

**THEORIES OF THE FIRM AND PRODUCT
PRICING OF CHEMICAL AND ENGINEERING
INDUSTRIES OF INDIA**

**A THESIS SUBMITTED
IN FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
in
Economics**

by

Chowdhury

SUMITRA CHOWDHURY

Supervisor
Prof. Shri Prakash
NIEPA, New Delhi

Supervisor
Dr. Nirankar Srivastava
NEHU, Shillong

TO



**NORTH-EASTERN HILL UNIVERSITY
SHILLONG
MEGHALAYA (INDIA)
JUNE, 1994**

CHAPTER-I

INTRODUCTION

1.1 Nature of the Problem:

Prices constitute one of the most crucial variables in a modern economic system. Levels of prices have a pivotal role in transforming entire economic phenomena thereby transforming economic structure itself. Economists have been offering theories and models for the analysis of movements, behaviour and determinants of prices under various contexts in order to formulate proper theories and to guide and facilitate the task of policy making. The price theory has evolved over a very long period and has passed through a chain of modifications and transformations in the course of development of economic analysis, prompted by the emergence of newer and newer forms of market structures and newer and different types of goods and services in real life. Studies relating to prices may be classified broadly under two groups:

- (i) those concerned with individual prices; and
- (ii) those concerned with aggregate price level.

Determination of prices of individual commodities is studied under micro economic theory of the firm, whereas the magnitude and direction of aggregate price level

are studied under macro theory of inflation. However, any micro system is only a part of greater macro system. Conversely, any macro system being an aggregate of micro systems, may not behave independently of its constituent parts.

A very brief resume of the development of economic thoughts relating to the theory of the firm reveals that the bulk of analytic literature on the theories of the firm has traditionally been devoted to the two forms of market structure: pure competition and pure monopoly. But economic development in general and industrial development in particular brought into existence the market forms which conform neither to pure competition nor to pure monopoly. They are mixed and mongrel type. This divergence between theory and empirical facts prompted J. Robinson (1954), Chamberlin (1950), and Triffin (1949) to put forward such new theories as are referred to as price theory of monopolistic competition and imperfect competition. It is universally agreed that their work constitutes a cohesive theory of the firm. Rapid technological development made second Industrial Revolution feasible. The technological feasibility and economic viability dictated the adoption of bigger and bigger scales of operation both in the industrial and commercial fields. This has tended to reduce progressively the number of

firms required to cater to ever increasing market size. This has given rise to new market forms which have come to be known as duopolistic and oligopolistic competition. Initially, an extension of classical duopoly model has been found adequate to deal with the analysis of such market structures. But further and further differentiation between varying forms of market structure has given rise to newer and newer price theories based on oligopolistic market form. Kinky demand analysis, price-leadership, mark-up principle etc. are some of the important developments in this field. The scope has further been extended by the contributions of economists like Sylos Labini (1962), Means (1972), Pashigian (1968) and Bhagwati (1970). An attempt has been made to generalise the varied price theories under a general rubric name of cost-pricing, average cost pricing, full cost pricing or mark-up principle.

The war time conditions necessitated imposition of controls and regulations even in the most liberal societies of the West while the Socialist countries of the East developed comprehensive tools of planning to cope up with the problems of development. This paved the way for the development of the theory of the administered prices. Contributions of the economists like Lange, Lerner (1963) and Means (1972) may be mentioned

as important in the evolution of this strand of price theory. Under these conditions, prices were not left to be shaped and determined by market forces. The controlled prices are generally developed by an executive fiat or an administrative order. They do not fluctuate in response to the changes in conditions of demand *per se*. These prices change only when public authority decides to revise them. Such prices are, therefore, referred as administered prices. The term 'administered prices' was first used by Means (1935) to represent those prices which do not change in response to change in demand and are associated with monopolistic markets. Contributions of Domberger (1983) and Andrews (1966) may also be mentioned.

