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**Working Paper**

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## Abstract

Computable general equilibrium models are used to study the short-run impact of fluctuating primary commodity prices on the economies of Colombia, Ivory Coast and Kenya. The results indicate that these economies are destabilized by primary commodity price fluctuations unless governments act to hold real domestic absorption constant. To achieve this, however, would require foreign exchange reserves in excess of the level normally available to these governments for the purpose of stabilising domestic economic activity.

# The Short run Impact of Fluctuating Primary Commodity Prices on Three Developing Economies: Colombia, Ivory Coast and Kenya*

## 1. Introduction

A feature of the economic structure of many developing countries is their heavy reliance for foreign exchange earnings on primary commodities whose world prices exhibit a marked degree of instability. The extent to which fluctuations in such prices and hence export revenues has contributed to instability at the macro level in these countries has been the subject of numerous investigations. A review of the literature in this area reveals an interesting evolution in the type of analytical technique considered appropriate for such studies. Using international cross-section analysis Coppock (1962) and Mac Bean (1966) found no statistically significant relationship between the average level of instability of a country's export earnings and its gross national product. As pointed out by Maizels (1968) however the international cross-sectional approach is somewhat inadequate because it implicitly assumes the existence of a unique relationship between export earnings and income so that all observed points fall on a single curve. This assumption is unlikely to hold given the considerable differences in economic structures exhibited by developing countries. Thus if the impact of export instability on aggregate income varies from country to country a cross country regression may reveal no relationship even if a strong relationship between the two

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variables is present on a country basis.

Mac Bean's study also provides, together with later studies by Maizels (1968), Massell et al (1972) and Lim (1974), examples of the use of country-specific time series analysis to investigate the export instability - national income link. While the Mac Bean study, from a simple non-parametric comparison of deviations from trend for both national income and export earnings in 11 developing countries, concluded that national income instability and export earnings instability were not related, Maizels (1968) performed country regression analyses with Mac Bean's data and found the opposite to hold. The Massell and Lim studies also reported a statistically significant positive relationship between export earnings and national income instability.

Both the international cross-sectional and country-specific time series studies amount to little more than casual empiricism between variables and contribute nothing to an understanding of underlying causal mechanisms. Furthermore, implicit in the restriction of explanatory variables to one is the assumption that export earnings instability is postulated to be the sole contributor to national income instability. In recognition of this fact Rangarajan and Sundararajan (1976) adopted a country modelling approach which aimed to isolate the contribution to national income instability made by export earnings instability from that attributable to other factors. They constructed small econometric

models for 11 developing and two developed countries to explain the behaviour of macroeconomic aggregates such as consumption, investment, imports and gross national product. They concluded, from comparisons of simulated income streams under actual changes in export proceeds with those under constant rate changes in export proceeds, that a reduction in export instability leads to a reduction in income instability.

Although the country modelling approach of Rangarajan and Sundararajan represents a considerable improvement on the earlier mentioned regression analyses their use of a model which distinguishes only macro aggregates precluded them from obtaining insights into the sectoral and economywide effects of instability originating in individual commodity markets. The recent country studies by Adams et al (1979) (coffee and Brazil) Priovolos (1981) (coffee and the Ivory Coast) and Nziramasanga and Obidegwu (1981) (copper and Zambia) have overcome this shortcoming to some extent by studying the effects of export instability within the context of econometric models in which the relevant primary commodity sectors and their links with the rest of the economy are explicitly recognized. These studies were able to demonstrate the consequences for various macro variables of changes in export prices and quantities of the above mentioned primary commodities. While the Adams et al study did not tackle the issue of export instability on national income growth the Priovolos and Nziramasanga and Obidegwu studies concluded that fluctuations in commodity export prices (coffee for Ivory Coast and copper for Zambia) did not necessarily have a negative

impact on growth and development in the respective economies.

The present study bears some similarities to the three last mentioned studies in that it provides evidence of the effects of commodity price instability on economic activity in selected developing countries (Colombia, Ivory Coast, Kenya) using a country model framework with sectoral detail. Each of these countries is a prominent producer and exporter of coffee. Colombian coffee exports represent about 12 per cent of world coffee trade (mid 1970's). The figure for Ivory Coast is 5 per cent. Ivory Coast in addition is an important cocoa exporting country (exports representing about 16 per cent of world trade) while Kenya is prominent in its exports of tea. It is on the instability of world coffee, cocoa and tea prices and their consequent effects on macroeconomic and sectoral activity in these three countries that we concentrate our analysis.

Our study however differs in three important respects from the Adams et al, Priovolos and Nziramasanga and Obidegwu studies.

