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PRICE INERTIA AND INFLATION: EVIDENCE AND THEORETICAL RATIONALE

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ABSTRACT

In this paper we look at some empirical evidence of and theoretical rationale for price inflexibility in the face of a decrease in short run demand in the Western-type industrialized economies. The empirical evidence suggests that price sluggishness is pervasive but varies across markets, industries and countries. There are different reasons for the price inertia. The response of firms to uncertainty, the cost of adjusting prices, the contents of the long-term contracts in the goods and input markets, the extent and variability of excess demand may differ among firms and industries. The structure of the industry, the degree of heterogeneity of the products in a market, the network of input-output relationship among industries, the nature of international competition, the process of forming expectations about the future,shocks from monetary and fiscal policies and input price shocks, all interact and create the ever changing environment of the firms. In these changing circumstances there are incentives for prices to be sluggish and thus arises the dilemma of achieving price stability at a high cost of unemployment. The ability of governments to achieve stable prices is probably endogenous in the system and may depend on a threshhold rate of inflation. A number of policy options are discussed to address the issue of price inertia which would reduce the adjustment burden of anti-inflationary policies.

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Introduction

The phenomenon of price insensitivity to changes in demand in the advanced Western economies has been a subject of considerable discussion among macro-economists and policy makers. In recent years prices have not only been rigid downward but even have risen in the face of slack demand. Short-run inflexibility of prices is critical for the success of fiscal and monetary stabilization policies and ability of the economic systems to accommodate external shocks. The question is what are the causes of price inflexibility and is it consistent with private maximization principles. How the dynamic interactions among various stages and types of economic activity lead to price stickiness of the aggregate price level?

The debate on aggregate price adjustment has been joined by two schools of thought: the neo-Keynesian approach which assumes that markets do not clear because of institutional and informational arrangements and the "new classical" equilibrium approach to business cycle which postulates market clearance and instantaneous prices adjustment in response to changes in nominal demand. The empirical evidence, as shown by Gordon [1982a] and others is that prices are neither perfectly fixed nor perfectly flexibile; they vary over time and across industries, markets, and countries. Neither of the two approaches seem as of yet to provide a consistent explanation of this empirical finding. This has led to a search for developing the micro foundations for price rigidity from an optimization viewpoint and models which explicitly take account of the structure of markets and input-output relationships in the economy. As of yet there is no general consensus

model available to explain the observed degree and pervasiveness of price inflexibility.

In this paper our purpose is to sketch some illustrative empirical findings on price adjustment at the aggregate and industry levels in some of the Western industrialized economies and to discuss some of the micro economic models of price adjustment that have been proposed. The second objective of the paper is to examine the relationship of market structure and pricing behavior and assemble some of the evidence on differential price behavior in competitive and oligopolistic markets. The third issue considered is how these differential price behaviors may lead to the price adjustment observed at the aggregate economy level. The paper is concluded with a few final remarks and policy suggestions.

I. The Extent and Degree of Price Inflexibility

The empirical evidence on the question of price vs. output flexibility has been quite extensive. The evidence comes partly from macro econometric studies, survey of transactions in different markets and studies of disaggregated price series. We shall briefly discuss each of these type of evidence before examining some of the theoretical rationale provided for the phenomenon of price inertia in the context of profit maximizing models.

1. Evidence from Macro Price Models

R. J. Gordon [1982a] has been one of the leading persons in the U.S. who has addressed empirically the question of price inertia in aggregate price level. His results indicate that nominal GNP has been divided consistently over the last 90 years of U.S. history about two thirds taking

the form of output changes and the remaining one third the form of price changes; the structure of price expectations has changed some time before the World War II from a regressive to an extrapolative form possibly due to the recognition of the stabilizing role of government policies and the emergence of overlapping wage contracts in the U.S. However, when the experience of the U.S. economy is compared to that of Japan and the U.K., Gordon finds that the wage and prices are more flexible in the latter countries. The degree of price inflexibility therefore varies among countries and overtime. Nonetheless, the evidence of price inertia particularly in the postwar U.S. economy suggests a sluggish response of prices to restrictive demand policies and the resulting high unemployment, thus constituting a dilemma for policy makers.

Evidence of price inflexibility in the postwar U.S. economy and the European economies has been reported by other studies as well. Otto Eckstein and G. Fromm [1968] using U.S. annual data found that both prices and outputs react within three to six months to changes in costs and demand. George Hay [1970] found for two U.S. industries that a temporary increase in demand caused a small increase in price but a large increase in output. de Minel [1974] using aggregate data for the U.S. reached similar conclusions. The evidence provided for the nineteen OECD countries by D. Grubb, R. Jackman and R. Layard [1982] suggests different degrees of price and wage inertia in these countries over the postwar period. Coutts, Godley and Nordhaus [1978] using British data for several industries reached the conclusion that prices are mainly determined by costs and affected little by changes in demand. Studies using time series data for

Germany found that firms keep their prices at their planned level and adjust their outputs when demand changes [Kawasaki, McMillan and Zimmerman [1983]]. The econometric results obtained by Nadiri and Gupta [1977] and Eckstein-Wyss [1977] for different U.S. manufacturing industries provides evidence of price inertia at the industry level. These results indicate that effects of demand changes on prices are small in most of the industries considered and there is evidence of considerable inertia in price adjustments. The degree of demand effect and price adjustment, however, varies among industries.

The studies differ in their coverage, level of aggregation and span of time. However, they all seem to point to the slow adjustment of prices and more rapid adjustment of outputs when the demand level changes in the short run. But a potential shortcoming of all these studies is that they are based not on transaction but list prices. George Stigler and J. Kindahl [1970] have argued that the relevant series is prices at which buyers and sellers transact a sale. They have indicated based on their study that transaction prices are highly variable and the price stickiness reported above may be an illusion. However, as Weiss [1977] has argued persuasively that changes in Stigler-Kindahl price series and BLS data (which is often used in studies mentioned above) reflect each other and therefore the Stigler-Kendall conclusion is not valid. Further new econometric studies using transaction prices indicate that firms in their immediate response to disequilibrium, are more likely to react immediately with an output change than a price change.

