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Macroeconomics of Demonetisation: A short period equilibrium[Ψ]

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The effects of demonetization in India have been a widely discussed and debated issue ever since 8th November, 2016. This paper wishes to add to that debate by focusing on a proper theoretical understanding of demonetization. In doing so, we construct a couple of models based on the Keynesian-Kaleckian framework. Both these models are based on interest rate targeting which makes money supply endogenous. The first model is an open economy AD-AS model while the second is a dual economy structuralist macro model. Both the models show how demonetisation can produce adverse macroeconomic outcomes.

Keywords: Demonetization, macro theoretic model, informal credit

JEL Classification: E12, E21, E51, E65

I. Introduction

The effects of demonetization in India have been a widely discussed and debated issue ever since its announcement on 8th November, 2016. Largely the debate has raised questions regarding the design and implementation of the initiative, the short and long run impacts of such an unanticipated shock and the implications for the future conduct of macroeconomic policies in general and monetary policy in particular. This paper wishes to add to that debate, by focusing on the

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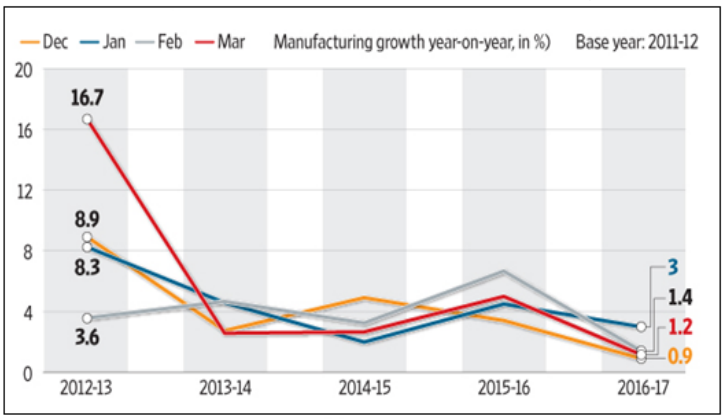
theoretical understanding of demonetisation which in our paper operates through cash disruption effect, credit disruption and multiple cross effects arising from the inter linkage between the agricultural and the industrial sector[1]. In particular, the paper attempts to offer a short run analysis of demonetisation from a macro-finance perspective.

In Economic Survey, 2016-17 certain short run costs of demonetisation have been identified. These costs include among others inconvenience and hardships of cash intensive sectors and stem from uncertainty that demonetisation inflicts on the economy. On the other hand, the timing and magnitude of long term benefits of demonetisation remain uncertain. As the Indian government scrapped 86.9% of the currency in circulation in one go, critics shouted that it will dampen the growth trajectory of India, sending ripples through a largely cash dependent economy. Unfortunately the critics have been proven correct as the current estimates of CSO shows growth to slow down to 7.1% during 2016-17 from 7.9% in the previous year. IMF in its first assessment, post demonetisation lowered India's growth forecast to 6.6% for 2016-17, citing the impact of note ban. As warned by several economists, India's industrial growth also faltered. Output fell in two out of the four months between November and February. This is shown in Figure 1.

Figure 1: Manufacturing Growth Trend In India post demonetisation



Source: Quarterly Report 2016-17, Ministry of Statistics and Programme Implementation

[1] A proper assessment of demonetization in an emerging market economy like India requires a careful understanding of different dimensions of dualism existing in such countries.

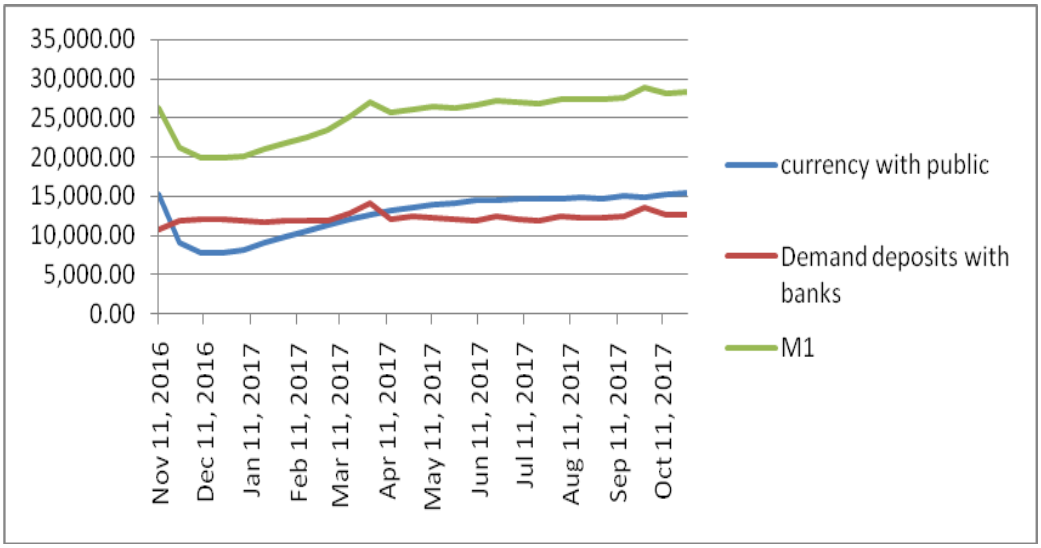
It is instructive to note that demonetization is an unanticipated monetary shock in a very specific sense. This policy with far reaching implications for the Indian economy has been implemented without any public discussion. A question may be asked whether the unprecedented action of the government at all had any relevance for the economy or not. At the time of implementation, the much-hyped objectives stated were (i) recovering the black money circulating in the economy, (ii) curbing the terrorist activities in the country which is largely financed by such black money, (iii) confiscating the fake currency circulating in the economy and iv) to fight corruption. As on date RBI data shows that all but 1% of the high-value bank notes demonetised have returned to the banking system. This would imply that black money hoarders found ways to legitimise their cash that now earns interest. Rajan (2017) [2] estimates this burden could be as high as Rs 24,000 crore a year, if one assumes there was about Rs 4 lakh crore worth illegal cash at the time of the note ban. Moreover, the seizure of new 2000 rupees notes shows that the second objective of removal of fake currencies ended in vain. Hence, Basu (2017) correctly pointed out that possibly demonetization was a monetary policy blunder in the sense that it achieved next to nothing, and inflicted a large cost on the poor and the informal sector.[3]

