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Commodity Price Fluctuations and Unemployment in a Dependent Economy

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ABSTRACT

The interconnected issues of commodity price fluctuation, unemployment and balance of trade developments are of critical importance in times of globalization. The present paper addresses these issues in terms of a monetary dependent economy macro model that applies to a large class of emerging market economies that export their primary products. However, there exists a manufacturing sector that produces non-traded goods using imported capital goods as an input. Moreover, in such an emerging economy, the stocks of primary commodities constitute a widely used financial asset, among other assets. Thus, the price of these primary commodities behaves as an asset price, which has significant implications for the nature of the interlinkage between the real sector and the financial sector of the economy. In an absence of any capital account transactions, and under a fixed exchange rate regime, the paper examines the effects of supply shock, devaluation, capital flow and fiscal policy on major macro variables, including terms of trade, the stock of primary commodities and real money balances. The result points to the contractionary implications of devaluation, while an exogenous increase in food production produces favorable macroeconomic outcomes.

KEY WORDS: Commodity price fluctuation; unemployment; emerging market Economies; globalization; dependent economy

JEL Classification: E6; F41; F62

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1. Introduction

Commodity price fluctuations, inflation, unemployment and change in the composition of national output are topics that have recently re-surfaced in the discussion on macroeconomic development in an emerging market economy. The following questions are posed in this paper:

1) Which variable holds the key to explaining the dynamics of commodity price, inflation and terms of trade adjustment in a dependent economy?
2) What is the nature of the linkage between the financial sector and the real sector in the presence of unemployment and inflation?
3) What are different policy instruments to mitigate not only commodity price volatility but also unemployment?

In the present paper, we attempt to address these questions using a dependent economy framework. In so doing, we have examined complex interactions

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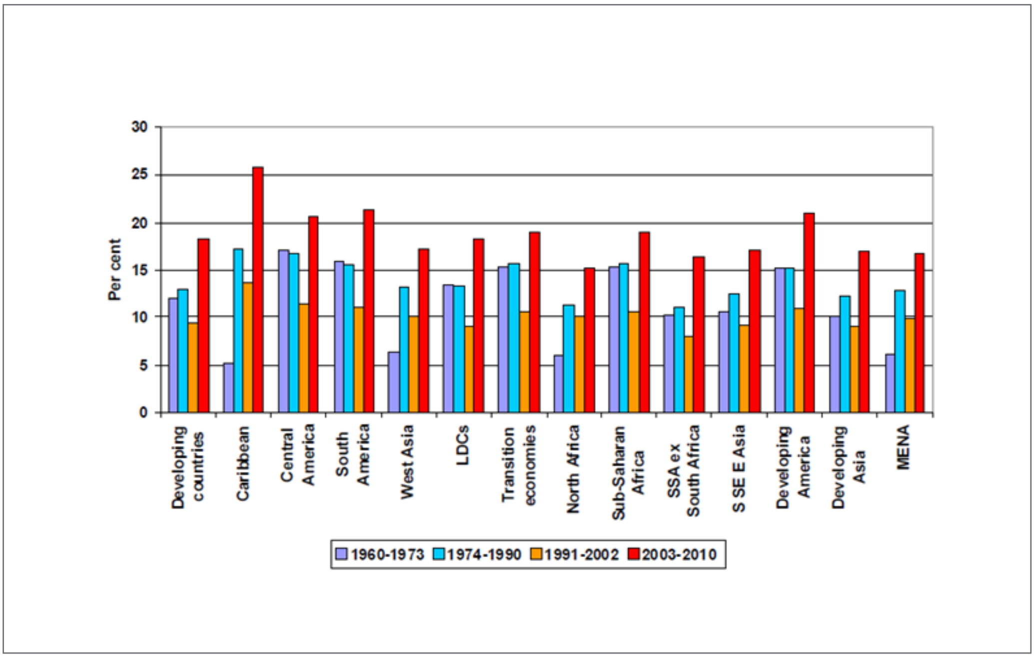

Figure 1. Volatility of commodity export baskets, selected country groups. 1960-2010
Source: From "Volatility of commodity export baskets, selected country groups. 1960–2010" by United Nations Conference on Trade and Development 2012, April 30, Excessive commodity price volatility: Macroeconomic effects on growth and policy options Contribution from the UNCTAD secretariat to the G20 Commodity Markets Working Group, p. 8.

among different macroeconomic variables, the analysis of which is seriously amiss in the existing literature.

Now, a few comments on commodity price (agricultural market) are in order.

The resurgence in interest in the commodity price volatility is backed by the empirical evidence that the volatility of commodity price indices has increased over the past 50 years. In the 2003–2010 period, it was significantly higher than in earlier decades. This is true for a dependent developing economy (figure 1).