(i) It employs a comparative static framework of the Johansen type rather than a time-series approach. This framework provides for each economy an integrated description of production possibilities (which depend on resource availabilities and production technologies) and demand conditions (which depend on consumer preferences, the distribution of income across consumers and world trade prospects). The models are constructed around input-output (IO) systems of accounts and have the ability to endogenise both

commodity and factor prices and quantities within an equilibrium process. Our choice of an IO framework provides for a considerably more convincing incorporation of the linkages between industries, commodities and primary factors within the domestic economy and between the domestic economy and overseas than that afforded by an econometric approach where degrees of freedom and time series data limitations severely curtail the extent to which intersectoral linkages can be incorporated.[1]

(ii) Its focus is on the short run (1-2 years) adjustment pressures imposed on sectors and the macroeconomy from world commodity price fluctuations. In our view it is inappropriate to tackle the issue of the longer term consequences for economic growth of export instability unless the effects of uncertainty associated with export instability on the behaviour of key economic agents - producers, consumers, governments - are captured.[2] In common with

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[1] The IO accounting system underlying each country model allows for (a) the incorporation of industrial production structure in terms of the intensities in industry costs of the various classes of inputs distinguished (domestic commodities, competing import commodities, non-competing imports, primary factors) and (b) the incorporation of demand side linkages in terms of the disposition of domestically produced and imported commodities to intermediate usage for current production and for capital creation and to other demand categories such as households, government and exports.

[2] For example Knudsen und Parnes (1975) have argued that with fluctuating incomes consumers save more to protect themselves from unforseen income shortfalls. Hence investment could be raised and growth stimulated. On the other hand unstable receipts could induce risk averse behaviour of primary commodity producers leading to a reduction in their output. Furthermore, if the government wished to avoid a fluctuating national income growth path it might have to increase its stock of foreign reserves to finance short run balance of payments shortages. Lim (1976) has argued that these latter effects could lead to diminished growth.

all the previous mentioned studies which failed to satisfactorily do this[3] our analytical framework does not explicitly recognize such behavioural changes hence the restriction of our focus to the short run.[4] Time series models which purport to tackle this issue in the absence of an explicit modelling of such factors are capturing nothing more than the cumulative effects of lagged adjustment mechanisms, many of which are incorporated only for the rather mechanical purpose of improving the explanatory power of the estimating equations.

(iii) It recognizes that the economy-wide and sectoral effects of export instability depend on the economic environment in which the exogenous shock (in this case the fluctuation in export prices) takes place. We therefore generate and compare results assuming several alternative macroeconmic policy objectives being pursued by the authorities. This enables some insights to be gained into the relative merits of alternative strategies available to the authorities to counteract the effects of export instability.

The remainder of the paper is organized as follows: Section 2 describes some key structural features of the economies under study. Section 3 contains a short description of the analytical framework and specifies the main assumptions underlying the simulations. Section 4 presents the results. Section 5 assesses the foreign exchange reserves needed by the countries to withstand some likely price shocks. Conclusions are contained in Section 6.

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[3] Priovolos (1981) did try to estimate the longer term effects of instability on imports, investment, consumption and inventories for the Ivory Coast but obtained ambiguous results.

[4] See Mayer (1982) for an explicit treatment of these long run phenomena for Colombia.

## 2. Key Structural Features of the Three Economies

Table 1 summarises some key structural characteristics of the three countries. A number of these, in particular export links to primary commodities and openness to trade, are important in explaining the different adjustment pressures arising from commodity export price instability. Based on 1977 data, Ivory Coast and Colombia have about the same GDP per capita. Kenya's GDP per capita is only about 38 per cent of that for Colombia and Ivory Coast. Kenya and the Ivory Coast are extremely open economies with trade representing 25 per cent (Kenya) and 37 per cent (Ivory Coast) of their GDP's. Colombia on the other hand has a trade share of GDP of only 15 per cent. Next we see that for the three countries, primary production represents around one third of GDP with coffee, cocoa and tea constituting a prominent part of this production. The distribution of each economy's aggregate factor returns (which follows from the industrial production pattern and industry factor intensities) is relatively more towards labour for Kenya and the Ivory Coast than for Colombia.

Turning to the commodity trade pattern we see that primary products dominate the exports of Colombia (58 per cent), followed by the Ivory Coast (49 per cent) and Kenya (32 per cent). The commodities coffee, cocoa and tea represent 40 per cent of Colombian, 20 per cent of Ivory Coast and 25 per cent of Kenyan exports. Manufactures (including textiles) represent 73 per cent of total imports for Colombia and about 60 per cent for Ivory Coast and Kenya, respectively.

