

SEARCH AND INFLATION: A SURVEY OF THE RECENT LITERATURE*

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ABSTRACT

In order to understand the macroeconomic effects of inflation, it is necessary to investigate the underlying microeconomic aspects. Inflation affects microeconomic interaction between firms and consumers in a substantial way. Firms choose pricing rules that affect consumers' search. The search is realized across firms and through time. The theory does not provide a clear answer to the effect of inflation on welfare. On one hand, because of adjustment costs, a higher inflation is associated with a higher dispersion of prices, making search more attractive. On the other hand, inflation deteriorates the information content of prices, reducing the ability of consumers to take advantage of the dispersion of prices through search. This article surveys very recent contributions to this subject. It argues that although one can get important insights from this literature, it does not provide a satisfactory answer to the question that has puzzled macroeconomists for more than two decades: how to explain the social costs of inflation?

SÍNTESES

Para comprender los efectos macroeconómicos de la inflación es necesario investigar los aspectos microeconómicos subyacentes. La inflación afecta las relaciones microeconómicas entre las firmas y los consumidores en forma substantiva. Las empresas eligen reglas de fijación de precios que afectan a la búsqueda de los consumidores, la búsqueda se lleva a cabo en las firmas y en el tiempo. La teoría no da una respuesta clara al efecto de la inflación sobre el bienestar. Por una parte, debido a los costos de ajuste, una inflación más alta se asocia a una mayor dispersión de precios, haciendo que la búsqueda resulte más atractiva. Por otro parte, la inflación deteriora el contenido de información de los precios, lo que reduce la habilidad de los consumidores para sacar partido de la dispersión de precios a través de la búsqueda. Este artículo analiza los aportes más recientes al tema. Argumentar, que sí bien es posible llegar a importantes puntos de vista basados en estos trabajos, éstos no proporcionan una respuesta satisfactoria a la pregunta que ha intrigado a los economistas por más de dos décadas: ¿cómo explicar los costos sociales de la inflación?

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1. INTRODUCTION

As it could be expected, the theoretical literature about the causes of inflation is widely known in Latin America. The surprising fact is that the latest literature, that tries to unveil the way inflation affects the interaction among agents at the microeconomic level, is almost ignored in those countries with a history of chronic inflation. This literature is important because the inflationary process is not neutral at the microeconomic level, i.e., different levels of inflation have different consequences on the behavior of economic agents, affecting not only the monopoly power of firms, but also social welfare. Moreover, the understanding of the causes of inflation is not dissociated from the knowledge of how inflation affects the microeconomic interaction among agents.

This survey aims at contributing to the understanding of the interrelation among search, pricing rules and inflation, in the light of the latest economic literature. The approach is based on the interaction between two sides, the supply side -which includes the firms' choice of optimal pricing rules- and the demand side -which focuses on how consumers, by taking into account the behavior of the prices at each firm and in the industry, search to extract the best out of the environment.

