BANCA D'ITALIA
EUROSISTEMA

Temi di Discussione

(Working Papers)

Firm entry, competitive pressures and the US inflation dynamics

by Martina Cecioni

September 2010

Number 773

BANCA D'ITALIA

EUROSISTEMA

Temi di discussione

(Working papers)

Firm entry, competitive pressures and the US inflation dynamics

by Martina Cecioni

Number 773 - September 2010

FIRM ENTRY, COMPETITIVE PRESSURES AND THE US INFLATION DYNAMICS

by Martina Cecioni*

Abstract

This paper studies the effect of competitive pressures on inflation dynamics. To this end it derives and estimates a New Keynesian Phillips curve in a model with endogenous firm entry. The number of active firms is inversely related to their market power. By taking into account the number of competitors, the pass-through of real marginal cost on inflation is separately identifiable from the effect of endogenous desired markup fluctuations. Estimates with US data suggest that the effect of real marginal cost on inflation is stronger than that found in the empirical test of the standard model. The estimated elasticity of the desired markup with respect to the number of firms implies that an increase of 10% in the number of active firms would lower annual inflation by 1.4% in the short run.

JEL Classification: E31.
Keywords: inflation dynamics, firm entry, markups.

Contents

1. Introduction... 5
2. The model 9
   2.1 Households 9
   2.2 Firms 10
   2.3 Entry 14
   2.4 Equilibrium, aggregate accounting conditions and monetary policy 15
   2.5 Markups and the New Keynesian Phillips curve.. 15
3. Empirical issues 17
   3.1 Data and measurement issues 17
   3.2 Empirical methodology 20
4 Estimation results... 23
5 The model's responses to technology and monetary policy shocks 28
6. Conclusions... 32
References 33
Appendix 37

* Bank of Italy, Economics, Research and International Relations.

1 Introduction*

> *"The relationship between marginal cost, properly measured, and prices also depends on the markups that firms can impose. One important open question is the degree to which variation over time in average markups may be obscuring the empirical link between prices and labor costs. [...] A consensus on the role of changing markups on the inflation process remains elusive."* - Fed Chairman Ben Bernanke (June 9, 2008)

The New Keynesian Phillips curve (henceforth, NKPC), that has become the benchmark description of the inflation dynamics during the last decade, is derived from a model of monopolistic competition and nominal rigidities and it links the fluctuations of the average real marginal costs to those of aggregate inflation. It assumes that the so-called desired markup, that is the one that firms are willing to charge on unit costs absent nominal rigidities, is constant over time and that markups fluctuate because nominal frictions induce a sluggish response of prices to changing economic conditions.

This paper extends the standard New Keynesian framework by introducing time-varying competitive pressures generated by the entry of new firms. The endogenous fluctuations of the number of firms that operate in the economy induce changes in firms' desired markup and eventually affect the inflation dynamics. I estimate this variant of the NKPC, similar to the one obtained by Bilbiie et al. (2007), and I find that, when taking into account the competitive pressures coming from the entry of new firms, the Phillips curve is not as flat as empirical test of the standard New Keynesian model have suggested. When one omits the number of firms from the estimation, the pass-through of real marginal cost on inflation is not separately identifiable from the effect of the desired markup on inflation and the estimates of it are downward biased. The paper also provides a structural estimate of the elasticity of the desired markup to changes in the number of firms.

---

*This paper is a revised version of a chapter of my PhD dissertation, at Universitat Pompeu Fabra. I am indebted to Jordi Galí for excellent supervision. I thank Jean Imbs, Vivien Lewis, Thijs Van Rens and participants of the Crei Macro break seminars at Universitat Pompeu Fabra and of the Dynare 2009 conference in Oslo (Norway) for useful comments and discussions. Any remaining errors are my responsibility. The views expressed in this paper do not necessarily coincide with those of the Bank of Italy. Corresponding address: martina.cecioni@bancaditalia.it

Contrary to statistical (reduced form) models of the inflation dynamics, the NKPC has the appealing feature of having sound microfoundations. When confronting the data, however, a considerable uncertainty surrounds the determinants of the inflation dynamics and the pass-through of real marginal costs.[1] The estimates of Galí and Gertler (1999) and Sbordone (2002), using real unit labor costs in the U.S. to measure real marginal costs, differ from those of Rudd and Whelan (2005 and 2006) suggesting opposite results. While the former studies found a significant role for the measured real marginal cost, the latter argues that such variable fails to be the appropriate measure of inflationary pressures both from a theoretical and empirical point of view. Moreover, the estimates of the pass-through of the real marginal cost in the Phillips curve based on aggregate data have implications for the structural parameters, such as the degree of nominal rigidities, which are at odds with evidence on micro data for the same parameters (i.e. the estimated coefficient is often too low compared to the one that would be consistent with micro evidence on the frequency of price adjustments). I claim that by taking into account endogenous fluctuations in the desired markup, the estimates of the effect of real marginal costs on inflation are higher and more precise.[2]

The assumption of a constant desired markup is usually relaxed in more recent models. Steinsson (2003), among many others, introduces exogenous fluctuations in the elasticity of substitution among differentiated goods which result in a markup (or cost-push) shock. In this case, variations of the desired markup enter as a residual of the inflation dynamics equation. Eichenbaum and Fisher (2007) introduce endogenous fluctuations in the desired markup assuming Kimball (1995) preferences and estimate the implied NKPC. In their specification of the inflation dynamics, however, the parameters that are relevant for the effect of competitiveness on inflation cannot be disentangled from the ones that pertain to nominal rigidities as they all enter in the coefficient of the real marginal costs. Therefore the quantitative impact of an endogenous time-varying desired markup on the inflation dynamics must be calibrated. This paper contributes to the literature since it identifies the effect of market power changes on the inflation dynamics, estimating it using a proxy for the competitive pressures in the market.

[1] One important point that is at stake in the debate is the extent to which forward and backward-looking components of inflation are relevant to explain the current one. This aspect, though extremely relevant, is not the strict focus of this paper.

[2] Galí and Gertler (1999) already suggested that with a countercyclical desired markup the implied slope of the Phillips curve would be higher.