## 3. Analytical Framework

We have constructed for each country a multisectoral general

Table 1 Some Structural Features of the Economies of Colombia, Ivory Coast and Kenya[a]

| Variable | Colombia | Ivory Coast | Kenya |
|---|---|---|---|
| Gross domestic product (GDP) per capita ($US)[b] | 760 | 770 | 290 |
| Trade as a percentage of gross domestic product | 14.7 | 36.8 | 24.8 |
| Primary Factor Intensity | | | |
| Wage share of value added | 0.46 | 0.64 | 0.60 |
| Fixed capital share of value added | 0.43 | 0.30 | 0.29 |
| Land share of value added | 0.11 | 0.06 | 0.11 |
| Industrial Structure of the GDP | | | |
| Share of GDP accounted for by; | | | |
| coffee, cocoa and tea | 0.06[d] | 0.08[e] | 0.08[f] |
| Other primary production | 0.26 | 0.26 | 0.29 |
| Food Processing | 0.12 | 0.05 | 0.07 |
| Textiles | 0.04 | 0.04 | 0.02 |
| Other manufacturing | 0.16 | 0.08 | 0.10 |
| Services | 0.36 | 0.49 | 0.44 |
| Commodity Composition of Exports | | | |
| Percentage accounted for by; | | | |
| Coffee, cocoa and tea | 40.4[d] | 19.6[e] | 25.2[f] |
| Other primary commodities | 17.9 | 29.4 | 7.0 |
| Processed foods | 6.9 | 10.2 | 7.4 |
| Textiles | 8.7 | 7.8 | 1.8 |
| Other manufactures | 12.9 | 7.9 | 22.1 |
| Other[c] | 13.2 | 25.1 | 36.5 |
| Commodity Composition of Imports | | | |
| Percentage accounted for by; | | | |
| Non-competing imports | 0.0 | 3.8 | 21.0 |
| Other primary commodities | 7.9 | 7.8 | 3.1 |
| Processed foods | 4.9 | 14.7 | 3.8 |
| Textiles | 2.2 | 7.6 | 6.3 |
| Other manufactures | 70.9 | 53.7 | 52.6 |
| Other | 14.1 | 12.4 | 13.2 |

a) Unless otherwise indicated, figures are obtained from the input-output (IO) tables underlying the base year data which refers to years in the mid 1970's,1973 (Colombia, Ivory Coast), 1976 (Kenya).

b) Refers to 1977. See World Bank(1980a)

c) Includes trade margins on commodity exports.

d) Represents coffee.

e) Consists of coffee (5 per cent of GDP and 12.5 per cent of exports) and cocoa (3 per cent of GDP and 7.1 per cent of exports).

f) Consists of coffee ( 6 per cent of GDP and 18.8 per cent of exports) and tea ( 2 per cent of GDP and 6.4 per cent of exports).

equilibrium model. While each country model conforms to the same basic design the equation system has sufficient flexibility to accomodate the relevant country specific structural and institutional features. The choice of a unique model design ensures that variations in response across countries to similar exogenous shocks can be attributed unambiguously to specific features of each country rather than to differences in model specification.

The design of the model system is simple and orthodox being firmly based in conventional microeconomic theory. It emphasises the role of prices and substitution prospects in explaining trade flows and the composition of domestic economic activity. The model system follows closely that developed by Dixon et al (1982). We consider a detailed presentation to be outside the scope of the present paper[5]. Instead, we first discuss the main behavioural postulates underlying the structural equation system. We then present a brief stylised version at the macro level. While this version abstracts from the large amount of sectoral detail captured in each model it nevertheless serves as a useful vehicle for illustrating the alternative model closures which we use in section 4 to capture differences in the macroeconomic environment in which the exogenous shock is assumed to occur.

The essential postulates governing producer and consumer behaviour are as follows. Producers are assumed to minimise

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[5]Vincent (1981) contains a complete list of the general system of country model equations written in explicit functional form. The description of the construction of the data base and specification of model parameters for two countries is contained in Mayer (1982) (Colombia) and Dick (1981) (Ivory Coast). A description for Kenya is available from the authors.

the cost of producing a given activity level subject to CRTS production functions of a three level or nested form. At the first level we have the Leontief assumption of no substitution between competing commodity categories or between them and an aggregate of the primary factors and non-competing imports. At the second level we have CES functions describing substitution possibilities between imported and domestic goods of the same type. At this level we also have CRESH[6] functions describing substitution between the primary factors, aggregate labour capital and land. At the third level we have CRESH functions describing substitution prospects between labour occupations within the aggregate labour category. The average household is assumed to maximise its utility from a consumption bundle of commodity input categories subject to CES functions describing substitution prospects in consumption between domestically produced and imported sources of the commodity category and to an aggregate budget constraint.

The solution to these types of constrained optimisation problems yields a system of commodity demand equations (domestic commodities, competing imports) for current production, capital creation and household consumption and a system of factor demand equations (land, labour, capital). The former contain parameters reflecting the elasticity of substitution between domestic and imported sources for the various end uses together with expenditure and cross-price elasticities in consumption. The latter contain parameters representing the pairwise substitution elasticities between factors in each industry.

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[6] See Hanoch (1971).

Government demands for commodities are simply linked to aggregate domestic consumption. Commodity export demands are a function of shifts in the world demand curve facing a particular commodity together with the world export price. The latter is included to allow for the fact that commodity exports from several of the countries under study are a sufficiently large share of world trade in these commodities to give such countries terms of trade power. They contain as parameters the respective foreign export demand elasticities.

