A MACROECONOMIC ANALYSIS OF THE AGRICULTURAL PRICES IN INDIA

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Dissertation submitted in partial fulfillment of the requirements for the degree of Master of Philosophy in Applied Economics of the Jawaharlal Nehru University.

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Master of Philosophy in Applied Economics

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CENTRE FOR DEVELOPMENT STUDIES

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BONA FIDE CERTIFICATE

I, hereby, affirm that the work for this dissertation, "A MACROECONOMIC ANALYSIS OF THE AGRICULTURAL PRICES IN INDIA", being submitted as part of the requirements of the Master of Philosophy Programme in Applied Economics of the Jawaharlal Nehru University, was carried out entirely by myself. I also affirm that it was not part of any other programme of study and has not been submitted to any other University for the award of any Degree.

Dated: 30th June, 2008

M. Bharath Raj Urs

Certified that this study is the bona fide work of Mr. Bharath Raj Urs, M. carried out under our supervision at the Centre for Development Studies.

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TO

ALL THOSE CAPABLE INDIVIDUALS
WHO ARE
DEPRIVED OF OPPORTUNITIES

PREFACE AND ACKOWLEDGEMENT

The interest in the Agriculture Sector began very early in my student life, but, with a slower rate. This interest got boosted for the first time with the recent growing farmers' distress in the Indian economy. The perception of the distress, I did have and still have, focused on the causes, especially, the Market and the Nature. In the former, the economic relationship between the external agricultural commodity price shocks and its domestic counterpart gets emphasized. Whereas in the latter, it was the immutable relationship between the weather fluctuations and the agricultural output & prices that gets highlighted. Since, the causes were obvious, it might be easy to discard them as of less value to be considered as a serious research work. What really mattered was not what we knew rather how we knew. The approach, which I had in my mind, seeks to examine those causes in a microeconomic analytical framework. Therein, the issues related to agricultural price variability attain the centre of the analysis. However, due to time constraint and lack of prerequisite knowledge for the analysis, I had to put a sudden break in that direction. I hope to comeback to this at the earliest possible. In the meantime, I did not drop that interest entirely by choosing the path of macroeconomists.

Today, most of them may not wonder at the link between the Agriculture Sector and the macroeconomics. Particularly, if Agriculture is a predominant sector in an economy then there will not be much difference in the behaviour of the economy and that sector. The corollary of the above conditional statement implies that the agricultural output and price fluctuations will tend to result in fluctuations in the macroeconomic variables connected to it. This is the thesis statement of my M.Phil dissertation work. The thesis statement will be tested in the case of the Indian economy, where Agriculture has an important position. The choice of India is obvious due to my attachment to it as well as my concern to the recent farmers' distress here.

To move towards the path of attainment, certain extra-ordinary experiences become desirable. The realization of what is desired may require an intermediation as well as the timely exposures. This is the space for me to thank those 'n' number of individuals[1], who have made me to think differently than others.

The ability to distinguish within and between colors, birds, animals, academic disciplines and all other things in this world is the representation of knowledge. Frankly speaking, I was filled with something diagrammatically opposite to knowledge. The silver-lining in my life appeared with my constant conversations with one of the beautiful human beings on this planet. And that person is Suja Janardhan, whose evergreen support has unlocked my "Enlightenment Box". The conversations with her have not been simply an ordinary exchange of words rather it is all about speaking sense and discouraging non-sense to all possible extents. It is during such discourses that I have realized the 'true' necessity to involve myself in "the ordinary business of mankind." Over time, the scope of our conversations has led us to think critically. Sometimes, for instance, the conversations have gone to the extent of identifying the consistency of dependency theories with the debt-trap in the academic research. However, such conversations are rare to occur if the individuals are too busy to read. Fortunately, she is of my wavelength

[1] My apologies to those, whose names I might have mis-spelt.

and both of us are fond of reading both light-weight and heavy-weight works! Here, I am also grateful to the heaven of CDS—its Library. Without this heaven, my academic life would have been incomplete, here. I also take an opportunity, here, to thank some of the important figures in economics for their influences on my thinking. However, I need to repay their debts in real terms as soon as possible.

I did see lot of the name, K.N. Raj in India's economic reports; in Delhi School of Economics (DSE), and, most importantly, Centre for Development Studies (CDS). But, unfortunately, due to his illness I missed an opportunity to meet him by person, when I joined the Centre. However, a fortunate occasion made possible my wish to see the economist behind India's First Five Year Plan document. That occasion was his Birthday; and I, with Suja, decided to meet him at his house. It was an amazing experience to hear him critically appreciating on a book dedicated to him. During our long meeting with him, I happened to get rechristened by him; and amazingly he gave me a name by rearranging my second and third names to "Urs Raj"! His justification was "for me to call you Raj, your name should end with Raj". Finally, we ended up celebrating his birthday and dining with him. I thank him and his family for giving such an opportunity. However, all this would have been impossible, if K. N. Raj's younger son, Dinu had not recognized us and introduced to his father. I will remember Dinu forever for his kindness and lovable nature.

Centre for Development studies (CDS) is indeed a wonderful place. As I already said, it has an excellent library, which contains a set of "classics" in all the areas of economics, mathematics, philosophy, statistics, econometrics, etc. What more a researcher wants to contribute to the existing knowledge base. Reading these classics is indeed a way of communicating to those who have written it. Of course, this is the essence of writing! To be in their list it is essential to answer the questions posed by them. I learnt this hard way, and still learning, from my friends-cum-teachers. Those, whom I admire a lot for shaping my thinking, before I came to the Centre, include Krishnamurthy—an inquisitive reader—and Dr. Joy Mukhopadyay—a modest old man with inclination to philosophy and science. In the Centre, I must be thankful to all the faculties, who always appreciated my approach to studies.

I am grateful to the rest of the CDS community, whom I was in touch with, for making me feel home. Also, I take this opportunity to whole-heartedly thank Sir. Soman Nair, the Registrar of the Centre, for the occasional conversations we had, spiritual and philosophical, during my stay at the Centre. I would also like to thank Director, Dr. Narayanan Nair, for providing a congenial atmosphere at the Centre.

No thesis will be complete without the acknowledgement to the Supervisors. I am extremely fortunate to have Supervisors—Dr. K. Pushpangadan and Dr. Lekha Chakraborty—who were always ready to help me. Also, they have given me sufficient freedom to do original research work amidst the nature of time constraint common at the M.Phil level. I am truly grateful to them.

I also take this opportunity to pay my gratitude to my loving parents and sister, who have been patient enough to tolerate my adventures with my career, which will be continuing forever!

June, 2008

ABSTRACT OF THE DISSERTATION

A Macroeconomic Analysis of the Agricultural Prices in India

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There is no doubt that the Agriculture Sector is the 'backbone of the Indian economy' as well as a mixed bag. This leads to a natural expectation that the supply shocks to the Agriculture Sector must have its impact on the economy. If that is the case then the Sector has a macroeconomic dimension. In this sense, there could be causal relationships between the Agriculture Sector and the macroeconomic variables. It is via these causal relationships, there arise, a possibility to explain the nature of the economic relationship between the Sector and the General economy. In the absence of such causal relationships, the explanation for the nature of economic relationship becomes redundant. This thesis has been justified in the chapter of the dissertation entitled 'Conceptual Framework'. The thesis has been put to testable form by framing two separate hypotheses termed as Hypothesis A and Hypothesis B. Both of these Hypotheses have been tested with the aid of Granger Causality technique. In this study, agricultural price has been taken as the proxy for the Agriculture Sector, due to data limitations. The result of this empirical exercise confirms, on the overall, that the Agriculture Sector is causally related to the chosen macroeconomic variables; and therefore, the nature of the economic relationship between the Agriculture sector and the Indian economy is better explained with the aid of the "Unorganized Sector" argument. The utility of this argument is that it alone provides room for explaining a phenomenon, like inflation, in India by attributing it completely to the output and price fluctuations in the Agriculture Sector.

As such, the purpose of the dissertation is two-fold: (i) to provide theoretical justifications for the Agriculture Sector to be considered as an important factor in the macroeconomic policies of India; and (ii) to propose a "New Direction", to the macroeconomic theorists of the country, in the analytical treatment of the Agriculture Sector with respect to the study of inflation.

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CHAPTER 1
INTRODUCTION

"The prime concern of macroeconomists is to analyse and attempt to understand the underlying determinants of the main aggregate trends in the economy with respect to the total output of goods and services (GDP), unemployment, inflation and international transactions. In particular, macroeconomic analysis seeks to explain the cause and impact of short-run fluctuations in GDP (the business cycle), and the major determinants of the long-run path of GDP (economic growth)."

—Snowdon and Vane, *Modern Macroeconomics*

1.1 The Background and Rationale

The whole point of writing this dissertation assumes importance in the stream of literatures focusing on the possible economic links between the Agriculture Sector and the General economy. This stream of literature could be thought of as a variant to Keynes' Macroeconomics and much remote to the Lucas' Research Programme in macroeconomics.[1] The importance of the Agriculture Sector in the Indian economy is almost limited to the benefits it brings in the form of food supply, employment, income—from both domestic as well as foreign trade—etc. A quite obvious fact of the India's agriculture is that it is a mixed basket, which is mainly due to its dependency on the monsoons. The declining emphasis of this sector in the country's Plans since the Second Five Year Plan is adding to that fact. As such, the sector is beyond the scope of any equilibrium analysis, which assumes some degree of constancy to prevail. For instance, there may not be any guarantee that the planned demand equals actual demand in the economy if the individuals face a set of non market-clearing prices (Screpanti and Zamagni, 2006). Specifically, due to output and income fluctuations in the Agriculture Sector, the individuals, who are dependent on this sector, will be in a difficult position to realize their planned demand/spending. If the proportion of such individuals in the economy is relatively large then it would not help in keeping the equality between the planned and actual demand in the economy.

Some Indian economists have made an attempt to bring about a causal relationship between the Agriculture Sector and the inflation via food shortage. This attempt has been termed as "Food-Shortage Hypothesis" of inflation (Gupta, 1974). However, such

[1] The Lucas Research Programme in macroeconomics refers to the longingness of Lucas to eliminate the distinction between "Micro" and "Macro" Economics (Vercelli, 1991; Lucas, 1987; Hoover, 2001).

attempts have got subsided and the Hypothesis failed to be popular. As a result, the literature on the causal relationship between the Agriculture Sector and the General economy in India, particularly with respect to the General Price Level, has become rare specie. Rather, the relationship between the Agriculture Sector and inflation has been brought out by the Structuralist macroeconomists in the country via the bargaining strength of the trade unions in the Industrial Sector. The implication of such an analysis is that the Agriculture Sector can become a potential economic factor to be reckoned with only if the trade unions are powerful enough to force a wage-decision in their favor. As per the implication, the disturbances in the Agriculture Sector, to have its impact on the economy, would require the presence of intermediates. Such conclusions, if at all they are made, have ignored a fundamental necessity of taking into account the important real facts of the economy like India. For instance, the presence of a large unorganized sector, which comprises of both the workers as well as "sellers"[2], is ignored in the Structuralist analysis of inflation in India. There may be a possibility that the individuals in the unorganized sector would react to the price changes of "their most important commodities" by raising the prices of their commodity—both goods and services— supplies. As a reason, this would immediately connect the Agriculture Sector to the rest of the economy; and make it more relevant in the context of India, which has a relatively large unorganized sector. Hence, one of the basic reasons to opt for analysing the economic links between the Agriculture Sector and the General economy is to look at this sector from a Bird's Eye-View. Such an attempt would also question the role of monetary factors as the important cause of inflation in the country. However, there is no doubt that the difference between the money growth and output growth would imply inflation, according to the monetarists. But, as it is usually argued, it is only a final cause. There is another line of literature[3], in the Indian context, which has attributed inflation to something other than the underlying factors. It treats inflation as a monetary policy phenomenon. Such an understanding may not be new since Structuralists[4] have relied upon the role of money as passive, which simply responds to the changes in prices in the economy. In other words, the monetary policy is accommodating. However, this is an intermediating factor between the underlying

[2] Sellers, here, refers to the large number of individuals engaging in petty business activities such as fish vendors, vegetable and fruits vendors, carpenters, electricians etc. This idea of unorganized sector was very well appreciated in Lewis (1954).

[3] An element of that line of literature is the paper by Srinivasan, et.al, (2006).

[4] Henceforth, Structuralists, here, refers to Structuralist macroeconomists.

factor and the inflation. Because, for the changes in the agricultural price, due to supply shocks, to have any impact on the economy would require the Central Bank to accommodate money supply. As such, the "Unorganized Sector" argument is also applicable here.[5]

1.1a: The Research Question and its Justification

In India, especially, the Agriculture Sector's contribution to the economy's Gross Domestic Product (GDP) has been on the decline and yet the labor force dependent on this sector is over fifty percent of the total labor force employed in the country. These facts, in conjunction, do not allow the observer to ignore this sector. Rather, they encourage the observer to ask certain equivalent questions, put in different ways such as: Is agriculture still an important sector in the economy? Or, Is this sector capable enough to cause macroeconomic disturbances? Or, Does this sector have causal links to macroeconomic variables? Etc. Of these questions asked, the point of interest, in this dissertation, is the question focusing on causality between Agriculture Sector and the General economy. However, why should one expect a causal relation to hold between the Agriculture Sector and the General economy? There are some good reasons to believe why a causal relation between the mentioned entities should exist. Firstly, the agriculture is a wage-goods; and raw materials producing sector. As such, it is connected to the Industrial Sector via the Mark-Up.[6] There is a wide range of literature focusing on this connection to explain inflationary processes in the economy.[7] Secondly, due to a relatively larger labor force—more than fifty percent in the case of India—depending upon the Agriculture Sector, one can imagine this as a potential source of demand and as an important contributing factor to aggregate demand in the economy. This property of the Agricultural Sector has been studied, specifically, contextualizing in the Agriculture-Industry interactions.[8] Thirdly, the size of this sector is relatively large and this adds to the importance of the first and second reasons. Fourthly, the Agriculture Sector is largely affected by the natural factors such as weather. If weather is an irregular phenomenon, or, equivalently, if weather fluctuation is a regular phenomenon, one should expect the output—and thereby, Price—

[5] This argument is very well elaborated in Chapter 7, as a matter of relevance.
[6] Mitra (1978)
[7] Some of the literatures in this tradition are Lewis (1954); Kalecki (1976); Kaldor (1975); Kaldor (1979) among others.
[8] Some of the literatures on this are Taylor (1982); Taylor (1991); Rakshit (1989) among others.

fluctuations in this sector to take place in a permanent fashion than in any other sectors of the economy, ceteris paribus. This is the basic reason as it, along with the third reason, reinforces the importance of the first two reasons.

Hence, it is quite natural to know whether such output and thereby, price fluctuations in the Agriculture Sector disturbs its equations with the General economy. This is the closest essence of the thesis statement formulated in the current dissertation for testing.

1.2 The Inspiration of the Thesis

The inspiration for engaging in this issue came from the joint paper written by Ardeni and Freebairn (2002) on the macroeconomics of agriculture. Their justification for the need to study macroeconomics of agriculture, as a separate branch of economic science, is largely based on distinguishing the Agricultural Sector from other sectors in the economy. No doubt, uniqueness itself should deserve a high score amidst the set of identicals[9]. Although their focus was on the Agriculture Sector, interestingly their justifications for establishing 'Macroeconomics of Agriculture' as a separate branch of economic science rested upon the characteristics of the Primary Sector—that is, Agriculture Sector together with the fishing, mining and energy sectors. In this sense, there can be a possibility of studying the macroeconomics of each sector, in a broad sense, that is, Primary, Secondary and Tertiary. But, there must be certain fixed criterion in order to avoid that possibility. Not because there can be two more branches of economic science related to secondary and tertiary sectors, respectively. Rather, while making a comparison across the sectors for distinguishing one as unique and the rest as identicals, it is essential to preserve consistency. The chapter on the conceptual framework, in this dissertation, provides a set of criteria in the form of axioms to avoid this inconsistency in Ardeni and Freebairn's paper. These axioms also set out to establish a conceptual basis for the objective of the dissertation.

1.3 The Objective and the Claim

The objective of the dissertation is to test the thesis statement[10]: *The growth of the economy should reflect the stochastic element present in the large sector's production function.*

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[9] Identicals refers to things that are homogenous in nature.

[10] Since the term 'thesis' refers to a main idea, the 'statement of the thesis' refers to presenting the main idea in a one-sentence statement.

To accomplish the testing of the thesis statement, two hypotheses have been formulated. One, is related to the causal nexus between the agricultural prices and the General Price Level. (Hypothesis A). Second, is the causal nexus between the agricultural prices and the money supply (Hypothesis B).

1.4 Data and Methodology

All the databases used for the current study are published in India. Data used for the analysis are taken from the Centre for Statistical Organization's *National Account Statistics,* the Reserve Bank of India's *Handbook of Monetary Statistics of India* 2006; and *Handbook of Statistics on the Indian Economy*, 2007. The time-series of the prices and money supply is for the period 1952-53 to 2004-05. The frequency of the data is monthly for the econometric analyses. The price variables for the empirical analysis are the Wholesale Price Index for all commodities, the Wholesale Price Index (WPI) for Food and Non-Food articles. The sum of the WPI for food and WPI for non-food is treated as the agricultural price. The Wholesale Price Index for all commodities is taken as a proxy for the General Price Level of the economy. All the above price series in India comes with a set of base years. As a result, a suitable Splicing technique has been applied to make the data series continuous from one time point to other time point. Also, the data for both prices as well as money supply has been converted into log form before making seasonal adjustments. Then, the point-to-point growth rates of the seasonally adjusted data have been computed prior to the stage of empirical analysis. These point-to-point growth rates serves the purpose of interpreting fluctuations in the time-series processes, purely based on the real world occurrences.

The empirical methodology that has been applied for examining the hypotheses is the Hsiao's Granger Causality procedure. In addition to this, a test of robustness is carried out in order to take into account the "Granger's Warning", while working with the monthly time-series data. The test of Robustness involved examining for the feedback causality for the same set of chosen relations, by reducing the sample period under study into five sub-groups of 120 observations each. The results of both the tests—original and the test of robustness—overall confirm to the presence of feedback causality under Hypothesis A and Hypothesis B. Hence, there is a definite causal relation moving from the Agriculture Sector to the General economy via the chosen macroeconomic variables. This result is crucial for a country like India, which has relatively a large unorganized sector. Therefore, by the "Unorganized Sector"

argument, there is a need to consider the Agriculture Sector as a potential candidate to understand the problems involving macroeconomic disturbances.

1.5 The Chapter Scheme

The significant contribution of this dissertation is its approach in examining the relatively neglected area of the macroeconomics of Agriculture Sector in India. The chapters of the dissertation are arranged as follows:

- **Chapter 1:** Introduction
- **Chapter 2:** The Conceptual Framework—offers a glimpse of the original attempt made for providing a conceptual basis to the thesis statement.
- **Chapter 3:** Review of the Literature—wherein certain literatures categorized as relevant for the study at hand are reviewed and analyzed in detail. As a consequence, the chapter concludes with detailing on the hypotheses to be formulated to facilitate the testing of the thesis statement.
- **Chapter 4:** Data and Methodology—it provides an introduction to the sources of data and its handling, along with a short review of the methodology of Granger Causality, which has been selected for its adaptation to answer the questions involving the direction of causality. One fundamental issue in the application of this empirical tool is the selection of optimal lag length. This is sought out by applying Hsiao's Procedure of Granger Causality.
- **Chapter 5:** The Stylized Facts—wherein exploratory data analyses, along with preliminary explanatory analyses, are conducted to facilitate the empirical testing of the thesis statement.
- **Chapter 6:** Empirical Findings
- **Chapter 7:** Conclusions.

CHAPTER 2
CONCEPTUAL FRAMEWORK

"As it is, your (French) economists are eclectic, too much (we sometimes think) without deep roots in systematic thought."

—John Maynard Keynes, *The General Theory*

As mentioned earlier, one of the essential reasons to bring out this chapter is to provide a conceptual basis for the statement of the thesis. In the meanwhile, it also provides a set of criteria to dissolve the problem mentioned, in Ardeni and Freebairn (2002). This chapter begins with the set of concepts, defined, before arriving at the axioms and thereby the theorem.

An Economy is a set of Sectors. A sector is a set of more or less homogeneous economic activities performed by a subset of a set (or the union of sets) of economic agents. For instance, agricultural activities performed by agricultural producers, in general. The correspondence between an economic activity and an individual economic agent represents the existence of specific skills, which is why the substitution of factor inputs, especially labor, of one sector for another sector's factor inputs (labor) seems an almost impossible task. Moreover, if a sector's performance largely depends upon the factors beyond the control of humans, it adds up to the problem of "structural rigidity", that is, the problem of reallocation of resources in the development process. On the one hand, the substitution is hindered and on the other hand, the stochastic nature of the sector weakens the incentives to invest in it. The presence of such characteristics in a sector may not be sufficient conditions in explaining its impact on the economy as a whole. The requisite characteristics are Size and the relative position of the sector in the economy. It is an obvious thread in the explanation for the reason that a large sector, for instance, requires the consumption of a large portion of the economy's resources. The outcome of such a large consumption of resources cannot be ignored as there is a notion of opportunity cost associated with it. Higher the consumption, higher is the opportunity cost.

