

## **Abductive Reasoning in Macroeconomics**

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## Abstract

*Macroeconomic analytical frameworks change with events they are unable to explain. The process is closer to abductive reasoning that is based on both events and analysis, unlike induction which is data-based and deduction where analysis dominates. Abduction reasons backwards from the outcome, to deduce the framework with which it is compatible. Therefore it is useful to study how macroeconomic conceptual frameworks evolve after anomalous outcomes such as crises. The post-crisis churning is assessed from this perspective using criteria such as greater generality, systemic feedback, and structural aspects. Abductive reasoning is also used to extract the structure of aggregate demand and supply consistent with the observed negative correlation inflation and growth in India. If prolonged growth slowdowns do not reduce inflation, it suggests underlying aggregate supply is elastic but volatile, so that supply-side issues, not excess demand, are primary inflation drivers. Monetary and fiscal policy need to focus on elements that reduce costs, while avoiding sharp cuts in aggregate demand.*

**Keywords:** Abduction; Evolution of macroeconomics; Global financial crisis; Aggregate demand and supply.

**JEL Code:** E10, E44, E32

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## Abductive Reasoning in Macroeconomics

A third wave of science studies would mean breaking away from now-routine and secure criticism, and instead taking the risks involved with the synthesis and generalization that build human culture.

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We cannot live by skepticism alone

Harry Collins

### 1. Introduction

Macroeconomic theories are being constantly surprised by events they are unable to predict, prevent, or even understand. The global financial crisis (GFC) was an illustration of this as were the stagflation of the seventies and the unemployment of the Great Depression. None of these could be understood in the prevailing analytical frameworks. Since theoretical modeling gives a causal structure that should hold not only in current but also in future data sets, this would seem to be a major flaw.

Although macroeconomics has a rich conceptual structure, it has to work with empirical relationships between aggregates. It therefore cannot build a water-tight deductive universe, as maybe possible in theories about individual behaviour. The latter can be deduced from behavioral axioms, without reference to facts, although their aim is also to explain real world behavior. Macroeconomics has to explain aggregates, removed from individual decisions, and therefore cannot escape induction, which is ultimately falsifiable. But does this mean it lacks a theoretical foundation?

Macroeconomics does, however, have a non-trivial logical structure in addition to the use of induction. Learning is based on the general methodological principle of abduction, which is a mixture of deduction and induction. There is a substantive role for deduction, while the interplay with induction creates relevance, in a stimulating interaction between analysis and events. Analysis develops in response to puzzling

events that cannot be understood in the existing framework. And it defines new concepts and generates new facts.

Abductive reasoning is based on both outcomes and analysis. Abduction and induction derive conclusions from outcomes, unlike deduction which derives them from assumed premises. But abduction reasons backwards from the outcome, to deduce the framework with which it is compatible.

Successful abduction normally requires greater generality. But sometimes a theory, which was unsuccessful in the past, is neglected. For example, Keynesian demand determined output was a reaction to the failure of classical economics to explain the involuntary unemployment of the Great Depression. But the neglect of the supply-side it led to, made the stagflation following the seventies oil shocks a puzzle. This in turn led to a reaction away from demand-led theories towards supply side real business cycle (RBC) dynamic stochastic general equilibrium (DSGE) based theories.

But different kinds of frictions had to be added to the DSGE in order to explain outcomes<sup>1</sup>. Similarly, while the New Keynesian Economics School (NKE) explored the sticky prices and industry structure that allowed demand shocks to be non-neutral, they added forward-looking behaviour. This evolution illustrates the response of theory to facts and the movement towards greater generality. The latter does not mean in-depth analysis of a specific issue is given up, only that all aspects relevant for the question asked are included in the analysis.

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<sup>1</sup> As a referee points out abduction need not be a smooth process, with resistance from dominant scientific communities. While this paper restricts itself to evolution in the mainstream approach, macroeconomics has many schools that have critiqued it on valid grounds. Going into details would be beyond the scope of this paper but some major schools are Post-Keynesians in whose view the mainstream neglects Keynes own views notably his emphasis on uncertainty (Azad, 2016); radical economists who disagree with ideas of market-clearing, neglect of distributional conflict, and minimizing the role of the Government (Bhaduri, 1986, Pattnaik 2009); structuralists in whose view aggregation neglects essential aspects of structure especially in developing economies (Taylor, 1983, Rakshit, 2009); finally those who would like to give priority to data because of lack of agreement on theory and lack of realism of theoretical abstractions (Coyle, 2012, Nachane 2016). This paper argues that given a basic theoretical discipline of multiple sectors interacting over time, driven by individual behavior, many of the relevant frictions and market failures can be incorporated as may be appropriate in a given context. Section 5 illustrates this by deriving aggregate demand and supply for an economy with a dualistic structure.

