Article

The Macroeconomics of Demonetization: Theory and Some Conjectures

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Abstract

The withdrawal of high-denomination paper money in India—popularly termed 'demonetization'—has generated interest among common people to understand what the usual macroeconomic consequences of such one-time monetary shock are. This article conjectures (a) that such unanticipated supply-side replacement of paper money of higher denominations may lead to a currency 'trap' in the short run and a permanent increase in the hoarding of lower denomination currencies in the long run and (b) that the effect on the GDP in the medium run can be ambiguous in a simple IS-LM framework once the effects of variable price level and changing inflation expectations are captured through the presence of an informal sector.

Keywords

Demonetization, currency trap, informal sector

JEL Classification: E 12, E 26, E 44, E 52

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Introduction

The *unanticipated* withdrawal of high-denomination currency notes (alternatively 'paper' money or 'cash') in India has opened up a space for discussion of 'monetary theory' in non-technical terms, for this is an issue that has attracted attention of the public at large. For the profession of Economics, such incident offers an opportune moment to debate on the likely macro-level effects of the so-called 'demonetization'. What follows is clearly full of conjectures—and should have otherwise been supported by rigorous general equilibrium modelling as well as by sound empirical evidence. Further, the material is drawn largely and liberally from the existing works on monetary theory and policy. So, by no stretch of imagination, this is to be treated as an original piece of work. The article is written around a few topics that might be of interest. They appear as paragraphs, and are often loosely connected.

Demonetization

This is not the first time India has demonetized high-denomination currency notes; 1,000- and 10,000-rupee notes were withdrawn in 1946, and 1,000-, 5,000- and 10,000-rupee notes were withdrawn once again in 1978. Other countries have also done this—Ghana in 1982, Nigeria in 1984, Myanmar in 1987, Russia in 1991, North Korea in 2010 and Zimbabwe in 2015. The objectives vary from curbing high inflation (or hyperinflation), to check counterfeit currency, to reduce black money and to promote digitized transactions. For India the stated objectives were the last two.

However, it is not very clear why using less 'cash' in transactions over time be termed as 'demonetization'. The role of 'fiat' money is to support transactions, and money has different forms. In India, a particular variety of money supply, M1 or the 'narrow' money, has largely two components—currency with non-bank public plus demand deposits at commercial banks net of inter-bank deposits. So a *voluntary* reduction in the demand for and supply of 'currency'—in equilibrium—in strict sense is not demonetization as overall money stock remains the same. It is just that the other forms and denominations of money are used instead.

If one takes the text-book 'Baumol-Tobin' form of money-demand function (Mankiw, 2010), income elasticity of money demand turns out to be ½. This is typically a 'short-run' demand function, but this elasticity means that as the income (GDP) of countries grow, the demand for

money should increase, albeit less than proportionately. The simplest form of the quantity theory predicts the long-run demand for money to be unitary elastic with income, at a given level of transaction technology. Empirical evidence for long-run money demand—though mixed—certainly points to an elasticity that is significantly greater than zero and sometimes is close to one. For instance, it is approximately 0.5 in the post-war USA (Ball, 2001), while earlier studies found that a unitary elasticity could not be rejected (Hoffman & Rasche, 1991). For Latin America, the figure stands at 0.94 (Carrera, 2012). The average income elasticities for the Organisation for Economic Co-operation and Development (OECD) countries are estimated to be 0.79 for M1 and 1.12 for M3 and for non-OECD countries at 0.89 and 0.96, respectively (Knell & Stix, 2006). The average income elasticity is 1.09 in the developing economies (Kumar, 2014). Part of the difference is also accounted for by the extent of financial market development—a deeper financial market reduces the elasticity.

Such data suggest that countries will not use less 'money' as they grow, though they might use less 'cash'. But, evidence for using less cash is also weak, at least in the short run. Here is the short-run pattern in the uses of cash, measured by the currency-to-GDP ratio: for the US, it is up from 5.9 per cent in 2001 to 6.5 per cent in 2010, for Japan from 14.7 to 18.1, for the UK from 2.5 to 3.1, for Thailand from 9.5 to 11 and for India from 11.6 to 13 (International Monetary Fund, 2011). So, at least in the short run, there is no evidence that the people across countries are using less cash. Further, financial markets and payment technologies are fairly developed in most of these countries. Therefore, it seems unreasonable to assume that India is going to voluntarily move over to a cash-less economy anytime soon.

In fact, the article is going to argue that *unanticipated* supply-side replacement of currencies of higher denominations may lead to currency hoarding of lower denomination, which, in turn, may lead to a currency 'trap', similar to what is observed in a 'liquidity' trap.

Why Use Money?

An inescapable reference to monetary theory is Samuelson's work (1958) that first introduced the idea that introduction of money to an economy populated by more than one generation may improve welfare. More specifically, he showed that supply of outside money is a sufficient condition to generate a better outcome (measured by 'Pareto' optimal

distribution of goods) for everyone. But this cannot guarantee the use of money (or demand) in the economy all the time; one requires further conditions that ensure a strictly positive price of money at any date—known as monetary equilibrium. A monetary equilibrium is a competitive equilibrium in which the price of money is strictly positive (refer to Bose & Ray, 1993 for more details).

But why one should like to use paper money? Paper money is not 'intrinsically' useful—it does not enter the utility function (together with goods) and hence does not offer direct consumption utility like commodities, nor is it 'redeemable' against goods. An example of intrinsically useful money can be gold—one does derive utility by using them in the form of jewellery. But that is 'commodity' money, not 'paper' money. Money supports transactions in the economy by fulfilling three well-known properties—medium of exchange, store of value and unit of account. Of these, the second one possibly deserves more attention in the current situation. If all transactions of the world were to be settled in a single day—hypothetically—everyone would hold goods in the end but not paper money. Uncertainty prevents such a once-for-all-transaction world to exist (markets are incomplete at each date), and therefore, some transactions always remain open. For paper money to remain useful later, it must be able to store the value of hitherto unsettled transactions. Since paper money is intrinsically useless, people will continue to use money as a medium of transaction so long they *believe* that it will remain useful in future. What conditions are required to support such belief?