Different theoretical models have been employed to formulate policy guidelines to reduce these fluctuations. The basic thrust of these models lies in explaining the overshooting of commodity prices as an outcome of unanticipated monetary expansion. The point is obvious. If the stock of primary commodity is an asset, and its price adjusts instantaneously compared with the industrial price, then commodity prices overshoot in response to monetary expansion. Frankel (1986) authored the seminal contribution to the analysis of the overshooting of agricultural prices. Subsequently, extensive literature emerged on the causes and effects of commodity price fluctuations. Notable studies include the works of

Bakucs and Ferto (2005), Cashin, Liang, and McDermott (2000), Gordon (1987), Goswami, and Nag (2012), Jacks, O'Rourke, and Williamson (2009), Lence and Hayes (2002), Morrison Paul and MacDonald (2003).

Lai, Hu, and Wang (1996) extended Frankel's model to investigate the effects of both anticipated and unanticipated monetary shocks on commodity prices. Moutos and Vines (1992) performed a similar exercise in a more detailed framework in which industrial output is demand determined and industrial inflation follows Phillips' curve relation. Saghaian, Hasan, & Reed, (2002) explained the overshooting of agricultural prices under monetary impacts in an open economy framework under flexible exchange rates. There are plenty of empirical works on the issue of commodity price volatility. Notable among them are Belke, Bordon, and Hendricks (2009), Belke, Bordon, and Volz (2013), Orden and Fackler (1989).

The contributions of the model in this paper are threefold. First, we expand the theoretical specification of the overshooting of agricultural prices by incorporating more macroeconomic variables. Second, the theoretical models are closed economy models, and hence, these models need to be extended to incorporate certain aspects of openness that are relevant to an emerging economy. Finally, the existing literature assumes full employment of labor, and accordingly, long-run neutrality of money exists. In this paper, we incorporate unemployment through wage indexation, and hence, money is not neutral in the long run. The relevance of this research extends far beyond the usual academic interest, and it can hopefully provide policy direction to mitigate commodity price fluctuations and unemployment.

This paper uses a dependent economy framework. Now, a few remarks on the nature of a dependent economy are in order. A dependent economy consists of both traded and non-traded sectors. We can aggregate both exportable and importable goods into a composite commodity called traded goods. Determination of the price of traded goods depends on conditions in the world market. However, domestic demand and supply conditions determine the price and output of non-traded goods.

Within the structure of a dependent economy used in this paper, the agricultural sector is the traded sector. The output from this sector is sold in both the domestic market and foreign markets. It is clear from the following figure that the share of exports of the primary commodities in their total exports has registered impressive growth for developing countries.

The industrial sector is the non-traded sector. However, the industrial sector imports capital goods. The ratio of price of exportable goods (that is, commodity price) to that of industrial goods is an economy's terms of trade, which are driven by both internal and external factors. The verbal upshot of the model is as follows. Agricultural production is fixed, and given the wage indexation, industrial production is obtained from the profit maximization exercise. The industrial price does not jump to clear the market, and industrial price inflation responds to the demand-supply gap. The asset market determines the agricultural price as a return on the stock of primary commodities. Over time, the state variables, namely the terms of trade, the stock of primary commodity and the real money balance, begin to change. The terms of trade dynamics are determined by the difference between agricultural price inflation and industrial price inflation. The change in the stock of primary commodities is governed by excess supply in the market for primary goods, while the change in the money supply is driven by the balance of payments disequilibrium under the fixed exchange rate regime. At the steady state, agricultural price inflation and industrial price inflation are equal, the market for agricultural goods clears, and trade is balanced. The system works under perfect foresight, and the macroeconomic variables of the model respond to a variety of shocks, including changes in agricultural production and policy-induced shocks, such as devaluation.

The rest of the paper is organized as follows. The model is set out in section 2, and the comparative static analysis is described in section 3. Section 4 contains the concluding remarks.

2. The Model

The nature of sectoral interlinkage in this paper is as follows. Agricultural and manufacturing are the two sectors. The agricultural sector produces primary commodities for domestic consumption and export, and agricultural production is fixed. On the other hand, the industrial sector produces non-traded goods using imported capital goods (Nag & Goswami, 2005; 2008; Rattsø & Torvik, 2003). In the spirit of the structuralist models (Buffie, 1986; Taylor, 1991), investment is a composite output produced by combining domestic and imported components. The exchange rate is fixed (Lizondo & Montiel, 1989), and the paper ignores capital account transactions (Edwards, 2001). We assume that the money wage is determined by a bargaining process, which protects the real consumption wage. Industrial price does not adjust instantaneously to clear the industrial goods market. Given any disequilibrium, the three adjustment variables are the terms of trade, the stock of primary commodities and the real money balance. Terms of trade is a jump variable, while the stock of primary commodities and the real money balance evolve continuously. The structure of the model is as follows.