Demonetisation is also very unusual in its monetary consequences. While currency in circulation has contracted, deposits in the banking system have surged. The sudden increase in deposits created large surplus liquidity conditions in the banking system. However, this did not transmit itself through the credit channel as RBI absorbed it through a mix of variable reverse repo rates, application of incremental cash reserve ratios and cash management bills. As a consequence, there was not only a shortage in cash per se, formal credit also did not receive much of a boost. Convertibility between cash and deposits was impeded by the policy undertaken on the 8th of November. However, interest rates on lending, borrowing and other assets declined significantly since November 9, 2016. The state of the monetary variables post demonetisation is shown in Figure 2.

[2] Raghuram Rajan (8th September, 2017) Hindustan Times Available at http://www.hindustantimes.com/business-news/raghuram-rajan-says-demonetisation-put-new-interest-burden-on-rbi-as-people-found-ways-to-convert-black-money/story-lsCv1XtaUNjMVnhtvECeiK.html

[3] He infers that given low international oil prices and high wages in China, India should have attained a high growth rate of over 8% following the introduction of Goods and Service tax and new bankruptcy laws.

Figure 2: Trend of Monetary Variables post demonetisation



Source: RBI database, November 2017

Demonetisation is an unfavourable shock. On one hand it can be perceived as a reduction in currency holding by public and hence they face cash-in-advance constraint. In our models, we consider cash as the determinant of consumption and investment. Moreover, one cannot overlook the uncertainty element which generated from the vagueness associated with the duration and impact of this unforeseen monetary policy. Keynesian financial accelerator hypothesis and propagation of business cycles explains how such confidence crisis leading to recession may give recession a permanent status. Again in the supply dimension, for a cash intensive production sector, a sudden cash crunch can have far reaching ramifications. In particular for a dual economy like India, where the agricultural sector and the informal sector is entirely credit dependent, a deceleration is evident. Though the agricultural output went largely unscathed,[4] the media reported that textile hubs and jewellery markets across India have been badly hit with workers not being paid wages, lay-offs taking place and sales coming down drastically, with many enterprises being forced to shut down. It remains to be seen whether the formal sector will be affected through second

[4] Normally agricultural production decisions are taken a priori. However, in case of the perishables, the farmers had to sell their winter crop at throw away prices to run their household. As the economy was remonetised and consumption plans were smoothened out, a tendency of hoarding may generate. A strict vigilance is essential to stop prices form escalating due to inventory shocks and causing food price inflation.

round effects of demand and supply constraints arising from the poor functioning of the informal sector.

In this paper we will examine effects of demonetisation from the perspective of structuralist macroeconomics. The theoretical literature on demonetization in the Indian context[5] is relatively sparse. Dasgupta (2016) explained the short run impacts of demonetisation in a simple open economy IS-LM framework. However, it is an aggregative study and ignores the informal sector altogether, and there is no inter-linkage between the two sectors. Ghosh (2017) has used a macro-theoretic framework to show that demonetisation will hamper the informal sector which in turn will affect the functioning of the organised sector.[6] Raychaudhuri (2017), Waknis (2017) identify alternative channels through which demonetisation operates. However, what is missing in the literature is a comprehensive theoretical model which can analyse the effects of such a un anticipatory monetary shock on a dualistic economy which is primarily cash-dependent.

In filling the caveat in the existing literature, we construct a couple of models based on the Keynesian-Kaleckian framework. The first model in our paper is an open economy AD-AS model. The model shows how uncertainty generated by demonetisation in financial markets can produce adverse macroeconomic outcomes. The channels of transmission operate through decline in investment and consumption and exchange rate depreciation arising due to capital outflow which in turn produces upward pressure on price level and fall in the real money balance. The second model constructed is a dual economy model, which considers two sources of credit i.e. formal and informal credit[7]. The key feature of the model is the effect of demonetisation on overall supply of credit in general and in particular informal credit. We will show that credit disruption affects agricultural production and through multiple cross effects, it causes decline in industrial output.

[5] Rajakumar and Shetty (2016), Nag (2016) and Raychaudhuri (2017).
[6] In his model, Ghosh (2017) sees demonetization as demonetization of currency notes of certain denominations along with restrictions on withdrawal of non-demonetized currency notes from bank deposits. Along with fall in currency, we also consider a fall in direct credit as a feature of the type of demonetization carried out in India.
[7] The two sector analysis is based on works of Bose (1989) and Basu and Nag (2017).

Furthermore, the nexus between finance and long run growth is an unsettled issue[8].The paper on demonetization can also be linked to a large literature on link between the banking sector development and the macroeconomic performance in both developed and developing countries. Though we will not consider the contemporary issue of causality between financial development and growth, what we can show is that credit disruption affects a developing country with different layers of dualism[9].

The rest of the paper is organised as follows. In section 2 we construct an open economy AD-AS model. In section 3, we construct a two sector model focussing on inter-linkage between an industrial sector and an agricultural sector. In sector 4, we analyse some related issues of demonetisation. Section 5 concludes the paper.

2. An Open Economy AD-AS Model

In this section, we construct an open economy AD-AS model. Consumption of the households is dependent on not only real disposable income but also the real value of currency held by them. Firms also need enough cash to finance their demand for working capital. In this context, one can refer to cash-in-advancement constraint or Clower constraint. India being a cash-reliant economy, we consider currency holding as determinant of consumption and investment. The model is based on Taylor's rule[10] under which the Central Bank fixes the nominal interest rate and money supply becomes endogenous[11]. We assume imperfect capital mobility. Exchange rate adjusts to equilibrate the balance of payments.