In finite horizon models, without money in the utility function, the demand for money in the last period would be zero as no one would like to hold money—there is no future beyond. Since the supply of outside money is still positive, excess supply drives the price of money to zero in the terminal year. Now in the penultimate period, no one would hold money as it will not be accepted in the last period. Knowing this, by backward induction, no one would hold money in each period including the first period. If money does not enter the utility function, with an 'end' date, a monetary equilibrium cannot exist.[1]

One of the ways to guarantee a positive price is to keep future open-ended—at each date all transactions must not be fully settled. There is another way out though. What if we can bring in an economic agent who has a final demand for paper money? If that 'agent' is ready to hold any amount of paper money whenever excess supply of it shows up, monetary

[1] A cash-in-advance constraint (aka 'Clower' constraint) cannot resolve the problem, as, once again, in the last period there would be no *willing* receiver of money.

equilibrium can still exist even if the future is close-ended. This is where the Central Bank comes into the picture. The agent is the Central Bank and positive final demand implies that paper money is redeemable against 'something'.[2] A Central bank is *obliged* to hold *all* paper money at the end of *all* transactions. This knowledge is comforting to everyone as that instils a belief that an otherwise useless paper money would always command a value.

We do not go to the RBI every now and then to redeem the paper money as transactions are never completed—future is open-ended to us. The moment it is announced that higher denomination notes will go out of circulation very soon, it is immediately understood that *all transactions with those notes have come to an end*—the future is no longer open-ended for those denominations. They become redeemable (up to a certain limit in this case) against lower denomination initially and then against new currency later on. The observed rush is due to two facts—the currency replacement (a new 500-rupee note for an old 500-rupee note) is not immediate and that only 14 per cent or so of the outstanding circulation was in 100-rupee notes pre-demonetization.

Since such replacement is induced by the supply side of money, one is tempted to ask, what could be the effects on demand for paper money (and on overall demand for money)? Do we expect any *permanent* change in the way people hold paper money due to this *temporary* withdrawal in circulation?

A Different Variety of Liquidity Trap?

A liquidity trap—in Keynesian macroeconomics—emerges due to *speculative* demand for money, primarily by the households. When interest rates (or rates of return) are low, market expects (speculates) that it will rise, sooner or later. Since traded (spot) prices of financial securities (say bonds) are inversely related to its yield (rate of return), it is better to buy securities later, otherwise there is a chance of capital loss. Under this condition, if market is supplied with more money, people would just keep on holding them—they will not 'spend' it on bonds. Demand for bond is unaffected and so is its interest rate. Any attempt to create excess

[2] What is that 'something' is difficult to fix. If money were 'inside' money, it could have been goods. But with 'outside' money, the initial supply of and final demand for money do not come from utility maximizing behaviour of the Central Bank—they are just *given*. See Bose (1997) for details.

supply of money will fail, all money will be 'voluntarily' held—money demand due to speculative motive becomes insatiable. This can be visualized through the text-book apparatus of money market equilibrium. Money demand is highly interest sensitive, which makes the money demand curve flat at the interest rate from where people expect it to rise. When money supply is increased, there will be no effect on the equilibrium interest rate as the demand curve is flat. So the economy gets 'trapped' into a situation where liquidity does not circulate. On the other hand, when market expectation is heterogeneous, excess supply of money induces some people—who speculate bond price to increase in future—to get rid of it by buying bonds, which increases spot price of the bond and reduces the interest rate. This is the usual monetary transmission mechanism. The efficacy of transmission depends on whether excess money induces people to buy bonds.

Closely linked to liquidity trap is the Zero Lower Bound (ZLB) —a phenomenon now observed in the advanced economies.[3] Nominal interest rate on bonds cannot touch zero as their spot price cannot be infinite. At ZLB, a liquidity trap is highly likely as one can only expect interest rate to rise. However, a liquidity trap may emerge at any interest rate, provided market expectation turns homogenous. For instance, imagine that repo rate in India has reduced to 4 per cent. Since such a low rate in India is unprecedented, market is most likely to anticipate a rise in the rate thereafter. So it is possible to get a liquidity trap at *any* positive interest rate, provided expectations turn homogenous.

But currency replacement has nothing to do with the speculative demand—speculation demand views money as an *asset*—it has to do with transaction demand.[4] Imagine that a part of income is to be held in the form of paper money in different denominations—say 100 and 500—to buy consumables. Also assume that it is possible to define a preference over them.[5] One can conceive a convex-to-origin indifference map. There is a liquidity premium attached to five 100-rupee notes over a 500-rupee note—carrying all 500-rupee notes may increase transaction cost. At the same time, households would not like hold all cash in 100-rupee form—that is too cumbersome. So households would like to hold

[3] See Eggertsson and Woodford (2003), Chattopadhyay (2013) and Singh (2014) for optimal monetary policies under liquidity trap and zero lower bound.

[4] Let us assume that such unanticipated monetary shock does not change the discount factor or the intertemporal elasticity of substitution in consumption in the usual intertemporal utility maximization.

[5] This is not the usual 'Money-in-the-Utility' function.

a balanced composition of different denominations, giving us a strictly convex-to-origin indifference map.

Now about the budget constraint. Households are price takers, so accept whatever relative price is offered to them from the supply side. For the RBI, the relative price between five 100-rupee notes and a 500-rupee note is unity for transactional purpose. In other words, there are no economies of scale associated with paper money of different denominations. So far as the transaction value is concerned, five 100-rupee notes would 'produce' exactly one 500-rupee note. This is not the case with 'goods'. A 500-g butter sells at a price that is less than five times of 100-g—the cost of production of one 500-g butter is less than that of five 100-g butter; hence there are economies of scale in the production of the butter. If there were private markets for exchanging different denominations, one 500-rupee note would be exchanged for less-than five 100-rupee notes.[6] But there is no 'private production' of notes, there is 'legal' restriction on that (Wallace, 1983)—one cannot produce more than five 100-rupee notes with an input of one 500-rupee note, thereby making a profit. Hence an individual is forced to accept the relative price as unity.

Bringing indifference curve and the budget constraint together gives us 'optimal' holding of denominations. Note that both the denominations are demanded in equilibrium—both of them are 'desirable'. As demand equals supply, proportion in which they are demanded must equal the proportion in which they are supplied.