Measuring the fluctuations of the desired markup at an aggregate level is an ambitious task due to the lack of aggregate data and the diversity of industries and market structures that are present in the economy.[3] I focus on the changes in the desired markup that are produced by fluctuations in the number of active firms in the economy. This is a rough measure of the degree of competitiveness in the market and it might be not comprehensive of all possible factors that affect market competition. However the industrial organization literature has pointed out that the relationship between market power and the number of competitors is quite robust across a broad range of industries (see e.g. Bresnahan and Reiss, 1991 and Campbell and Hopenhayn, 2005). Oliveira Martins, Scarpetta and Pilat (1996), focusing on a number of manufacturing sectors across OECD countries, find that markups tend to be lower for sectors with a high number of firms.[4] Furthermore aggregate data on the entry of firms are available for the U.S. economy for a sufficiently large span of time and display volatility at the business cycle frequency.

The proposed framework builds on the standard new Keynesian model of monopolistic competition and price stickiness. The entry decision and the number of firms, however, are determined endogenously as in the work of Floetotto and Jaimovich (2008). There is a finite number of firms that produce differentiated goods in a regime of monopolistic competition. Firms set their price by taking as given the conditional demand of their own good and the prices set by the other competitors in the market. The nominal rigidities are modeled as in Rotemberg (1982); thus firms must pay a cost when they want to change their price. The log-linear solution of the model entails an inflation dynamics equation that has the same reduced form as the forward-looking NKPC derived from a model with Calvo price stickiness but it features an additional term on the number of firms in the market, the proxy for the desired markup.

Recently several contributions in the real business cycle literature emphasized the importance of taking into account endogenous firm entry. Bilbiie et al. (2007) are among the first to introduce nominal rigidities into this kind of models, obtaining a NKPC that depends on the real marginal costs and an extra term on the number of producers (varieties, in their interpretation).

---

[3]See Rotemberg and Woodford (1999) for a comprehensive review of the markup measures.

[4]Up to my knowledge there is no time series evidence of this relationship.

They concentrate on the optimal monetary policy implications of the endogenous fluctuations of the number of products available and they point out to a potential endogeneity bias on the estimates of the Phillips curve when the number of varieties is not included, though they do not provide estimates of it.

I estimate the NKPC using the present-value approach on U.S. data, originally used in the empirical finance literature by Campbell and Shiller (1987), computing the expectations of future real marginal costs and number of firms with the projections of a VAR. Following Guerrieri et al. (2008) I estimate jointly the inflation dynamics and the VAR parameters. I focus on the estimation of two parameters: the pass-through of real marginal costs on inflation and the elasticity of the desired markup to changes in the number of firms.

The main results are the following. (i) The elasticity of the desired markup with respect to the number of firms is significantly different from zero and it implies that a theoretical increase of 10% in the number of active firms would lower annual inflation by 1.4 percentage points in the short run. (ii) The point estimate of the coefficient of real marginal costs on inflation is found to be 70% higher than in the standard case with a constant desired markup. In fact when the number of active firms and the real marginal costs are positively correlated, the increase of the latter would come with a rise of the former that, through the implied decrease of the desired markup, has a negative impact on inflation. If one omits the number of firms from the estimation of the inflation dynamics process, the estimates of the impact of the real marginal costs on inflation are biased downward.

The model with endogenous firm entry is then calibrated with some of the estimated parameters and the responses to a positive technology shock and to an expansionary monetary policy shock are compared to the ones of the benchmark NK model. While the transmission of the technology shock is affected by the presence of firm entry, as previously found by Bilbiie et al. (2005), the implications of endogenous desired markup for the monetary transmission mechanism are almost negligible.

The rest of the paper is organized as follows. Section 2 lays out the model and derives the NKPC. Section 3 describes the data, some empirical issues in the measurement of the real marginal costs as well as the number of active firms and the econometric methodology. Section 4 presents the estimation results and some robustness checks. Section 5 illustrates the implications of these results for the response to a positive technology and a tightening monetary policy shock. Section 6 concludes.

2 The Model

In this section I lay out a very basic model for a closed economy that features monopolistic competition and free entry together with price rigidities à la Rotemberg (1982). Building on Floetotto and Jaimovich (2008) the number of operating firms is an endogenous variable that causes fluctuations in the desired markup at business cycle frequencies.

2.1 Households

The representative household derives utility from consuming C_t and disutility from supplying hours of work L_t. The preferences are described by the following lifetime utility function

$$U(C_t, L_t) \equiv E_0 \sum_{t=0}^{\infty} \beta^t \left\{ logC_t - \frac{L_t^{1+\xi}}{1+\xi} \right\} \tag{1}$$

where β_t is the discount factor and ξ is the inverse of the Frisch elasticity of labor supply. The consumption that enters in the utility function is a bundle of many differentiated consumption goods aggregated as follows

$$C_t = \left[\int_0^1 C_t(j)^{\frac{\omega-1}{\omega}} dj \right]^{\frac{\omega}{\omega-1}} \tag{2}$$

where $\omega > 1$ is the elasticity of substitution among them. The representative household maximizes its lifetime utility subject to the following intertemporal budget constraint written in nominal terms

$$B_{t+1}+P_tC_t+a_tv_tP_tN_t \leq B_t(1+i_{t-1})+W_tL_t+a_{t-1}v_tP_t(1-\delta)N_{t-1}+a_{t-1}\Pi_{t-1}(1-\delta)N_{t-1}P_{t-1}$$

where B_t is a risk-free nominal bond and W_t is the nominal wage paid on hours worked. Households own a share a_t of each of the N_t firms with value v_t that are operating at time t. Each firm distributes as a dividend the entire profits earned at time t, Π_t. Every period t each firm faces an exogenous probability δ of exiting the market.

The solution of the expenditure minimization problem yields the following demand of consumption for each good j

$$C_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\omega} C_t$$

where P_t is the consumer price index

$$P_t = \left[\int_0^1 P_t(j)^{1-\omega} dj\right]^{\frac{1}{1-\omega}}.$$

At each point in time households decide how many hours they want to work and their holdings of bonds and shares. The first order conditions with respect to L_t, B_{t+1} and a_t are

$$\frac{W_t}{P_t} = L_t^{\xi} C_t \quad (3)$$

$$1 = \beta(1+i_t)E_t\left[\frac{C_t}{C_{t+1}}\frac{P_t}{P_{t+1}}\right] \quad (4)$$

$$v_t = \beta(1-\delta)E_t\left[\frac{C_t}{C_{t+1}}(v_{t+1}+\Pi_t)\right] \quad (5)$$

Equation (3) describes the labor supply of the household. The labor market is perfectly competitive; thus the household supplies hours so that the marginal rate of substitution between leisure and consumption equals the real wage. Equations (4) and (5) are the asset pricing equations of the nominal bond and the firms' shares respectively. Future firms' shares must be discounted taking into account that firms may exit the market.