The following symbols will be used in the formal representation of the model.

Y : Domestic output level

P : Domestic price level

[8] See Bencivenga and Smith (1993), Demirgüç-Kunt and Maksimovic (1998), King and Levine (1993), Levine (1999), Levine and Zervos (1998)

[9] See Bernanke (1993)

[10] An offspring of the debate between rule versus discretion, the Taylor rule emphasized the importance of adjusting policy rates more than one-for-one in response to an increase in inflation. Based on the U.S. experience in the late 1980s and early 1990s, the rule suggested that interest rate could be explained by a simple equation: r = p + 1/2y + 1/2(p-2) + 2, where y represents the percent deviation of real GDP from trend and p represents the rate of inflation over the previous four quarters.

[11] The RBI acts as an inflation hawk. Inflation-targeting is achieved by fixation of nominal interest rate.

P_0 :Price of oil in the international market
P^* : Foreign Price level
l : Labour
O : Oil which is imported
e : Nominal exchange rate
k : Kaleckian mark-up
C : Consumption
M: Money supply
i : Domestic rate of interest
i^* : Foreign rate of interest
G: Government expenditure
NX: Net Exports
CU: Currency
Y^* : Foreign income
e^e :Expected exchange rate
α : Uncertainty parameter

The model is represented by the following equations.

$$P = k\left[wl + eOP_o^*\right], \quad k > 1 \tag{1}$$

$$Y = C\left(\frac{CU}{P}, Y, \alpha\right) + I\left(i, \frac{CU}{P}\right) + G + NX\left(\frac{eP^*}{P}, Y, Y^*\right) \tag{2}$$

$$\frac{M}{P} = L(i, Y) \tag{3}$$

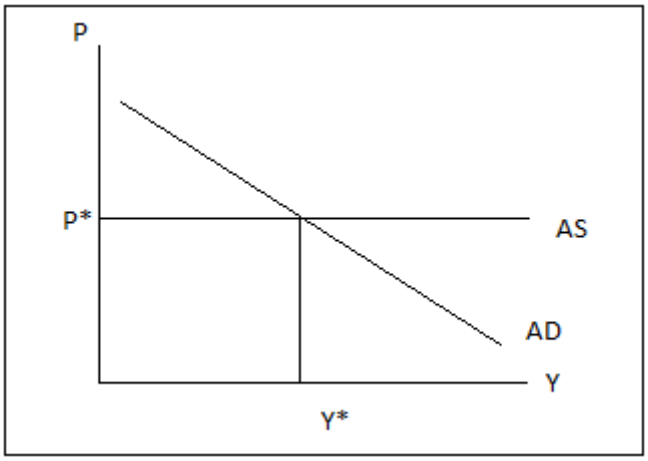
$$NX\left(\frac{eP^*}{P}, Y\right) + F\left[\bar{i} - \left(i^* + \frac{e^e}{e} - 1\right)\right] = 0 \tag{4}$$

Equation (1) gives the mark-up pricing. Equations (2), (3) and (4) represent the demand side of the economy. Equation (2) is the commodity market equilibrium. Aggregate demand is composed of consumption, investment, government expenditure and net exports. Consumption depends on both real disposable income and real value of currency. Both households and firms face cash-in-advancement constraint. They require sufficient cash to finance their consumption expenditure and investment expenditure respectively. Hence, both consumption and investment are positively related to the real value of currency.

Moreover, investment is negatively related to the interest rate. Net Exports (NX) varies directly with real exchange rate (which follows from Marshall-Lerner condition) and indirectly with domestic income. Equation (3) gives the money market equilibrium. The BOP equilibrium under flexible exchange rate is shown in equation (4).

Given the type of production function, the aggregate supply curve will be horizontal. Increase in price level reduces the real cash balance and hence reduces consumption. The net export also falls. Hence, the AD curve is downward sloping. The equilibrium in the model is shown in Figure 3.

Figure 3: Equilibrium in the model

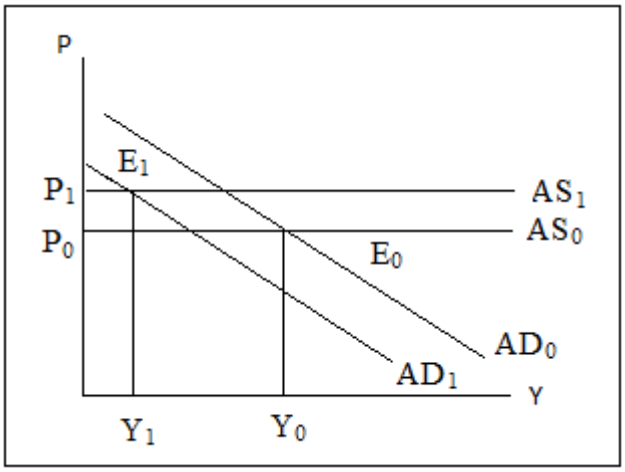


Next we pose the following question. How can demonetisation affect the economy? It is evident from the government's move to drain out old currency in circulation in form of deposits and limiting the amount of withdrawal, it has dried up the currency holding of the public. Given the fact that in India around 87% of transactions are made in cash, real currency holding will fall, thus reducing both aggregate consumption and investment expenditures. In addition, an uncertain economic environment is generated. As a result the AD curve shifts leftward. However, it is instructive to note that the currency ban would not affect the money supply in the economy at least in the short run per se[12]. Demonetisation generates unexpected monetary shock. It may lead to noisy signal in financial

[12] First currencies are converted into deposits. Since public sector banks have been highly undercapitalized, in most of the cases excess reserve ratio has increased. Hence, effect on money multiplier is ambiguous. Effect of capital flow on money base is ruled out on ground of Taylor rule.

market particularly foreign exchange market. As a result capital outflow occurs and exchange rate depreciates. This leads to rise in real exchange rate and hence cost of importing intermediate input, particularly oil goes up. Situation may be complicated due to rise in international price of oil, this may further escalate the cost of importing oil. This generates adverse supply shock leading to an upward shift of AS curve. On the other hand, the real exchange rate depreciation stimulates net exports leading to generate a positive effect on aggregate demand. However, the effect of decrease in consumption and investment dominates the effect of rise in net exports. This has been illustrated in the following Figure 4.