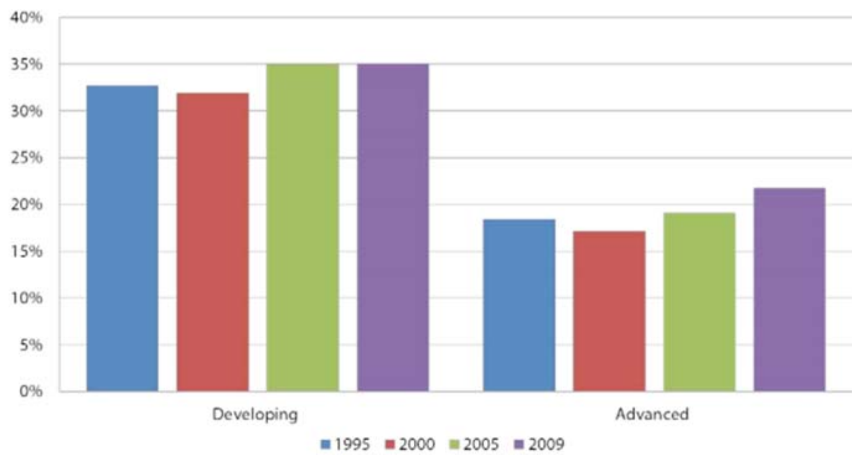

Figure 2. Share of primary commodity exports to total exports, 1995-2009
Source: From "Share of primary commodity exports in total exports, 1995-2009" by Bureau for Development Policy, 2011, September, Poverty reduction. Towards human resilience: Sustaining MDG progress in an age of economic uncertainty, p. 60.

2.1. Supply Side of the Economy:

Agricultural output (F) is exogenously given, and thus, the agricultural sector imposes a supply constraint on the economy. Relaxing supply constraints by making agricultural output dependent upon terms of trade will hardly make a major qualitative change.

The supply function of the agricultural output is

$$F = \overline{F} \qquad (1)$$

Labor (L) and capital (K) are used to produce industrial output (Y). The production function for industrial output takes the following form:

$$Y = f(L, K) \qquad (2)$$

Employment in the industrial sector is derived from the condition of profit maximization, that is, equality between the marginal product of labor and real product wage with an assumption that the stock of capital is a fixed factor. Thus, we get the following labor demand function:

$$L = L\left(\frac{W}{P_Y}\right), L' < 0 \qquad (3)$$

where W is money wage, and P_Y is the price of industrial output.

Next, we consider the determination of money wage. Instead of assuming flexible adjustment, we take money wage to be determined as an outcome of a bargaining process. Money wage is linked to the consumer price index as

$$W = P_Y^{\alpha} P_F^{1-\alpha} \text{ with } 0 < \alpha < 1 \qquad (4)$$

where α and $1-\alpha$ are the constant expenditure shares of industrial goods and agricultural goods, respectively, and P_F is the price of agricultural output.

Now, the real wage in the unit of industrial goods is

$$\frac{W}{P_Y} = \theta^{1-\alpha} \tag{5}$$

where $\theta = \dfrac{P_F}{P_Y}$.

From equations (2), (3) and (5), we get the supply function of industrial goods:

$$Y_s = Y_s(\theta), \ with \ Y_s' < 0$$

In linear form, the supply function is given by

$$Y_s = -x_1\theta, \ with \ x_1 > 0 \tag{6}$$

The aggregate output is the sum total of the agricultural and industrial output. Let Z denote aggregate output (or real income), measured in the unit of industrial goods. That is,

$$Z = \theta F - x_1\theta \tag{7}$$

with $\dfrac{dZ}{d\theta} = F - x_1$. We assume that $F > x_1$ such that $\dfrac{dZ}{d\theta} > 0$.

2.2. Financial Sector:

In an emerging economy, the stocks of food grains constitute a widely used financial asset. Accordingly, the financial sector is represented in terms of an asset structure that includes money (M) and stock of food grains (H). The modeling of demand for money is based on Tobin's portfolio choice. We consider a risk averter who chooses an optimum portfolio mix of money and stock of primary goods based on their respective returns.

Thus, the total value of assets (A) is given by

$$A = M + P_F H$$

The value of assets in terms of industrial goods is given by

$$a = A/P_Y = m + \left(P_F/P_Y\right)H = m + \theta H \ with \ m = \frac{M}{P_y} \tag{8}$$

The desired ratio of money to the stock of primary goods depends on the expected return of the assets, that is, on the expected percentage change in the price of food grains. Under perfect foresight, expected change in food price is equal to actual change in food price, that is, $\left(\dfrac{\dot{P}_F}{P_F}\right)^e = \dfrac{\dot{P}_F}{P_F}$, and hence, we can write

$$\frac{m}{\theta H} = h\left(\frac{\dot{P}_F}{P_F} + k\right), with \ h' < 0 \tag{9}$$

The term $\dfrac{\dot{P}_F}{P_F}$ represents the expected change (and actual change based on the assumption of perfect foresight) in food price. The term k is the difference between the convenience yield and the storage cost of holding primary commodities. Hence, the return on stocks of primary commodities is $\left(\dfrac{\dot{P}_F}{P_F} + k\right)$.