Axiom 1 (Size axiom): **For any large sector in the economy, the opportunity cost of its resource consumption is higher than that of any other sector.**

A factor which works in conjunction with the Size is the relative position of the sector in the economy. As per the Hirschman's notion of the existence of links between the sectors—both the forward and the backward links—in the context of applying a development strategy in the less developed world, a sector that supports a large number of sectors is the right choice of investment (Hirschman, 1958). It is obvious that to have such a strong linkage the sector needs to be large. But all large sectors need not have strong linkage. Consider, for instance, a mud-pot producing sector, which is assumed to be larger in relation to other sectors in the economy. However, its input requirements are only few and may not need a sector to produce them. On the other hand, the mud-pots are, generally, a final consumption good. Hence, it neither demands the existence of a large number of sectors for its input requirements, nor for its output sales. Such a sector fails to be a right choice of investment, given the resource constraint.

Axiom 2: **For any sector s, s is large if and only if it has strong links in the economy**.

Hence, both the axioms (1 and 2) emphasize the following theorem:

Theorem 1 (Growth Dependency Theorem): The growth of the economy depends upon the growth of its large sector, provided that the large sector supports other sectors.

By implication of the above theorem it is clear that a sector can influence the growth path of the economy independent of any factors other than its size and relative position in the economy. However, an implicit assumption was made in it that the resources a sector consumes is homogeneous to that required by the other sectors in the economy. This is not often the case. Let us characterize the resources as factors of production. Each factor of production has properties specific to the sector where it is made use of. In other words, the utility of a factor input is a real function of its suitability to the production process. For instance, given that all lands are fertile, the utility of a fertile land to the Agriculture Sector is the greatest. Similarly, the utility of tractors is greater for the Agriculture Sector than for any other sectors. The money printing machines have greater utility for the Government (including the Central Bank), provided there do

not exist a shadow economy.[11] The software engineers have greater utility for the information technology sector and so on. All these are instances of suitability of the factor inputs to the production needs of a sector. Despite this, the mechanics of the opportunity cost principle do not disappear. Rather, the resource that goes into the production of different kinds of skills and machines itself obeys the principle. For instance, given other things, the opportunity cost of preferring social science researchers over medical researchers is the risk of falling health levels in the society. This choice is interesting when both these class of researchers contribute to social welfare. However, in a highly decentralized economy such preference-backed decisions ultimately rest on the working of the 'Law of Large Numbers'.[12] Otherwise, the decisions are taken by the benevolent government, howsoever defined.

2.1 An Illustration of the Importance of the Large Sector

The theorem also implies a trivial truth that the underperformance of such a sector can have adverse growth consequences for the economy. Suppose the growth function of a closed economy 'G^E' is functionally related to the growth in its component sectors 'G^i', where i=large 'L' and small 'S'.

$$\mathbf{G^E} = f(\mathbf{G^L}, \mathbf{G^S}) \qquad f_{G^L} > 0, f_{G^S} > 0 \qquad \text{--- (2.1)}$$

Where, f_{G^L} and f_{G^S} are partial derivatives of the growth of the economy with respect to growth in the Large sector and Small sector, respectively. The sign of these partial derivatives is expected to be positive since the growth of the economy positively depends upon the growth of its component sectors. The parameter restriction in favor of the Large Sector allows the influence of the Large Sector to be greater than that of the Small Sector. That is,

$$f_{G^L} > f_{G^S} \qquad \text{--- (2.2)}$$

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[11]The Shadow economy, also known as the Illegal economy, includes the possibility of duplicating the money, which is in circulation. For duplicating the legal tender, money-printing machines are required. This would, then result in cheating the government as well as looting the people's money in circulation. Such a situation would diminish the utility of these printing machines to the government. The fall in the utility would be reflected by the demonetization efforts of the government.

[12]Technically, the Laws of Large Numbers is a generic name given to a class of theorems concerned with stating conditions under which the average of a sequence of random variables converges to the expected average. (Nelson, 2003 and Ross, 2006). It can be explained in our context as follows: If the society is composed of two groups, say M and N, and each of the group picks one of the two investment choices, say A and B; and M picks A and N picks B, then the investment choice of the society depends upon whether M is sufficiently larger than N. Suppose that the number of individuals in group M increases with the movement of individuals from group N to group M, reflecting their preference towards A. In such a case, A remains to be the investment choice of the society.

To enable the inter-relation between the sectors, let us introduce the functional relationship,

$$\mathbf{G^S} = g(\mathbf{G^L}) \qquad ; g' > 0 \qquad \text{--- (2.3)}$$

Where, g' measures the effect of change in the growth of the Large Sector on the growth of the Small sector. The sign is expected to be positive because G^S is made to depend on the growth performance of the G^L and not otherwise to emphasize on the fact that the large sector is more influential than the small sector. By substituting the expression (2.3) in the expression (2.1), we get,

$$\mathbf{G^E} = f(\mathbf{G^L}, g(\mathbf{G^L})) \qquad \text{--- (2.4)}$$

The expression (2.4) relates the growth of the economy solely to the growth of the large sector. According to it, the growth of the large sector affects the growth of the economy directly as well as indirectly.

$$\frac{\mathrm{d}\mathbf{G^E}}{\mathrm{d}\mathbf{G^L}} = f_{\mathbf{G^L}} + f_{g(\mathbf{G^L})}g' \qquad \text{--- (2.5)}$$

The first term on the right-hand side of the expression (2.5), $f_{\mathbf{G^L}}$, represents the direct effect of the growth performance in the large sector; and the second term $f_{g(\mathbf{G^L})}g'$ represents its indirect effects via the small sector. The expression (2.5) quite clearly suggests that "whatever" happens in the large sector will be reflected upon the economy. The stress on the word "whatever" is to indicate that the analysis here assumes away any other shocks than that generated in the large sector. Such an assumption is a prerequisite for considering the importance of one entity in relation to others. To illustrate the importance of G^L, let us assume that the $f_{\mathbf{G^L}}$ is zero. As a result, the growth of the economy will get reduced to

$$\frac{\mathrm{d}\mathbf{G^E}}{\mathrm{d}\mathbf{G^L}} = (f_{g(\mathbf{G^L})}g')^* \qquad \text{--- (2.6)}$$

Clearly, $(f_{g(\mathbf{G^L})}g')^*$ in the expression (2.6) is smaller than $f_{g(\mathbf{G^L})}g'$ in the expression (2.5) due to the debilitating effect of the zero growth in the large sector on the growth of the small sector. The zero growth case, as already said, has been taken as an illustrating aid to show the importance of the large sector in the economy. Even a positive and diminishing growth can have similar debilitating effects. Now, the central question for the analysis is whether there exist growth-reducing factors in the large sector? Given other things, the answer to this question depends on the nature of goods

produced in the large sector. Suppose, the nature of goods is such that it can be produced only with the help of natural factor, then, in such a case, the production function has a stochastic element present in it since, the natural factors are uncontrollable.

$$\mathbf{Q}^{L} = \mathbf{Q}^{L}(\mathbf{I};\Omega) \qquad \text{--- (2.7)}$$

Where $\mathbf{Q}^{L}$ is the output in the large sector; $\mathbf{I}$ is the set of controllable factor inputs; and Ω is the stochastic element representing the uncontrollable natural factor.

Hence, the growth of the output is conditioned upon the state of the natural factor. A favourable state would support the production, whereas the unfavorable state would not. Due to this, the $\mathbf{Q}^{L}$ behaves stochastically. For the purpose of my analysis, the expression (2.7) type supply-constraint will be adopted and this is formalized in the following axiom:

Axiom 3 (Nature of Goods Axiom): $\forall x(x \in \mathbf{L}, \textit{iff } x \in \Omega)$, **where** x **is any good;** $\mathbf{L}$ **is a set of goods produced in the large sector; and** Ω **is a set of goods that are stochastic in nature.**

The above axiom reinforces the earlier axioms, based on which, the Theorem is deduced.

2.2 Statement of the Thesis

Based on the above conceptual framework, in which an attempt is made to formalize the relation between the activities in the large sector of an economy to that of the economy itself, the current work is designed to test the proposition:

The growth of the economy should reflect the stochastic element present in the large sector's production function.

To test the above thesis statement, the current study applies a simple strategy. By assuming the links between the macroeconomic variables such as inflation and money supply; and the economy; an examination of the causal links between these macroeconomic variables (particularly, inflation and money supply) and the large sector is carried out. In other words, the effects of the concerned macroeconomic variables on the economy are taken for granted.[13] With the aid of this assumption, the empirical focus of the current study remains to be examining the causal relationship

[13] Some of the literatures on the link between inflation and the economy are Phelps (1970), Marty (1999), Shaalan (1962), Olivera (1964), Laidler and Parkin (1975) among others. With respect to the role of money supply in the context of inflation, see Olivera (1970), for example.

between the agricultural price and the concerned macroeconomic variables. Hence, the positive empirical evidence on the direction of causality from the agriculture price to the concerned macroeconomic variables would imply the relationships that have been assumed.[14] In this way, the causal connections provide, in an indirect way, the information to draw crucial inferences with respect to the behaviour of the economy. However, there is yet another fundamental problem to be resolved. The stochastic element that gets highlighted in the thesis statement needs to be quantified; and there is no easy way to accomplish it due to data limitations. But, there is one satisfactory way to sought out this problem. Let us take the expression (2.7), which indicates that the output follows a random walk process due to presence of Ω. That is,

$$Q_{L_t} = Q_{L_{t-1}} + \upsilon_t \qquad \text{--- (2.8)}$$

Where, Q_{L_t} refers to the output produced in the Large sector at time t, $Q_{L_{t-1}}$ refers to the output produced in the Large sector at time t-1 and υ_t refers to the disturbance term at time t. As per the expression (2.8), the output at time t depends not only on the level of output at time t-1, but also on the disturbance term representing the stochastic element. If there is a data limitation on collecting the observations on output variable, one can make use of the following relation to generate a proxy for the output variable.

On the supply side of the market, an increase in output would result in the fall in its price and vice versa, ceteris paribus.[15] Hence, the price and output are inversely related to each other. Due to this fact, the above random walk process involving output can be replaced by the one involving price, without any loss of information. That is,

$$P_{L_t} = P_{L_{t-1}} + \mu_t \qquad \text{--- (2.9)}$$

Where, P_{L_t} refers to the Price of the output produced in the Large sector at time t, $P_{L_{t-1}}$ refers to the price of the output produced in the Large sector at time t-1, and μ_t refers to the disturbance term. We can easily arrive at the empirical definition of the disturbance term in the price expression (2.9) by taking the first difference of it. That is,

$$\Delta P_{L_t} = P_{L_t} - P_{L_{t-1}} = \mu_t \qquad \text{--- (2.10)}$$

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[14] By this, a transitivity relation is imposed upon. That is, if the changes in the agricultural price causes changes in the concerned macroeconomic variables; and the changes in these concerned macroeconomic variables causes changes in the economy's output (by assumption), then, by transitivity axiom, changes in the agriculture price causes changes in the economy's output.

[15] This should not be confused with the 'Law of Supply', which states that an increase in the price of a commodity would invariably result in increase in its quantity supplied and vice versa, ceteris paribus.

This idea has been incorporated while undertaking empirical analyses.[16]

There can be an argument, whose premises are that the price is influenced by the supply; and is influenced by demand in the market. Hence, the conclusion of the argument is that the price gets influenced by both demand and supply in the market. Such an argument can be made, easily, redundant if one can reinterpret the demand and supply as a relation between the "commodity stock produced", S*, and the "commodity stock needed for consumption", D*. This is, of course, a qualified relation. It is qualified, because it is restricted to the space limited to market interactions only. Let us look at how this qualified relation works.

The difference between S* and D* would result in the following:

$$S^* - D^* > 0 \text{ iff } S^* > D^* \quad \text{--- (2.11a)}$$

Similarly,

$$S^* - D^* < 0 \text{ iff } S^* < D^* \quad \text{--- (2.11b)}$$

The above results imply the following conclusions:

$$S^* > D^* \Rightarrow \Delta P < 0 \quad \text{--- (2.12 a)}$$

$$S^* < D^* \Rightarrow \Delta P > 0 \quad \text{--- (2.12b)}$$

Because, both the relations—S* > D* and S* < D*—are symmetric, the above conclusions also applies to their symmetrics. Let the commodity in question satisfy the **Axiom 3**. In such a case, S* is more dominant than D* in influencing price change. The reasons for this are explicitly noted in the **Axiom 3.** Hence, price in the large sector, influenced by stochastic element, follows a random walk process. The above analyses are meant to serve as points of clarification to the thesis statement. With this understanding, the following chapters are prepared to provide more information on the ways and means of testing the thesis statement.

[16] For the empirical analyses, the simple growth rate of the concerned variables is taken into account, in a logarithmic form. This is done in order to reflect the stochastic element in the time series.

CHAPTER 3
THE REVIEW OF LITERATURE

"I have called my theory a *general* theory. I mean by this that I am chiefly concerned with the behaviour of the economic system as a whole,—with aggregate incomes, aggregate profits, aggregate output, aggregate employment, aggregate investment, aggregate saving rather than with the incomes, profits, output, employment, investment and saving of particular industries, firms or individuals."

—John Maynard Keynes, *The General Theory*

3.1 Structural Transformation and Agriculture Sector: Some Related Issues

The literature on the macroeconomic effects of the Agriculture Sector on the General economy is not a well-explored area (Ardeni and Freebairn, 2002). In the context of India, an indication is provided that the works done to establish the links between the Agriculture Sector and inflation is meager; and has been largely ignored as having no theoretical basis (Gupta, 1974). It is in this regard that the current work has been taken up with an intention to examine the lacuna in the literature, while bringing in the economic significance of the Agriculture Sector in the economy. The issue of structural transformation of the less-developed economies is taken as a useful beginning point for this chapter since, it directly throws light on the importance of the Agriculture Sector in the development process of the economy.

Structural transformation is considered to be essential for an economy to grow faster than ever. It implies a shift from the traditional ways of producing to the modern ways; from the production of low value-added products to higher value-added products; from the production and trade of low price and income inelastic products to relatively higher price and income-elastic products. Some or all of these implications are explicitly recognized in the development literature. For instance,

"The two basic factors generally recognized as responsible for the structural transformation of an economy are: (1) an income elasticity of demand for food that is less than 1 and declining, and (2) the possibility of a substantial expansion of agricultural production with a constant or declining farm labor force." (Johnston and Mellor, 1961, pp. 567)

The "first basic factor" develops pessimism towards the reliance on the growth of the Agriculture Sector for general economic growth, whereas the "second basic factor" by itself is not 'the reason' for structural transformation. Let me justify my inference on the "first basic factor". Such pessimism implicitly assumes that the income growth is

guaranteed and is sufficient enough to activate the trend of lower income-elasticity of demand for food. Suppose that the demand function for food is

$$q_f = q_f(p_f, y) \qquad \text{--- (3.1)}$$

where q_f is the quantity demanded of food; p_f is price of food; and y is income of the individual.

Given the own price, and taking natural log on both the sides and differentiating q_f with respect to y, we get the income elasticity of demand for food (η_y)

$$\frac{\partial \ln q_f}{\partial \ln y} = \eta_y \qquad \text{--- (3.2)}$$

The rationale behind expecting the income elasticity of demand for food to be less than one is that the food is consumed in fixed proportions. Although, it is one of the important basic necessities of life, due to its fixed nature of consumption, when expressed as a share in the consumer's income, it tends to be relatively smaller as the income expands.[17] However, it is a case of single consumer only. If one assumes it to be the case for entire society, it implies the absence of income inequality. Is this the case in the less developed economies? May be not. Moreover, if a large proportion of the population resides in the rural sector; and they are dependent on the agricultural and agriculture-related works, their income may not grow smoothly. In such a situation, η_y for the society may not decline nor remain low forever.

Rather, η_y may show fluctuations in it, conditioned upon the behaviour of the income of a larger sub-population residing in the rural sector. The economies remaining in the above situation virtually do not support the structural transformation. This conclusion is deduced for the closed-type economies. In case, if the economies are open to international markets then η_y can be expected to be an important factor, discouraging the reliance on the food exports; and thereby motivating the structural transformation. But, this would require, as a prerequisite, finding an alternative use for the factor inputs employed in the food sector, possibly in the leading sector. However, the mentioned prerequisite demands the suitability of labor input in the accommodating sector. If time as a factor is taken into account, the molding of the labor skills to suit the

[17] In other words, this is referred to as the Engel's Law. "The Law was formulated by Engel, the director of the Bureau of Statistics in Prussia, in a paper published by him in 1857." (Baxter and Davis, 2003).

accommodating sector can be expected to take place on the 'new generation'[18] than the existing ones. Even here, the behaviour of the population growth can deceive us in thinking that the leading sector is accommodating. Suppose, the working population in the entire economy is classified into food sector population $\mathbf{L}^{f}$ and non-food sector population $\mathbf{L}^{nf}$; and the former is larger than the latter. Also, let us suppose that the job accommodating space in the leading sector is equivalent to $\mathbf{L}^{f}$. Since, it takes time for the transformation to take place, the relation between initial population at time 0 and the new population at time T can be shown in the following expressions for both the sub-populations in the economy:

$$\mathbf{L}_{T}^{f} = \mathbf{L}_{0}^{f}(1+g)^{t} \qquad ---(3.3a)$$

$$\mathbf{L}_{T}^{nf} = \mathbf{L}_{0}^{nf}(1+r)^{t} \qquad ---(3.3b)$$

If both grows at the same rate (g = r) and takes twenty years to double their initial levels, supposing that it takes so long to bring out a working population through molding, the labor supply to the accommodating sector will be $\mathbf{L}^{f} + \mathbf{L}^{nf}$, which is in excess to what is demanded. To accommodate this excess supply, the leading sector has to be more labor intensive over time during the course of its expansion. Moreover, the accommodation is only one side of the problem of structural transformation. The real problem is in the process of molding the skills, where we initially assumed that both the populations have equal accessibility to skill development. If the $\mathbf{L}^{f}$ grows at a higher rate than that of $\mathbf{L}^{nf}$ and a share of $\mathbf{L}^{f}$, say φ, is held back due to the inaccessibility, then the employment in the leading sector may have a greater proportion of the $\mathbf{L}^{nf}$ and the pressures for adopting labor-intensive technology would be lower.

Food sector or, in general, the Agriculture Sector is the predominant one in a country like India. Apart from being predominant, it is also one of the important contributors to economic growth. Its importance has not gone undersighted is clear from the set of five propositions, provided by Johnston and Mellor (1961). They are:

"(1) Economic Development is characterized by a substantial increase in the demand for agricultural products, and failure to expand food supplies in pace with the growth of demand can seriously impede economic growth. (2) Expansion of exports of agricultural products may be one of the most promising means of increasing income and foreign exchange earnings, particularly in the earlier stages of development. (3) The labor force for manufacturing and other expanding sectors of the economy must be drawn mainly from agriculture. (4)

[18] New generation is also referred here as new working population.

Agriculture as the dominant sector of an underdeveloped economy can and should make a net contribution to the capital required for overhead investment and expansion of secondary industry. (5) Rising net cash incomes of the farm population may be important as a stimulus to industrial expansion." (Johnston and Mellor, 1961, pp.571).

With respect to the first proposition, the authors have specifically emphasized on the population growth and per capita income as the only important determinants of the demand for food. The driving point here is the razor-edge situation the sector had to face; and hence, the supplies "must always" equate demands.

But, one point that got implied in relation to the first proposition is the role played by weather as a determinant of food supply. Given the growth in demand, the supply may never be equal to it due to fluctuations in the weather. Of course, the shortages imply a rise in the prices of food and its attendant problems.

3.2 Agriculture Sector and the Macroeconomy

Having established the causal link between the large sector output and the General level of output in the conceptual framework, it is desirable to focus on the way the fluctuations in the Agriculture Sector can have macroeconomic implications. The tradition in studying the macroeconomic effects of prices in the Agriculture Sector is to look at the expectations and fear of the industrial workers whose wages are linked to some cost of living index. Such an index gives a high weightage for food items. So that any rise in the price of these food items will tend to reduce the real income of the industrial workers, who in turn pressurize their employers to maintain the real wages. This, in turn, tends to increase the price of industrial goods, which is linked to a mark-up on the wages. The rising industrial goods' price again reduces the real income of the industrial workers, thereby, repeating the earlier process of wage rise. This, in short, is the highly popular 'Wage-Price Spiral' hypothesis. Another mechanism through which such a hypothesis may be expected to occur is the impact of the agricultural prices on the non-wage cost of production of the Industrial Sector. But, the hypothesis do require the existence of a strong and wide spread trade union culture in the Industrial Sector to enforce the wage bargain, at least to a certain extent, in favor of the working class. For the 'agricultural prices-non wage cost in Industrial Sector' link, a large number of industries relying on the agricultural output for the non-wage cost of production have to be of important concern.

For the purpose of generality, there is a need for abstracting from the wage and non-wage cost of production of any particular sector. As it is an obvious fact that the food is an essential component of the consumption basket of the individuals, any rise in its price implies the shift in the consumption expenditures in favor of it. What happens to the aggregate consumption expenditure in the economy? The aggregate consumption expenditure may be defined as the sum total of all individual consumption expenditures and, as such, the composition of the individual consumption expenditure does not get explicitly reflected in the aggregate. What is actually reflected is the level of the individual consumption expenditure. Then, how is it possible to know the effect of the rise in the food price on the aggregate consumption expenditure? One strategy is to consider the allocation of consumption expenditures in a special sense. That is, any changes in the allocation of the consumption expenditure imply the shifting demands for the output of different sectors in the economy, ceteris paribus. In this sense, any rise in the price of food should affect the demand for non-food. Hence, the aggregate consumption expenditure is no more the same before and after the change in the allocation of the consumption expenditure, due to rise in the price of food, here. In the absence of such an understanding, the strangeness in the aggregate consumption expenditure will not be revealed and one encounters what one may call as the "Consumption Illusion".