Similarly, the GFC has forced more analysis of the interaction between macroeconomics and finance. But over-reaction such as jettisoning the entire framework, in response to recent events, can hurt progressive evolution. While the focus of the discussion has been on the absence of finance in DSGE models, interesting issues have risen about the impact of financial malfunction on the relative effectiveness of monetary versus fiscal policies, and of bringing a macroeconomic view of systemic effects and spillovers to bear on financial regulation. The paper discusses these. While finance has to be added to macroeconomic models, it is equally important to add macroeconomics to finance.

After explaining abduction, the paper illustrates the argument by analyzing some specific anomalies and the developments in macroeconomic theory they led to. It then applies abductive reasoning to derive the aggregate demand and supply structure consistent with observed combinations of growth and inflation in India.

The remainder of the paper is structured as follows: Section 2 explains abductive reasoning and its application to macroeconomics; Section 3 shows why moving to more generality is a sign of progress; Section 4 highlights another aspect essential in macroeconomics—the inclusion of spillovers and systemic effects; Section 5 applies abduction to explain Indian growth inflation puzzles, before Section 6 concludes.

## **2. Events and theories: Between deduction and induction**

In macroeconomics, stylized facts generate theory, which organizes facts. For example, the Great Depression led to the theory of aggregate demand, and to the creation of national accounts statistics that measured these demand categories. Anomalies generate new theories. There is a chain from analysis to facts to analysis. The methodology is neither deduction nor induction alone but a combination of the two that Peirce christened abduction<sup>2</sup>:

The surprising fact, C, is observed,  
But if A were true, C would be a matter of course,

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<sup>2</sup> As in all philosophical contributions there are now extensive interpretations of abduction (see Aliseda, 2006 and Magnani, 2001) —examples are creative and selective abduction. We restrict ourselves to the logical structure below that shows how facts affect an analytical framework.

Hence, there is a reason to suspect A is true (Peirce 5.189, Hoover (1994 pp 301)).

Both abduction and induction belong to ampliative inference, which justifies conclusions on the basis of specific outcomes. Explicative inference, by contrast, derives conclusions from assumed premises. This includes deductive logic based theories. For example, classical logic, starts with a major premise, such as, ‘All humans are mortal’ adds a minor premise ‘I am a human’ and derives the conclusion: ‘Therefore I am mortal’. Induction works by accumulating evidence—for example, instances of mortality. But, without deduction from premises, even one counter example can upset a conclusion. Therefore, inductive knowledge is temporary. For example, the observation of black swans when the continent of Australia was discovered upset the inductive inference ‘all swans are white’. That is why in econometrics, which is an inductive science hypotheses can be falsified, but not proved.

Abduction, however, shares features of deduction because it uses logic as in Peirce’s chain of reasoning above. But it is not deduction. If abduction was only disguised deduction it would commit the fallacy of affirming the consequence. What it does is reason backwards from the consequence. The derivation of Kepler’s laws of motion is an example of how abduction works. Kepler observed certain surprising patterns (C). If planetary orbits were elliptical (if A were true), the patterns followed (then C). So he concluded the orbits were elliptical, deducing backwards from the facts to the framework. Similarly, if a contraction in demand is surprisingly observed to affect output much more than it affects price (if C) such an outcome would be a matter of course if a particular structure of aggregate demand and supply holds (then A). In section 5 we apply such reasoning to derive the structure of Indian aggregate demand and supply.

So abduction is a weak form of inference. Sense perception is a limiting case of abduction. All ideas start with abduction. It is detective work using facts that do not fit into preconceptions. This is what Sherlock Holmes did when he reasoned from the surprising fact that the dog did not bark that some external factor had silenced it. Such reasoning explained the anomalous events.

For example, the classical framework, in which supply determined output because flexible prices cleared markets, could not explain the involuntary unemployment of the Great Depression. The Keynesian framework, however, explained this. If output was demand-determined excess supply could persist. So it was accepted, and led to the development of new facts. Concepts of national accounts and the whole apparatus for measurement of output and its components was a consequence of the framework.

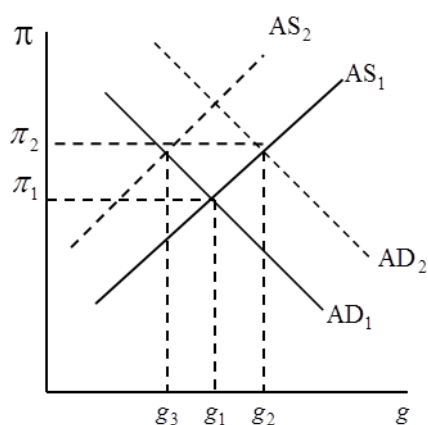


Figure 1: Understanding stagflation

But the focus on aggregate demand (AD) and neglect of aggregate supply (AS) made the stagflation that followed the oil shocks of the early seventies a puzzle. If output was demand determined, higher growth ( $g$ ) and inflation ( $\pi$ ) should occur together, as higher demand raised output and generated inflationary pressures. In Figure 1, where AD and AS curves are drawn in growth and inflation space, assuming a positive trend in inflation and growth rates, the equilibrium  $\pi_1, g_1$  should shift to  $\pi_2, g_2$ . This, however, does not explain stagflation. But once aggregate supply is also considered, an upward shift of the AS curve allows a fall in growth and a rise in inflation to occur together. That is, the equilibrium,  $\pi_1, g_1$  shifts to  $\pi_2, g_3$ , a point of lower growth yet higher inflation. Analyzing the role of demand explained low growth, but bringing in supply again explained the combination of low growth and high inflation—stagflation. Note a framework that includes demand and supply is more general.