2. Survey of Market Transactions

Another source of evidence of whether prices are inflexible is provided in an interesting study by Carlton [1979]. Tables 1 and 2 provide evidence on the pattern of transactions prices in a sample of businesses during a relatively non-inflationary period 1957-66. Table 1 lists by product the average duration of price inflexibility in months and the standard deviation of duration. The results suggest several important points: For many transactions between individual buyers and sellers, price once set tends to remain unchanged for a substantial period of time. This suggests that quantity adjustment and not prices may be the mechanism used to allocate some goods when supply or demand changes. Since the standard deviation of length of price rigidity is quite high we can infer that a wide variety of contracts have differing price flexibility; i.e., some contracts with very flexible prices while others with very inflexible prices for the same broad commodity group. Finally, there are very large differences across industries in degree of price inflexibility.

The results in table 2 show the frequency of price rigidity by the duration of contract i.e., annual and monthly. It seems that the contracting structure for each product is not only different but there are many annual contracts whose prices change well before one year is elapsed while there are many monthly contracts whose prices often do not change for one year. Thus the contract terms seem to be very flexible and adaptable to changes in market condition. Perhaps ongoing relations between buyer and seller account for this behavior. Also the monthly contract prices vary more frequently than those for the annual contracts which implies that

there are contracts whose prices remain unchanged at the same time that demand and supply forces are changing other contract prices for the same commodity group.

From these results it is likely to draw the conjecture that markets resemble liquid markets with flexible prices performing the allocative role and markets which resemble illiquid markets with fixed prices and quantity allocations performing the allocative role. Nonferrous metal, petroleum and plywood are likely to have submarkets that are highly liquid while steel, paper and chemicals seem likely to have submarkets that are highly illiquid. For some goods highly liquid and illiquid submarkets may exist as well. These observations suggest there are different degrees of price inflexibility in different markets and for different products which are likely to change over time and among different industries.

An econometric study using monthly transaction prices and output changes of individual firms in various German industries substantiates the results noted above and confirms the hypothesis of differentiated behavior in different markets. Kawasaki et al [1982] develop a dynamic disequilibrium model taking account of inventories and unfilled orders in determining the adjustment path of prices and output in response to changes in demand. Their results show that both prices and output flexibility vary markedly across industries reflecting some of differences among industries noted above. They show that prices are in the short-run inflexible in industries such as stone and clay machinery; electrical equipment, iron, tin and other products, glass and products and clothing. While nonferrous metals, textiles, plastic and products exhibit short-run price flexibility.

The results also indicate that each firm changes its output whenever there is an inventory or unfilled order disequilibrium but changes its price only when disequilibrium persists long enough to reflect permanent changes in demand or costs. However, there is no evidence of asymmetry in their price behavior i.e., prices are no less flexible downwards than upward. When firms face high level of inventories, they are just as likely to cut their prices as they are to raise their prices when inventories are too low.

3. Evidence from Disaggregated Prices Studies

The most thorough study of behavior of prices during periods of recession has been published by Cagan [1975]. Using approximately 1100 BLS wholesale price series for 1947-70, he demonstrated that in each succeeding recession since World War II there was a tendency for a smaller average decline in prices. The pattern is especially clear when the rate of price change in a recession is regarded as a decline from the rate of price increase in the immediately preceding expansion. The important question is whether the distribution of recession rates of price change differs between classes of industries with different levels of concentration ratio. Cagan's results are unequivocal for all recessions except the 1969-70 period. The average decrease in the rate of price change has been greater for less concentrated industries. In the 1969-70 recession the average price of the high concentration group increased less than the mean price of the intermediate group, but both average rates increased, whereas the average rate for the least concentrated group declined relatively to the preceding expansion.

There are two principal points to be noted in connection with Cagan's study:

1) The responsiveness of all prices to recessions declined during the post World War II period.

2) The prices in less concentrated industries were more responsive than the prices in more concentrated industries.

The evidence seems to favor the view that all prices have become less responsive to decline in aggregate demand. Also Wachtel and Adelsheim's [1977] results imply that, even if cost changes are taken into account, the conclusion reached by Cagan on the growing downward inflexibility of prices in successive recessions is reaffirmed.

An examination of the empirical evidence of other disaggregated studies suggest several important conclusions:

1. Factor costs such as wage rates and material prices are the dominant determinants of industry price changes. The importance of factor costs is overwhelmingly supported by cross-sectional and time-series studies. This finding is consistent with studies of aggregate price behavior.

2. Prices are generally much less sensitive to demand changes than to cost changes.

3. Pricing behavior is related to the level of industry concentration. Although costs are important determinants of prices in all industries, the influence of demand varies considerably among industries. Short-run demand changes have an effect on price changes in the competitive industries. In contrast, long-run trend of aggregate demand influences prices in more concentrated industries. This implies that short-run decline in demand can be expected to have minimal effect on many industry prices. This finding of disaggregate studies may explain why the demand variable has been often found insignificant in aggregate price equations.

4. Prices are often perversely affected by a decline in demand, that is, a type of compensatory pricing behavior seems to have occurred in some industries.

5. An important conclusion is that the structure of the economy has changed in the 1960's toward domination of costs on prices. This is manifested in the upward shift in the distribution of price changes; there is less downward flexibility of prices in recessions. In the most recent recessions wholesale prices have not generally fallen.

