollerslev, T.** (1986): 'Generalised Autoregressive Conditional Heteroskedasticity', *Journal of Econometrics,* **31**, pp. 307-327.
2. **Cashin, P., Liang, H., and McDermott, C. J.** (1999): 'How Persistent are Shocks to World Commodity Prices?', *IMF Working Paper* (80).
3. **Cashin, P., McDermott, C. J., and Scott, A.** (1999): 'The Myth of Comoving Commodity Prices', *IMF Working Paper* (169).
4. **Clements, M. P., and Hendry, D.** (1998): *Forecasting Economic Time Series,* New York and Melbourne (Cambridge University Press).
5. **Cochrane, J. H.** (1988): 'How Big is the Random Walk in GNP?', *Journal of Political Economy,* **96**(5), pp. 893-920.
6. **Cochrane, J. H.** (1991): 'A Critique of the Application of Unit Root Tests', *Journal of Economic Dynamics and Control,* **15**, pp. 175-184.
7. **Colman, D., and Nixson, F.** (1986): *Economics of Change in Less Developed Countries*, Oxford (Philip Allen Publishers).
8. **Deaton, A., and Laroque, G.** (1992): 'On the Behaviour of Commodity Prices', *Review of Economic Studies,* **59**, pp. 1-23.
9. **Deaton, A. J., and Miller, R. I.** (1995): 'International Commodity Prices, Macroeconomic Performance, and Politics in Sub-Saharan Africa', *Princeton Studies in International Finance* (79).
10. **Dickey, D. A., and Fuller, W. A.** (1981): 'Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root', *Econometrica,* **49**(4), pp. 1057-1072.
11. **Enders, W.** (1995): *Applied Econometric Time Series*, New York (John Wiley and Sons, Inc.).
12. **Hendry, D. F., and Neale, A. J.** (1991): 'A Monte Carlo Study of the Effects of Structural Breaks on Tests for Unit Roots' in *Economic Structural Change, Analysis, and Forecasting,* Hackl, P. and Westlund, A. H. (Eds.), Berlin (Springer-Verlag) pp. 95-119.
13. **Hylleberg, S.** (Ed.) (1992): *Modeling Seasonality* , Oxford, New York, Toronto, Melbourne (Oxford University Press).
14. **International Task Force on Commodity Risk Management in Developing Countries, I.** (1999): 'Dealing with Commodity Price Volatility in Developing Countries: A Proposal for a Market Based Approach', paper presented at *Roundtable on Commodity Risk Management in Developing Countries* (World Bank).
15. **Leon, J., and Soto, R.** (1995): 'Structural Breaks and Long Run Trends in Commodity Prices', *World Bank Policy Research Working Paper* (1406).
16. **Lo, A. W., and MacKinlay, A. C.** (1989): 'The Size and Power of the Variance Ratio Test in Finite Samples', *Journal of Econometrics,* **40**, pp. 203-238.
17. **Mash, R.** (1995): *The Consequences of International Trade Price Volatility for National Income and Welfare: Theory and Evidence*, D.Phil. thesis, Institute of Economics and Statistics, Oxford University.
18. **Meadows, D. H.** (Ed.) (1972): *The Limits to Growth* , London (Pan).
19. **Perron, P.** (1989): 'The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis', *Econometrica,* **57**(6), pp. 1361-1401.

20. **Phillips, P. C. B.** (1987): 'Time Series Regression with a Unit Root', *Econometrica,* **55**(2), pp. 277-301.
21. **Phillips, P. C. B., and Perron, P.** (1988): 'Testing for a Unit Root in a Time Series Regression', *Biometrika,* **75**(2), pp. 335-346.
22. **Pindyck, R., and Rotemberg, J. J.** (1990): 'The Excess Co-Movement of Commodity Prices', *Economic Journal,* **100**(403), pp. 1173-1189.
23. **Ramey, G., and Ramey, V. A.** (1995): 'Cross-Country Evidence on the Link Between Volatility and Growth', *American Economic Review,* **85**(5), pp. 1138-1151.
24. **Rudebusch, G. D.** (1993): 'The Uncertain Unit Root in Real GDP', *American Economic Review,* **83**(1), pp. 264-272.
25. **Serven, L.** (1998): 'Macroeconomic Uncertainty and Private Investment in LDCs: An Empirical Investigation', *mimeo* (World Bank).

Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS2403	Can the World Cut Poverty in Half? How Policy Reform and Effective Aid Can Meet International Development Goals	Paul Collier David Dollar	July 2000	E. Khine 37471
WPS2404	The Distribution of Mexico's Public Spending on Education	Gladys Lopez-Acevedo Angel Salinas	July 2000	M. Geller 85155
WPS2405	Marginal Willingness to Pay for Education and the Determinants of Enrollment in Mexico	Gladys Lopez-Acevedo Angel Salinas	July 2000	M. Geller 85155
WPS2406	How Mexico's Financial Crisis Affected Income Distribution	Gladys Lopez-Acevedo Angel Salinas	July 2000	M. Geller 85155
WPS2407	Utility Privatization and the Needs of the Poor in Latin America: Have We Learned Enough to Get It Right?	Antonio Estache Andrés Gomez-Lobo Danny Leipziger	August 2000	G. Chenet-Smith 36370
WPS2408	What Makes Banks Special? A Study of Banking, Finance, and Economic Development	Biagio Bossone	August 2000	E. Mekhova 85984
WPS2409	How Did the World's Poorest Fare in the 1990s?	Shaohua Chen Martin Ravallion	August 2000	P. Sader MC3-556
WPS2410	Is Functional Literacy a Prerequisite for Entering the Labor Market? An Analysis of Determinants of Adult Literacy and Earnings in Ghana	Niels-Hugo Blunch Dorte Verner	August 2000	H. Vargas 37871
WPS2411	Natural Openness and Good Government	Shang-Jin Wei	August 2000	H. Sladovich 37698
WPS2412	Urbanization without Growth: A Not-So-Uncommon Phenomenon	Marianne Fay Charlotte Opal	August 2000	A. Abuzeid 33348
WPS2413	Foreign Direct Investment in Services and the Domestic Market for Expertise	James Markusen Thomas F. Rutherford David Tarr	August 2000	L. Tabada 36896
WPS2414	Pension Reform and Capital Market Development: "Feasibility" and "Impact" Preconditions	Dimitri Vittas	August 2000	A. Yaptenco 31823
WPS2415	Infrastructure Restructuring and Regulation: Building a Base for Sustainable Growth	Ian Alexander Antonio Estache	August 2000	M. Salehi 37157

Policy Research Working Paper Series