It will be useful to express equation (9) as

$$\left(\frac{\dot{P}_F}{P_F} + k\right) = L\left(\frac{m}{\theta H}\right), \ with \ L' < 0.$$

In a linear form, we get

$$\left(\frac{\dot{P}_F}{P_F} + k\right) = -x_2 m + x_3\theta + x_4 H + k \ with \ x_2, x_3, x_4 > 0 \tag{10}$$

2.3. Demand Side and Inflation Mechanism for the Industrial Sector:

Aggregate demand for industrial goods consists of private consumption expenditure, private investment, government expenditure and imports. Shares of expenditure on industrial goods and primary commodities are fixed, viz. α and $(1-\alpha)$, respectively. Total consumption is a function of aggregate output ($Z = \theta F - x_1\theta$) and financial assets $(a = m + \theta H)$. We choose a linear consumption function, $C = x_5\theta + x_6 H + x_7 m + x_8 F$. Thus, consumption expenditure on industrial goods is $\alpha(x_5\theta + x_6 H + x_7 m + x_8 F)$.

Investment expenditure is assumed to be exogenously given, that is, $I = \overline{I}$. The industrial sector also imports capital goods, which are taken to be some fraction $(1-\beta)$ of total investment. Therefore, import demand for industrial goods is $(1-\beta)I$. Government expenditure (G) is parametrically given.

Thus, the aggregate demand for industrial goods is $\alpha C + \beta \bar{I} + G$. Although the industrial price is assumed to be sticky, the inflation rate can change in response to excess demand for industrial goods. Therefore, the rate of industrial price inflation can be written as

$$\frac{\dot{P}_Y}{P_Y} = \pi_Y = \delta\{\alpha C + \beta \bar{\mathrm{I}} + \mathrm{G} - \mathrm{Y_s}\} \quad with\ \delta > 0$$

Substituting the value of C and $\mathrm{Y_s}$, we get

$$\Rightarrow \frac{\dot{P}_Y}{P_Y} = \delta\left\{\alpha(x_5\theta + x_6\mathrm{H} + x_7\mathrm{m} + x_8\mathrm{F}) + \beta\bar{\mathrm{I}} + \mathrm{G} + x_1\theta\right\},\ \delta > 0$$

In a linear form, we get

$$\pi_Y = b_1\theta + b_2H + b_4m + b_3F + b_5 \qquad (11)$$

with $b_1 = (\delta\alpha x_5 + x_1) > 0,\ b_2 = \delta x_6 > 0,\ b_3 = \delta x_8 > 0,$
$b_4 = \delta x_7 > 0\ \ and\ \ b_5 = \beta \bar{I} + G > 0$

2.4. External Sector and Adjustment in Money Supply:

Any difference between the value of export and that of import involves quantity adjustment through change in foreign exchange reserves, the stock of high-powered money and money supply under the fixed exchange rate regime. Thus, we get the following equation:

$\dot{M} = P_F X\left(\frac{s}{P_Y}\frac{1}{\theta}\right) - (1-\gamma)s\bar{I}$, where s is the nominal exchange rate.

In a linear form, we get

$$\dot{M} = P_F(\alpha_4 s - x_{10}\theta - x_{11}P_y) - (1\text{-}\lambda)\,\mathrm{s}\bar{\mathrm{I}}\ \ ;\alpha_4, x_{10}, x_{11} > 0 \qquad (12)$$

2.5. Steady State Analysis:

The steady state analysis centers around the adjustment in terms of trade, the stock of primary commodities and the real money balance. Now, comments on adjustment in each variable are in order.

2.5.1. Terms of Trade Adjustment:

Equations (10) and (11) can be combined to produce the dynamic adjustment in the terms of trade. Noting that $\theta = \frac{P_F}{P_Y}$, we get

$$\frac{\dot{\theta}}{\theta} = \frac{\dot{P}_F}{P_F} - \frac{\dot{P}_Y}{P_Y}$$

$$\frac{\dot{\theta}}{\theta} = \text{-}x_2m + x_3\theta + x_4H\ \text{-}k\,\text{-}b_1\theta - b_2H - b_4m - b_3F - b_5$$

$$\frac{\dot{\theta}}{\theta} = -am + b\theta + \gamma H - b_3F - b_6 \qquad (13)$$

where $a = x_2 + b_4 > 0,\ b = x_3 - b_1 > 0,\ \gamma = x_4 - b_2 > 0$,
$b_6 = b_5 + k$

In the long run, $\dot{\theta} = 0$, and the stationary values of θ, m, and H are assumed; that is, $\theta = \bar{\theta}$, $H = \bar{H}$, and $m = \bar{m}$. Thus, the long-run version of equation (13) becomes

$$b\bar{\theta} - a\bar{m} + \gamma\bar{H} - b_3F - b_6 = 0 \qquad (14)$$

Explanations of the sign restrictions of the coefficient of θ, m H of equation (13) are as follows:

First, an increase in θ leads to a rise in real income, which subsequently raises the consumption demand. As a result, there will be an increase in industrial price inflation. On the other hand, an increase in θ also results in food price inflation, which follows from equation (10). However, we assume that food price inflation exceeds industrial price inflation in response to an increase in θ such that $\dot{\theta} > 0$. Next, we consider an increase in H, which pushes up food price inflation from the asset market, and hence, we get $\dot{\theta} > 0$. However, an increase in H raises total financial assets, and hence, consumption demand also increases. As a result, there will be an increase in industrial price inflation. However, based on the assumption that food price inflation exceeds industrial price inflation in response to increase in θ, we get $\dot{\theta} > 0$. Again, from the asset market, an increase in m reduces food price inflation and simultaneously increases the industrial price inflation through a rise in consumption demand; hence, $\dot{\theta} < 0$.

2.5.2. Adjustment in the Stock of Primary Commodities:

Any excess supply of agricultural output over domestic absorption (D_F) generates adjustment in the stock of primary commodities. That is,

$$\dot{H} = \bar{F} - D_F$$

$$\dot{H} = \bar{F} - \frac{(1-\beta)C(Z, m+\theta H)}{\theta} - \frac{X\left(\frac{s}{P_Y}\frac{1}{\theta}\right)}{\theta} - \frac{\bar{P}}{P_Y}\left(\frac{G_w}{\theta}\right) \quad (15)$$

where G_w is the amount of government expenditure on agricultural goods at a procurement price, $\bar{P}$.

Substituting the value of C and X from equations (11) and (12), we get

$$\dot{H} = \bar{F} - (1-\alpha)(x_5\theta + x_6 H + x_7 m + x_8 F) - d_1\theta -$$

$$+(\alpha_4 s - x_{10}\theta - x_{11}P_Y) - \frac{\bar{P}}{P_Y}G_w - d_2\theta$$

$$\dot{H} = \bar{F} - \alpha_1\theta - \alpha_2 m - \alpha_3 H - x_8 F - \alpha_4 s - \frac{\bar{P}}{P_Y}G_w + x_{11}P_Y \quad (16)$$

where $\alpha_1 = (1-\alpha)x_5 - x_{10} + d_1 + d_2 > 0$, $\alpha_2 = (1-\alpha)x_7 > 0$, $\alpha_3 = (1-\alpha)x_6 > 0$

In the long run, the stationary values of θ, m and H are assumed as $\theta = \bar{\theta}$, $H = \bar{H}$ and $m = \bar{m}$. Additionally, in the long run, $\dot{H} = 0$. Thus, the long-run version of equation (16) becomes

$$\bar{F} - \alpha_1\bar{\theta} - \alpha_2\bar{m} - \alpha_3\bar{H} - x_8 F - \alpha_4 s - \frac{\bar{P}}{P_y}G_W + x_{11}P_y = 0 \quad (17)$$

Explanations of the sign restrictions of the coefficients of θ, m and H of equation (16) are as follows:

To begin with, we consider an increase in H, which raises the total financial assets. It follows from the asset market equilibrium that the food price increases. A rise in both total assets and food price inflation increases the consumption demand, and consequently, we get $\dot{H} < 0$. Again, an increase in m leads to a rise in total assets, which eventually increases the consumption demand. However, there is a counteractive force on the consumption demand originating from the asset market itself. It follows from the asset market equilibrium that a rise in total assets results in a decline in food price and thus a fall in terms of trade, which ultimately leads to a fall in consumption demand. Assuming that the asset effect dominates the terms of trade effect and that the consumption elasticity is greater than one, we get $\dot{H} < 0$.

2.5.3. Adjustment in Real Money Supply:

Equations (9) and (10) can be combined to produce the adjustment in the real money supply ($m = \frac{M}{P_Y}$)

$$\dot{m} = \theta X\left(\frac{s}{P_Y}\frac{1}{\theta}\right) - (1-\gamma)\frac{s}{P_Y}\bar{I} - \pi_Y m + J \quad (18)$$

where J denotes the capital flow.

Substituting the values of X and π_Y from equations (10) and (11), we get

$$\dot{m} = -\alpha_5\theta - \alpha_8 m - b_3 F + s\left[\alpha_4 - \frac{(1-\gamma)}{P_y}\bar{I}\right] + \theta + J$$

$$\dot{m} = -\alpha_5\theta - \alpha_8 m - b_3 F + \alpha_9 s - x_{11}P_y - b_5 + J \quad (19)$$

where $\alpha_5 = (d_3 - x_{10} - b_1) > 0, \alpha_8 = (b_4 - d_4) > 0,$

$$\alpha_9 = \alpha_4 - \frac{(1-\gamma)}{P_y}\bar{I} > 0.$$

In the long run, the stationary values of θ and m are assumed to be $\theta = \bar{\theta}$ and $m = \bar{m}$. Additionally, in the long run, $\dot{m} = 0$. Thus, the long-run form of equation (18) becomes

$$-\alpha_5\bar{\theta} - \alpha_8\bar{m} - b_3 F + \alpha_9 s - x_{11}P_y - b_5 + J = 0 \quad (20)$$

The sign restrictions of the coefficients of θ and m of equation (19) can be explained as follows:

An increase in θ causes a fall in industrial output, and accordingly, there will be a rise in industrial price inflation. Again, as θ increases, the physical volume of exports decreases. Since we assume that export elasticity is greater than one, the real value of export demand decreases. The increase in industrial price inflation and the decrease in the real value of exports makes $\dot{m} < 0$. On the other hand, an increase in m directly makes $\dot{m} < 0$.