From the evidence presented here it seems that prices are subject to sluggish adjustment in the postwar period. However, the degree and pervasiveness of price adjustment vary considerably over time, markets,

industries and countries. The response to a change in demand in the short-run, however, is mainly to adjust output and to a much smaller extent prices. The questions that arise are: Why such asymmetry in response of prices and quantitities in majority of industries? Whether the market structure such as the degree of concentration has some relationship with price inflexibility? And how the various degrees of price inflexibility in different markets, for whatever reason, may led to aggregate price level inflexibility? These are some of the questions we shall attempt to address below.

Section II. The Theoretical Rationale for Price Inflexibility

There are varieties of theoretical rationale for firms to be reluctant to change their prices in face of a short term change in demand. If firms are interested in long term profits they may equate their long term marginal revenue to long term marginal cost and then prices may become invarient to changes in the short run. If firms are producing multiple output they will face the problem of jointly setting prices for all of their product. The cost associated with price adjustments may induce the firms to have a stable price policy even if the demand for the individual product fluctuates. Firms may be interested in goals other than profit maximization such as increasing market share, stable profit margin or target rate of return on investment. In such a case firms may want to change their prices infrequently. It is impossible to present all the theoretical arguments and evidence for why prices are inflexible. We shall discuss some of the main theoretical models put forward to rationalize why price inertia may arise from an optimizing behavior.

1. Industrial Structure and Price Behavior

One of the most important structural features of the Western industrial economies is the difference between individual industries in the extent to which particular markets are dominated by one or a few large sellers. The traditional view has relied on the difference in the discretionary power over the price as the main explanation of the differences in the pricing behavior between oligopolistic and competitive industries. Thus prices in competitive markets are supposed to arise out of interaction between market demand and supply, whereas prices in oligopolistic industries are set by some implicit collusive agreement between few oligopolistic firms dominating the industry.

The notion of differential price behavior in concentrated and unconcentrated industries was first raised by Gardiner Means [1962]. He advanced the "administered price" thesis, i.e., administrative control over prices in markets where there are relatively small numbers of firms results in less price flexibility than is found in more competitive markets: prices in concentrated industries tend to fall less than competitive prices during periods of recession and to rise less than the market determined prices during expansionary periods.

Studies attempting to verify or reject Means' hypothesis have been basically empirical with little theoretical explanation of the process underlying the differential pricing behavior of the concentrated and unconcentrated industries. The usual criticism of the traditional view has centered on the lack of explicit price determination mechanism in both types of industries. In the absence of Walrasian actioneer it is not clear

how prices in the competitive markets are in fact "made" as a result of interaction of supply and demand. On the other hand, theories of oligopolistic pricing have been generally ad-hoc and lack rigorous theoretical foundations [Frydman and Nadiri (1978)]. However, recent studies have clarified to some extent the basic issues involved and has led to a more sophisticated understanding of the possible relationship between industrial structure and pricing behavior.

Phelps and Winter [1970] have developed an atomistic competition made of price behavior. In a significant departure from traditional analysis the authors assume that each atomistic firm is in a position of a transient monopolist and it is a price setter. Due to imperfect and costly information as to the currently set prices, the result will be not one price in the competitive market, but a distribution of prices. Thus, each firm will not lose its customers instantaneously when it raises its price above the average of competitors' prices and will also not attract a substantial number of customers at the instant in which it lowers its prices below the average of market prices. The firm will fix its price according to standard theory of price settings under monopoly conditions with the significant difference that it will have to take explicitly into account the cost of setting the price which is different than the mean industry price. The Phelps-Winter model replaces the fiction of Walrasian actioneer with explicit account of price setting under conditions of atomistic competition. The recent advance in theory of disequilibrium pricing suggested by F. Fisher [1981] and others also substantiates the rationale of inertia or relative inflexibility of prices in the competitive industries.

From the point of view of our discussion the importance of the Phelps-Winter model lies in the apparent blurring of the distinctions between oligopolistic and competitive pricing behavior. The differential pricing behavior is dependent on the degree of response of rivals. What is important to note is the information aspects of price setting that underlie price formation in all markets [Frydman and Nadiri (1978)]. This, however, does not lead to the conclusion that prices in oligopolitic and competitive industries are set in the same way. The crucial difference lies in the likelihood of collusion among firms in a given industry. G. Stigler [1964] has argued that when the number of sellers is lower, the ability to detect price cutters is much stronger and a collusive agreement easier to maintain. This argument provides an essential link between the likelihood of collusion among firms and degree of industry concentration. Recently Phlips [1980] has derived a price rule which links price behavior to the parameters representing market structure, degree of cooperation among firms and the possibility of entry. It is shown that price rigidities can result from an intertemporal optimizing behavior. The optimal path of the firms price rule is obtained from an intertemporal price discrimination model where firms accumulate inventories and the possibility of entry of exist. The industry price equation takes the following form:

$$P = \left(\frac{\delta}{m+\delta}\right) \alpha + \left(\frac{m}{m+\delta}\right) \bar{k} - \left(\frac{\delta m}{m+\delta}\right) \psi \frac{\partial h}{\partial p} \frac{\partial P}{\partial q}$$

where δ reflects the degree of cooperation among firms in the industry, m is the number of firms, α is the slope of the linear industry demand sche-

dule, $\bar{k}$ is the average normalized marginal cost, while $\psi \frac{\partial h}{\partial P} \frac{\partial P}{\partial Q}$ is the average cost (or loss of profit) due to entry. It is likely that the degree of cooperation δ will depend on the degree of concentration, m. Also barrier to entry represented by $\psi \frac{\partial h}{\partial P} \frac{\partial P}{\partial Q}$ should have a positive effect on industry price and the better the cooperation among firms (for given m) the larger δ and the stronger is the negative impact of the threat of entry on price. Other implications of this model are: In more concentrated industries costs increases are less fully transmitted into prices than in less concentrated industries; changes in demand are transmitted more fully into prices in concentrated industries than in more competitive industries; for a given industry structure an increase in industry demand will have smaller impact on prices than an increase in average marginal normalized costs. These are testable hypothesis and Phlips' empirical results for a select group of industries in Belgium, the Netherlands, and France confirm them. Particularly costs turn out to be the dominant factors affecting prices in different catagories of industries and the barrier to entry has a highly significant positive effect on prices.

