Multipliers: imperfect competition or increasing returns to scale?

Antonio Fatás *

INSEAD

Abstract

In a recent paper, Rotemberg and Woodford (1995) study the behavior of imperfectly competitive economies to conclude that imperfect competition magnifies the response of output to certain exogenous shocks. We show that their results are entirely driven by the presence of increasing returns to scale and not by imperfect competition.

Keywords: Increasing returns to scale; Imperfect competition; Multipliers; Business cycles.

JEL classification: E23; E32.

1.- Introduction

There is a long literature that has explored the implications of models of imperfect competition for business cycles. In most cases, imperfect competition is presented as a mechanism to amplify the response of output to exogenous shocks.

In a recent paper, Rotemberg and Woodford (1995) (henceforth RW) study the behavior of imperfectly competitive economies to conclude that imperfect competition amplifies the response of output to exogenous shocks (technology and government purchases). Quoting from their paper: *"We show that the level of the average markup matters when it comes to the response of the economy to changes in technology."* and *"In our model, a larger μ (markup), magnifies the response of output for given values of the other parameters. But this is solely due to the fact that imperfectly competitive firms set the wage below the marginal product of labor so that one percent increase in hours raises output by μs_H percent rather than by s_H percent"* (where s_H is the share of labor in the production function).

In this paper we show that the multiplier effects of higher markups in RW are entirely due to the existence of increasing returns to scale and the fact that in their calibration the markup is made equal to the degree of increasing returns to scale so that the resulting profit rate is equal to zero. Strictly speaking, imperfect competition and the markup do not have any effect on the response of output

* INSEAD, Boulevard de Constance, 77305 Fontainebleau, France, Phone: 33 (0)1 60 72 44 19, Fax: 33 (0)1 60 72 42 42, E-mail: fatas@insead.fr.

and a model with perfect competition and external returns to scale would display the same output response.

Our result is related to a recent paper in this journal, Bénassy (1996), which shows that another feature of business cycles which had been previously related to imperfect competition, output persistence, is also entirely caused by increasing returns to scale. These results cast doubt on the common practice of using calibrated models where the degree of increasing returns to scale is assumed to be equal to the degree of market power.

2.- The Model

We present a simple static monopolistically competitive model which contains most of the features of the one presented in RW and where we distinguish between the effect of increasing returns to scale and imperfect competition by having two different parameters. We look at the elasticity of output to changes in the technology parameter. As it will become evident, the results can be generalized to other shocks.

Consumption

The economy is populated by a single agent who inelastically supplies L units of labor.[1] She consumes from a continuum of goods normalized in the unit interval and maximizes the following utility function

$$U = \mathcal{C} = [\int_0^1 c_i^{1-\phi}]^{\frac{1}{1-\phi}} dj \tag{1}$$

subject to the budget constraint

$$\int_0^1 p_i c_i dj = WL + \Pi \tag{2}$$

Production

There is a single producer in each of the monopolistically competitive markets. All firms have identical production functions and they use labor and intermediate inputs. All goods are used both as final goods and as intermediate inputs. The production function is

$$q_i = (AL_i)^{\gamma(1-\delta)} M_i^{\gamma\delta} \tag{3}$$

[1] By assuming an inelastic labor supply we make the case for multipliers as strong as possible. As RW show, the response of labor supply to shocks is smaller for imperfectly competitive economies.

where M_i represents a basket of intermediate inputs defined as

$$M_i = \left(\int_0^1 m_{ji}^{1-\phi} dj\right)^{\frac{1}{1-\phi}} \tag{4}$$

where m_{ji} is the quantity of intermediate inputs from sector j used in the production of good i. The composite intermediate good has been defined so that the elasticity of demand for intermediate inputs coincides with the elasticity of demand for final goods. γ represents the degree of increasing returns to scale and δ represents the share of intermediate inputs in gross production.