2.2 Firms

The production in the economy occurs in two layers. The economy has a continuum of mass one of industries indexed by j. Each industry produces a differentiated good, $Y_t(j)$. The industry goods are imperfect substitutes for the consumers and the elasticity of substitution among them equals to $\omega > 1$. Inside each industry, a finite number of firms, indexed by i, supplies differentiated intermediate goods. The output of industry $j \in (0, 1)$ is a Dixit-Stiglitz aggregate of the production of all firms in the industry and it is defined as follows

$$Y_t(j) = N_t(j)^{-\frac{1}{\tau_t - 1}} \left[\sum_{i=1}^{N_t(j)} x_t(i,j)^{\frac{\tau_t - 1}{\tau_t}} \right]^{\frac{\tau_t}{\tau_t - 1}} \tag{6}$$

where $x_t(i,j)$ is the output of firm i in industry j and $N_t(j)$ is the number of active firms in the industry.[5] Each firm in industry j produces a differentiated good and τ_t is the elasticity of substitution among them. I assume that such elasticity is stochastic and that its variance is such that in all possible states τ_t is higher than one, implying imperfect substitutability among goods.[6] The price index of industry j is defined as

$$P_t(j) = N_t(j)^{\frac{1}{\tau_t - 1}} \left[\sum_{i=1}^{N_t(j)} p_t(i,j)^{1-\tau_t} \right]^{\frac{1}{1-\tau_t}}.$$

The intermediate good firms in each industry operate in a regime of monopolistic competition. As in the original work of Dixit and Stiglitz (1977), each producer has a finite number of competitors and chooses the price in order to maximize its profit given the conditional demand for its own good and the price set by its $N_t(j) - 1$ competitors. Firms thus take into account that their price decisions have a nonnegligible weight in the market.

The production of good $x_t(i,j)$ requires firm-specific labor with the following technology

$$x_t(i,j) = Z_t \ell_t(i,j)$$

where Z_t is an economy-wide technology shock whose stochastic process is given by

$$logZ_t = \rho_z logZ_{t-1} + \epsilon_t^z.$$

The conditional demand of the variety i of the good produced by industry j is the following

[5]The first term of the right hand side of equation (6) offsets the "love for variety" effect that is present in the Dixit-Stiglitz index of aggregation. See Bilbiie et al. (2007), Bergin and Corsetti (2005) and Fujiwara (2007) for an analysis of the implications of taking into account a time-varying number of available varieties.

[6]As explained by Steinsson (2003) this is a shortcut to introduce a cost-push shock, that is exogenous fluctuations in the desired markup. The model I propose has also endogenous fluctuations in the market power. As it will be clearer later I need to introduce exogenous markup fluctuations to estimate the Phillips curve.

$$x_t(i,j) = \left(\frac{p_t(i,j)}{P_t(j)}\right)^{-\tau_t} \frac{Y_t(j)}{N_t(j)} \tag{7}$$

$$= \left(\frac{p_t(i,j)}{P_t(j)}\right)^{-\tau_t} \left(\frac{P_t(j)}{P_t}\right)^{-\omega} \frac{Y_t}{N_t(j)}. \tag{8}$$

When the elasticity of substitution among varieties (τ) differ from the one among industries (ω), the demand of the variety $x_t(i,j)$ depends both on the price of the variety relative to the industry price index and on the relative price of the industry.

Each firm i of industry j faces a convex price adjustment cost

$$AC_t(i,j) = \frac{\theta}{2}\left[\frac{p_t(i,j)}{p_{t-1}(i,j)} - \lambda\pi_{t-1} - (1-\lambda)\right]^2.$$

Firms must pay this cost, proportional to their sales, if they want to change the price.[7] When λ is equal to zero, the producer has to pay a fixed cost for whatever change in the price he is willing to implement. When $\lambda > 0$, such cost is paid only when the desired change in price is different from the one implied by a fraction λ of the previous period inflation.[8] The real profits at time t and for the generic firm (i,j) are the following

$$\Pi_t(i,j) = x_t(i,j)\left[1 - \frac{W_t}{P_t} Z_t^{-1} - AC_t(i,j)\right]. \tag{9}$$

The value of a firm is given by the expected value of the discounted future stream of profits

$$v_t(i,j) \equiv E_t \sum_{s=t}^{\infty} Q_{t,s}\Pi_s(i,j) \tag{10}$$

where $Q_{t,s} = [\beta(1-\delta)]^{s-t} \frac{U_{c,s}}{U_{c,t}} \frac{P_t}{P_s}$.

The price setting problem is thus to maximize (10) subject to (8). I solve this problem under the assumption of symmetry both across firms belonging

[7] For simplicity I assume that also newly entered firms pay a cost to change their price so that all firms are symmetric. Bilbiie et al. (2007) consider the possibility that new entrants in their first period choose their price as if there were no nominal rigidities. They show that the dynamic responses to shocks are almost identical to the benchmark ones.

[8] This is a shortcut to introduce indexation in a way similar to Christiano, Eichenbaum and Evans (2005) but in a Rotemberg (1982) framework.

to the same industry and across industries. This implies that the optimal price, the price adjustment cost and the number of competitors are the same across industries. The first order condition is

$$(1-\tau_t)+(\tau_t-\omega)N_t^{-1}+\frac{W_t}{Z_t}p_t^{-1}\left[\tau_t-(\tau_t-\omega)N_t^{-1}\right]-$$
$$-\theta(\pi_t-\lambda\pi_{t-1})(1+\pi_t)-\frac{\theta}{2}(\pi_t-\lambda\pi_{t-1})^2\left[1-\tau_t+(\tau_t-\omega)N_t^{-1}\right]+$$
$$+\beta(1-\delta)E_t\left\{\frac{C_t}{C_{t+1}}\theta(\pi_{t+1}-\lambda\pi_t)(1+\pi_{t+1})\frac{x_{t+1}}{x_t}\right\}=0.$$

Rearranging the terms it implies the following price for all firms

$$p_t=\mu_t MC_t$$

where the nominal marginal costs MC_t are

$$MC_t\equiv Z_t^{-1}W_t$$

and the actual markup charged over marginal costs is

$$\mu_t = \frac{\tau_t-(\tau_t-\omega)N_t^{-1}}{\left[1-\frac{\theta}{2}(\pi_t-\lambda\pi_{t-1})^2\right]\left[\tau_t-1-(\tau_t-\omega)N_t^{-1}\right]+\theta\Omega} \tag{11}$$
$$\Omega \equiv (\pi_t-\lambda\pi_{t-1})(1+\pi_t)-\beta(1-\delta)E_t\left[(1+\pi_{t+1})(\pi_{t+1}-\lambda\pi_t)\frac{C_t}{C_{t+1}}\frac{x_{t+1}}{x_t}\right]$$

where I defined inflation as $\pi_t=\frac{p_t}{p_{t-1}}-1$.