Now consider the news of withdrawal. All old 500-rupee instantly become 'undesirable'. The indifference map becomes upward sloping (with 500 placed on the X-axis) and the budget constraint reduces to a point (it comprises only 100-rupee notes) leading to a corner solution at which only 100-rupee notes are demanded—this is an 'unconstrained' solution. Since so many notes are not available, the relative price of 100-rupee notes must increase against goods. This should stimulate the supply of it and each note should be able to buy more goods now. But currency cannot be manufactured by private players, and since this news is unanticipated, the banking system as a whole within a short period cannot augment the supply.[7] Hence, the RBI must force a 'constrained' solution—a withdrawal limit must be set (a quantity rationing). Also

[6] One can indeed see such a market just outside RBI offices. But, usually, that is for exchanging soiled/torn notes.

[7] We abstract from any private market in which a 500-rupee old note is exchanged for less than five 100-rupee notes.

note that at a higher relative price of the note, excess demand for the note must show up as excess supply of goods—goods remain unsold.

Consider now the likely effect on the demand for different denominations over time. Such unanticipated withdrawal may lead to a belief that it would be better to *always* hold smaller denomination currencies—at the best up to 500-rupee. This belief is reinforced by the fact that since one of the objectives for currency withdrawal is to promote cashless economy, the same amount of cash (in value) will not come back to circulation. Further, uncertainty over when things would normalize may generate an urge to 'hoard' 100-rupee notes increasing the demand for it excessively. This hoarding behaviour (can also be thought of as a sort of precautionary demand) may have several other effects in the *short run*. First, a sharp fall in the aggregate demand is expected as people start saving in the form of currencies. This may have further repercussions on inflation—see next section. Second, households will be reluctant to hold the new 2,000-rupee note because of perceived (high) illiquidity. It may also happen that, to get smaller denominations, people may start settling high-value transactions of worth closer to ₹3,000, ₹5,000 and so on with 2,000-rupee note, so that they get 100/500-rupee notes in exchange. Transaction values that are multiples of ₹2,000 are more likely to be settled through electronic mode. So, supermarkets may become intermediaries for both goods and smaller denominations notes.[8]

Finally, demand for smaller denomination due to hoarding might make the demand curve flat—not due to the usual variety of speculation on the future prices of financial securities—due to an anticipation of further increase in the illiquidity of higher denomination notes; in equilibrium no one wants to hold these notes. This anticipation can also be self-fulfilling in nature. The situation can be viewed as a 'small denomination' or a 'small exchange' trap—similar to a liquidity trap but arising due to voluntary cash hoarding (of smaller denominations) to smoothen out future transaction cost. Any attempt on the part of the central bank to mitigate this situation by supplying with more small denomination notes may fail, as all additional supply (or at least a significant portion of it) might be 'voluntarily' hoarded. Under normal circumstances, excess supply of 100-rupee would have generated excess

[8] One can raise a general equilibrium concern here. If this is optimal for *everyone*, then the supermarkets have to become a net seller of 100-rupee notes, which is clearly impossible as they do not manufacture currencies, nor are they designated financial intermediaries.

demand for higher denominations—carrying too many 100-rupee notes is extremely cumbersome.[9] High elasticity of voluntary hoarding is clearly undesirable and costly—the liabilities of the central bank go up, but the currency does not circulate in the economy. One needs more and more currency to support a given level of income.

The situation might aggravate if people were to believe that high-denomination notes are indeed used to hold black money. If black money is sought to be made defunct this time by unanticipated withdrawal of 1,000-rupee notes, the same can happen with 2,000-rupee notes later. Anticipating this, common people may not like to hold 2,000-rupee note at all. At any subsequent date, hoarding demand for lower denomination notes then increases *permanently*—this is the long-run effect. In fact, one can foresee a possible emergence of multiple equilibria—a portion of the economy uses only small denominations, and the rest uses electronic cash. One benefit of introducing 2,000-rupee notes may be that any unaccounted income is unlikely to be held in these notes—they act as a deterrent to holding black money.

The hoarding demand has to be interpreted carefully. It is *not* an increase in the relative demand for cash, say measured by the currency-to-deposit (C/D) ratio. It is an increase in the demand for *smaller denominations*—it is a portfolio decision (induced by the opportunity cost of transaction) amongst several (liquid) medium of exchanges—even though an *actual* and *permanent* fall in the C/D were to be observed due to demonetization. It is not also a fall in the currency-to-demand deposit (C/DD) ratio—it is in effect holding a larger portion of smaller denomination notes in relative terms. A shift towards holding smaller denominations can be viewed as a change in the intrinsic preference. Such shift can be segregated into two parts. Since the largest denomination has doubled post demonetization—and assuming a linear relation—the ₹2,000 note is twice as illiquid as the ₹1,000 note. On this account, people would hold relatively more ₹100 notes. This is liquidity effect. Any holding of ₹100 note (in relative terms) over and above this should be treated as the 'hoarding' demand here. If there were three varieties of notes—say ₹100, ₹500 and ₹2,000—to exist, then higher hoarding demand is an increase in the 100/500, 100/2000 and 500/2000 ratios in *equilibrium after controlling for the liquidity effect*.

[9] Let us not assume that the excess supply of 100-rupee will be spent directly on goods, as that may destroy the classical dichotomy between the goods and money markets.

Behaviour of Currency-holding Trend

Let us now see the trend in different deposit ratios around demonetization and afterwards. Figure 1 shows long-term behaviour of four ratios—Currency-to-Deposit (C/D), Currency-to-Demand Deposit (C/DD), Currency-to-Time Deposit (C/TD), and Demand Deposit-to-Time Deposit (DD/TD).

Demand deposit can be treated as 'electronic' cash—it can be used for digital transactions. So the C/DD ratio is a decision involving how much to settle in cash against electronic form. The C/D ratio is a portfolio decision induced by the opportunity cost of holding cash in hard and electronic form. As an economy grows over time and accumulates savings, and with financial market liberalization, the *portion* of money that supports transaction should decline in relative terms—that is evident from declining C/D, C/TD and DD/TD ratios. However, interestingly, the C/DD ratio has been high and is rising in recent years—cash holding is high in India.

Figure 2 shows the trend in the C/DD and C/D ratios around demonetization—the shocks to both the ratios are distinct.