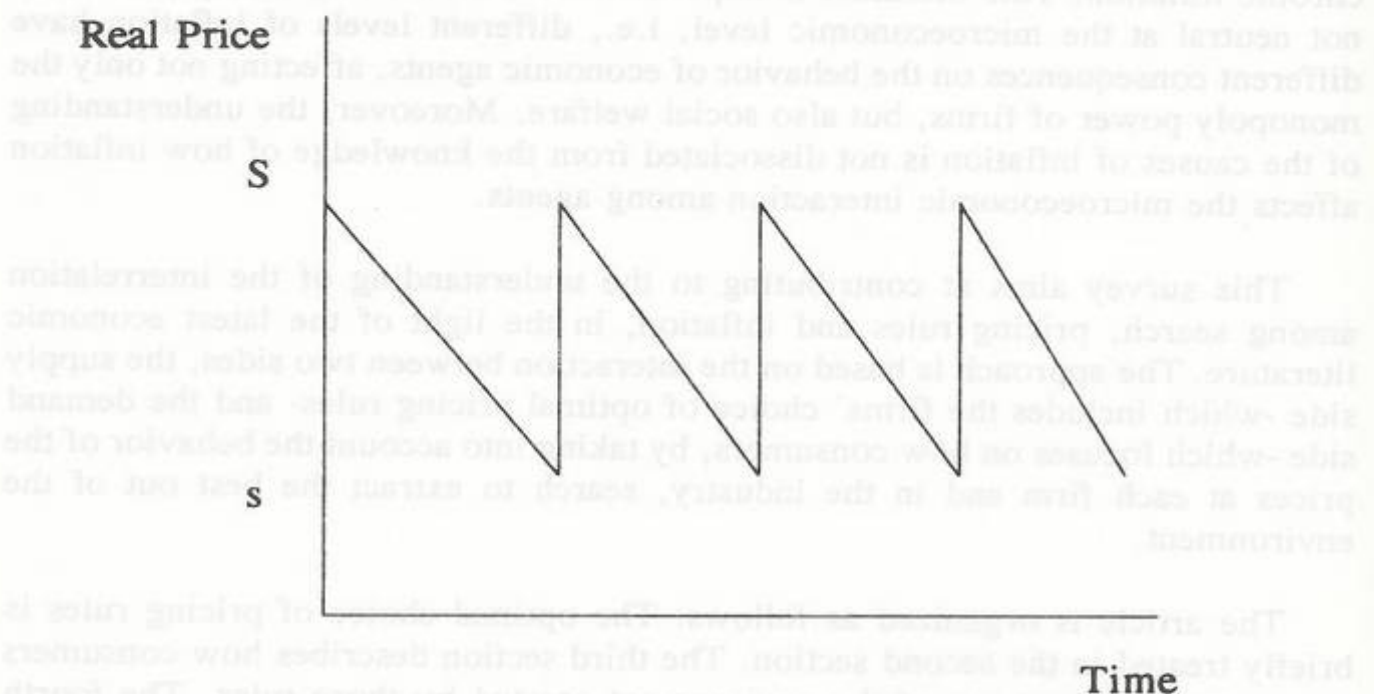
The article is organized as follows. The optimal choice of pricing rules is briefly treated in the second section. The third section describes how consumers can extract the best out of the environment created by those rules. The fourth section hinges on the most recent literature addressing the consequences of inflation which, by interfering in the interaction between firms' price setting and consumers' search, affects the monopoly power of firms and social welfare. Final considerations are presented in the last section.

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2. THE SUPPLY SIDE: MENU COSTS AND PRICING RULES WITH DISCONTINUOUS ADJUSTMENT

Even in economies of high inflation, in which the general level of prices is continuously increasing, the nominal price of each good remains constant for some time and then suddenly jumps, while the frictionless optimal price of each firm increases in a more continuous way. The existence of adjustment costs explains price rigidity, and that is one of the most important elements of the New Keynesian Theory. When the adjustment cost is specifically that of changing prices (for instance, it does not include the cost of getting information or of making estimates of new optimal prices), it is referred to as menu cost. Obviously, this cost includes more than the cost of either printing new price lists or changing tags, but some recent work shows that even very small menu costs may be enough to make a firm keep its nominal price fixed for a relevant period of time [see, for example Akerlof and Yellen (1985), Mankiw (1985) and Dixit (1991)].

Figure 1: Ss Pricing Rule



Sheshinski and Weiss (1977) derived the optimal pricing rule of a monopolist facing constant inflation and menu costs.¹ The optimal rule, shown in figure 1, is of the Ss kind, i.e., the firm keeps its nominal price fixed while its real price falls, until the latter reaches the minimum level s . Then the nominal price is adjusted so that the real price peak S is reestablished and a new cycle starts again.

¹ Sheshinski and Weiss (1983) assume a stochastic inflation with non-decreasing prices to get the Ss rule as the monopolist's optimal pricing policy.