Moreover, the Agriculture Sector can affect the business activities of the economy. The role of agricultural fluctuation in explaining trade cycle—cyclicality and the crisis—has a long history, though not exactly in the way it is contemplated here. Jevons spent most of his life in providing evidence to his "Sunspot theory" of trade cycle wherein he had a belief that the cyclicality of sunspots is related to seasonal variations in the weather, causing agricultural fluctuations and hence, macroeconomic fluctuations. Such a physical cause to weather patterns has lost its relevance for the economists now and the attention has been given only to the agricultural fluctuations as a causal determinant of macroeconomic fluctuations. The others who engaged in the debates concerning the links between agricultural fluctuations due to weather fluctuations; and the level of economic activity were the economic historians like T.S.Ashton, J.D. Chambers, G.E. Mingay etc., and economists like G. Haberler.[19] Keynes, in his General Theory, iterated the point made by Jevons while explaining his theory of trade cycle. Infact, he restates

[19] On this, see Gould (1962).

the Jevons theory of trade cycle that a good harvest induces increase in current investment, whereas, a bad harvest tends to reduce it. As per this, an upward turning point is associated with the good harvest and a downward turning point is associated with the bad harvest. However, Keynes ends up his notes by providing two qualifiers in considering the agricultural fluctuations as a cause for investment fluctuations. One, the above theory works if the Agriculture Sector is large. Two, the presence of a world market would tend to average out the fluctuations for agricultural commodities. Both of these qualifiers are in the context of the Modern World only.

But, is there any link between a bad harvest and investment in the Agriculture Sector? A bad harvest due to weather shock may have a certain implication on the investment behavior in the Agriculture Sector. Suppose that the producers in this sector depend upon the value of output, attained in the time period t, for reinvesting in the time period t+1. In the event of the weather shock, the agricultural output falls to a lower level leading to a rise in its price. As a result, the value of output falls if the fall in output is greater than the rise in price. The fall in the level of the value of output results in fall in the reinvestment into the future production. Should we expect a cobweb on the way, the reinvestment has to rise even in the event of fall in the value of output due to price rise. The deficit in the reinvestment then has to be financed from money market—formal or informal. The rise in the investment demand for money leads to an increase in money supply in the economy. This is so, if the Agriculture Sector is relatively large. On the other hand, in the event of bounty, the price of the agricultural commodities will decline and the investment demand for money from this sector remains negligible. Hence, one could conjecture a direct relationship between the agricultural price and money supply at any time, provided the money supply matches the investment demand for money. In other words, increase in the agricultural price would lead to increase in the money supply and vice versa. The increase in the money supply may lead to a rise in the aggregate demand for goods and services with the consequent increase in the General Price Level. In the presence of unutilized resources in the economy, this would create an additional demand for labor. The increase in employment and, thereby, income have their own multiplier effects on the growth of national income. However, this may not work as expected since, the rise in the agricultural prices would have increased the cost of living of the nonagricultural workers and consequently, the money wages. Rather, the increased money wages would be spent on the purchases of agricultural commodities to protect the minimum subsistence level of consumption.

Such purchases again put more money into the economy. As a result, the General Price Level would rise; and may shorten the time-length of the booming phase of business cycle in the economy. Here, one could make another conjecture that there is a direct relationship between the agricultural price and the General Price Level.

Let me elaborate on the above conjectures before doing any empirical analysis of these. The above conjectures require the absence of certain qualifiers such as Central Bank's monetary non-accommodation. Moreover, as already argued, the money supply in the economy could rise due to increased investment demand for money, arising from the Agriculture Sector, due to bad monsoons. But, this would require a large Agriculture Sector as a precondition.[20] In order to understand the causal links between the Agriculture Sector, General Price Level and money supply and their possible implications on the macroeconomic balance of the economy, the following seeks for the plausible explanations.

A theoretical expectation, in a country like India, on the Agriculture Sector is that any factor that causes production to fall would lead to a series of causal effects. The fall in the production would lead to a rise in the domestic price level; and increase in the domestic prices would make exports costlier, thereby, worsening the balance of payments. This is based on the assumption of flexible exchange rate system, wherein the central bank does not hold any foreign exchange reserves. Moreover, under such a system, capital outflow may occur due to fall in the domestic real interest rate and would cause the exchange rate to depreciate. Thus, imports become costlier. If unchecked, the domestic economy would have to face growing inflationary pressures that may be detrimental to the growth and development of the economy. One way to avoid it is to introduce the government sector, which has an assigned function to take care of the welfare levels of the individuals as well as to stabilize the inflationary pressures in the economy. With respect to the latter, the immediate step, the government may take, is to fill the supply-demand gap through imports of the scarce goods. Supposing the unchanged exports level, which may be justified to a certain extent as occurring due to opposing effects of depreciation of the exchange rate and high domestic prices, the action taken by the government would lead to a current account deficit, on the one hand, and increase in subsidy, on the other hand. Hence, the

[20] The higher the number of qualifiers, weaker is the possibility of conjectures to be empirically true. The qualifier refers to certain conditions that need to be satisfied. However, in our case, there is an agriculture sector in India that is relatively large; and hence, this qualifier is satisfied.

cost of government intervention is the subsidy provided to the individuals in the economy. But, how does the government manage to incur this cost? Or in other words, how does it finance its expenditures? The standard answer given in the literature is the taxation and debt-financing. Let us look at the case of debt-financing. To sell the government bonds to the public, the government should sufficiently raise the real returns on it so as to induce the buyers to purchase amidst rising price level. This adds up to the government's debt. Provided the private investors are not competing for the investible resources, the pressure of the government borrowing on the interest rates remains mild. The private investors can be expected to demand money only in the wake of profit expectations, as suggested by Keynes, which is the case when the General Price Level is not rising. If we consider a fixed exchange rate system, the existence of foreign exchange reserves creates a problem of competition, for it is engaged by the government and the central bank. Unlike the Keynesian style of government expenditure, which is made in order to improve the effective demand in the economy, here the intention of government expenditure is one of improving the effective supply, to use the analogy from the Keynes.

3.3 Supply Shocks, Agriculture Sector and the Macroeconomy: A Causal Note

There has been a controversy, among India's macroeconomists, regarding whether inflation is a monetary or structural phenomenon in India, for long now.[21] The Structuralists obviously point out at the rigidities in the economy as a source of inflation, whereas the Monetarists believe that the inflation is due to money supply being larger than output growth. Very recently[22], there appeared a new way of interpreting the inflation as a (monetary) policy phenomenon, in the sense that the India's central bank had not accommodated the supply shocks at all. This explanation seems to be a clever one. Because, for the Structuralists, passive money is essential to ensure that the inflationary process take place fully in the economy. But, money—to be active or passive—rests largely upon the decision of the Central Bank. Hence, all these three explanations are related to the performance of the Agriculture Sector in the economy.

[21] Some of the literatures that would give an approximate idea on the nature of controversy regarding the source of inflation in India are Raj (1966), Simha (1974), Rao (1974),Bhattacharya (1984), Balakrishnan (1991), Balakrishnan (1994), Nachane and Laxmi (2002), Srinivasan et.al, (2006) among others. Of these, Balakrishnan (1991 and 1994) is interesting since its "Simple Model" give rise to a possibility of something what I term as 'Inflation ad infinitum'.

[22] See Srinivasan, et.al., (2006)

Do agricultural supply shocks have a tendency to cause inflation in India? The question here belongs to a set of short run explanation of inflation, which is often regarded as controversial.[23] What can be called as "Supply Shocks"? Any sharp fall in the output of any commodity is technically a supply shock. But, to treat something as a shock to the economy implies a strong relation between them. The result of a sharp fall in the output is a sharp rise in its price, relative to all other prices. Here, it is appropriate to use Milton Friedman's quotation that is quoted in the literature relevant to the present context.[24]

"It is essential to distinguish changes in relative prices from changes in absolute prices. The special conditions that drove up the price of oil and food required purchasers to spend more on them, leaving them less to spend on other items. Did that not force other prices to go down or to rise less rapidly than otherwise? Why should the average level of prices be affected significantly by changes in the price of some things relative to others?"

One can agree with Friedman that the changes in relative prices are not the same as the changes in absolute prices. But, there can be disagreement when there seems to be a hint of generalization in one of his questions that "*why should the average level of prices be affected significantly by changes in the price of some things relative to others*?" Of course, all relative prices do not affect the average is as true as some relative prices do affect the average. This should go as an **economic dictum** following the explanation for the WHY[25] question. The argument in support of the above proposed **economic dictum** is as follows. There are some goods that form an important component of the cost of production of large number of goods and services in the economy. Oil and food are the classic examples at hand. The increase in their prices relative to others will, in general, push up the prices of the commodities that make large use of them. Hence, the changes in relative prices may cause a direct change in the average price level. In a country like India, in its stages of development, both these goods have assumed an equal importance and the behaviour in their prices are expected to significantly affect the average price level of the country. One of the reasons[26] why

[23] See Ball, L. and Mankiw, G. N. (1995)

[24] Yet, 'I' regret for my inaccessibility to the Friedman's paper "Perspectives on Inflation," which was published in Newsweek on June 24, 1975 as it is dangerous to rely on a few lines of an article for inferences. Since, it increases the risk of committing a 'Fallacy of Composition'. However, being aware of this fallacy, 'I' continue with the quotation since, some new theories of inflation have emerged as a reply to it.

[25] The WHY question here is what Friedman asks in the quotation: "*why should the average level of prices be affected significantly by changes in the price of some things relative to others*?"

[26] See Ball, L. and Mankiw, G.N. (1995)

Friedman was having an opposite belief is his inclination towards a proposition provided by the Classical Economists that the relative prices are only determined by real factors and the absolute price level is determined by the money supply. The world, however, is not solely ruled by such correspondences.

One of the important motivations to study supply shocks is its consequences, on the one hand, and the possible policy responses to mitigate the shocks, on the other hand. Obviously, one would expect a temporal ordering function to operate, which assigns a value, say, t to the occurrence of the consequence; and a value, t+1 to the policy response. The term 'Consequence'(C) means, here, any event whose occurrence cannot take place without a particular action, A. That is, if it has to be expressed in terms of the language of Probability, the probability of the occurrence of event C is conditional on the event A to have already occurred, Pr(C/A). However, it does not mean that C is the only consequence of the A. There may be cases where A can lead to the joint occurrence of more than one C, Pr{(C1, C2...Cn)/A}. Here, this possibility will be ignored and rather, the focus is on the situation where causal chain exists. For any given A, a causal chain is said to exist if A produce a sequence of Cs corresponding to a vector of temporal ordering, **T**, made possible by a one-to-one temporal ordering function. An action, A, is treated, here, as any event whose occurrence is governed by the Nature; or by the deliberate design of the individuals. The problem is to provide a connection between a consequence and a policy response. By treating a policy response as a counter-action to negate or reduce the effects of a particular consequence, it is possible to allow for a correspondence to occur between the set of consequence and the set of policy response. In other words, every element in the set of consequence attracts a unique policy response. Let us illustrate the relation between an action, Consequence and policy response with an example. The sharp increase in the relative prices of the important goods due to supply shocks will tend to depress the aggregate demand and, thereby, may run the risk of recession, in the less than full employment situation. This could be avoided if there is a timely increase in the money supply to accommodate the demand amidst rising prices.[27] In the example given, supply shocks belong to the set of actions; the relative prices, the aggregate demand and the recession belong to the set of consequences origination from an action; and money supply accommodation belong to the set of policy actions. One may note, here, that the money supply accommodation is

[27] See Gordon, R. J. (1974)

the policy response to a fall in the aggregate demand to avoid a further consequence, the recession. Turnovsky provides a survey on more variations of the above example for the understanding of the possible policy responses to supply shocks under varying conditions.[28]

Based on the above conceptualization of action, consequence and policy action, it is possible to formulate an empirical design for testing the thesis statement of the study and to deduce possible inferences from it. The equivalent interpretation of the thesis statement of the study is that the shocks to the Agriculture Sector always have its repercussions on the behaviour of the economy. The shocks, which are particularly interesting, here, are those related to the supply side only. As a result of this choice, the variable that becomes immediately relevant is the agricultural output due to its obvious relation with the monsoons. However, all the produced agricultural output may not enter the market for exchange, as some producers may prefer to allocate a part of their produce to meet their own consumption needs. But, in general, let us assume that the ultimate motive behind production is to exchange. This implies that the output is priced in the market. The inverse relation between the output and price is, obviously, guaranteed by the microeconomic Law of Demand. The law helps us to understand the link between the supply shocks and the price. Since, most of the transactions in the economy, if assumed to take place through the market mechanism then the relative prices reflect the relative scarcities of the commodities produced. Thus, agricultural prices can be considered as the relevant variable for the analysis of the link between the Agriculture Sector and the rest of the economy. In the real world, all exchange may not take place through the market mechanism for there is a government intervention. In such a case, the role of relative prices as the most appropriate source of information on the relative scarcities of the commodities may come into doubt. Yet, there is a possibility to resolve the doubt by incorporating a variable that proxies a relation between the price and output. One strategy to arrive at an appropriate proxy is to measure the difference between the growth of the output and the growth of its own price.

The agricultural prices can be related to the rest of the economy through two important sectors of the economy: the Industrial Sector and the Household Sector. Both these sectors receive the similar effects from the Agriculture Sector since, both form the

[28] See Turnovsky, S. J. (1987)

components of aggregate demand for the agricultural output. It implies that for any increase in the agricultural prices at any time the aggregate demand will fall. To put it more clearly in the perspective, let us assume that the production needs of the entire economy is fulfilled by the Agriculture Sector alone. In that case, the supply shocks to the sector will lead to an increase in the General Price Level, directly. The increased price level tends to put a downward pressure on the level of the aggregate demand unless the demand for agricultural commodities is price inelastic. This has two possible implications. One, the level of aggregate consumption expenditure declines due to a rise in the prices of the agricultural consumption goods. Two, the employment level in the economy will decline due to increased cost of production, wherein the increased cost is due to rise in the prices of agricultural goods used as inputs. The employment level further get worsen with the fall in the level of the aggregate demand. If we assume a Keynesian multiplier to exist, the process of declining output and employment would take some time to die out. Hence, the economy enters into a recessionary stage.

The implication of the above line of reasoning is that a supply shock to the Agriculture Sector will result in the General Price Level to fall ultimately instead of causing inflation. This result is equivalent to that occurring under the policy of non-monetary accommodation, wherein money supply does not follow rise in the agricultural prices.

However, it does not matter how the inflationary process is being explained for the above result to occur in the absence of an accommodating monetary policy. Because, the explanations for the inflationary process starts with the basic premise that the supply shocks lead to inflation. Hence, the first question that needs to be answered is whether there is a causal link between the supply shocks in the Agriculture Sector and the inflation. Secondly, if there is an evidence for the causal link then whether it is due to monetary accommodation.

3.4 Statement of the Hypotheses

One of the ways in which the Agriculture Sector has been linked to the rest of the economy is through its connection with the General Price Level. Since, General Price Level is a macroeconomic variable and the changes in it generates its own causal chain involving other macroeconomic variables, it is necessary and sufficient to empirically prove the causal link between the supply shocks originating in the Agriculture Sector and the General Price Level. The appropriate proxy for the supply shocks originating in

the Agriculture Sector is the agricultural output/ price. With this, the hypothesized statement for the current study is as follows:

"Given any time t, the fall/rise in the agricultural output/price should lead to a rise/fall in General Price Level." (Hypothesis A)

If the data confirms the above hypothesis, the change in the General Price Level will be treated as the consequence of the change in the agricultural output (or agricultural price). However, no firm conclusion can be arrived at the plausible, if not exact, causal chain of that action unless it is ensured, at least, that the policy response has been passive or active, when the issue is inflation. However, there may also be a possibility of the money supply varying to the fluctuations in the agriculture sector. To this end requires examining the causal link between the agriculture sector and the money supply.

"Given any time t, the fall/rise in the agricultural output/price should lead to a rise/fall in money supply." (Hypothesis B)

Hence, both these conjectures/hypotheses are constructed to test the thesis statement that the fluctuations in the agricultural sector tend to bring in changes in the entire economy through changes in the macroeconomic variables such as the General Price Level and money supply.

CHAPTER 4
THE DATA AND THE METHODOLOGY

"Classic disputes in macroeconomics frequently turn on causal questions, even when causal language is explicitly eschewed."

—Kevin D. Hoover, ***Causality in Macroeconomics***

4.1. The Data

The data used in the chapters, The Stylized Facts and Empirical Findings, are taken from the Centre for Statistical Organization's *National Account Statistics* (NAS, 2006 and 2007), Reserve Bank of India's *Handbook of Statistics on the Indian Economy* (2007) and the Reserve Bank of India's *Handbook of Monetary Statistics of India* (2006). All these databases are published in India. The NAS (2006) provides annual time-series data for the period 1999-00 to 2004-05 with 1999-00 as the base year, whereas the NAS (2007) provides annual time-series data for the period 1950-51 to 1999-00 with 1999-00 as the base year. However, the data for agricultural Gross Domestic Product, as provided by the NAS, used for the analyses is not free from a problem. This variable includes the value of output from the Livestock sector. As such, the agricultural Gross Domestic Product does not purely represent value of agricultural output. The reason is, the NAS (2006) does not give a separate data for agricultural Gross Domestic Product without livestock sector. Though it is true that the NAS (2007) provides data on the variable net of the Livestock sector, the time series for that is available only till the year 1999-00. Hence, the current study makes use of the agricultural Gross Domestic Product with livestock sector for the chapter on Stylized Facts.

RBI provides both monthly and yearly data on prices and Money supply for the period 1952-53 to 2004-05. The price variables that have been considered appropriate for the analysis are the Wholesale Price Index for all commodities, the Wholesale Price Index for Food and Non-Food articles, and the Wholesale Price Index for Manufactured goods. The 'Wholesale Price Index for all commodities' is taken as a proxy for the General Price Level of the economy. The sum of Wholesale Price Index for Food and Wholesale Price Index for Non-Food articles is treated as the proxy for agricultural price. The method of construction is adopted from the Economic Survey of India. The reason for such an adoption is obvious. The Survey reflects the ways and means

through which the Ministry of Finance studies and understands the economic behaviour of the country; and therefore, keeping the analyses consistent with their conceptualization of certain variables would be essential. The money supply measures such as M0 (Reserve money), M1 (Narrow money) and M3 (Broad money) are chosen for the analyses. The idea is to capture the effects of government borrowing (M0); money as medium of exchange (M1); and money as a relatively less liquid asset (M3).

All the above price series in India comes with different base years. As a result, the Splicing technique has been applied to make the data series continuous from one time point to other time point. Also, the monthly data for prices and money supply has been seasonally adjusted by using a moving average technique for the empirical analyses.

4.2 The Methodology

It is factually true that identifying exactly what causes what, depends on the knowledge of causal factors and zero ignorance level[29] on causal ordering of those factors. However, it is trivial that the zero ignorance level is yet to be realized on all the possible causal factors and their ordering. In the meanwhile, the primary empirical method of economics—that is, the Econometrics—has witnessed a cyclical change in its focus on developing techniques to unveil causality among the economic variables. The issues of causality has been explicitly discussed prior to the 1960s in the works of Simon (1953), Koopmans (1950), Orcutt (1952), Wold (1954) among others before it received a "structural guise" from the Cowles Commission approach to econometrics, which marks the beginning of no interest in the issues of causality on the part of econometricians (Hoover, 2001). The revival began with the advent of Time-Series Econometrics. A notion of causality has been captured by Granger (1969) in the form of an econometric technique, popularly known as the Granger Causality. The popularity of this technique is specifically attributed to Sims (1972), who provided a modified version of it to validate the monetarist hypothesis that money causes income. Since then, there have been significant developments on detecting causality empirically. Infact, there has been econometric approaches to detect causality other than the one developed by Granger. Some of the leading figures in these alternatives are Spirtes, Glymour and Scheines (1993); and Stephen LeRoy (1995). There are also efforts been made to apply the Granger causality tests in the Vector Autoregression (VAR)

[29] Zero ignorance level refers, here, to infallible knowledge.

Frameworks, which have come to limelight with the work of Sims (1980); and have taken several forms since then.

The core of the hypotheses stated in the current study is to explore the causal content among the variables under consideration. To satisfy this core, it seems to be apt to apply the Granger Causality tests here. Before justifying the aptness of the Granger Causality test to the context of the current study, an attempt is made, here, to introduce the method first.

Such tests as Granger Causality are, these days, executed with two or three mouse-clicks in some econometric software packages—benefits of labor-saving technical progress. However, certain important points while performing any econometric technique cannot be undermined and, thereby, the econometric knowledge of the researcher is equally important to coexist with the econometric software packages. Before applying the Granger Causality tests, it is quite necessary to explicitly bring out the notion of Granger Causality as conceptualized by its originator, Clive W.J. Granger.

Granger (1969) develops certain definitions of causality based on a theory, developed by him, which is alternative to the mainstream theory.[30] The general definition of causality is given by the following:

$$\sigma^2(\mathbf{X} \mid \mathbf{U}) \; < \; \sigma^2(\mathbf{X} \mid \overline{\mathbf{U}-\mathbf{Y}}) \qquad \text{--- (4.1)}$$

Where, σ^2 is the variance of the predictive error series, $\mathbf{U}$ represent the information set, and $\overline{\mathbf{U}-\mathbf{Y}}$ represents the information set of the past period apart from the information on the past values of the $\mathbf{Y}$ variable. The expression (4.1) denotes that the variance of the prediction error of the variable $\mathbf{X}$, which is a stationary stochastic process, based on the universal set of information is lesser than that based on the information set which is deprived of the information on $\mathbf{Y}$ variable. Hence, $Y_t \Rightarrow X_t$— that is $\mathbf{Y}$ causes $\mathbf{X}$.

