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MACROECONOMIC ANALYSIS OF SHOCKS IN A DUAL ECONOMY: A RATIONAL EXPECTATION APPROACH

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Abstract: The paper examines the macroeconomic implications of different shocks in a two-sector model which involves industry-agriculture interlinkage. The model posits supply constraint for the agricultural sector and demand constraint for the industrial sector. The articulation of industry-agriculture interlinkage depends on income distribution parameters and the behavioural pattern of different income groups, namely landlords, capitalists and industrial workers. The crucial feature of the model is rational expectation regarding future food-price. The model highlights importance of distinction between anticipated and unanticipated shocks in the assessment of macroeconomic developments in a shock sensitive, dual economy. The paper attempts to offer a new classical foundation for the macroeconomic analysis of shocks in a semi-industrialised, developing country.

Key words: Dual Economy, Rational Expectation.
JEL Classification Number: F41, Q1, Q11.

1. INTRODUCTION

The advent of 'new classical macroeconomics' has shaken the macroeconomic consensus about the causes of short run fluctuations in real economic activity in industrial countries. The 'policy ineffectiveness' proposition associated with Lucas (1973) and

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Sargent and Wallace (1975), which claims that only unanticipated change in aggregate demand can cause output fluctuations, has been contested on both theoretical and empirical grounds in an extensive literature. An important contribution to this debate was the development by Barro (1976, 1977) of a methodology for implementing empirical tests of equilibrium business cycles. Undoubtedly the ability of Barro's empirically testable reduced form equations to track aggregate time series data and the favourable results of various tests of new classical propositions contributed to the wide acceptance that the 'new classical macroeconomics' received.

The theoretical and empirical literature of the new classical macroeconomics was based on rational expectation formalization of shocks in terms of one-sector aggregative models that have been employed for macroeconomic analysis of the developed countries. Initially the focus of the literature is on study of demand shocks, both anticipated and unanticipated. Since the late 1970s a rapidly expanding body of literature has proceeded to investigate the theoretical formulation of supply shocks, particularly oil shocks (Blanchard and Fischer, 1989). Such shocks tend to change the output-inflation mix in the economy. However the estimated reduced form output equation has typically not been derived from an underlying structural model suitable for a developing country. The key aspect of a developing country is existence of structural dualism and hence an inevitable economic disaggregation into wage goods and industrial goods is a theoretical imperative.

In the context of closed economy versions of dual economy models, the source of supply shocks is attributed to harvest failure, while demand shock is identified with government expenditure of different types. The conventional treatment in development economics of the effects of exogenous change in agricultural output generally relies on a Ricardo-Lewis paradigm in which bad harvest raises the price of food and thereby the product wage in the industrial sector. Industrial contraction then follows from the marginal productivity theory. This is essentially a profit-squeeze argument. Clearly the Lewisian theory explores supply side interlinkage between the industrial sector and the agricultural sector. On the other hand, the structural macromodels, though of recent origin (Rakshit, 1982, 1989; Taylor, 1983, 1991; Dutt, 1990), focused on income expenditure structure of dualistic economies and offers analysis of demand side interlinkage between the two sectors.

In view of the dominance of dual economy model and of the importance of the policy issues raised by new classical macroeconomics, it is surprising that little attention has been given to the reformulation of new classical macroeconomics in a dual economy framework, with a view to deriving appropriate reduced form output equations that can be used for the study of shocks in a dual economy. An important exception is Montiel (1986, 1987). Montiel derived reduced form output equation in a small open economy with features of a developing country, namely dependent economy structure, use of intermediate imports and foreign exchange constraint. However Montiel's papers did not focus on rational expectation treatment of shocks in a dual economy. The present paper attempts to offer a new classical foundation for macroeconomic analysis of shocks in a semi-industrialized economy with a predominant agricultural sector.

The paper is organized as follows. Section 2 is concerned with pure description of the economy. We build up the model in section 3. Section 4 contains comparative static results. Few concluding remarks are made in section 5.