Abduction is more than a Lakatosian defensive heuristic since conceptual frameworks do change substantially in response to anomalies, as in the shift from a Classical to a

Keynesian macroeconomics. But it is less than a Popperian falsification since an old hypothesis can be modified and need not be discarded. Parts of old frameworks normally need to be retained for more generality. Abduction differs from inductive inference such as used in econometrics in that a process of deductive thinking develops a framework consistent with facts, but which can be altered by new facts.

A framework, that is constantly forced to accommodate new facts, would be subjected to criticism (Coyle, 2012). But this can be a valid process of scientific discovery, as long as old theoretical frameworks are significantly expanded and explain the new as well as old facts.

### **3. Progress as more generality**

Compared to the early post-Keynes focus on demand, itself a reaction to a sole focus on supply, oil shocks forced more analysis of the supply-side, leading to more generality. The theoretical framework used became more comprehensive also since the gap between RBC and NKE<sup>3</sup> was smaller compared to that between Keynesians and monetarists—there was some sharing of a richer conceptual apparatus, and agreement that to study aggregate time series, the natural benchmark was optimizing over time subject to the general equilibrium of a number of interacting markets. More generality is progress because a more general model or set of models, can address a wider variety of circumstances<sup>4</sup>.

Another example of moving from less to more generality comes from theories of currency crises. In first generation crisis models, that sought to generalize from the series of crises in Latin America in the seventies and eighties, an attack on a currency was the logical culmination of weak macroeconomic policies. Large deficits, and monetary policy that accommodated the deficits, were not consistent with a fixed currency value. But these models ignored the possible complicity of markets in

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<sup>3</sup> The two are known as freshwater (Chicago, Minnesota) and saltwater (Harvard, MIT, Berkeley) macroeconomics because of the location of the universities where the major proponents of New Classical and New Keynesian Macroeconomics respectively are. Their convergence then should generate “brackish” macroeconomics!

<sup>4</sup> Rodrick (2014) argues that advance in economics comes from a richer and more relevant set of models, with a better understanding of the conditions in which they apply. The evolution of models used in macroeconomics satisfies these conditions.



creating crises, and so they were unable to explain the attacks on the British pound in the early days of the Exchange Rate Mechanism, when macroeconomic fundamentals were not weak. Answers were provided by second-generation models that allowed for multiple equilibria and the possibility that market expectations converge to the attack outcome under intermediate fundamentals. Again the dialectic between theories and facts improved analytical frameworks by making them more general.

Although the major failures were in financial regulation, the global financial crisis (GFC), beginning in 2008, generated a fresh debate on macroeconomic policy. Krugman (2009b) alleged that overuse of mathematics, and return to classical supply-side economics, had led to a forgetting of the basic issues Keynes had highlighted. The efficient markets hypothesis, DSGEs and rational expectations implied that markets cleared and output was supply not demand determined. The crisis had discredited DSGEs. The return to the supply-side had been a regression.

The debate exposes the fallacy of extreme positions that do not learn over time from both facts and theories allowing a move to more generality. Cochrane (2009) rightly pointed out that Krugman was neglecting real progress made in using mathematics to clarify, refine, add transparency and think through the consequences of assumptions. But both Fama's (2009) and Cochrane's (2009) arguments validate Krugman's criticism that the Chicago school lacked understanding of even elementary demand side economics.

Fama, using the basic macroeconomic identity, argued since aggregate savings must always equal investment, the US government bailout would not work. It would only reduce government and private savings and therefore investment. But this assumes output is fixed by supply and confuses the distinction between an identity and behaviour. While an identity will always hold, the components may differ, depending on behavior. An argument cannot be just based on an identity without an appropriate theory of behavior. In a downward spiral, government spending can counter the fall in demand thus reducing the fall in output. Private savings would then rise with output. Even if the Chicago School does not believe output can be demand determined, an

argument based on an identity alone, which can hold for different outcomes, is logically flawed<sup>5</sup> (Krugman, 2009a).

Thus a complete reversion to supply-side economics is not helpful, but neither is the neglect of supply. Learning should follow an upward spiral, rather than a swing from one extreme to the other. The implications of abductive thinking for post-GFC monetary policy would be to include financial considerations without sacrificing macroeconomic targets. Flexibility is essential for this. It would suggest that short interest rates, which are the policy instruments, should target inflation and output flexibly. But if the output gap is positive and rates are to be low for extended periods, their effect on raising risk-taking and expanding financial balance sheets needs to be watched and countered with prudential regulations<sup>6</sup>. Similarly the effect of very high interest rates on a leveraged financial sector, or very low interest rates on excessive risk taking, should be countered through regulatory measures. The interest rate spread should be an input in policy making. All arms of policy should be coordinated rather than over-reliance on any one.