The higher the inflation, the greater the ratio between S and s is, and also, under some conditions, the more frequent the adjustments are. It is important to notice that the increased frequency of adjustments does not prevent the increase in the S/s ratio. Such theoretical results are confirmed by the real world experience. Low inflation countries have smaller and less frequent adjustments than high inflation countries. With high inflation the difference between the highest real price and the lowest real price in the cycle becomes substantial. This poses implications for the demand side too, where consumers have the opportunity of taking advantage of this difference.

The rules above are state-dependent, because what triggers an adjustment is the level of a state-variable. The state-variable in question is the ratio between the firm's price and the firm's optimal price. However, in the real world, we often find adjustment rules that show some dependence with respect to the time elapsed since the most recent adjustment. One example is the rule by which the price adjustments occur with fixed periodicity. Those rules are difficult to justify theoretically. Costs of gathering information about the value of the relevant state-variable rationalize time-dependent rules where a nominal price is not fixed over a finite interval of time, as shown in Caballero (1989). The optimality of time-dependent rules which present nominal rigidity should require both menu costs and costs of information. In that case the pricing rules should be both time and state dependent.

In the discussion below we assume that menu cost is the only kind of adjustment cost. Accordingly, pricing rules are state-dependent. This simple assumption, although not totally realistic, captures the most important aspects of the relation between inflation and pricing rules.

3. THE DEMAND SIDE: INSTANTANEOUS SEARCH THROUGH FIRMS AND TIMELY RECALL

Either visiting several firms or repeatedly visiting the same firm involves what is called search cost. When studying a price, the consumer will decide if she should continue the search or settle for buying the good. The purchase takes place if the price found is low enough to make the expected gain of continuing the search—as given by the expected reduction in the price— inferior to the search cost.

For didactic purposes, we describe two distinct processes whereby the consumer can attempt to gain with the difference between the highest price (peak) and the lowest one (trough).

- a) The first one occurs when the consumer, after knowing the firm's price, chooses between buying or visiting another firm. We can call this

instantaneous search through firms. The customer does so because usually the prices of the firms are not synchronized, e.g., a firm can have its price at the peak while another has it in the trough. Hence, the consumer is able to take advantage of the difference in prices among firms at the same moment.²

- b) The second process consists in exploring this difference through time. If a consumer finds a very high price she can decide to return later to the same firm. This is due to the fact that the price of the firm, that now can be next to the peak, will be later in the trough. The consumer then returns when conceivably the price would be next to the trough.³ We will refer to this process as timely recall.⁴

Reality has something of both processes, because the search process itself is time-consuming and it is quite common that in countries with high inflation rates consumers engage in search through time and through firms.

On the other hand, firms, conscious of the searching decisions of consumers, choose their pricing rules in order to maximize profits. For instance, for a firm that sells durable consumption goods and has some kind of monopoly power, it is not a good policy to announce that it will adjust its nominal price on every 19th of the month. In this case consumers will wait until the 18th of the month to buy, when the real price of the firm will be in the trough. Therefore, the sales tend to increase when the price is next to the trough. In this wise, firms have an incentive to mislead consumers and in fact this frequently happens.⁵ Bénabou (1989) pursues this idea in a model where the optimal pricing rule is found to be stochastic: the time that elapses between adjustments is a random variable.

In the case of non-storable and daily consumed goods as bread, milk, transportation services, the search is done through firms. As all firms go through the S_s cycle, it is interesting for consumers to buy from firms with prices next to the s^6 . However, firms usually coordinate themselves so as to prevent consumers from buying only from firms with prices next to the trough. If several firms go through the cycle at the same time and a consumer needs to consume the good daily, buying it at a price next to the peak cannot be avoided. This coordination

² This process was first modeled in Bénabou (1988).

³ If one consumes a good during the whole period and tries to establish a long run relationship with a firm from which one will buy during this period, one's problem might be to infer the average price of this firm from the observed price. See section 4bii.

⁴ This process is modeled in Bonomo and Najberg (1993).