Another definition of causality incorporates the feedback effect or, in other words, it expresses mutual causality:

$$\sigma^2(\mathbf{X} \mid \overline{\mathbf{U}}) < \sigma^2(\mathbf{X} \mid \overline{\mathbf{U}-\mathbf{Y}}) \qquad \text{---(4.2)}$$

$$\sigma^2(\mathbf{Y} \mid \overline{\mathbf{U}}) < \sigma^2(\mathbf{Y} \mid \overline{\mathbf{U}-\mathbf{X}}) \qquad \text{---(4.3)}$$

[30] The main difference between the two theories is that the latter ignores the stochastic nature of the variables as well as the temporal ordering.

Where, σ^2 is the variance of the predictive error series, $\overline{\mathbf{U}}$ represent the information set including only past values, and $\overline{\mathbf{U}-\mathbf{X}}$ represent the past values of the information set apart from the past values of the **X** variable. The expressions (4.2) and (4.3) clearly reveal the feedback effect. Hence, $Y_t \Leftrightarrow X_t$—that is Y causes X and X causes Y.

The third definition of causality incorporates the effect of the current value of Y on the current value of X:

$$\sigma^2(\mathbf{X} \mid \overline{\mathbf{U}}, \overline{\overline{\mathbf{Y}}}) < \sigma^2(\mathbf{X} \mid \overline{\mathbf{U}}) \qquad \text{--- (4.4)}$$

Where, $\overline{\overline{\mathbf{Y}}}$ represent the past and present values of the Y variable. This definition is called as Instantaneous Causality, because the variance of the prediction error is lower when the current values of Y are made use of.

All these definitions are expected to work under certain assumptions, such as, stationarity of the stochastic processes; availability of fully relevant information set and linear predictors. For instance, given the stationarity of the stochastic processes and the fully relevant information set being $\mathbf{I} = (\mathbf{X}_t, \mathbf{Y}_t)$, the best linear predictors making use of only the past values of X and Y takes the following form:

$$\mathbf{P}_t(\mathbf{X} \mid \overline{\mathbf{X}}, \overline{\mathbf{Y}}) = \sum_{j=1}^{\infty} a_j \mathbf{X}_{t-j} + \sum_{j=1}^{\infty} b_j \mathbf{Y}_{t-j} \qquad \text{--- (4.5)}$$

Where, $\overline{\mathbf{X}}, \overline{\mathbf{Y}}$ represent the past values of the variables, **X** and **Y**, and $\mathbf{P}_t$ is a best linear predictor. The variance of the prediction errors of the best linear predictors is made minimum by choosing the appropriate values for the coefficients in the above expression. This is the modification that Granger introduces to operationalize his general definitions of causality given earlier. Due to the variance being used as a criterion for its simplicity and convenience, the causality is interpreted as the **"linear causality in mean with respect to a specified set I"**.

There are various testing procedures to perform Granger Causality tests. Some of them are the Sims procedure (1972), Sargent's Direct Granger Causality procedure (1976), Haugh and Pierce procedure (1977) and Hsiao procedure (1979). Of these procedures, the current work focuses on Hsiao's procedure only.[31] One of the main reasons for adopting this procedure is that the optimal lag lengths are selected not based on any

[31] For a detailed discussion on the procedures other than Hsiao's in a comparative framework, one can refer to Hsiao (1977), for example.

arbitrary mechanisms; and it also paves way for system identification without exhausting the degrees of freedom.

For bivariate time series models, Hsiao's procedure follows certain sequence of steps[32]:

1. Determining the optimal lag length, ℓ', of a univariate autoregressive process of explained variable (Y).
2. Determining the optimal lag length, ℓ'', of the explanatory variable (X) by keeping constant the optimal lag length of Y in the model representation, which includes both the past values of Y as well as the past values of X.
3. Comparing the Minimum Final Prediction Errors (MFPE) of Step1 and Step 2 to infer whether the X is causing Y or not. In case, the MFPE of Step 2 is lower than the MFPE of Step 1, then it is inferred that X is causing Y (i.e., $X_t \Rightarrow Y_t$).
4. Applying Step 1 to Step 3 by reversing the roles of Y and X variables.
5. If the step four results in
    a) $Y_t \Rightarrow X_t$, it is treated as the case of feedback causality.
    b) Y not causing X then it is treated as the case of univariate causality.

The fine point in Akaike's FPE is that it is an expected variance of the prediction error, which sounds similar to that of Granger's notion of variance of the prediction error. An important qualifier with regard to the application of the Akaike's Final Prediction Error criterion for the selection of the optimal lag length is that it is asymptotically inefficient (Liew 2004). As such, the size of the sample acts as a constraint to the free application of the criterion. However, the criterion avoids the ad hoc choice of the level of significance to add or remove the variable from an equation (Hsiao 1981). Thus, the FPE does two things at a time. One, it provides an optimal lag length. Two, it provides information on the direction of causality. In the process of the application of the Hsiao's procedure of Granger Causality, the determination of the direction of the Granger Causality and the selection of the model takes place simultaneously. Moreover, the use of monthly data does not require the need for examining contemporaneous/instantaneous correlation (Granger, 1969). Hence, one may stop at the stage in which the Granger causality is determined without going for the simultaneous equation estimation of the selected pair of models. One of the main

[32] For Steps 1 and 2 the Akaike's (1969) Final Prediction Error Criterion is made use of to determine the optimal lag length.

reasons going for such estimation is to identify the role of third variable or to test for contemporaneous correlation. However, executing a simultaneous equation estimation require huge data sets. This requirement seems to be too restrictive to proceed ahead with the Hsiao's procedure. One escape route to this problem is to make use of a battery of diagnostic checks for each selected model. a diagnostic checks that turns out to be handy in such situations is Breusch-Godfrey- LM Test of serial correlation (Breusch, 1978; Godfrey, 1978). To test for contemporaneous correlations among the pair of selected models, an approximate (and crude) strategy is to store the residuals of each of the model pair and undertake residual correlation analysis. In the present study, the test for contemporaneous correlation is not required, as the frequency of data used for the analyses is monthly.[33]

[33] See Granger (1969)

CHAPTER 5
THE STYLIZED FACTS

"Stylized facts seem to me dangerous tools indeed, if they are used as anything more than preliminary inputs into a model building"

—David Laidler, ***Issues in Contemporary Macroeconomics***

This chapter aims to provide the evidence on the importance of Agriculture Sector in India. One factor that largely stands out in relation to the Agriculture Sector in India is the proportion of the total working population employed. Obviously, the Agriculture Sector is the largest source of employment. The definition of the Agriculture Sector as given by Central Statistical Organization (CSO) is a package of more than one sector. It includes data on crop cultivation plus data on livestock and animal husbandry. But the definition of agriculture includes the addition of forestry, logging and fishery. Sometimes mining and quarrying sector is also included in which case the entire sum of sectors mentioned comes to be known as the Primary Sector. For the current analysis, the definition of Agriculture Sector has been limited to pure agriculture plus livestock and animal husbandry since the data on pure agriculture Gross Domestic Product is not available in the CSO database. According to the Census of India, the percentage of total workforce engaged in this sector was 75.9 percent in 1961. It declined to 59.9 percent in 1999-00.[34] As per the data provided in the Agriculture Statistics at a Glance, 2004, it is interesting to note that of the total population of 361.1 million, 82.7 percent were residing in the rural areas in the year 1951. This share got declined by 10 percent in 2001. Of the total rural population of 298.6 million in 1951, 69.9 million were cultivators and 27.3 million were agricultural labourers. Over the decades, the percentage share of cultivator, in the total working population in the agricultural sector, has fallen from a high of 76 percent in 1961 to 54.4 percent in 2001. The opposite is the trend for the agricultural labourers. If we look at the absolute figures, both the cultivators as well as the agricultural labourers' share have been increasing, but, with a slower rate for the former. One plausible reason may be the gradual exposure of the cultivators' children to education. Another plausible reason may be the distressed sale of the land. However, the population that is being supported by the agriculture is of no

[34] See Kapila (2006).

meager size to be ignored. They can influence the aggregate consumption and investment levels in the economy. It is not difficult to imagine a situation where 50 percent of the working population suddenly gets vanished and the consumption level falls instantly. Similar is the case for investment.

The share of agriculture in the Gross Domestic Product (GDP) at factor cost at 1999-00 prices was 48.21 percent in 1950-51 and it declined to 45.43 percent in 1960-61, to 39.37 percent in 1970-71, to 34.37 percent in 1980-81, to 28.75 percent in 1990-91, to 22.15 percent in 2000-01. In the year 2004-05, its share has got reduced to 18.93 percent of GDP. With this, there could arise some natural questions: Is the fall in the agriculture's contribution solely due to the fall in its output levels, other things remaining the same? Is the fall in the agriculture's contribution merely a statistical illusion? Or Is the fall in the agriculture's contribution is due to the better performances and/or expansion of the other sectors? Over time, it is plausible to expect that the economy's growth would be such that it allows the possibility for diversifying its economic activities as well as for shifting from low-productivity areas to high-productivity areas. It follows directly from the message of structural transformation. Hence, in the long-run, the emphasis shifts from agriculture to secondary; and from secondary to tertiary sector—a variant of Clark's hypothesis. However, the Agriculture Sector still turns out to be a sector to be reckoned with since, it is the mainstay of all other economic activities in the economy—in the sense that food is produced in this sector. Let us imagine a two-by-two economy, with equal factor endowments in country A and country B, producing two non-food commodities, M and N. There is no full employment before trade. The "additional assumption" here is that in country A, the availability of food matches the demand for it, whereas in Country B there is a deficient food production. Both these countries would engage in international trade if there is any gain from trade. However, the occurrence of gains solely depends upon the positive terms of trade as well as the cost of consumption. Suppose, in the absence of the "additional assumption", the trade takes place under constant cost conditions; and the country A specializes in commodity M and the country B specializes in commodity N. Both the countries gain from trade on production account. To bring in the role of demand here, let us suppose that the consumers in country A are fond of commodity N. This implies that the terms of trade would improve for the country B. Now, by introducing the "additional assumption", the above result seems to be doubtful. The argument is that with specialization taking place in country B, certain unemployed

resources, particularly labor, gets employed in the production of the commodity, which is getting specialized. With this, the market demand curve for food in the entire economy becomes more flat. However, due to the limited supplies of food in the market, the price of food rises through the competitive bidding of the consumers. As the food price rise in the economy in relation to the specializing commodity N, either there will be an increase in the export price to stand against the rising food price, or the country B looks for the new trading partner, which is specialized in the production of food and is in want of commodity N. The first option is temporary whereas the second option is permanent solution. Even, when the country chooses for the second option, there still arises a problem of double coincidence of wants. If the country finds a food producing and exporting country, whose consumers have no taste for commodity N, the country B will experience worsening terms of trade. Hence, there is 'Gains from trade uncertainty' for country B due to the mismatch between the food supply and food demand.[35]

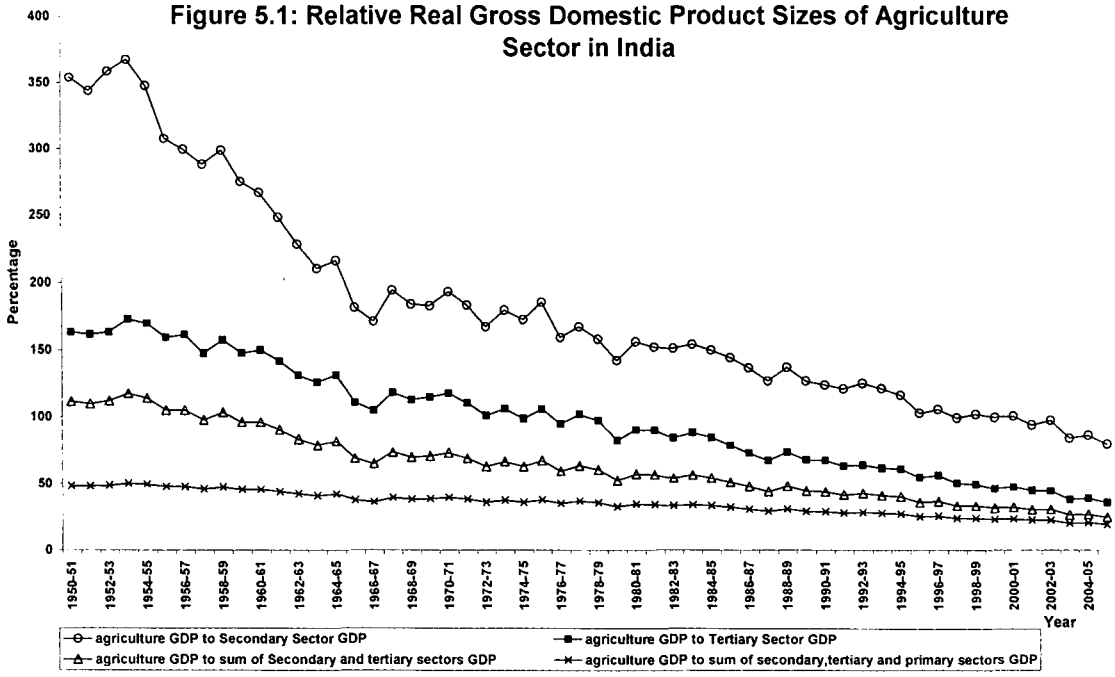
One way to find out whether the Agriculture Sector has deteriorated in terms of its contribution to GDP is to obtain the ratios of agricultural GDP to other important sectors' GDP. Following this vein, four such ratios have been computed. They are the real agricultural GDP-to- real secondary sector GDP ratio (A/S); real agricultural GDP-to-real tertiary sector GDP ratio (A/T); real agricultural GDP-to-sum of real secondary and tertiary sector GDP ratio (A/S+T); and real agricultural GDP-to-sum of real secondary, tertiary and primary GDP ratio (A/S+T+P). All these four ratios are technical relations only. The denominator contained broad sector categories than a disaggregated one, like manufacturing sector, to highlight the size of agricultural sector. This is one of the criteria essential for a sector to have considerable macroeconomic influences. All the above mentioned ratios are expressed in percentage terms; and put in a multiple time series graph for the period 1950-51 to 2005-06 (see Figure 5.1). All the four ratios are showing a declining trend throughout the period of analysis. This is an interesting result because, at the outset, all the four ratios are pointing out at the declining real GDP for the agriculture sector[36]. To throw more light on this result, the

[35] If we replace the "additional assumption" by the monsoon-determined food supply, the results do not change by much. Joshi and Little (1994) argue that in India, agriculture is mainly affected by the Monsoons than terms of trade.

[36] Such interpretations cannot be taken at the face value while working with ratios. Since, the ratio is an increasing function of the numerator and the decreasing function of the denominator, there arises what I call as the "Ignorance Problem"—that is the problem of attributing the change in the ratio to

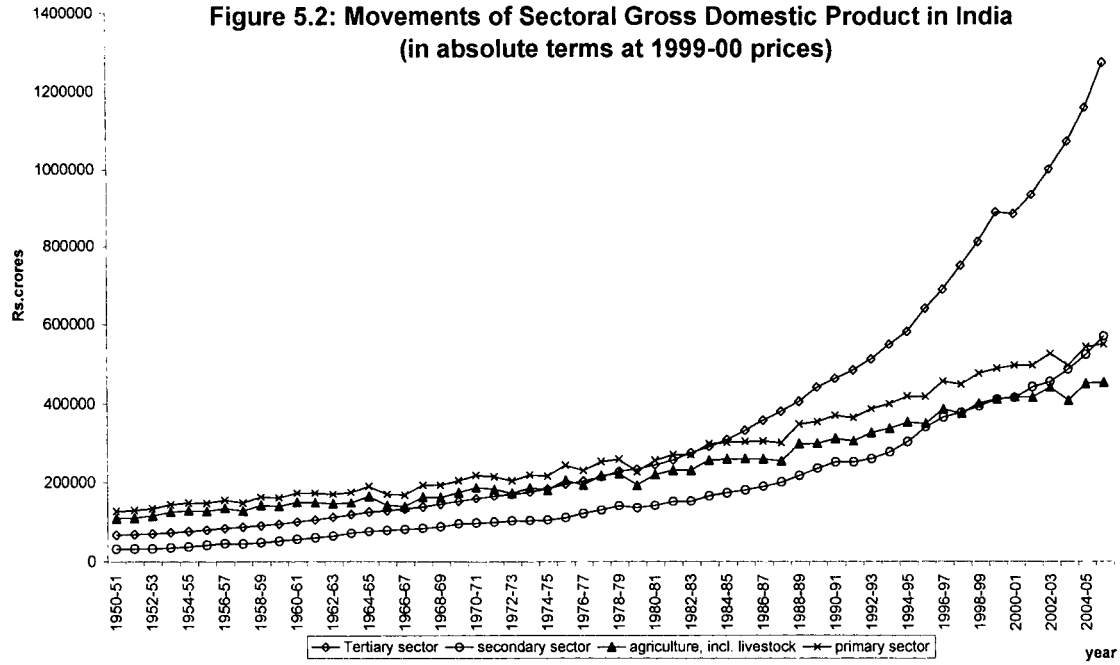
movements in the absolute values of the relevant sectoral GDPs are drawn in the same graph (see Figure 5.2). Such usage of the absolute values is justified when the relative measures violate the condition of constancy in the denominator values. The multiple graphs clearly reveal the increasing absolute values for GDP in all the relevant sectors, but with different slopes. That is, the slopes have a positive sign; overall .The overall slope is greater for the tertiary sector followed by that of the secondary sector. Since, agriculture is the major component of the Primary sector, their overall slopes are almost the same. Hence, the revealing factor is that GDP of all the relevant sectors are growing (positive slope) with different slopes. This solves the "ignorance problem" prevailing while interpreting the ratios of sectoral GDPs. Now, based on the above analysis, it is pretty much clear that the falling ratios of agricultural GDP to other sectors is not completely due to decline in the real agricultural GDP, rather it is due to the growth in the real GDPs of other sectors. This is an important conclusion for evaluating the role of Agriculture Sector in India.

Figure 5.1: Relative Real Gross Domestic Product Sizes of Agriculture Sector in India



denominator or numerator, when one does not have sufficient information on the movements in the numerator and denominator values.

Figure 5.2: Movements of Sectoral Gross Domestic Product in India (in absolute terms at 1999-00 prices)



An alternative way of looking at the declining relative importance of the real agricultural GDP is to make use of correlation coefficients. Let us pose a question suiting to the second analysis. Does the decline in the relative importance of the Agriculture Sector, in terms of GDP, indicate a weak relation between the sector and the performance of the economy? To answer this, let us look at the behaviour of the percentage change in the real agricultural GDP and the economy's real GDP (see Figure 5.3). With few exceptions, the figure clearly shows a strong comovement between the two GDPs throughout the sample period.

This is confirmed by the correlation coefficient values between them (see Table 5.1). For the entire sample period, the correlation coefficient (CC) value is 0.87. The decadal CC value is well above 0.90 during the period 1951 to 1989. The CC value dropped down to 0.63 in the 1990s. However, when we divide the 1990s into two sub-periods of 1991-95 and 1996-99 the CC value turns out to be 0.42 and 0.95, respectively. A careful examination of the Figure 5.3 reveals that the statistical reason for such a low CC value was due to the opposite movements of the two GDPs in 1993-94 and 1995-96. One might wonder on the reliability of these CC values as an aid to indicate a definite link between the GDP and its components. To clear up this doubt, CC between the manufacturing GDP and the economy's GDP has been computed (see Table 5.2).

Figure 5.3: Percentage Rate of Changes of Agriculture Gross Domestic Product and the Economy's Gross Domestic Product in India for the period 1951-52 to 2004-05 (at 1999-00 prices)

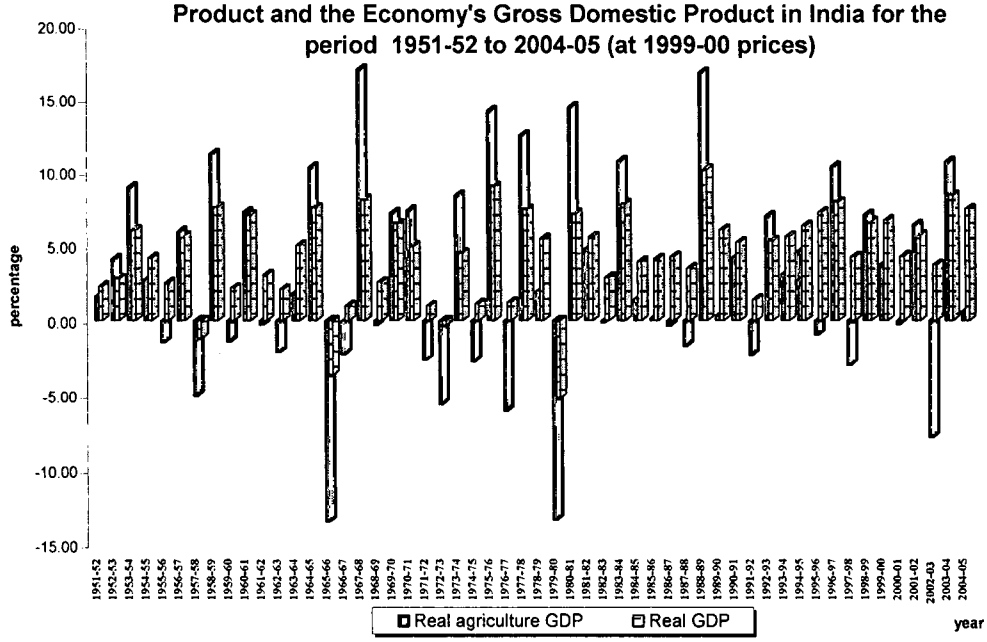


Table 5.1: Correlation Coefficient between the Percentage Changes of Agricultural Gross Domestic product and the Economy's Gross Domestic Product of India (at 1999-00 prices)

Category	Time	Correlation Coefficient[37]	5% Level of significance
Full Sample	1951-04	0.87	*
Decadal	1951-59	0.95	*
	1960-69	0.96	*
	1970-79	0.96	*
	1980-89	0.91	*
	1990-99	0.63	
Quinquennial	1951-55	0.84	
	1956-60	0.98	*
	1961-65	0.99	*
	1966-70	0.96	*
	1971-75	0.98	*
	1976-80	0.94	*
	1981-85	0.98	*
	1986-90	0.95	*
	1991-95	0.42	
	1996-00	0.88	
	2001-04	0.79	

* indicates statistical significance

As it is clear from the Table 5.2, the correlations do not appear to be similar to that of the Agriculture Sector. Hence, one can expect the existence of a strong link between the Agriculture Sector and the General economy.