While the focus has been on the absence of finance in DSGE models, interesting issues have risen about the relative effectiveness of monetary versus fiscal policies. RBC economics does not expect government expenditure, or fiscal policy more generally, to affect the level of output since a forward-looking private sector reduces its spending to provide for the higher future taxes required to finance government spending. It views monetary policy as more effective, but even its impact on output is thought to be short-term, and in the long run it only affects inflation. Even so, the view of high post crises debt and fiscal deficits due to bailouts constraining expenditure, led to over-reliance on unconventional monetary policy such as quantitative easing (QE). Opportunities to use fiscal policy to rebuild infrastructure that could, with interest rates near zero and high unemployment, pay for itself through

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<sup>5</sup> The Keynesian perspective won the initial battle as coordinated government stimuli reversed the 2008 global crisis that, in the beginning stages, was more severe than the Great Depression on many parameters (see Eichengreen and O'Rourke 2009). But the persistence of unemployment despite sustained monetary stimuli pointed to supply-side factors, that government expenditure could have addressed.

<sup>6</sup> For example, Blanchard (2011, 2015) made the case for such pragmatism in policy, with macro prudential polices, use of capital controls and foreign exchange market intervention complementing flexible inflation targeting. Incentives created by regulation affect macroeconomic outcomes.

higher revenues, were neglected. Moreover, QE, together with lags in agreement and in implementation of financial reforms, created asset price bubbles. Indeed it aimed for this as a way to raise wealth and consumption. But the search for yield once more raised pre GFC-type financial risks. Although the Keynesian position won the post GFC argument with respect to use of monetary policy it lost it with respect to use of fiscal policy<sup>7</sup>, which was underutilized. Progress in financial and prudential reforms necessary to reduce risks from QE was also slow.

The GFC has also turned attention to systemic risk, which arises from the effect of parts on the whole. General equilibrium is the natural framework in which to analyze such spillovers<sup>8</sup>. Feedback from the whole is an essential part of macroeconomics. This would add a necessary macroeconomic way of thinking to finance.

#### **4. Accounting for systemic effects**

A view of the whole, and of the critical interactions between parts, is a special feature of macroeconomic thinking. But such analysis can become unwieldy if it includes everything, so macroeconomics requires a modular structure, with modules that can be added as required depending on the question asked. DSGE forms a rigorous and flexible foundation for such a structure. Although all markets are included, a selected module can be developed in more detail, depending on the issue at stake, somewhat like using a magnifying glass, as long as all the relevant modules are included. For example, leaving out either supply or demand will not do, as we saw in the last section, but specific aspects can be highlighted to address the questions asked. A large part of a macroeconomist's skill consists of the ability to select the right framework to address the question posed. Even if the basic framework is correct, emphasizing inappropriate aspects can result in errors.

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<sup>7</sup> Keynes own view was that AD was likely to be interest inelastic. For him income dominated the consumption decision and 'animal spirits' or uncertainty dominated investment. Government expenditure would have a larger impact than a monetary stimulus. Especially in times of low confidence, public investment can be very productive. But public expenditure has other problems of inefficiencies and corruption. Progress comes not from remaining true to an individual but in moving to more general and relevant frameworks.

<sup>8</sup> A referee points out that the DSGE framework has been criticised for lack of realism and as suffering from the fallacy of composition where the whole is assumed to behave like a part. But some abstraction from realism is inevitable. A systemic view allows spillovers to be accounted for. When appropriate frictions and market failures are introduced, the behaviour of the whole can be very different from that of its parts.

Moreover, the crucial difference between micro- and macro-modeling has to be retained. Micro-modeling assumptions such as *ceteris paribus* are designed to remove spillovers, or feedbacks from the whole to the part. Macro-modular analysis has to retain these spillovers and feedbacks. As Caballero (2010) argues, it may be worthwhile to give up making welfare statements with the same degree of confidence as in a full micro model, breaking the link between the individual and the outcome, in order to achieve greater macroeconomic empirical realism.

Haldane (2012), like many others, blames the GFC on a loss of the historical memory of many past credit-led crises. This, he argues, led to a neglect of commercial banks' balance sheets in inflation targeting policy frameworks. Contagion-causing interactions among diverse agents were also neglected in fundamentals-based representative agent DSGE models. But the criticism applies to a loss of relevant institutional detail and the assumption of market efficiency. Not tracing macro outcomes to micro-behaviour in a general equilibrium framework including necessary feedback, frictions, and structural aspects. Neglecting systemic thinking, and focusing only on institutional and historical detail, is the way to invite the next crisis.