2. STRUCTURAL FEATURES

The building blocks of the model include (1) features of a semi-industrialized economy, (2) existence of different socio-economic groups, (3) wage indexation, (4) farm inventory investment and (5) rational expectation. Few comments on each of these building blocks are in order.

(1) Semi-industrialized countries are assumed to have certain similarities. The level of economic development is high enough to let aggregate demand considerations be important. The capacity utilization in the manufacturing sector is variable and demand determined. Moreover, the manufacturing sector is characterized by oligopolistic competition. The demand for labour is linked to the scale of output and not sensitive to the real product wage. The agricultural sector is still the dominant sector in terms of value added and the interplay between agriculture and the rest of the economy has macroeconomic relevance. Agricultural inflation and economic fluctuations influenced by agricultural droughts are experienced. Agricultural output is determined by supply side factors. Clearly the distinction between the two sectors is important for macroeconomic analysis of fluctuations in a dual economy because of difference in their production conditions and adjustment mechanisms.

(2) Different social classes related to the functional distribution of income have conflicting interests and show different saving and consumption patterns. We consider three groups, namely landlords. capitalists and industrial workers. The main behavioural assumption is that the workers spend all their income and marginal propensity to consume of landlords is greater than that of industrial capitalists.

(3) Money wage is exogenously fixed. This is a reasonable assumption in a developing country, which is characterized by surplus labour. Trade union activities in organized sector do not permit wage to fall, despite presence of surplus labour. In the context of the present model money wage, though exogenously fixed, is one of the major sources of price shock.

(4) Inventory investment in farm product is major economic activity in all LDCs.Experts (Blinder, 1990) in the field have noted importance of inventory in the propagation of business cycles. In the present model, inventory depends on the difference between actual and expected food price.

(5) The cornerstone of the paper is rational expectation the essence of which is determination of expectation with reference to the process, which determines the actual variable. The rational expectation approach helps us assess macroeconomic effects of anticipated and unanticipated shocks, the distinction of which is seriously amiss in the conventional dual economy macroeconomics.

3. THE MODEL

3.1. The Industrial Sector

In our dual economy model the industrial sector has the Keynesian features so that effective demand plays a major role in determining its output. In demand constrained model industrial price is assumed to be determined as a mark up (K) on prime cost:

$$P^y = KNW\,, \quad K > 1 \tag{1}$$

where

P^y = price of industrial goods
N = labour coefficient
W = industrial wage rate
K = profit mark-up

In log-linear terms we have,

$$p_t^y = w_t + k_t + n_t \tag{2}$$

where $x = \log X$. X being any variable. Subscript t is used to denote time.

Next consider demand for industrial product. It has three different sources: capitalists' consumption expenditure (C^c), landlords' consumption expenditure (C^L) and government expenditure (G).

Now capitalists' expenditure depends on profit income (π) which is inversely related to real wage. Thus we get:

$$C^c = E[\pi(W/P^y)]E' > 0\,, \quad \pi' < 0 \tag{3}$$

In log-linear form this can be written as:

$$c_t^c = -\beta_1(w_t - p_t^y) \tag{4}$$

where β_1 is the capitalists' propensity to consume and $0 < \beta_1 < 1$.

Now landlords' income comes from sales of marketable surplus of food (F). Hence, landlords' consumption expenditure is:

$$C^L = \psi(P^f F/P^y)\,, \quad \psi' > 0 \tag{5}$$

where P^f is food price.

Again in log-linear from we write equation (5) as:

$$c_t^L = \beta_2(p_t^f + f_t - p_t^y) \tag{6}$$

where β_2 is landlords' propensity to consume and $0 < \beta_1 < \beta_2 < 1$.