An important question is to substantiate whether there is a link between the likelihood of collusion among firm and the degree of industry concentration. We noted Stigler's [1964] argument in favor of this propostion. However, to establish its validity, it is important to show whether collusion among firms leads to higher long term profits. Some evidence is provided by the studies of the relationship between con-

centration and profits. Weiss [1974] concludes on the basis of extensive survey of empirical evidence that, "The bulk of the studies show a significant positive effect of concentration of profits or margins." Since implicit cooperation is usually found in concentrated industries, these findings imply that collusion seems to be profitable for cooperating firms.

But how does the process work? Ross and Wachter [1975] provide an explanation for an observation that firms in oligopolistic industries act so as to maintain fixed pricing strategies (although not necessarily or generally fixed prices), which they alter at regular points of time. The interval of time in which the pricing strategy is unchanged is called the planning period. Thus their model is not an explanation of price determination under oligopoly, but it provides an analysis of timing of price changes in concentrated industries. They assume that the firms are denied a possibility of outright collusion and that particular equilibrium industry structure has developed. The implication of this equilibrium is that none of the firms or any coalition of firms, bound by the implicit collusive agreement, views it to be in their interest to alter the equilibrium structure. As the demand and supply conditions of the industry change, in deciding on whether or not to adjust to the new developments, the firm is forced to balance the loss of profits due to inappropriate price structure against the potential profit loss if an attempt to alter prices should lead to a breakdown in the level of oligopoly cooperation.

The significance of Ross-Wachter's model lies in its applicability to a wide variety of market structures. The firms in the competitive industries will repsond continuously to changes in market conditions, since

the atomistic firms find it impossible to collude and therefore will not face the trade off between benefits of collusion and losses due to inappropriate price structure. On the other hand, the firms in oligopolistic industries will move in discrete time intervals. The conclusion regarding competitive firms should be modified, however, to take account of the factors elaborated in the Phelps-Winter model, i.e., informational structure of the market would cause firms in the competitive markets to respond, also in discrete time intervals.

2. Inventory and Price Stickiness

A firm's profit maximizing inventory strategy may also cause the firm to react differently to a change in demand depending on whether the firm perceives the change to be transitory or permanent. The assumption about the demand fluctuation is essential in models which link inventory decisions and price inflexibility. Since demand fluctuates randomly around a given mean, the firms respond to these fluctuations by changing their level of inventories because they cannot instantaneously adjust their prices or outputs. The inventory change is followed in the next period by a change in the rate of production to restore their equilibrium inventory stocks while leaving their prices unchanged. Kawasaki et al [1983] constructs a model of dynamic profit maximization under uncertainty and imperfect competition to derive an analogue of repeated Cournot equilibrium framework. Using such analytical framework they demonstrate that firms change their output in response to any demand change but change their prices in response to only permanent demand changes. A. Blinder [1982] also reaches similar

conclusions though using a different analytical framework. That is, both prices and output respond less to a transitory demand shock than to a permanent demand change and when output becomes more "inventorable." Prices will become sticky when inventories can be stored without much cost and when the demand shocks are transitory. In both of these models the existence of inventories reduces the flexibility of prices in all states of demand and in both directions. In fact, the empiricial results reported by Kawasaki et al [1982] as was noted earlier suggest no evidence of asymmetrical response of prices, i.e., prices are less flexible downwards than upwards.

Note that these models provide an explanation of the relative price inflexibility and not sluggish absolute prices. However, changes in relative prices can affect the rate of inflation [see Fischer [1982]]. The models described here can be modified to relate firm price decision to their expectations about aggregate price expectations or demand fluctuation. If the mean of the firm demand functions stated above shifts, a new equilibrium emerges with each firm having a new target inventory stock and perhaps a new price. This can arise if firms form expectations about future changes in aggregate demand or general price levels and use them as indicators of how the mean of the individual demand functions will shift. This will lead to possibility of linking the sluggishness of relative prices and absolute prices as shown by J. Rotemberg [1982] and R. J. Gordon [1981].

3. Adjustment Costs in Changing Prices

The degree of price inflexbility, in econometric price equations is measured by the coefficient of lagged price variable. The estimates of this coefficient imply that firms incur a cost for not being able to change its price readily. The partial adjustment of prices in these equations are mainly ad-hoc in the same way as the adjustment lags were postulated in econometric investment functions prior to the advent of the cost of adjustment models. If the firms know the costs involved in adjusting their prices in face of a changed demand condition it is logical for them to take these costs into account in their optimization behavior. The adjustment costs for changing prices are due to administrative cost of changing the price lists, etc. and more importantly due to potential unfavorable reaction of consumers to frequent price changes. J. Rotemberg [1982] has developed an interesting equilibrium model of monopolistic price adjustment with cost of adjustment of prices explicitly taken into account. The model is like the Lucas [1972] equilibrium model of business cycle and incorporates the Phelps-Winter type of monopolistic pricing behavior. Firms optimize their objective function taking the prices set by other firms as given; they make the best full use of the current information i.e., they form their expectations rationally. The firms produce differentiated products, they observe their demand and cost functions before setting their prices, they know the prices of their suppliers, the price level and the level of aggregate nominal money balances. The cost to changing prices is assumed to be a function of the square of the price change and the monopolists set their prices optimally given that it is costly to change them.