A feature of the Ivory Coast and Kenyan models is their incorporation of multicommodity output functions in agricultural industries. For example technical conditions in the modern agriculture sector of the Ivory Coast are such that producers can alter their output mix between cocoa, coffee and other products according to relative product price changes. The ensuing system of commodity supply equations is derived assuming that producers in these industries choose their output mix to maximise their revenue subject to CRETH[7] functions describing transformation prospects between products. The extent of transformation for given relative product price changes is captured by a set of pairwise product-product transformation elasticities.

Competitive pricing behaviour is imposed by equations relating prices to costs for each of the activities current

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7 CRETH in product space is the analog of CRESH in input space. See Vincent, Dixon and Powell (1980).

production, capital creation, importing and exporting. A system of market clearing relationships equates demands with supplies for domestic commodities,occupational labour,fixed capital and land. Finally there is a group of miscellaneous equations which (a) describe capital accumulation, rates of return and investment allocation across industries, (b) aggregate variables (for example aggregating occupational labour demands to the workforce level), (c) allow for various indexing relationships (for example the linking of macro aggregates such as real consumption and real investment) and (d) define useful summary variables (for example the GDP).

3.1 Solving the Models

The technique pioneered by Johansen (1960) is used. Equations are first converted to linear form by logarithmic differentiation. Since the number of exogenous variables (m) exceeds the number of equations (n) the system is closed by assigning values to n-m variables. Projections for the m endogenous variables are then obtained by simple matrix methods.[3]

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[3] Alternatively a non-linear solution algorithm could be applied to the structural equations before differentiation. Such a method has the advantage of being free from the so-called linearisation errors associated with Johansen's method. However, its cost is a severe reduction in the flexibility of operation of the model particularly with respect to the different model closures that can be imposed. Our preference for the linear method is enhanced by the recent work by Dixon et al (1982) which indicates that the linearisation errors in this type of model, even for fairly large changes in exogenous variables, are small.

## 3.2 Alternative Model Closures

In section 4 we report results from two experiments incorporating different model closures i.e. different assignments of model variables between m and n. To illustrate the macroeconomic environments described by these closures we consider the following stylized version of the model system at the macro level.

| | | |
|---|---|---|
| Output | $Y = Y(F_1, F_2, F_3)$ | (1) |
| Factor marginal products | $dY/dF_i = r_i/P \quad i = 1,2,3$ | (2)-(4) |
| Income | $Y = ABS + B$ | (5) |
| Trade balance | $B = P^eX - P^mM$ | (6) |
| Imports | $M = (ABS, P^m/P)$ | (7) |
| Exports | $X = X(P^e/P)$ | (8) |
| Numeraire | $P = 1$ | (9) |

In (1), which describes the economy's aggregate production function, Y is real output and $F_i$ are aggregate factor inputs i = 1 (labour), i = 2 capital and i = 3 (land). Competitive cost minimising behaviour by producers implies (2)-(4) in which the marginal product of factor i ($dY/dF_i$) is equated with its real factor price ($r_i$ is factor i's money price and P the price of output). In (5), which describes the real national income identity, ABS denotes real domestic absorption (aggregate real consumption, investment and government expenditure) and B the balance of trade. B is defined in (6) as the difference between the foreign currency value of exports ($P^eX$) and imports ($P^mM$). Commodity import demands (M) are depicted in (7) as a function of the size of the domestic market (ABS) and the domestic price level relative to the world price of imported goods. Equation (8) specifies export demands while (9) serves as the

numeraire of the system.[9]

To close the above system of 9 equations in 14 variables requires the exogenous setting of 5 variables. The closures in the simulations reported later differ only according to the treatment of ABS and B. In terms of the stylized system $F_2$ (capital) and $F_3$ (land) are exogenous in all closures reported emphasising the short run nature of the adjustment horizon. Hence rates of return to capital ($r_2$) and rents on land ($r_3$) are determined endogenously. Next the money price of labour ($r_1$) is set exogenously with employment demand ($F_1$) being endogenous. This reflects the short run slack labour market with employers being able to absorb as much labour as they wish at the given money wage. The closure in simulation 1 is completed by setting ABS exogenously and allowing B to be endogenous. Underlying this is the idea that the short run level of domestic absorption can be maintained (by a set of government policies not modelled in this system) in the face of an exogenous shock such as fluctuations in world commodity prices.

In simulation 2 aggregate real absorption is determined endogenously by imposing a balance of trade constraint such that foreign currency export receipts must equal foreign currency import expenditures, i.e. B = 0. The composition of this absorption, between aggregate consumption, investment and

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[9] In practice any money price variable can serve as the numeraire. In the simulations reported later we use the money exchange rate as the numeraire. Thus the models endogenise the ratio of the domestic cost level to the foreign currency price of traded goods (the real exchange rate). They have nothing however to say about how the projected movements in this ratio are partitioned into changes in the money exchange rate on the one hand and changes in the domestic rate of inflation on the other.

government expenditure, is assumed fixed. That is, each country must undertake equiproportional changes in its domestic absorption components to achieve balanced trade in the face of the exogenous shock.