From equations (4) & (6) we write equilibrium for industrial sector in log-linear form:

$$y_t = -\beta_1(w_t - p_t^y) + \beta_2(p_t^f + f_t - p_t^y) + g_t + \phi_t \tag{7}$$

where g_t is the government expenditure and ϕ_t is a stochastic disturbance term which obeys the following restrictions:

$$E\phi_t = 0 \tag{8a}$$

and

$$\text{Var}\,\phi_t = \sigma_\phi^2 \tag{8b}$$

Money wage, though exogenously specified, follows a random walk process and hence

$$w_t = w_{t-1} + \eta_t \tag{8c}$$

where η_t follows a while noise process with $E(\eta_t) = 0$ and $\text{Var}(\eta_t) = \sigma_t^2$

From equations (2) & (7) we get the industrial output:

$$y_t = \beta_1(k_t + n_t) + \beta_2(p_t^f + f_t - k_t - n_t - w_t) + g_t + \phi_t \tag{9}$$

3.2. *The Agricultural Sector*

3.2.1. *Supply of Food*

With the introduction of technology-based new agricultural strategy in most LDCs, a fundamental change has taken place in the input base of agriculture which means spectacular increase in the rate of fertilizer consumption. Let us assume that fertilizer input is provided by the government at an administered price. Given that the production function is differentiable and concave, the food supply function can be written as:

$$f_t^s = \alpha(p_t^f - p_t^m) + u_t \tag{10}$$

where p_t^m is log of fertilizer price and u_t is a random term which denotes quantity shock in the agricultural sector and for all practical purposes can be interpreted as supply shock in our dual economy.

3.2.2. *Demand for Food*

There are two components of demand for food — workers' food demand (F^w) and inventory investment in farm product (I^f). Since workers spend their entire income on food we have,

$$F^w = \frac{WNY}{Pf}$$

In log-form we write workers' food demand as

$$f_t^w = w_t + n_t + y_t - p_t^f \tag{11}$$

Next we turn to inventory investment in farm output. To plan for inventories landlords take into account difference between the current price and the expected future price. Landlords' expectation is based on current information set $I_t(z)$. The greater the difference between the current price and the expected future price, the lower the inventory demand. Accordingly, we write the inventory demand function as:

$$i_t^f = -\gamma(p_t^f - Ep_{t+1}^f \mid I_t(z)), \quad \gamma > 0 \tag{12}$$

where γ is the price elasticity of inventory demand and $I_t(z)$ includes all information at time t.

Thus the aggregate demand for food from (11) & (12) is:

$$f_t^d = w_t + n_t + y_t - p_t^f - \gamma(p_t^f - Ep_{t+1}^f \mid I_t(z)) \tag{13}$$

3.3. Solution Procedure

We start with food market equilibrium condition and we solve for food price and expected food price. We use these solutions to determine industrial output. In our model, food price flexibility ensures instantaneous attainment of the food market equilibrium which is written as:

$$f_t^d = f_t^s \tag{14}$$

From equations (9), (10), (13) & (14) we get,

$$\begin{aligned}[(1+\alpha)(1-\beta_2)+\gamma]p_t^f &= \gamma Ep_{t+1}^f - (1-\beta_2)u_t + g_t + \alpha(1-\beta_2)p_t^m \\ &\quad + \phi_t + (1-\beta_2)w_t + d_t \end{aligned} \tag{15}$$

where

$$d_t = n_t(1+\beta_1-\beta_2) - (\beta_1-\beta_2)k_t \tag{16}$$

To implement the rational expectation approach we consider the following equations:

$$u_t = u_{t-1} + v_t \tag{17a}$$

$$g_t = g_{t-1} + e_t \tag{17b}$$

$$p_t^m = p_{t-1}^m + s_t \tag{17c}$$

$$d_t = d_{t-1} + \varepsilon_t \tag{17d}$$

$$w_t = w_{t-1} + \eta_t \tag{17e}$$

where $v_t, e_t, s_t, \varepsilon_t, \eta_t$ follow white-noise process with zero mean and constant variance. In this context, some comments on d_t are in order. The term d_t contains exogenous variables including profit mark-up (k_t) and labour coefficient (n_t). These variables can change following a random walk process as specified in equation (17d).

