POLICY RESEARCH WORKING PAPER 2455

The Effects on Growth of Commodity Price Uncertainty and Shocks

Jan Dehn

Commodity export dependency confers *ex post* shocks and *ex ante* uncertainty upon producing countries. What reduces growth is not the prospect of volatile world prices, but the actual realization of negative shocks.

The World Bank
Development Research Group
Rural Development
September 2000

Summary findings

Dehn estimates the effects on growth of commodity price shocks and uncertainty within an established empirical growth model. Ex post shocks and ex ante uncertainty have been treated in the empirical literature as if they were synonymous. But they are distinct concepts and it is both theoretically and empirically inappropriate to treat them as synonymous.

He shows that the interaction between policy and aid is robust to the inclusion of variables capturing commodity price movements. More important, his approach departs in three ways from earlier empirical studies of the subject:

- It deals with issues of endogeneity without incurring an excessive loss of efficiency.
- It defines the dependent variable to allow an assessment of the longer-term implications of temporary trade shocks.
- It imposes no priors on how commodity price movements affect growth, but compares and contrasts a range of competing shock and uncertainty specifications.

Dehn resolves the disagreement about the long-run effect of positive shocks on growth, finding that positive shocks have no long-run impact on growth (that windfalls from trade shocks do not translate into sustainable increases in income).

He shows that negative shocks have large, highly significant, and negative effects on growth, but that commodity price uncertainty does not affect growth.

This paper—a product of Rural Development, Development Research Group—is part of a larger effort in the group to analyze the impact of commodity price risks on developing economies. 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.oxford.ac.uk. September 2000. (62 pages)

The Effects on Growth of Commodity Price Uncertainty and Shocks

By

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

Preliminary Draft

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

[1] This paper is preliminary and is circulated for comment. The findings, interpretations, and conclusions expressed in this paper are entirely those of the author. They do not necessarily represent the view of the World Bank, its Executive Directors, or the countries they represent. Many thanks are extended to Panayotis N. Varangis, Christopher L. Gilbert, Richard Mash, Paul Collier, and Jan Willem Gunning for considerable help and support. Special thanks are also extended to David Dollar and Craig Burnside for the use of their data, and to the Danish Trust Fund of the World Bank for financial support.

1. Introduction

It has long been believed that commodity price variability causes problems for primary-producing developing countries, both for the governments and for the producers themselves. For governments, unforeseen variations in export prices can complicate budgetary planning and can jeopardize the attainment of debt targets. This is a particularly serious problem for 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 specialization. For all of these reasons, we should expect vulnerability to commodity price variability to retard growth.

There is less agreement about which particular manifestations of commodity price movements matter to developing countries. The literature is replete of references to volatility, variability, and uncertainty. Other studies have paid attention to trends and to discrete price shocks. The paper focus specifically on two manifestations of commodity price movements, namely discrete temporary *ex post* commodity price shocks and commodity price uncertainty. The latter can be thought of as the *ex ante* manifestation of commodity price unpredictability. The emphasis on these particular manifestations of commodity price movements is not accidental; the importance of large discrete price changes has been recognized in the 'Dutch Disease' literature for some time, while an older, larger and more diverse literature has examined the effects of commodity price uncertainty in various contexts.

This paper departs from earlier contributions in two regards. Firstly, the paper aims to be more specific about which attributes of commodity price movements matter to growth in developing countries, to measure their impact, and to document their robustness. Discrete shocks and uncertainty about future prices have been treated in the empirical commodity price literature more or less as if they were synonymous. Studies of shocks have invariably ignored uncertainty about future prices a potential regressor, and similarly studies of commodity price uncertainty have not tested for the effects of current period shocks. However, shocks and uncertainty are distinct concepts and it is therefore both theoretically and empirically inappropriate to treat them as synonymous. The paper therefore departs from Collier and Gunning (1999a), whose analysis is restricted to positive shock episodes, by examining the effects of both positive and negative shocks. Similarly, this paper tests for asymmetric effects of large price changes on growth and thus departs from the analyses of Deaton and Miller (1995) and Deaton (1999) who impose an assumption of symmetry between small and large price changes. Finally, by modeling *ex post* shocks and *ex ante* uncertainty jointly, it is possible to determine which of these manifestations of commodity price movements are most relevant to growth, and, in the event both are important, to avoid omitted variable bias.

Secondly, the paper aims to obtain better estimates of the long term effects of exposure to shocks and uncertainty. Recently, the availability of reasonably long panel data sets covering a substantial group of developing countries has facilitated a more systematic evaluation of the determinants of relative growth rates in developing countries – see Temple (1999) for a survey. It is therefore a natural step forward to examine the importance of commodity shocks and uncertainty in the context of an established empirical panel growth model. By using epoch growth rates rather than annual growth rates and cyclical income changes, it is possible to obtain better estimates of long term effects of exposure to shocks and uncertainty. This increases the scope for resolving the debate between Deaton and Miller (1995) and Collier and Gunning (1999a) over the medium to long run implications of positive shocks for economic growth.

The analysis shows that per capita growth rates are significantly reduced by large discrete negative commodity price shocks, while positive commodity price shocks and commodity price uncertainty do not exert an influence on economic growth. The magnitude of the effect of negative shocks on growth is very substantial, and appears to work independently of investment, which suggests that the adjustment is achieved through severe reductions in capacity utilization. Negative shocks also remain highly significant after controlling for government economic policy and institutional quality, which indicates that the result cannot be attributed exclusively to inappropriate policy responses on the part of governments. The results are robust to changes in sample composition, changing the time series dimensions of the data, instrumenting for endogenous regressors, and across different estimation methods.

The paper is structured as follows. Section 2 briefly summarizes the panel growth literature and Section 3 discusses the relationships between uncertainty and growth, and shocks and growth, respectively. The empirical literature on shocks and uncertainty are also reviewed. Section 4 describes the structure of a new data set compiled to evaluate commodity price effects, and Sections 5 and 6 describe the distribution of discrete shocks and uncertainty in a sample of 113 developing countries, respectively. In Section 7, the analytical framework for an empirical examination of the effects of uncertainty and shocks on growth is presented. A canonical growth model framework is augmented to include measure of commodity price uncertainty and shocks. Section 8 looks at methodological issues involved in the estimation of panel growth models. In Section 9, the results of the regression analysis and robustness tests are presented, and Section 10 concludes.

2. Panel growth models

In his recent review of the growth evidence, Temple (1999) underlines the current lack of consensus with regard to the specification of empirical growth models. Two broad canonical models have featured in the empirical growth literature. The models by Caselli, Esquivel and Lefort (1996), Islam (1995), Mankiw, Romer and Weil (1992), and Hoeffler (1999), all of which are closely based on theoretical growth models, define the first class. The other type of model, typified by Barro (1991) and subsequently widely replicated, places far more emphasis on the role of policy variables.

These two approaches are not mutually exclusive. Consider the Mankiw, Romer and Weil (1992) augmented Solow model with convergence. The central empirical specification is

$$g_{yt} = \alpha_0 + \alpha_1 \log(s_t) + \beta \log(n + g - \delta) - \gamma \log(y_0) \qquad [1]$$

where s_t denotes the total savings rate, which consists of aid, domestic savings, foreign savings, and other foreign flows. g_{yt} is the rate of growth of per capita GDP, and y_0 is the initial income per effective worker at some initial date. The latter is intended to capture the extent of deviations from the steady state, while n, tp, δ denote the rates of population growth, technical progress and depreciation respectively, which are typically assumed to grow at exogenously determined constant rates and are thus subsumable into the intercept.

In equations such as [1], it is popular to substitute out savings in terms of its determinants, an approach first proposed by Papanek (1972), and since widely adopted following the influential paper by Barro (1991). Using standard national income identities, savings may be expressed in terms of domestic investment (id_t), and foreign investment (if_t) as follows:

$$s_t \equiv id_t + if_t \equiv ti_t \quad [2]$$

where ti_t is the total investment rate. Equation [1] can then be rewritten as

$$g_{yt} = \alpha_0 + \alpha_1 \log(ti_t) - \gamma \log(y_0) \quad [3]$$

which makes explicit the link from investment to growth. Subsequent studies may be grouped into three broad classes:

a) Studies that replace savings by government and private investment rates without including policy variables of any kind (see for example Caselli, Esquivel and Lefort (1996), Islam (1995), Mankiw, Romer and Weil (1992), and Hoeffler (1999)). In these models, empirical specifications closely follow the underlying theory.
b) Studies that focus on policy variables and exclude investment variables. Prominent papers in this tradition include Burnside and Dollar (1997), Hansen and Tarp (1999a), and Guillaumont and Chauvet (1999). The argument justifying substitution of policy variables for investment is that policy and external environment variables fully explain how investment influences growth. In other words, these variables may be thought of as incentive variables.

c) Studies that contain a mixture of investment and incentive variables (Hadjimichael *et al.* (1995), Barro (1991), and Lensink and Morrissey (1999)). The simultaneous inclusion of both investment and incentive variables raises issues of interpretation. For example, when investment is included, the other variables in the model affect growth through the 'level of efficiency', whereas when investment is omitted the effect of other variables on growth is either via investment, via efficiency, or both. The implication is that in certain circumstances it may be insightful to estimate growth equations both with and without investment included as in Lensink and Morrissey (1999).

Since our purpose is to investigate the impact of commodity price uncertainty and shocks on developing country performance, we adopt an established empirical model, which allows approximate comparisons of our results with those from previous studies. In particular, we use the data set compiled by Burnside and Dollar (1997), and in the main we closely follow their intermediate approach - (b) in the above classification.

A word on the measurement of economic growth: Over a given period, a change in income partly reflects cyclical transitory income changes and partly reflects underlying permanent changes in income. From a theoretical point of view, economic growth refers to the latter only. In empirical analysis, however, growth rates are usually calculated without drawing a distinction between transitory and permanent income changes. Since growth rates calculated thus only make use of end point observations, they are potentially very sensitive to outliers caused by transitory cyclical movements in income. To minimize this bias, growth rates are usually calculated over longer periods, typically 5 to 10 years for panel estimation, and up to 20 or 30 years in cross-section studies. This paper follows other contributions to the empirical growth literature by not drawing a distinction between transitory and permanent changes income. The reasons are twofold: First, the number of annual observations on GDP in most developing countries is insufficient to enable an unambiguous decomposition of income into its permanent and transitory components. Secondly, to the extent that the adjustment to temporary shocks and uncertainty involves transitory changes in capacity utilization, it is useful to be able to capture such effects. We are obviously presented with an identification problem since we cannot determine whether the observed income changes are transitory or permanent, but if the transitory adjustment processes to shocks and uncertainty are lengthy the distinction may be largely irrelevant, particularly if policy makers have relatively short time horizons.

3. Commodity price uncertainty, shocks, and growth

The uncertainty variables which have received particular attention in the empirical growth literature include measures of political instability, business cycles, and inflation. A number of studies have found negative correlations between these variables and growth[2]. One way to think about how uncertainty affects growth is via factor accumulation, technical progress, and efficiency. Technical progress and factor accumulation shift out the production possibility frontier, while efficiency brings the economy from a point within the frontier to a point closer to the perimeter.

The theoretical literature shows that the link between uncertainty and factor accumulation - investment - depends on the relationship between the expected marginal revenue product of capital and the uncertainty variable. When the profit function is convex, the link between investment and uncertainty is positive[3]. When investments are irreversible the positive link is not broken, but a range of inaction is created within which investment does not respond to the conventional net present value criterion - see Dixit and Pindyck (1994) and Abel and Eberly (1994). A negative relationship between investment and uncertainty requires either imperfect competition or decreasing returns to scale or both (see Caballero (1991)). Additionally, aggregate uncertainty may have effects, which are distinct from those of idiosyncratic uncertainty. Caballero and Pindyck (1996) show that aggregate uncertainty has asymmetric effects, because in good states there is free entry, while in bad states free exit is not possible if investments are irreversible. Hence, positive shocks do not raise profits, while negative shocks lower them, so the average payoff is decreased by uncertainty.

The empirical literature shows a robust negative association between investment and certain sources of uncertainty. Serven (1998) estimates private

[2] Bleaney and Greenaway (1993) and Aizenman and Marion (1993) find that policy instability lowers growth. Similarly, inflation has been shown to be negatively related to growth, although the correlation is not robust (Levine and Renelt (1990), Levine and Zervos (1993)). Gyimah-Brempong and Traynor (1999) find a significant negative correlation between growth and political instability.

[3] Hartman (1972) abstracted from agent attitudes to risk.Zeira (1987) shows that when investors are risk averse the investment-uncertainty link becomes ambiguous even under the conditions specified by Hartman.

investment equations for a large number of developing countries and finds very robust evidence in favor of a negative link between real exchange rate uncertainty and investment[4]. Given the robust link between investment and growth (see Levine and Renelt (1990)), it seems reasonable to suppose that real exchange rate uncertainty will also have a strong negative effect on growth[5]. However, after controlling for real exchange rate uncertainty Serven finds that terms of trade uncertainty *per se* is not a significant determinant of investment. This suggests that to the extent that terms of trade uncertainty affects growth it must do so via routes other than investment, for example via efficiency and/or the rate of adoption of new technologies.

The link between uncertainty and technical progress is less well understood and only rarely modeled empirically. Ramey and Ramey (1995) cite a model by Fischer Black which predicts a positive link between growth and uncertainty on the grounds that agents can choose from a shelf with high risk/high return technologies and low risk/low return technologies. Uncertainty in this model facilitates growth by allowing agents to exploit different technologies as external conditions change.