## 3.3 Some Likely Response Patterns

Before presenting the results it is useful to foreshadow some likely response patterns under the two types of model closure. We do this in the context of an increase in agricultural commodity export prices. Output effects on the respective producing sectors follow from the export-led output expansion in response to a favourable shift in the price received for the industry's output relative to its domestic production costs. Output growth in the commodity producing sector in turn increases the input demands of that sector. The extent to which these demands are met by domestic or overseas suppliers and hence the implications for the output response of the domestic supplying industries depends on the extent of relative price induced substitution between domestic and imported sources of supply. This in turn is governed by the size of the relevant model substitution parameters and the extent to which the initial shock brings about a change in the economy's domestic price level relative to overseas prices. It is this latter relative price change which is fundamental in determining the international competitiveness and hence the domestic output response of all traded (export oriented and import competing) industries.

In the face of a sudden increase in export prices, the government could pursue a range of adjustment strategies. At one end of the range would be a policy which aimed entirely for domestic expenditure stability. That is, the foreign account would simply

be allowed to accumulate while domestic fiscal and monetary policies would be designed to keep domestic absorption constant (Simulation 1). We would expect (in the absence of strong linkages between the exporting sectors enjoying the world price increases and other domestic sectors) under such policy that the adjustment pressures would be confined largely to the commodity producing sector. At the other end of the range could be a policy of stabilisation of the foreign account by endogenous adjustment of domestic expenditure (Simulation 2). This involves a shift of resources from traded to the more domestically oriented sectors. The price adjustment mechanism underlying this resource shift is in fact a revaluation of the real exchange rate sufficient to bring about the required increase in the price of non-traded relative to traded goods. In such a situation we would expect the adjustment pressures to be spread more evenly over sectors in the domestic economy.

## 4. Results

We consider here only commodity export price fluctuations as the source of fluctuations in export earnings. This is not to imply that we regard output and hence export fluctuations due to for example adverse growing conditions as an unimportant source of export revenue instability. Their exclusion from the present analysis is purely to keep the results to a manageable size.[10]

In what follows we simulate the effects of a hypothetical

[10] Within our model framework such supply side aspects of export revenue instability are simulated simply by exogenous shifts in the outputs of the respective commodities.

10 per cent increase in the "real" world prices of coffee, cocoa and tea[11] on the level and composition of economic activity in each country. Our results should be seen as a set of elasticities of endogenous variables with respect to a 10 per cent increase in the respective commodity prices rather than as capturing actual price movements over a particular time period. They therefore facilitate a cross-country comparison of the sensitivity of endogenous variables in each country to world commodity price shocks of equivalent amounts. Since the models are linear in the percentage changes of the variables the resultant elasticities can be scaled appropriately to correspond to the price shocks which actually occurred. In this regard we note that by multiplying all results by minus one yields the effects on endogenous variables of a 10 per cent decline in world prices for the commodities of our focus.

We present projections for some selected macroeconomic and sectoral variables. It is important to emphasise that our results are in fact projections and not forecasts. They refer solely to the effects of the exogenous change in world commodity prices on endogenous variables given the specified macroeconomic environment and assuming that values for all other exogenous variables are held constant. For example the figure in row 3 column 1 of table 2 indicates that after an adjustment period long enough for the effects of the price shock to work its way through the economy, aggregate labour demand in Colombia would be 0.39 per cent higher than it would have been at the same point in time had no change in world commodity prices occurred.[12]

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[11] By this we mean that prices for coffee, cocoa and tea increase by 10 per cent relative to all other world commodity prices.

[12] The exact calendar time interpretation of this period is somewhat vague. We postulate a period of 1-2 years as being sufficient to accomodate the necessary adjustments.

## 4.1 Simulation 1 (Stabilisation of Domestic Absorption)

Table 2 contains projections for key macro variables and table 3 for industry outputs and commodity exports and imports. The pattern of response at both the macro and micro levels is much the same for all countries. With fixed aggregate absorption the increased commodity prices lead to a surplus of export earnings over import expenditures and hence to an increase in real GDP (0.7 per cent (Colombia), 1.1 per cent (Ivory Coast) and 1.3 per cent (Kenya)). This necessitates an increased aggregate labour demand (employment) at the constant money wage ranging from 0.4 per cent (Colombia) to 1.3 per cent (Ivory Coast) and 2.3 per cent (Kenya). The increase in the balance of trade makes a large contribution to foreign exchange reserves in all countries. The domestic price level, as measured by the index of consumer prices, shows very little change.[13]

From table 3 we see that with real domestic absorption assumed fixed the output effects of the commodity price increases are confined essentially to the relevant producing sectors in each economy. These sectors have few forward and backward linkages to other domestic sectors. For example domestic intermediate input purchases represent only 15 per cent of total costs for the Colombian coffee sector, 10 per cent for the modern agricultural sector of the Ivory Coast and 11 per cent for the modern agricultural sector of Kenya. Furthermore, since the competitive position of

[13] Note that for Kenya the domestic price index declines slightly. The mechanism is through an expansion of the exports of other products produced in competition with tea and coffee in the model's modern agricultural sector. This export expansion brings about in turn a slight lowering of the world and hence domestic price for this commodity category which has a large weight in household consumption and hence the domestic consumer price index.