Looking at Figures 1 and 2, it seems that the C/D ratio did not go back to its pre-demonetization level (around 0.16) for quite some time. Such a fall may be attributed to three factors. First, due to an already existing declining trend. Second, the volume of digital transactions has picked up

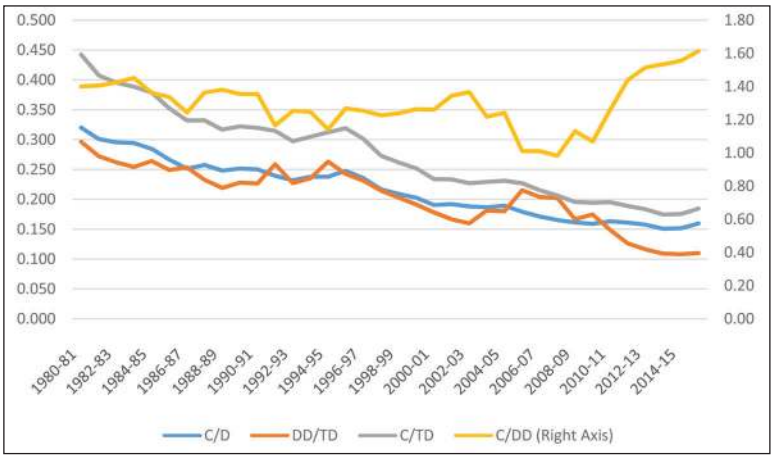

Figure 1. Long-term Currency-Holding Trend

Source: RBI time series.

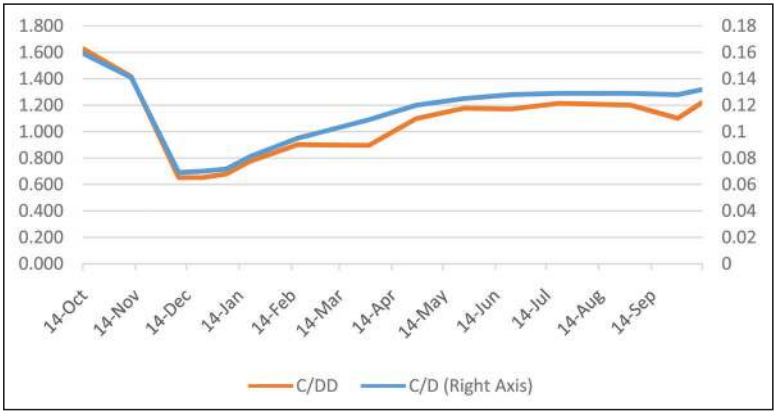

Figure 2. Currency-holding Trend around Demonetization (14 October 2016 onwards)

Source: RBI weekly statistical supplements.

(Subramanian, 2017, Vol. 2, Chapter 1; *Times of India*, 2017). Third, due to the fact that people who deposited cash did not withdraw—they remained invested in time deposits. This behaviour may be viewed as an optimal one—one would like to optimize on the future transaction cost of depositing savings held in the form of cash.

As argued before, even if the decrease in the C/D ratio (against the trend) is statistically significant, that does not rule out the possibility of hoarding of smaller denominations. For instance, while ₹500 and ₹1,000 notes together comprised about 85 per cent of total currency a year ago (pre-demonetization), ₹500 and ₹2,000 notes together make nearly 72 per cent of total currency as on September 2017 (*The Economic Times*, 2017). This shows that there are more 100-rupee currencies in circulation now. However, it would be difficult to uncover hoarding demand until a longer time series data on the proportions of currency note circulating are available.

Aggregate Demand and Inflation

To fix the ideas, let us think of three periods—the brief moment (very short run) between the announcement and the time till which the old notes are accepted (period 1), a short run in which currencies are getting

replaced (period 2) and a medium run when all currencies have been fully replaced (period 3).

First consider the period 1. The 'locked-up' currencies (black money?) come to circulation suddenly. Though there is no change in the monetary base in this period, due to more circulation there is an *endogenous* increase in the available supply of money in the market. Note also that there is no change in the C/D ratio in this period. In this period, people may like to spend the old notes quickly—on consumables and on real assets like gold. This increases the aggregate demand *temporarily* and hence the price level (or inflation level).

In period 2, however, prices (inflation) are expected to fall as people become thrifty in spending 100-rupee notes. This causes aggregate demand to fall. A factor that determines the magnitude of fall in prices—due to a fall in aggregate demand—is the extent to which economic activities are 'organized'. If the organized sector is large, all the suppliers may not be able to reduce prices in the short run as there is menu cost attached to it. So a fall in the aggregate demand shows up primarily as a fall in the equilibrium output (aggregate supply curve is flat). If there is a large unorganized sector, a fall in the aggregate demand shows up partly as a fall in the price level and the rest as a fall in the equilibrium output (aggregate supply curve is upward sloping). With a larger unorganized sector, output fluctuation is expected to be moderated. Further, there is a possibility that rising unemployment in the organized sector (as the output contracts sharply) be mitigated by absorption of labours into the unorganized sector. In the time of recession, existence of unorganized sector might help.[10] However, the intensity of cash uses in the unorganized sector is much more than organized sector. Hence the cash crunch would be felt more in the unorganized sector, and the unemployment will increase in that sector too. The labour absorption channel under normal circumstances—that a rise in the unemployment in the organized sector can somewhat be mitigated by labour absorption in the unorganized sector—also gets blocked. Therefore, overall aggregate demand would definitely reduce.

The fall in aggregate demand in period 2 might somewhat be arrested by falling nominal interest rates. As people are depositing the old

[10] It may not be correct to think unorganized sector as contributing to the so-called black economy. Unorganized sector mostly comprises unregistered firms that engage in productive activities, which is a part of the national product. In India, the size of it is no less than 50 per cent of the gross value added.

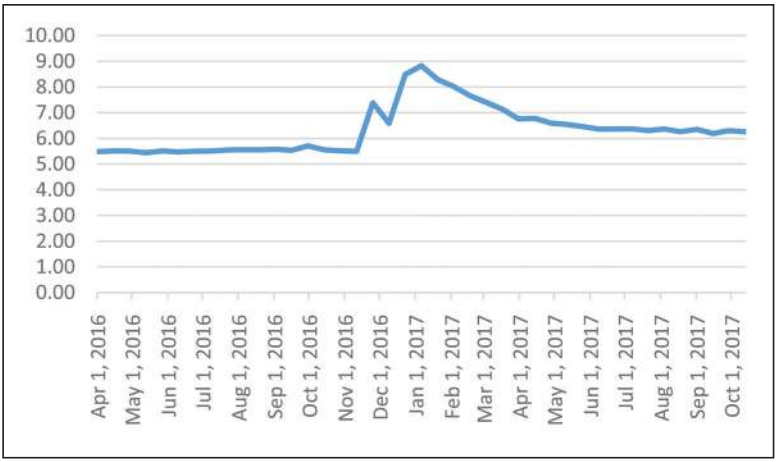

Figure 3. The Behaviour of Money Multiplier

Source: Calculated from RBI's data on 'components of money stock'.