The empirical evidence in favor of a growth-commodity price uncertainty link is relatively weak. The classic study is MacBean (1966), who failed to support the hypothesis that export instability reduces growth in developing countries. Subsequent contributions include Erb and Schiavo-Campo (1969), Glezakos (1973), Knudsen and Parnes (1975), Yotopoulos and Nugent (1976), Lutz (1994), Guillaumont, Guillaumont Jeanneney and Brun (1999), and Guillaumont and Chauvet (1999). The latter study finds that a broad measure of instability (which includes the variability of terms of trade) remains significant with a negative coefficient in a growth regression which includes investment as a regressor. This supports the notion that uncertainty operates via efficiency or technical progress, but is it not possible on the basis of this study to determine if the result is due to commodity price uncertainty or to some other component in the composite vulnerability index. There is some indication, however,

[4] He examines the role of uncertainty of inflation, the relative price of capital, real exchange rate, the terms of trade, and GDP growth on private investment. For each of these variables he develops seven different measures of uncertainty, and finds that each measure is negatively correlated with private investment.

[5] Kormendi and Meguire (1985) and Grier and Tullock (1989) found output growth to be positively correlated with output fluctuations in large cross-sections of countries. They found that this relationship was unchanged when investment was introduced, the implication being that uncertainty may operate through technical progress, although the route may equally well be capacity utilization. Making the distinction between the predictable and unpredictable components of output volatility, Ramey and Ramey (1995) show the positive relationship between growth and volatility only holds for the variability of the unpredictable component; the correlation between the unpredictable component and growth is negative and strong enough, in fact, to dominate the total effect. They also argue that uncertainty exerts its negative impact on growth mainly technical progress or efficiency, not investment.

that commodity prices may not be culprit. Controlling for investment, Lutz (1994) compares the effects on growth of Net Barter Terms of Trade and Income Terms of Trade (ITT) instability measures. His two main findings are that there is no consistently significant and robust effect of NBTT volatility on growth, and secondly that ITT volatility affects growth (negatively) mainly via volume rather than price shocks. In other words, it may be that it is output rather than price volatility which drives the negative growth effects in the index of Guillaumont and Chauvet (1999).

The theoretical literature linking growth and discrete temporary trade shocks is very limited. The Ramsey model by Collier and Gunning (1999a), which formalises the seminal work in Bevan, Collier and Gunning (1990), appears to be unique. The model shows that positive boom income is initially invested, and in the post-boom period the investment is reversed to enable a higher level of consumption. Investment is therefore the vehicle whereby consumption is smoothed. Consumption is permanently higher than before the boom after jumping up at the time of the shock and then declining monotonically towards its pre-shock level after the shock. The model shows that temporary trade shocks ought to increase the level of GDP with accompanying short to medium term growth effects.

Rodrik (1998) proposes a linkage from temporary trade shocks to growth via a country's institutional capacity for managing conflicts. In his model, shocks give rise to conflicts over who should benefit from windfalls (in the event of positive shocks) and who should bear the cost of adjustment (negative shocks). In countries with strong institutions for conflict management, the dominant strategy is for competing interests to cooperate. On the other hand, when conflict management institutions are weak there are large potential returns to opportunistic behavior which makes fighting for the spoils of (or to avoid bearing the costs of adjustment to negative) shocks the optimal strategy irrespective of what other groups choose to do. In the presence of an intermediate range of institutional capacity, the outcome is determined by the degree of latent social conflicts in society.

Empirical studies of the effects of discrete *ex post* shocks on growth are almost as rare as their theoretical counterparts, possibly due to the arbitrariness involved in defining shock episodes. In the empirical part of his paper, Rodrik (1998) specifically considers a period in history when many developing countries experienced a decline in their terms of trade, defining his shocks as the standard deviation of (the log) difference of terms of trade over the (1971-1980). It is not clear, however, if this variable reflects the downward trend in prices at the time, the variability of prices, their uncertainty, or individual episodes of powerful negative price changes. It is therefore not possible to be entirely confident about what drives Rodrik's results.

Easterly *et al.* (1993) find a strong positive correlation between changes in the terms of trade and economic growth in both the 1970s and 1980s, and they attribute as much variation in economic growth to terms of trade shocks as to economic policies. It is not clear, however, that the dichotomy between terms of trade and policy is entirely valid. Collier and Gunning (1999a) point out that policy changes are often endogenous to shocks, such that the growth effect depends as much on the shock itself and the policies in place at the time as on the policy changes which are subsequently made in direct response to the shock. Collier and Gunning (1999a) consider the effects on annual growth rates of 19 positive shock episodes over the period 1964-1991 for a sample of developing countries. Using a series of shock intercept dummies, investment-shock interaction dummies, and dummies which capture the post-shock period, they measure the effect on growth during as well as after the shock. Their main finding is that despite initial high savings rates windfalls do not translate into sustainable increases in income; initial positive effects are more than reversed in the post-shock period. They attribute the reversal to a combination of low quality public investment projects and disincentives for private agents to lock into their savings decisions on account of policy decisions taken prior to and during the shock itself. In contrast, Deaton and Miller (1995) who examine the effects of commodity price movements on growth using a VAR approach find a positive coefficient between growth in commodity prices and growth in income. There is therefore disagreement over the long run growth implications of temporary commodity price shocks. A consensus reading of these studies suggests that positive shocks tend to boost growth in the short run, but that any long run effects may depend on the policy response, the economy's flexibility, institutions for conflict resolution, and the importance of commodities in the country's terms of trade. Meanwhile, the effects of negative shocks are not well-documented. Likewise, none of the papers test whether large and small shocks and negative and positive shocks have asymmetrical effects on growth.

4. Constructing a suitable commodity price index

With a few exceptions (notably Deaton and Miller (1995)), studies of the effects 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). Neither of these approaches are, however, satisfactory for the following reasons:

First, only a few oil producing countries are specialized to the point of exporting only a single commodity, so for the majority of developing countries the full ramifications of specializing in commodities cannot be determined with reference to the movements in the price series of just a single commodity. 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; their inclusion present a problem mainly because it is not possible with confidence to determine if the results are due to commodity prices *per se*.

Until recently, it might have been seen as overkill to construct commodity prices indices for individual countries, because the prices of even unrelated commodities were seen to display 'excess comovement', which implied that there was little to gain over using broad aggregates of commodity prices (Pindyck and Rotemberg (1990)). However, recent work by Cashin, McDermott and Scott (1999) suggests that much of the comovement in unrelated commodity prices can be accounted for mainly by extreme outliers and structural breaks, which have powerful influences on the correlation based measures of comovement used by Pindyck and Rotemberg (1990). Using a concordance measure, which is insensitive to outliers, Cashin, McDermott and Scott (1999) find that unrelated commodities do not display comovement as hitherto thought. This has a clear implication for the choice of index used to evaluate the effects of commodity price movement in developing countries: Broad aggregate indices are likely to behave very differently from individual country indices, especially if the country is specialized in a narrow range of commodities

The structure of the index used here is identical to the geometrically weighted index used by Deaton and Miller (1995), namely

$$DM = \prod_i P_i^{W_i} \qquad [4]$$

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 :

$$W_i = \frac{P_{ji}Q_{ji}}{\sum_n P_{jn}Q_{jn}}. \qquad [5]$$

Since W_i is country specific, each country's aggregate commodity price index is unique. As an average of the prices of the commodities exported by each country, the index is primarily suited to the study of macroeconomic rather than sectoral effects. A 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. The appendix describes the data sources and country coverage of the indices.

5. The distribution of temporary commodity price shocks

The temporary trade shock model by Collier and Pattillo (2000) is not restricted to discrete shocks of a particular magnitude. Nevertheless, most empirical studies of temporary trade shocks have focussed specifically on events associated with large price changes (see for example the collection of case studies in Collier, Gunning and Associates (1999)). There is therefore a slightly odd dichotomy between the theoretical treatment of shocks, which makes no distinction between large and small shocks, and the empirical analysis of shocks, which does make this distinction.

Larger disturbances obviously give rise to larger absolute annuity values, larger absolute changes in consumption, and larger absolute quantities of savings. There is therefore some intuitive appeal in focusing on large price changes to the extent that larger effects are more likely to show up in the data. Additionally, there may be theoretical reasons for paying particular attention to large price changes. Deaton (1991) for example has argued that large negative shocks can give rise to consumption collapses when consumers are characterized by a combination of impatience and precautionary savings, particularly in the presence of liquidity constraints. This is because large negative shocks are the one manifestation of the stochastic process against which buffer stocks cannot give adequate protection. Secondly, agents may not treat windfall and other sources of income as fully fungible in terms of consumption (Thaler (1990)). Hatsopoulos, Krugman and Poterba (1989), Summers and Carroll (1987), and Ishikawa and Ueda (1984) show that marginal propensities to consume out of different types of wealth differ considerably. There is also evidence that agents assign different consumption propensities according to the magnitude of windfalls (Holcomb and Nelson (1989), Horowitz (1988), Benzion, Rapoport and Yagil (1989) and Thaler (1981)). Landsberger (1966) is an early result in the same vein based on a study of Israeli recipients of German restitution payments after World War II. Thirdly, large and highly visible shocks may trigger discrete government interventions, because they signal new untapped taxation possibilities. Schuknecht (1997) has argued, for example, that many governments respond to commodity shocks by digging deeply into the pool of rents created by increases in the price of commodities in the 1970s. Schuknecht (1996) shows that higher revenues from windfall taxation are associated with higher fiscal deficits, higher current expenditure, lower shares of health and education expenditures and lower growth.

While there may therefore be good reasons to examine the specific effects of large shocks, there are practical problems involved in finding a suitable definition of 'large'. The theoretical arguments presented above offer only limited guidance about a suitable cut off point due to the general unobservability of the relevant conditioning variables. The second best solution is to locate shocks using a purely statistical definition, which is consistently applied to each country's commodity price index. The steps are the following: First, each country's aggregate commodity price series is made stationary by first differencing the series, which removes the any permanent innovations[6]. Secondly, the remaining 'predictable' elements are removed by

[6] It is assumed that the commodity price series are I(1) rather than trend stationary. In practice, determining whether a series is a stochastic trend process or a deterministic trend process is difficult. See Leon and Soto (1995).

regressing the differenced series on its own lag, and a second lag in levels as well as a linear time trend. This error correction specification [6] is the most efficient way to model an integrated process, and it removes both the levels and differences information, which may inform the data.

$$\Delta y_{it} = \alpha_0 + \alpha_1 t + \beta_1 \Delta y_{i,t-1} + \beta_2 y_{i,t-2} + \varepsilon_{it}; \quad t = 1,\ldots,T \qquad [6]$$

The residuals from [6], ε_{it}, are normalized by subtracting the mean and dividing by the standard deviation, and finally an extreme but essentially arbitrary cut off point can be applied to the stationary normalized residuals. The base case cut off point used here puts 2.5% of the observations into each tail region.

A total of 179 positive and 99 negative shocks were found in this data, constituting 4.06% and 2.25% of the total number of observations, respectively. The disproportionate number of positive shocks is consistent with the predictions of the competitive storage model proposed by Deaton and Laroque (1992). Figure 3 and 4 show the distribution of positive and negative shocks over the period 1957 to 1997 for 10 different cut off points in the range of 1%-10%. It is evident from these figures that shocks do not appear to be distributed randomly across time. The incidence of shocks is low prior to the 1970s, and then suddenly increases dramatically with close to 1/3 of all countries in the sample experiencing positive shocks across several years, notably in the 1970s. The incidence of positive shocks then declines, but remains higher than in the period prior to the 1970s. This pattern is consistent with the findings of Love (1989) who calculates estimates of mean variability of commodity prices in 65 developing countries over the two periods 1960-1971 and 1972-1984. Love finds that instability increased in the latter period using three different deterministic trend specifications (linear, exponential, and moving average). It is also evident that the incidence of negative shocks increased in the 1970s, although the numbers of shocks are always smaller than those for positive shocks. Negative shocks are particularly prevalent in the 1980s and 1990s.

It is not the objective of this paper to explain the uneven temporal distribution of shocks. It is important, however, to establish that the high concurrence of shocks in some years is not attributable to some specific factors such as oil price movements, or the choice of deflator. Consider first the role of oil. A total of 59 countries experienced shocks in either 1973 or 1974 (the oil shock year), which is more than twice the number of countries in the sample, which exports oil (23 countries). The negative shock in 1986 could also be construed as a product of the collapse in oil prices, but again a large number of non-oil exporting countries saw shocks in that year. The fact that the 1979 shock is exclusive to oil producers also suggest that the price changes for other commodities in 1974 and 1986 were not indirectly due to oil either. Clearly, oil is not the whole story.

All indices are deflated by the same deflator; the MUV index. It is therefore possible that the similarities in the distribution of shocks across different countries are due to specific outliers in the common deflator. Closer inspection of the deflator, however, reveals that its volatility is much smaller than the volatility of commodity prices, usually by a factor between 2 and 5 depending on the time period and choice countries. The differences are significant at the 1% level. Even in the critical year of 1986, where the MUV index has an upwards kink which could potentially account for the high incidence of negative shocks in the commodity price indices, the price change in the deflator is a mere 11.3% compared to 49.5% for the 40 country's whose aggregate indices experienced negative shocks in that year. Indeed, the average magnitude of price changes in each of the 10 commodities, which saw outliers was 51.6% in that year[7]. It therefore seems fairly certain that the high incidence of shocks in particular years reflects instability in many commodities rather than oil shocks or deflator shocks.

6. Commodity price uncertainty in developing countries

Uncertainty can be measured in many different ways, and there is no consensus on what constitutes the 'correct' method of measurement. The lack of consensus suggests that there is merit in considering more than one measure, and we therefore consider three broad alternative approaches to measuring uncertainty.