Figure 4: Effect of demonetisation



3. An Extension: A dual economy model with informal credit

The model formulation is based on stylized facts about the behaviour of a dual economy[13]. The economy consists of two sectors, namely an industrial sector and an agriculture sector. Output is demand determined in the industrial sector. On the other hand, all commodity and factor prices are flexible in the agriculture sector. Industrial price is fixed. We also abstract from import of intermediate inputs. Credit plays a significant role in determining output level in the agriculture sector. There are two sources of credit, namely formal and informal credit. Though the outreach and the amount of formal credit had increased in the last decade, several weaknesses in the institutional credit system have

[13]The basic framework of sectoral interlinkage follows the tradition of structural macroeconomics (see Bose (1989), Rakshit (1983) and Taylor (1977)).

significantly affected the viability and sustainability of these institutions, thus providing a space for the continuation of the role of informal credit in the agriculture sector. Moreover, the formal interest rate is fixed by Central bank which causes disequilibrium credit rationing. This in turn leads to emergence of informal credit market in which interest is endogenously determined. This completes the description of the economy. Thus a proper assessment of Demonetisation requires a careful understanding of different dimensions of dualism in an emerging market economy like India.

The following symbols will be used in the formal representation of the model.

Y : Output in the manufacturing sector
$\mathrm{P_Y}$: Industrial price
F : Output in agricultural sector
p_F : Price in agricultural sector
L : Formal credit
K : Informal credit
r : Informal interest rate
i : Formal interest rate
k : Capital inflow
ε : Profit mark-up
H : Farmers' demand for formal credit
m : Village money lenders' demand for formal credit

3.1 The agricultural sector

Agricultural farmers borrow from both formal and informal credit markets to carry out the food production process. Farmers are subject to several constraints in the formal credit market. Credit rationing takes place in the formal credit market which in turn imposes a credit ceiling on the amount of fund $(\bar{H})$ advanced to the farmers. This amount of loan is sufficient to finance farmers' demand for working capital if food production does not cross some threshold level, say F_0. However, if food production rises above F_0, farmers are compelled to take loans from village money lenders to finance their demand for working capital.

Hence, profit of farmers is given by[14]

[14] $For, F = F_0, H = \bar{H}$ and for $F > F_0, [H(F - F_0) - \bar{H}] > 0$

$$\pi_F = p_F(F - F_o) + p_F F_o - i\overline{H} - r[H(F - F_o) - \overline{H}] \qquad (5)$$

Here, P_F is the food price; i is the fixed interest rate in the formal credit market; H is the demand for credit; and r is the interest rate in the informal credit market; $[H(F - F_0) - \bar{H}]$ is the demand for informal credit. Note that, $H' = \frac{\partial H}{\partial F} > 0$, $H'' = \frac{\partial^2 H}{\partial F^2} > 0$.

From the first order condition of profit maximization we get

$$p_F = rH'(F)$$

Now the profit maximizing behaviour of farmers gives us food supply function as,

$$F^s = F^s(p_F, r) \qquad (6)$$

where, $F_1^s = \frac{\partial F^s}{\partial p_F} > 0$ and $F_2^s = \frac{\partial F^s}{\partial r} < 0$

The market demand for food (F_D) is

$$F^D = F_c\left(Y, w, \frac{CU}{p_F}\right) + X\left(\frac{ep_F^*}{p_F}\right) + I_F\left(\frac{p_F^e}{p_F}\right) \qquad (7)$$

The demand for food consists of industrial workers' consumption, exports[15] and Inventories. Workers spend their entire wage bill ($wa_l Y$) to purchase food[16].

[15] Unlike most Latin American countries, the industrial sector and the service sector account for major share of India's exports. However, both industrial and service sectors are heavily import dependent and in a macro setting in which Indian economy is placed in recent times requires foreign exchange through different alternative avenues. Agricultural sector is definitely one of the potential sources for the earning of the foreign exchange. This issue has to be analyzed against the background of burgeoning current account deficit. This underscores need for agricultural exports. Another issue to reckon with is emergence of a new type of agricultural sector namely export oriented, modern agricultural sector. Hence, the relevance of agriculture as a source of earning foreign exchange cannot be brushed aside. We may think of a hypothetical situation in which the industrial sector may face a dominant binding foreign exchange constraint. The relaxation of such constraint is possible through diversification of export basket with specific thrust on development of modern agriculture which can exploit the favourable world market.

Here, w is the wage rate, a_l is fixed labour coefficient in the industrial sector (Y) and hence, $a_l Y$ measures the industrial employment level. Now the food consumption of industrial workers depends on industrial output (Y), wage rate (w) and real value of currency holding measured in units of food $\left(\frac{CU}{P_F}\right)$.[17] Exports are positively related to the world price (measured in units of domestic currency) relative to the domestic price of food $\left(\frac{eP_F^*}{P_F}\right)$. The increase in food price causes a decrease in real value of currency holding of industrial workers leading to decrease in food consumption. Exports also decline due to decrease in relative world food price. Moreover, the increase in food price reduces expected relative price of food grains which in turn causes a decrease in inventories. On the other hand, an increase in industrial output raises level of employment in the industrial sector which entails an increase in food consumption of industrial workers.