When nominal rigidities are absent (i.e. when $\theta=0$), firms charge their desired markup on the nominal marginal costs. Differently from the standard New Keynesian framework, the desired markup is time-varying and it depends inversely on the number of competitors in the market[9]

$$\mu_t^n=\frac{\tau_t-(\tau_t-\omega)(N_t^n)^{-1}}{\tau_t-1-(\tau_t-\omega)(N_t^n)^{-1}}. \tag{12}$$

Conditional on the number of competitors in the market, the price elasticity of demand faced by each competitor depends on the "within industry"(τ) and "across industries"(ω) elasticity of substitution and is defined as follows

[9]The n suffix indicates the flexible price ("natural") equilibrium.

$$\varepsilon(N_t^n) = \tau_t - (\tau_t - \omega)\frac{1}{N_t^n} \tag{13}$$

Even if the variance of τ_t is equal to zero, the price elasticity is time-varying and so it is the desired markup. When $N \to \infty$, the price elasticity of demand is equal to τ_t and the desired markup does not depend on the fluctuations of the number of firms as in the standard model.

Consistently with the findings of Broda and Weinstein (2007), according to which the price elasticities of demand are higher for more disaggregated goods[10], I consider the case in which $\omega < \tau$, that is the elasticity of substitution across industries is lower than the elasticity of substitution within each industry. In this case an increase in the number of firms increases the price elasticity of demand.[11]

2.3 Entry

There is free entry in the market. At each point in time a large group of prospective entrepreneurs decides whether to create a new firm and enter the market. They compare the discounted stream of future profits with the entry cost Ψ. Differently from Bilbiie et al. (2007), the entry cost is paid in terms of output units instead of effective labor units. The free entry condition is thus

$$v_t = \Psi.$$

All firms, from the period subsequent to incorporation, face an exogenous probability δ of exiting the market. The number of firms in the economy evolves according to the following law of motion

$$N_t = (1 - \delta)N_{t-1} + N_t^e. \tag{14}$$

[10]One could think to the two layers of production as levels of statistical aggregation.

[11]The price elasticity of demand depends not only on the "within industry"elasticity of substitution (τ) but also on the extent to which the producer of a variety by changing his price is able to affect the price index of the industry ("across industries"elasticity of substitution). A decline in the firm's market share (i.e. an increase in the number of firms) would decrease the price elasticity of demand only in the theoretical case in which an increase in the price of a variety leads to a substitution away from the industry, which the variety belongs to, that is stronger than the substitution across varieties (i.e. $\omega > \tau$).

2.4 Equilibrium, aggregate accounting conditions and monetary policy

The aggregate output of firms is allocated to consumption and to pay the entry and the price adjustment cost. Thus the following accounting equation must hold

$$Y_t = Z_t N_t l_t = C_t + \Psi N_t^e + AC_t. \tag{15}$$

In a symmetric equilibrium the output of each firm is given by $x_t = \frac{Y_t}{N_t}$.

The equilibrium condition for nominal bonds and the firms' shares in the economy are $B_t = 0$ and $a_t = 1$ for each time t. The aggregate accounting equation, derived from the aggregation of the household's budget constraint is given by

$$\frac{W_t}{P_t} L_t + \Pi_{t-1}(1-\delta) N_{t-1}(1+\pi_t)^{-1} = C_t + v_t N_t^e.$$

The labor market clears when the hours demanded for the production by all firms are equal to the hours that households are willing to supply:

$$N_t l_t = L_t.$$

Finally, the conduct of monetary policy is described by a very standard Taylor rule

$$i_t = \frac{1}{\beta} - 1 + \phi_\pi \pi_t + i_t^*.$$

The i^* is an unexpected deviation from the interest rate path implied by the Taylor rule and it can be interpreted as a monetary policy shock.

2.5 Markups and the New Keynesian Phillips curve

Substituting into (11) the equilibrium condition (15) the actual markup is given by

$$\mu_t = \frac{\tau_t - (\tau_t - \omega) N_t^{-1}}{\left[1 - \frac{\theta}{2}(\pi_t - \lambda \pi_{t-1})^2\right]\left[\tau_t - 1 - (\tau_t - \omega) N_t^{-1}\right] + \theta \bar{\Omega}} \tag{16}$$

$$\bar{\Omega} \equiv (\pi_t - \lambda \pi_{t-1})(1+\pi_t) - \beta(1-\delta) E_t \left[(1+\pi_{t+1})(\pi_{t+1} - \lambda \pi_t) \frac{N_t}{N_{t+1}} \frac{1 - \frac{\theta}{2}(\pi_t - \lambda \pi_{t-1})^2}{1 - \frac{\theta}{2}(\pi_{t+1} - \lambda \pi_t)^2}\right]$$

For the moment I restrict the parameter on inflation indexation λ to be equal to zero. By log-linearizing equation (16) it results that the fluctuations in the actual markup are caused by the changes in the desired markup, which are driven by variations in the number of firms and by exogenous changes of the elasticity of substitution, and by the nominal rigidities that imply sluggish adjustment of prices after any perturbation of the steady state equilibrium. After log-linearization,[12]

$$\hat{\mu}_t = \underbrace{\frac{\theta}{\varepsilon - 1}\left[\beta(1-\delta)E_t\pi_{t+1} - \pi_t\right]}_{nominal\ rigidities} - \underbrace{\frac{\tau - \varepsilon}{(\varepsilon - 1)\,\varepsilon}\hat{n}_t}_{endogenous\ desired\ markup} + \underbrace{\frac{\tau(N^{-1}-1)}{(\varepsilon-1)\varepsilon}\hat{\tau}_t}_{exogenous\ desired\ markup} \tag{17}$$

Rearranging the terms, I obtain the usual form of the NKPC

$$\pi_t = \beta(1-\delta)E_t\pi_{t+1} + \kappa\widehat{rmc}_t - \kappa\eta\hat{n}_t + u_t \tag{18}$$

where $\kappa \equiv \frac{\varepsilon-1}{\theta}$ and $u_t \equiv \frac{\tau(N^{-1}-1)}{(\varepsilon-1)\varepsilon}\hat{\tau}_t$. The parameter η is the elasticity of the desired markup with respect to the fluctuations in the number of active firms and it is defined as follows

$$\eta \equiv \frac{\partial\mu^n(N)}{\partial N}\frac{N}{\mu^n(N)} = \frac{\tau - \varepsilon}{(\varepsilon-1)\varepsilon}.$$

When this elasticity is equal to zero, that is the desired markup does not fluctuate in response to changes in the number of active firms, the model implies a standard NKPC.