The naïve approach involves treating all price movements as indicative of uncertainty by calculating the standard deviation each country's aggregate commodity price index. This is unsatisfactory on a number of counts. Most importantly, it does

[7] The standard deviations were small at 3.1% for the country shocks and 5.0% for the commodity shocks.

not control for the predictable components and trends in the price evolution process, and is therefore likely to overstate uncertainty. Both Ramey and Ramey (1995) and Serven (1998) have shown and argued that this distinction is important.

The second approach distinguishes between predictable and unpredictable components of the price series, but remains time invariant. The measure is based on the principle proposed by Ramey and Ramey (1995) 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. However, in contrast to Ramey and Ramey (1995), we do not regress commodity prices on a series of explanatory variables, but adopt instead a time series approach, whereby the first difference of real commodity prices (in logs) is regressed 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:

$$\Delta y_{i,t} = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \beta_1 \Delta y_{i,t-1} + \beta_2 y_{i,t-2} + \gamma_1 D_t + \varepsilon_{i,t};$$
$$t = 1,\dots,T; \qquad [7]$$

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.

Cashin, Liang and McDermott (1999) argue that uncertainty worsened during the 1970s. If this is so, it is clearly not appropriate to impose an assumption of homoskedasticity upon the variance of the residuals. The third approach to measuring uncertainty therefore distinguishes not only between predictable and unpredictable components of prices, but also allows the variance of the unpredictable element to be time varying. Time varying conditional variances can be estimated by applying a Generalized 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. We therefore estimate, for each country,

$$\Delta y_{i,t} = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \beta_1 \Delta y_{i,t-1} + \beta_2 y_{i,t-2} + \gamma_1 D_t + \varepsilon_{i,t};$$
$$t = 1 \ldots, T; \qquad [8]$$
$$\sigma_{i,t}^2 = \gamma_{i0} + \gamma_{i1}\varepsilon_{i,t-1}^2 + \delta_i \sigma_{i,t-1}^2$$

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

Large shocks may dominate both the time invariant and time varying uncertainty measures, but it is possible that agents view such large shocks as sufficiently infrequent and atypical to effectively discount them when they form estimates about future price uncertainty. Versions of the Ramey and Ramey and GARCH uncertainty measures were therefore also constructed which 'dummy out' particular events. The six uncertainty measures are summarized in Table 1.

Table 2 shows average uncertainty for different groups of countries over different periods of time for each uncertainty measure. The columns labeled 'I' to 'VI' correspond to the six uncertainty measures in Table 1. The first line in Table 2 shows the average commodity price uncertainty for the full 113 countries sample. Evidently, these highly aggregated statistics do not differ a great deal 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 standard deviation measure, which does not remove '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; the large discrepancy between uncertainty measures which do and do not control for predictable elements suggests that much of the movement in the price series reflects 'predictable' changes such as autoregressive parameters and trends, and failure to account for these components leads to considerable overstatements of actual uncertainty.

The second block of statistics in Table 2 shows average uncertainty by broad regional grouping calculated over the full sample period (1957-1997). According to the uncertainty measures, which do not control for shocks ('I', 'IV' and 'VI') the region, which faces by far the most commodity price uncertainty is the Middle East and North Africa. Among the remaining regional groups, there is little difference in commodity price uncertainty. This includes Sub-Saharan African countries, which do not appear to experience more uncertainty on average than other developing countries. To the extent that the commodity share of total exports is greater for African countries, the same level of uncertainty will of course have greater effects, *ceteris paribus*. When 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 ('V') does not change, however, which is probably because the trend break allowed for in this measure is a poor control for the first oil shock.

The third block of data in Table 2 splits the sample by time period in accordance with 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. On most measures, the increase in uncertainty is as much as 100%. There is no consistent evidence that uncertainty falls in the 1986-1997 period relative 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. It would therefore appear that uncertainty rose in the 1970s and has not subsequently declined. Moreover, 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 final eight blocks of data in Table 2 show uncertainty for each regional group, 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.

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 more prone to weather shocks, while non-food products by virtue of not being consumer goods may be more prone to business cycles. Oil is often best treated on its own. On these grounds, it is 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 total commodity exports. If no single commodity type accounts for 50% of exports the country was labeled a 'mixed' exporter. Table 3 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.[8] 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 that 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 tends to be higher during the 1973-1985 period than in the preceding period, and in many cases remains 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.

7. The empirical growth model

This section describes the approach which will be used evaluate if and how the uneven distribution of discrete shocks and the increase in uncertainty since the 1970s have impacted growth rates in developing countries. The approach involves augmenting a canonical empirical growth equation with suitably defined variables. Our approach departs from recent work by Guillaumont and Chauvet (1999) in two

[8]Since the oil producers are primarily from the Middle East and North Africa, this explains why this group of countries faced the

important regards. First, an established empirical growth model is used as the canonical basis for the empirical analysis. Since the choice of explanatory variables in the Burnside and Dollar (1997) growth model encapsulates what are regarded as the key empirical determinants of growth in the literature, the use of this model enables more direct comparison of our results with other papers in the growth literature. Secondly, the uncertainty and shocks variables are different from the vulnerability index used by Guillaumont and Chauvet (1999) which is a composite index which picks up not only terms of trade shocks, but also the effects of ecological shocks on agricultural output, changes in the trend in terms of trade, and the economy's structural exposure to these types of shocks. In contrast, the measure used here is based entirely on commodity prices. In estimating a full growth model, the present analysis also goes considerably further than Deaton (1999), who only considers the simple correlation between commodity prices and growth.

The canonical specification has the following arguments:

$$g_{yt} = f(Y_0, X) \qquad [9]$$

where the matrices $\{Y_0, X\}$ respectively denote initial conditions, and canonical regressors. Two time invarying variables capture initial conditions, namely the institutional quality index constructed by Knack and Keefer (1995), which measures the security of property rights and efficiency of the government bureaucracy, and the ethnolinguistic fractionalization index which has been shown to be an important determinant of growth by Easterly and Levine (1997).

The time varying variables include the log of real GDP in the beginning of each growth epoch, which is included to capture convergence effects, and the ratio of money supply (M2) to GDP, which proxies for development of the financial system (King and Levine (1993)). The latter is lagged one period to avoid endogeneity problems. To capture political instability effects, a variable, which measures assassinations is included, and this variable is also interacted with the ethnic fractionalization index. Finally, Sub-Saharan Africa and East Asia dummy variables

greater uncertainty in Table 2.

are included to capture the sharply contrasting growth performances of these two regions.

Instead of using a range of policy indicators, the policy incentive regime is modeled using the policy index produced by Burnside and Dollar (1997). This index is constructed as a product of the coefficients of the relevant policy variables in a growth regression and the means of these variables. Their specification is:

Policy=1.28 + 6.85 Budget surplus -1.40 Inflation +2.16 Openness

where the constant is scaled to ensure that the mean of the policy index and the dependent variable are identical. This index has been criticized on the grounds that it does not capture what constitutes 'good policies' (Lensink and White (2000)). However, the particular choice of variables for inclusion in a policy index is always bound to be controversial. A strong argument for using the Burnside and Dollar (1997) policy variable is its very impressive explanatory power in regressions.

The key objective is to explore whether and how commodity prices affect growth. Various different manifestations of commodity price movements may potentially affect growth, and it is important not to prejudice the analysis by excluding any of these *a priori*. We therefore consider a full range of specifications. First, we use the log of real commodity prices in levels as a potential regressor, because commodity prices in levels may matter to growth. A levels measure may also be important if, say, the effects of shocks and uncertainty are conditional upon the level of commodity prices. Secondly, the first difference of (log) commodity prices can be thought of as a base case variable, because this variable encompasses the large price changes which form the basis for the shock variable. In particular, the first difference of log commodity prices can be seen as a variable, which imposes an assumption of symmetry between positive and negative price movements, and between large and small price changes. Thirdly, interaction terms are introduced to enable distinctions to be made between large and small commodity price changes, and between positive and negative price changes. Large price changes - shocks - are identified in accordance with the methodology described in Section 6.5. Finally, the full range of commodity price uncertainty measures described in Section 6.6 are tested for their explanatory power in the growth regression.

A shocks is modelled as year-specific dummy, which presents a problem in the context of estimating a growth panel whose epoch time dimension spans more than one year. The shock variable therefore has to be redefined to suit the panel context. The new shock variable takes a value of unity if a shock occurs in the *epoch* as opposed to a particular year, zero otherwise. Clearly, the length of the epoch used in the growth regression is of considerable importance. For example, if growth rates are calculated over the full 1970-1993 sample period, the shock variables will become near meaningless, because most countries experienced at least one positive or negative shock during this time, wherefore the shock variable would be indistinguishable from the constant. In the Burnside and Dollar (1997) growth panel, however, this is not a problem, since the growth epochs are only 4 years long.

8. Estimation issues

Estimation of a panel growth equation with policy variables introduces at least two potential estimation issues, namely country specific effects and endogeneity. This section briefly discusses each in turn.

A number of methods exist for coping with unobserved country specific effects in static panels. When country specific effects are present, they will give rise to omitted variable bias (OVB) in a pooled OLS regression. One way to avoid OVB is to include a set of *n-1* country specific intercept dummy variables (LSDV model). However, given that the sample consists of a mere 275 observations in the preferred specification, the inclusion of 55 additional parameters puts a serious drain on degrees of freedom. An alternative way to deal with the problem is to use the Fixed Effects (Within Groups) estimator, which sweeps out any country specific effects by subtracting the mean from each variable, although this also means that the variables which capture initial conditions in the equation drop out along with the country specific effects.

Here, we shall estimate pooled OLS and FE(WG) models and perform Hausman tests across the specifications to check if there are gains in moving from the former to the latter. We shall also use a Hausman test to determine if country specific effects are best modeled as random or fixed.

Issues of endogeneity are potentially very important – see Burnside and Dollar (1997), Guillaumont and Chauvet (1999), and especially Hansen and Tarp (1999b). Both the policy variable and the investment variable (when included) are likely to be determined by growth itself. For example, supply shocks such as droughts cause incomes, and therefore growth, to fall. If the fall in income causes policy to worsen, the result is that policy is positively correlated with the error term, and the coefficient will be biased.

Deaton and Miller (1995) and Collier and Gunning (1999a) estimate the effects of various commodity price manifestations on GDP and annual growth rates, respectively. They both include investment as a regressor, but they are at near opposite extremes in terms of their treatment of endogeneity issues. In the spirit of Sims (1980), the VAR of Deaton and Miller treats all variables symmetrically by not imposing any prior assumptions of endogeneity and exogeneity (except commodity prices which are treated as exogenous). In contrast, Collier and Gunning (1999a) treat growth as endogenous and investment rates as exogenous. The possible endogeneity of investment to growth is therefore not taken into account.

Arguably, neither of these approaches are ideal. The VAR analysis produces inefficient estimates and is not well suited for estimating long run effects, and ignoring endogeneity can hardly be recommended either. Alternative approaches involve simultaneous equation estimation, or instrumental variable estimation (IV). Simultaneous equation methods typically involve the introduction of other explanatory variables for purposes of identification, which themselves may be endogenous, which in turn means that more equations and more variables are needed, and so on. The methodology favored here is therefore the instrumental variable method, which strikes a balance by correcting for the potential bias in the Collier-Gunning paper dealing with the potential endogeneity problem, while avoiding the inefficiency of VAR estimation.

IV techniques require that instruments be found which are correlated with the endogenous variable, but uncorrelated with the error term. A full range of external instruments is provided in the Burnside Dollar data. As an alternative to the conventional instrumental variable estimation approach to dealing with endogeneity, however, we also carry out the Systems GMM analysis proposed by Blundell and

Bond (1998), which uses internally generated instruments to instrument for both policy and, as part of our robustness analysis, for investment.

The sample consists of 56 countries over the period 1970/1973 to 1990/93. The data is an unbalanced panel with a maximum of six growth observations per country.

9. Results

In this section, we present a progression of results leading towards a preferred model specification. Several regressions are reported in order to illustrate what does *not* work. This is of some interest, because one of the objectives is to establish which among the competing manifestations of commodity price variability actually affect growth. We then test the robustness of the preferred model specification to changes in sample size, estimation methods, time series dimension, and equation specification.

In regression 1 of Table 4, we report the canonical growth specification, which is identical in all respects to the canonical model reported in Burnside and Dollar (1997). The most important determinants of growth in the canonical model are policy and institutional quality. Ethnolinguistic fractionalization interacted with assassinations is also significant as is the Sub-Saharan Africa dummy. In regressions 2, 3, and 4 we augment the canonical model with the log of commodity prices in levels and differences, and the positive and negative shock dummies, respectively. These regressions are carried out to give a basic flavor of how commodity prices affect growth, if at all. It is evident from regressions 2 and 3 that there is no simple strong statistical relationship either between the log of the real commodity price in levels or its difference (which is also the annual growth rate since the levels variable upon which it is based is in logs). In regression 4, we enter the positive and negative shock dummies, which, it is recalled, indicate episodes of 'large' changes in (log) commodity prices. In contrast to the simple levels and differences specifications, the negative shock dummy enters the growth regression with a significant negative coefficient. The positive shock dummy is not significant. This provides a first indication that there may be asymmetrical effects in terms of how commodity price changes affect growth. However, since both the positive and negative shock dummy impose an untested restriction that smaller commodity price changes do not matter to growth, it is not clear if the significance of the negative shock dummy indicates that large negative commodity price changes have asymmetric effects from smaller price changes, or whether all negative commodity price changes would have this effect on growth.

In order to determine if positive and negative price changes have different effects on growth and whether the effects are sensitive to the magnitude of the price changes, we ran a new set of regressions shown in Table 5. Regression 1 in Table 5 splits the first difference of the log of real commodity prices into positive and negative changes, thus no longer imposing the assumption of symmetry for positive and negative price changes. It is clear that negative price changes have a significant negative effect on growth rates, while again positive price changes do not appear to matter. In terms of growth, positive and negative price changes therefore have very different effects.

