Price Rigidity and Strategic Uncertainty: An Agent-Based Approach

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ABSTRACT

The phenomenon of infrequent price changes has troubled economists for decades. Intuitively one feels that for most price-setters there exists a range of inaction, i.e., a substantial measure of the states of the world, within which they do not wish to modify prevailing prices. Economists wishing to maintain rationality of price-setters resorted to fixed price adjustment costs as an explanation for price rigidity. This paper proposes an alternative explanation, without recourse to any sort of physical adjustment cost, by putting strategic interaction into the center-stage of the analysis. Price-making is treated as a repeated oligopoly game. The traditional analysis of these games cannot pinpoint any equilibrium as a reasonable “solution” of the strategic situation. Thus, decision-makers have a genuine strategic uncertainty about the strategies of other decision-makers. Hesitation may lead to inaction. To model this situation, the authors follow the style of agent-based models, by modeling firms that change their pricing strategies following an evolutionary algorithm. In addition to reproducing the known negative relationship between price rigidity and the level of general inflation, the model exhibits several features observed in real data. Moreover, most prices fall into the theoretical “range” without explicitly building this property into strategies.

Keywords: Agent-Based Modeling, Evolutionary Algorithm, Price Rigidity, Social Learning, Strategic Uncertainty

1. INTRODUCTION

Everyday observations tell us that some prices are changing almost continuously. Financial asset prices, of foreign exchange or of stocks, are obvious examples. Though most people do not buy commodities regularly, it is also well-known that the prices of crude oil, gold, or grain behave similarly. On the other hand, most prices we meet in shops or kiosks seem familiar, we expect that they do not move from one day to another.

Infrequent price adjustment has troubled economists for decades. The problem is not the lack of change in itself, but the conviction that prices are kept fixed for much longer than market conditions, costs, and competitors’ prices would justify. Intuitively, there exists a range of inaction for most price-setters, i.e., a substantial range of “the states of the world”, where they do not wish to modify prevailing...
prices. Meanwhile basic economic theory instructs us that, at least, when marginal costs change it is rational to adjust prices, even in not fully competitive markets.

According to the prevailing wisdom the stickiness of money prices is the root of the ability of monetary policy to affect (significantly) real - as opposed to merely nominal - variables. It is perhaps less in evidence, but the same phenomenon is a concern for competition authorities, too, as it may signal collusion among market participants.

Economists wishing to maintain the rationality assumption for price-setters resorted to price adjustment costs ("menu costs") as an explanation of price rigidity. The basic idea is that, for instance, the everyday reprinting of an elegant menu for a restaurant is not a reasonable option, being too costly. Certainly, similar issues may be relevant for many other businesses. However, what about meal prices written on a blackboard at a pub’s entrance? These prices appear to exhibit the same stickiness, despite the fact that overwriting them each day does not entailing any additional cost. Magazine prices have been one of the foremost examples of unreasonably strong price inflexibility, but printing a different price on each new edition would not entail even a negligible extra cost.

It must be the case that the rigidity of prices has more than one reason. In this paper we propose an alternative, though admittedly partial, explanation, without having recourse to any sort of physical adjustment cost. Rather, we focus on the possible role of strategic uncertainty, and put strategic interaction into the center-stage in our analysis.

The main idea of our approach can be summarized as follows. Price-making can be considered a repeated game, as firms usually act in markets where there exist identifiable competitors. The traditional analysis of these games cannot pinpoint any equilibrium as a reasonable “solution” of the strategic situation. Thus there is genuine strategic uncertainty, a situation where decision-makers cannot know for sure the strategies of other decision-makers. Strategic uncertainty may cause hesitation. If I cut the price would it be interpreted as a signal for a “price-war”? Or if I raise the price shall I lose market-share? Hesitation may lead to inaction, as we all know too well. To model this situation we follow the style of agent-based models. While traditional economics rely on full rationality and on an equilibrium concept, we model boundedly rational agents, thus must assume something about learning. To achieve our goal we adopted an evolutionary algorithm.

In Section 2 we give a survey of the price rigidity literature, followed by notes on agent-based modeling as applied to economics problems. In Section 3 a traditional approach to oligopoly pricing is surveyed. In Section 4 the agent-based oligopoly model is set up, and the learning algorithm is discussed. Section 5 presents the analysis of the model, and the concluding Section summarizes, pointing out paths to further research.

2. LITERATURE SURVEY

The Rigidity of Prices

The most salient fact conflicting with price flexibility this presumption has been termed the PPP (Purchasing Power Parity) puzzle (Rogoff, 1996), this is the general observation that there are large variations across currencies in purchasing power parity, induced by nominal exchange rate changes. Due to this and similar empirical findings, price rigidity has become a fundamental assumption in New-Keynesian macroeconomic models, that are sometimes called the “workhorse” of modern macroeconomics (Gali, 2008). New-Keynesian Phillips curves are derived from individual profit maximization, whereby prices are set by monopolistically competitive firms that face costs of price adjustment. As not all prices are raised immediately following a positive money injection demand increases, and output becomes - temporarily - higher than normal (the same with opposite signs happens after a monetary contraction). Prices follow suit eventually resulting in a positive correlation between growth and inflation. Price adjustment costs imply – in
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