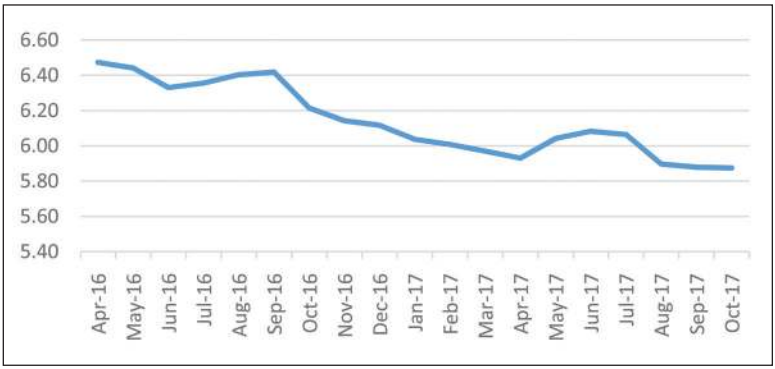

Figure 4. Weighted Average Call Rates

Source: RBI time series.

notes into the banks, some M_0 (base/high-powered money) is converted to M_1 (and M_3) increasing the money multiplier (M_1/M_0, M_3/M_0) endogenously. Viewed alternatively, since currency notes are deposited in the banks, the C/D ratio would decrease in this period, increasing the money multiplier (see Figure 3). One should therefore expect a decrease in the nominal policy rate if liquidity is not sucked up by the

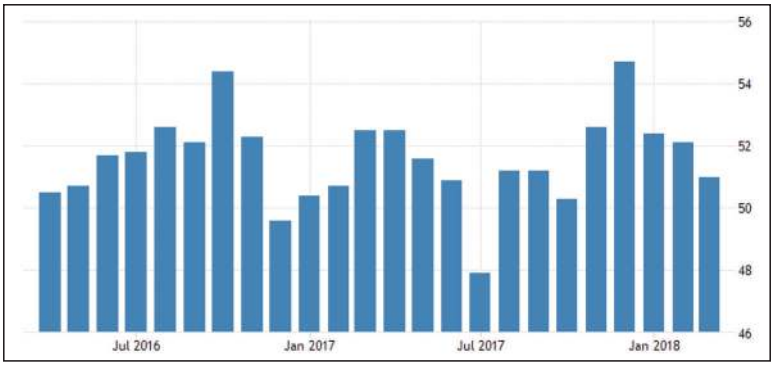

Figure 5. India Manufacturing PMI

Source: Tradingeconomics.com.

RBI.[11] Notwithstanding a change in the policy rates, a fall in the money market call rates is expected (see Figure 4). The net effect on the overall price (inflation) level would therefore depend on to what extent reduced policy rates are passed onto lending rates by the banking system and, in turn, to what extent reduced lending rates affect expenditures. However, interest 'pass through' is often weak in India and the empirical evidence on the impact of interest rates on investment is not very encouraging. So the net effect is most likely to be a fall in the aggregate demand and hence in the price level in period 2.

However, relaxed liquidity condition and reduced weighted average cost of capital (WACC) did not actually help businesses. Figure 5 shows the Nikkei India Manufacturing Purchasing Managers' Index (PMI). PMI is derived from a survey of 500 manufacturing companies. The index is based on five individual indices with the following weights: new orders (30%), output (25%), employment (20%), suppliers' delivery times (15%) and stock of items purchased (10%). A PMI above (below) 50 indicates an expansion (contraction) of the manufacturing sector compared to the previous month. It is amply clear that there is a sharp contraction in manufacturing activity after demonetization (and another around implementation of GST).

In terms of investments, new investment proposals worth ₹1.25 trillion were observed during the quarter ended December 2016. This was

[11] Note that, a larger money multiplier results in larger money supply only under full-employment in the economy, that is, when commercials banks are fully loaned up.

low compared to the average ₹2.36 trillion worth of new investments seen per quarter in the preceding nine quarters (Centre for Monitoring Indian Economy (CMIE)). CMIE's data suggest that 227 new investment proposals worth ₹818 billion were announced during demonetization-quarter till 8 November. In comparison, only 177 investment proposals worth ₹437 billion were made between 9 November and 31 December 2016. Further, new investments worth ₹20.97 billion were announced, on an average, per day during the 39 pre-demonetization days from 1 October through 8 November. This average dropped sharply by 61 per cent to ₹8.24 billion during the 53 post-demonetization days. The number of projects announced per day dropped from 6 to 3 by a similar comparison. Hence, on both counts, falling WACC and easing liquidity seemed to have failed to boost the manufacturing sector's output and investments.[12]

Now about the period 3. If the level of aggregate demand (or rate of growth in nominal demand) decreases leading to a downward shift in the price trend, then actual, as well as, expected inflation would decrease. From the standard Fisher equation—nominal interest rate = real interest rate + expected inflation—the nominal rate is expected to decrease. From the money market equilibrium, the overall price level P is written as $P = M/L\,(r + \pi^e, Y)$. The r value is determined from saving–investment equality along with fixed output (under full-employment). Now a permanent fall in the aggregate demand, given the level of potential output, decreases the real interest rate r. The combined effect of these would be to increase the money demand, demand being inversely related to the nominal rate. Post-demonetization, M decreases (for an appropriate definition of M, see next section) and the denominator increases, and the fall in P will be more than the fall in M—there is a sharp fall in P. This may have a destabilizing effect on expectations. To avoid such a sharp fall, the standard prescription is that the Central Bank should increase money supply suddenly (for details, refer to Romer, 2012, Chapter 11).

A lower inflation over time should be of help to the RBI for inflation targeting. Pre-demonetization, the RBI was well within the pre-announced

[12] There may be some longer term effect of lower interest rate hidden in the form of what is known as bank balance sheet channel in monetary policy. Cross-country evidence indicates that monetary transmission is greatly hindered if bank balance sheets are weak in that they do not have much loss-absorption capacity to deal squarely with their problem loans. When liquidity is abundant and interest rates are low, there might be ever-greening of bad loans along with fresh lending to distressed firms at lower rates that increases defaults down and non-performing assets down the road. To assess this, one, of course, would require longer time series data.

range (on the glide path). For the money supply growth rate to be consistent with a different inflation path, the RBI may need to recalibrate the monetary base—see section 'On RBI's Credibility'.