The remaining question is now whether the significant coefficient on the negative price changes variable is driven by large shocks or small commodity price changes, or indeed by both. This question can be answered by introducing an interaction term between the negative shocks dummy and the negative changes in commodity prices (regression 2). The interaction term between the shock dummy and the change in commodity prices enables large and small price changes to be distinguished in terms of their effects on growth. It is very clear from this regression that it is large negative price changes, which matter rather than negative price changes *per se*. We also tested whether the coefficients on these variables were equal in magnitude, but opposite in sign, which would imply that the coefficient on the shock interaction term is zero. This was firmly rejected at the 99% confidence level ($F(1, 258)=12.34$)). Meanwhile, when a similar decomposition was carried out for positive shocks, it was not possible to reject the null hypothesis that the coefficient on the positive shock interaction term was identical but of opposite sign to the positive changes in prices base variable ($F(1,256)=0.06$)). This means that large and small positive shocks do not have different effects on growth, indeed, they do not appear to have any effects at all. Finally, a test was carried out to verify that positive price changes on the one hand and the disaggregated negative price changes on the other are statistically distinct in their effect on growth. This was validated at the 5% significance level ($F(1,257)=4.08$). On the basis of these tests, it is therefore possible to conclude that statistically speaking commodity prices have highly asymmetrical effects on growth in terms of both magnitude and direction. In particular, only negative changes appear to matter to growth, and within this subset only large negative changes appear to matter.

Shocks are 'large' price changes, and they can, by virtue of the stochastic process, which determines their incidence, occur at any point in time. They can for example occur at a time when the level of commodity prices is historically low, or indeed when commodity prices are already high. It might be hypothesized that a large negative shock is more growth reducing when it occurs at a time when commodity prices are already low. This does not appear to be the case, however. In regression 3, we interact the negative shock interaction term with the log of real commodity prices, but this variable is insignificant. The implication is that negative shocks exert their negative influence on growth regardless of whether they occur when epoch commodity prices are on average high or low. It should be borne in mind, however, that this test is likely to be weak because of the use of epoch averages of the levels variable. For example, the shock may have occurred during a particular year, when the level of commodity prices was indeed low by historical standards, which accounts for the large effect on growth, but the epoch average of the level variable is a poor estimator of the price level in the critical year.

In regression 4, we include both negative changes in prices, negative changes interacted with the negative shock dummy, and the negative shock dummy itself to capture any intercept effects. It is evident from this regression that the intercept dummy and the negative price changes are not significant after controlling for the interaction between the negative shock dummy and large price changes. This suggests that the effect is confined to the interaction term. Thus, in regression 5, we present our preferred model, where the insignificant positive price changes, the small negative price changes, and the intercept shock dummies have been dropped. The negative shocks interaction term is significant at the 99% confidence level, and exercises a very considerable negative effect on growth. To illustrate the magnitude of this effect, consider the first row of numbers in Table 6. Given the estimated beta coefficient of -62.463 from the preferred regression, the mean of the change in commodity prices during shocks of 0.025, and the mean of the dependent variable of 1.17, the elasticity of growth with respect to changes in price can easily be evaluated conditional upon a large shock having occurred. At the mean, the growth elasticity is -1.345. Evaluated at two standard deviations above the mean, the growth elasticity is -2.876, while evaluated at one standard deviation below the mean the growth elasticity is -0.580.

Elasticities were also calculated for negative commodity price changes more generally and for negative commodities price changes net of shocks (respectively the 2nd and 3rd rows in Table 6). Although these elasticities are also substantial, they are smaller than for shocks, which is supportive of asymmetric effects from large shocks. Moreover, it should be remembered that the coefficients upon which they are based are statistically indistinguishable from zero.

Two conclusions can be drawn from these results. Firstly, negative shocks are important due to their large growth elasticities. Secondly, the fact that the elasticity is very different depending on whether it is evaluated at, above, or below the mean shows that, conditional upon a shock having occurred, the bigger the shock the more severe its effect. Indeed, elasticities of this magnitude are supportive of the hypothesis proposed by Rodrik (1998) that negative shocks can cause growth collapses, although we are not at liberty on the basis of the information presented so far to evaluate if, as Rodrik suggests, the mechanism whereby these collapses occur is via poor conflict resolution. However, it is clear from the regressions that negative shocks remain highly significant even when the canonical model includes ethnolinguistic fractionalization and institutional quality variables. This is interesting, because in his growth regressions, Rodrik (1998) finds that negative shocks cease to have a significant effect on growth when these variables are introduced. Rodrik interprets the sudden insignificance of the shock variable upon the introduction of the institutional variables as indicative of the importance of social structures of conflict resolution in ensuring that shocks have beneficial effects on growth. Our results suggest a different interpretation of Rodrik's results, namely that changes in terms of trade, and their standard deviation may be poor instruments for large negative shocks, which are therefore not robust to the inclusion of other standard growth regressors. Thus, while social conditions may still matter in the way that Rodrik suggests negative shocks can clearly precipitate growth collapses even after controlling for social conditions.

A natural next step is to evaluate the robustness of these findings along several different dimensions. First, we examine the impact of changing the sample of countries. Table 7 reports OLS estimates of the preferred model for four different sample specifications. Regression 1 excludes the five observations identified as outliers by Burnside and Dollar (1997). It is clear from the results that while these countries may be outliers in terms of how aid have affected their growth rates, their inclusion clearly does not alter the shock coefficient in the shock augmented growth equation.

A more serious concern is the role of oil shocks, although typically one thinks of positive shocks in this context. However, oil prices dropped dramatically in the 1980s and it is important to check whether the results are not simply driven by the decline in the price of oil. Regression 2 therefore excludes oil producers defined as countries for which oil constitutes 50% or more of total commodity exports. While magnitude of the coefficient is reduced somewhat by their exclusion, negative shocks are still highly significant when oil producers are omitted from the sample. This is a strong indicator that the shock results are not driven by oil shocks alone.

Another interesting question is whether negative shocks affect the poorest countries in the world, because the welfare implications of a fall in growth rates are arguably more serious in the poorest countries, where people live closer to absolute destitution. Regression 3 therefore additionally omits countries whose income per capita in 1970 was above US$1900 in constant 1985 US Dollars. This reduces the sample to 60% of the original sample size, wherefore the efficiency of the estimates declines considerably. The coefficient on negative shocks is nevertheless still significant at the 10% level, and of the same order of magnitude as for the full sample.

Finally, we ran the preferred model on a sample consisting of just Sub-Saharan African countries (regression 4). This reduced the sample to just 84 observations, and predictably the t statistic on the negative shock term is now only 1.52 (corresponding to a p value of 13%). Again, however, the magnitude of the coefficient is close to the previous estimates. Taking into account the small sample size, it would seem that the effect of negative shocks on growth is quite robust to changes in sample composition, and particularly relevant in the poorest developing countries.

A second dimension of robustness testing concerns the method of estimation. In estimating our preferred specification using a pooled OLS estimator, we have implicitly assumed that pooling across countries is valid so long as we include Sub-Saharan African and East Asian dummies. However, it is possible that the bias introduced by not allowing for individual country specific effects is sufficiently strong to give grounds for concern. The other concern is endogeneity. The pooled OLS model treats all right hand side variables as exogenous, although the policy variable in particular may well be endogenous. If this is the case, the result is that coefficients in the preferred specification are both biased and inconsistent. Table 8 reports a number of regressions, which use different estimation methods to control for country specific effects and endogeneity. Country specific effects may be modeled as random or fixed effects. Regression 1 reports the preferred model estimated using a random effects model. It is worth noticing that the coefficient on the negative shock variable is entirely stable in the face of this change in estimation methodology, although the random effects model is not the preferred estimator. This is evident from the Chi-squared test statistic of 5.71 which fails to reject null of the Hausman test of no systematic difference in coefficients in this model and a fixed effects within group estimator (FE(WG)). Hence, there are efficiency gains to considering an estimator, which allows for fixed country specific effects.

One way to do this is to is to transform the variable by subtracting their means. This sweeps out the country specific effects, but also the time invariant variables, which capture initial conditions. Regression 2 reports the FE(WG) estimates and shows that the negative shock variable is robust to the transformation and remains significant at the 5% level. The country specific effects are not jointly significant according to the F test (F(55,208)=1.25), but this does not mean that individual coefficients are not different from zero, and hence potentially a source of bias. What is important is whether such biases are sufficiently important to produce systematic differences in the coefficients between a model, which accounts for them, and one that does not. The effect on the beta coefficients can be determined by applying a Hausman test to a FE(WG) model against the OLS alternative. The test is unable to reject the null that the beta coefficients for the FE(WG) are indistinguishable from the OLS model (Chi-squared test of 10.50). We therefore take this to suggest that the OLS model is not strongly biased by the omission of country specific effects for each individual country.

Regression 3 reports an estimate of the preferred model using Two Stage Least Squares (TSLS) instrumenting for policy. Burnside and Dollar (1997) argue that the policy variable can be regarded as exogenous, which is extremely convenient given the difficulties in finding good instruments for policy. However, we elected to take the endogeneity issue more seriously. First, we constructed a set of instruments composed variously of initial income and log of population and their squares in combination with the Sachs-Warner openness index. The argument for using the Sachs-Warner openness index as an instrument for policy despite the fact that this variable is actually part of the policy index itself is the following: Unlike the budget deficit and inflation, which make up the other components of the policy index, the openness variable captures *discrete* trade policy changes, and therefore does not adjust *continuously* to income shocks. Regression 3 shows that these instruments predictably perform well, because policy remains highly significant. Conditional upon the Sachs-Warner index being genuinely exogenous, the result appears to vindicate the assumption maintained in Burnside and Dollar (1997) that the policy variable is indeed exogenous, since there are no notable differences in the size and significance of coefficient on the negative shock variable compared to the OLS estimate. The other coefficients are also statistically unchanged by instrumentation as indicated by the Hausman test, which is unable to reject the model treating all variables as exogenous in favor of the TSLS model (Chi-squared test statistic is 0.00).

However, the close similarity between the OLS and TSLS model may simply reflect that the correlation coefficient between the instrument, the Sachs-Warner index, and the instrumented policy variable is high (0.78). The key question is whether the Sachs-Warner index should be treated as exogenous. This is a valid question since the index is partly a function of the black market premium, which is arguably endogenous. More fundamentally, Collier and Gunning (1999a) argue that discrete trade policy measures may to all intents and purposes be endogenous to shocks, which therefore puts a further question mark over the validity of treating the Sachs-Warner index as exogenous, even if we ignore the issue of the black market premium. In order to deal with this potential endogeneity problem, we therefore re-estimated the preferred model using the SYS-GMM estimator of Blundell and Bond (1998). By jointly estimating both levels and differenced equations, the SYS-GMM estimator solves the problem of the Nickell bias through an Anderson-Hsiao differencing transformation, while simultaneously finding an efficient solution to the endogeneity problem by using internally generated lagged instruments which exploit all available moment restrictions. In addition to the policy variable, which we treat as endogenous, we also allow for both initial income and the financial development variable to be pre-determined[9]. The SYS-GMM estimator requires a minimum of 5 observations per country, which reduces the sample size from 275 to 234 observations and from 56 to 40 countries. The results are reported in regression 4 and shows that the policy index is still significant. More importantly, the negative shock variable remains significant (5% level). The coefficients on both the policy index and the shock variable are smaller, which perhaps indicates that there is some bias due to endogeneity in the OLS regressions. The Sargan test for the SYS-GMM estimates does not reject that the instruments are optimal for this regression, although there is some evidence of first order serial correlation.

The third and fourth dimensions of robustness, which we examine pertain to the stability of the coefficients over time, and the sensitivity of the coefficients to the inclusion of investment in the growth equation. Regarding stability of coefficients over time, two issues are of importance: First, are the coefficients the same in the first half of the sample period as in the second half? Given that the panel covers the period from 1970-1993, a split in the middle (corresponding to 1981/1982) may be telling because the 1970s was a period of unusually many positive shocks, while the 1980s saw mostly negative shocks. Both periods also saw marked changes in uncertainty. In addition, in the second period many developing countries found themselves unable to borrow on international capital markets due to the debt crisis. It is therefore possible that negative shocks are not a general problem, but one that is specifically attributable to events, which occurred in the 1982-1993 period. The first two regressions in Table 9 report estimates of the preferred model for observations up to and including 1981 (growth epochs 1970-73, 1974-77, 1978-81) and the remaining growth epochs (1982-85, 1986-89, and 1990-1993), respectively. These regressions show that the coefficient on negative shocks for the latter half of the sample is indeed greater than that the coefficient in the earlier period as one would expect, but negative shocks also have a considerable and significant effect on growth in the 1970s, which saw predominantly positive shocks. In other words, the growth implications of negative shocks are clearly neither a decade specific phenomenon, nor a specific ramification of the debt crisis.

[9] Pre-determined variables are variables, whose current values are correlated with past shocks, but not with current and future errors. Valid instruments for pre-determined variables include regressors lagged one period or more. Endogenous variables are variables, whose current values are correlated with past and current errors, but not with future errors. Valid instruments for endogenous variables are regressors lagged two periods or more. In the same vein, exogenous variables are variables which are uncorrelated with any past, current or future errors, and these variables act as their own instruments.