[37] The correlation coefficient technique has been mainly employed, here, to discern the degree of association between certain economic variables, only. Moreover, the importance of the tests of statistical significance comes only when the researcher has to infer from the selected samples on the behavioral characteristics of the population. However, there are no attempts being made, here, to engage in such statistical inference, although the level of significance has been stated.

Table 5.2: Correlation Coefficient between the Percentage Changes of Manufacturing Gross Domestic product and the Economy's Gross Domestic Product of India (at 1999-00 prices)

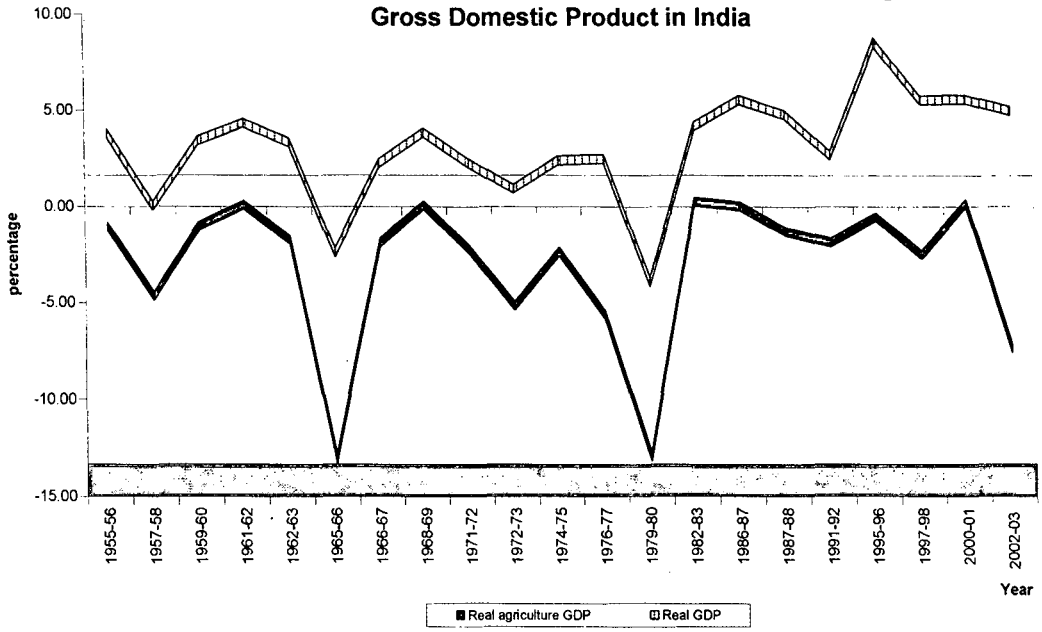
Category	Time	Correlation Coefficient	5% Level of significance
Full Sample	1951-04	0.44	*
Decadal	1951-59	0.41	
	1960-69	0.42	
	1970-79	0.46	
	1980-89	0.45	
	1990-99	0.74	*
Quinquennial	1951-55	0.59	
	1956-60	0.56	
	1961-65	0.80	
	1966-70	0.16	*
	1971-75	-0.49	
	1976-80	0.48	
	1981-85	0.95	*
	1986-90	0.71	
	1991-95	0.93	*
	1996-00	0.41	
	2001-04	0.31	

* indicates statistical significance

The movements in the real agricultural GDP as shown by the earlier graphs also suggest a very close link between the fluctuations of real agricultural GDP and the real GDP. The Figure 5.4[38] captures the impact of a fall in the real GDP of the Agriculture Sector on the real GDP of the economy. For the data period in the sample since 1950-51, real agricultural GDP showed a negative percentage change in nineteen occasions. In each of these nineteen occasions, except 1976-77 and 1986-87, real GDP showed the similar behaviour. However, the opposite movements in the real GDP did not stayed any longer as they got immediately reversed by the subsequent fall in the real agricultural GDP in 1979-80 and 1987-88. These reverse movements are, as if that the Agriculture Sector cannot tolerate the economy moving in an opposite direction. Does this mean that the fall in the relative contribution of agriculture to the economy's GDP has not reduced its impact on the economy? Also, there seems to be a peculiar pattern in the occurrences of negative percentage change in the real GDP of the agriculture sector.The year when the negative percentage change in the real agricultural GDP started showing up in the data is 1955-56. Since that year the subsequent occurrences are not far from each other.

[38] This figure is drawn on the basis of the nineteen occasions when the agricultural GDP showed a negative growth due to bad monsoons. (Economic Surveys, India). The close movements between the agricultural GDP and the economy's GDP suggest that the fluctuations in the output of the Agriculture Sector and the fluctuations in the economy are closely related.

Figure 5.4: Behavior of Real Gross Domestic Product and Real Agriculture Gross Domestic Product in India



These nineteen occasions largely represent the time-period during which the bad monsoons had its recurring presence. Every time, its occurrence meant that there was a supply shock to the Agriculture Sector. As noted in the Figure 5.4, these shocks had its toll on the economy's GDP. The implication of such evidence would be that if there was a continuous supply shock, that is bad monsoon occurring every year, then the economy's GDP would be continuously weakened. However, India did not experience such a case. The elapsed year before the new occurrence of a supply shock in the country was 1.33 years, on average. That is, it took 1.33 years before the new occurrence of a supply shock, on average. There has been only four occasions in which the elapsed year is zero—they are 1962-63, 1966-67, 1972-73 and 1987-88 (Table 5.3).

Table: 5.3: Time Elapsed between the Supply Shocks in the Agriculture Sector of India

Year	Elapsed Year	Year	Elapsed year
1955-56		1974-75	1
1957-58	1	1976-77	1
1959-60	1	1979-80	2
1961-62	1	1982-83	2
1962-63	0	1986-87	3
1965-66	2	1987-88	0
1966-67	0	1991-92	3
1968-69	1	1995-96	3
1971-72	2	1997-98	1
1972-73	0		

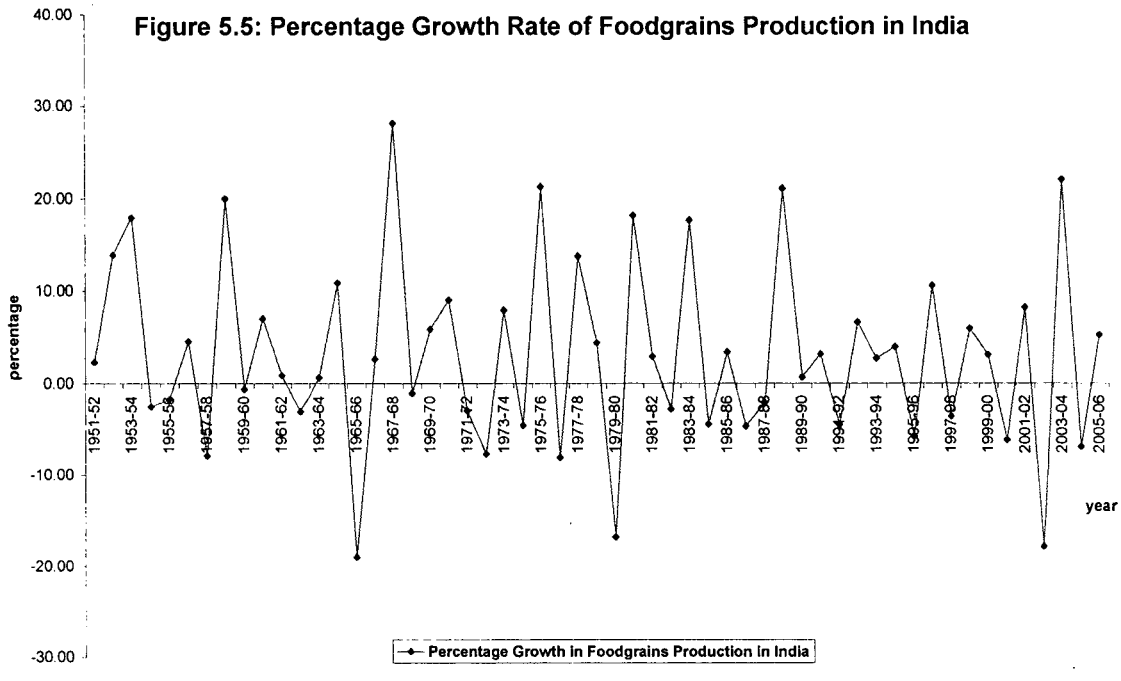
The frequency at which the negative occurrences in real agricultural GDP have taken place is higher in the 1960s and 1970s than any other (Table 5.4). As already pointed out, these negative occurrences were the outcome of bad monsoons in the country. Hence, the negative occurrences can be termed as the supply shocks. In that case, the supply shocks in 1960s and 1970s were greater. But, the supply shocks in the 1980s and 1990s were no lesser than the 1950s.

Table 5.4: The Frequency of Supply Shocks per decade in India

Decade	Frequency
1950s	2
1960s	5
1970s	5
1980s	3
1990s	3

To further improve the inductive probabilities of the above arguments, the annual data on foodgrains production has been brought into the analysis. Interestingly, there are nineteen occasions in which the annual foodgrains production growth had been negative. (See Figure 5.5).

Figure 5.5: Percentage Growth Rate of Foodgrains Production in India



During the period 1950-51 to 2005-06, the annual real agricultural GDP, as already pointed out, had been negative for nineteen occasions. This gives an indication that the real agricultural GDP had been dominated by the movements in the foodgrains production in India.

It is also confirmed by Figure 5.6, wherein except for some years in the 2000s there has been an almost perfect comovement of the negative occurrences of both these variables. Hence, it can be inferred that the supply shocks to foodgrains output will reduce the agricultural income. Since, agricultural income is highly positively correlated with economy's income; it is plausible to conclude, by the axiom of transitivity that the supply shocks to foodgrains production affects the economy's income.

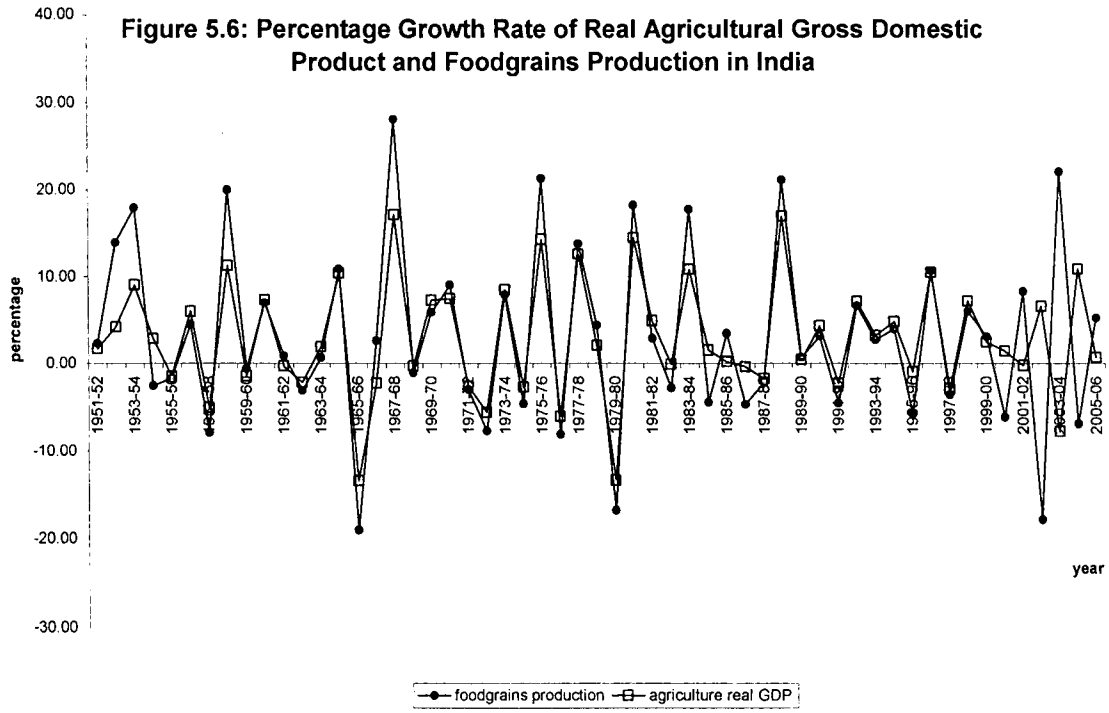


Figure 5.6: Percentage Growth Rate of Real Agricultural Gross Domestic Product and Foodgrains Production in India

Is real agricultural GDP related to real manufacturing sector GDP? The percentage growth of real agricultural GDP do not seem to have a strong relation with the percentage growth of the real manufacturing sector GDP as indicated by the correlation coefficient results in Table 5.5. If at all there was any considerable relation it was only for the shorter duration only and that too, infrequent. If the demand for the manufacturing sector's output from the Agriculture Sector is made to depend positively upon the agricultural income; and if the manufacturing sector's income is made to depend positively upon the demand from the Agriculture Sector for its output, the correlations suggest that there was not any strong interdependency between the two sectors. There have also been instances of negative correlation for the second quinquennial of the 1960s and the first quinquennial of the 1970s, which put even more doubt on the relation between the two incomes.

Table 5.5 Correlation Coefficient between the Percentage Changes of Manufacturing Gross Domestic product and the Agricultural Gross Domestic Product of India (at 1999-00 prices)

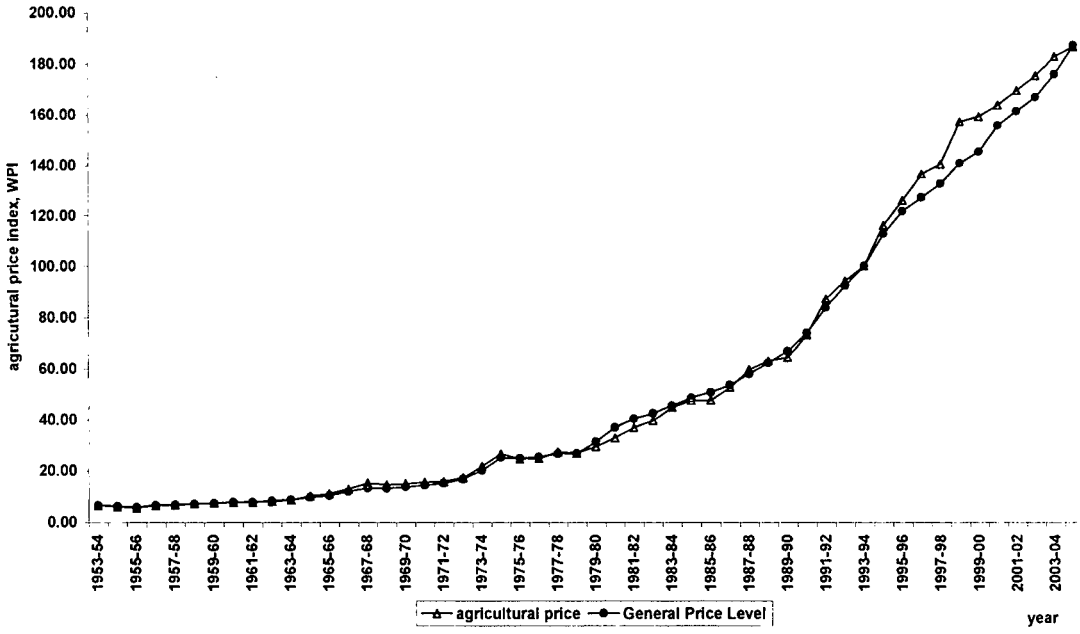
Category	Time	Correlation Coefficient
Full sample	1951-04	0.19
Decadal	1951-59	0.15
	1960-69	0.17
	1970-79	0.23
	1980-89	0.12
	1990-99	0.26
Quinquennial	1951-55	0.09
	1956-60	0.38
	1961-65	0.72
	1966-70	-0.13
	1971-75	-0.32
	1976-80	0.16
	1981-85	0.97*
	1986-90	0.46
	1991-95	0.07
	1996-00	0.66
	2001-04	0.31

* indicates 5% level statistical significance

However, the variable that matters for the study is the agricultural prices for examining its causal links with the General Price Level and the money supply. Its behavior should reflect the fluctuations in monsoons and, thereby, agricultural output. For this analysis, the data on annual time-series of agricultural price have been relied upon.

The Figure 5.7 shows a steady growth of the agricultural price and the General Price Level in India for quite some time, till the end of the 1970s. Thereafter, seems to be an inclination of the agricultural price toward higher growth rates before showing a downward inclination, since the early part of the 2000s. Remarkably, the movement in both the price series shows an almost overlapping trend. During this period, the percentage change in the prices of the Agriculture Sector has been fluctuating. These fluctuations suggest a possible connection with the output fluctuations, although other factors cannot be ignored of.

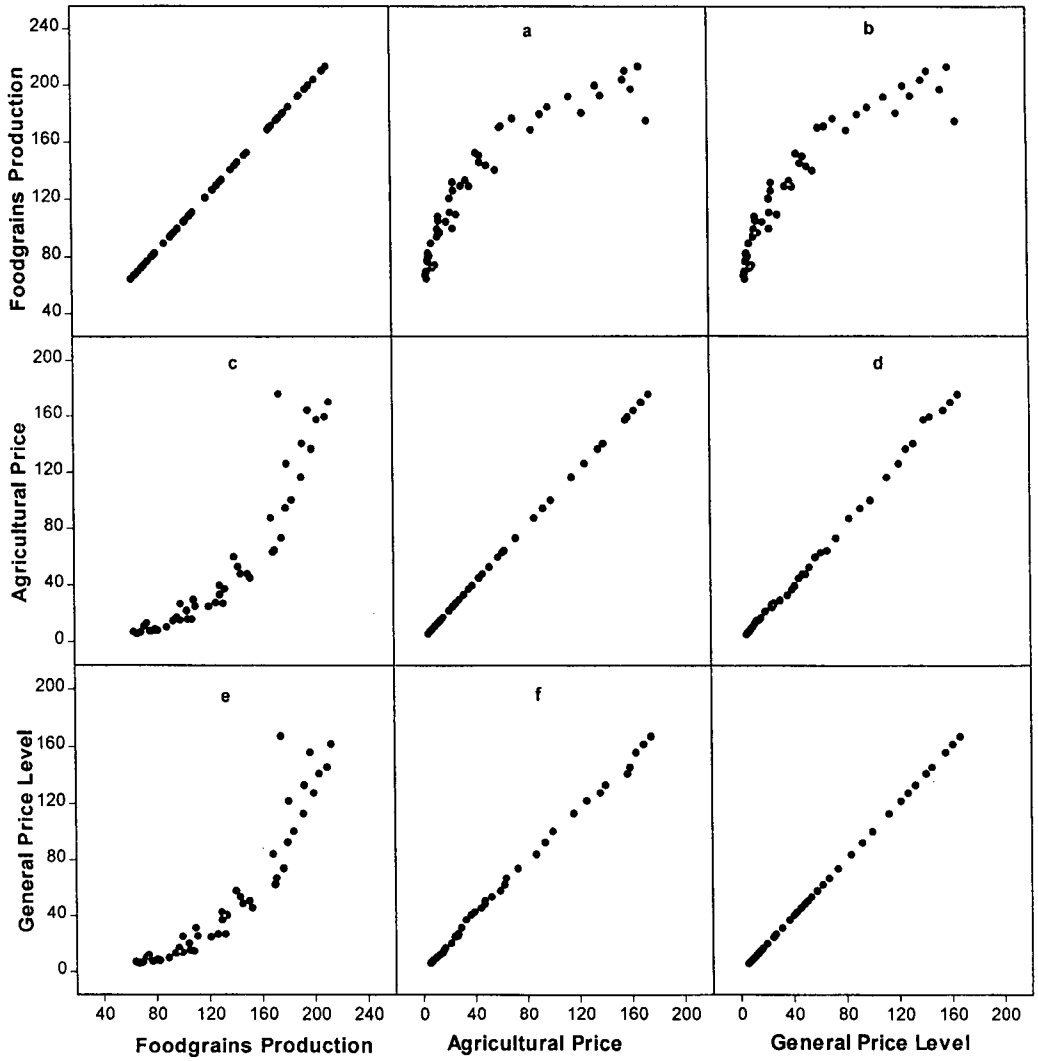
Figure 5.7: Behaviour of Agricultural Price and General Price Level in India



The relationship between foodgrains production, agricultural price and the General Price Level, for the time period 1953-54 to 2002-03, has been shown through the scatter plots in a matrix format—also called, here, as matrix plot (See Figure. 5.8). Other than the self-scatter plots, all the scatter plots need to be looked for gaining information. The agricultural price and the General Price Level show almost a perfect positive correlation. Whereas, the scatter plots for prices and the foodgrains production show a non-linear relationship. For such a relation, the usual correlation coefficient cannot be computed since, it is constructed on the basis of linearity. However, the interesting result here is the non-linear relationship between prices and foodgrains production. Since, the time-period of the data spans over five decades of the India's development experience, there might be a possibility that the India's development process had influenced the relationship between those variables. If one look at the matrix plot for the variables, foodgrains production (X-axis) and the prices (Y-axis) then one can find a relationship similar to that of the supply function. If one can consider the agricultural price and the General price as the proxies for the foodgrains price then one can trace out the following relation: lower the levels of production, greater is the price elasticity of supply, and higher the levels of production, lesser is the price elasticity of supply. This implies that producers are more sensitive to price changes at lower levels of foodgrains production and lower prices. However, as the price continues to rise there is little tendency among the producers to produce more as

shown by the increasingly inelastic portions of the matrix plots, **c** and **e**, in the Figure 5.8. But, there is a danger if these interpretations are exaggerated as supply response to price in the Indian agriculture, in general, or Indian foodgrains sector, in particular.