⁵ Salespeople generally do not reveal the dates of price increases. More than that, many of them try to induce the potential buyer to believe that the timing of the purchase was perfect because soon there will be an increase in prices, i.e., that the price charged at that moment is the lowest real price of the cycle.

⁶ Here we suppose identical firms. If the firms are heterogeneous in terms of production costs (and consequently in terms of average prices) and if buying each time from a different firm involves a very high transaction cost, the consumer's problem might be to infer the firm's average price in order to establish a customers' relationship.

frequently happens in practice.⁷ The firms coordinate themselves adjusting prices at the same time in order to neutralize the bargaining power that the search possibility gives to consumers.

To state it briefly, regardless of the characteristics of the good, the analysis of the market under inflation must consider the existence of frictions both on the supply side (adjustment costs) and on the demand side (search costs). Hence, it is possible to investigate the effect of inflation over the interaction between consumers that search and firms ("price setters") that optimally determine their pricing rules. Owing to the existence of adjustment costs, inflation affects the ratio between the peak price and the trough price, changing the environment and the incentive to search. This brings consequences to the market power of firms and to the social welfare.

4. THE RECENT LITERATURE

In the first subsection we describe models where the level of inflation does not directly interfere with the transmission of information to the consumer. In this case inflation favors the consumer. In the second subsection we describe models where the loss of information caused by inflation is capable of reversing this result.

a) Search and Recall with Certain Inflation and Homogeneous Firms

Bénabou (1988)⁸ analyses the interaction between consumers who make their search through firms at the same instant and firms that have menu costs. On account of those costs, a higher level of inflation increases the ratio between S and s . The larger dispersion of firms' prices at a given moment makes search a more profitable activity for consumers, in the sense that the expected gain obtained from searching increases. Thus, the maximum real price the consumer is willing to pay for the good is reduced. Producers lose bargaining power and

⁷ We find many instances of that phenomenon reported in the Brazilian press. One example is the coordination of the coconut salespeople along dozens of miles of beach in Rio de Janeiro, who charge the same price and have simultaneous price adjustments. The daily newspaper *Jornal do Brasil* (01/13/92) in the article entitled "O Cartel dos Pequenos" (The Cartel of the Small Retailers) reports this and other instances of coordination of agents with small individual market power.

⁸ In Bénabou (1988) consumers are homogeneous. Consequently, there is no search in equilibrium because the reservation price is the same for all consumers. That is, since the price which makes a consumer indifferent between searching and buying immediately is the same for all consumers, a firm that charges a price higher than this one has no customers. If a firm charges a lower price, it will sell to all the consumers who visit it. In Bénabou (1992), consumers are heterogeneous. Therefore, there exists search in equilibrium and resources are spent in this activity. Higher inflation rates imply that more resources are spent in search, which makes the inflation effect over social welfare ambiguous.

reduce their real prices, therefore increasing consumers' welfare. Briefly speaking, the level of inflation would be positively correlated to consumers' welfare and negatively related to the monopoly power of firms.^{9,10}

Bonomo and Najberg (1993) show that the benefit to consumers may be still larger if one considers that the consumer can learn the firm's price cycle by observing its price once and recall the firm at the exact moment its real price is in the trough. Consequently, the expected gain which recalling entails for consumers, in terms of price reduction, is larger than that of searching for another firm immediately. However, to get a real price reduction through recall takes time, and it is reasonable to assume that consumers are impatient. Therefore, recall will happen when inflation is high enough to bring about the deterioration of the real price at a much faster pace than the deterioration of the utility of consuming at a given price. That is the reason why recall is observed in markets for durable goods in high inflation countries, but not in low inflation countries.