Another interesting endeavor is to change the epoch length. Arguably, four years is a very short epoch length, which means that growth rates may be more reflective of business cycles than of actual underlying long-term growth rates. There is therefore merit in changing the epoch length. But in the context of measuring the effects of discrete shocks identified by dummy variables, there is clearly a limit to how far the epoch length can be extended. As mentioned earlier, the original shock variable is a year specific variable, but in the growth regression where the time dimension is the epoch instead of the year, the shock variable must necessarily be redefined to take the value of unity if a shock occurs within the epoch rather than within a particular year. It follows that as the epoch length is expanded, the likelihood of encountering a shock increases. Hence, in the extreme cases of an infinite number of observations, there will be no time variation in the shock variable at all. While we should therefore not estimate the model on growth rates calculated over the full sample period, shocks are arguably sufficiently rare to enable an enlargement of the epoch length from four to eight years. In this framework, the shock variable is the redefined to take the value of unity if a shock occurs within an eight-year epoch rather than the default four-year period. Regression 3 reports the results of running the regression on eight year rather than four year epochs. The shock coefficient is large, negative and highly significant. This is strong evidence that the effect of shocks on growth is not purely a cyclical effect.

An interesting question is obviously how negative shocks manage to depress growth rates. A possible route is via investment, which is known to be robust determinant of growth (Levine and Renelt (1990)). So far we have assumed that investment is fully determined by policies, which allows us to simply estimate the reduced form empirical growth equation. The validity of this approach is supported by regression 1 in Table 10, which is simply the canonical regression to which we have added the ratio of private investment to GDP as a regressor. The investment data are from Serven (1998). Due to the obvious endogeneity of investment rates and the possible endogeneity of policy, we have estimated the investment augmented growth equations in Table 10 using SYS-GMM. Regression 1 shows that investment is insignificant when the growth equation includes the policy variable. In regression 2, the policy variable is dropped, and the investment equation is now significant at the 10% level. This is not a major improvement over regression 1, but it does suggest that policy has some influence over investment as has been supposed so far. More importantly, negative shocks remain highly significant regardless of whether or not policy and/or investment are included in the regression. This suggests that the main route whereby negative shocks affect growth is neither via a worsening of the policy environment nor via a dramatic reduction in investment. The remaining avenue of adjustment is via 'efficiency'[10]. In this view, output is adjusted downwards in the face of shocks through a reduction in the utilization of existing capacity.

Finally, in regressions 3 and 4, we examine if the relationship between policy and aid established by Burnside and Dollar (1997) is robust to the inclusion of the negative shock term. Burnside and Dollar show that aid has a positive impact on growth in developing countries with good fiscal, monetary, and trade policies, but has little effect in the presence of poor policies. In regression 3, we estimate the preferred model using the full sample of 275 observations, and we find that aid interacted with policy and aid squared interacted with policy are both significant as found by Burnside and Dollar. The significance of the interaction term is, however, attributed by the authors to 5 outliers, wherefore we also ran the negative shock augmented growth model without these five outliers. The result reported in regression 4 is identical to what Burnside and Dollar find, namely that the aid policy variable is still significant, while the interaction term is now no longer significant. Hence, Burnside and Dollar's results are not reversed by the inclusion of negative shocks into their growth model.

This paper aims to evaluate the effects on growth of commodity price uncertainty as well as commodity price shocks, and the preferred specification reported so far is notable for the absence of uncertainty variables among the regressors. This is simply because uncertainty was *never* found to be significant in the growth equation regression. To illustrate this, in Table 11 we report 4 growth regressions, which include different measures of commodity price uncertainty. In regression 1, we measure uncertainty using epoch averages of the conditional variance of commodity prices correcting for the oil shock in the early 1970s. This measure, which was the best performing among the competing specifications, is insignificant. Similar measures, which variously did and did not 'dummy' out the effects of various shocks produced similar effects. In regression 2, we replace the GARCH measure by

[10] Ignoring technical progress.

a simple standard deviation of commodity prices variable, which can be thought of as a measure of commodity price variability rather than uncertainty. This variable is also insignificant. Finally, in regressions 3 and 4 we estimate uncertainty augmented growth equations on different sub-samples of the data by splitting the sample into pre-1982 and post-1981 samples, respectively. This is done in order to evaluate if pooling across the highly unstable 1970s and periods of less instability is the reason for the insignificance of the uncertainty term. In both regressions, however, uncertainty is consistently insignificant as a determinant of growth, while the negative shock variable in all cases remains highly significant. In total, we experimented with nine different uncertainty measures[11], with and without the negative shock variable, but none of these experiments produced robust and significant coefficients in the growth equation.

10. Conclusion

The key contributions to the empirical temporary trade shocks literature have been made by Deaton and Miller (1995) who estimate a VAR extended to include commodity prices in levels, and Collier and Gunning (1999a) who regress annual growth rates of GDP on investment, positive shocks, and various lags and interaction terms within a pooled OLS model. Deaton and Miller (1995) find that international commodity prices strongly affect output, mostly via investment. Collier and Gunning (1999a) likewise find that output initially responds very strongly to shocks, but they reach the conclusion that the long run overall effect of shocks on growth is negative. They argue here and elsewhere (Collier and Gunning (1996)) that adverse policy decisions are to blame.

Our approach has been to estimate the effects on growth of commodity price shocks and uncertainty within an established empirical growth model. This confers certain advantages in that our results are more easily compared to other growth models, including the influential model of Burnside and Dollar (1997). We have thus been able to show that the interaction between policy and aid is robust to the inclusion of variables capturing commodity price movements. More importantly, however, our approach has made three important methodological departures from the contributions

[11] The six measures described in Table 1 plus conditional standard deviation versions of each of the GARCH measures.

by Deaton and Miller (1995) and Collier and Gunning (1999a). Firstly, we have attempted to deal with issues of endogeneity without incurring an excessive loss of efficiency. Our methodology therefore strikes a balance between these two papers by correcting for the potential bias in the Collier-Gunning paper by employing a methodology, which takes explicit account of endogeneity issues, while also maximizing efficiency by not estimating fully unrestricted equations.

Secondly, we have defined our dependent variable to better enable an assessment of the longer-term implications of temporary trade shocks. While we do not claim to be able to discriminate between cyclical and long run growth rate effects, the present analysis does go further towards this goal by using four and eight year epoch growth rates as the dependent variable, since epoch averages are more likely to erase purely cyclical effects.

Thirdly, we have not imposed any priors on how commodity price movements affect growth. Instead, we have compared and contrasted a range of competing shock and uncertainty specifications, which include but are not confined to the variables used in other contributions. Thus, we both allow for the possibility of non-linearity in the effect of commodity prices on growth, and for asymmetrical effects of positive and negative shocks on growth. By testing for the best performing among competing specifications, we have arguably been able to obtain more efficient and less biased estimates of the effects of shocks.

A key contribution of this paper is to offer a resolution to the disagreement over the long run effect of positive shocks on growth. We find that positive shocks have no long run impact on growth. This result confirms that windfalls from trade shocks do not translate into sustainable increases in income as suggested by Collier and Gunning (1999a). The result is also supportive of Deaton and Miller (1995) who find evidence of positive effect on income in the short run, but no evidence of negative effects. The result, however, overturns the finding of Collier and Gunning that the long run effect of positive shocks in negative.

Why might positive commodity shocks not translate systematically into higher growth rates? Collier and Gunning (1996) attribute this to five key policy errors on the part of governments. First, they sometimes fail to save windfalls. Secondly, even when they save early on they then fail to lock into the savings decision, proceeding to spend the windfall rapidly. Thirdly, windfall spending typically results in large expenditures on capital projects undertaken while the boom is still in progress. Since domestic prices are high at such times, the efficiency of public investment projects is reduced. Fourthly, windfall is often channeled into low return projects for political rather than economic reasons. Finally, governments often end up with widened fiscal deficits after the end of the shock (Schuknecht (1996)), which must be financed by extracting taxes from the private sector after the boom ends.

The second key contribution is to show that negative shocks have large, highly significant and negative effects on growth as suggested by Rodrik (1998). An interesting difference from Rodrik's work is that Rodrik's shock variable loses significance when indicators of latent social conflict are introduced. In contrast, our negative shock variable remains highly significant at the introduction of such indicators (institutional quality, ethnolinguistic fractionalization and assassinations). The implication of this is clear: With greater attention paid to how shocks are modeled, it can be shown that negative shocks precipitate growth collapses regardless of whether a country is socially divided or has weak institutions. Hence, institutions may not matter as much as Rodrik's results suggest. Indeed, the insignificance of Rodrik's shock variable may have more to do with not distinguishing between large and small shocks than with the inclusion of social conflict variables into his regression.

The negative shock effect is also robust to the inclusion of investment in the growth regression. This indicates that economies adjust to negative shocks by lowering capacity utilization rather than by disinvesting. This interpretation is consistent with the observation that investment decisions in developing countries are irreversible (Collier and Gunning (1999b)).

By modeling shocks and uncertainty simultaneously, it is possible to determine whether growth is affected by *ex post* shocks, *ex ante* uncertainty, or indeed by both these manifestations of commodity price movements. To the extent that both matter, of course, this approach also avoids omitted variable bias. The third key result, however, is that commodity price uncertainty does not affect growth. This finding holds for various different specifications of the uncertainty variable and across different sample periods. Commodity price uncertainty remains insignificant regardless of whether we include or exclude *ex post* shocks in the regression specification. This is a surprising result, because uncertainty is often put forward as an important determinant of investment, and therefore growth.

Our results are highly robust. In particular, we have showed that negative shocks affect growth across different samples of countries, across different growth epochs, and across different lengths of growth epochs. The results also hold when we consider different specifications of the growth model, and when we include additional regressors, such as aid and uncertainty. Our preferred model is robust to the inclusion of country and time dummies and to estimation using TSLS and SYS-GMM methods, which take full account of endogeneity.

Table 1: Uncertainty and Variability Measures

No.	Nature of uncertainty variable	Description	Predictable element in 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**	*(0.16)*
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: 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)*

<u>Key:</u>

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 4

Growth regression results

Dependent variable: Growth of real per capita GDP
White heteroskedasticity consistent standard errors in (*italics*)
("***", "**", and "*" denote significance at 1%, 5%, and 10% respectively)

No.	1	2	3	4
Model	*Pooled OLS Canonical model*	*Pooled OLS with commodity prices in levels*	*Pooled OLS with 1st difference of commodity prices*	*Pooled OLS with positive and negative shock dummies*
Initial income (lnIY)	-0.65	-0.67	-0.70	-0.58
	(0.53)	*(0.52)*	*(0.52)*	*(0.53)*
Ethnolinguistic fractionalisation (ethnf)	-0.58	-0.60	-0.58	-0.59
	(0.74)	*(0.73)*	*(0.74)*	*(0.74)*
Assassinations (ASSAS)	-0.44	-0.42	-0.40	-0.41
	(0.27)	*(0.27)*	*(0.27)*	*(0.27)*
Ethnolinguistic fractionalisation x Assasinations (ethnas)	0.81 *	0.78 *	0.74 *	0.73
	(0.45)	*(0.45)*	*(0.45)*	*(0.46)*
Institutional quality (ICRGE)	0.64 ***	0.64 ***	0.65 ***	0.59 ***
	(0.18)	*(0.18)*	*(0.17)*	*(0.18)*
M2/GDP (M21)	0.01	0.01	0.01	0.01
	(0.01)	*(0.01)*	*(0.01)*	*(0.01)*
Sub-Saharan Africa dummy (SSA)	-1.53 **	-1.51 **	-1.58 **	-1.47 **
	(0.73)	*(0.72)*	*(0.71)*	*(0.74)*
East Asian dummy (EASIA)	0.89	0.90	0.90	0.78
	(0.55)	*(0.55)*	*(0.55)*	*(0.54)*
Policy (policy)	1.00 ***	1.00 ***	0.97 ***	1.03 ***
	(0.15)	*(0.14)*	*(0.15)*	*(0.15)*
Log(Commodity prices) (ldmav)		-0.56		
		(0.60)		
1st Difference of Log(Commodity prices) (dldmav)			13.03	
			(10.66)	
Large positive shock dummy (pos)				0.55
				(0.51)
Large negative shock dummy (neg)				-1.04 **
				(0.49)
Epoch dummy (ed3)	-0.01	0.13	-0.02	-0.07
	(0.59)	*(0.60)*	*(0.59)*	*(0.60)*
Epoch dummy (ed4)	-1.35 **	-1.19 *	-1.24 **	-1.32 **
	(0.65)	*(0.62)*	*(0.67)*	*(0.65)*
Epoch dummy (ed5)	-3.37 ***	-3.23 ***	-3.20 ***	-3.26 ***
	(0.59)	*(0.59)*	*(0.63)*	*(0.60)*
Epoch dummy (ed6)	-1.96 ***	-1.96 ***	-1.71 ***	-1.37 ***
	(0.53)	*(0.53)*	*(0.56)*	*(0.56)*
Epoch dummy (ed7)	-2.31 ***	-2.39 ***	-2.07 ***	-2.04 ***
	(0.62)	*(0.63)*	*(0.66)*	*(0.64)*
Constant	3.76	3.94	4.07	3.30
	(3.80)	*(3.75)*	*(3.72)*	*(3.82)*
No. countries	56	56	56	56
No. observations	275	275	275	275
F(regression)	18.29 ***	17.27 ***	17.49 ***	16.24 ***
R squared	0.39	0.39	0.40	0.40

Table 5

Growth regression results

Dependent variable: Growth of real per capita GDP
White heteroskedasticity consistent standard errors in (*italics*)
('***', '**', and '*' denote significance at 1%, 5%, and 10% respectively)