Figure 5.8: Matrix Plot of All Pairs of Agricultural Price, General Price Level and Foodgrains Production in India



The data, on the basis of which the Figure 5.9 is drawn, suggests that the inflation in the Agriculture Sector, whenever it occurred, has been a six-yearly phenomenon between the time period 1955-56 and 1984-85—these six-yearly periods are 1955-56 to 1960-61; 1962-63 to 1967-68; 1969-70 to 1974-75 and 1979-80 to 1984-85. From 1986-87 onwards, the inflation has been a permanent feature of this sector. As argued earlier, the supply shocks do affect the price level. The expectation on the price is to increase. However, the percentage change of agricultural prices, which is point-to-point change in percentage terms, does suggest a peculiar pattern. Until 1976-77, the years

corresponding to the supply shocks does show either a fall or a small increase in the agricultural price. But, the following year shows a sharp rise. One may expect a lag effect working in, here. Between 1976-77 and 1992-93, corresponding to the supply shocks there were sharp increase in the price. But from 1995-96 onwards, the pattern seems to have come back to the pre 1976-77 period.

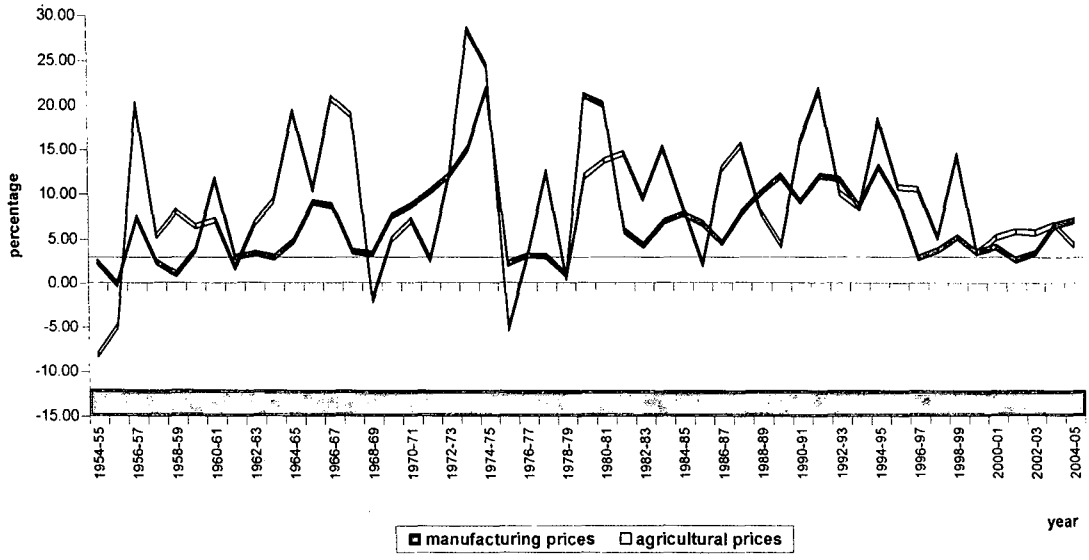
Figure 5.9: Percentage Growth Rate of Agricultural Price in India

As already mentioned, there is an almost perfect positive correlation between the agricultural price and the General Price Level. But, correlation need not be causation. To examine this simple hypothesis, the ordinary least squares method was applied in the regression analysis by treating the General Price level as the dependent variable and the agricultural price as the regressor. The OLS estimates produced a result, which was spurious since, the Durbin-Watson test statistic value was lower than the R-square. Therefore, the time series were subjected to the stationarity test to find out the order of integration. As a result of the stationarity test, the order of integration was found to be one for both the time-series processes when accounted for trend and intercept. The spurious-free regression was run by applying the OLS estimation method. The results of this estimation showed that both the regression parameters were statistically significant with R-square value equal to 66 percent. Also, the sign of the coefficients turned out to be consistent with the apriori that there was a positive relation. As per the result, with every one point increase in the agricultural price, the General Price Level rose by 0.67 point. Hence, one could infer from this result, here, that the agricultural price cause General Price Level in the regression sense.

One of the ways the Structuralists predict the mechanism of inflation is through the agriculture-industry interaction. The variable that has been thought to have certain macroeconomic implication under this context is the relative price of agriculture vis-à-vis manufacture. The relative movements of the two prices, as shown in the Figure 5.10, though related to each other with a positive correlation coefficient of about 0.53, suggest that the two sectors may be related to each other via the agro-based manufacturing sector in India. Because, agro-based industries are one key link between the two sectors, the increase in the agricultural price would tend to raise the prices in the agro-based industries via their cost of production.

The link between the supply shocks and the General Price Level depends on whether there has been an increase in the money supply or not. This is the standard explanation in the literature on the relationship between relative prices and inflation[39].

Figure 5.10: The Relative Movements of Manufacturing and Agricultural Prices in India (in terms of Percentage Growth Rate)

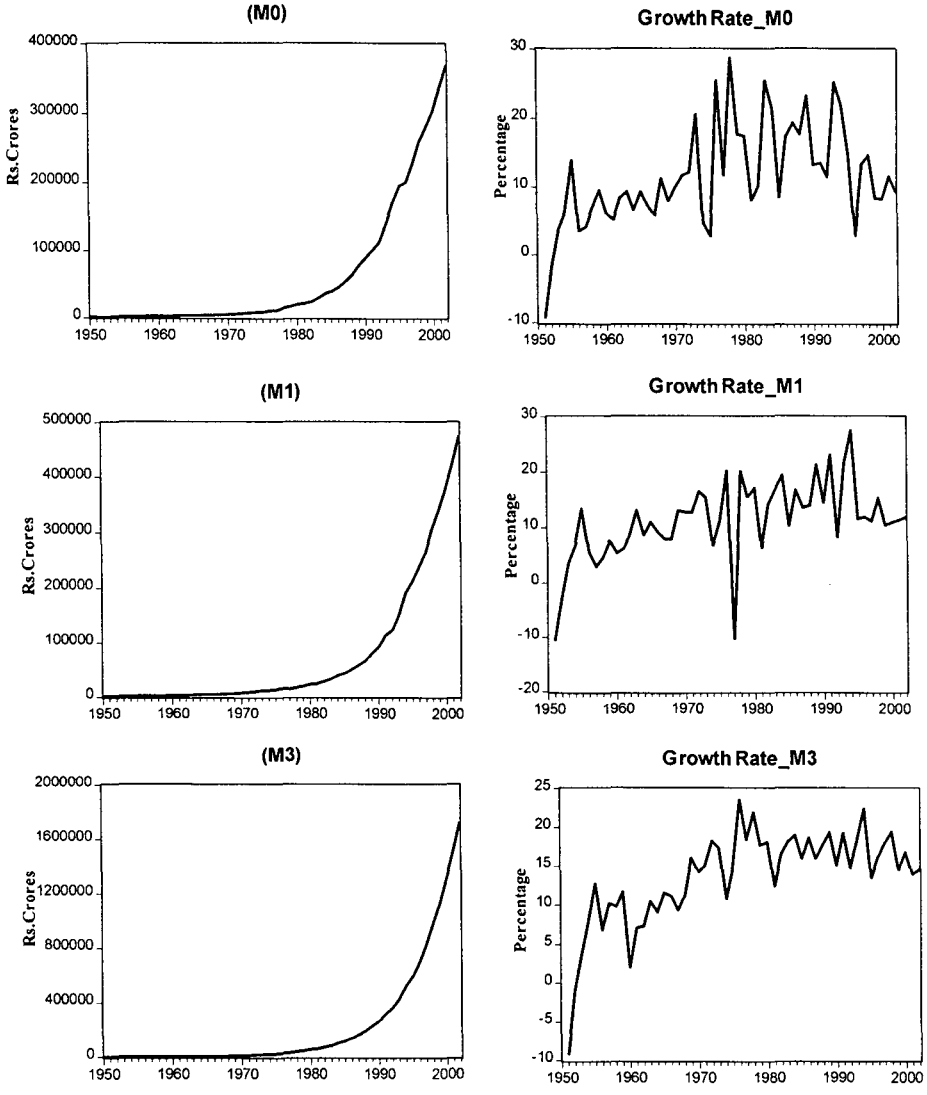


The variables that can be taken as the proxies for money supply are the Reserve money (M0), Narrow money (M1), M2 and the Broad Money (M3). The Figure 5.11 shows the behaviour of these proxies during the period 1951-52 and 2002-03. The left panel of the Figure 5.11 shows the absolute movements, whereas the right panel shows the growth rate movements of these proxies. The Reserve money, which was stagnant till 1978-79, tended to show a sharp growth, thereafter, probably reflecting the expansionary fiscal policies in the country. The increase in the Reserve money would translate into increase

[39] Refer the literature review chapter of this dissertation.

in the money supply in the economy via money multiplier process. Therefore, it may not be confusing to see all the measures of money supply moved by the Reserve money in the economy. The Broad Money (or Aggregate Monetary Resources) also shows a similar behaviour. But, its behaviour could be attributed to the growth in the time deposits since, the Narrow money was less pronouncing in its growth. Hence, one might jump into the conclusion that, if at all, the money supply has any relationship with the General Price level; it should be since the 1980s. The Figure 5.11 lend support to the above analysis since, there is a presence of comovements of the measures of money supply.

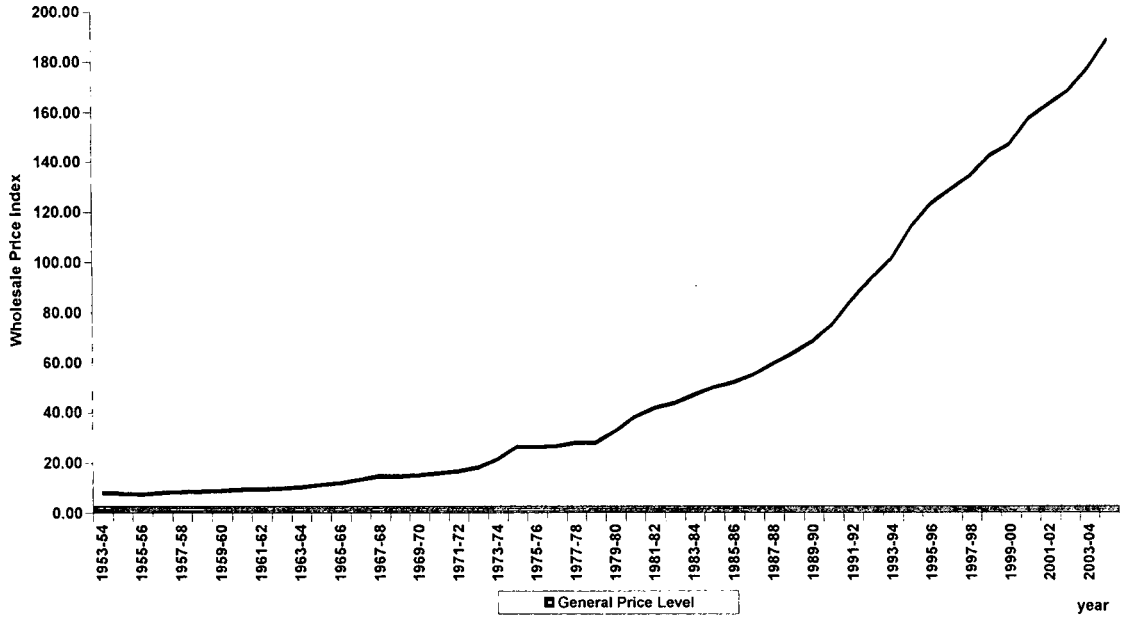
Figure. 5.11: Money Supply Measures in India (In absolute and growth rate terms)



The prices in India have been continuously growing over time, as shown by the Figure 5.12. But, it also suggests that since the beginning of the 1980s, there has been a sharp

growth in the General Price Level—a possible correlation between the behaviour of the money supply measures in absolute terms, and the General Price Level, as measured in terms of Wholesale Price Index (WPI), is visible. Due to that possibility, one may look out for the relation between the agricultural price and the measures of money supply. When the simple regression of M1 on agricultural price, using OLS, was run, the result appeared to be close to spuriousness. The other measures also gave spurious results. As a means of correcting for the spurious regression problem, the variables under consideration were put to stationarity test.

Figure 5.12: The Behaviour of the General Price Level in India



As a result, except M1, other measures of money supply turned out to be integrated of order more than 2; and M1 had an order of integration equal to 2. The corrected regression gave the expected positive sign for the coefficient; and it was statistically significant. But the R-square was weak. In the case of M0, the results appeared to be much better with R-square closer to 45 percent, with statistically significant estimates devoid of spuriousness. With these preliminary results, there was a statistical curiosity, on the one hand, and the economic reasoning on the other hand, to examine the causal relations between the agricultural price and the macroeconomic variables such as General Price Level and inflation as well as the money supply.

The above stylized facts provides a crude, yet important information in guiding empirical testing, particularly, if one is relying upon the Time-Series Econometrics techniques.

CHAPTER 6
EMPIRICAL FINDINGS

"The Ultimate rationale for macroeconomics is to give policy advice, even when the advice, as it is for Hume, is to do nothing"

—Kevin D. Hoover, *Causality in Macroeconomics*

As systematized, the statement of the thesis is examined via the strategy of testing two separate hypotheses/conjectures concerning the causal relation between the agricultural price and the General Price Level (Hypothesis A); and the causal relation between the agricultural price and the money supply (Hypothesis B), respectively. The testing of these hypotheses is based on the Hsiao's Procedure of Granger Causality, which is, of course, a Time-Series Econometric technique meant to detect the causal direction among the concerned variables, with a special emphasis on optimal lag selection. To incorporate the idea of fluctuations in the Agriculture Sector having its effects on the economy, the variables chosen for the econometric analyses are kept in the form of point to point growth rate. [40] One of the important prerequisite for applying this technique is that the variables must be stationary. For this reason, all the economic variables chosen for the empirical analysis have been subjected to stationarity tests. As in the tests of Granger Causality, the selection of maximum lag is an important feature in the unit root tests, at least when the Augmented Dickey-Fuller Test for unit root is applied. This problem has been circumvented by using Schwarz Information Criterion (SIC) for setting the maximum lag.

For testing the Hypothesis A, the point-to-point growth in agricultural price and the point-to-point growth in the General Price Level—proxied by Wholesale Price Index—are considered. The Table 6.1 presents the unit root test results for the examination of the Hypothesis A concerning the causal relation between the agricultural price and the General Price Level, as measured by the WPI.

As per the Table 6.1, both the variables are stationary at levels, for the significance levels set, in all the three models of the Augmented Dickey-Fuller Test. Hence, these

[40] The natural log of agricultural price and General Price Level are taken. They are converted into point to point growth form. Henceforth, the usage of agricultural price and General Price Level/WPI in this chapter is in the sense of log percentage growth form. This strategy is adopted for the Money Supply variables (M1, M3, and M0) also. Such strategies have a typical property of pre-whitening the time-series processes. Pre-whitening is supposed to make the time-series processes stationary.

variables turn out to be eligible for the application of Hsiao's Procedure. This procedure involves the calculation of Akaike (1969)'s Final Prediction Errors (FPEs) at two stages. In the first stage, FPEs are calculated for each of the M univariate autoregressive processes, where M refers to the maximum lag set for the procedure to take place. Of these computed FPEs, the one that is minimum, determine the optimum lag length. The univariate autoregressive process, corresponding to the minimum FPE, is selected for the later analysis in order to determine the causal direction. In the second stage, the selected univariate autoregressive process is converted into a bivariate autoregressive process with the addition of a regressor.

Table 6.1: Unit Root Test Results for Agricultural Price and General Price Level (1953: 11 to 2005: 11)

Variables			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
Agricultural Price	ADF t-statistic		-5.676*	14	-5.657*	14	-4.022*	14
	Test Critical Values@	1%	-3.441		-3.973		-2.569	
		5%	-2.866		-3.417		-1.941	
		10%	-2.569		-3.131		-1.616	
General Price Level	ADF t-statistic		-4.792*	12	-4.761*	12	-2.889*	12
	Test Critical Values@	1%	-3.441		-3.973		-2.569	
		5%	-2.866		-3.417		-1.941	
		10%	-2.569		-3.130		-1.616	

Note: 1%, 5% and 10% are levels of significance; * indicate significance at 1%, 5% and 10% respectively; @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Here, the final prediction errors is calculated for each of the N bivariate autoregressive process by keeping constant the chosen lag length of the dependent variable, where N refers to the maximum lag set for the regressor. Again, the minimum FPE criterion is used to determine the optimum lag length, now, of the regressor. The corresponding bivariate autoregressive process is chosen for the analysis, as the earlier one. With the completion of these two stages, the Granger Causality result is directly obtained by comparing the minimum FPEs of the selected univariate and bivariate autoregressive processes.

The first stage FPEs for the Hypothesis A is presented in Table 6.2, concisely. The maximum lag length of 11 months is chosen on the basis of the Schwarz Information Criterion[41] rather than relying upon any arbitrary judgment for the upper bound. This is an improvisation over the studies made by Hsiao, and others while applying the Hsiao's Procedure. The minimum FPEs for General Price Level and agricultural price determine the optimum lag length to be 11 and 9 months, respectively. This is also confirmed by the Hannan-Quinn (HQ) Information Criterion[42]. The second stage FPEs have been computed by adding a regressor each to the univariate autoregressive processes identified in the Table 6.2.

Table 6.2 Final Prediction Error for the Univariate Autoregressive Processes (Agricultural Price and General Price Level)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
General Price Level	11	11	6.32499
Agricultural Price	11	9	12.0838

For instance, the univariate autoregressive process for the General Price Level variable is set for the second stage by adding the agricultural price as a regressor. This is done by keeping the optimum lag length, selected for the General Price Level, constant while manipulating the lag length of the regressor between 1 and N. The FPEs for the converted univariate autoregressive process are presented in the Table 6.3.

Table 6.3 Final Prediction Error for the Bivariate Autoregressive Processes (Agricultural Price and General Price Level)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
General Price Level (11)	Agricultural Price	11	9	5.30566
Agricultural Price (9)	General Price Level	11	11	10.4674

The terms "control variable" and "manipulated variable" are given by Hsiao (1979) for distinguishing between the variable, whose optimum lag length has been kept constant from the variable, whose lag length is being varied between 1 and N in the same bivariate autoregressive process. The optimum lag length selected for the manipulated variables or the regressors is given in the fourth column of Table 6.3. These lag lengths,

[41] Schwarz Information Criterion (SIC), also known as Bayes Information Criteria (BIC), is used in determining the estimate of the true lag length. It has the advantage over F-statistic approach since, it is a consistent estimator of the true lag length. Theoretically, it is also superior to Akaike Information Criterion (AIC). AIC is known to be an inconsistent estimator of the true lag length and therefore, in large samples there is a risk of overestimating the lag length. SIC/BIC is free from such problem (Stock and Watson, 2004).

[42] Hannan-Quinn (HQ) Information Criterion is also known to be providing an estimate of the lag length, closer to the true lag length, in relatively large samples (Liew, 2004).

obviously corresponds to the minimum FPEs for the respective bivariate autoregressive processes. The most interesting stage of analysis in the Hsiao's Procedure relating directly to the issue of causality, as measured by the Granger's definitions, is the comparison of the minimum FPEs computed in the first and second stage of the analysis. As per the Granger's own definition of causality, the key to identify the causal relations is the comparison of the minimum variances of the prediction error. The comparison of the minimum FPEs presented in the Tables 6.2 and 6.3 clearly indicates that the agricultural price Granger-causes the General Price Level and the General Price Level Granger-causes the agricultural price. Hence, there is a feedback causality between the two variables—refer Granger's definition of feedback causality. Thus, the importance of agricultural price in the policy analysis related to macroeconomic price stability as well as in the theoretical analysis related to the sources of inflation cannot be ignored.

