Inflation tax in the lab: a theoretical and experimental study of competitive search equilibrium with inflation

Nejat Anbarci [a], Richard Dutu [b], Nick Feltovich [c,*]

[a] Department of Economics, Deakin University, 70 Elgar Road, Burwood VIC 3125, Australia
[b] OECD Economics Department, 2, rue André Pascal, 75775 Paris Cedex 16, France
[c] Department of Economics, Monash University, Clayton VIC 3800, Australia

A R T I C L E   I N F O

A B S T R A C T

In this paper we measure the effect of the inflation tax on economic activity and welfare within a controlled setting. To do so, we develop a model of price posting and monetary exchange with inflation and finite populations. The model, which provides a game–theoretic foundation to Rocheteau and Wright (2005)'s competitive search monetary equilibrium, is used to derive theoretical propositions regarding the effects of inflation in this environment, which we test with a laboratory experiment that closely implements the theoretical framework. We find that the inflation tax is harmful – with cash holdings, production and welfare all falling as inflation rises – and that its effect is relatively larger at low inflation rates than at higher rates. For instance, for inflation rates between 0% and 5%, welfare in the two markets we consider (2[seller] × 2[buyer] and 3 × 2) falls by roughly 1 percent for each percentage–point rise in inflation, compared with 0.4 percent over the range from 5% to 30%. Our findings lead us to conclude that the impact of the inflation tax should not be underestimated, even under low inflation.

1. Introduction

When prices rise, the real value of individuals' money holdings falls. This phenomenon is known as the *inflation tax*. It affects agents' behaviour, inducing them to adopt strategies (such as shifting consumption away from cash-intensive activities, or simply holding less money) to avoid its effects. Both the inflation tax itself and the resulting behavioural distortions can have implications for social welfare. This inflation tax channel is present in many monetary models, from reduced-form cash-in-advance models (Lucas and Stokey, 1987) to the more micro-founded money search models (Lagos and Wright, 2005).

Quantifying the effect of the inflation tax is tricky, however. The inflation tax may be one of several channels for inflation, making it difficult to disentangle each within the broader issue of the costs of inflation (Burstein and Hellwig, 2008). Moreover, the welfare loss due to inflation may not be due to the tax itself but to other frictions such as an inefficient pricing mechanism, as the welfare costs of inflation have been shown to depend critically on the pricing mechanism being used (Aruoba et al., 2007; Craig and Rocheteau, 2008; Rocheteau, 2012). Also, due to the inherent difficulty of implementing a

controlled test of the inflation tax in the field, all measures of the effects of inflation – regardless of the channel – have been conducted within the confines of theoretical macroeconomic models.

In this paper we propose the first experimental measure of the inflation tax. Our goal is to help quantify the effect of the inflation tax using tools other than a theoretical construct. To do so, we begin by developing a simple model of monetary exchange with price posting suitable for experimental testing. The model is built by fitting the m-seller n-buyer ($m \times n$) price-posting model analysed by Burdett et al. (2001), BSW hereafter, into the money search environment in the vein of Lagos and Wright (2005). We use the model to derive predictions relating to the effect of inflation on price-setting decisions by sellers, cash-holding decisions by buyers, production and welfare. We then test the model's predictions by conducting a laboratory experiment that closely implements the model's strategic setting. In our experiment, 193 subjects participated in a total of 2322 trading rounds, by taking on the role of buyers and sellers in one of two types of price-posting market (2×2 or 3×2), and making their decisions in an environment where the inflation rate is 0%, 5% or 30%.

Our results provide support for and help quantify the inflation tax, with behaviour in the experiment qualitatively in line with the theoretical predictions. Additionally, some striking quantitative results emerge. First, statistical tests easily reject the null hypothesis of no difference across our three inflation rates, showing that *the inflation tax matters*. Second, *the effect of the inflation tax is powerful*. In the 2×2 market, for example, real prices fall by 11.3 percent and welfare falls by 4.2 percent as inflation rises from 0% to 5%, and by a further 11.5 percent and 13.6 percent respectively when inflation jumps from 5% to 30%. Third, *a rise in inflation is relatively more consequential when initial inflation is low*. As inflation rises from 5% to 30% in the 2×2 market, each one-point increase in the inflation rate translates into a 0.5 percent drop in the real transaction price and a 0.4 percent drop in welfare. But when inflation rises from 0% to 5% we find that for each percentage-point increase in inflation, real transaction prices fall by 2.6 percent and welfare falls by 0.8 percent, an effect of 2 to 5 times stronger. Similar results are observed in the 3×2 market.

Using a controlled setting, our approach also allows us to provide novel insights about the effect of the inflation tax that, while tangential to our main research questions, may help guide future research. First, we can precisely track the effects of changing parameters in the experiment. For instance, how does a change in market size or tightness impact on buyers' visit and cash holding strategies? What is their effect on sellers' price posting strategies? How do those reactions compare to those predicted by the model? Second, we are able to assess and quantify out-of-equilibrium behaviour, such as dispersion in prices and cash holdings as well as agents' time spent on making their decisions.

In the end, our research points to a significant effect of the inflation tax on real economic activity, perhaps greater than one may have expected, and apparent even – indeed, especially – when inflation is low. We view our findings as a reminder that the inflation tax should not be underestimated, even under low inflation.

2. Other relevant work

Although there is a huge literature concerned with inflation, we will focus on a handful of papers most closely related to ours, with emphasis on papers not mentioned in the introduction. Much of the work on the effects of inflation has been conducted within theoretical macroeconomic models. This work has been very useful – for instance, in quantifying the costs of inflation to the economy. The earliest attempts by Bailey (1956) and Friedman (1969) treated real money balances as a consumption good and inflation as a tax on these balances, leading to a deadweight loss like that of an excise tax on a commodity. Following Lucas (1987), compensated measures of the costs of inflation within a general equilibrium setting (based on the increase in consumption that an individual would require to be as well off as under zero inflation) were computed, such as Cooley and Hansen (1989) using a cash-in-advance model or Lucas (2000) including money as an argument in the utility function. The welfare cost of 10% inflation was found to be as high as one percent of GDP.

Recently, Burstein and Hellwig (2008) developed a model combining nominal rigidities and the inflation tax. They found that the welfare cost of raising inflation from 2.2% to 12.2% varies widely by model parameters, from roughly zero to almost 7 percent of GDP. More importantly, and directly related to our findings, they showed that the contribution of relative price distortions to the welfare effect of inflation is negligible compared to the other channel: the inflation tax (or more precisely, the opportunity cost of holding money since in addition to inflation their model also has a positive real interest rate).

Using short-cuts such as cash-in-advance constraints to introduce money, however, makes it difficult to source the effect of inflation on agents' decisions. As noted by Lucas (2000), "[these models] are not adequate to let us see how people would manage their cash holdings at very low interest rates. Perhaps for this purpose theories that take us farther on the search for foundations, such as the matching models introduced by Kiyotaki and Wright (1989), are needed" (p. 272). Since then, several papers have studied the costs of inflation using money search theory (e.g., Lagos and Wright, 2005; Craig and Rocheteau, 2008). They found that eliminating a 10% inflation rate can have a fairly large welfare benefit – as much as 4 percent of consumption in some circumstances. Other contributions have shown that the actual cost depends critically on the pricing mechanism used. In particular, by removing the holdup problem, mechanisms that include posting or competitive pricing instead of bargaining tend to find lower costs of inflation. For instance, with price posting, the cost of inflation is close to previous estimates in the non-search literature, around 1 percent (Craig and Rocheteau, 2008; Rocheteau and Wright, 2009; Rocheteau, 2012).