A Simple IS-LM Model with Flexible Price

While thinking of the problem in an aggregative model, there are two immediate choices—the Keynesian (of IS-LM variety) and the quantity theory. At the outset, IS-LM seems to be a better fit as the analysis is predominantly a short-run one. And a short run is about the extent of price flexibility. Any analysis in monetary theory and policy is now overwhelmingly tilted towards staggered price setting of Calvo variety. This means that the aggregate price level is not fully flexible, which fails to satisfy the requirement of full price flexibility in the quantity theory. Further, the quantity theory cannot handle well the interconnections between markets—goods and money markets—so it is difficult to trace the effects of money on output.

There is one issue with IS-LM though—that it is not suitable for analysis of inflation, one needs an IS-LM-AS framework. However, we try to address that by bringing in expected inflation through the nominal interest rate that features in the LM curve, and by making price level (incompletely) flexible within a two-sector model, by incorporating an informal/unorganized sector to the formal/organized sector. To preserve the essence of staggered price setting at the aggregate level, we assume that the formal sector is a 'fix' price system in the short run, but becomes variable in the medium run. On the other hand, the informal sector is a 'flex' price system. The aggregate price level is an index of sectoral prices with weights determined by the respective contribution to GDP. Such a 'fix-price-flex-price' system can also be viewed as an optimal decision—the formal firms do not find it optimal to revise prices at all in the short run and the informal firms always find it optimal to revise the price in the same period. The degree of overall price flexibility then depends on the weight of informal sector's output in GDP—which is around 44 per cent in India.

There are several ways through which formal and informal sectors could be connected. First—and the obvious—is from the demand side; formal and informal goods are substitutes in households' utility. From the supply side, many formal firms outsource a part of the production to informal firms (Beladi, Dutta, & Kar, 2016; Ramaswamy, 1999). When

demand for formal goods decline it will have cascading effect on informal output. Further, informal sector's output is often an intermediate input to the formal sector. This output is likely to suffer as informal firms mostly use cash for settling all types of transaction—be it payment to the workers, or working capital requirement. All such effects would lower employments, aggregate wage payments (assuming nominal wages to be sufficiently rigid downwards) and aggregate demand.

The standard formulation of IS curve does not involve money or 'cash'. But, if the shortage of cash is considered as an adverse shock to demand, in effect we are assuming that there is a liquidity constraint. So a change in the circulation of currency would affect IS and LM curves *simultaneously*. However, we will not consider the 'real balance' effect (*a la* Patinkin) that captures the effect of variable price (via a change in the real money balances) on aggregate demand.

The other concern is with an appropriate definition of 'money' to be used for the LM curve. Though in contemporary monetary policy a central bank does not target the level (or the growth rate) of money supply, still, for the LM curve should one use 'M3' or 'H'? In the standard Keynesian money market, 'money' is an asset does not bear interest. However, M3 has time deposits which clearly is an interest bearing security. Further, it is well known that a central bank can control 'H' but not 'M3' because of instability/unpredictability of the money multiplier. Therefore, for money to be really 'exogenous' as well as non-interest bearing in LM formulation, the appropriate definition of money should be 'H'.[13] If people voluntarily deposit currency (i.e., reduce currency demand for each rupee of deposit held), there would be no change in 'M3' (Cu + Deposits), but 'H' (Cu + Reserves) would reduce due to fractional reserve system. This would increase money multiplier (M3/H) in a predictable way. Hence, a change in the C/D ratio does not change 'M3' but 'H' reduces. So when the measure of money supply is 'M3', there would be no shift in the LM curve, but if it is 'H' then LM would shift left/up.

The instability of the money multiplier can be more pronounced in case of a monetary shock due to demonetization. Table 1 brings this out sharply. With demonetization, currency with public in RBI's book reduces to the extent of defunct currencies immediately, but people are yet to deposit all such defunct currencies. Hence, one-for-one change between currency and deposits does not happen, yet 'H' reduces sharply

[13] For a detailed discussion on this issue, see Romer (2010).

Table 1. Money Stocks after Demonetization (in ₹billion)

	Nov. 11	Nov. 25	Change (2–1)	Dec. 9	Change (3–2)
	1	2		3	
M3	1,23,768	1,21,759	–2,009	1,21,199	–560
Currency with the Public	15,262	9,119	–6,143	7,810	–1,310
Demand Deposits with Banks	10,772	11,951	1,180	11,974	22
Time Deposits with Banks	97,531	1,00,537	3,007	1,01,262	724
Reserve Money (H)	22,493	16,490	–6,003	18,392	1,902
Money Multiplier (M3/H)	5.50	7.38		6.59	

Source: RBI, weekly statistical supplements.

(reserves also do not go up that much since all the currencies with public is not converted to deposits). Note also that the behaviour of 'M3' is much smoother than 'H'. This would cause money multiplier to increase sharply, and in an unpredictable way—see Table 1. Under such situation, if RBI were to maintain a targeted level of M3 (or to smooth out variations in M3), the best way to do it is to manipulate 'H'.[14] Hence, the most appropriate measure for 'M' for the LM curve should be the stock of 'H'. With this definition, the LM curve would shift to left sharply.

IS-LM During Demonetization

Figure 6 shows shifts in the IS and the LM curves after demonetization, till the time all the currencies are replaced or till 'H' is fully restored. Actually, the central bank works with the *growth* rate of money supply rather than the stock of it. Change in money supply means change in the growth rate of it. In the short run, though, one may work with the stock of money supply. In this period, aggregate demand decreases, and since price is somewhat flexible due to the presence of informal sector, the

[14] This has been the essence of 'quantitative easing' during great recession—see Dornbusch, Fischer, and Startz (2011; Figure 11.5).