3.- Response to Technology Shocks

RESULT. *The response of final (net) output to a technology shock is independent of the mark-up.*

$$\frac{dln(Q^F)}{dln(A)} = \frac{(1-\delta)\gamma}{1-\delta\gamma}$$

PROOF. The result is trivial for the case where there are no intermediate inputs. In that case ($\delta = 0$) the response of output to a technology shock is always equal to γ.

When $\delta > 0$, after cost minimization one can solve for the demand of intermediate inputs which, added to the consumer's demand, leads to the following expression for total demand[2]

$$q_i(p_i) = \left(\frac{p_i}{P}\right)^{-\frac{1}{\phi}} \left[\mathcal{C} + \left(\frac{W}{A\,P}\right)^{1-\delta} \left(\frac{1-\delta}{\delta}\right)^{1-\delta} Q^{1/\gamma}\right] \tag{5}$$

where symmetry is assumed ($Q = q_j$ for all j) and

$$P \equiv \left[\int_0^1 p_i^{\frac{\phi-1}{\phi}} dj\right]^{\frac{\phi}{\phi-1}} \text{ and } \kappa \equiv (1-\delta)^{-(1-\delta)}\,\delta^{-\delta}$$

Firms chose prices to maximize

$$p_i\, q_i(p_i) - \kappa P^{\delta} \left(\frac{W}{A}\right)^{1-\delta} \left(q_i(p_i)\right)^{1/\gamma} \tag{6}$$

Maximization of (6) subject to (5) gives

$$p_i = \frac{\mu\kappa W}{A^{(1-\delta)}} \left(\frac{W}{P}\right)^{-\delta} \frac{1}{\gamma} Q^{\frac{1-\gamma}{\gamma}} \tag{7}$$

[2] The cost function is equal to $C_i = \kappa P^{\delta} \left(\frac{W}{A}\right)^{1-\delta} q_i^{1/\gamma}$

where

$$\mu \equiv \frac{1}{1-\phi}$$

and solving for a symmetric equilibrium where $p_i = P$ we obtain

$$P = [\frac{\mu\kappa}{\gamma}Q^{\frac{1-\gamma}{\gamma}}]^{\frac{1}{1-\delta}}\frac{W}{A} \tag{8}$$

and as for final (net) output

$$Q^F = \left[(AL)^{(1-\delta)\gamma}(\frac{\delta\gamma}{\mu})^{\delta\gamma}\right]^{\frac{1}{1-\delta\gamma}}(1-\frac{\delta\gamma}{\mu}) \tag{9}$$

From this equation one can derive the effect of changes in A on final output.

As it is clear from equation (9), the degree of imperfect competition has an effect on the output wedge but has no impact on the response of output to technology shocks.[3] It is the degree of increasing returns to scale (γ) the key parameter that determines the multiplier effect. By calibrating the model to fit the stylized fact of zero profits (and therefore $\mu = \gamma$), one cannot distinguish between the effects of imperfect competition and those of increasing returns to scale. Equation (9) makes clear that the relationship between imperfect competition and multipliers only exists to the extent that a degree of market power is needed to justify internal increasing returns to scale and zero profits. Indeed, one could write a model with perfect competition and external returns to scale and replicate the response of output. This model would also fit the stylized fact of zero profits but would not require imperfect competition.

Separating between the effects of market power and increasing returns to scale is key to understand the welfare implications of these models. Moreover, from an empirical point of view, recent empirical estimates suggest that the degree of returns to scale in US manufacturing is close to 1 and different from estimates of the markup (see Basu and Fernald (1997)).

4.- Conclusions

We have shown that imperfectly competitive economies do not display any type of multiplier effect in response to exogenous technology shocks. This contradicts previous results by Rotemberg and Woodford (1995) who claim that the existence of a wedge between marginal cost and price is a source of multipliers. We have shown that their result is entirely due to the presence of increasing returns to scale and the fact that the size of the markup is calibrated to match

[3] Even if we had allowed for an elastic labor supply, the response of output to the number of hours would have also been independent of the markup, contrary to the above quote from RW.

the degree of increasing returns to scale. An economy with perfect competition and external increasing returns to scale would display the same multiplier effects.

5.- References

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