2.6. Saddle Path Stability:

State variables in this model are terms of trade, the stock of primary commodities and the real money balance, the dynamics of which are obtained as follows.

Subtracting equation (14) from equation (13) and solving for $\tilde{\dot{\theta}}$, we get

$$\tilde{\dot{\theta}} = -a(m - \bar{m}) + b(\theta - \bar{\theta}) + \gamma(H - \bar{H})$$

$$\text{where } \tilde{\dot{\theta}} = \frac{\dot{\theta}}{\theta} \quad (21)$$

Subtracting equation (17) from equation (16) and solving for $\dot{H}$, we get

$$\dot{H} = \alpha_1(\theta - \bar{\theta}) - \alpha_2(m - \bar{m}) - \alpha_3(H - \bar{H}) \tag{22}$$

Subtracting equation (20) from equation (19) and solving for $\dot{m}$, we get

$$\dot{m} = \alpha_5(\theta - \bar{\theta}) - \alpha_8(m - \bar{m}) \tag{23}$$

Thus, the dynamic system about its initial equilibrium is made up of equations (21), (22) and (23).

$$\begin{bmatrix} \dot{\tilde{\theta}} \\ \dot{H} \\ \dot{m} \end{bmatrix} = \begin{bmatrix} b & \gamma & -a \\ -\alpha_1 & -\alpha_3 & -\alpha_2 \\ -\alpha_5 & 0 & -\alpha_8 \end{bmatrix} \begin{bmatrix} (\theta - \bar{\theta}) \\ (H - \bar{H}) \\ (m - \bar{m}) \end{bmatrix} \tag{24}$$

The characteristic roots for equation (24) are the solutions, $\beta_1, \beta_2, \beta_3$, to the characteristic polynomial $|\beta - \alpha I| = 0$, where β is the matrix in the system equation $dX/_{dt} = BX$ of (24). In the presence of perfect foresight, the existence of the unique convergent saddle path requires that there be one positive and two negative characteristic roots. Hence, the determinants are as follows:

$$\Delta = \begin{vmatrix} b & \gamma & -a \\ -\alpha_1 & -\alpha_3 & -\alpha_2 \\ -\alpha_5 & 0 & -\alpha_8 \end{vmatrix} > 0$$

In what follows, we explore the comparative static analysis in terms of a parametric rise in agricultural production and devaluation.

3. Comparative Static Analysis:

3.1. Increase in Agricultural Output:

The rise in agricultural production has prime significance in the context of economic development. Agricultural output can increase over time due to technical progress. The increase in agricultural output raises aggregate real income, which in turn leads to an increase in consumption demand. This, in turn, raises industrial price inflation, and as a result, $\dot{\theta} < 0$. On the other hand, an increase in agricultural output tends to increase the stock of primary goods. Again, it tends to reduce the stock of the real money balance by increasing seigniorage through industrial price inflation. Both the rise in the stock of primary goods and fall in the real money balance leads to $\dot{\theta} > 0$, and hence, θ tends to fall through the portfolio balance effect. Thus, the final effect on θ is ambiguous. In the case of a fall in θ, the industrial production rises since real wage measured in the unit of industrial goods falls. Ambiguity also exists regarding the nature of m and H. Since multiple cross effects exist, one cannot theoretically ascertain the direction of change in state variables. Overshooting or undershooting of terms of trade depends on the adjustment of the stock of primary commodity and real money supply. Next, we consider the long-run effects, short-run effects and transitional dynamics.

Long-run Effects:

Considering long-run equilibrium equations (14), (17) and (20), differentiating them with respect to F and arranging them in matrix form, we get

$$\begin{bmatrix} b & \gamma & -a \\ -\alpha_1 & -\alpha_3 & -\alpha_2 \\ -\alpha_5 & 0 & -\alpha_8 \end{bmatrix} \begin{bmatrix} \frac{d\bar{\theta}}{dF} \\ \frac{d\bar{H}}{dF} \\ \frac{d\bar{m}}{dF} \end{bmatrix} = \begin{bmatrix} b_3 \\ -(1 - x_8) \\ b_3 \end{bmatrix} \tag{25}$$