Table 2 A Comparison of Projections Across Countries for Selected Macro Variables: Simulation 1

(percentage changes)

| Variables | Colombia | Ivory Coast[b] | | Kenya[b] | |
|---|---|---|---|---|---|
| | 10 per cent increase in coffee prices | 10 per cent increase in coffee prices | 10 per cent increase in cocoa prices | 10 per cent increase in coffee prices | 10 per cent increase in tea prices |
| Aggregate Real Absorption | 0 (ex)[c] | 0 (ex)[c] | 0 (ex)[c] | 0 (ex)[c] | 0 (ex)[c] |
| Aggregate Real GDP | 0.66 | 0.77 | 0.35 | 0.99 | 0.34 |
| Aggregate Labour demand | 0.39 | 0.87 | 0.40 | 1.67 | 0.61 |
| Aggregate Exports | 4.49 | 1.98 | 0.88 | 4.03 | 1.38 |
| Aggregate Imports | -0.02 | 0.06 | 0.00 | 0.03 | 0.02 |
| Balance of Trade (per cent of reserve stock)[a] | 13.09 | 19.65 | 9.00 | 13.63 | 4.65 |
| Domestic Consumer Price Index | 0.08 | 0.00 | 0.00 | -0.17 | -0.06 |

[a] Reserve stock represents a three year average centred on the base year of the I-O data.

[b] Note that by adding the projections in the coffee and cocoa columns (Ivory Coast) and in the coffee and tea columns (Kenya) for a particular variable gives the projection of the percentage change in that variable from a 10 per cent increase in both coffee and cocoa (Ivory Coast) and coffee and tea (Kenya) prices.

[c] Denotes exogenous setting to zero.

the traded goods sector in each country (except of course the coffee, cocoa and tea sectors) shows little change, competing imports and exports of commodities other than coffee, cocoa and tea are relatively unaffected.

## 4.3 Simulation 2 (Foreign Account Stability with Balanced Changes in Domestic Absorption)

Macro projections are contained in table 4 and industry output and commodity trade projections in table 5. The initial effect of the higher export prices is to move the balance of trade into

Table 3 Industry Output and Commodity Export and Import Projections: Simulation 1

(percentage changes)

| Variables | Colombia | Ivory Coast | | Kenya | |
|---|---|---|---|---|---|
| | 10 per cent coffee price increase | 10 per cent coffee price increase | 10 per cent cocoa price increase | 10 per cent coffee price increase | 10 per cent tea price increase |
| Output | | | | | |
| 1. Coffee | 3.91 | 6.65 | 0.29 | 6.20 | 0.50 |
| 2. Cocoa | - | 0.47 | 5.14 | - | - |
| 3. Tea | - | - | - | 1.34 | 5.35 |
| 4. Subsistence Agriculture | 0.01 | 0.00 | -0.02 | 0.00 | 0.00 |
| 5. Other Agriculture | | 0.57 | 0.26 | 1.08 | 0.39 |
| 6. Mining | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 |
| 7. Food Processing | -0.01 | -0.02 | -0.34 | 0.31 | -0.09 |
| 8. Textiles | | 0.02 | 0.01 | 0.09 | 0.03 |
| 9. Light Manufacturing | 0.01 | 0.00 | 0.00 | 0.06 | 0.00 |
| 10. Petroleum Products | | | | 0.06 | 0.02 |
| 11. Other Manufacturing | | | | 0.08 | 0.02 |
| 12. Services | 0.02 | 0.02 | 0.00 | 0.04 | 0.00 |
| Selected Exports | | | | | |
| 1. Coffee | 4.67 | 7.27 | 0.31 | 6.72 | 0.54 |
| 2. Cocoa | - | 0.57 | 6.25 | - | - |
| 3. Tea | - | - | - | 1.59 | 6.58 |
| 4. Food Processing | -0.39 | -0.34 | -1.09 | 1.99 | -0.82 |
| 5. Textiles | | -0.01 | 0.00 | 0.30 | 0.08 |
| 6. Other Manufacturing | -0.40 | -0.34 | -0.10 | 0.06 | 0.05 |
| Selected Imports | | | | | |
| 1. Food Processing | 0.08 | 0.01 | 0.04 | -0.28 | 0.13 |
| 2. Textiles | | 0.01 | 0.00 | 0.09 | 0.03 |
| 3. Other Manufacturing | -0.08 | 0.07 | 0.03 | 0.13 | 0.03 |
| 4. Services | 0.09 | 0.05 | 0.00 | 0.06 | 0.02 |

surplus. In order to meet the balance of trade constraint this surplus must be eliminated by an increase in the domestic price level relative to world prices, that is, a revaluation of the