In the case of indexation, i.e. $\lambda > 0$, I obtain the so-called hybrid NKPC that features a backward-looking term on inflation

$$\pi_t = \frac{\beta(1-\delta)}{1+\beta(1-\delta)\lambda}E_t\pi_{t+1} + \frac{\lambda}{1+\beta(1-\delta)\lambda}\pi_{t-1} + \frac{\kappa}{1+\beta(1-\delta)\lambda}\widehat{rmc}_t - \frac{\eta\kappa}{1+\beta(1-\delta)\lambda}\hat{n}_t + u_t. \tag{19}$$

Henceforth I consider as a benchmark for the empirical exercise equation (18). However I also estimate equation (19) to check the robustness of the results as many studies have found a significant role for lagged inflation in the inflation dynamics.

[12]Henceforth I write $\varepsilon = \varepsilon(\bar{N})$ for shortness, where $\varepsilon(\cdot)$ is defined in equation (13); furthermore τ without a time subscript indicates the steady state level of the elasticity of substitution.

3 Empirical issues

This section discusses some of the issues that are related to the estimation of the NKPC derived in section 2. I first examine how to measure the real marginal costs and the number of firms in the data. Then I present the empirical methodology with which I intend to proceed with the estimation.

3.1 Data and measurement issues

In order to estimate the NKPC implied by the model, some issues about the measurement of the real marginal costs and of the number of firms must be discussed. In fact, real marginal costs are not directly observable in the data. The model, however, provides some conditions under which they can be constructed from available data. It has been shown that with a Cobb-Douglas technology the real marginal costs are proportional to the real unit labor costs.

$$\begin{aligned} RMC_t &= \frac{W_t}{P_t} Z_t^{-1} \\ &= \frac{W_t L_t}{Y_t P_t} \equiv S_t, \end{aligned}$$

where S_t is an observable variable.[13]

For what concerns the measurement of the number of firms, only data on the number of newly entered firms (i.e. new incorporations) are available at quarterly frequency and for a sufficiently large span of time.[14] Data on business failures are available only for a subset of industries[15] and thus they are not comparable with those on new incorporations. Furthermore the business failures series has a discontinuity in 1984 and, up to my knowledge, reconstructed data are available only at annual frequency (see Naples and Arifaj, 1997). To overcome the lack of data I proceed in two different ways. Using some conditions of the model, I rewrite the NKPC so that it

[13] I abstract from capital accumulation. However one can show that in a model with capital accumulation real marginal costs are the same up to a first order approximation.

[14] These data are in the Survey of Current Business published by the BEA. They are collected by the Dun & Bradstreet corporation and are available until 1998. An index of net business formation is also available for the same period.

[15] Namely the commercial and industrial sectors.

features the number of new entrants as a driving force of inflation instead of the stock of active firms (see section 3.2). This is the equation on which are based the benchmark estimates of the paper. Furthermore, to confirm the robustness of the results exercises, I use data on the total number of firms reconstructed in a way that is consistent with the model. From equation (14), that is the dynamic evolution of business population, using the data on new incorporations and calibrating the parameter for the probability of a firm of exiting the market, δ, I can retrieve the data on the stock of existing firms. As initial condition I use the number of firms that were active in December 1947.[16] A plausible calibration of δ can be derived using the annual data on business failures.[17] In the sample period of 1988-1998, on average 12% of the total number of firms active in the U.S. economy fails each year. This implies a calibration of 0.03 for δ. The business failures are countercyclical, as documented by Bilbiie et al. (2005). My model, by considering a constant fraction of firms exiting the market, undervalues the impact of $\hat{n}_t$ on the business cycle.

As a measure of inflation I use the log differences of the GDP deflator for two reasons. First of all, most of the literature estimate the NKPC using the changes in the GDP deflator as a measure of inflation, thus results are more easily comparable. Secondly, the GDP deflator reflects the prices of all domestically produced goods, excluding import prices, thus it is the appropriate inflation measure for the closed economy described in the model. Appendix A illustrates the data source and shows the plots of the real marginal costs and the constructed data for the number of firms.

Solving forward the NKPC (18) I have

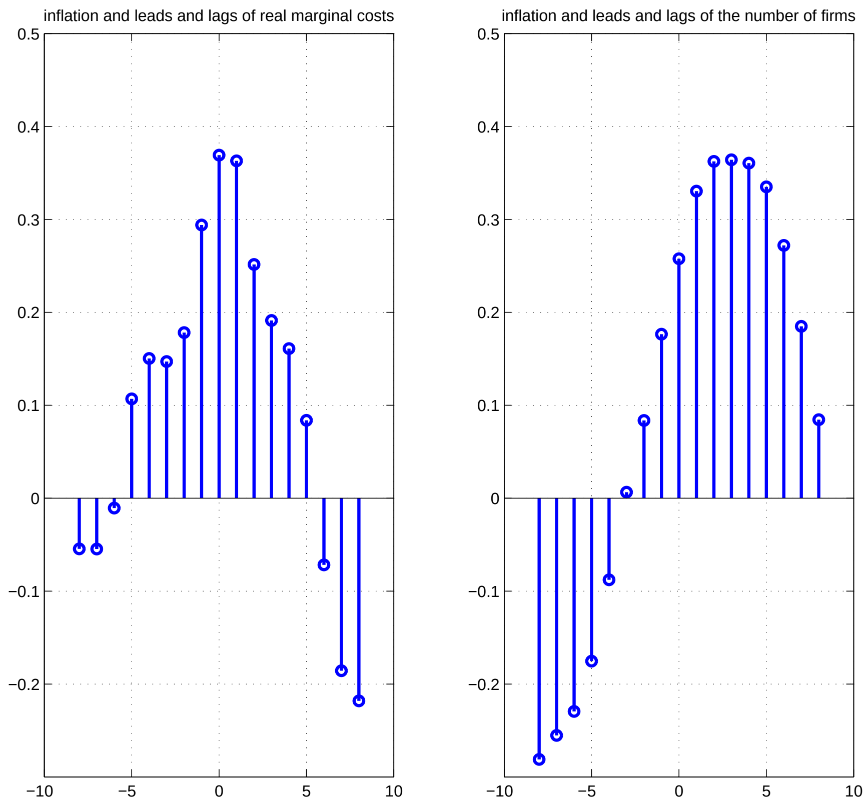
$$\pi_t = \kappa E_t \sum_{j=0}^{\infty} [\beta(1-\delta)]^j \, \widehat{rmc}_{t+j} - \kappa\eta E_t \sum_{j=0}^{\infty} [\beta(1-\delta)]^j \, \hat{n}_{t+j} + u_t. \tag{20}$$