Equilibrium in the food market requires that

$$F^s(p_F, r) = F_c\left(Y, w, \frac{CU}{p_F}\right) + X\left(\frac{ep_F^*}{p_F}\right) + I_F\left(\frac{p_F^e}{p_F}\right) \qquad (8)$$

From equation (8) we can obtain the equilibrium food price (P_F^*):

$$p_F^* = \rho(Y, e, w, r, CU, p_F^e) \qquad (9)$$

Let us explain partial effect of each variable on food price. An increase in industrial output (Y) raises food demand leading to increase in the food price and

[16] In this paper we assume that the workers consume only food. If we assume that workers spend on both food and industrial output the qualitative results of this paper remain unaltered, only the algebra will be complicated.

[17] In Indian economy most of the people wish to hold sufficient cash to finance their consumption expenditure. Therefore, real value of currency is considered to be an important determinant of workers' consumption expenditure.

hence, $\rho_1 = \frac{\partial \rho}{\partial Y} > 0$. An increase in exchange rate raises food export which in turn causes higher food demand leading to increase in food price such that $\rho_2 = \frac{\partial \rho}{\partial e} > 0$. An increase in wage rate raises workers' demand for food and hence, $\rho_3 = \frac{\partial \rho}{\partial w} > 0$. An increase in informal interest rate raises cost of borrowing in the agricultural sector leading to decrease in the supply of food and hence, food price rises to restore equilibrium in the food market. Therefore, we get $\rho_4 = \frac{\partial \rho}{\partial r} > 0$. An increase in currency holding raises demand for food which results in higher food price and consequently, we get $\rho_5 = \frac{\partial \rho}{\partial CU} > 0$. An increase in expected food price raises inventories leading to increase in demand for food and hence, higher food price. Therefore, we get $\rho_6 = \frac{\partial \rho}{\partial p_F^e} > 0$.

3.2 The Industrial Sector

The industrial sector uses two variable factors of production namely labour (L) and imported intermediate input, that is, oil (O) as factors of production. We assume that labour coefficients (a_l) and intermediate input coefficients (a_o) are fixed. Capital is a fixed factor of production.

The price equation for the industrial goods follows the Kaleckian mark up pricing

$$P_Y = \varepsilon\left[wa_1 + eP_O a_0\right] \qquad (10)$$

where, $\varepsilon > 1$ is the constant profit mark-up; e is the nominal exchange rate; P_o is the international price of oil which is given in the world market. Hence, domestic price of oil is eP_o. An increase in food price reduces exports leading to exchange rate depreciation which in turn raises domestic price of imported intermediate inputs.

The industrial profit less taxes is given by

$$\pi_Y = Y\left(1 - \frac{wa_1}{P_Y} - \frac{eP_O a_O}{P_Y}\right) - \frac{\tau}{P_Y} \quad (11)$$

Here, τ denotes business taxes levied on industrial producers.

The aggregate demand for industrial output (in real term) is given by,

$$AD_Y = C\left(\pi_Y, \frac{CU}{p_Y}\right) + I(i) + \frac{G}{p_Y} \quad (12)$$

According to equation (11), the aggregate demand for industrial output consists of consumption expenditure of industrial producers, investment expenditure and government expenditure. Consumption expenditure can be expressed as a positive function of profit of the industrial producers. Industrial producers are subject to cash-in-advance constraint. They need sufficient cash to purchase both consumption goods and working capital. Hence, both consumption expenditure and investment expenditure are positively related to real currency balance measured in units of industrial output. Moreover, industrial producers borrow from the formal credit market to finance their investment expenditure.

Hence, there exists a negative relation between investment and formal interest rate which is nothing but the cost of borrowing [$I_1 = \frac{\partial I}{\partial i} < 0$]. In nominal term, the government expenditure is exogenously given. However, we consider the real government expenditure, measured in units of industrial output, as a component of aggregate demand for industrial output. Since the industrial output is demand determined, equilibrium condition in the industrial sector is given by,

$$Y = AD_Y \quad (13)$$

From equation (13) we can obtain the equilibrium value of industrial output as,

$$Y^* = Y(e, p_Y, CU, w, i, G, T, P_o) \quad (14)$$

Let us interpret the partial effect of each variable on the industrial output. An increase in exchange rate raises cost for imported intermediate input which in

turn reduces profit of industrial producers leading to decrease in demand for industrial output and hence, $Y_1 = \frac{\partial Y}{\partial e} < 0$. An increase in industrial price causes lower real government expenditure. Moreover, the increase in industrial price reduces real value of currency generating a negative effect on consumption expenditure. On the other hand, the increase in industrial price reduces real costs of industrial producers leading to increase in industrial profit which in turn generates a positive effect on consumption expenditure. However, the restoration of a stable equilibrium requires that an increase in industrial price should reduce demand for industrial output, and hence, $Y_2 = \frac{\partial Y}{\partial P_Y} < 0$. An increase in currency holding raises demand for industrial goods and hence, $Y_3 = \frac{\partial Y}{\partial CU} > 0$. An increase in the wage rate reduces profit of industrial firm owners leading to decrease in producers' consumption expenditure. Hence, the demand for industrial output decreases due to increase in the wage rate, that is, $Y_4 = \frac{\partial Y}{\partial w} < 0$. An increase in domestic interest rate reduces investment demand. Therefore, demand for industrial output falls, that is, $Y_5 = \frac{\partial Y}{\partial i} < 0$. An increase in G leads to increase in demand for industrial output, that is, $Y_6 = \frac{\partial Y}{\partial G} > 0$. However, an increase in tax reduces profit of producers leading to decrease in demand for industrial output, that is, $Y_7 = \frac{\partial Y}{\partial \tau} < 0$. An increase in oil price in the world market leads to increase in the input cost and fall in the demand for industrial output. Therefore, $Y_8 = \frac{\partial Y}{\partial P_O} < 0$.

3.3 Balance of Payment Equilibrium

The balance of payment (BOP) equilibrium is,

$$p_F^* X\left(\frac{ep_F^*}{p_F}\right) + \bar{k} + k\left[\bar{i} - \left(i^* + \frac{e^e}{e} - 1\right)\right] = P_o a_o Y \qquad (15)$$

The left-hand side of the equation (15) consists of the agricultural exports and capital flow. The capital flow (k) has both exogenous ($\bar{k}$) and endogenous components. The endogenous capital flow is a positive function of the uncovered interest differential[18]. The right-hand side of the equation (15) shows the demand for foreign exchange which includes imports of oil.

