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Optimal monetary policy under Calvo pricing with Bertrand competition ☆

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ABSTRACT

We consider a NK model characterized by a small and fixed number of firms competing in prices à *la* Bertrand and we study the implications for monetary policy under both exogenous and endogenous market concentration. We find that the implied NKPC has a lower slope compared to a standard NK model with atomistic firms, and the determinacy region enlarges assuming a standard Taylor rule. We characterize the impact of competition on the optimal monetary rules within the linear-quadratic approach of Rotemberg–Woodford. The optimal monetary rule requires a less aggressive reaction to inflationary shocks compared to monopolistic competition, but an increase in competition, due to either an increase in substitutability between the goods or in the number of firms, makes it optimal to adopt a more aggressive reaction in front of inflationary shocks. Finally, more competition increases the gains from commitment.

1. Introduction

We consider a New Keynesian (NK) model characterized by oligopolistic competitive markets stemming from a small (and fixed) number of firms competing à *la* Bertrand. Prices are staggered and modeled as in Calvo (1983). In this context we examine the effect of strategic interaction and market concentration on the slope of the New Keynesian Phillips Curve (NKPC) and on the optimal interest rate rules set by the monetary authority.

The implication of having assumed a small and fixed number of firms interacting *à la* Bertrand is analyzed under two alternative assumptions on the nature of markets concentration: exogenous market concentration, with markets composed by an exogenous and constant number of firms, which is the assumption that characterizes our baseline model, and endogenous markets concentration, where markets are composed by an endogenous number of firms. In the latter case, we follow the industrial organization literature (see for instance Sutton, 1991) by assuming that firms enter in the market until their net profits are zero.[2]

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[2] For this purpose we introduce a fixed cost of production which is independent from the output of the firm, but is proportional to sectoral revenues. Under this assumption the number of firms in each sector remains fixed over time, but it negatively depends on the degree of substitutability between goods.

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We show that under staggered prices more concentrated markets (with less firms or a lower elasticity of substitution) generate smaller price adjustments and therefore deeper forms of nominal rigidities than in a standard model with a continuum of atomistic monopolists. To realize this, consider an inflationary environment, where a firm able to adjust its price is considering how much to increase it: this firm is changing its price less if there are more competing rivals that do not adjust their prices and if the other price-adjusters are changing less their own prices. This is a typical consequence of strategic complementarity in concentrated markets with price competition, and its strength depends on the substitutability between goods. Paradoxically, if products are (almost) homogenous, as long as there is a single firm that does not increase its prices, none of the others will be able to increase its price without losing (almost) the entire demand. All this implies that small nominal rigidities are reinforced when markets are highly concentrated and the substitutability between products is high. A direct consequence of this result is that the slope of the NKPC is lower than in the basic NK model with atomistic price setters. Also the determinacy region enlarges under the typical Taylor rule compared to a standard NK model.

The result on the slope of the NKPC seems of particular interest, since in our baseline model such slope decreases up to a third of the slope of the standard NKPC with monopolistic competition. Thanks to this, our model contributes to reconcile the micro-evidence of frequent price adjustments (Bils and Klenow, 2004; Nakamura and Steinsson, 2008) with the macroeconomic data indicating that inflation is rather inertial (see Altig et al., 2011). Moreover, we provide a natural foundation (from an industrial organization perspective) for the shape of the long run Phillips curve: an increase in the number of competitors due to deregulation reducing entry barriers or to an increase in the size of the market (associated with growth or globalization) is going to increase the elasticity of inflation to the output gap.

Our results are affected by the nature (exogenous or endogenous) of firms concentration. When the number of firms is exogenous the elasticity of substitution has a direct effect on the slope of the NKPC given by the fact that higher goods' substitutability leads firms to change less their prices because demand is more sensitive to price changes. When the number of firms is endogenous there is an additional and indirect effect stemming from goods' elasticity of substitution. Indeed, higher goods' substitutability increases firms competition, reducing profits and thus entry. The reduction in entry enhances the strategic complementarities between price setting and non-price setting firms.

On the basis of these results, we characterize the optimal interest rate rules deriving the welfare-based loss function with the linear quadratic approach of Rotemberg and Woodford (1997). With an exogenous number of firms we find that in a more competitive environment, either because of lower concentration (more firms) or higher substitutability, monetary authorities should respond to inflationary shocks in a stronger way. The intuition is now simple: more competition leads to larger price changes in reaction to shocks, which requires more aggressive intervention of the central bank to keep inflation under control. When the number of firms is endogenous we find that higher substitutability still requires a more aggressive monetary policy in reaction to inflationary shocks, but the impact is much more reduced because markets become more concentrated and this strengthens nominal rigidities. Finally, to better understand the importance of the results obtained under the optimal discretionary rule, we examine the welfare gains from commitment to an optimal monetary rule and we find that they heavily increase in more competitive markets.

The assumption that markets are highly concentrated, which is key for our results, is supported by a strong empirical evidence showing that most local markets for traditional goods and services, which represent a big portion of our economies, do involve a small number of competitors interacting strategically. Nevertheless, one should not think that global high-tech markets are different in this dimension: a well known result of industrial organization theory and empirics (Sutton, 1991; Etro, 2009) is that also global markets tend to be highly concentrated because of a process of escalation of fixed costs. More generally, a large body of empirical evidence in industrial organization (Campbell and Hopenhayn, 2005), trade (Feenstra and Weinstein, 2010) and macroeconomics (see the discussion in Rotemberg and Michael, 2000) suggests that common markets are characterized by relevant competition effects due to imperfect competition.

Despite this evidence, this is one of the first studies on the implications of competition and strategic interactions for the optimal monetary policy. The standard NK literature considers the role of price stickiness under monopolistic competition with CES preferences and an exogenous number of firms, as was first formalized by Blanchard and Kiyotaki (1987) and then crystallized in NK-DSGE models assuming price staggering à *la* Calvo (1983).[3] However, under monopolistic competition between a large number of atomistic firms, price adjusters take as given the current and future price levels and the number of firms, ignoring any strategic interaction with the competitors. Again, this is unrealistic when local markets include a small number of firms producing highly substitutable goods: for instance, in the spatial model of monopolistic competition of Salop (1979), each firm is competing only with two firms, its two immediate neighbors, and, as we show, even in the Dixit–Stiglitz framework strategic interactions become relevant when the number of firms is finite and small. Other works, at least since Ball and Romer (1990), have stressed the role of strategic complementarities between firms' prices as a source of real rigidities (see Nakamura and Steinsson, 2013; Romer, 2011, for surveys),[4] but we are not aware of any formalization of price staggering with Bertrand competition as the natural source of strategic complementarities. Basu (1995) has introduced real rigidities assuming that each firm employs all the other goods as intermediate inputs. Woodford (2003) and Altig et al.

[3] See Yun (1996), King and Wolman (1996) and Woodford (2003). As well known, the alternative microfoundation of nominal rigidities advanced by Taylor (1979) relies on prices predetermined for a fixed number of periods. In principle Bertrand competition between a fraction of price-setting firms would lead to the same qualitative implications as those obtained under Calvo pricing.

[4] Blanchard and Kiyotaki (1987) and others have also stressed the potential role of generic strategic complementarities in generating multiple equilibria, but multiple equilibria are not the focus of our work.