Applying Cramer's rule, we get

$$\frac{d\bar{\theta}}{dF} = \frac{b_3\alpha_3\alpha_8 - \gamma\left[(1 - x_8)\alpha_8 + \alpha_2 b_3\right] - ab_3\alpha_3}{|\Delta|} \tag{26}$$

with $\frac{d\bar{\theta}}{dF} < 0 \quad if\ b_3\alpha_3\alpha_8 < \gamma\left[(1 - x_8)\alpha_8 + \alpha_2 b_3\right] + ab_3\alpha_3$

$$\frac{d\bar{H}}{dF} = \frac{b\left[(1 - x_8)\alpha_8 + \alpha_2 b_3\right] - b_3(\alpha_1\alpha_8 - \alpha_2\alpha_5) +}{|\Delta|}$$

$$\frac{+a\left[b_3\alpha_1 + \alpha_5(1 - x_8)\right]}{|\Delta|} \tag{27}$$

with $\frac{d\bar{H}}{dF} > 0\ if \quad \alpha_1\alpha_8 < \alpha_2\alpha_5$

$$\frac{d\bar{m}}{dF}=\frac{-b\alpha_3 b_3+\gamma\left[\alpha_1 b_3+\alpha_5\left(1-x_8\right)\right]-b_3\alpha_5\alpha_3}{|\Delta|} \tag{28}$$

with $\frac{d\bar{m}}{dF}<0 \quad if\,\gamma\left[\alpha_1 b_3+\alpha_5\left(1-x_8\right)\right]<(b\alpha_3 b_3+b_3\alpha_5\alpha_3)$

Short-run Effects and Transitional Dynamics:
We consider equation (24).

$$\begin{bmatrix}\dot{\tilde{\theta}}\\ \dot{H}\\ \dot{m}\end{bmatrix}=\begin{bmatrix}b & \gamma & -a\\ -\alpha_1 & -\alpha_3 & -\alpha_2\\ -\alpha_5 & 0 & -\alpha_8\end{bmatrix}\begin{bmatrix}(\theta-\bar{\theta})\\ (H-\bar{H})\\ (m-\bar{m})\end{bmatrix} \tag{24}$$

The positive roots are ignored to ensure the saddle path stability of the system. This amounts to setting the coefficients of positive roots equal to zero. Suppose that $-\beta_1,-\beta_2$ ($\beta_1>0,\beta_2>0$) are two negative characteristic roots. The solutions for expected future paths of θ, H and m in level form, as t goes from 0 to ∞, are

$$\left\{\begin{array}{ll}\theta(t)-\bar{\theta}(t)=\exp(-\beta_1 t)[\theta(0)-\bar{\theta}(0)]+ & \\ \quad +\exp(-\beta_2 t)[\theta(0)-\bar{\theta}(0)] & (29.1)\\ H(t)-\bar{H}(t)=\exp(-\beta_1 t)[H(0)-\bar{H}(0)] & \\ \quad +\exp(-\beta_2 t)[H(0)-H(0)] & (29.2)\\ m(t)-\bar{m}(t)=\exp(-\beta_1 t)[m(0)-\bar{m}(0)]+ & \\ \quad +\exp(-\beta_2 t)[m(0)-\bar{m}(0)] & (29.3)\end{array}\right\} \tag{29}$$

Alternatively, we can write equations (29.1), (29.2), & (29.3) as

$$\left\{\begin{array}{l}\dot{\tilde{\theta}}=-(\beta_1+\beta_2)(\theta-\bar{\theta})\\ \dot{H}=-(\beta_1+\beta_2)(H-\bar{H})\\ \dot{m}=-(\beta_1+\beta_2)(m-\bar{m})\end{array}\right\} \tag{30}$$

Combining equations (25) and (30), we get

$$-a\left(m-\bar{m}\right)+b\left(\theta-\bar{\theta}\right)+\gamma\left(H-\bar{H}\right)=-\left(\beta_1+\beta_2\right)\left(\theta-\bar{\theta}\right)$$

$$\theta=\bar{\theta}+\frac{a}{\beta_1+\beta_2+b}(m-\bar{m})-\frac{\gamma}{\beta_1+\beta_2+b}(H-\bar{H}) \tag{31}$$

Differentiating equation (30) with respect to agricultural output and considering the short-run stickiness of H and m, we get

$$\frac{d\theta}{dF}=\frac{d\bar{\theta}}{dF}+\frac{a}{\beta_1+\beta_2+b}\frac{d\bar{m}}{dF}-\frac{\gamma}{\beta_1+\beta_2+b}\frac{d\bar{H}}{dF}$$

$$\frac{d\theta}{dF}-\frac{d\bar{\theta}}{dF}=\frac{a}{\beta_1+\beta_2+b}\frac{d\bar{m}}{dF}-\frac{\gamma}{\beta_1+\beta_2+b}\frac{d\bar{H}}{dF} \tag{32}$$

Overshooting or undershooting depends on the sign of $\frac{d\bar{m}}{dF}$ and $\frac{d\bar{H}}{dF}$. Suppose we consider that θ decreases as F increases. Thus, if $\frac{d\theta}{dF}-\frac{d\bar{\theta}}{dF}<0$, we can say that initially, θ decreases more than its long-run value; that is, there will be undershooting of θ. It is also observed that this undershooting occurs if $\frac{d\bar{m}}{dF}<0$ and $\frac{d\bar{H}}{dF}>0$; that is, the real money supply decreases and the stock of primary commodity increases as agricultural output increases.