The entire post Second World War period has been marked by the persistence of inflationary pressures almost throughout the World economy. Surprisingly, the recessionary phases have also been emerging periodically with almost monotonic regularity in certain sectors of the economy. This is at variance with the postulates of the theory of trade cycles according to which inflation and recession emerge alternatively in different phases of the cycle. The problem has been further accentuated by the oil crisis of early 1970s. This new empirical phenomenon does not fit well into any existing theoretical framework, be it classical, neo-classi-

cal, Keynesian, neo-Keynesian or neo-monetarist. All failed to grapple with this new empirical reality. This has generated an urgent need to develop the price theory which is capable of explaining the differential behaviour of various sectoral prices in an economy. Several efforts have been made in this direction. Hicksian (1965) framework of flex and fix-prices, postulating that flex prices are determined by the forces of demand and supply and fix prices depend upon cost of production, has been found appropriate for telescoping the differential behavioural traits of the sectoral prices, whereas input-output analysis has been found to be an appropriate methodological tool for the study of fix-prices (Mathur, 1986a, 1986b; Prakash 1981a; 1981b, 1986). Notable progress has been made in this direction with respect to analytical sophistication and methodological diversities.

The present work is an attempt towards further enrichment of such theoretical framework of price behaviour to arrive at a more precise explanatory model and ultimately relate the theoretical issues of differential sectoral price behaviour to the empirical facts of pricing by Indian industries.

However, Indian industries have undergone enormous structural change since independence. At independence, industry was clearly dominated by the oldest industry, textiles, which alone accounted for approximately 53 per cent of total industrial output in 1951. By 1970, its weight had fallen substantially to 21.5 per cent. The industries which have grown the fastest have been the modern industries in the basic and capital goods sector, such as chemicals and engineering. These have replaced the traditional consumer goods industries as the leading sector. The changing structure of the industry has contributed to the high degree of concentration of industry. The Report of the Monopolies Enquiry Commission, New Delhi, 1965, identifies chemicals as one of the highly concentrated industries and general engineering to be a medium concentrated industry group (1). The measure of concentration used is the share of top four enterprises in total output. A high degree of concentration refers to this share to be more than 75 per cent, a medium concentration to be 50 to 75 per cent and low concentration to be below 50 per cent. Concentration across product groups also reveals that concentration has been highest in the newer industries like chemicals, machinery and metal products (2). Besides, a dominant feature of industrial concentration in India has been the institution of managing houses each of which controls a large number of firms. Thus

the top ten business groups controlled some 876 firms in 1958 (Hazari, 1967). The same group controlling more than one firm in an industry indicates the existence of monopoly power especially in the highly concentrated industry groups. These characteristics are the indicators of oligopolistic industrial structure of Indian industries.

The present study aims at synthesising the oligopolistic behaviour of highly concentrated chemicals and machinery industries of India with the Hicksian fix-price hypothesis in the context of temporal behaviour of general price level and manufacturing price level, delineating the economic environment of inflationary pressures and recessionary phases, on the one hand, and the theoretical framework furnished by various theories of pricing by the firms, on the other.

1.2 Objectives of the Study

The basic objectives of the study are:

- (i) to examine the inter-relations between temporal movement of prices of chemical and machinery industries and the movements of overall manufacturing prices and general prices. However, in an economy where well over a third

of GDP still originates in agriculture, linkages between agriculture and industry and the influence of agricultural performance on the economy generally are very strong. Hence, analysis of temporal movement of manufacturing prices is required to be supplemented by movement of agricultural prices as well;

- (ii) to examine the responsiveness of prices to cost in chemical and machinery industries;
- (iii) to examine the behaviour of individual factors of changes in cost and their impact upon price and profitability. These factors include changes in material cost, technology, wage cost and interest cost; and
- (iv) to examine the viability of the firms belonging to the two selected industry groups in the context of changing cost-price structure.