An important aspect of the models above, is that the firms are homogeneous and inflation is known. Consequently, before drawing the first price observation, the only information the consumer does not have is when the most recent price adjustment was made in the specific firm being visited. The introduction of either stochastic inflation or heterogeneity in the costs of firms generates inference problems for the consumers to the extent it is no longer guaranteed that inflation benefits consumers.

b) Inflation and Information

That inflation and consumers' welfare should be positively related was a source of dissatisfaction for those economists who believe that the sign of the correlation is symmetric to the one derived in the models above. A negative relation between inflation and consumers' welfare can be obtained from models that assume that the price observed conveys information about the price that a consumer can find in a new search. Inflation interferes with the transmission of information, hence contributing to its imperfection. Here we describe two mechanisms whereby this can occur.

⁹ In Bénabou's (1988) model, social welfare increases because profits are always zero. The decrease in the number of firms reduces the fixed cost per unit produced, and this reduction is completely rebated to prices.

¹⁰ The implications change if instead of menu costs there are sticker costs. Sticker costs differ from menu costs because with sticker costs there is no cost of selecting a different price when the new unit of inventory arrives. Diamond (1993) shows that with sticker costs consumer welfare is inverse u-shaped in inflation and the optimal inflation rate is strictly positive.

i) Instantaneous search through firms and uncertain inflation

The first, forwarded by Bénabou and Gertner (1993), is based on the information that a firm's price provides on the price at another firm. The analysis neglects the intertemporal aspect and concentrates in the instantaneous search through firms. It assumes that the higher the inflation is, the higher the variability of inflation will be. In this sense it is essential to consider inflation as a phenomenon that affects not only the trend increase of the average price, but also the variance of the increase of the average price. Consequently, when in this search process a consumer finds a higher price than the one expected, it is difficult to ascertain if this happened because this firm has a higher than average price of the good or if this price is reflecting an inflation higher than the one expected. The problem of inferring which part of the observed price reflects the relative price of the good and which part reflects the price level is the well-known signal extraction problem that producers face in Lucas (1973).

While deciding on whether to continue the search or not, a consumer takes into consideration that there is a positive correlation between the firms' costs (and consequently between the firms' prices). It is assumed that the correlation between costs is greater when inflation is higher. The idea is that the higher the inflation, the higher the relative frequency of the aggregate shocks (affecting all economic units) vis à vis the idiosyncratic shocks (that affect only one firm) is. Therefore, when the average level of inflation is higher, a consumer facing an unexpectedly high price gives more weight to the occurrence of an increase in costs common to all firms. The prospective buyer makes an upward revision of the price that she expects to find in another firm, consequently reducing the incentive to search. Thus, a mechanism is provided so that a higher inflation may increase the monopoly power of firms, reducing consumers' welfare.^{11,12}

ii) Recall and heterogeneity of firms

The second mechanism, modeled by Tommasi (1992) and Ball and Romer (1992), is based on the information given by the current price about the same firm's future price. It emphasizes the intertemporal aspect of information. In both works, a higher inflation leads to a greater deterioration of the information given by the current price about the same firm's future price, involving a greater monopoly power to the firms and a consequent reduction of consumers' welfare.

¹¹ The reasoning above depends critically on the magnitude of the search cost. It requires this cost to be high enough to make the consumers' reservation price higher than the unconditional expectation of a firm's price.

¹² There exists a "variance effect" which poses a countervailing effect: an increase in the variance of the aggregate shocks increase the variance of a firm's price, conditioned to the knowledge of the other firm's price. This increases the value of search.

In Tommasi (1992), search made through firms and recall of the same firm in the following period are both allowed, encompassing, in some way, the two aspects of search emphasized above. He deduces that consumers become less informed when inflation is higher as an outcome of the reduction in the autocorrelation of the same firm's price. The assumption underlying this result is that the autocorrelation of the production cost of a firm is inversely related to the level of inflation. Consequently, this work shows that if a higher inflation increases the deterioration of the information on a firm's cost, this process carries over to prices. The paper also draws attention to the negative allocational implication on the production side: the price system becomes less efficient in distributing output across firms of differential productivity.