No.	1	2	3	4	5
Model	***Pooled OLS w. positive and negative price changes***	***Pooled OLS w. positive, small negative price changes, and shocks***	***Regression 2 with level interaction terms***	***Pooled OLS with negative price changes, negative shock dummy, and interaction term***	***Pooled OLS preferred specification***
Initial income (iniY)	-0.63	-0.41	-0.38	-0.42	-0.44
	(0.50)	*(0.52)*	*(0.52)*	*(0.54)*	*(0.54)*
Ethnolinguistic fractionalisation (ethnf)	-0.51	-0.28	-0.31	-0.27	-0.30
	(0.74)	*(0.73)*	*(0.74)*	*(0.74)*	*(0.73)*
Assassinations (ASSAS)	-0.37	-0.38	-0.39	-0.38	-0.37
	(0.27)	*(0.27)*	*(0.27)*	*(0 27)*	*(0.27)*
Ethnolinguistic fractionalisation x Assasinations (ethnas)	0.69	0.62	0.63	0.62	0.62
	(0.44)	*(0.47)*	*(0.47)*	*(0.47)*	*(0.47)*
Institutional quality (ICRGE)	0.64 ***	0.59 ***	0.58 ***	0.59 ***	0.59 ***
	(0.17)	*(0.17)*	*(0 17)*	*(0.18)*	*(0.18)*
M2/GDP (M21)	0.01	0.02	0.02	0.02	0.02
	(0.01)	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*
Sub-Saharan Africa dummy (SSA)	-1.54 **	-1.42 **	-1.42 **	-1.42 *	-1.44 **
	(0.71)	*(0.70)*	*(0.70)*	*(0 72)*	*(0.72)*
East Asian dummy (EASIA)	0.84	0.77	0.78	0.80	0.78
	(0.56)	*(0.55)*	*(0.55)*	*(0.54)*	*(0.54)*
Policy (policy)	0.98 ***	1.02 ***	1.02 ***	1.02 ***	1.02 ***
	(0.15)	*(0.15)*	*(0.15)*	*(0.15)*	*(0.15)*
Negative commodity price changes (dldmN)	-30.44 **	2.72	-3.58	6.39	
	(14.34)	*(17.62)*	*(24.94)*	*(17.60)*	
Positive commodity price changes (dldmP)	-4.99	-3.51	-3.38		
	(22.95)	*(22.74)*	*(22.80)*		
Neg. shock/com. price change interacton (negdldmN)		-65.90 ***	-72.15 **	-76.17 **	-62.46 ***
		(21.40)	*(29.50)*	*(30 70)*	*(17.05)*
Neg. price change/level interaction (negDNldm)			19.35		
			(58.96)		
Shock/Neg. price change/level interaction (negDNldm)			55.75		
			(98.57)		
Negative shock dummy (neg)				0.33	
				(0.69)	
Epoch dummy (ed3)	0.30	0.27	0.24	0.20	0.24
	(0.59)	*(0.58)*	*(0.59)*	*(0.61)*	*(0 59)*
Epoch dummy (ed4)	-1.19 *	-1.30 *	-1.38 **	-1.32 *	-1.28 *
	(0.66)	*(0.66)*	*(0.67)*	*(0.67)*	*(0.66)*
Epoch dummy (ed5)	-3.26 ***	-3.43 ***	-3.43 ***	-3.43 ***	-3.39 ***
	(0.63)	*(0.63)*	*(0.63)*	*(0.60)*	*(0.59)*
Epoch dummy (ed6)	-1.60 ***	-1.42 ***	-1.31 **	-1.51 ***	-1.40 ***
	(0.54)	*(0.53)*	*(0.54)*	*(0.56)*	*(0 52)*
Epoch dummy (ed7)	-2.09 ***	-2.39 ***	-2.30 ***	-2.43 ***	-2.33 ***
	(0.66)	*(0.66)*	*(0.72)*	*(0.66)*	*(0.61)*
Constant	3.70	2.08	1.86	2.02	2.24
	(3.64)	*(3.74)*	*(3.75)*	*(3.88)*	*(3.85)*
No. countries	56	56	56	56	56
No. observations	275	275	275	275	275
F(regression)	16.64 ***	16.26 ***	14.38 ***	15.52 ***	17 82 ***
R squared	0.40	0.41	0.42	0.41	0.41

Table 6

Growth elasticities of negative shocks

		Mean of variables		Coefficient and standard deviation		Elasticity evaluated at:			
	Obs	*Growth*	*Negative changes in commodity prices*	*Beta*	*Sigma (Beta)*	*Mean*	*Mean - 1*sigma*	*Mean + 1*sigma*	*Mean + 2*sigma*
Shock changes	31	1.173	0.025	-62.463	0.014	-1.345	-0.580	-2.111	-2.876
All changes	171	1.173	0.014	-62.463	0.012	-0.763	-0.134	-1.393	-2.022
Non-shock changes	140	1.173	0.012	-62.463	0.010	-0.634	-0.119	-1.150	-1.665

Table 7

Growth regression results

Dependent variable: Growth of real per capita GDP
White heteroskedasticity consistent standard errors in (*italics*).
("***", "**", and "*" denote significance at 1%, 5%, and 10% respectively)

No.	1		2		3		4	
Model	*Pooled OLS preferred specification (omitting 5 Burnside Dollar outliers)*		*Pooled OLS preferred specification (omitting oil producers)*		*Pooled OLS preferred specification (omitting oil producers and middle income countries)*		*Pooled OLS preferred specification (SSA only)*	
Initial income (inlY)	-0.46		-0.58		-0.31		0.50	
	(0.54)		*(0.48)*		*(0.87)*		*(1.40)*	
Ethnolinguistic fractionalisation (ethnf)	-0.30		-0.52		-0.97		2.11	
	(0.74)		*(0.76)*		*(0.91)*		*(1.96)*	
Assassinations (ASSAS)	-0.37		-0.44		-0.76		9.86	
	(0.27)		*(0.29)*		*(0.52)*		*(7.59)*	
Ethnolinguistic fractionalisation x Assasinations (ethnas)	0.62		0.82	*	1.19		-16.34	
	(0.47)		*(0.48)*		*(0.93)*		*(12.83)*	
Institutional quality (ICRGE)	0.62	***	0.84	***	0.96	***	0.62	
	(0.18)		*(0.17)*		*(0.21)*		*(0.43)*	
M2/GDP (M21)	0.01		0.02		0.03		0.04	
	(0.01)		*(0.01)*		*(0.02)*		*(0.05)*	
Sub-Saharan Africa dummy (SSA)	-1.40	*	-2.01	***	-2.04	***		
	(0.73)		*(0.60)*		*(0.71)*			
East Asian dummy (EASIA)	0.74		0.03		-0.18			
	(0.56)		*(0.59)*		*(0.71)*			
Policy (policy)	1.03	***	1.06	***	1.12	***	1.06	**
	(0.16)		*(0.15)*		*(0.21)*		*(0.43)*	
Neg. shock/com. price change interacton (negdldmN)	-65.75	***	-53.04	***	-40.72	*	-64.44	
	(17.16)		*(17.31)*		*(24.40)*		*(42.37)*	
Epoch dummy (ed3)	0.27		0.15		0.46		-0.27	
	(0.59)		*(0.55)*		*(0.67)*		*(1.55)*	
Epoch dummy (ed4)	-1.26	*	-0.70		-0.54		-2.36	
	(0.65)		*(0.64)*		*(0.81)*		*(1.69)*	
Epoch dummy (ed5)	-3.36	***	-3.00	***	-2.26	***	-4.07	***
	(0.59)		*(0.62)*		*(0.79)*		*(1.30)*	
Epoch dummy (ed6)	-1.20	**	-1.05	**	-1.00		-1.95	
	(0.52)		*(0.52)*		*(0.65)*		*(1.28)*	
Epoch dummy (ed7)	-2.28	***	-2.40	***	-2.70	***	-4.49	***
	(0.63)		*(0.62)*		*(0.79)*		*(1.45)*	
Constant	2.34		2.03		-0.58		-7.25	
	(3.89)		*(3.51)*		*(6.19)*		*(9.32)*	
No. countries	56		47		35		21	
No. observations	275		230		166		84	
F(regression)	16.76	***	16.41	***	12.43	***	2.78	***
R squared	0.41		0.47		0.48		0.26	

Table 8

Growth regression results

Dependent variable: Growth of real per capita GDP
White heteroskedasticity consistent standard errors in (*italics*)
('***', '**', and '*' denote significance at 1%, 5%, and 10% respectively)

No.	1	2	3	4
Model	*Pooled OLS preferred specification (Random effects model)*	*Pooled OLS w. positive, small negative price changes, and shocks*	*TSLS (instrumenting for policy)*	*SYS-GMM (instrumenting for policy)*
Initial income (iniY)	-0.45	-2.36 **	-0.44	-3.99 ***
	(0.37)	*(1.04)*	*(0.54)*	*(1.51)*
Ethnolinguistic fractionalisation (ethnf)	-0.30		-0.30	-2.33
	(0.81)		*(0.73)*	*(1.50)*
Assassinations (ASSAS)	-0.38	-0.61	-0.37	-0.40
	(0.30)	*(0.38)*	*(0.28)*	*(0.28)*
Ethnolinguistic fractionalisation x Assasinations (ethnas)	0.63	1.10	0.63	0.80 *
	(0.62)	*(0.78)*	*(0.47)*	*(0.44)*
Institutional quality (ICRGE)	0.60 ***		0.59 ***	1.32 ***
	(0.18)		*(0.18)*	*(0.49)*
M2/GDP (M21)	0.02	0.01	0.02	0.01
	(0.02)	*(0.03)*	*(0.01)*	*(0.02)*
Sub-Saharan Africa dummy (SSA)	-1.45 **		-1.43 *	-3.86 **
	(0.63)		*(0.73)*	*(1.68)*
East Asian dummy (EASIA)	0.78		0.73	1.14
	(0.69)		*(0.61)*	*(1.00)*
Policy (policy)	1.01 ***	0.85 ***	1.05 ***	0.73 **
	(0.17)	*(0.21)*	*(0.22)*	*(0.32)*
Neg. shock/com. price change interacton (negdldmN)	-62.26 ***	-54.51 **	-62.59 ***	-37.14 **
	(20.27)	*(21.24)*	*(17.14)*	*(18.92)*
Epoch dummy (ed3)	0.24	0.44	0.25	0.52
	(0.61)	*(0.62)*	*(0.59)*	*(0.55)*
Epoch dummy (ed4)	-1.28 **	-1.01	-1.28 *	-0.77
	(0.61)	*(0.65)*	*(0.65)*	*(0.75)*
Epoch dummy (ed5)	-3.39 ***	-3.12 ***	-3.38 ***	-3.08 ***
	(0.62)	*(0.67)*	*(0.59)*	*(0.70)*
Epoch dummy (ed6)	-1.40 **	-1.31 *	-1.40 ***	-1.41 **
	(0.66)	*(0.72)*	*(0.52)*	*(0.63)*
Epoch dummy (ed7)	-2.34 ***	-1.98 **	-2.36 ***	-1.68 **
	(0.68)	*(0.76)*	*(0.65)*	*(0.77)*
Constant	2.29	19.01 **	2.21	27.45 ***
	(2.69)	*(7.62)*	*(3.86)*	*(10.03)*
No. countries	56	56	56	40
No. observations	275	275	275	194
F/Wald Chi2	178.39 ***	16.26 ***	15.53 ***	113.03 ***
R squared (overall)	0.41	0.11	0.41	
R squared (within)	0.28	0.30		
R squared (between)	0.58	0.01		
Hausman(RE vs.FE)	5.71			
F test for country specific effects		1.25		
Hausman(FE vs. OLS)		10.50		
Hausman(TSLS vs. OLS)			0.00	
F test for time dummies				31.75 ***
Test for 1st order serial correlation				-2.41 **
Test for 2nd order serial correlation				1.16
Sargan test for instrument optimality				39.59
Instruments for policy			SACW*iniY	First and greater lags of iniY
			SACW*iniY^2	First and greater lags of M21
			SACW*LPOP	Second and greater lags of policy

Table 9

Growth regression results

Dependent variable: Growth of real per capita GDP
White heteroskedasticity consistent standard errors in *(italics)*
('***', '**', and '*' denote significance at 1%, 5%, and 10% respectively)

No.	1	2	3
Model	*Pooled OLS preferred specification (1970-1981)*	*Pooled OLS preferred specification (1982-1993)*	*Pooled OLS with 8 year epochs*
Initial income (iniY)	-0.46	-0.33	-0.10
	(0.88)	*(0.62)*	*(0.68)*
Ethnolinguistic fractionalisation (ethnf)	-0.27	-0.20	-0.02
	(1.11)	*(1.01)*	*(0.88)*
Assassinations (ASSAS)	-0.88	0.10	-0.22
	(0.59)	*(0.22)*	*(0.30)*
Ethnolinguistic fractionalisation x Assasinations (ethnas)	1.51	-0.09	0.15
	(0.93)	*(0.63)*	*(0.57)*
Institutional quality (ICRGE)	0.69 ***	0.50 **	0.47 **
	(0.26)	*(0.24)*	*(0.20)*
M2/GDP (M21)	0.00	0.02	0.02
	(0.03)	*(0.02)*	*(0.01)*
Sub-Saharan Africa dummy (SSA)	-1.66	-1.23	-1.10
	(1.19)	*(0.78)*	*(0.82)*
East Asian dummy (EASIA)	0.06	1.69 *	0.65
	(0.84)	*(0.86)*	*(0.62)*
Policy (policy)	0.93 **	1.00 ***	1.12 ***
	(0.40)	*(0.16)*	*(0.17)*
Neg. shock/com. price change interacton (negdldmN)	-52.25 **	-82.30 ***	-95.75 ***
	(22.95)	*(25.83)*	*(28.44)*
Epoch dummy (ed3)	0.29		
	(0.60)		
Epoch dummy (ed4)	-1.19 *		
	(0.67)		
Epoch dummy (ed5)			
Epoch dummy (ed6)		2.15 ***	
		(0.61)	
Epoch dummy (ed7)		0.90	
		(0.63)	
Constant	2.55	-1.96	0.08
	(6.26)	*(4.54)*	*(4.68)*
8 year epoch dummy (v81)			-2.56 ***
			(0.58)
8 year epoch dummy (v82)			-1.93 ***
			(0.49)
No. countries	50	52	56
No. observations	136	139	149
F	7.56 ***	13.75 ***	16.80 ***
R squared (overall)	0.28	0.50	0.46