We solve the model by applying the Barro-Lucas method of undertermined coefficients to a trial solution.

In the present context p_t^f depends on the following variables in log-linear form:

$$\begin{aligned}p_t^f &= \pi_1 u_{t-1} + \pi_2 g_{t-1} + \pi_3 d_{t-1} + \pi_4 p_{t-1}^m + \pi_5 w_{t-1} + \pi_6 v_t + \pi_7 e_t \\ &\quad + \pi_8 \varepsilon_t + \pi_9 s_t + \pi_{10}\eta_t + \pi_{11} f_t \end{aligned} \tag{18}$$

Next comes the determination of landlords' expected price. From (18) we get,

$$\begin{aligned}p_{t+1}^f &= \pi_1 u_t + \pi_2 g_t + \pi_3 d_t + \pi_4 p_t^m + \pi_5 w_t + \pi_6 v_{t+1} + \pi_7 e_{t+1} \\ &\quad + \pi_8 \varepsilon_{t+1} + \pi_9 s_{t+1} + \pi_{10}\eta_{t+1} + \pi_{11}\phi_{t+1} \end{aligned} \tag{19}$$

Hence,

$$\begin{aligned}Ep_{t+1}^f \mid I_t(z) &= \pi_1 u_{t-1} + \pi_1 Ev_t \mid I_t(z) + \pi_2 g_{t-1} + \pi_2 Ee_t \mid I_t(z) + \pi_3 d_{t-1} \\ &\quad + \pi_3 E\varepsilon_t \mid I_t(z) + \pi_4 p_{t-1}^m + \pi_4 Es_t \mid I_t(z) + \pi_5 w_{t-1} + \pi_5 E\eta_t \mid I_t(z) \end{aligned} \tag{20}$$

Since

$$E v_{t+1} \mid I_t(z) = 0,$$
$$E e_{t+1} \mid I_t(z) = 0,$$
$$E \varepsilon_{t+1} \mid I_t(z) = 0,$$
$$E s_{t+1} \mid I_t(z) = 0,$$
$$E \eta_{t+1} \mid I_t(z) = 0,$$
$$E \phi_{t+1} \mid I_t(z) = 0.$$

The key to the formation of price expectation is the calculation of expectations, Ev_t, Ee_t, $E\varepsilon_t$, Es_t & $E\eta_t$ conditioned on observation of p_t^f. Following Barro (1976), we obtain these conditional expectations by running regression of v_t, e_t, ε_t, s_t & η_t respectively on the observed sum $(\pi_6 v_t + \pi_7 e_t + \pi_8 \varepsilon_t + \pi_9 s_t + \pi_{10}\eta_t + \pi_{11}\phi_t)$.

Thus we get,

$$E v_t \mid I_t(z) = \frac{\theta_1}{\pi_6}(\pi_6 v_t + \pi_7 e_t + \pi_8 \varepsilon_t + \pi_9 s_t + \pi_{10}\eta_t + \pi_{11}\phi_t) \tag{21}$$

where

$$\theta_1 = \frac{\pi_6^2 \sigma_v^2}{\Delta} \tag{21a}$$

$$E e_t \mid I_t(z) = \frac{\theta_2}{\pi_7}(\pi_6 v_t + \pi_7 e_t + \pi_8 \varepsilon_t + \pi_9 s_t + \pi_{10}\eta_t + \pi_{11}\phi_t) \tag{22}$$

where

$$\theta_2 = \frac{\pi_7^2 \sigma_e^2}{\Delta} \tag{22a}$$

$$E \varepsilon_t \mid I_t(z) = \frac{\theta_3}{\pi_8}(\pi_6 v_t + \pi_7 e_t + \pi_8 \varepsilon_t + \pi_9 s_t + \pi_{10}\eta_t + \pi_{11}\phi_t) \tag{23}$$