According to the model, current inflation should be correlated with leads of both the log deviations from steady state of the real marginal costs and of the number of firms. Figure 1 shows the cross correlograms of inflation with real marginal costs and the (reconstructed series of the) number of firms.

[16]This information is available from the Economic Report of the President of 1948, available through the Federal Reserve of Saint Louis (FRED) database.

[17]The U.S. Small Business Administration has detailed data on the total number of firms and the business demography. However, the observations are annual and they start starting from 1988.

Figure 1: Dynamic correlation of inflation and leads and lags of real marginal costs and the number of firms.



Notes: Data are in logs and they have been HP-filtered. Sample period: 1960q1-1998q4.

The maximum correlation of inflation with the measured real marginal costs and the number of firms is obtained for leads of both variables as predicted by the model. Regarding the sign of the comovements, these unconditional correlations are not too informative and the estimation of the inflation dynamics equation is needed to carry out a meaningful comparison with the model's predictions.

Table 1 reports the unconditional correlations of the relevant series. It shows that the reconstructed series for the number of firms is procyclical and

Table 1: Correlations

	Real unit labor costs	*Number of firms*	*Real GDP*
Real unit labor costs	1.000 (—)		
Number of firms	0.381 (0.000)	1.000 (—)	
Real GDP	-0.287 (0.000)	0.250 (0.002)	1.000 (—)

Notes: Data are in logs and they have been HP-filtered. Sample period: 1960q1-1998q4. In brackets the p-value of the t-statistics test on the significance of the correlation.

that it is positively correlated with my measure of the real marginal costs.

3.2 Empirical methodology

The estimation of the NKPC, as equation (18), is challenging since it involves the measurement of expectations. The empirical methodologies that have been used so far have been strongly debated[18]. The approaches, proposed respectively by Galí and Gertler (1999) and Sbordone (2002), handle the expectation term in the inflation dynamics equation differently. The former exploits the rational expectations hypothesis to have an orthogonality condition to estimate the NKPC with GMM; the latter estimates the closed form solution of the NKPC using a two-step procedure that involves obtaining the projections of the relevant variables from a VAR and using a distance estimator to find the values of the structural parameters.

As discussed in the previous section, data on the number of active firms are not available and one has to make some assumptions in order to reconstruct them from the available data on new entry of firms. However, working with the closed-form solution and using the dynamics of the number of firms of the model in equation (14), I can rewrite equation (20) so that the NKPC depends on the number of new entrants instead of the stock of existing firms.

[18] See the Journal of Monetary Economics issue of 2005 on the econometrics of the new Keynesian price equation.

$$\pi_t = \kappa \sum_{j=0}^{\infty} \beta^j (1-\delta)^j E_t \widehat{rmc}_{t+j} - \frac{\kappa\eta\delta}{1-\beta(1-\delta)^2} \left[\sum_{h=1}^{\infty} (1-\delta)^h \hat{n}^e_{t-h} + \sum_{j=0}^{\infty} \beta^j (1-\delta)^j E_t \hat{n}^e_{t+j} \right] + u_t. \tag{21}$$

I estimate the closed-form equation above in the same spirit as Sbordone (2002). However instead of using her two-step procedure, that is estimate the VAR first and then use a simple minimum distance criterion to find the relevant parameters of the NKPC, I estimate jointly all the parameters as in Guerrieri et al. (2008). This is a one step-procedure that allows to take better into account the uncertainty around the estimates of the NKPC parameters.

As in Sbordone (2002) I construct the expectations of future real marginal cost and new incorporations from the projections of a VAR. The VAR is specified as follows

$$x_t = Ax_{t-1} + \epsilon_t \tag{22}$$

where $x_t = [\widehat{rmc}_t \ \hat{n}^e_t]'$. After having incorporated such assumptions on the representation of the real marginal costs and the new incorporations series into equation (21), I jointly estimate with GMM the system composed by (22) and the following equation

$$\pi_t = \kappa e_1'[I-\beta(1-\delta)A]^{-1}x_t - \frac{\delta\kappa\eta}{1-\beta(1-\delta)^2} \left\{ e_2'[I-\beta(1-\delta)A]^{-1}x_t + \sum_{h=1}^{L} (1-\delta)^h e_2' x_{t-h} \right\} + u_t \tag{23}$$

where e_1' and e_2' are vectors that select the real marginal cost and the new incorporations respectively. Appendix B shows the algebraic details.

To deal with the backward-looking terms in the LHS I have to arbitrarily truncate the infinite sum of past realizations of the new incorporations. In the benchmark specification I set L equal to 3. I then perform a check on the robustness of the estimates to this truncation.[19] As pointed out by Guerrieri et al. (2008) this estimation methodology requires to model an error in equation (21), which, in this case, is represented by an iid markup shock

[19] This truncation implies that the uncertainty around the estimates is higher since we are using a constructed regressor for the number of firms. However since the standard errors of the estimates are very similar across different choices of the truncation parameter L, we conclude that the additional uncertainty is small.

(i.e. $u_t \equiv \frac{\tau(N^{-1}-1)}{(\varepsilon-1)\varepsilon}\hat{\tau}_t$). As a benchmark set of instruments I use two lags of inflation, real GDP, wage inflation, real marginal costs. All variables, except inflation and wage inflation, are in logs and detrended with a polynominal of third order.[20] I do not consider as instruments the lagged values of the new incorporations, since they could bias the estimates given their direct impact on inflation according to the theoretical specification of the NKPC. Following Eichenbaum and Fisher (2007) I also present results for a different set of instruments that include current and five lags of the monetary policy and technology shocks as identified in Altig et al. (2005).