Rotemberg shows that in the presence of adjustment costs changing prices today will affect tomorrow's profit and the pricing rule for the firm will be the usual partial adjustment equation used in most empirical studies i.e.,

$$P_{it} = \gamma P_{it-1} + (1-\gamma)\ P^*_{it}$$

where P^*_{it} in the expectation formed by firm i of its optimal price; p_i depends on the cost of changing prices, say c; and ρ the discount rate. When c increases price increases i.e., it will take longer for current prices to adjust toward their long run value. The effect of changes in ρ on speed of adjustment is ambiguous; a decrease in ρ makes it relatively cheaper to change prices in the future but it also penalizes the monopolists relatively more for current deviations of actual prices from their long run values.

If each firm picks its own P^*_{it} optimally given the prices charged by other firms and expects its decision not to influence the path of aggregate variables such as the stock of money or the aggregate price level, then Rotemberg shows that the industry equilibrium can be established and an aggregate price equation analogous to the one stated above can be derived, i.e.,

$$P_t = \lambda P_{t-1} + (1-\lambda)\ P^*_t$$

where P^*_t is the price level "desired" at t and λ is the partial adjustment coefficient of aggregate price level. This type of equation is often

used to estimate the aggregate price level [Gordon (1981), Nadiri-Gupta (1977)]. The virtue of Rotemberg's model is that it derives the partial adjustment price equations for both individual and aggregate prices from an optimization model, links the parameters of the aggregate and individual price equations and develops a cost of adjustment model of prices based on rational expectations in which producers are aware of their true trading opportunities and information in aggregate statistics concerning the present is available to them.

4. Uncertainty and Price Inflexibility

Production is essentially a dynamic phenomenon i.e., it takes time and therefore is subject to uncertainty. Firms may take different steps to reduce uncertainty. In a world of dynamic uncertainty firms will perform intertemporal arbitrage. The market variation is met only in part by market adjustment in sales and the remainder is met by the firms internal adjustment in inventory and to a lesser degree in production. In a world of static certainty when the market is purely competitive through price and entry and exit of firms the market adjusts to variation in demand and supply. When the firm faces an uncertain market environment and a multi-period decision horizon, price flexibility may not be a necessary condition for efficient allocation of resources [Wu (1979)]. A stable price will have certain benefits both to the sellers and buyers; it will cut the search cost of buyers of the firm and eliminate the necessity for buyers to accumulate precautionary inventory used to guard against price uncertainty. These factors may encourage buyers to buy more at a given price or pay more

for a given quantity of goods in exchange for reduction in price uncertainty. This could mean a higher demand for sellers. On the other hand, any price cut could be construed in most industries as an attempt to obtain a larger market share which will be resisted by rivals and may lead to lower revenue for the seller.

Another way to mitigate the haphazard results of uncertainty in a world where production takes time is the use of contract [Davidson (1977)]. The wage contract implicit or explicit is the most pervasive agreement in the economy. If it were constantly revised and recontracted, the transaction cost will be so high that it would likely inhibit production in a decentralized market economy. To a lesser degree the same argument applies to other types of costs and products. When contracts are taken into consideration then the past and future of economic activities becomes part of the economic process and provides the element of inertia i.e., the overlapping labor contract as a source of inflexibility of prices. Because if money wages are determined outside the theoretical market system over the forthcoming three year interval, then prices will adjust to money wages rather the converse.

The inflexibility of wages arises from a number of factors. The most widely accepted is based on the behavior of unions where collective bargaining introduces lags in wage response of some industries. In absence of unions firms may want to pay premium wages in order to have a queue of available skilled labor and therefore the firms will not change wages immediately as labor conditions change [Wachter (1976)]. Also firms may desire an ongoing relationship with their labor force, especially if the

jobs are ideosyncratic in nature and require specific skills and training. The wages for these type of jobs will be determined by the internal wage structure and the short-run market forces will be ignored in this situation.

5. Heterogeneity of Markets and Price Inertia

A number of models have been proposed which emphasize the diversity and heterogeneity of different markets as the source of inertia of the aggregate price level. The basic notion is that the economy is composed of a variety of markets with different characteristics and different rules of behavior. Sticky prices may be a rational outcome in certain markets in the economy which in turn may impart the price inertia at the aggregate level. Arthur Okun, W. Nordhaus and R. J. Gordon have discussed various aspects of how models of heterogeneous markets may lead to price inertia at the aggregate level.

The Okun [1981] model is based on a "contract-theoretic" framework and states that in order to economize on transaction costs with one and other, economic agents will trade repeatedly with each other. Wages and price behavior are explained in a search theoretic framework. In markets with heterogeneous products prices tend to be inflexible because information about prices is difficult to obtain and there is a continuing relationship between the buyer and seller. The transactions costs are very high and price stability is in the interest of both parties. In these types of markets called "customer markets" both customers and producers have an interest in stable prices. The customers would like to avoid excessive search cost and are willing to pay a premium to do business with customary

suppliers. Firms have an incentive in stable prices to encourage customers to return using yesterday's prices as a guide. But if permanent changes in demand and costs have accrued and both the customers and firms have this knowledge, prices could change without inducing customers to do comparison shopping. Price stability is considered as a service in Okun's model which is a complete reversal of Means' model of administered prices noted earlier. The auction or what we called liquid markets clears instantaneously and there is no incentive to induce long term contractual arrangements, infrequent price changes and quantity rationing. In markets with homogeneous products information flows rapidly and the market machanism is impersonal.