where

$$\theta_3 = \frac{\pi_8^2 \sigma_\varepsilon^2}{\Delta} \tag{23a}$$

$$E s_t \mid I_t(z) = \frac{\theta_4}{\pi_8}(\pi_6 v_t + \pi_7 e_t + \pi_8 \varepsilon_t + \pi_9 s_t + \pi_{10}\eta_t + \pi_{11}\phi_t) \tag{24}$$

where

$$\theta_4 = \frac{\pi_9^2 \sigma_s^2}{\Delta} \tag{24a}$$

$$E n_t \mid I_t(z) = \frac{\theta_5}{\pi_{10}}(\pi_6 v_t + \pi_7 e_t + \pi_8 \varepsilon_t + \pi_9 s_t + \pi_{10}\eta_t + \pi_{11}\phi_t) \tag{25}$$

where

$$\theta_5 = \frac{\pi_{10}^2 \sigma_\eta^2}{\Delta} \tag{25a}$$

and

$$\Delta = \pi_6^2\sigma_v^2 + \pi_7^2\sigma_e^2 + \pi_8^2\sigma_\varepsilon^2 + \pi_9^2\sigma_s^2 + \pi_{10}^2\sigma_\eta^2 + \pi_{11}^2\sigma_\phi^2 \tag{26}$$

The π coefficients must be such that the market clearing condition for the agricultural sector, namely $f_t^d = f_t^s$ holds. We can determine the 'π' coefficients by term—by term coefficient equalities for variables that appear in equation (15). The 'π' coefficients are—

$$\pi_1 = -\frac{1}{1+\alpha} \tag{27a}$$

$$\pi_2 = \frac{1}{(1+\alpha)(1-\beta_2)} \tag{27b}$$

$$\pi_3 = \frac{1}{(1+\alpha)(1-\beta_2)} \tag{27c}$$

$$\pi_4 = \frac{\alpha}{1+\alpha} \tag{27d}$$

$$\pi_5 = \frac{1}{1+\alpha} \tag{27e}$$

$$\pi_6 = -\left[\frac{\gamma}{1+\alpha}\{\theta_1(1+\alpha) + (\theta_2+\theta_3+\theta_4+\theta_5\} + (1-\beta_2)\right] \tag{27f}$$

$$\frac{\pi_6}{\pi_7} = -(1-\beta_2) \tag{27g}$$

$$\frac{\pi_6}{\pi_8} = -(1-\beta_2) \tag{27h}$$

$$\frac{\pi_6}{\pi_9} = -\frac{1}{\alpha} \tag{27i}$$

$$\frac{\pi_6}{\pi_{10}} = -1 \tag{27j}$$

$$\frac{\pi_6}{\pi_{11}} = -(1-\beta_2) \tag{27k}$$

These coefficients imply the solution for food price as:

$$\begin{aligned} p_t^f = {} & -\frac{1}{1\alpha}u_{t-1}\frac{1}{(1+\alpha)(1-\beta_2)}g_{t-1} + \frac{1}{(1+\alpha)(1-\beta_2)}d_{t-1}\frac{\alpha}{1+\alpha}p_{t-1}^m \\ & + \frac{1}{1+\alpha}w_{t-1} - \left(v_t - \frac{e_t}{1-\beta_2} - \frac{\varepsilon_t}{1-\beta_2} - \alpha s_t - \eta_t - \frac{\phi_t}{1-\beta_2}\right) \\ & \times \left[\frac{\gamma}{1+\alpha}\{\theta_1(1+\alpha) + (\theta_2+\theta_3+\theta_4+\theta_5)\} + (1-\beta_2)\right] \end{aligned} \tag{28}$$

Substituting the values of 'π'coefficients in equation (20) we get the value of expected food price. Once food price is determined equation (9) solves for the industrial production.