In the above equation I identify only two parameters: the pass-through of real marginal cost on inflation, κ, and the elasticity of the desired markup with respect to the number of firms, η. I need to calibrate the exit rate of firms δ and the discount factor β. I consider a value of 0.03 for δ, as explained in section 3.1, and I set $\beta = 0.99$ as it is usual in the business cycle literature. I thus estimate the parameters κ and η together with the VAR companion matrix. Unfortunately, the steady state level of the price elasticity of demand, ε, and the curvature of the price adjustment function θ are not separately identifiable. My estimation results are thus comparable only with the reduced form parameter that measures the slope of the Phillips curve obtained in previous contributions of the literature.

The positive comovement between the real marginal costs and the number of firms (see table 1) suggests that if one omits the number of firms from the standard NKPC the estimates of the coefficient on real marginal costs is smaller and it might not be significant. This is because the increase in real marginal costs would come with a rise in the number of entrants that decreases the desired markup, partially compensating the inflationary pressures of the increasing real marginal costs. By explicitly considering the fluctuations of the markup that comes from those changes in competitiveness due to new entrants, one can disentangle the effect of real marginal costs on the inflation dynamics from the one of decreasing market power.

[20] I use the polynomial detrending method, instead of the HP filter used before, as the GMM orthogonality conditions might be affected by the latter procedure which uses both backward and forward information to extract the cyclical component from the time series. The cyclical components extracted under the two procedures are however strongly correlated.

4 Estimation results

Table 2 shows the estimates of the NKPC in the case of endogenous firm entry and in the standard case, which is the model in which the parameter η is restricted to be zero in the estimation (i.e. the fluctuations in the number of firms do not affect the inflation dynamics).

Table 2: Estimates of the Phillips curve with firm entry

	with firm entry	*standard*	*with firm entry*	*standard*
κ	0.03	0.018	0.055	0.051
	(0.007)	(0.006)	(0.010)	(0.014)
η	1.172	-	0.786	-
	(0.221)	-	(0.296)	-
VAR estimates:				
a_{11}	0.953	0.949	0.919	0.887
	(0.015)	(0.024)	(0.053)	(0.041)
a_{12}	0.014	-	0.021	-
	(0.003)	-	(0.009)	-
a_{22}	0.927	-	0.846	-
	(0.011)	-	(0.044)	-
a_{21}	-0.219	-	-0.783	-
	(0.052)	-	(0.252)	-
J-statistic	12.84	10.39	12.1	9.87
	[0.30]	[0.32]	[0.36]	[0.54]
g_{min}	27.18	74.87	0.39	1.77
crit. values	16.80	15.18	4.75	4.75
Instrument set	**A**	**A**	**B**	**B**

Notes: Sample: 1960q1-1998q4. Standard errors are in brackets. P-values are in square brackets. The covariance matrix has been computed with a 12-lag Newey-West estimator. g_{min} is the Cragg-Donald statistics and the critical values are those of table 5.1 of Stock and Yogo (2005). Instrument set **A** includes two lags of inflation, real marginal costs, detrended real GDP and wage inflation. Instrument set **B** includes current and five lags of identified monetary policy and technology shocks.

As it is shown in the first column, the coefficient on real marginal cost fluctuations (κ) and the elasticity of the desired markup with respect to the number of market participants (η) are both significantly different from zero.[21] The estimate of κ suggests that measured real marginal costs are a relevant

[21] I computed Newey-West corrected standard errors with 12 lags since the estimated

driving force of the inflation dynamics as found by Galí and Gertler (1999) and Sbordone (2002). The estimate of η indicates that, when the number of firms that are active in the economy increases, the market power of firms declines as predicted by the model. The benchmark estimate for η implies that a theoretical 10% increase of the number of firms from the steady state would bring down the desired markup by about 12%; this, in turn, would lower annual inflation of about 1.4% in the short run.

The point estimate of the real marginal cost pass-through is almost 70% higher than what obtained by estimating with the same methodology the standard curve without endogenous firm entry. As explained above, omitting the fluctuations of the desired markup from the empirical specification of the inflation dynamics generates a downward bias in the estimates of the coefficient on real marginal costs. Such bias however is relatively small in size. The value of κ estimated in the standard case lies in the confidence interval of the estimates of the inflation dynamics curve with firm entry.

This paper is not the first one that provides evidence which suggests that the NKPC is not as flat as baseline estimations seem to imply. Imbs et al. (2007) show that heterogeneity in pricing behavior matters for assessing the driving forces of inflation. Not accounting for it generates a downward bias in the estimation of the coefficient of aggregate marginal costs on aggregate inflation. Küster et al. (2007) found that if shocks to the price markup are persistent and negatively correlated with the real unit labor costs the estimated pass-through of measured marginal costs into inflation is limited, even if prices are fairly flexible. Here endogenous fluctuations in the desired markup, due to entry and exit of firms, imply that the estimated pass-through is higher. The intuition behind this result is the same as the one of Küster et al. (2007) but an economically more sound explanation of the cost-push shock usually added in the inflation equation is provided.[22]

In order to check whether the chosen set of instruments is sufficiently correlated with independent variables, table 2 also reports the Cragg-Donald statistics. Compared with the critical values computed by Stock and Yogo (2005) I can reject the null hypothesis of instrument weakness. In order to test for the validity of the overidentifying restrictions the J statistics is re-

residuals show some autocorrelation under both the standard and the endogenous firm entry specification.

[22]This shock, even in large-scale estimated model, plays an important role in explaining inflation. In an estimated model for the euro area, Smets and Wouters (2003) found that it accounts for at least 50% of the volatility of inflation.

ported. It indicates that such restrictions are satisfied. I also estimate the same system with a different set of instruments that includes the identified current and lagged monetary policy and technology shocks. The results are more or less in line with those obtained with the benchmark set of instruments, though the elasticity of the desired markup is somewhat lower and the slope of the Phillips curve higher. In this case the null hypothesis for the validity of overidentifying restrictions is accepted, however the Cragg-Donald statistics suggests that these instruments are weak. For this reason, from now on I consider estimates based on the benchmark set of instruments.