Nordhaus [1976] elaborates further this line of thinking. The economy can be divided into "auction" and "administered" markets. In the auction markets competitive supply and demand forces prevail and prices are flexible. In the administered markets either buyers or sellers have significant market power and one use of that power has been to restrain price movements. Prices and wages are set in these markets on some principle of "normal pricing" i.e., cyclical fluctuations are largely removed in setting prices and wages. The effect of demand on aggregate price will be fairly weak and there will be an effect from what Nordhaus calls the "momentum effect." Demand changes affect prices through three channels: through the mark up in the administered market prices equation, through unemployment in the wage equation and from "auction" market. The combination of these forces due to nonlinearities are likely to be weak at low levels of demand but high when the economy operates at capacity. The "momentum effect" of

current and past wage and prices in the administered markets of the economy dominates their short term movements. The effect of demand policies will be small in the initial stage but would be spread out over a long period. The third effect comes from the auction prices which may be due to such factors as oil price increase, increases in commodity prices, changes in weather, speculation, etc. If these changes are significant, then as Bruno and Sachs [1982] have shown, input price shocks can affect aggregate prices significantly.

An elaborate model of price behavior is outlined by R. J. Gordon [1981]. No adjustment costs are formally included in the analysis but the emphasis is put on diversity of circumstance facing firms in differnt markets and the cost of communication and coordination through a complex input-output network of relationships among firms. Firms may face diverse sets of circumstances in various markets: they may have distinct technologies, produce heterogeneous products, discover information about changes in their own demand and costs and the aggregate demand and cost changes with different degrees of certainty. The learning capacity of firms are usually not the same [Frydman (1981)] i.e., there may be long lags in formation of expectations [Maccini (1981)]. What emerges in Gordon's model is the crucial role of the local vs. aggregate components of demand and costs i.e., the ratio of the variance of local to the sum of variances of local and aggregate components of demand shift and the ratio of the local to the sum of the local and aggregate components of costs. These ratio's are likely to be zero in periods of war and hyperinflation when there is extreme pressure for prices to change; the variance of the

aggregate components of demand and costs will dominate in such periods and individual prices respond immediately to changes in aggregate demand and costs.

A further extension of the idea that the network of input-output or stages of production matter in pricing behavior of firms has been developed recently by Blanchard [1983]. Some of the simplifying assumptions are that production is instantaneous, all goods are perishable, input supply is an increasing function of its real price, output demand depends positively on real money balances and money is neutral and affects only the level of all prices. Firms choose their relative prices every two periods and their prices depend on current and expected input prices for the next two periods. Assuming rational expectations and uncertainty Blanchard shows that if the firm's price decisions are not completely synchronized the price level will depend on three elements: the actual and expected past input prices, the actual value and past expectations of current input prices and both past and current expectations of input prices. As the number of stages of production increases the dependence of the price level on input prices further in the past and expected in the future. Price level will react less and adjust more slowly to changes in money if real input prices are insensitive to market conditions. Increase in money affects the structure of prices; prices early in the chain of production move more and adjust faster, prices further in the chain move less and adjust more slowly. When a nominal disturbance requires a change in the price level what will likely follow is a change in prices of a complex structure of final goods, intermediate goods and inputs. These adjustments will not be

taken continuously nor in the same manner in different markets or industries. Thus the desynchronization of individual price decision can generate price level inertia observed at the aggregate economy or industry level.

There is some empirical evidence that suggests that the response of prices by stage of process to a change in demand differ substantially. The model of stage of process developed by Popkin [1977] links the movements of crude, intermediate and finished goods components of the WPI with each other and with the CPI. The results of the twenty-one sector price model, when viewed as a whole, suggest that it is in the primary and semi-finished goods industries, rather than in the finished goods producing and distributing sectors, that changes in demand affect the relationship between the output and input prices. The initial response in the finished goods industries is to reduce output and not prices. Cutbacks in orders for materials and supplies placed by these industries are often larger than they would be if prices had been flexible. The fluctuations in output are much larger at the earlier stage than at the latter stage of production and also the ratio of price of output to the weighted price of inputs behave not procyclically in the finished goods sectors while that for the primary and semi finished products it moves procyclically. In response to a cutback of orders from the finished product manufacturers, the prices in the primary product manufacturing industries weaken. Such weakness then feeds forward to final demand prices, with a lag, affecting prices in all finished manufacturing and service sectors. Thus, the amplitude of output and price responses to changes in final demand vary considerably among dif-

ferent stages of production and there is a dynamic relationship among the response pattern through the input-output structure of the economy.

III. Asymmetrical Price Increase

We have noted that not only most prices have become less responsive to decline in aggregate demand but they may also rise in a recession. What can explain this perverse behavior? There are several lines of reasoning for this phenomenon to occur.

Under the conditions of monopoly the traditional theoretical explanation for rigidity of prices in the presence of contraction in demand is based on the difference between short and long run price elasticity of demand. Since the short-run elasticity of demand is less than the long run elasticity, and in many cases must be less than one. It implies that a monopolist considering a price cut to deal with a temporary recession would face a possibly negative marginal revenue compared to marginal revenue it would face in making general price policy. The natural conclusion seems to be that optimal price policy in a recession would often be to hold prices stable or to change them only in response to changes in long-run expectations.

This reasoning has some relevance to the explanation of price inflexibility during recessions of oligopolistic prices. Spence [1976] has suggested the concept of market share equilibrium and showed that there exists the set of market shares having the property that no firm can increase its profits if all others react by maintaining their market share. In this framework market shares serve as basis of strategic interaction

among firms in oligopolistic industry. Suppose now that the fall in industry demand affects proportionately all the firms so they continue to be in the market share equilibrium. It is clear that if industry demand becomes inelastic the firm would not find it profitable to lower their prices given that other firms will react to maintain their market shares. Lowering of the price by individual may be considered by other firms as "competitive" price cutting and lead to the breakdown of implicit collusive agreement and benefits associated with such agreement. Moreover considerable uncertainty will exist as to the true value of industry's price elasticity of demand. Therefore, it is very likely that known benefits of implicit collusion will outweight highly uncertain benefits of contemplated price reduction. On the other hand if costs during the recessions because of "momentum effect" build in past contracts rise, the firm will likely to pass these prices without any danger of retaliation from its competitors. Cost increases are likely to be experienced by all the firms in the oligopolistic industry where firms are likely to follow a normal pricing decision rule with respect to prices of inputs and outputs.