4. COMPARATIVE STATICS

In this section we carryout a few comparative static exercises. Specificly we study supply shock in the agricultural sector, demand shock due to change in fiscal policy parameters & different types of price shocks either in the form of change in money wage rate or change in input-price of fertilizer. In each of these exercises we pay explicit attention to current shock & previous shock. As is usual in new-classical macroeconomics, anticipated and unanticipated shocks have different implications.

4.1. Supply Shock

First we start with supply shocks. A primary source of macroeconomic flactuation in semi-industrialized economics is supply shock in the agricultural sector which takes the form of parametric change in the food production. The implications of supply shocks are examined in the following propositions:

PROPOSITION 1. *A fully anticipated supply shock has no real effect on industrial production.*

Suppose that $\Delta u_{t-1} > 0$. (It corresponds to bumper harvest).

It follows from equation (28) that

$$\Delta p_t^f = -\frac{1}{1+\alpha}\Delta u_{t-1} \tag{29}$$

Now,

$$\Delta y_t = \beta_2[(1+\alpha)\Delta p_t^f + \Delta u_{t-1}] = 0 \tag{30}$$

Next we consider implications of unanticipated supply shock in terms of proposition 2.

PROPOSITION 2. *An unanticipated supply shock may lead to industrial contraction.*

In case of an unanticipated supply shock, we have $\Delta v_t > 0$. Equation (28) gives

$$\Delta p_t^f = -\left[\frac{\gamma}{1+\alpha}\{\theta_1(1+\alpha) + (\theta_2+\theta_3+\theta_4+\theta_5)\} + (1-\beta_2)\right]\Delta v_t < 0. \tag{31}$$

Now,

$$\begin{aligned}\Delta y_t &= \beta_2[(1+\alpha)\Delta p_t^f + \Delta v_t] \\ &= \beta_2[(1+\alpha)(\beta_2 - \gamma\phi_1) - \gamma(\theta_2+\theta_3+\theta_4+\theta_5) - \alpha]\Delta v_t\end{aligned} \tag{32}$$

If $\beta_2 < \gamma\phi_1$ or $\gamma > \frac{\beta_2}{\theta_1}$ we have $\Delta y_t < 0$. This is a case of 'problem of plenty' in the sense that bumper harvest may lead to industrial contraction. The result is amenable to economic interpretation. In case of unanticipated increase in food production, food price falls more than the expected food price, leading to rise in farm inventory holding. If inventory demand rises more than the rise in food production, worker's food demand falls which necessitates a decline in the industrial employment and production. This is supported by fall in landlord's income on account of sharp fall in food price.

4.2. Fiscal Policy

Fiscal policy changes constitute major sources of demand shocks in a developing country. The implications of the fiscal policy changes are examined in the following proposition:

PROPOSITION 3. *Increase in government expenditure leads to output expansion in both the sectors.*

First we examine the increase in anticipated government expenditure. Letting $\Delta g_{t-1} > 0$, we get the following results:

$$\Delta p_t^f = \frac{1}{(1+\alpha)(1-\beta_2)} \Delta g_{t-1} \tag{33}$$

$$\Delta f_t = \frac{\alpha}{(1+\alpha)(1-\beta_2)} \Delta g_{t-1} \tag{34}$$

$$\therefore \Delta y_t = (1+\alpha)\Delta p_t^f + \Delta g_{t-1}$$

$$= \frac{1}{1-\beta_2} \Delta g_{t-1} \tag{35}$$

Next consider unanticipated increase in government expenditure, i.e., $\Delta e_t > 0$. Its effects on different macrovariables are:

$$\Delta p_t^f = \left[\frac{\gamma}{(1+\alpha)(1-\beta_2)} \{\theta_1(1+\alpha) + (\theta_2+\theta_3+\theta_4+\theta_5)\} + 1 \right] \tag{36}$$

$$\Delta p_t = \left[\frac{\alpha\gamma}{(1+\alpha)(1-\beta_2)} \{\theta_1(1+\alpha) + (\theta_2+\theta_3+\theta_4+\theta_5)\} + 1 \right] \tag{37}$$

$$\Delta y_t = \left[\frac{\gamma\beta_2}{(1-\beta_2)} \{\theta_1(1+\alpha) + (\theta_2+\theta_3+\theta_4+\theta_5)\} + \beta_2(1+\alpha) + 1 \right] \Delta e_t \tag{38}$$