3.2. Devaluation:

Extensive literature focuses on various channels by which devaluation might be contractionary in emerging economies (Edwards, 1989; Lizondo & Montiel 1989). In this paper, devaluation produces stagflationary effects along with a fall in the stock of primary commodities. The intuition is as follows. The rise in the nominal exchange rate causes improvement in trade balance and makes $\dot{m}$ >0 provided that the export elasticity is greater than one. As a result, the real money balance increases. Consequently, we get $\dot{\theta}$<0 from the equilibrium condition in the financial market. Hence, the terms of trade increases, which in turn causes an increase in the real wage anda fall in industrial employment and output. On the other hand, a rise in the nominal exchange rate along with an increase in the terms of trade and the real money balance lead to an increase in demand for food, and hence, $\dot{H}$ <0. Therefore, H has to decrease to maintain the steady state.

Long-run Effects:
Considering long-run equilibrium equations (14), (17) and (20), differentiating them with respect to the

nominal exchange rate(s) and arranging them in matrix form, we get

$$\begin{bmatrix} b & \gamma & -a \\ -\alpha_1 & -\alpha_3 & -\alpha_2 \\ -\alpha_5 & 0 & -\alpha_8 \end{bmatrix} \begin{bmatrix} \frac{d\bar{\theta}}{ds} \\ \frac{d\bar{H}}{ds} \\ \frac{d\bar{m}}{ds} \end{bmatrix} = \begin{bmatrix} 0 \\ \alpha_4 \\ -\alpha_9 \end{bmatrix} \tag{33}$$

Applying Cramer's rule, we get

$$\frac{d\bar{\theta}}{ds} = \frac{\gamma(\alpha_4\alpha_8 + \alpha_2\alpha_9) + a_9\alpha_3}{\Delta} > 0 \tag{34}$$

$$\frac{d\bar{H}}{ds} = -\frac{b(\alpha_4\alpha_8 + \alpha_9\alpha_2) + a(\alpha_1\alpha_9 + \alpha_5\alpha_4)}{\Delta} < 0 \tag{35}$$

$$\frac{d\bar{m}}{ds} = \frac{b(\alpha_3\alpha_9) - \gamma(\alpha_1\alpha_9 + \alpha_4\alpha_5)}{\Delta} > 0 \tag{36}$$

$$\text{if } b(\alpha_3\alpha_9) > \gamma(\alpha_1\alpha_9 + \alpha_4\alpha_5)$$

3.3 Fiscal Policy:

Contractionary fiscal policy will produce a favorable macroeconomic outcome in this model. Reduction in government expenditure on industrial goods reduces industrial price inflation (following from equation 11). Starting from the initial steady state, we get $\dot{\theta} > 0$, and hence, θ begins to fall. This in turn reduces real wage, measured in the unit of industrial goods, and hence, employment rises.

3.4: Capital Mobility and its Effects:

The model can explain how monetary liquidity through capital flow may generate adverse side effects in terms of inflation, output contraction and a rising unemployment rate. Greater capital flow (increase in J) leads to an increase in the stock of real balance (which follows from equation 18). It follows from the asset market (equation 10) that food price rises, and the terms of trade move in favor of the agricultural sector (from equation 13). The resulting increase in the real wage (measured in the unit of industrial goods) leads to a fall in employment, and contraction of the industrial sector ensues. Thus, capital flow produces adverse macroeconomic outcomes.

4. Conclusion:

The paper offers some insights on the relationship between money, commodity prices, terms of trade and unemployment. The existence of different dynamic adjustments in terms of trade and the rate of growth of the real balance may provide an explanation for the change in relative prices between agricultural goods and industrial goods and for unemployment. Now, we sum up the findings of our paper. The rise in agricultural production may reduce terms of trade and hence give rise to industrial employment and output. The effects on the stock of primary commodities and the real money balance are ambiguous. Overshooting or undershooting in terms of trade depends on the adjustment in the stock of primary commodities and real money supply. Devaluation produces a stagflationary effect along with a fall in the stock of primary commodities.

Contractionary fiscal policy will produce a favorable macroeconomic outcome in this model.

Again, monetary liquidity through capital flow may generate adverse side effects in terms of inflation, output contraction and a rising unemployment rate. In this section, we examine how different policies may reduce not only agricultural price volatility but also unemployment.

The broad policy message is that the long-term solution to commodity price volatility, inflation and unemployment is sustained agricultural growth. We also show that contractionary fiscal policy in the form of reduced expenditure on industrial output is also an effective policy. Moreover, both devaluation and greater capital flow might be counterproductive in controlling commodity price volatility and checking unemployment.

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