Another rationale for asymmetric pricing behavior is suggested by Kuran [1983]. He argues that prices of monopolistic firms with nonincreasing price elasticity of demand and nonincreasing marginal costs can be relatively more rigid downward than upward. Such firms raise their prices to a greater extent when they expect inflation, than they lower them when they expect equivalent reduction in demand. In response to an increase in price level uncertainty these firms will increase their prices. These results follow from the notion that the monopolist's loss is greater

from charging a price below the monopoly price than the loss from charging above it by a proportionally equivalent amount. A price cut may trigger a reaction from competitors while an increase in prices may not.

To show that relative prices variability can be linked to variation in the rate of inflation require that prices respond asymmetrically to disturbances. If prices behave asymmetricaly in either direction the association between relative prices and rate of inflation can be established and not if prices are equally sticky in recessionary and expansionary phases of the business cycle. Fischer's [1982] results indicate that there is a strong link between unanticipated inflation and relative price variability for both U.S. and Germany. There are weaker links between the variation of relative prices and rate of inflation. Unanticipated inflation was found to affect relative price variability much more than a deflation suggesting support for the asymmetric price response hypothesis.

But why should many firms in the competitive industry raise prices when demand falls? The only conceivable circumstance is the perception of the decrease in the short-run elasticity of demand coupled with increase of marginal costs of firms in the competitive industry. In such a case, if properly perceived by individual firms the proper profit maximizing response is the increase, not decrease in the price [Frydman and Nadiri (1978)]. Since the firm contemplating the price change will be highly uncertain as to the price elasticity of demand for its product but it will be able to observe the increases in its costs, it might decide to increase its price. If all firms perceive the situation in this way the fall in demand will be mostly reflected in the output changes.

The overall conclusion from the above reasoning is that when contraction of demand is accompanied by increases in direct costs the rational response of both competitive and oligopolistic firms might be to raise prices. This phenomenon will be considerably strengthened, if the firms in both oligopolistic and competitive industries expect the contraction in demand to be temporary, while cost increases are perceived to be permanent. It is also clear that due to the element of implicit collusion in oligopolistic industries the increase in prices should be more widely observed in more concentrated industries.

An interesting explanation of this perverse behavior of prices is provided by Cagan [1979]. If the anticipated trend of prices is upward and price changes over the cycle are the cyclical deviations from the trend, then prices will rise in the recession, however, less than the trend. The long trend in prices can be subject to rational expectations. This anticipation factor will be incorporated in contract prices of inputs or some input supplies will be withheld from the market. Thus, the anticipated rise in price trend can limit decline of prices in the recession and may cause prices to rise if the anticipated trend is rising fast enough. But the anticipated price trend will be revised by rational agents depending on the severity and duration of current and past business cycles.

IV. International Competition and Pricing Behavior

In the previous sections we have examined a pricing behavior across industries in the domestic economy. A number of the industries considered produce goods that are sold in the foreign markets. In many industries

foreign firms have a significant share of the domestic markets. Moreover, many industries use inputs that are traded internationally. Therefore, the developments in the world markets, trade patterns and currency fluctuations have a potentially important role in understanding of the pricing adjustment in domestic industries. Unfortunately, no systematic theoretical and empirical analysis of price formation seems to exist for industries producing exportable or import-competing goods. Therefore, the discussion in this section will necesarily be limited to few observations on the possible significance of these issues.

We noted earlier that barriers to entry could play an important role in pricing behavior of firms. Competition in the world market could have the same effect as entry of a competitor in the domestic economy. For example, Wachtel and Adelsheim [1977] have argued that in U.S. automobile industry foreign competition provides an extraordinarily intense competitive check on what had traditionally been a mature oligopoly with routinized pricing behavior. Due to this competition, price increases for domestically produced cars have been restrained and price markups in the automobile industry have declined in recent years.

Even though similar calculations have not been performed for other industries the potentially significant effect of imports can be inferred by noting that between 1960 and 1970 imports increased in high concentration industries by the following percentages: Machinery and transportation equipment - 662 percent; rubber tires and tubes - 876 percent; iron and steel mill products - 352 percent. These developments suggest caution in the use of concentration ratios as a basis for studying price behavior

across industries. In the presence of substantial volume of imports, the concentration ratios might significantly overstate the degree of market power or possibility of implicit price coordination in domestic industries. [Frydman and Nadiri (1978)].

As we noted earlier, material costs are generally very significant in explaining industry price behavior. Since many of raw materials are traded internationally, it is clear that the domestic prices will be strongly affected by the conditions in the world commodity markets. Also, the effect of changes in exchange rate in addition to having an effect on import prices, will have an effect on domestic prices of import competing goods.

Some empirical results are available on the role played by changes in import prices and particularly the recent increase in material prices. Nordhaus and Shoven [1977] have decomposed the rate of inflation of 58 sectors in the U.S. economy during 1972-1974 into its components. They have considered the effect of acceleration in agricultural prices, rise in mining and domestic fuel prices, imports price increase, and increase in labor costs. Several results stand out: First, the contribution of these components vary considerably in different sectors; in some import prices dominate, in a few the rise in agricultural prices stands out, while in some others the labor cost increase seems to be the major component of the sectoral inflation rates; second, about 85% of the inflation was explained by the pass-through of hikes in the commodity prices and wages, suggesting the dominance of the costs in prices behavior; third, there were shifts in the composition of the inflation over the two years 1972-74. In the early

parts of the period wage increase was the major contributory factor to inflation, while prices of agricultural products accounted for two thirds of the inflation in November 1972 to August 1973; imports contributed about 16% to inflation in this period. In the last part of 1973-74 period imports dominated the picture. 36% of total inflation was due to rise in import prices and the price rise of the domestic crude oil and natural gas contributed significantly to inflation in this period.