Further analysis, other than causality, requires certain diagnostic checks for data-congruency. The identified[43] autoregressive models based on the Hsiao's procedure are specified as under:

$$\begin{bmatrix} \mathbf{AP} \\ \mathbf{GPL} \end{bmatrix} = \begin{bmatrix} \psi^{9}_{11} & \psi^{11}_{12} \\ \psi^{9}_{21} & \psi^{11}_{22} \end{bmatrix} \begin{bmatrix} \mathbf{AP} \\ \mathbf{GPL} \end{bmatrix} + \begin{bmatrix} \boldsymbol{\alpha} \\ \boldsymbol{\beta} \end{bmatrix} + \begin{bmatrix} \boldsymbol{\mu} \\ \boldsymbol{\upsilon} \end{bmatrix}$$

Where AP refers to agricultural price and GPL refers to General Price Level. One of the intentions of Hsiao (1979) to specify the model after determining the direction of Granger Causality is to make use of the optimum lag lengths, selected for solving a lag length problem in the Vector Autoregressive (VAR) processes, which came to limelight since Sims (1981). In this sense, the representation of the above model is, therefore, in the VAR form with different lag length for each of the variables in the system. This is sometimes called as 'near VAR' or 'Asymmetric VAR'. However, sometimes the VAR system may not be put to any system estimation methods such as Full Information Maximum Likelihood Method, Three Stage Least Squares Estimation Method, Seemingly Unrelated Regression Estimates etc. Even if it is wished to incorporate the system estimation, it may become impossible due to insufficient observations. As an approximate alternative to this, certain model adequacy tests can be conducted for the selected models. One of the immediate questions that could arise in the bivariate

[43] The term "identified" should not be confused with the notion of Identification in simultaneous equations models.

regression or autoregression analyses is the possibility of the omitted variable bias. This bias is supposed to take place when an omitted variable in the model is correlated with the regressor—violation of the Ordinary Least Squares assumption of $E(u_i \mid X_i) = 0$— or when it determines the values of the dependent variable. The consequence of the non-zero conditional mean would imply an inerasable bias in the OLS estimator. Also, the estimator becomes inconsistent, rendering the OLS estimates completely unreliable for policy prescriptions, or for further study. The omitted variables are captured in the disturbance term. In the time-series data, there is a violation of another OLS assumption of $E(u_t, u_{t-s}) = 0$. The explanations for such a violation are the correlation among the omitted variables; and the omission of the relevant variables in the model.[44] The problem of serial correlation would render the OLS estimates less efficient; and the standard error of estimated parameters biased, leading to incorrect statistical tests. Since, the models selected in the current empirical analysis are autoregressive, that is, the models contain the lagged dependent variables, an appropriate method for testing serial correlation among the residuals of the model need to be selected. This constraint would automatically eliminate the use of Durbin-Watson statistic. The method that is given priority over others for its "beauty"[45] is the Breusch-Godfrey-LM Test. The null hypothesis of this test is that there is no serial correlation among the residuals. However, these considerations would become relevant if the objective of the researcher is to fit Vector Autoregression (VAR) models. Hence, the analysis of the current study is limited to the detection of Granger causality only, for providing empirical support to the theoretical expectations on the causal link between the agricultural price and the General Price Level; and also the money supply.

However, there was a line of argument[46], based on an examination of the augmented Phillips curve and an analysis of the Central Bank's reaction function to supply shocks in India, which attributed inflation entirely to a monetary policy phenomenon. Such a conclusion was based upon the time period between 1995 and 2005, among other things, which should be taken as the qualifier than anything else. In this sense, the value of inductive probability of such arguments should always be treated with caution. The debate on the role of money in the context of supply shocks, is not only limited to

[44] See Maddala (2007)'s chapter on 'Autocorrelation'.
[45] See Baltagi (2005)'s chapter on 'Violations of the Classical Assumption' for the exposition of the word "beauty" in relation to the Breusch-Godfrey Test.
[46] See Srinivasan et.al., (2006)

macroeconomists in India, but also the macroeconomists all over the world are into this debate. Monetarists believe that the money supply is the source of changes in the price and income and, thereby, it has been given an active role. On the other hand, Structuralists perceive money supply to have a passive role due to which it simply responds to the changes in the prices of the economy. Such debates[47], generally, misses the space-time context within which the issue need to be resolved. In order to shed a plausible light on the debate of active or passive role of money supply and then on its possible implications for the monetary policy, particularly the inflation targeting[48], the Hypothesis B, relating to the causal connections between the agricultural price and the money supply, has been put to empirical test. The same empirical methodology as applied to the Hypothesis A is carried out for the Hypothesis B. The results of the unit root tests for all the measures of money supply considered for the study are presented in the Table 6.4.

Table 6.4: Unit Root Test Results for M0, M1 and M3 (1952-53: 10 to 2004-05: 11)

Variables			Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
M0	t-statistics		-4.479*	12	-4.869*	12	-1.399	13
	Test Critical Values@	1%	-3.441		-3.974		-2.569	
		5%	-2.866		-3.417		-1.941	
		10%	-2.569		-3.131		-1.616	
M1	t-statistics		-5.649*	11	-6.389*	11	-1.815$	12
	Test Critical Values@	1%	-3.441		-3.974		-2.569	
		5%	-2.866		-3.417		-1.941	
		10%	-2.569		-3.131		-1.616	
M3	t-statistics		-3.227#	12	-4.168*	11	-0.407	12
	Test Critical Values@	1%	-3.441		-3.974		-2.569	
		5%	-2.866		-3.417		-1.941	
		10%	-2.569		-3.131		-1.616	

Note: * indicate significance at 1%, 5% and 10% respectively; $ indicate significance at 10%; # indicate significance at 5% &10% respectively; @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

[47] I have not brought the debates involving fiscal dimension here. However, its role also cannot be undermined if the government spending in India is largely independent of the supply shocks in the Agriculture Sector. But, it may not be so in India, given the Government's subsidies to this sector.

[48] The whole point behind inflation targeting is setting up of an inflation level or its range. The inflation target refers to adoption of an explicit level of inflation to which monetary policy is geared towards steering the economy (Baxter and Davis, 2003). Hence, I am, here, referring to the possible determinants of setting a level of inflation or its range in a country like India, which do not have the same economic structure as the countries in the European Union; or as the Unites States of America.

The Augmented Dickey-Fuller (ADF) models 1 and 2 with constant; and with constant and linear trend, respectively are the better performers than the model 3. Since, the unit root tests have performed better while taking account of the time trend, which is a potential source of non-stationarity of the stochastic process, the measures of money supply are considered to be level stationary. These measures are then subjected to the Hsiao's procedure of Granger Causality.

The minimum final prediction errors determining the optimum lag length of the money supply measures for the univariate autoregressive processes are presented in Table 6.5.

Table 6.5: Final Prediction Error for the Univariate Autoregressive Processes (M0, M1 and M3)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0	11	9	6.50546
M1	11	9	3.61796
M3	11	11	0.899597

Based on the minimum FPEs and the corresponding lag lengths for the univariate autoregressive process, the final prediction errors of the bivariate autoregressive processes is calculated. The results are reported in the Table 6.6. The comparison of the minimum final prediction errors obtained for univariate and bivariate autoregressive processes suggests the existence of feedback causality for all the measures of money supply, employed for the analysis. This is in contrast to unidirectional causalities that have been theoretically postulated in the debates involving money supply and prices. The important point in the context of the thesis statement is the presence of causal direction running from the agriculture price to the money supply, thereby indicating that the Agriculture Sector needs a continuing emphasis in the matters related to monetary policy, specifically, in relation to the Price Stability objective of the Central Bank, the RBI.

Table 6.6: Final Prediction Error for the Bivariate Autoregressive Processes (M0, M1, M3 and Agricultural Price)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0 (9)	Agricultural Price	11	11	6.18286
M1(9)	Agricultural Price	11	9	3.49162
M3 (11)	Agricultural Price	11	1	0.902476
Agricultural Price (9)	M0	11	8	11.5957
Agricultural Price (9)	M1	11	9	11.6516
Agricultural Price (9)	M3	11	1	12.117

The models selected from the Hsiao's procedure for the different measures of money supply; and the agricultural price is presented in the system form below:

$$\begin{bmatrix} \mathbf{M0} \\ \mathbf{AP} \end{bmatrix} = \begin{bmatrix} \psi^{9}{}_{11} & \psi^{11}{}_{12} \\ \psi^{8}{}_{21} & \psi^{9}{}_{22} \end{bmatrix} \begin{bmatrix} \mathbf{M0} \\ \mathbf{AP} \end{bmatrix} + \begin{bmatrix} \alpha \\ \beta \end{bmatrix} + \begin{bmatrix} \mu \\ \upsilon \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{M1} \\ \mathbf{AP} \end{bmatrix} = \begin{bmatrix} \psi^{9}{}_{11} & \psi^{9}{}_{12} \\ \psi^{9}{}_{21} & \psi^{9}{}_{22} \end{bmatrix} \begin{bmatrix} \mathbf{M1} \\ \mathbf{AP} \end{bmatrix} + \begin{bmatrix} \alpha \\ \beta \end{bmatrix} + \begin{bmatrix} \mu \\ \upsilon \end{bmatrix}$$

$$\begin{bmatrix} \mathbf{M3} \\ \mathbf{AP} \end{bmatrix} = \begin{bmatrix} \psi^{11}{}_{11} & \psi^{1}{}_{12} \\ \psi^{1}{}_{21} & \psi^{9}{}_{22} \end{bmatrix} \begin{bmatrix} \mathbf{M3} \\ \mathbf{AP} \end{bmatrix} + \begin{bmatrix} \alpha \\ \beta \end{bmatrix} + \begin{bmatrix} \mu \\ \upsilon \end{bmatrix}$$

Overall, the empirical results points out that there exist a causal link between the Agriculture Sector and the macroeconomy. However, yielding to the warning given by Granger (1969) while considering the feedback causality obtained from monthly data, a strategy of reducing the sample period was employed. As per this strategy, the entire sample period was divided into five decadal time periods of 120 observations each. In the process, twenty four observations that appeared at the end of the original sample period, that is, from 2003 November till 2005 October, have been dropped as redundant for the specified analysis. The five decadal sub-sample periods were 1953 (11) to 1963 (10); 1963 (11) to 1973 (10); 1973 (11) to 1983 (10); 1983 (11) to 1993 (10); and 1993 (11) to 2003 (10). This type of classification was due to the outcome of data availability. For each of these sub sample periods, the Granger Causality tests were applied to find out whether the results obtained earlier were spurious or not.

6.1 Confirming the Evidence on Feedback Causality[49]

All the variables for all the decades were subjected to stationarity tests and found to be stationary at levels. In the case of the agricultural price and General Price Level, feedback causality was found for the decades 1953 (11) to 1963 (10); 1963 (11) to 1973 (10); 1983 (11) to 1993 (10) and 1993 (11) to 2003 (10). For the decade 1973 (11) to 1983 (10), it was found that there did not exist any clues on the direction of causal relations. That is, the causality test was inconclusive for this decade. One possible reason for such a result would be the presence of oil shocks, which could have over

[49] All the tables related to this sub section are put in this chapter's appendix.

dominated the influence of the agricultural price. Hence, except for the decade of 1973 (11) to 1983 (10), in all cases the evidence of feedback causality was found. This implies that the results obtained earlier for the variables, agricultural price and the General Price Level, were almost robust to changes in the sample period.

In the case of money supply and the agricultural price, the Granger Causality tests were applied separately to each of the decadal period as in the case of agricultural price and General Price Level. The feedback causality was found for the decades 1953 (11) to 1963 (10); 1963 (11) to 1973 (10); 1983 (11) to 1993 (10) and 1993 (11) to 2003 (10). The only exception was the decade 1973 (11) to 1983 (10), which showed a unidirectional causality running from all the measures of money supply to the agricultural price. However, even in the decades that showed feedback causality, there was a unidirectional causality running from the broad money (M3) to the agricultural price—unidirectional causality from M3 to agricultural price was found for the decades 1963 (11) to 1973 (10) and 1983 (11) to 1993 (10). However, on the overall, the evidence of feedback causality was present in four of the five decades, thereby resulting in almost robustness of the earlier evidence related to the money supply and agricultural price.

APPENDIX

Table A1: Unit Root Test Results for Agricultural Price and General Price Level (1953:11 to 1963:10)

Variables			Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
Agricultural Price	ADF t-statistics		-4.662*	11	-4.626*	11	-4.298*	11
	Test Critical Values@	1%	-3.492		-4.045		-2.587	
		5%	-2.888		-3.452		-1.944	
		10%	-2.581		-3.151		-1.615	
General Price Level	ADF t-statistics		-4.344*	11	-4.292*	11	-3.797*	11
	Test Critical Values@	1%	-3.492		-4.045		-2.587	
		5%	-2.888		-3.452		-1.944	
		10%	-2.581		-3.151		-1.615	

Note: * indicate significance at 1%, 5% and 10% respectively. @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Table A2: Final Prediction Error for the Univariate Autoregressive Processes for Agricultural Price and General Price Level (1953:11 to 1963:10)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
Agricultural Price	11	9	9.04874
General Price Level	11	9	3.89105

Table A3: Final Prediction Error for the Bivariate Autoregressive Processes for Agricultural Price and General Price Level (1953:11 to 1963:10)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
Agricultural Price (9)	Wholesale Price Index	11	9	5.74243
General Price Level (9)	Agricultural Price	11	9	2.88051

Table A4: Unit Root Test Results for Agricultural Price and General Price Level (1963:11 to 1973:10)

Variables	Significance Level		Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
Agricultural Price	t-statistics		-10.032*	11	-10.008*	11	-9.324*	11
	Test Critical Values @	1%	-3.487		-4.038		-2.585	
		5%	-2.886		-3.448		-1.944	
		10%	-2.580		-3.149		-1.615	
General Price Level	t-statistics		-11.135*	11	-11.087*	11	-0.988	11
	Test Critical Values @	1%	-3.487		-4.038		-2.585	
		5%	-2.886		-3.448		-1.944	
		10%	-2.580		-3.149		-1.615	

Note: * indicate significance at 1%, 5% and 10% respectively. @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Table A5: Final Prediction Error for the Univariate Autoregressive Processes for Agricultural Price and General Price Level (1963:11 to 1973:10)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
Agricultural Price	11	1	6.74188
General Price Level	11	1	3.40569

Table A6: Final Prediction Error for the Bivariate Autoregressive Processes for Agricultural Price and General Price Level (1963:11 to 1973:10)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
Agricultural Price (1)	Wholesale Price Index	11	1	6.12447
General Price Level (1)	Agricultural Price	11	1	3.19645

Table A7: Unit Root Test Results for Agricultural Price and General Price Level (1973:11 to 1983:10)

Variables	Significance Level		Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
Agricultural Price	t-statistics		-7.914*	11	-7.925*	11	-7.521*	11
	Test Critical Values@	1%	-3.487		-4.038		-2.585	
		5%	-2.886		-3.448		-1.944	
		10%	-2.580		-3.149		-1.615	
General Price Level	t-statistics		-7.284*	11	-7.252*	11	-6.361*	11
	Test Critical Values@	1%	-3.487		-4.038		-2.585	
		5%	-2.886		-3.448		-1.944	
		10%	-2.580		-3.149		-1.615	

Note: * indicate significance at 1%, 5% and 10% respectively. @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Table A8: Final Prediction Error for the Univariate Autoregressive Processes for Agricultural Price and General Price Level (1973:11 to 1983:10)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
Agricultural Price	11	6	4.33228
General Price Level	11	1	1.42439

Table A9: Final Prediction Error for the Bivariate Autoregressive Processes for Agricultural Price and General Price Level (1973:11 to 1983:10)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
Agricultural Price (6)	Wholesale Price Index	11	1	4.58387
General Price Level (1)	Agricultural Price	11	1	1.44206

Table A10: Unit Root Test Results for Agricultural Price and General Price Level (1983:11 to 1993:10)

Variables			Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
Agricultural Price	t-statistics		-4.771*	11	-5.039*	11	-2.880*	11
	Test Critical Values@	1%	-3.492		-4.045		-2.587	
		5%	-2.888		-3.452		-1.944	
		10%	-2.581		-3.151		-1.615	
General Price Level	t-statistics		-4.433*	11	-6.071*	11	-1.450	11
	Test Critical Values@	1%	-3.492		-4.045		-2.587	
		5%	-2.888		-3.452		-1.944	
		10%	-2.581		-3.151		-1.615	

Note: * indicate significance at 1%, 5% and 10% respectively. @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Table A11: Final Prediction Error for the Univariate Autoregressive Processes for Agricultural Price and General Price Level (1983:11 to 1993:10)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
Agricultural Price	11	9	7.59933
General Price Level	11	10	1.60439

Table A12: Final Prediction Error for the Bivariate Autoregressive Processes for Agricultural Price and General Price Level (1983:11 to 1993:10)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
Agricultural Price (9)	Wholesale Price Index	11	10	6.04902
General Price Level (10)	Agricultural Price	11	9	1.41751

Table A13: Unit Root Test Results for Agricultural Price and General Price Level (1993:11 to 2003:10)

Variables			Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
Agricultural Price	t-statistics		-12.922*	11	-14.801*	11	-8.389*	11
	Test Critical Values@	1%	-3.492		-4.045		-2.587	
		5%	-2.888		-3.452		-1.944	
		10%	-2.581		-3.151		-1.615	
General Price Level	t-statistics		-17.458*	11	-19.839*	11	-8.114*	11
	Test Critical Values@	1%	-3.492		-4.045		-2.587	
		5%	-2.888		-3.452		-1.944	
		10%	-2.581		-3.151		-1.615	

Note: * indicate significance at 1%, 5% and 10% respectively. @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Table A14: Final Prediction Error for the Univariate Autoregressive Processes for Agricultural Price and General Price Level (1993:11 to 2003:10)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
Agricultural Price	11	11	0.00235
General Price Level	11	11	0.00146

Table A15: Final Prediction Error for the Bivariate Autoregressive Processes for Agricultural Price and General Price Level (1993:11 to 2003:10)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
Agricultural Price (11)	Wholesale Price Index	11	10	0.00154663
General Price Level (11)	Agricultural Price	11	10	0.00089759

Table A16: Unit Root Test Results for M0, M1 and M3 (1953:11 to 1963:10)

Variables			Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
M0	t-statistics		-6.456*	9	-6.428*	9	-2.180#	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	
M1	t-statistics		-4.937*	9	-4.912*	9	-1.692$	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	
M3	t-statistics		-3.730*	9	-3.900#	9	-1.085	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	

Note: * indicate significance at 1%, 5% and 10% respectively; # indicate significance at 5% and 10% respectively; $indicate significance at 10%; @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Table A17: Final Prediction Error for the Univariate Autoregressive Processes for M0, M1, M3 and Agricultural Price (1953:11 to 1963:10)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0	11	9	1.48726
M1	11	11	1.19361
M3	11	11	0.601078
Agricultural Price	11	9	8.96944

Table A18: Final Prediction Error for the Bivariate Autoregressive Processes for M0, M1, M3 and Agricultural Price (1953:11 to 1963:10)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0 (9)	Agricultural Price	11	10	1.31904
M1(11)	Agricultural Price	11	10	0.992016
M3 (11)	Agricultural Price	11	11	0.517581
Agricultural Price (9)	M0	11	7	7.38256
Agricultural Price (9)	M1	11	6	6.86824
Agricultural Price (9)	M3	11	8	6.98491

Table A19: Unit Root Test Results for M0, M1 and M3 (1963:11 to 1973:10)

Variables			Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
M0	t-statistics		-5.237*	9	-6.683*	9	-1.640$	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	
M1	t-statistics		-4.609*	9	-6.552*	9	-0.989	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	
M3	t-statistics		-3.424#	9	-6.560*	9	-0.555	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	

Note: * indicate significance at 1%, 5% and 10% respectively; # indicate significance at 5% and 10% respectively; $indicate significance at 10%; @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Table A20: Final Prediction Error for the Univariate Autoregressive Processes for M0, M1, M3 and Agricultural Price (1963:11 to 1973:10)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0	11	9	2.64964
M1	11	8	1.34220
M3	11	11	0.74805
Agricultural Price	11	1	6.57682

Table A21: Final Prediction Error for the Bivariate Autoregressive Processes for M0, M1, M3 and Agricultural Price (1963:11 to 1973:10)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0 (9)	Agricultural Price	11	3	2.54976
M1(8)	Agricultural Price	11	8	1.29355
M3 (11)	Agricultural Price	11	1	0.76077
Agricultural Price (1)	M0	11	9	5.72537
Agricultural Price (1)	M1	11	1	6.00476
Agricultural Price (1)	M3	11	7	6.31848

Table A22: Unit Root Test Results for M0, M1 and M3 (1973:11 to 1983:10)

Variables			Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
M0	t-statistics		-4.722*	9	-4.769*	9	-1.925$	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	
M1	t-statistics		-4.519*	9	-4.528*	9	-2.754*	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	
M3	t-statistics		-3.917*	9	-3.876*	9	-0.640	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	

Note: * indicate significance at 1%, 5% and 10% respectively; $ indicate significance at 10%; @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Table A23: Final Prediction Error for the Univariate Autoregressive Processes for M0, M1, M3 and Agricultural Price (1973:11 to 1983:10)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0	11	1	7.47609
M1	11	1	8.55633
M3	11	1	1.19656
Agricultural Price	11	1	4.20431

Table A24: Final Prediction Error for the Bivariate Autoregressive Processes for M0, M1, M3 and Agricultural Price (1973:11 to 1983:10)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0 (1)	Agricultural Price	11	1	7.61445
M1(1)	Agricultural Price	11	1	8.71324
M3 (1)	Agricultural Price	11	7	1.22456
Agricultural Price (1)	M0	11	3	3.81647
Agricultural Price (1)	M1	11	3	4.06665
Agricultural Price (1)	M3	11	4	3.82442

Table A25: Unit Root Test Results for M0, M1 and M3 (1983:11 to 1993:10)

Variables			Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
M0	t-statistics		-5.912*	9	-6.002*	9	-1.669$	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	
M1	t-statistics		-6.027*	9	-5.990*	11	-1.806$	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	
M3	t-statistics		-5.217*	9	-5.262*	11	-0.737	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	

Note: * indicate significance at 1%, 5% and 10% respectively; $ indicate significance at 10%; @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Table A26: Final Prediction Error for the Univariate Autoregressive Processes for M0, M1, M3 and Agricultural Price (1983:11 to 1993:10)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0	11	11	10.3866
M1	11	8	3.42204
M3	11	4	0.826487
Agricultural Price	11	9	7.64018

Table A27: Final Prediction Error for the Bivariate Autoregressive Processes for M0, M1, M3 and Agricultural Price (1983:11 to 1993:10)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0 (11)	Agricultural Price	11	8	9.73747
M1(8)	Agricultural Price	11	9	2.61327
M3 (4)	Agricultural Price	11	11	0.702473
Agricultural Price (9)	M0	11	9	7.10413
Agricultural Price (9)	M1	11	11	6.60066
Agricultural Price (9)	M3	11	8	7.67134

Table A28: Unit Root Test Results for M0, M1 and M3 (1993:11 to 2003:10)

Variables			Augmented Dickey Fuller Test Statistics					
			Model 1 (With constant)	Lags	Model 2 (With Constant + Trend)	Lags	Model 3 (Without constant)	Lags
M0	t-statistics		-5.883*	9	-5.986*	9	-2.576#	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	
M1	t-statistics		-5.430*	9	-5.888*	9	-1.429	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	
M3	t-statistics		-4.820*	9	-5.342*	9	-0.877	9
	Test Critical Values@	1%	-3.491		-4.044		-2.586	
		5%	-2.888		-3.451		-1.944	
		10%	-2.581		-3.151		-1.615	

Note: * indicate significance at 1%, 5% and 10% respectively; # indicate significance at 5% and 10% respectively; @ refers to the MacKinnon critical values corresponding to the significance levels (1%, 5% and 10%).