In a post GFC debate on economics (Coyle 2012), many participants were concerned about a greater reliance on reductive rather than inductive thinking. All wanted to promote empiricism over theory, with economics becoming an empirical study of continuously evolving phenomena. Abductive thinking is the way to include such phenomena in macroeconomic policy frameworks without throwing the baby out with the bath water. Otherwise there is a danger of economics becoming an ad hoc collection of stories with little connection to each other. To give up theory entirely would also be an over-reaction and itself a loss of historical memory.

Deductive logic based on behavioural axioms can be used to some extent since DSGE models individual behavior. This makes the model more robust to policy changes—invariant to the Lucas critique. But the aggregation-friendly assumption of identical individuals can be relaxed when the question asked requires it. One natural way to select the necessary disaggregation, or detail, is to ask what sectoral issues affect aggregate outcomes. For example, in an emerging market (EM) dualism in the labour market and in consumption would be an essential structural feature that must be

included. Low per capita incomes imply food has a large share in the consumption basket. Then food prices may affect aggregate prices and have to be included in a macroeconomic model of such an economy. The Lucas critique of change in the structure with a change in policy does not apply to the resulting model because the base in individual maximization remains, while the additional structural aspects included, such as dualistic labour markets, change slowly.

Forward-looking optimization itself has to be moderated by various kinds of frictions and imperfections, including those of human psychology, to reproduce outcomes of actual economies. The NKE school systematically includes frictions in DSGE models to add necessary realism. For EMs deeper structural aspects have to be included. Forward-looking behaviour coexists with slower moving institutions that constrain behaviour. Such an analytical framework is useful to include and analyze typical EM distortions, which affect the whole. Although their constraints are more numerous and severe and may be different, with such a strategy, analysis is possible in a common language that allows comparison and communication at similar standards of rigour.

There is progress also if theories are refined to make complex structures simpler and useful to policy. The NKE school has reduced DSGE into simple but forward-looking AD and AS curves with clear implications for policy. This has led to an explosion of work on the theory of macroeconomic policy (Clarida et. al., 1999; Woodford, 2003). Such AS AD curves have also been derived for EMs (Goyal, 2011). They can be used to understand Indian growth and inflation, even as they illustrate the use of abduction to extract the relevant framework.

## **5. Using abduction to understand Indian growth and inflation puzzles**

Indian post-reform growth and inflation showed frequent episodes of either: (i) low growth with high and sticky inflation, or (ii) lower inflation and higher growth. In the standard excess demand explanation for inflation, a rise in demand raises prices ( $\pi_2$ ,  $g_2$  in Figure 2(b)). Then a policy tightening should reduce inflation, not growth. But in 2008, 2011, and 2013, policy tightening reduced growth while inflation remained sticky—the opposite effect. Even if a vertical AS shifts leftwards or the AS is backward bending at high inflation (Pattanaik and Nadhanael, 2013)) a fall in growth should precede the policy shock. In addition, the latter should still impact inflation

more than growth. But inflation remained high and sticky despite sharply higher policy rates, while growth fell in the quarter immediately following peak rates (Table 1).

For a much larger effect of a demand shock on growth than on inflation the AS has to be elastic as in Figure 2a. So such an AS explains the Indian case where tightening episodes hurt growth more than they reduced inflation. The surprising patterns of growth and inflation (C) are explained if AS has this shape (if A), just as Kepler's patterns follow from an elliptical orbit. If AS-AD has the more standard structure of Figure 2(b) the observed pattern would not follow since a demand contraction would affect inflation more than it would affect growth.