Grubb et al [1982] explore the causes of stagflation in 19 OECD countries and estimate the contributrion of slowdown in productivity growth, the unfavorable trends in relative import prices and the higher level of unemployment. They show that in the average OECD country relative import prices made inflation in 1980 5% higher than it would have been if import prices had continued their pre 1973 trend. Lower productivity growth had an equal effect in raising inflation. These two effects were offset by the effect of higher unemployment measured as deviation from its trend. Bruno and Sachs [1982] also have argued that input price shocks can lead to decline in growth of output and productivity, real wages, and capital accumulation. When real wages are sticky these effects are greatly magnified leading to greater unemployment and decline in output. With real wage inertia profitability is reduced significantly by the rise in input prices and investment tends to become sharply reduced. Their empirical analysis suggests that recent sharp increases in material prices has been a major contributory of the increase in the rate of inflation in most of the OECD countries. Since materials is a major component of the imports in these countries, the exogeneous increase in prices of materials and oil

since 1973 was one of the major factors in the stagflation of the Western economics.

V. Concluding Remarks

In this paper we have looked at some empirical evidence on price inflexibility and presented some of the theoretical bases for why price stability in the face of a decrease in short run demand may be an outcome of rational maximization behavior. The response of firms to uncertainty, the cost of adjusting prices, the contents of the long-term contracts (explicit or implicit) in the goods and input markets, the extent and variability of excess demand may differ among firms and industries. The structure of the industry, the degree of heterogeneity of the products in a market, the network of input-output relationship among industries, the nature of international competition, the process of formation of expectations shocks from monetary and fiscal policies and input price increases, all may interact and create the ever changing environment of the firms. There is a continual interplay of institutional forces, market arrangements and cultural factors and customs that govern the behavior of firms with the governmental policies and macroeconomic forces, which will result in price rigidities in the short-run. These rigidities will evolve over time and will vary across different markets, industries, or countries. In the long run the institutions and market arrangments will also change when they are no longer useful and serve their purpose.

In the presence of the price rigidities, the conventional monetary and fiscal restraint can achieve price stability at a high cost of high

unemployment. This would result from the momentum of built in lags in the costs and if people form their expectations by extrapolating past rates of inflation. The cost of restraining inflation could be fairly high as recently documented by Gordon [1982b]. On the other hand there is convincing evidence that monetary and fiscal restraints have been very successful in reversing the inflationary spiral in hyper-inflations experienced by a number of countries in the early 1920's (Sargent [1982]). The cause of such hyper-inflations may have been the excessive increase of money and peoples' expectations that the government will accommodate the inflationary developments. To end the hyper-inflation the governments were forced to adopt a dramatically new strategy of a coordinated set of policies. An abrupt change in government policies and an effective inforcement of the new legislations were the prerequisites for ending the hyper-inflations. Though there are not any specific estimates of costs of such anti-inflationary policies, it seems they did not lead to any widespread unemployment that are implied in the models discussed in this paper.

In hyper-inflationary situations the transaction costs of holding money is so high that all contracts expressed in money terms become excessively burdensome and the length of contracts dramatically shrinks; the distortive effects of high inflation on incentives could lead to disorientation of the business and consumers, the distribution of income and wealth gets distorted and finally the self generating nature of inflationary expectations become very much understood by the public and the government. In such situations the government will get the mandate to follow dramatic anti-inflationary policies to break the inflationary expectations and put

the economy on a stable course. However, at low rates of inflation a consensus often does not exist for a decisive action. In democractic societies, the governments will not have the ability to sustain anti-inflationary policies for too long and with sufficient force to achieve growth with stable prices. The central point to stress is that the ability of governments to combat inflationary expectations is endogenous in the system. There is a nonlinear relationship between the costs of inflation, the ability of the government to pursue effective anti-inflationary policies, and the public's acceptance of the needed adjustments.

What kind of policy options are open in an economy with moderate rates of inflation which exhibits, in the short-run, price inflexibility for the reasons described in this paper? This is a very difficult question and would require considerable analysis and space beyond the scope of this paper. A few such options can be mentioned here but only briefly. If the price inflexibility is partly due to imperfect and costly information or its uneven distribution and utilization then such a market failure can be corrected with timely and relevant information provided by policy makers and emergence of firms that could make the needed information available. If the problem is partly due to overlapping wage contracts and institutional rigidities in other markets, or if it is due to disynchronised nature of pricing decision, then the possibility of successes in the short-run is not encouraging. Only a consistent policy targeted at the disaggregated industry levels and sustained for a number of years might dampen the effects of these structural forces. If the price inflexibility is partly in response to uncertainty and inability to determine precisely the changes

in aggregate demand, then governmental policies can minimize potential disturbances by avoiding erratic and sizeable shifts in its monetary and fiscal policies. Government policies that lessen the degree of concentration in domestic markets and encourage international competition may dampen the potential effects of monopoly power on prices. But international agreements may also be required to stabilize prices of inputs such as raw materials, which can exert significant effect on the level of prices when the domestic prices are inflexible. Promoting increase in productivity and technical change may be one of the important ways to lower the rate of inflation and reduce price inflexibility. Further, the price structure of government services and the effect of governmental regulations on price behavior must be examined carefully for they may impart significant inflexibility to the price structure.

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