1.3 Hypotheses

The following hypotheses have been set up in empirically testable forms:

- (i) Agricultural prices, which are flex in nature,

generate the inflationary pressure in the Indian Economy that ultimately percolate to the prices of manufactures and to the general prices;

- (ii) Movements of chemical and machinery goods prices follow similar patterns as general prices of manufacturing. This will apply if the market structures are the same which need not necessarily be the case. This may, therefore, be treated as the null hypothesis.

Alternatively, it is hypothesised that the market structure is oligopolistic where price formation process in chemical and machinery industries approximates fix price process. Thus, level of cost determines level of price and change in cost determines change in price.

1.4 Chapter Scheme

Given the above objectives and hypotheses, the present study has been hiererchically designed at the following four levels:

- (a) at the macro level of the economy as a whole;
- (b) at the macro sectoral level of agriculture and manufacturing;
- (c) at the level of the industries under manufacturing sector; and

(d) at the level of the firms belonging to the selected industry groups.

The chapterisation of the thesis is as follows:

Chapter II gives a brief review of the literature relating to studies on cost-based prices with special reference to Hicksian fix-price hypothesis.

Chapter III discusses the movement of prices and output in chemical and machinery industries in the context of temporal movement of overall manufacturing prices and general inflationary pressures in the economy. In this chapter, attempt has also been made to apply time series model to analyse the movement of general price, agricultural price and manufacturing price and to discover the inherent lead-lag structure of movement between these price series.

In Chapter IV, Hicksian fix-price hypothesis has been tested empirically with Indian data by making use of the input-output model.

Chapter V is an attempt to measure the extent of technological changes in chemical and machinery industries of India and to analyse the impact of such technological changes on cost and profitability of the selected industry groups.

Chapter VI analyses the movement of wage rates and the impact of such movement of changing wage costs on overall cost of production of the chemical and machinery industries.

Chapter VII discusses the pricing decisions of the companies belonging to the chosen industry groups.

Chapter VIII summarises the major findings and conclusions.

Notes, References, Appendices, Statistical Tables and Graphs relevant to a particular chapter are reported at the end of the concerned chapter.

Notes

1. For instance, out of 520 chemical products enquired into by the Monopolies Enquiries Commission, 496 were produced by three firms whereas out of 415 products belonging to machinery and engineering equipment, 368 were found to be produced by three firms.

2. The other highly concentrated industries as per this report, are paper and iron and steel industries.

References

Andrews, P.W.S. (1966), *On Competition in Economic Theory*, McMillan, London.

Bhagwati, J.N. (1970), *Oligopoly Theory, Entry Prevention and Growth*, Oxford Economic Papers.

Chamberlin, E.H. (1950), *Theory of Monopolistic Competition*, Harvard University Press, Cambridge.

Domberger, S. (1963), *Industrial Structure, Pricing and Inflation*, Martin Robertson & Co. Ltd., Oxford.

Hazari, R.K. (1967), *The Structure of Corporate Sector*, Second Edition, Bombay.

Hicks, J.R. (1965), *Capital and Growth*, Clarendon Press, Oxford.

CHAPTER VIII

CONCLUSIONS

The major findings from the time series analysis of prices at the macro level are:

i) Indian economy has been inflicted by inflationary pressures.

ii) Out of the monetary factors, namely, deficit financing and money supply, deficit financing has not been found to be the cause of inflationary pressures in India. Although both money supply (M3) and General prices (WPI) have been found to be moving in the same direction from both sign-test and regression estimates, the cause and effect relationship between these two variables have not been taken to be certain in view of the facts that

(a) sign test is a non-parametric test which shows only change in direction and not relationship;

(b) regression results conforming the covariation of any two or more variables need not necessarily imply the existence of causal relationship. Besides, regression results are always tentative as change in data set and availability of additional observations

may lead to altogether different results. Moreover, any given results furnished by regression may be compatible with more than one theoretic approach;