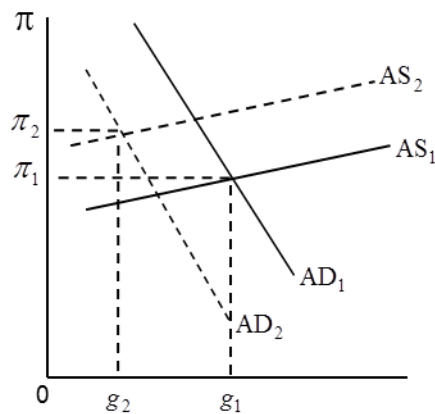


Figure 2(a): Elastic supply

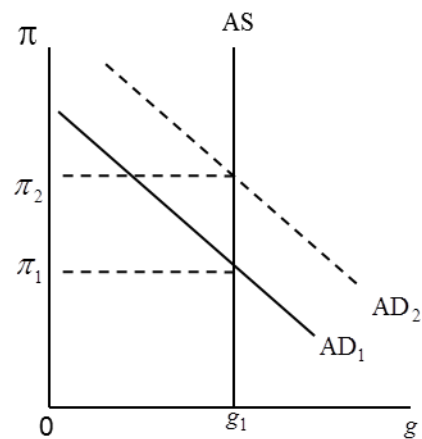


Figure 2(b): Inelastic supply

Table 1: Growth, inflation, and policy rates

	2008-09: Q1-Q4				2009-10: Q1-Q4				2010-11: Q1-Q4				2011-12: Q1-Q4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b>Growth (Y-o-Y) (%) (constant 2004-05 prices)</b>																
GDP at factor cost	7.9	7.7	5.8	5.9	6.3	8.6	7.3	9.4	8.5	7.6	8.2	9.2	8.0	6.7	6.1	5.3
Manufacturing	7.0	6.6	2.6	1.3	2.0	6.1	11.4	15.2	9.1	6.1	7.8	7.3	7.3	2.9	0.6	-0.3
GFCF/GDP*	33.0	34.8	31.5	32.7	30.4	31.9	30.9	34.5	32.2	34.0	32.3	31.4	33.9	33.4	30.3	30.9
<b>Inflation (Y-o-Y) (%)</b>																
WPI	9.6	12.5	8.6	3.2	0.5	-0.1	5.0	10.2	11.0	9.3	8.9	9.3	9.4	9.7	8.9	7.0
WPI Core	7.1	8.3	6.3	3	0.8	0.2	2.7	5.3	6	5.3	5.2	6.3	7.4	7.9	8	5.9
CPI-IW	7.8	9.0	10.2	9.5	8.9	11.6	13.2	15.1	13.6	10.5	9.3	9.0	8.9	9.2	8.4	7.2
<b>Policy rate</b>																
Overnight money	6.8	9.5	7.8	4.2	3.2	3.2	3.2	3.3	4.2	5.4	6.6	6.8	7	7.8	8.6	8.9

Source: CSO press releases, Reserve Bank of India and updated from Goyal (2012a)

Note: 1.\* This row is a ratio not a rate. 2. GFCF: gross fixed capital formations; WPI core excludes commodities; CPI-IW : consumer price index for industrial workers.

After high growth and low inflation over 2003-07, Tb. 1.1 illustrates the many episodes of type (ii) that occurred. Monetary tightening raising short rates above 9 percent in the summer of 2008 precipitated a collapse in industrial output even before the September fall of Lehman.

The tightening came after a period of high growth. The economy was feared to be overheating and inflation, following the international spike in fuel and food, was high. Although interest rates peaked, the wholesale price index (WPI) did not fall until November when Indian fuel prices fell, while the consumer price index (CPI) remained high.

There was a V shaped recovery in response to a sharp end 2008 cut in policy rates. This also indicates the crisis resulted in demand destruction rather than more intractable destruction of capacity. With the latter, recovery could not have been so fast. A rise in government consumption, as part of a coordinated global stimulus, compensated for the fall in private consumption and investment, and contributed to recovery in early 2009. The episode showed that demand is interest inelastic in India, and demand affects output. An impact of interest rates on consumer durable spending, housing demand, etc. had been visible since 1996.

Over-stimulus led to growth rising to 9.2 per cent in Q4 2010-11. The tables show only a short lag from policy rates to manufacturing output; 2-3 quarters for a sharp fall and one quarter for a sharp rise. The crisis response was fast but the resurgence of inflation before recovery was firmly established led to policy dilemmas regarding exit. The response to early signs of industrial inflation was delayed, due to uncertainties about global recovery. The very large cut in interest rates that had to be reversed then led to too fast a pace of increase in interest rates<sup>9</sup> and to tightening of liquidity. The latter contributed to volatility in interest rates and sustained the industrial slowdown.

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<sup>9</sup> The operative rate went from the reverse repo at 3.25 in March 2010 to the repo at 8.5 by October 2011.

An even greater collapse in growth occurred—manufacturing actually contracted—after policy rates were raised to 8.5 in October 2011, while inflation remained high and sticky. Similarly the rise in interest rates to above nine in the summer of 2013, as part of the interest rate defense following US taper-on announcement led outflows, turned industrial growth negative (Table 2) while WPI core actually rose, although from low levels. Although core WPI fell from Q4 2011-12, it rose again despite low growth and policy rates that were at their peak since mid-2013.

<b>Table 2: Growth, inflation, and policy rates</b>										
	<b>2012-13: Q1-Q4</b>				<b>2013-14: Q1-Q4</b>				<b>2014-15: Q1-Q2</b>	
(2004-05 base)	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q1</b>	<b>Q2</b>
GDP at factor cost	4.5	4.6	4.4	4.4	4.7	5.2	4.6	4.6	5.7	5.3
Manufacturing	-1.1	0	2.5	3	-1.2	1.3	-1.5	-1.4	3.5	0.1
GFCF/GDP*	30.8	31.4	29.2	30.3	32.3	34.2	31.6	31.2	32.7	32.3
<b>Inflation (Y-o-Y) (%)</b>										
WPI	7.5	7.8	7.4	6.7	4.8	6.7	6.9	5.4	5.8	3.9
WPI Core	5.3	6.2	5.5	4.7	3.3	2.4	2.8	3.3	3.8	3.5
CPI Combined	10.2	9.9	10.1	10.7	9.5	9.7	10.4	8.4	8.1	7.4
CPI Core	10.5	8.8	8.6	8.8	8.4	8.6	8.4	8.3	7.9	7.0
<b>Policy rate</b>										
Overnight (call money)	8.3	8.0	8.0	7.9	7.4	9.2	8.5	8.3	8.1	8.0

Source: CSO press releases, Reserve Bank of India

Notes: 1.\* This row is a rate % of GDP not a growth rate. 2. Core inflation excludes commodities, and CPI is the new aggregate CPI to the base 2010.