Table A29: Final Prediction Error for the Univariate Autoregressive Processes for M0, M1, M3 and Agricultural Price (1993:11 to 2003:10)

Variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0	11	10	5.74366
M1	11	9	2.62102
M3	11	9	0.704917
Agricultural Price	11	11	17.6866

Table A30: Final Prediction Error for the Bivariate Autoregressive Processes for M0, M1, M3 and Agricultural Price (1993:11 to 2003:10)

Control Variable	Manipulated variable	Maximum Lag	Optimum Lag	Minimum Final Prediction Error
M0 (10)	Agricultural Price	11	11	3.34772
M1(9)	Agricultural Price	11	11	1.34241
M3 (9)	Agricultural Price	11	10	0.65542
Agricultural Price (11)	M0	11	9	14.5541
Agricultural Price (11)	M1	11	9	10.435
Agricultural Price (11)	M3	11	10	15.5855

CHAPTER 7
CONCLUSION

The empirical results based on the econometric techniques employed, provide conclusive evidence on the causal connections between the Agriculture Sector and the chosen macroeconomic variables, General Price Level and Money Supply, for the analysis. Hence, these results are consistent with the theoretical result derived in the chapter entitled "Conceptual Framework". In that chapter, it was shown that the growth in a sector has its influence on the growth of an economy (Growth Dependency Theorem), if that sector is large (Axiom 1) and linked to other main sectors of the economy (Axiom 2). This influence would get reinforced if this sector is infected by supply shocks (Axiom 3). The testing of both the formulated hypotheses led to the evidence of feedback causality between the agricultural price and the general price level (Hypothesis A); between the agriculture price and the money supply (Hypothesis B), respectively in India for the chosen period of the study. The evidence of feedback causality is essential in the sense that there is a direction of causality running from the Agriculture Sector to the macroeconomic variables, such as, General Price Level and Money Supply; and, by postulation, the General economy.[50] Such evidence become important when there already exist controversies in the Indian academia regarding the sources of inflation. On the one hand, the Structuralists point out at the role of trade unions, given the passive money supply. On the other hand, Monetarists point out at the mismatch between the growth in money and the growth in output. Quite distinct from these two, some point out at the decisions made by the Central Bank of the country, the Reserve Bank of India, on the question of responding to changes in prices, especially in our context, occurring due to changes in the stochastic conditions in the Agriculture Sector of the country. Amidst these attributions, the empirical results of feedback causality demand for the explanations on the existence of causal direction from the Agriculture Sector to the macroeconomic variables, such as, General Price Level and the money supply. One such explanation—provided in the conceptual framework--is already proved while testing those hypotheses.

Another strong possibility for explaining such a causal direction is the "Unorganized Sector" argument, on which few things were detailed in the 'Introductory' chapter of

[50] For an evidence that supports this postulation, see Rangarajan (1998).

this dissertation. The argument is basic. It states that "Given a large unorganized sector and its dependence on agro and agro-based commodities, the output and price disturbances in the Agriculture Sector would tend to bring in quick changes in the prices of the commodities produced in the unorganized sector." It also serves as an exception to the "Lucas Islanders"[51]. These Islanders are rational agents. They get confused between the relative price changes and the absolute price changes due to some given economic circumstance. What the "Unorganized Sector" argument claims is that different relative prices emits different signals to the individuals in the economy. Such differences, if smoothened, would result in the "Lucas Islanders". Hence, the distinction between the relative price changes and the absolute price changes would vanish away. The rationale of "differences in signals" turns out to be important in explaining the relative-aggregate dynamics. The "differences in signals" can be understood through the following classification of the price signals: (1) Confused Price Signal and (2) Clear Price Signal. This classification emanates from recognizing that some goods are relatively more important than other goods in terms of consumption expenditures—direct or indirect. A high proportion of consumption expenditures attributed to few or more goods are called, here, as "Clear" and their price changes as "Clear Price Signals". The "Confused Price Signals" refers to the "Lucas Price signals" caught by the "Lucas Islanders". Hence, with this sweet treatment of concepts, the "Unorganized Sector" argument gains inductive probability. Now, the argument being given a more scientific flavor, it directly fits into the shoes in explaining the importance of considering Indian Agriculture as an essential input in the macroeconomic policies of the country.

There are quite a number of possibilities to explore the economic relationship between the Agriculture and the General economy. However, before embarking upon any empirical analyses on it in India, it is essential to develop theoretical frameworks based

[51] For Lucas, Island refers to market for each commodity produced in an economy. Islanders, here, refer to the suppliers of these markets. "Lucas Islanders" are rational agents facing imperfect information, due to which they are unable to distinguish between the changes in the relative price—their sole concern—and the changes in absolute (or General) price level in the economy. Such behaviour, Lucas argues, would result in inducing the suppliers to produce more. This was advanced by him as an explanation to the positive association between the output and price level as shown by the data confronted by him. See Lucas (1972) for its exposition. He also makes use of this as assumption in Lucas (1973). However, my concern, via the "Unorganized Sector" argument, is the ability of the rational agents (suppliers), to distinguish between changes in the relative price and changes in the absolute price. This argument is based upon the premise that the suppliers have full information on their input prices. It is plausible to expect the premise to be closer to the real world. In such a case, suppliers would tend to increase their commodity prices instead of output. In this line of reasoning, the conclusion is an increase in the General Price Level in the economy.

on the "local a priories" or economic knowledge largely conditioned upon the working of the Indian economy. Such an approach would easily provide the answers that are closer to true answers. This is an important research agenda for the future.

The findings of this dissertation have certain significant utility for the policymakers of the country. Particularly, its role in the design of monetary policy needs to be emphasized. India, currently, is witnessing a move towards inflation targeting by choosing the interest rate, as an appropriate intermediate target.[52] It is a move, away from the 'Monetary targeting'.[53] The choice of an appropriate intermediate target for dealing with inflation has been the concern of developed economies. The reason for their shift from the monetary targeting to interest rate targeting, for example, has been motivated by the fact that the demand for money function in these economies have been found to be unstable. This is not so in the case of India.[54] Hence, there may be some degree of doubt on the interest rate targeting in the country. Moreover, with the causal direction coming from the Agriculture Sector to the General Price Level and the Money Supply, the role of "Unorganized Sector" argument assumes more importance. With this argument, the demand for money in the economy would increase, due to supply shocks to the Agriculture Sector. That is, the prices of the commodities produced in the unorganized sector rises, due to the shocks in the Agriculture Sector, which occupies an important position in the consumption function of the individuals in the Unorganized Sector. Due to its relatively large size in the economy, the prices of its commodities would tend to reduce the purchasing power of the individuals, who depend on it. An expectation, here, is that the number of individuals, who depend on the commodities of the Unorganized Sector, would approximate the total population in the country. Therefore, the transactions demand for money in the economy would rise; and it would not be determined by any inventory considerations. Rather, the transactions demand for money may be perfectly interest-inelastic, a possibility that need to be examined. [55] It implies that the interest rate targeting in India may be too soon an event. As such, examining the role of the "Unorganized Sector" argument in connection to inflation targeting is another important research agenda for the future.

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[52] See Raghuram Rajan Committee Report (2008).
[53] Monetary targeting was recommended by the Chakravarty Committee Report (1985) in India.
[54] See Rangarajan (1998).
[55] See Baumol (1952) and Tobin (1956) for the relationship between interest rate and the transactions demand for money.

In addition to this, it is important to emphasize the fact that the "Unorganized Sector" argument assumes theoretical significance, only when it is related to the prices in the Agriculture Sector, especially, in the case of India. Hence, the dissertation should not be confused as dealing only with the Unorganized Sector.

Another, useful research agenda is with respect to the existing inflation theories, specifically, the Structuralist version. The Structuralist theory of inflation focus more on the trade unions' bargaining power for the inflationary process to get ignite, whenever there is a supply shock to the Agriculture Sector. In the case of India, this can be modified by incorporating the effect of the Unorganized Sector into the analyses of inflation. Obviously, what one looks for in such analysis is whether there is a possibility for inflationary process to take place, in a sustained manner. Infact, what is argued, here, is that it is possible with the link between the agricultural price and the actions of the economic agents in the Unorganized Sector, to an extent that may undermine the role of the trade unions in the inflation analyses.

BIBLIOGRAPHY

Akaike, H. (1969). "Fitting Autoregressions for Prediction." *Annals of the Institute of Statistical of Mathematics,* 21, 243-247.

Ardeni, P.G. and Freebairn, J. (2002). "The Macroeconomics of Agriculture." In B.L. Gardner and Gordon C. Rausser, eds., *Handbook of Agricultural Economics Volume 2A: Agriculture and its External Linkages*, The Netherlands: Elsevier Science B.V.

Balakrishnan, P. (1991). *Pricing and Inflation in India.* Delhi: Oxford University Press.

Balakrishnan, P. (1994). "How Best to Model Inflation in India." *Journal of Policy Modeling*, 16, 677-83.

Ball, L. and Mankiw, G.N. (1995). "Relative Price Changes as Aggregate Supply Shocks." *The Quarterly Journal of Economics*, 110 (1), February, 161-193.

Baltagi, B. H. (2005). *Econometrics.* India: Springer International Edition.

Baumol, W. (1952). "The Transactions Demand for Cash: An Inventory-Theoretic Approach." *Quarterly Journal of Economics*, 66, November, 545-556.

Baxter, R. E. and Davis, E. (2003). *The Penguin Dictionary of Economics.* England: Penguin Books Ltd.

Breusch, T.S. (1978). "Testing for Autocorrelation in Dynamic Linear Models." *Australian Economic Papers,* 17, 334-355.

Central Statistical Organisation of India. (2006). *New Series of National Account Statistics: Base Year 1999-00.* Government of India: Ministry of Statistics and Programme Implementation.

Central Statistical Organisation of India. (2007). *National Account Statistics: Back Series- 1950-51 to 1999-00.* Government of India: Ministry of Statistics and Programme Implementation.

Chichilnisky, G. and Lance, T. (1980). "Agriculture and the Rest of the Economy: Macro Connections and Policy Restraints." *American Journal of Agricultural Economics*, 62 (2), 303-309.

Friedman, M. (1975). "Perspectives on Inflation." *Newsweek*, June 24.

Godfrey, L.G. (1978). "Testing against General Autoregressive and Moving Average Error Models When the Regressors Include Lagged Dependent Variables." *Econometrica,* 46, 1293-1302.

Gordon, Robert J. (1974). "The Consequences of Inflation for Monetary Policy." *The Conference Board's Fifth Annual Midyear Outlook Conference*, April 10, Chicago, Illinois.

Gould, J.D. (1962). "Agricultural Fluctuations and the English Economy in the Eighteenth Century." *The Journal of Economic History*, 22(3), September, 313-333.

Government of India. (2008). "Draft Report of the Committee on Financial Sector Reforms." *Raghuram Rajan Report*, New Delhi: Planning Commission.

Granger, Clive. W. J. (1969). "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods." *Econometrica*, 37(3), August, 424-438.

Gupta, S. B. (1974). "Food-Shortage, Demand-Pull, and Inflation in India." In S.L.N. Simha, ed, *Inflation in India*, Institute for Financial Management and Research, Bombay: Vora & Co Publishers.

Hirschman, A. (1958). *Strategy of Economic Development*, New Haven, Conn: Yale University Press.

Hoover, K. D. (2001). *Causality in Macroeconomics*, Cambridge: Cambridge University Press.

Hsiao, C. (1977). "Money and Income Causality Detection." *NBER Working Paper Series, No.* 167, March, 1-41.

Hsiao, C.(1979). "Autoregressive Modeling of Canadian Money and Income Data." *Journal of the American Statistical Association*, 74(367), September, 553-560.

Hsiao, C. (1981). "Autoregressive Modelling and Money-Income Causality Detection." *Journal of Monetary Economics*, 7, 85-106.

Johnston, B. F. and Mellor, J.W. (1961). "The Role of Agriculture in Economic Development." *The American Economic Review*, 51(4), September, 566-593.

Joshi, V. and Little, I.M.D. (1994). *India: Macroeconomics and Political Economy* 1964-1991. Washington D.C: The World Bank.

Kaldor, N. (1975). "What is Wrong with Economic Theory?" *Quarterly Journal of Economics*, 89(2), 347-357.

Kaldor, N. (1979). "Equilibrium Theory and Growth Theory." In M.J. Boskin, ed, *Economics and Human Welfare: Essays in Honour of Tibor Scitovsky*, New York: Academic Press.

Kalecki, M. (1976). "Problems of Financing Economic Development in a Mixed Economy." In M. Kalecki, *Essays on Development Economics*, Brighton: Harvester.

Kapila, U. (2006). *Indian Economy Since Independence*, New Delhi: Academic Foundation.

Keynes, J.M. (1936). *The General Theory of Employment, Interest and Money.* London: Mcmillan and Company.

Koopmans, T.C. (1950). *Statistical Inference in Dynamic Economic Models*, New York: Wiley and Sons.

Laidler, D and Parkin, M. (1975). "Inflation: A Survey." *The Economic Journal*, 85(340), December, 741-809.

Laidler, D. (1992). "Issues in Contemporary Macroeconomics." In Alessandro Vercelli and Nicolo Dimitri, *Macroeconomics: A Survey of Research Strategies*, ed, New York: OUP.

LeRoy, S. F. (1995). "Causal Orderings." In Kevin D. Hoover, ed, *Macroeconometrics: Developments, Tensions and Prospects*, Boston: Kluwer.

Lewis, A. (1954). "Economic Development with Unlimited Supplies of Labour." *The Manchester School of Economics and Social Studies*, 22(2).

Liew, Venus Khim-Sen. (2004). "Which Lag Length Selection Criteria Should We Employ?" *Economics Bulletin*, 3(33), 1-9.

Lucas. Jr, Robert. E. (1972). "Expectations and the Neutrality of Money." *Journal of Economic Theory*, 4, April, 103-124.

Lucas. Jr, Robert. E. (1973). "Some International Evidence on Output-Inflation Tradeoffs." *The American Economic Review*, 63(3), 326-334.

Lucas. Jr, Robert. E. (1987). *Models of Business Cycles.* Oxford: Basil Blackwell.

Maddala, G. S. (2007). *Introduction to Econometrics.* India: Wiley Student Edition.

Marty, A. L. (1999). "The Welfare Costs of Inflation: A Critique of Bailey and Lucas." *Federal Reserve Bank of St. Louis Review*, 81 (1), 41-6.

Ministry of Finance. Economic Survey: *Various Issues*. Economic Division, New Delhi: Government of India Press.

Mirowski, P. (1984). "Macroeconomic Instability and the "Natural" Processes in Neoclassical economics." *The Journal of Economic History*, 44(2), June, 345-354.

Mitra, A. (1978). *Terms of Trade and Class Relations.* London: Frank Cass and Company.

Nachane, D.M. and Laxmi, R. (2002). "Dynamics of Inflation in India: A P-Star Approach." In Ahluwalia, M.S, Reddy, Y.V, and Tarapore, S.S, Eds, *Macroeconomics and Monetary Policy: Issues for a Reforming Economy*, New Delhi: Oxford University Press.

Nelson, D. (2003). *The Penguin Dictionary of Mathematics*, England: Penguin Books Ltd.

Olivera J. H. G. (1970). "On Passive Money." *The Journal of Political Economy*, 78(4), Part 2: Key Problems of Economic Policy in Latin America, July-August, 805-814.

Olivera, J. H. G. (1964). "On Structural Inflation and Latin American Structuralism." *Oxford Economic Papers*, New Series, 16(3), November, 321-332.

Orcutt, G.H. (1952). "Actions, Consequences and Causal Relations." *Review of Economics and Statistics*, 34, 305-13.

Patterson, K. (2000). *An Introduction to Applied Econometrics: A Time Series Approac*h. London: Macmillan Press Ltd.

Phelps, E. (1970). *Employment and Inflation Theory*. New York: Norton.

Pierce, D.A. and Haugh, L.D. (1977). "Causality in Temporal Systems: Characterizations and a Survey." *Journal of Econometrics*, 5, 265-293.

Raj, K.N. (1966). "Price Behaviour in India: An Explanatory Hypothesis." *Indian Economic Review*, New Series, 2, 34-51.

Rakshit, M. K. (1989). "Effective Demand in a Developing Country: Approaches and Issues." In Mihir Rakshit, ed, *Studies in the Macroeconomics of Developing Countries*, Delhi: Oxford University Press.

Rangarajan, C. (1998). "Development, Inflation and Monetary Policy." In Isher Judge Ahluwalia and I.M.D.Little, eds, *India'a Economic Reforms and Development: Essays for Manmohan Singh*, Delhi: Oxford University Press.

Rao, B.S.R. (1974). "Money and Prices in India." In S.L.N. Simha, ed, *Inflation in India*, Institute for Financial Management and Research, Bombay: Vora & Co Publishers.

Reserve Bank of India. (2006). *Handbook of Monetary Statistics of India*. Mumbai: RBI.

Reserve Bank of India. (2007). *Handbook of Statistics on the Indian Economy*. Mumbai: RBI.

Ross, S. (2006). *A First Course in Probability*, Delhi: Pearson Education, Inc.
Sargent, T.J. (1976). "A Classical Macroeconomic Model for the United States." *Journal of Political Economy*, 84, 207-237.

Screpanti, E. and Zamagni, S. (2006). *An Outline of the History of Economic Thought*. New Delhi: Oxford University Press.

Shaalan, A.S (1962). "The Impact of Inflation on the Composition of Private Domestic Investment." *Staff Papers-International Monetary Fund*, 9(2), July, 243-263.

Simha, S.L.N. (1974 Ed.). *Inflation in India*. Institute for Financial Management and Research, Bombay: Vora & Co Publishers.

Simon, H.A. (1953). "Causal Ordering and Identifiability."In Hood, W.C. and Koopmans, eds, *Studies in Econometric Method*, New York: Wiley and Sons.

Sims, C. (1972). "Money, Income and Causality." *The American Economic Review*, 62(4), September, 540-552.

Sims, C. (1980). "Macroeconomics and Reality." *Econometrica*, 48(6), 1-48.

Snowdown, B. and Vane, H. R. (2005). *Modern Macroeconomics: Its Origins, Development and Current State*, UK: Edward Elgar Publishing Limited.

Spirtes, P., Glymour, C. and Scheines, R. (1993). *Causation, Prediction and Search.* New York: Springer-Verlag.

Srinivasan, N., Mahambare, V. and Ramachandran, M. (2006). "Modelling Inflation in India: A Critique of the Structuralist Approach." *Journal of Quantitative Economics*, New Series, 4(2), July, 45-58.

Stock, J.H. and Watson, M.W. (2004). *Introduction to Econometrics*. India: Pearson Education.

Taylor, L. (1982). "Food Prices, Terms of Trade and Growth." In M.Gersovitz, C.F. Diaz-Alejandro, G. Ranis and M.R. Rosenzweig, Eds, *The Theory and Experience of Economic Development of Essays in honor of Sir.W. Arthur Lewis*, London: George Allen and Unwin.

Taylor, L. (1991). *Income Distribution, Growth and Inflation: Lectures of Structuralist Macroeconomic Theory*. Cambridge, MA: MIT Press.

Tobin, J. (1956). "The Interest-Elasticity of the Transactions Demand for Cash." *Review of Economics and Statistics*, 38, August, 241-247.

Turnovsky, S. J. (1987). "Supply Shocks and Optimal Monetary Policy." *Oxford Economic Papers*, New Series, 39(1), March, 20-37.

Vercelli, A. (1991). *Methodological Foundations of Macroeconomics: Keynes and Lucas*. Cambridge: Cambridge University Press.

Wold, H. (1954). "Causality and Econometrics." *Econometrica*, 22(2), April, 162-177.