Rise in government expenditure involves direct favorable effect on industrial output. Employment and food demand begin to rise. This leads to rise in food price, food production and landlord's income which reinforces the initial expansion of the industrial output.

COROLLARY 1. *In case of inelastic inventory demand ($\gamma = 0$), unanticipated increase in government expenditure causes greater output expansion, compared to anticipated increase if $\alpha > \frac{\beta_2}{1-\beta_2}$.*

COROLLARY 2. *In case of inelastic food supply ($\alpha = 0$), unanticipated increase in government expenditure causes greater output expansion, compared to anticipated increase if $\gamma > \frac{1}{\beta_2(\theta_1+\theta_2+\theta_3+\theta_4+\theta_5)}$.*

Both the corollaries follow from equations 35 and 38.

4.3. Price Shocks

Price shocks can take different forms. They can operate either as demand shock or as supply shock. Rise in industrial wage is primarily a demand shock, while change in administered price of fertilizer input causes supply side adjustment in the first place. The following propositions explore implications of price shocks.

PROPOSITION 4. *Anticipated increase in money wage has no real effect on the industrial output, but the agriculture production goes up.*

Consider $\Delta w_{t-1} > 0$

$$\begin{aligned}\Delta p_t^f &= \pi_5 \Delta w_{t-1} \\ &= \frac{1}{1+\alpha}\Delta w_{t-1} \end{aligned} \tag{39}$$

$$\Delta f_t = \left(\frac{\alpha}{1+\alpha}\right)\Delta w_{t-1} \tag{40}$$

$$\Delta y_t = \beta_2[(1+\alpha)\Delta p_t^f - \Delta w_{t-1}] = 0 \tag{41}$$

PROPOSITION 5. *Unanticipated increase in wage involves expansion of the agricultural sector, but its effect on the industrial output is ambiguous.*

Consider $\Delta \eta_t > 0$

Now,

$$\begin{aligned}\Delta p_t^f &= \pi_{10}\Delta \eta_t \\ &= \left[\frac{\gamma}{(1+\alpha)}\{\theta_1(1+\alpha) + (\theta_2+\theta_3+\theta_4+\theta_5\} + (1-\beta_2)\right]\Delta \eta_t \end{aligned} \tag{42}$$

$$\Delta f_t = \left[\frac{\gamma\alpha}{(1+\alpha)}\{\theta_1(1+\alpha) + (\theta_2+\theta_3+\theta_4+\theta_5)\} + \alpha(1-\beta_2)\right]\Delta \eta_t \tag{43}$$

$$\begin{aligned}\Delta y_t &= \beta_2[(1+\alpha)\Delta p_t^f - \Delta \eta_t] \\ &= [\gamma\beta_2\{\theta_1(1+a) + (\theta_2+\theta_3+\theta_4+\theta_5)\} \\ &\quad + \beta_2\{(1+\alpha)(1-\beta_2) - 1\}]\Delta \eta_t \end{aligned} \tag{44}$$

Increase in money wage involves two opposite effects on industrial production. It tends to reduce landlord's demand for industrial output at constant food price. On the other hand, it increases worker's demand for food and causes food price to go up leading to rise in food production and landlord's income. In case of anticipated increase in wage, these two effects cancel out each other. However, the effect on landlord's real income in terms of industrial output becomes ambiguous in case of unanticipated shock leading to ambiguity regarding effect on industrial production.