The sharp resurgence of WPI inflation by Q3 of 2009, although industry had barely recovered, was due to the impact of sustained high CPI and food inflation on wages. Because of the latter, the manufacturing price index fell only for a few months, and had risen again to its November 2008 value of 203 by April 2009. This can be understood as a cost shock pushing up the elastic AS. For example, the rural unskilled real wage, that had been constant earlier, began to grow from 2007 as food price inflation jumped (Goyal and Baikar, 2015). Its growth peaked at double digits in 2012, and then it began to fall as food inflation fell below double digits and fiscal contraction reduced the types of government expenditure that had boosted consumption. This reduction in cost-push softened persistent service sector inflation by Q1 2014-15, so that finally core CPI began to fall by late 2014. While CPI core inflation remained sticky until well into 2014, headline CPI<sup>10</sup> fell below double digits

<sup>10</sup>Since India did not have a producer price, the WPI was the nearest available giving the quoted price of bulk transactions at a primary stage, which could be the price at the factory gate for manufactured goods. CPI indices were heterogeneous and subject to larger delays, but in 2011, a revised and



in early 2014, helping reduce the inflationary expectations that enter core CPI inflation. By end 2014 crashing oil prices softened all types of inflation, but especially WPI.

The new GDP series, rebased, and with many other changes, show a higher growth in 2013-14 (Table 3 compared to Table 2). The series were still controversial since other data such as credit growth, corporate sales and IIP indices showed a continuing slowdown. A better corporate database was used with improvements in measurement of informal sector and government activity, and a shift to international concepts and practices, so it may reflect a one-time jump rather than a turnaround in the macroeconomic cycle.

<b>Table 3: Rates in new GDP series (Base 2011-12)</b>										
	2013-14: Q1-Q4					2014-15: Q1-Q4				
	Q1	Q2	Q3	Q4	% change over previous year 2013- 14	Q1	Q2	Q3	Q4	% change over previous year 2014- 15
Supply-side break up of GDP growth										
Gross value added at basic prices	7.2	7.5	6.6	5.3	6.6	7.4	8.4	6.8	6.1	7.2
Manufacturing	7.2	3.8	5.9	4.4	5.3	8.4	7.9	3.6	8.4	7.1
Public administration	14.4	6.9	9.1	2.4	7.9	2.8	7.1	19.7	0.1	7.2
Demand side break up of rates of GDP (%)										
Private consumption	58.8	56.9	59.1	55.3	6.2	58.5	56.2	57.8	55.5	6.3
Government final expenditure	12.7	13.1	8.7	9.6	8.2	12.1	13.2	10.4	8.2	6.6
Gross fixed capital formation	29.8	31.7	30.8	30.7	3.0	30.4	30.3	29.6	29.7	4.6
Exports	23.0	27.1	24.3	24.5	7.3	23.6	24.5	22.8	20.9	-0.8
Imports	27.6	28.9	25.2	25.0	-8.4	24.9	26.9	24.3	21.2	-2.1

Source: CSO [http://mospi.nic.in/Mospi\\_New/site/home.aspx](http://mospi.nic.in/Mospi_New/site/home.aspx)

Since the series measure value added, growth in value added may reflect the effort by severely pressured firms to save costs, and thus raise value added for a given resource base. Even in the new series there is a slump in growth and in gross fixed capital formation (GFCF) in Q3 after the mid-2013 peak interest rates. The share of gross capital formation in GDP fell from 36.6 in 2012-13 to 32.3 per cent in 2013-14.

expanded (base 2010) unified index CPI (combined), became available, with a higher weight of services in the consumption basket.

Therefore, abductive reasoning applied to explain the anomalies in the tables suggests a modification of the classical supply-constrained macroeconomic framework with vertical AS to one where the AS is elastic but subject to upward shocks (Figure 2a). Policy induced demand contraction during a supply shock can then explain lower growth and higher inflation such as  $\pi_2, y_2$  in Figure 2(a). A leftward shift of the demand curve along an elastic supply curve, pushed up due to supply shocks or cost creep, results in a high output loss with little effect on inflation as illustrated in Tables 1-3 and Figure 2(a)<sup>11</sup>. Periods of higher growth and lower inflation as in  $\pi_1, y_1$  in Figure 2(a) occur when restraints on demand stimulus are reduced during the absence of adverse supply shocks.