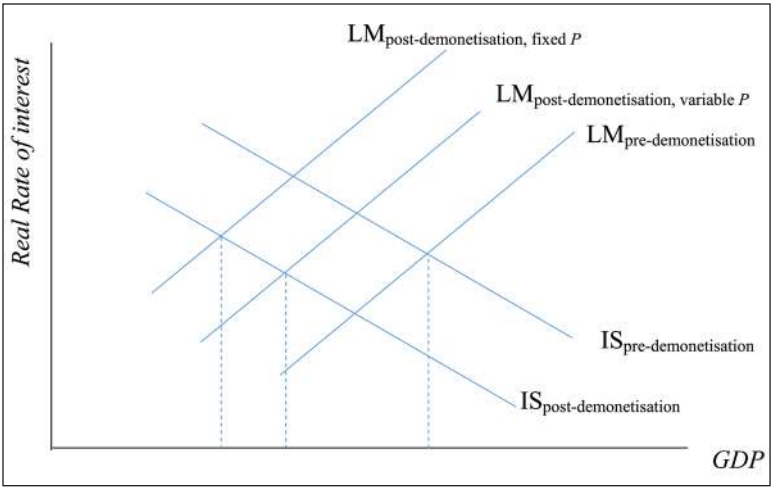

Figure 6. GDP and Interest Rate after Demonetization

Source: Author's own.

leftward shift in the LM would be less than the standard Keynesian case of absolute price rigidity in the short run. However, the price level is not fully flexible either due to the presence of a formal sector, so the LM would still remain shifted. The level of equilibrium GDP decreases, but the effect on the interest rate is ambiguous—it may increase or decrease depending on the extent of price flexibility. This period does not capture the effect of variable prices on inflation expectation. Note that, with an informal sector, the adverse effect on the GDP is *moderated*.

IS-LM After Full Adjustment in Money Supply

Now consider the time period in which 'H' has already been fully restored. We consider two possibilities, one in which IS is back to pre-shock position, and in other, it is not due to a permanent fall in demand in the informal sector. Can there be permanent effects on the economy in both the cases? There can be one through price expectation channel. Assume that people revise their inflation expectation *after observing* the movement in the *actual* price level. A lower price level post-demonetization reduces inflation expectation, and such expectation may further be reinforced by the fact that there seems to be a permanent decrease in the level

of actual inflation in India recently (Subramanian, 2017, Vol. 2, p. 6). From the money market equilibrium condition $M/P = L\ (r + \pi^e, Y)$, with lower π^e, money demand increases at given levels of (r, Y). Since 'P' is the actual price level that has already adjusted, a lower money-demand would shift LM left/up.

Now, there are two sub-cases for each position of the IS curve. First, there is no change in the inflation expectation and in actual inflation, and the second, inflation expectation and therefore the actual level of inflation is permanently down. These are shown in Figure 7. There is a distinct difference in the price path in both cases. Irrespective of the effect on π^e, the price path is *permanently* shifted down at all future dates, and with lower π^e, it is even lower than with the same π^e. It is clear that, with lower π^e, expected inflation needs to be *raised* to get back to the pre-demonetization price-path.

For easy exposition, we look separately at the following cases.

A1. IS is fully back, with same π^e
A2. IS is fully back, with lower π^e
B1. IS is not fully offset, with same π^e
B2. IS is not fully offset, with lower π^e

A permanent fall in the aggregate demand is a distinct possibility (cases B1 and B2). As noted in the Economic Survey (Subramanian, 2017,

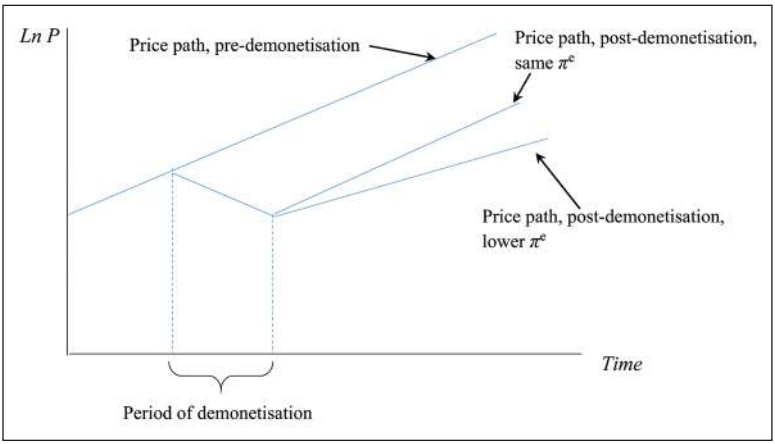

Figure 7. Price Path with Different Inflation Expectations

Source: Author's own.

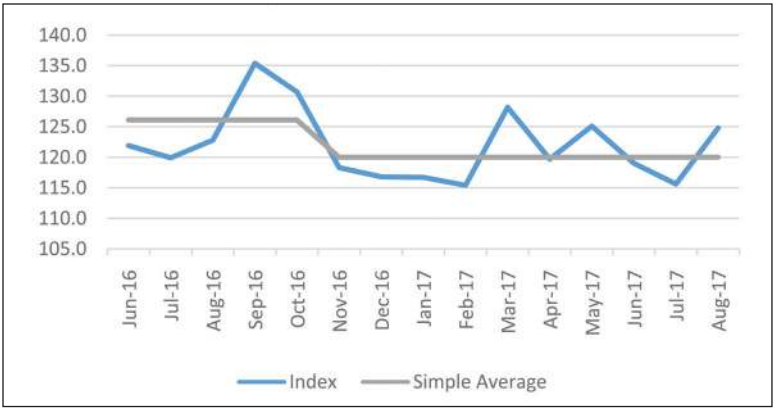

Figure 8. Index of Industrial Production, Consumer Durables (2004–2005 = 100)

Source: Calculated from Economic and Political Weekly Research Foundation Time Series database.

Vol. 2, Chapter 1, Figure 23), two-wheeler sales can be treated as a proxy for demand generated from the informal sector and the demand has not returned to September 2016 trend. Another proxy can be index of industrial production (IIP), consumer durable—which shows (Figure 8) that the simple average has declined post-demonetization.

A1. When looking at longer term effects, one should work with *growth* rates in money supply rather than with the *level* of money supply. In reality also the stock of money is never constant, it actually grows over time at a particular rate to meet an interest rate/inflation target. So a constant real balance means growth rate of 'H' = growth rate of 'P'. The real balances change only when growth rates are not equal. When RBI restores 'H', it is to be interpreted as restoring the growth rate of 'H' in the medium run to the pre-shock level. A constant level of real balances pre-demonetization implies growth rate of 'H' = growth rate of 'P' $\left(\frac{1}{P}\frac{dP}{dt}\right)$. Since π^e and π remain the same (and so the growth rate of 'P') and the growth rate of 'H' is fully restored, real balances would come back to its pre-shock level. Therefore, the level of GDP and real interest rate would be restored fully. Only difference would be in terms of the price *level*—it would be lower at all future dates. Further, since the actual level of inflation does not change, RBI would not miss intermediate targets of inflation.