From equation (15) we can determine the equilibrium exchange rate as

$$e^* = e(p_F, Y, \bar{k}, \bar{i}, i^*, P_o, P_F^*) \qquad (16)$$

Let us consider the partial effect of each variable on the exchange rate. An increase in food price reduces exports leading to excess demand in the foreign exchange market. Hence, exchange rate depreciates, that is, $e_1 = \frac{\partial e}{\partial P_F} > 0$. An increase in industrial output raises demand for oil which in turn causes an increase in demand for foreign exchange leading to exchange rate depreciation and hence, we get $e_2 = \frac{\partial e}{\partial Y} > 0$. An exogenous increase in capital flow leads to excess supply in the foreign exchange market leading to exchange rate appreciation and hence, $e_3 = \frac{\partial e}{\partial \bar{k}} < 0$. An increase in domestic interest rate raises capital inflow leading to increase in supply of foreign exchange. Hence, exchange rate appreciates, that is, $e_4 = \frac{\partial e}{\partial i} < 0$. An increase in the world interest rate leads to capital outflow and hence, $e_5 = \frac{\partial e}{\partial i^*} > 0$. An increase in oil price in the world

[18] The uncovered interest differential is $\bar{i} - \left(i^* + \frac{e^e}{e} - 1\right)$, where, i and i^* are domestic and foreign interest rates respectively. Here, risk premium is represented by the expected change in exchange rate. In this model, the expected exchange rate is assumed to be fixed. Clearly, our model departs from the Mundell-Fleming framework in the sense that we allow for imperfect capital mobility and hence, we drop the assumption of interest rate parity.

market raises import spending and hence, $e_6 = \frac{\partial e}{\partial P_O} > 0$. An increase in the food price in the world market raises exports and consequently, we get $e_7 = \frac{\partial e}{\partial P_F^*} < 0$.

3.4 The Credit Market

The credit market of this economy consists of both formal and informal financial sectors, which characterises the financial structure of a developing country. In this context, we assume that the industrial sector takes loans from the formal credit market to finance investment expenditure on the fixed capital. In addition, the village money lenders can also borrow from the formal credit market. The agricultural farmers borrow from both formal and informal credit markets to finance their working capital.

3.4.1 The Informal Credit Market

Farmers' demand for informal credit is,

$$K^d = H(F - F_o) - \overline{H}$$

$$\Rightarrow K^d = K^d(P_F, r, \overline{H}) \qquad (17)$$

where, $K_1^d = \frac{\partial K^d}{\partial P_F} > 0$, $K_2^d = \frac{\partial K^d}{\partial r} < 0$ and $K_3^d = \frac{\partial K^d}{\partial \overline{H}} < 0$.

The village money lenders take loans from the formal credit market and use this fund to provide loan to the agricultural farmers in the informal credit market. These money lenders behave like monopolist and hence, they have the power to set the informal interest rate.

The demand for loan is negatively related to the interest rate (r) of informal credit market, and the inverse demand function for loanable fund becomes,

$$r = r(K, a) \qquad (18)$$

Here, 'a' is the shift parameter which represents exogenous component of loan demand function[19], and $r_K = \frac{\partial r}{\partial K} < 0$, $r_\alpha = \frac{\partial r}{\partial a} > 0$.

The village money lenders are also subject to default risk, that is, a fraction of the loan may not be repaid. We take default risk (γ) as a positive function of the loan size (K). One possible justification for positive relation between the default risk and amount of loan is this. The amount of loan depends on the scale of operation. With an increase in scale of operation any harvest failure produces a stronger effect on farmers' income which in turn increases the default. Accordingly, the default risk rises with an increase in production. Hence,

$$\gamma = \rho\gamma(K) \tag{19}$$

Therefore, the revenue (R) earned by the village money lender is

$$R = [1-\gamma]Kr(K,a) \tag{20}$$

The cost incurred by the village money lender is

$$C = im(K) + \delta N(K) \tag{21}$$

Here, m is the money lender's demand for formal credit; and N represents number of trips to the bank which is positively related to the size of informal credit and δ represents fixed cost per trip to the bank, and $m_K = \frac{\partial m}{\partial K} > 0$, $N_K = \frac{\partial N}{\partial K} > 0$.

Now the profit of the money lender is,

$$\pi^m = [1-\rho\gamma(K)Kr(K,\alpha) - \bar{i}m(K) - \delta N(K) \tag{22}$$

The profit maximising behaviour of the money lender gives the following equilibrium condition,

[19] An increase in food price (P_F) or a decrease in credit ceiling $(\bar{H})$ in the formal credit market causes exogenous increase in loan demand as represented by higher 'a'.

$$[1-\rho\gamma(K)[r(K,\alpha)+Kr_K]\rho\gamma_K Kr(K,\alpha)=\bar{i}m_K-\delta N_K \qquad (23)$$

From equation (23) we get equilibrium value of loanable fund in the informal credit market and it can be expressed as,

$$K^*=K(a,\rho,\delta,\bar{i}) \qquad (24)$$

Note, $K_1=\frac{\partial K}{\partial a}>0, K_2=\frac{\partial K}{\partial \rho}<0, K_3=\frac{\partial K}{\partial \delta}<0, K_4=\frac{\partial K}{\partial i}<0$.