Table 10

Growth regression results

Dependent variable: Growth of real per capita GDP
White heteroskedasticity consistent standard errors in (*italics*)
("***", "**", and "*" denote significance at 1%, 5%, and 10% respectively)

No.	1	2	3	4
Model	SYS-GMM preferred specification with investment	SYS-GMM preferred specification with investment and without policy	Pooled OLS with aid and policy interaction terms (full sample)	Pooled OLS with aid and policy interaction terms (without outliers)
Initial income (iniY)	-4.20 ***	-4.32 ***	-0.39	-0.44
	(1.20)	*(1.23)*	*(0.59)*	*(0.59)*
Ethnolinguistic fractionalisation (ethnf)	-2.15	-2.15	-0.18	-0.19
	(1.55)	*(1.71)*	*(0.75)*	*(0.74)*
Assassinations (ASSAS)	-0.33	-0.27	-0.37	-0.37
	(0.25)	*(0.23)*	*(0.27)*	*(0.27)*
Ethnolinguistic fractionalisation x Assasinations (ethnas)	0.71 *	0.57	0.61	0.60
	(0.39)	*(0.38)*	*(0.48)*	*(0.48)*
Institutional quality (ICRGE)	1.17 ***	1.31 ***	0.62 ***	0.64 ***
	(0.36)	*(0.37)*	*(0.18)*	*(0.18)*
M2/GDP (M21)	0.00	0.00	0.02	0.01
	(0.02)	*(0.03)*	*(0.01)*	*(0.01)*
Sub-Saharan Africa dummy (SSA)	-3.63 ***	-3.82 ***	-1.67 **	-1.67 **
	(1.20)	*(1.24)*	*(0.77)*	*(0.79)*
East Asian dummy (EASIA)	0.13	1.11	1.03 *	1.13 *
	(1.18)	*(1.16)*	*(0.59)*	*(0.59)*
Policy (policy)	0.66 **		0.84 ***	0.77 ***
	(0.29)		*(0.20)*	*(0.20)*
Neg. shock/com. price change interacton (negdldmN)	-37.14 **	-36.09 **	-61.94 ***	-62.10 ***
	(17.12)	*(18.05)*	*(17.14)*	*(17.10)*
Investment/GDP (I/Y)	0.14	0.15 *		
	(0.09)	*(0.09)*		
Aid/GDP (EDA)			0.03	-0.06
			(0.13)	*(0.16)*
Aid/GDP x Policy (edapolA)			0.18 *	0.17 **
			(0.10)	*(0.07)*
(Aid/GDP)^2 x Policy (eda2polA)			-0.02 **	
	(0.66)	*(0.70)*	*(0.01)*	
Epoch dummy (ed3)	0.25	0.13	0.23	0.24
	(0.53)	*(0.55)*	*(0.59)*	*(0.59)*
Epoch dummy (ed4)	-0.93	-1.00	-1.32 **	-1.31 **
	(0.69)	*(0.67)*	*(0.66)*	*(0.66)*
Epoch dummy (ed5)	-2.95 ***	-3.24 ***	-3.47 ***	-3.45 ***
	(0.66)	*(0.70)*	*(0.60)*	*(0.60)*
Epoch dummy (ed6)	-1.13 *	-1.11	-1.46 ***	-1.39 ***
	(0.64)	*(0.74)*	*(0.53)*	*(0.52)*
Epoch dummy (ed7)	-1.46 *	-0.92	-2.37 ***	-2.27 ***
	(0.79)	*(0.86)*	*(0.65)*	*(0.65)*
Constant	28.04 ***	28.98 ***	1.68	2.21
	(7.60)	*(7.79)*	*(4.28)*	*(4.28)*
No. countries	40	40	56	56
No. observations	234	234	275	270
R squared			0.42	0.42
Wald Chi2/F	157.35 ***	114.11 ***	16.59 ***	16.50 ***
Wald test for time dummies	29.32 ***	35.56 ***		
Test for 1st order serial correlation	-2.90 ***	-2.71 ***		
Test for 2nd order serial correlation	1.02	0.65		
Sargan test for instrument optimality	40.84	40.79		
Instruments	First and greater lags of iniY First and greater lags of M21	First and greater lags of iniY First and greater lags of M21		

Table 11

Growth regression results

Dependent variable: Growth of real per capita GDP
White heteroskedasticity consistent standard errors in *(italics)*
("***", "**", and "*" denote significance at 1%, 5%, and 10% respectively)

No.	1	2	3	4
Model	*Pooled OLS preferred specification w. GARCH uncertainty*	*Pooled OLS preferred specification w. commodity price variability*	*Pooled OLS preferred specification w. GARCH uncertainty (1970-1981)*	*Pooled OLS preferred specification w. GARCH uncertainty (1982-1993)*
Initial income (lnlY)	-0.48	-0.45	-0.46	-0.46
	(0.55)	*(0.53)*	*(0.88)*	*(0.65)*
Ethnolinguistic fractionalisation (ethnf)	-0.31	-0.33	-0.27	-0.26
	(0.73)	*(0.74)*	*(1.11)*	*(1.02)*
Assassinations (ASSAS)	-0.37	-0.36	-0.88	0.10
	(0.28)	*(0.28)*	*(0.59)*	*(0.23)*
Ethnolinguistic fractionalisation x Assasinations (etl nas)	0.62	0.60	1.51	-0.06
	(0.47)	*(0.47)*	*(0.93)*	*(0.63)*
Institutional quality (ICRGE)	0.61 ***	0.58 ***	0.69 ***	0.55 **
	(0.18)	*(0.18)*	*(0.26)*	*(0.24)*
M2/GDP (M21)	0.02	0.02	0.00	0.02
	(0.01)	*(0.01)*	*(0.03)*	*(0.02)*
Sub-Saharan Africa dummy (SSA)	-1.48 **	-1.39 *	-1.67	-1.41 *
	(0.74)	*(0.72)*	*(1.20)*	*(0.78)*
East Asian dummy (EASIA)	0.82	0.76	0.06	1.76 **
	(0.54)	*(0.54)*	*(0.84)*	*(0.86)*
Policy (policy)	1.01 ***	1.02 ***	0.93 **	0.99 ***
	(0.15)	*(0.14)*	*(0.40)*	*(0.16)*
Neg. shock/com. price change interacton (negdldmtl)	-65.03 ***	-60.46 ***	-52.30 **	-94.00 ***
	(16.95)	*(17.34)*	*(22.99)*	*(24.40)*
GARCH conditional variance (gar70)	11.34		0.72	28.62
	(19.39)		*(27.04)*	*(25.35)*
Commodity price variability (std)		-2.70		
		(3.55)		
Epoch dummy (ed3)	0.20	0.43	0.28	
	(0.61)	*(0.67)*	*(0.63)*	
Epoch dummy (ed4)	-1.33 **	-1.18 *	-1.19 *	
	(0.66)	*(0.64)*	*(0.68)*	
Epoch dummy (ed5)	-3.40 ***	-3.40 ***		
	(0.59)	*(0.59)*		
Epoch dummy (ed6)	-1.44 ***	-1.33 **		2.12 ***
	(0.53)	*(0.53)*		*(0.62)*
Epoch dummy (ed7)	-2.39 ***	-2.33 ***		0.80
	(0.62)	*(0.61)*		*(0.64)*
Constant	2.45	2.63	2.55	-1.19
	(3.92)	*(3.89)*	*(6.30)*	*(4.76)*
No. countries	56	56	50	52
No. observations	275	275	136	139
F(regression)	17.27 ***	16.51 ***	6.93 ***	14.05 ***
R squared	0.41	0.41	0.28	0.50

Appendix: Data Sources and Coverage

Shocks were identified using an annual index, while uncertainty was estimated using quarterly indices. Both indices have identical composition, use similar weights, and therefore differ only in terms of their frequency. It was necessary to use high frequency quarterly data to obtain convergence for the GARCH models used to estimate uncertainty, while discrete shocks are arguably better thought of as annual events.

The indices are have constant 1990 base year weights, wherefore they do not cope well with shifts in the structure of trade. In particular, the indices do not capture resource discoveries and other quantity shocks after the base period. Nor do they capture temporary volume shocks except for those, which 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, indices will understate income effects of a given price change. The data set covers 113 countries of which 44 are Sub-Saharan African countries, 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. Table A1 provides basic descriptive statistics on each country's structure of trade and regional affiliation.

Each individual country's commodity price index is constructed using international commodity price indices for 57 commodities. 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 Organization (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 include notably prices of 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.

The complete quarterly data set covers the period from 1957Q1 to 1997Q4, producing a total of 18,532 observations[12]. Unfortunately, it was not possible to obtain *IFS* data starting in 1957Q1 for all commodities, but since identical sample length is an important consideration when measuring uncertainty, 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:

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

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 then used to 'backcast' the missing observations. This method was applied 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 a 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). These gaps are all very short and were filled by linear interpolation.

[12] 113 countries times 164 observations per country.

The biases introduced by filling early gaps in the data using annual data and holding real prices constant are unlikely to be very large for the following reasons. First, the GARCH based uncertainty measure allows the uncertainty to vary with time, so biases early on 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 number of affected observations are only 332 out of a total sample of 9348 observations[13], thus affecting only 3.46% of the observations.

The annual data used to locate discrete shocks also covers the period 1957-1997. Data availability was better than for the quarterly series. However, for a few commodities there were missing observations in first part of the series. These included Coal (1957-1966), Hardwood (1957), Superphosphates (1957-62), and Tobacco (1957-1967). The missing values for these commodities were generated by holding real prices constant at the value of the first available observation. Gold prices were unavailable for the period 1957-1962, and its nominal price was therefore held constant for this period. Finally, Palm kernel prices for 1957-1959 were generated as annual averages of the quarterly observations obtained by the regression with Palm Oil described above.

The data on export values used in constructing the weighting item are exports *(fob)* in current US$ in 1990. It was not possible to obtain quarterly weights so annual 1990 weights were also used for the base year in the quarterly indices; this also avoids biases arising from any seasonal effects affecting output. 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. Effort was made to select a new base year as close to 1990 as possible. The cases with different base year weights are: 1994 (Aluminum, 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

[13] 57 commodities times 164 observations per commodity.

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 a complete set of the exported commodities. In deciding whether to drop or retain a commodity, the cost in terms of lost observations from including an additional commodity was balanced somewhat informally against the possible gain in terms of a more representative index. To ensure consistency and to minimize 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 was lower than the number of observations on all the other commodities included in the index (i.e. the commodity 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. But Uruguay and South Africa produce this commodity in moderate amounts (5 and 10% of sampled commodity exports, respectively). So while the omission of this commodity is unlikely to affect most indices it may have a minor impact on the indices for these two countries.

The quarterly and annual indices for each the countries were deflated by the same deflator; namely 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 Quaterly Bulletin of Cocoa Statistics)

References

1. **Abel, A. B., and Eberly, J. C.** (1994): 'A Unified Model of Investment Under Uncertainty', *American Economic Review,* **84**(5), pp. 1369-1384.
2. **Aizenman, J., and Marion, N.** (1993): 'Policy Uncertainty, Persistence and Growth', *Review of International Economics,* **1**(2), pp. 146-163.
3. **Barro, R. J.** (1991): 'Economic Growth in a Cross Section of Countries', *Quarterly Journal of Economics,* **106**(2), pp. 407-443.
4. **Benzion, U., Rapoport, A., and Yagil, J.** (1989): 'Discount Rates Inferred from Decisions: An Experimental Study', *Management Science,* **35**(March), pp. 270-284.
5. **Bevan, D., Collier, P., and Gunning, J. W.** (1990): *Controlled Open Economies: A Neo-Classical Approach to Structuralism,* Oxford (Clarendon Paperbacks).
6. **Bleaney, M., and Greenaway, D.** (1993): 'Adjustment to External Imbalance and Investment Slumps in Developing Countries', *European Economic Review,* **37**, pp. 577-585.
7. **Blundell, R., and Bond, S.** (1998): 'Initial Conditions and Moment Restrictions in Dynamic Panel Data Models', *Journal of Econometrics,* **87**, pp. 115-143.
8. **Bollerslev, T.** (1986): 'Generalised Autoregressive Conditional Heteroskedasticity', *Journal of Econometrics,* **31**, pp. 307-327.
9. **Burnside, C., and Dollar, D.** (1997): 'Aid, Policies, and Growth', *World Bank Policy Research Working Paper* (1777).
10. **Caballero, R. J.** (1991): 'On the Sign of the Investment-Uncertainty Relationship', *American Economic Review,* **81**(1), pp. 279-288.
11. **Caballero, R. J., and Pindyck, R. S.** (1996): 'Uncertainty, Investment, and Industry Evolution', *NBER Working Paper Series* (4160).
12. **Caselli, F., Esquivel, G., and Lefort, F.** (1996): 'Reopening the Convergence Debate: A New Look at Cross-Country Growth Empirics', *Journal of Economic Growth,* **1**, pp. 363-389.
13. **Cashin, P., Liang, H., and McDermott, C. J.** (1999): 'How Persistent are Shocks to World Commodity Prices?', *IMF Working Paper* (80).
14. **Cashin, P., McDermott, C. J., and Scott, A.** (1999): 'The Myth of Comoving Commodity Prices', *IMF Working Paper* (169).
15. **Collier, P., and Gunning, J. W.** (1996): 'Policy Towards Commodity Shocks in Developing Countries', *IMF Working Paper* (84).
16. **Collier, P., and Gunning, J. W.** (1999a): 'Chapter 1: Trade Shocks: Theory and Evidence' in *Trade Shocks in Developing Countries,* Collier, P., Gunning, J. W. and Associates (Eds.), Oxford (Oxford University Press) pp. 1-72.
17. **Collier, P., and Gunning, J. W.** (1999b): 'Explaining African Economic Performance', *Journal of Economic Literature,* **37**(March), pp. 64-111.
18. **Collier, P., Gunning, J. W., and Associates** (Eds.) (1999): *Trade shocks in Developing Countries* , Oxford (Oxford University Press).
19. **Collier, P., and Pattillo, C.** (Eds.) (2000): *Chapter 1: Investment and Risk in Africa* , New York (MacMillan Press).
20. **Deaton, A.** (1991): 'Saving and Liquidity Constraints', *Econometrica,* **59**(5), pp. 1221-1248.
21. **Deaton, A.** (1999): 'Commodity Prices and Growth in Africa', *Journal of Economic Perspectives,* **13**(3), pp. 23-40.