Table 4 A Comparison of Projections Across Countries for Selected Macro Variables: Simulation 2

(percentage changes)

| Variables | Colombia | Ivory Coast | | Kenya | |
|---|---|---|---|---|---|
| | 10 per cent increase in coffee prices | 10 per cent increase in coffee prices | 10 per cent increase in cocoa prices | 10 per cent increase in coffee prices | 10 per cent increase in tea prices |
| Aggregate Real Absorption (real GDP) | 1.07 | 1.40 | 0.64 | 2.19 | 0.75 |
| Aggregate Labour Demand | 1.33 | 1.58 | 0.73 | 3.06 | 1.09 |
| Aggregate Exports[a] | 1.40 | 1.15 | 0.50 | 1.84 | 0.07 |
| Aggregate Imports[a] | 1.40 | 1.15 | 0.50 | 1.84 | 0.07 |
| Balance of Trade | 0(ex)[b] | 0(ex)[b] | 0(ex)[b] | 0(ex)[b] | 0(ex)[b] |
| Domestic Consumer Price Index | 0.60 | 0.16 | 0.08 | 0.30 | 0.10 |

[a] We assume balanced trade in the base period. Hence the percentage change in exports is forced to equal the percentage change in imports to restore each economy to balanced trade.

[b] Denotes exogenous setting to zero.

real exchange rate, sufficient to cause the required redirection of resources from the traded to the more domestically oriented sectors. With money wages assumed fixed the increased productivity of each of the economies implied by the improvement in their terms of trade permits increased employment. The real absorption gains in each country range from 1.1 to 2.9 per cent. The size of these gains reflects essentially the importance of coffee, cocoa and tea exports in the GDP's of the respective countries.

Table 5 Industry Output and Commodity Export and Import Projections: Simulation 2

(percentage changes)

| Variables | Colombia | Ivory Coast | | Kenya | |
|---|---|---|---|---|---|
| | 10 per cent coffee price increase | 10 per cent coffee price increase | 10 per cent cocoa price increase | 10 per cent coffee price increase | 10 per cent tea price increase |
| Output | | | | | |
| 1. Coffee | 3.84 | 6.66 | 0.29 | 6.39 | 0.56 |
| 2. Cocoa | - | 0.47 | 5.15 | - | - |
| 3. Tea | - | - | - | 1.51 | 5.41 |
| 4. Subsistence Agriculture | 0.09 | 0.43 | 0.18 | 1.39 | 0.47 |
| 5. Other Agriculture | | 0.58 | 0.26 | 1.40 | 0.50 |
| 6. Mining | -0.05 | -0.21 | -0.10 | -0.15 | -0.05 |
| 7. Food Processing | 0.22 | 0.07 | -0.30 | 0.47 | -0.04 |
| 8. Textiles | | 0.07 | 0.03 | 1.30 | 0.44 |
| 9. Light Manufacturing | | | | 0.55 | 0.17 |
| 10. Petroleum Products | 0.29 | -0.04 | -0.02 | 0.21 | 0.07 |
| 11. Other Manufacturing | | | | 0.47 | 0.16 |
| 12. Services | 0.98 | 1.01 | 0.46 | 1.70 | 0.57 |
| Selected Exports | | | | | |
| 1. Coffee | 4.42 | 7.15 | 0.26 | 6.74 | 0.55 |
| 2. Cocoa | - | 0.52 | 6.24 | - | - |
| 3. Tea | - | - | - | 1.61 | 6.59 |
| 4. Food Processing | -8.55 | -2.72 | -2.18 | -5.47 | -3.36 |
| 5. Textiles | | -1.70 | -0.77 | -11.51 | -3.95 |
| 6. Other Manufacturing | -10.30 | -5.05 | -2.27 | -7.72 | -2.60 |
| Selected Imports | | | | | |
| 1. Food Processing | 2.12 | 1.64 | 0.79 | 2.03 | 0.92 |
| 2. Textiles | | 1.27 | 0.59 | 3.13 | 1.07 |
| 3. Other Manufacturing | 1.06 | 1.09 | 0.49 | 1.82 | 0.61 |
| 4. Services | 2.30 | 1.39 | 0.62 | 4.53 | 1.54 |

The results in table 5 indicate that in line with the revaluation of the real exchange rate observed in table 4, traded industries (except those producing coffee, tea and cocoa) are confronted with a deterioration in their international competitiveness. Thus (non-agricultural) export industries suffer an export led output decline. Import competing industries, while receiving

a boost to their outputs from the increase in the size of the domestic market they supply, lose market share to imported sources of supply. A prominent gainer in all economies is the services sector whose sales pattern is heavily oriented to the expanding domestic market.