Now the equilibrium value of informal interest rate (r^*) can be obtained by using equation (17) and equation (24). Hence, the equilibrium informal interest rate is,

$$r^*=r(K^*,a)\Rightarrow r^*=r(a,\rho,\delta,\bar{i}) \qquad (25)$$

Equation (25) shows that equilibrium informal interest rate depends on exogenous component of loan demand (a) , rate of default risk (ρ), cost per trip to the bank (δ) and formal interest rate (i). Let us interpret partial effect of each parameter on informal interest rate. An exogenous increase in loan demand leads to increase in informal interest rate and hence, $r_1=\frac{\partial r^*}{\partial a}=r_K K_1+r_a>0$. An increase in rate of default risk raises informal interest rate such that $r_2=\frac{\partial r^*}{\partial \rho}=r_K K_2>0$. An increase in cost per trip to the bank raises cost of lending which in turn causes higher informal interest rate such that $r_3=\frac{\partial r^*}{\partial \delta}=r_K K_3>0$. An increase in formal interest rate also leads to increase in cost of lending and hence, $r_4=\frac{\partial r^*}{\partial i}=r_K K_4>0$.

3.4.2 The Formal Credit Market

Interest rate in the formal credit market is assumed to be fixed.

$$i=\bar{i} \qquad (26)$$

The supply of formal credit is also fixed at a given point of time, that is,

$$L^s = \bar{L} \tag{27}$$

Now the demand for formal credit comes from activities of farmers, village money lenders and industrial producers.

Farmers are subject to credit ceiling in the formal credit market and it is given by,

$$H = \bar{H} \tag{28}$$

Village money lenders' demand for formal credit can be represented as

$$m^* = m(K^*) \tag{29}$$

The industrial sector also takes loans from the formal credit market to finance investment expenditure. Hence, loan demand function of the industrial sector is

$$I = I(\bar{i}) \tag{30}$$

Therefore, total demand for formal credit is

$$L^d = \overline{H} + I(\bar{i}) + m(K^*) \tag{31}$$

Since, the formal interest rate is fixed below the equilibrium interest rate there exist disequilibrium in formal credit market in the form of excess demand and hence, we get

$$L^s < L^d \Rightarrow \bar{L} < \overline{H} + I(\bar{i}) + m(K^*) \tag{32}$$

3.5 Macroeconomic Equilibrium

The model can be solved for five endogenous variables namely food price, the industrial output, the exchange rate and the informal interest rate from the equations (9), (14), (16) and (25) respectively.

The diagrammatic representation can be used to depict the relationship between the food price and the industrial output with simultaneous determination of other

endogenous variables. For this purpose we substitute equation (16) into equation (9) and equation (14) and we get,

$$p_F^* = \rho[Y, e(p_F, Y, \bar{i}, P_o, i^*, p_F^*), w, r, CU, P_Y, p_F^e] \qquad (9a)$$

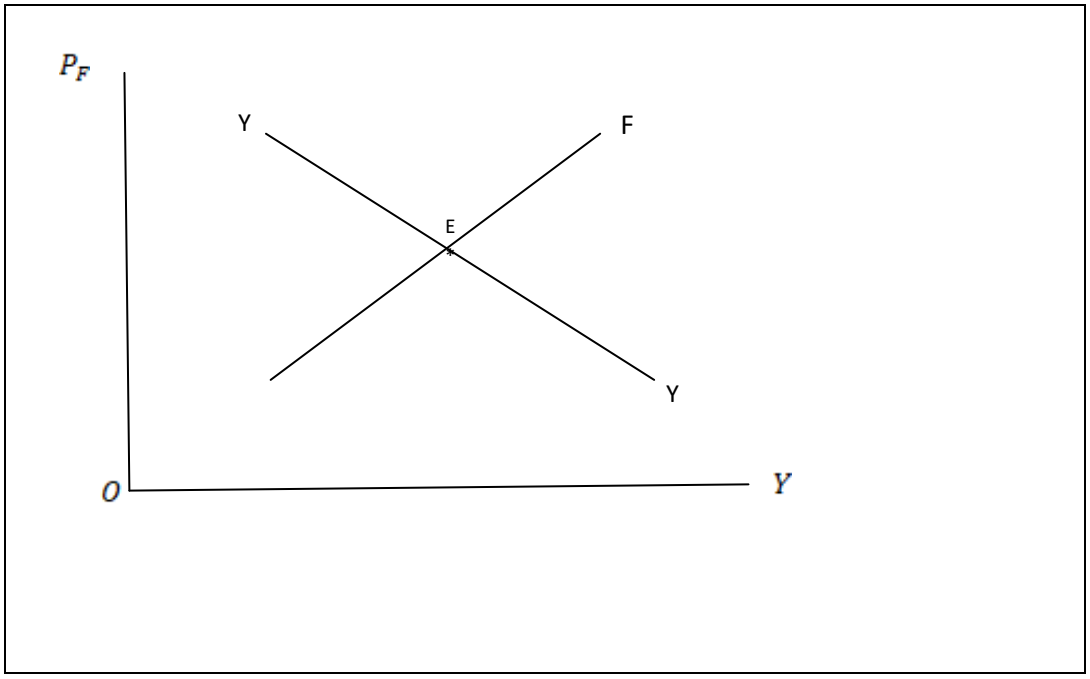
$$Y^* = Y[e(p_F, Y, \bar{k}, \bar{i}, i^*, P_o, p_F^*), w, i, G, T, CU, P_Y, P_o] \qquad (14a)$$

The equation (9a) represents a locus of combinations of food price and industrial output such that food market is in equilibrium. For instance, an expansion of the industrial sector requires more labour and imported intermediate inputs. This increase in level of employment raises workers' demand for food. Moreover, the increase in industrial output raises demand for imported intermediate inputs which in turn causes exchange rate depreciation and hence, an increase in agricultural exports. The resulting excess demand for food is eliminated by an increase in food price and hence, FF curve is upward sloping, as shown in Figure (5).

Similarly, the equation (14a) represents a relation between food price and industrial output so as to maintain equilibrium in the industrial sector. Let us intuitively explain this. An increase in food price reduces exports which entail exchange rate depreciation and hence, imported intermediate inputs become more expensive. This reduces profit of the industrial producers leading to decrease in consumption expenditure. Moreover, the increase in exchange rate raises industrial price, as represented by equation (14), which in turn causes a fall in real government expenditure $\left(\frac{G}{P_y}\right)$. After considering all the effects, it is clear that any increase in food price reduces aggregate demand for industrial output leading to contraction of the industrial sector. Consequently, the YY schedule is negatively sloped, as shown in Figure (5).