(c) in a rapidly growing economy, like the Indian one, where all the core variables have been increasing consistently, rise in money supply and general prices through time is almost inevitable.

iii) In view of (i) and (ii) above, attempt has been made to discern alternative theory of inflation to understand the genesis of inflation by examining the long time series data on general prices, agricultural prices and manufacturing prices covering a period of 131 years. The major findings from this set of analyses are:

- a) exponential trend fits the general prices best whereas quadratic trends fit better in cases of agricultural prices and manufacturing prices.
- b) an examination of the year to year percentage changes in all the three sets of prices (i.e., general price, agricultural price and manufacturing price) reveal that the movements in general prices have been dominated by the direction and magnitudes of

the movements of agricultural prices rather than by the manufacturing prices.

- c) the distributed lagged model applied to general prices and agricultural prices indicates the lead-lag pattern of agricultural prices and general prices.
- iv) Indian price movement conforms to spectral shape as discovered by Granger. This implies that events affecting the prices in the long run are more decisive determinant of inflation rather than the events affecting prices in the short run.
- v) Spectral densities of manufacturing prices moved *together with spectral densities of general* prices, whereas spectral densities of agricultural price remained higher throughout. This implies that agricultural price lead the movement of general price in India.
- vi) Inflationary pressure is more intense in agriculture than in manufacturing.
- vii) Production performances of chemical and machinery industries have been above the average performance of the economy in general and manufacturing sector, in particular. Prices of these industries' products have not increased due to short-fall in supply rather the prices have

increased due to cost-push effects.

To apply the Hicksian Fix-Price theory to Indian industries, cost-based prices of chemical and machinery sectors have been estimated by using input-output model. Observed prices of the same sectors have been calculated as the weighted average of prices of individual products derived from the quantities and money values of products and by-products reported in Annual Survey of Industries. The weights have been assigned according to the share of each product to total output of the industry/sector. The major findings from this part of the analysis are:

1. The elements of the solution vector P , that is, sectoral cost-based prices have been found to be positive which conforms to the technological feasibility of all the sectors.
2. Hicksian fix-price hypothesis has been tested by comparison of the estimated cost-based prices with the calculated observed prices. The differences between these cost-based prices and observed prices have been called as profit margins. Technological feasibility of the sectors does not ensure economic viability. This is evident from the fact that six out of nine sectors in 1968-69

and one each out of nine sectors in 1973-74 and 1978-79 have been found to be economically non-viable as indicated by the corresponding negative profit margins, even though these sectors were technologically feasible. Thus, these non-viable sectors do not conform to the theoretical postulate that historically given mark-up rate should be $0 < m < \delta$. The question, therefore, arose whether prices of these sectors conform to fix-price hypothesis. But an analysis of the behaviour of costs and prices of the nine sectors under consideration show that absolute values of costs and prices of six sectors during 1968-69 to 1973-74, of seven sectors in 1973-74 to 1978-79 and during 1978-79 to 1983-84 have recorded increase both in costs and prices indicating responsiveness of prices to costs although the changes in prices to costs have not been proportional. The discrepancies between costs and prices have rendered certain sectors economically non-viable at some point of time, but such non-viability were only temporary aberrations as the industries have been found to have gained viability in the next period.

3. In order to test the fix-price hypothesis, behaviour of costs and prices have been analysed in more details.

Cost-based prices have been found to be different at different points of time for the same sector.

4. In 1973-74, five out of six non-viable sectors of 1968-69 have become viable. This has been possible due to the combined effects of the following reasons:-

- i) Less efficient firms have left the industry,
- ii) Existing firms have expanded their scale of operation and/or introduced new products and new technology.
- iii) The existing firms have increased their prices at rates more than warranted either by cost or by general inflationary pressure thereby taking advantage of their monopolistic power to control and regulate prices.