In Ball and Romer (1992), firms have menu costs, and therefore they adopt Ss pricing policies. Firms are heterogeneous with respect to production costs. However, search through firms is neglected. Suppose, for example, that a consumer observes a relatively high firm's price. The problem in this case is to ascertain whether the high price is due to the fact that this firm exhibits a cost higher than the average or if the firm's price is next to the peak. Every time the consumer observes a firm's price, an attempt is made to infer what this firm's average price is because this is the price that matters in a long-run relationship where purchases are made at all prices of the cycle. Ball and Romer (1992) restrict a consumer's choice to the alternatives of either establishing a customer relation with a firm or giving up the consumption of the good. The information on the firm's average price, obtained by observing the firm's price at a single moment, becomes worse when there is inflation. This happens because there is a larger range of possible prices charged by a firm which has a specific cost. Therefore, consumers can make a wrong decision more easily when inflation is high. Of course, the utility of a consumer is lower when a wrong decision is made than when the right decision is made. Therefore, a higher inflation leaves the consumer worse off.

Another channel through which a higher inflation can negatively affect consumers is the increase in a firm's average price, caused by the reduction of the elasticity of demand. First, imagine an economy with no inflation. Each firm has a price that remains constant through time. When observing a firm's price, a consumer knows exactly what this firm's average price is. If a higher price is observed, the estimate of the average price will be updated to a higher value. In an inflationary economy, the same firm can have different price levels. Accordingly, when a consumer observes a price, there is no possibility of knowing where the firm stands in the cycle between the peak and the trough. Consequently, less weight is attached to this information. When a firm increases its average price, the consumer's estimate of the firm's average price will have a lesser increase, when inflation is higher. This is due to the inference problem. Therefore, a higher level of inflation makes demand less elastic. This second mechanism in the model forwarded by Ball and Romer (1992) also implies that

a higher inflation leads to an increase in the markup by firms, generating a loss in consumers' social welfare.

5. FINAL REMARKS

The economic theory dealing with the effect of the level of inflation on the interaction between search and pricing rule is quite recent and, therefore, it is still being developed. For instance, the works that relate higher inflation with less welfare of consumers due to a loss of information, are based on undesirable and restrictive assumptions. While Bénabou and Gertner (1993) assume that a higher inflation increases the cross-section firms' cost correlation, Tommasi (1992) assumes that inflation has the opposite effect on the serial autocorrelation of each firm's cost.¹³ In Ball and Romer (1992) it is the process of search which is restrictive: the consumer is not allowed to search through firms, and should the decision be made to buy from the only firm visited, then the subsequent purchases will have to be made there for a number of periods exogenously specified.

All the following options: (i) durable and non-durable goods, homogeneous and differentiable goods, (ii) homogeneous and heterogeneous consumers with respect to preferences, or to search costs, (iii) homogeneous and heterogeneous firms with respect to entry, fixed, variable and menu costs, (iv) different kinds of adjustment costs, (v) different information structures, which to a great extent have already been resorted to in a non-inflationary context, give us a full idea of the potential of theoretical research in this area. In addition, we could also mention empirical research, still in its initial phase.¹⁴

Latin America's considerable experience with high and variable inflation places the researchers in the Region in an advantageous position to understand the effect of inflation on markets. This is so, because high and variable inflation tends to exacerbate such effects. Likewise, Latin American data should be extremely useful in testing those theories.

¹³ Moreover, in Bénabou and Gertner (1993), the negative relation between the consumer's surplus and inflation is only a possibility.

¹⁴ Although a substantial amount of empirical work focused on the relation between inflation and relative price variability, or between average inflation and inflation uncertainty, the sign of those relations is not sufficient to draw conclusions about the costs of inflation. Bénabou (1992) examines the relation between markup and inflation in one of the few empirical works aimed at testing implications of the recent literature on the real effects of inflation in imperfectly competitive markets. Other recent studies which use data from high inflation countries are Lach and Tsiddon's (1992) work on empirical evidence from Israel and Tommasi's (1993) study on Argentina.

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