What underlying features generate such an AS-AD structure? An aggregate supply as in Figure 2(a) is natural in a populous economy undergoing catch-up growth, where structural unemployment is being converted into cyclical unemployment, as new types of jobs appear. Once a populous EM crosses a critical threshold and high catch-up growth is established, higher labour mobility blurs the distinction between formal and informal sectors. Higher productivity releases labour from traditional occupations. The demographic profile ensures a steady stream of youthful entrants to the work force. Improvements in education supply, and more important, the returns to acquiring an education, ensure that new entrants have adequate skills. Low skilled and service jobs can absorb new rural migrants. A macroeconomics of the aggregate economy, rather than development theories applied to the informal sector and macroeconomics to the modern sector, becomes both necessary and feasible.

Capital is a produced means of production that can be expanded. Higher per capita income growth with sticky consumption habits and a larger share of earners raises aggregate savings, financial deepening improves intermediation of savings, and freer capital inflows complement domestic savings. Therefore finance becomes less of a constraint.

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<sup>11</sup> Structural VAR based tests, time series causality tests, GMM regressions of AD and AS, and calibrations in a DSGE model for such an economy Goyal (2011, 2012a), Goyal and Tripathi (2015) all support the elastic longer-run supply and the dominance of supply shocks. Analysis of the Indian case draws on and extends earlier work (see Goyal 2012a and 2012b).

Labour is taken as the only input into aggregate production in modern macroeconomics (Woodford, 2003), and specific distortions are included. Therefore, it can be a useful framework for EMs after incorporating the effects of dualistic labour markets. The derived AS would be elastic until surplus labour is fully absorbed, and becomes vertical only as the economy matures and capacity constraints raise marginal costs of production.

But poor infrastructure, inadequacies in governance, dependence on oil imports, restrictions on agriculture and food price linked wage expectations impart an upward bias to costs. These inefficiencies, distortions and cost shocks tend to push aggregate supply upwards over the entire range, rather than only at the margin, as occurs in the L shaped Keynesian AS. Thus although the AS is elastic it is volatile, subject to frequent upward shifts. These upward shifts are the sense in which the Indian economy is supply constrained, not in the conventional understanding of a vertical aggregate supply. For example, cross subsidization of passenger with freight subsidy and a subsidy on diesel shifted freight from the railways to trucks, with a large rise in environment and other resource costs.

While governance failures result in chronic cost rise (Goyal, 2012a), sticky inflation expectations also shift the AS up. The food price wage cycle is an important mechanism propagating price shocks and creating inflationary expectations, given low per capita incomes, and the large share of food in the consumption basket. Political pressure from farmers was normally successful in raising farm support prices, especially if international prices were high.

In such a structure monetary tightening does reduce inflation expectations but at high output cost. Falling food inflation is more effective. Studies show food inflation has the maximum impact on inflation expectations, although the new flexible inflation targeting regime may also contribute to anchor inflation expectations<sup>12</sup>. Therefore first

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<sup>12</sup> Recent research has demonstrated the pervasiveness of multiple equilibria, some of which can be sub-optimal. This removes the unique rational expectations equilibria to which agents with perfect foresight converge in canonical RBC type DSGE models. Other convergence mechanisms are required, giving a role for social preferences, and for central bank communication. As Blinder et. al. (2008) point

best policy requires both monetary and fiscal policy to focus on measures that shift down the AS. If the composition and effectiveness of fiscal expenditure improves, monetary policy can be more accommodative, reducing the output cost of disinflation.

## **6. Conclusion**

Abductive reasoning is based on both analysis and facts. It can be used to understand how macroeconomic conceptual frameworks evolve after crises. But if a crisis has the effect of over emphasizing one particular aspect it can neglect relevant issues, laying the seeds for the next crisis. This, not the necessary change in macroeconomic frameworks, is the real flaw in macroeconomic thinking. It is not wise to destroy knowledge. Progress requires more generality, which is consistent with a tactical emphasis on a particular aspect, depending on the issue at stake.

A theoretical framework should be generalizable to situations other than the one in which it was produced. But macroeconomic frameworks frequently have to be updated after some event. For example, the modeling of the financial sector prior to the crisis was inadequate. But if something is found to be missing, the constructive response is to include it in the analysis if it is important for the question asked. A more comprehensive set of models are an advance since including missing aspects reduces the chances of neglecting relevant issues.

Many examples of abductive reasoning are given in the paper. It is used to assess the post crisis churning and suggests that progress requires more generality and inclusion of systemic feedbacks. Such reasoning is also used to extract the structure of aggregate demand and supply consistent with the observed negative correlation inflation and growth in India. If prolonged growth slow-downs do not reduce inflation, it suggests supply-side issues, not excess demand, are causing the inflation. The underlying aggregate supply is elastic but volatile. The lesson for both monetary and fiscal policy is to focus on elements that reduce costs, while avoiding sharp cuts in aggregate demand.

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out this coincided with the shift towards greater transparency for central banks to aid them in guiding market expectations.

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