In Figure (5), macroeconomic equilibrium is shown by the point E^* at which the FF curve intersects the YY curve.

Figure 5: Macroeconomic Equilibrium with Food Price and Industrial Output



4. Demonetization

Now we will examine effects of demonetization. The effects not only depend on fall in the supply of currency but also on credit disruption. Credit disruption is captured by a fall in supply of formal credit. As a result, farmers face a fall in the credit ceiling $(\overline{H})$ in the formal credit market which in turn causes an increase in demand for informal credit leading to rise in 'a' which in turn causes higher informal interest rate as represented by equation (25). Moreover, this credit disruption raises cost per trip (δ)[20] to the bank leading to increase in the cost of village money lenders which also generates a positive effect on the informal interest rate shown in equation (25).

The increase in informal interest rate and a decrease in credit availability in both formal and informal credit market reduce food production. Demonetization also

[20] We can interpret δ as the value of the time spent on traveling to and from the bank and waiting in line for getting the cash credit.

reduces currency holding leading to decrease in demand for food. However, the decrease in supply may dominate the decrease in demand for food. As a result, there generates excess demand in the food market which in turn causes an increase in food price leading to leftward shift of the FF curve as represented in Figure (6).

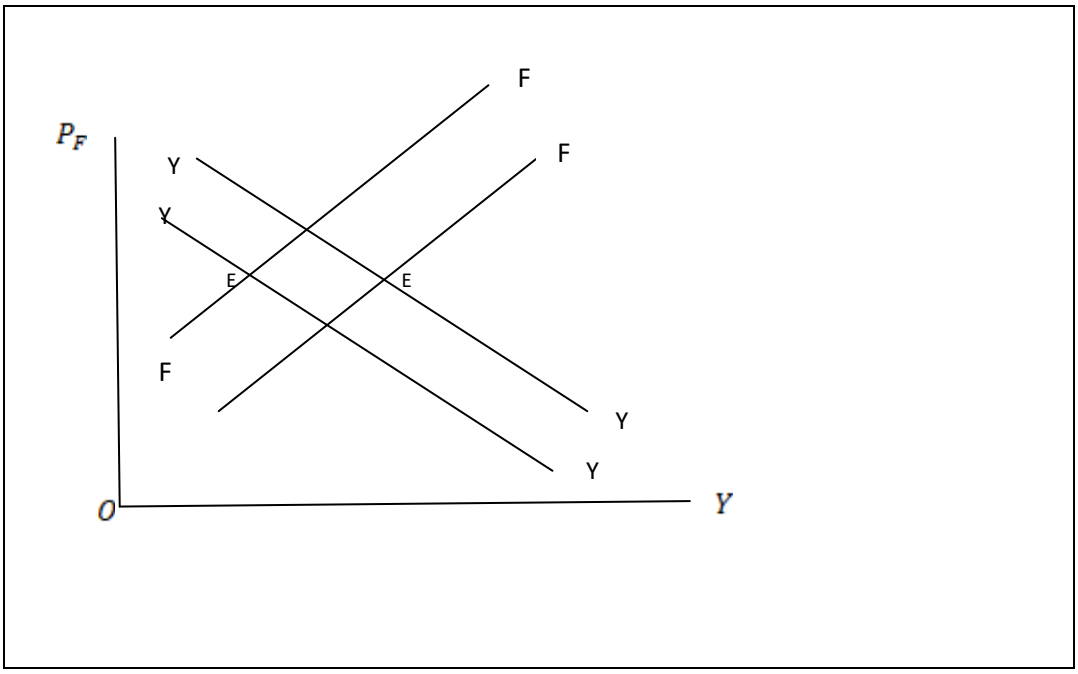
On the other hand, the decrease in currency holding causes a decline in consumption expenditure as well as investment expenditure on industrial goods. Moreover, openness in the economy can escalate the impacts of such a sudden policy prescription. Demonetization is an unanticipated monetary shock and it causes uncertainty in the foreign exchange market. This results in rise in exogenous capital outflow and exchange rate depreciates. The cost of importing intermediate input particularly oil goes up which in turn cause a fall in the profit of industrial producers and hence, consumption expenditure on industrial goods. In addition, the increase in exchange rate raises industrial price leading to decrease in real government expenditure. Therefore, demonetization entails a decrease in aggregate demand for industrial output leading to industrial contraction. Consequently, the YY schedule will shift leftward as represented in Figure (6). The effect on food price is ambiguous. However, the industrial output unambiguously falls.

The most probable outcome is represented by Figure (6). In this case shift of the FF schedule dominates shift of the YY schedule such that food price will increase and industrial output will fall as represented by the new equilibrium point E_2. What will happen to money supply? There is a fall in M_3. The logic is simple. When interest rate is targeted by the Central bank, money supply becomes endogenous. It is obtained from the money market. $\frac{M_s}{p} = l(\bar{\imath}, Y)$. As a consequence, money contraction follows from output contraction.

5. Conclusion

This paper shows that demonetization behaves as an adverse supply shock to the economy. Given the dual economy framework of a developing nation like India, the cash dependent agrarian sector will be affected unfavourably due to a sudden

Figure 6: Effect of Demonetization on Macroeconomic Equilibrium



shortage of liquidity. Though demonetization can have long term benefits,[21] short term losses are anticipated. The most important effort of the government should be to replenish the cash shortage as quickly as possible. Moreover in an open economy, which is sensitive to availability of cash, supply of currency should follow actual demand and not be determined through official estimates of desirable demand. In particular the effect on the poorer section of the economy has been significant. So the government should be more careful while choosing a policy instrument and its effects must be measured against their stated objectives and their logical consistencies. The subsequent effects of remonetisation are not considered here.

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