COROLLARY 3. *A sufficient condition for the industrial production to rise is*

$$\alpha > \frac{\beta_2}{(1-\beta_2)}$$

It follows from equation (44).

Next we turn to revision of administered price of fertilizer. A very common aspect of economic reforms is removal of subsidies. In the context of the this model, removal of fertilizer subsidy takes the form of an increase in the administered price of fertilizer. Its macroeconomic implications are examined in the following propositions.

PROPOSITION 6. *Anticipated increase in fertilizer price has no effect on industrial production, though agricultural production falls.*

It follows from equation (28) that

$$\Delta p_t^f = \left(\frac{\alpha}{1+\alpha}\right)\Delta p_{t-1}^m \tag{45}$$

$$\begin{aligned}\Delta f_t &= \alpha[(\Delta p_t^f - \Delta p_{t-1}^m) \\ &= \alpha\left[\frac{\alpha}{1+\alpha} - 1\right]\Delta p_{t-1}^m \\ &= -\alpha\Delta p_{t-1}^m\end{aligned} \tag{46}$$

$$\begin{aligned}\Delta y_t &= \beta_2[\Delta p_t^f + \alpha(\Delta p_t^f - \Delta p_{t-1}^m)] \\ &= \beta_2[(1+\alpha)\Delta p_t^f - \alpha\Delta p_{t-1}^m] \\ &= \beta_2\left[(1+\alpha)\frac{\alpha}{1+\alpha} - \alpha\right]\Delta p_{t-1}^m \\ &= 0\end{aligned} \tag{47}$$

PROPOSITION 7. *Unanticipated rise in fertilizer price may lead to rise in the industrial production.*

First we note that

$$\begin{aligned}\Delta p_t^f &= \pi_9 \Delta s_t \\ &= \left[\frac{\gamma\alpha}{(1+\alpha)}\{\theta_1(1+\alpha) + (\theta_2+\theta_3+\theta_4+\theta_5)\} + \alpha(1-\beta_2)\right]\Delta s_t\end{aligned} \tag{48}$$

Now,

$$\begin{aligned}\Delta y_t = \alpha\beta_2[\{&\theta_1(1+a) + (\theta_1+\theta_2+\theta_3+\theta_4+\theta_5)\} \\ &+ (1+\alpha)(1-\beta_2) - 1]\Delta s_t\end{aligned} \tag{49}$$

It follows from (49) that $\Delta y_t > 0$ if $\alpha > \frac{\beta_2}{1-\beta_2}$

At first look, this result appears to be counterintuitive to conventional wisdom. However, a closer look at the structure of the model can clarify this result. A rise in fertilizer price causes food price to go up. For reasonably elastic food supply landlord's income

measured in terms of industrial output rises, leading to demand-led expansion of the industrial sector.

5. CONCLUSION

This paper deals with macroeconomic implications of shocks in a dual economy which incorporates the Keynesian principle of aggregate demand for the industrial sector and supply constraint for the agricultural sector. The crucial feature of the model is rational expectation treatment of shocks leading to macroeconomic fluctuations in semi-industrialized economies. The model highlights importance of distribution of shocks over time. The different propositions obtained in the paper stress proper knowledge of the structural parameters and the timing of shocks in the assessment of macroeconomic consequences of shocks. A very natural advantage of rational expectation lies in making careful distinction between anticipated and unanticipated shocks in context of the model developed in this paper.

The model can be extended in different directions. The monetary factors can be accommodated and the link between the interest rate and commodity prices can be established on assumption that stock of primary goods is an asset which features in the portfolio choice of wealth owner in a financially repressed economy (see Moutos and Vines, 1992). A very natural extension is to recast the paper in a dependent economy framework on assumptions that the industrial sector uses an imported input, the agricultural sector is a traded sector and economy faces binding foreign exchange constraint (see Montiel, 1986 for a dependent economy structure of a developing country operating under binding foreign exchange constraint). Since not much of analytical work has been undertaken in these directions, future research programme can take up these challenges.

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