For analysing the impact of technological changes on cost, first, attempt has been made to fill-up the gap in the empirical measurement of technological changes by using input-output model. The nominal input coefficients have been decomposed into

real-coefficients and price relatives by using the decomposition model developed for the purpose. An input-output model has been formulated for measuring the effect of technological changes on costs and profitability of industries and the model has been tested empirically.

On the basis of empirical results, the following conclusions have been drawn :

- (i) Real input-coefficients are significantly different from nominal input coefficients, implying that the prices have a significant role in the temporal changes of the nominal input-coefficients;
- (ii) Real input coefficients have been found to differ significantly between different time periods, implying that the significant technological changes had taken place from one period to another. This also implies that the adjusting of the input-coefficients only for price changes, as has been the practice, does not furnish the appropriate estimates of the true coefficients. It is thus desirable that the technological changes should be taken into account explicitly.

- (iii) The weighted average of sectoral input prices has been found to be higher than the corresponding output prices in 7 sectors in 1968-69, in 4 sectors each in 1973-74 and 1978-79; and in 6 sectors in 1983-84, implying that the costs of these sectors have been driven up due to high input-prices. The annual compound growth rates of output prices, costs and input-prices also support this argument, thereby leading to the inference that cost based prices are high because these are high and the cost and price inter-relations move in a temporally circular hierarchy.
- (iv) Results of the decomposition of nominal input coefficients into real coefficients and price relatives show that
- (a) the sum of the source wise changes equal overall changes, validating the accounting identity as the conceptual base and the method of decomposition on which the model has been based;
 - (b) share of price changes has dominated technological changes in overall change in

nominal input-coefficients in 3 out of 4 chemical sectors and in 4 out of 5 machinery sectors during the period from 1968-69 to 1973-74. The changes in technology and prices have moved in tandem. During the period from 1973-74 to 1978-79, in 3 out of 4 chemical sectors and 3 out of 5 machinery sectors the share of technological changes dominated price changes, implying that there had been significant technological changes in these sectors during this period. During the period from 1978-79 to 1983-84, again in 3 out of 4 chemical sectors and in all the five machinery sectors, share of price changes dominated the technological changes. These findings imply that neither the sectoral inflationary pressures nor the technological changes are distributed evenly over time or sectors. The pace of technological changes may also decelerate or accelerate through time, depending upon pace and nature of technological changes in the preceding period(s). These results warrant that while updating input-coefficients, both technological changes and price changes should ideally be taken into account.

(v) Measuring the effects of technological changes on costs and profitability reveal that the cost increases along with technological changes. In certain sectors, change in technology have been found to be raising profit margins, whereas in others, changes in technology have resulted in the lowering of the profit margins. The sectors in which profit margins have increased with new technology, the choice of technology must have been guided by the considerations of efficiency, productivity and cost effectiveness, as well as market potential to bear the higher cost of production whereas sectors in which profit margins have declined with change in technology, the choice of technology has been guided more by diversification of product-mix, upgradation of technological base of production and the introduction of new product designs to satisfy customers preferences rather than by considerations of productivity, efficiency and cost.

(vi) Cost-based prices of 1983-84 have been calculated with alternative technologies of 1968-69, 1973-74, and 1978-79 to analyse the viability and non-viability of the vintage technologies. 1968-69 technologies would have been viable in 8 out of 9 industry groups in 1983-84; 1973-74 and 1978-79 technologies would have been viable in 7 out of 9 industry groups in 1983-84 provided that the observed price structure remained operative. However, none of the old technologies would have been viable in case of Industrial Machinery for food and textiles in 1983-84.

The empirical results to analyse the impact of changes in wages on cost lead to the following conclusions :

- (i) Both MWI and CPI in India have increased exponentially conforming to the fact that both these variables have tended to rise consistently through time.
- (ii) Money wages rise as the cost of living rises, but the rate of increase in money wages is lower than the rate of increase in the cost of living. Consequently, the real wages decline and average living standard

deteriorates. However, increase in money wages has actually been higher than the increase in the cost of living in India during the decades of fifties and sixties whereas cost of living index increased more rapidly than money wages during seventies and eighties. Thus, the results conform to the proposition that the process of forcing down the real wage by employers to take advantage of the "money illusion" has been in operation in India since seventies.