22. **Deaton, A., and Laroque, G.** (1992): 'On the Behaviour of Commodity Prices', *Review of Economic Studies,* **59**, pp. 1-23.
23. **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).
24. **Dixit, A. K., and Pindyck, R. S.** (1994): *Investment Under Uncertainty,* Chichester (Princeton University Press).
25. **Easterly, W., Kremer, M., Pritchett, L., and Summers, L. H.** (1993): 'Good Policy Or Good Luck? Country Growth Performance and Temporary Shocks', *Journal of Monetary Economics,* **32**, pp. 459-483.
26. **Easterly, W., and Levine, R.** (1997): 'Africa's Growth Tragedy: Policies and Ethnic Divisions', *Thomas Jefferson Centre Discussion Paper* (284).
27. **Erb, G. F., and Schiavo-Campo, S.** (1969): 'Export Instability, Level of Development, and Economic Size of Less Developed Countries', *Bulletin Oxford University Institute of Economics and Statistics,* **131**, pp. 263-283.
28. **Glezakos, C.** (1973): 'Export Instability and Economic Growth: A Statistical Verification', *Economic Development and Structural Change,* **21**(4), pp. 670-678.
29. **Grier, K. B., and Tullock, G.** (1989): 'An Empirical Analysis of Cross-National Economic Growth, 1951-80', *Journal of Monetary Economics,* **24**, pp. 259-276.
30. **Guillaumont, P., and Chauvet, L.** (1999): 'Aid and Performance: A Reassessment', *mimeo (CERDI)* .
31. **Guillaumont, P., Guillaumont Jeanneney, S., and Brun, J.-F.** (1999): 'How Instability Lowers African Growth', *Journal of African Economies,* **8**(1), pp. 87-107.
32. **Gyimah-Brempong, K., and Traynor, T. L.** (1999): 'Political Instability, Investment and Economic Growth in Sub-Saharan Africa', *Journal of African Economies,* **8**(1), pp. 52-86.
33. **Hadjimichael, M. T., Ghura, D., Muhleisen, M., Nord, R., and Ucer, E. M.** (1995): 'Sub-Saharan Africa: Growth, Savings and Investment, 1986-93', *IMF Occasional Paper* (118).
34. **Hansen, H., and Tarp, F.** (1999a): 'Aid Effectiveness Disputed', *mimeo (University of Copenhagen)* .
35. **Hansen, H., and Tarp, F.** (1999b): 'The Effectiveness of Foreign Aid', *mimeo (University of Copenhagen)* .
36. **Hartman, R.** (1972): 'The Effects of Price and Cost Uncertainty on Investment', *Journal of Economic Theory,* **5**, pp. 258-266.
37. **Hatsopoulos, G. N., Krugman, P. R., and Poterba, J. M.** (1989): 'Overconsumption: The Challenge to US Economic Policy', paper presented at *American Business Conference* .
38. **Hoeffler, A. E.** (1999): 'The Augmented Solow Model and the African Growth Debate', paper presented at *Centre for the Study of African Economies 10 Year Anniversary Conference* (Oxford University).
39. **Holcomb, J. H., and Nelson, P. S.** (1989): 'An Experimental Investigation of Individual Time Preference', *Unpublished working paper* .
40. **Horowitz, J. K.** (1988): 'Discounting Money Pay-Offs: An Experimental Analysis', *Department of Agricultural and Resource Economics (University of Maryland) Working Paper* (43).

41. **Ishikawa, T., and Ueda, K.** (1984): 'The Bonus Payment System and Japanese Personal Savings' in *The Economic Analysis of the Japanese Firm,* Aoki, M. (Ed.) Amsterdam (North Holland) .
42. **Islam, N.** (1995): 'Growth Empirics: A Panel Data Approach', *Quarterly Journal of Economics,* **110**(4), pp. 1127-1179.
43. **King, R. G., and Levine, R.** (1993): 'Finance, Entrepreneurship, and Growth', *Journal of Monetary Economics,* **32**, pp. 523-542.
44. **Knack, S., and Keefer, P.** (1995): 'Institutions and Economic Performance: Cross-Country Tests Using Alternative Institutional Measures', *Economics and Politics,* **7**(3), pp. 207-227.
45. **Knudsen, O., and Parnes, A.** (1975): *Trade Instability and Economic Development*, Lexington (Lexington Books).
46. **Kormendi, R. C., and Meguire, P. G.** (1985): 'Macroeconomic Determinants of Growth: Cross-Country Evidence', *Journal of Monetary Economics,* **16**, pp. 141-163.
47. **Landsberger, M.** (1966): 'Windfall Income and Consumption: Comment', *American Economic Review,* **56**(3), pp. 534-540.
48. **Lensink, R., and Morrissey, O.** (1999): 'Uncertainty of Aid Inflows and the Aid-Growth Relationship', *CREDIT Research Paper* (3).
49. **Lensink, R., and White, H.** (2000): 'Aid Allocation, Poverty Reduction and the 'Assessing Aid' Report', *Journal of International Development,* **12**, pp. 1-13.
50. **Leon, J., and Soto, R.** (1995): 'Structural Breaks and Long Run Trends in Commodity Prices', *World Bank Policy Research Working Paper* (1406).
51. **Levine, R., and Renelt, D.** (1990): 'A Sensitivity Analysis of Cross-Country Growth Regressions', *American Economic Review,* **82**(4), pp. 942-963.
52. **Levine, R., and Zervos, S.** (1993): 'Looking at the Facts: What We Know About Policy and Growth From Cross-Country Analysis', *World Bank Policy Research Working Paper* (1115).
53. **Love, J.** (1989): 'Export Earnings Instability: The Decline Reversed?', *Journal of Development Studies,* **25**(2), pp. 183-191.
54. **Lutz, M.** (1994): 'The Effects of Volatility in the Terms of Trade on Output Growth: New Evidence', *World Development,* **22**(12), pp. 1959-1975.
55. **MacBean, A. L.** (1966): *Export Instability and Economic Development*, London (George Allen & Unwin Ltd.).
56. **Mankiw, N. G., Romer, D., and Weil, D. N.** (1992): 'A Contribution to the Empirics of Economic Growth', *Quarterly Journal of Economics,* **107**(2), pp. 407-437.
57. **Papanek, G. F.** (1972): 'The Effect of Aid and Other Resource Transfers on Savings and Growth in Less Developed Countries', *Economic Journal,* **82**(327), pp. 935-950.
58. **Pindyck, R., and Rotemberg, J. J.** (1990): 'The Excess Co-Movement of Commodity Prices', *Economic Journal,* **100**(403), pp. 1173-1189.
59. **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.
60. **Rodrik, D.** (1998): 'Where Did All the Growth Go? External Shocks, Social Conflict, and Growth Collapses', *NBER Working Paper Series* (6350).

61. **Schuknecht, L.** (1996): 'Fiscal Policies, Natural Resource Rents, and Rent Seeking', paper presented at *Annual Meeting of the European Public Choice Society* (Israel).
62. **Schuknecht, L.** (1997): 'Tying Governments' Hands in Commodity Taxation', paper presented at *Centre for the Study of African Economies 10 Year Anniversary Conference* (Oxford University).
63. **Serven, L.** (1998): 'Macroeconomic Uncertainty and Private Investment in LDCs: An Empirical Investigation', *mimeo* (World Bank).
64. **Sims, C. A.** (1980): 'Macroeconomics and Reality', *Econometrica,* **48**(1), pp. 1-48.
65. **Summers, L., and Carroll, C.** (1987): 'Why is the US Savings Rate So Low?', *Brookings Papers on Economic Activity,* (3), pp. 607-635.
66. **Temple, J.** (1999): 'The New Growth Evidence', *Journal of Economic Literature,* **37**(March), pp. 112-156.
67. **Thaler, R. H.** (1981): 'An Economic Theory of Self-Control', *Journal of Political Economy,* **89**(2), pp. 392-410.
68. **Thaler, R. H.** (1990): 'Anomalies: Saving, Fungibility, and Mental Accounts', *Journal of Economic Perspectives,* **4**(1), pp. 193-205.
69. **Yotopoulos, P. A., and Nugent, J. B.** (1976): *Economics of Development: An Empirical Investigation*, Singapore (Harper and Row).
70. **Zeira, J.** (1987): 'Investment As Search Process', *Journal of Political Economy,* **95**(1), pp. 204-210.

Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS2429	Corruption, Composition of Capital Flows, and Currency Crises	Shang-Jin Wei	August 2000	H. Sladovich 37698
WPS2430	Financial Structure and Bank Profitability	Asli Demirgüç-Kunt Harry Huizinga	August 2000	K. Labrie 31001
WPS2431	Inside the Crisis: An Empirical Analysis of Banking Systems in Distress	Asli Demirgüç-Kunt Enrica Detragiache Poonam Gupta	August 2000	K. Labrie 31001
WPS2432	Funding Growth in Bank-Based and Market-Based Financial Systems: Evidence from Firm-Level Data	Asli Demirgüç-Kunt Vojislav Maksimovic	August 2000	K. Labrie 31001
WPS2433	External Interventions and the Duration of Civil Wars	Ibrahim A. Elbadawi Nicholas Sambanis	September 2000	H. Sladovich 37698
WPS2434	Socioeconomic Inequalities in Child Malnutrition in the Developing World	Adam Wagstaff Naoko Watanabe	September 2000	A. Maranon 38009
WPS2435	The Evolution of Poverty during the Crisis in Indonesia, 1996–99	Asep Suryahadi Sudarno Sumarto Yusuf Suharso Lant Pritchett	September 2000	P. Sader 33902
WPS2436	Safety Nets and Safety Ropes: Who Benefited from Two Indonesian Crisis Programs—the "Poor" or the "Shocked?"	Sudarno Sumarto Asep Suryahadi Lant Pritchett	September 2000	P. Sader 33902
WPS2437	Quantifying Vulnerability to Poverty: A Proposed Measure, Applied to Indonesia	Lant Pritchett Asep Suryahadi Sudarno Sumarto	September 2000	P. Sader 33902
WPS2438	Measurements of Poverty in Indonesia: 1996, 1999, and Beyond	Menno Pradhan Asep Suryahadi Sudarno Sumarto Lant Pritchett	September 2000	P. Sader 33902
WPS2439	State-Community Synergies in Development: Laying the Basis for Collective Action	Monica Das Gupta Helene Grandvoinnet Mattia Romani	September 2000	M. Das Gupta 31983
WPS2440	Lessons from Uganda on Strategies to Fight Poverty	John Mackinnon Ritva Reinikka	September 2000	H. Sladovich 37698
WPS2441	Controlling the Fiscal Costs of Banking Crises	Patrick Honohan Daniela Klingebiel	September 2000	A. Yaptenco 38526

Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS2442	A Firms's-Eye View of Policy and Fiscal Reforms in Cameroon	Bernard Gauthier Isidro Soloaga James Tybout	September 2000	L. Tabada 36896
WPS2443	The Politics of Economic Policy Reform in Developing Countries	Richard H. Adams Jr.	September 2000	M. Coleridge-Taylor 33704
WPS2444	Seize the State, Seize the Day: State Capture, Corruption, and Influence in Transition	Joel S. Hellman Geraint Jones Daniel Kaufmann	September 2000	D. Billups 35818
WPS2445	Subsidies in Chilean Public Utilities	Pablo Serra	September 2000	G. Chenet-Smith 36370
WPS2446	Forecasting the Demand for Privatized Transport: What Economic Regulators Should Know, and Why	Lourdes Trujillo Emile Quinet Antonio Estache	September 2000	G. Chenet-Smith 36370
WPS2447	Attrition in Longitudinal Household Survey Data: Some Tests for Three Developing-Country Samples	Harold Alderman Jere R. Behrman Hans-Peter Kohler John A. Maluccio Susan Cotts Watkins	September 2000	P. Sader 33902
WPS2448	On "Good" Politicians and "Bad" Policies: Social Cohesion, Institutions, and Growth	Jo Ritzen William Easterly Michael Woolcock	September 2000	A. Kibutu 34047
WPS2449	Pricing Irrigation Water: A Literature Survey	Robert C. Johansson	September 2000	M. Williams 87297
WPS2450	Which Firms Do Foreigners Buy? Evidence from the Republic of Korea	Caroline Freund Simeon Djankov	September 2000	R. Vo 33722
WPS2451	Can There Be Growth with Equity? An Initial Assessment of Land Reform in South Africa	Klaus Deininger Julian May	September 2000	33766
WPS2452	Trends in Private Sector Development in World Bank Education Projects	Shobhana Sosale	September 2000	S. Sosale 36490
WPS2453	Designing Financial Safety Nets to Fit Country Circumstances	Edward J. Kane	September 2000	K. Labrie 31001
WPS2454	Political Cycles in a Developing Economy: Effect of Elections in Indian States	Stuti Khemani	September 2000	H. Sladovich 37698