## 5. An Assessment of the Ability of the Countries to Withstand Price Shocks

As the results in section 4 indicate the three countries are faced with a trade-off between alternative stabilisation policies when confronted with fluctuating export prices. At the one extreme they can pursue a policy of constant domestic absorption. Our results indicate that while such a policy successfully isolates the shock to the sectors producing the relevant export commodities large changes in foreign exchange reserves may be involved. At the other extreme they can adjust their domestic absorption to restore balance of trade equilibrium. As we have seen this involves a shift in the industrial structure of the GDP towards domestic oriented sectors at the expense of traded (principally export) sectors in the case of an increase in export prices and the reverse in the case of a decrease in export prices. In the light of the amount of commodity price instability which took place over the 1970-79 period it is of interest to calculate, on the basis of the elasticities in table 2, the size of the foreign exchange reserves such countries would have needed to successfully pursue the domestic absorption stabilisation policy option. In order to do this we first need to establish the size of the price shock that countries could have been expected to cope with over the period.

Table 6 presents some summary statistics which illustrate the extent of world price instability exhibited by the commodities coffee, cocoa and tea over the 1970-79 period. The table contains two indices of instability. The first, reflecting short run price behaviour, measures the average percentage deviations from a three-year moving average. The second, reflecting medium run behaviour, computes these deviations from a five-year moving average. In order to abstract from world inflation the statistics are presented on a "real" basis.

Table 6 Instability of "Real"[a] Commodity Prices 1970-1979

| Absolute average percentage deviations from | Coffee | Cocoa | Tea |
|---|---|---|---|
| a 3 year moving average | 12.25 (13.59)[b] | 14.38 (8.21)[b] | 9.88 (8.85)[b] |
| a 5 year moving average | 20.67 (16.88)[b] | 25.00 (14.60)[b] | 14.67 (15.13)[b] |

[a] Commodity prices are deflated by the industrialized countries "cif" index of US dollar prices of manufactured exports to developing countries.

[b] Standard deviation of the absolute percentage deviations from the moving averages.

Source: Calculated from information in World Bank (1980b).

The figures indicate real price fluctuations for coffee, cocoa and tea during the 1970's of between 10 and 14 per cent around their three-year moving averages and between 15 and 25 per cent around their five-year moving averages. Furthermore, as the rather large standard deviations of the absolute year to year fluctuations from their moving averages indicate, there have been considerable variations in the amplitudes of these price swings.

We define the upper bound of the shock that must be accomodated as one which consists of the mean instability (around the 3 year mean) plus two standard deviations.[14] In terms of the figures in table 6 this is equivalent to a price shock of 39.43 per cent for coffee, 30.80 per cent for cocoa and 27.58 per cent for tea. We assume further that the price movements for the three commodities are in phase. Hence the Ivory Coast must cope with simultaneous price fluctuations for coffee and cocoa and Kenya with simultaneous fluctuations for coffee and tea. Applying these price shocks to the relevant elasticities in table 2 yields changes in reserve stock of 51.61 per cent for Colombia, 105.20 per cent for the Ivory Coast and 66.57 per cent for Kenya. This result, which indicates such large variations in foreign exchange reserves in relation to the base period reserves casts doubts on the ability of these countries to successfully pursue a domestic absorption stabilisation objective as depicted in simulation 1.[15]

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[14] Assuming that the deviations from the 3-year moving average are normally distributed then the bounds we have set will encompass 95 per cent of the price deviations.

[15] In any case our estimates of the size of the price shock that governments must accomodate would seem to be rather conservative being based around a 3-year moving average. As table 6 shows the shocks are considerably magnified when considered around a 5-year moving average. Furthermore our consideration of the shock to be planned for as one which represents the average instability plus two standard deviations may not appeal to a risk-averse government which plans for the worst scenarios.

This is specially the case when one considers that these commodity price fluctuations have occurred over a period in which the three countries have also had to accomodate very large increases in oil prices. Given such a pricing environment it seems inevitable that some reorganization of production between domestic and traded sectors would be required to modify the effects on the balance of trade.

## 6. Conclusions

We have investigated two macroeconomic adjustment options open to three developing countries when confronted with unstable commodity export prices and earnings. Our results show that these countries, by pursuing a policy of fixed domestic absorption in the face of the price instability, can successfully isolate the effects of the price shock to the relevant commodity producing sectors. The main difficulty with this strategy however, is that the foreign exchange reserves required are large. At the other extreme, by seeking to maintain balance of trade equilibrium requires changes in the real exchange rate to facilitate a switch in the industrial composition of the economy between domestic oriented and traded (principally export) sectors. Thus the output effects of the price shock are spread more evenly around the domestic economy.

Since adjustment costs in shifting resources to achieve the restructuring come into consideration under the second option, this option would seem to be rational only when the price shock could be considered as representing a shift in the price trend.

The domestic stabilisation option would seem more appropriate in the case where the world commodity price movements represent genuine fluctuations about trend rather than a shift in the trend. A major problem facing the authorities when choosing the appropriate adjustment policy is to distinguish between shifts in price trends and shifts about the trend. Given this difficulty, compensatory financing schemes, which extend the time available to countries before having to embark on internal restructuring to correct the foreign account disequilibrium, would seem particularly useful.

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