(iii) There is a relationship between nominal wages and the cost of living. The regression results show that 107 per cent increase in CPI in the previous years leads to 100 per cent increase in nominal wages in the current year.

(iv) Decomposition of the growth of money wages into its components shows that change in CPI accounted for the major proportion of change in nominal wages in India.

(v) Increase in nominal wages in response to increase in cost of living does not guarantee the increase in real wages. Real wages will

increase only when nominal wages are increased at a higher rate than the CPI. Trade Unions' demand for increase in real wages will be conceded by employers only if labour productivity increases.

- (vi) However, labour productivity has not been found to be the sole determinant of real wages. Productivity of the current period together with the preceding years real wages determine the real wages in the current period.
- (vii) There are also empirical evidence to support the inference that real wages are determined by productivity via profitability.
- (viii) There is some empirical evidence to support the hypothesis that changes in wage rates lead to changes in wage costs. However, in certain years out of the long time period of 1950-51 to 1988-89, wage cost has declined even when wage rates increased. This has been possible due to increase in labour productivity on the one hand and change in production technology as indicated by decline in labour capital ratio, on the other.

Technological upgradation has resulted in the substitution of capital for labour that lead to the reduction in labour required per unit of output and per unit of capital invested.

(ix) Decline in wage cost has not resulted in decline in overall cost of production. This is due to the fact that wage cost constitutes only 11 to 18 per cent of the overall cost of production in Indian manufacturing industries whereas the remaining 82 to 89 per cent is accounted by material costs and other costs including fuel costs, cost of packaging etc. which have increased thereby increasing the overall cost of production. It implies that the improvements in labour productivity resulting from the induction of new technology need not necessarily lead to decline in cost, the rationale of liberalisation so ardently advanced by its advocates.

(x) An examination of the wage rates in chemical and machinery sectors reveals that wages paid in these sectors are generally higher than average uniform wage rate that exists in the

economy. The existing wage rates in other sectors may also be inferred to be higher or lower than the uniform rate. Such differentials in sectoral wage rates give rise to over estimation/under estimation of cost based prices from input-output model. The degree of divergence of sectoral wage rate will show either the degree of imperfection in the labour market or the divergence in occupational pattern, skill component and education and training, components of the employees.

- (xi) The impact of changes in wage rate on cost when worked out in input output framework reveals that cost of production increases with increase in wage rates provided technology remains unchanged.

Findings regarding pricing decisions of the firms based on primary survey are as follows:

- i) Various companies have different objectives even when they belong to the same industry group;
- ii) Most of the companies aim at expansion of their production capacity but due to

different reasons, some wishes to realise export target, some others want to retain market share. Although the companies wish to realise maximum profit goal, but their maximisation of profit is subject to the feasibility constraint, that is, maximisation of profit is not desired to be achieved at the cost of declining market share or at the risk of survival;

- iii) The regression equation to test the responsiveness of prices to changes in cost when fitted to the company level data conforms that prices are responsive to changes in costs, although the extent of responsiveness are different for companies belonging to different industries. For some, the cost elasticity of price is more than unity, for others it is equal to or less than unity. The industries for which cost elasticity is less than unity implies that a part of overall increase in cost is absorbed by the companies themselves rather than shifting the whole increase in cost to the customers and this must have resulted in reduction of their profit margin/mark-up rate. Thus, these companies must have

preferred to lower their profit margins than losing market share. On the whole, however, from the regression results as well as from the survey it follows that we have empirical evidence at the company level as well to support the hypothesis that the prices of chemical and machinery industries behave as fix-prices.