A2. Since the growth rate of 'H' exceeds that of 'P', the final position of the LM would be to the right of what it is in case A1. So the level of GDP would increase, with a decrease in the interest rate.

In this case, if RBI wanted to get back to the pre-demonetization level of actual inflation, it may need to increase money supply, and rather rapidly (ideally in one shot). However, price is never fully flexible in the short run, so the LM may shift to right during the period in which money supply growth rate gets adjusted to a higher level—and that would cause GDP to increase further (which may be undesirable as RBI also tries to stabilize the GDP) albeit temporarily. It is also amply clear that, to get back to original price path (i.e., a case of price level targeting), money supply needs to increase more sharply.

B1. Comparing with case A1, there would be a reduction in the level of GDP and interest rate.

B2. Comparing with case A2, the effect on the level of GDP is ambiguous—it depends on the relative strength of inflation expectation channel and the extent to which aggregate demand reduces permanently.

Therefore our analysis suggests that the effect on the GDP in the medium run (by when money supply growth rate is fully adjusted for by the RBI) can be ambiguous once the effect of inflation expectation is incorporated into the standard IS-LM model. Effects of demonetization can be deep, but at the same time, the recovery can also be faster under an inflation targeting regime.

Empirically, the GDP growth rate (quarterly) declined sharply after demonetization and as evident from Figures 9 and 10, and it took a long time to recover. So from data it seems that the demand did not return to its pre-demonetization level with no change in inflation expectations (case B1 discussed earlier).

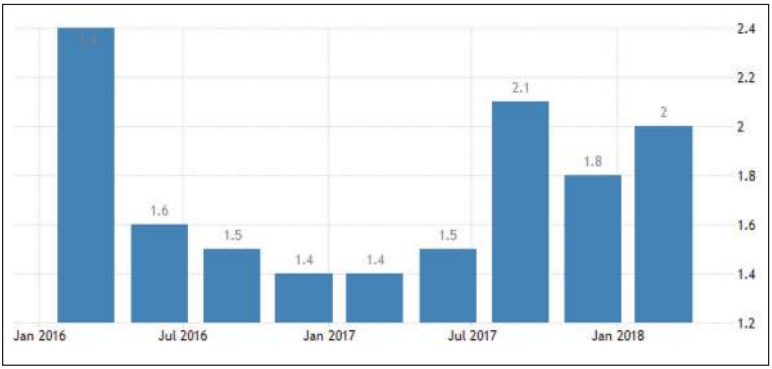

Figure 9. Quarterly GDP Growth Rates

Source: Tradingeconomics.com.

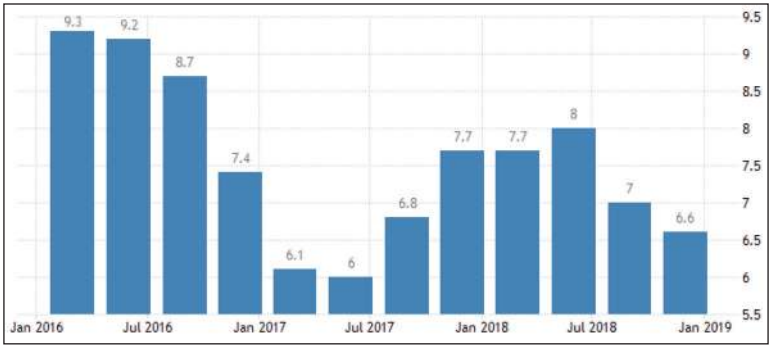

Figure 10. Annual GDP Growth Rates

Source: Tradingeconomics.com.

On RBI's Credibility

The efficacy of monetary policy depends on Central Banks' ability to influence the real interest rate. However, a Central Bank can only set the nominal interest rate, and the real rate is determined via the inflation expectation. But inflation expectation is formed by the 'non-bank public' or the households. It is noted already that such expectation also plays a role in determining the price path whenever monetary policy changes its stance. Hence, it is extremely important for the Central Bank to anticipate and then be able to control such expectation, especially in an inflation targeting regime. Controlling inflation expectation is a difficult task, but the task gets easier if the Central Bank is *credible*—when the Bank announces that it wants to tame inflation, people should believe that the Bank will actually do so. Among other things, this depends on how well the Bank has been able to contain inflation in the past. Since the RBI has adopted inflation targeting, such credibility is of extreme importance to achieving this goal. Controlling inflation requires independence of the Bank. For instance, when the Bank is vigorously after taming the inflation, other policies (printing money to finance central government's deficit for instance) that ceteris paribus raise inflation should be consistent with inflation targeting.

In such context, a question that was raised is this: since the currency notes are signed by the RBI governor, did the announcement of the withdrawal of currency by the Prime Minister of India undermine the independence of the RBI? One must carefully interpret what does 'independence' mean in monetary policy. A Central Bank is 'instrument'

independent but is 'goal' dependent. The goal must come directly from the central government, and, indirectly from the public in a democratic system. In this case, the goal is a task that requires the RBI to smoothly carry out currency replacement. Given this task, the RBI is supposed to smooth out transactions. A discussion on whether the RBI has been able to do so holds merit, but, from the perspectives of the standard monetary policy strategy, the recent incident has not anyway undermined the independence of the RBI.

Concluding Remarks

This article has presented a few arguments in non-technical terms and that too in the form of 'partial' equilibrium models. To prevent drift in the arguments, one should instead go for a full-blown model (see Chodorow-Reich, Gopinath, Mishra, & Narayanan, 2019 for such a model). There are probably two points that this article tries to highlight. First, a monetary shock in the form of demonetization of the recent variety may have permanent effect on how households hold lower denomination currencies. Second, the effect on the level of GDP should be carefully looked at, once the effects of variable price level and changing inflation expectations are captured through the presence of an informal sector. The latter insight is something different from the other recent theoretical works on demonetization (Dasgupta, 2016; Waknis, 2017), primarily because they do not capture the effects of variable prices and inflation expectation. Such effects cannot be overlooked in an inflation targeting regime in India.

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