Table 3: Robustness checks

		Truncation lags			*Calibration of δ*		*Forecasting VAR*
		$L=1$	$L=2$	$L=4$	$\delta=0.01$	$\delta=0.04$	
κ	*firm entry*	0.022 (0.006)	0.022 (0.007)	0.025 (0.006)	0.028 (0.007)	0.031 (0.007)	0.023 (0.005)
	standard	0.018 (0.006)	0.018 (0.006)	0.018 (0.006)	0.014 (0.006)	0.02 (0.006)	0.018 (0.006)
η		3.51 (0.621)	1.75 (0.357)	1.19 (0.248)	1.17 (0.201)	1.00 (0.188)	1.50 (0.326)
J	*firm entry*	12.32 [0.26]	12.66 [0.24]	12.14 [0.28]	12.88 [0.23]	12.82 [0.23]	12.60 [0.34]
	standard	10.39 [0.32]	10.39 [0.32]	10.39 [0.32]	10.39 [0.24]	10.39 [0.24]	10.39 [0.32]

Notes: Standard errors are in brackets. P-values are in square brackets. The covariance matrix has been computed with a 12-lag Newey-West estimator. J is the J-statistics for overidentifying restrictions.

The estimation of equation (21) required to make some assumptions about the calibration of the average rate of firm exit, the number of lags at which the new incorporations terms are truncated and the specification of the VAR to produce forecasts of the real marginal costs and the new incorporations. Table 3 shows the results of the estimated NKPC parameters when such assumptions are modified. The benchmark estimates are generally robust to such changes. The forecasting VAR used in the estimates of the last column of table 3 is restricted so that the lags of the real marginal costs do not affect the new incorporations. Such restrictions are justified by the fact that the corresponding coefficient is not significant in the benchmark estimates.

Table 4: Robustness checks - Alternative samples and detrending

		Subsample stability		*Detrending*
		1960q1-1983q4	1984q1-1998q4	fourth order polynomial
κ	*firm entry*	0.074 (0.011)	0.012 (0.002)	0.037 (0.008)
	standard	0.033 (0.007)	0.007 (0.003)	0.017 (0.006)
η		1.09 (0.123)	1.92 (0.376)	1.15 (0.185)
obs		96	60	156
J stat	*firm entry*	8.53 [0.58]	6.26 [0.79]	12.78 [0.17]
	standard	8.17 [0.42]	5.80 [0.67]	10.17 [0.18]

Notes: Standard errors are in brackets. P-values in square brackets. The covariance matrix has been computed with a 12-lag Newey-West estimator.

Table 4 reports the results of other robustness checks. In the first two columns I show the estimates of the NKPC in two subsample periods. I split the sample at the year 1984 since much of the literature on the Great Moderation in the U.S. economy agrees in recognizing it as a relevant breakdate. The results are approximately similar to those found in the estimates over the whole sample. In particular the increase in the estimates of the marginal cost coefficient when taking into account the firm entry dynamics is of the same order of what found in the benchmark case. The third column of the table displays the estimates in the case in which a different detrending procedure, namely a fourth order polynomial trend, is applied to the real marginal cost and the new incorporations series.[23]

I also check whether the results are robust to the econometric methodology that has been considered so far. Instead of considering the closed form

[23]Detrending with a linear and quadratic trend does not eliminate the unit root in the new incorporations series and the GMM estimation procedure requires stationary time series.

Table 5: Robustness checks - Alternative econometric methodologies

	Reduced form estimates		FIML	
	with firm entry	*standard*	*with firm entry*	*standard*
κ	0.018	0.006	0.031	0.023
	(0.009)	(0.008)	(0.009)	(0.007)
κ_n	-0.011	–	–	–
	(0.004)	–	–	–
$\beta(1-\delta)$	0.980	0.909	–	–
	(0.031)	(0.029)	–	–
η	–	–	1.155	–
	–	–	(0.451)	–
g_{min}	91.99	119.39	–	–
crit vals	17.8	16.8	–	–

Notes: Standard errors are in brackets. The covariance matrix has been computed with a 12-lag Newey-West estimator. The specification for the reduced form estimates is $\pi_t = \beta(1-\delta)E_t\pi_{t+1} + \kappa\widehat{rmc}_t + \kappa_n\hat{n}_t$. The instrument set include 4 lags of inflation and 2 lags of the real marginal costs, the number of firms, the wage inflation and the detrended real GDP.

of the NKPC, I also estimate equation (18). The results are in table 5. I used the series for the number of firms constructed in the way explained in section 3.1. Parameters have been estimated with GMM, which in this linear case coincide with the two-stage least square estimator. The set of instruments include: four lags of inflation and two lags of wage inflation, the output gap, the real marginal costs and the number of firms. The data for my measure of real marginal costs and the number of firms have been detrended with a third order polynomial. The estimates above imply that η is significant and equals 0.6. Since GMM have been criticized on the grounds of delivering poor small sample properties when instruments are weakly identified, I consider also the estimation of the system of equations (21) and (22) using a full information approach. The system of equations is estimated with maximum likelihood. The results are in line with those produced by a limited information approach (see the second column of table 5).

Table 6 presents the estimates of the hybrid version of the NKPC above, namely the one in which firms pay a cost in order to change their price by more or less than a fraction λ of the previous period inflation. The current inflation dynamics in this case depend also on lagged inflation as evidenced in

Table 6: Estimates of the hybrid New Keynesian Phillips curve

	with firm entry	*standard*
κ	0.002	0.001
	(0.001)	(0.001)
η	0.937	-
	(0.468)	-
λ	0.316	0.341
	(0.026)	(0.021)
J-stat	11.630	9.650
	[0.39]	[0.38]

Notes: Standard errors are in brackets. P-values are in square brackets. The covariance matrix has been computed with a 12-lag Newey-West estimator.

equation (19) derived above.[24] In this case neglecting endogenous firm entry implies that the estimates of κ are not significant, while they are significant, though lower than the benchmark one, when the new incorporations series is taken into account. The parameter η is significant and it has a value in line with the one of the benchmark estimates. The parameter λ that indicates the degree of indexation to past inflation of firms is significant and it has a similar magnitude in the standard model and in the one with firm entry.

5 The model's responses to technology and monetary policy shocks

In this section, I use the estimates obtained in the previous section to analyze the changes in the transmission mechanism of technology and monetary policy shocks when considering the endogenous firm entry. To this end, I plot the impulse response functions of the model described above and the one of the standard model of constant desired markup. While the transmission of the technology shock is affected by the presence of firm entry, as previously found by Bilbiie et al. (2005), the implications of endogenous desired markup for the monetary transmission mechanism are almost negligible.

The calibration of the model is illustrated in table 7. I choose standard values of the parameters that I cannot back out from the estimation results.

[24]The closed form of the hybrid NKPC that is estimated is equation (26) in the appendix.

Table 7: Calibrated parameter values

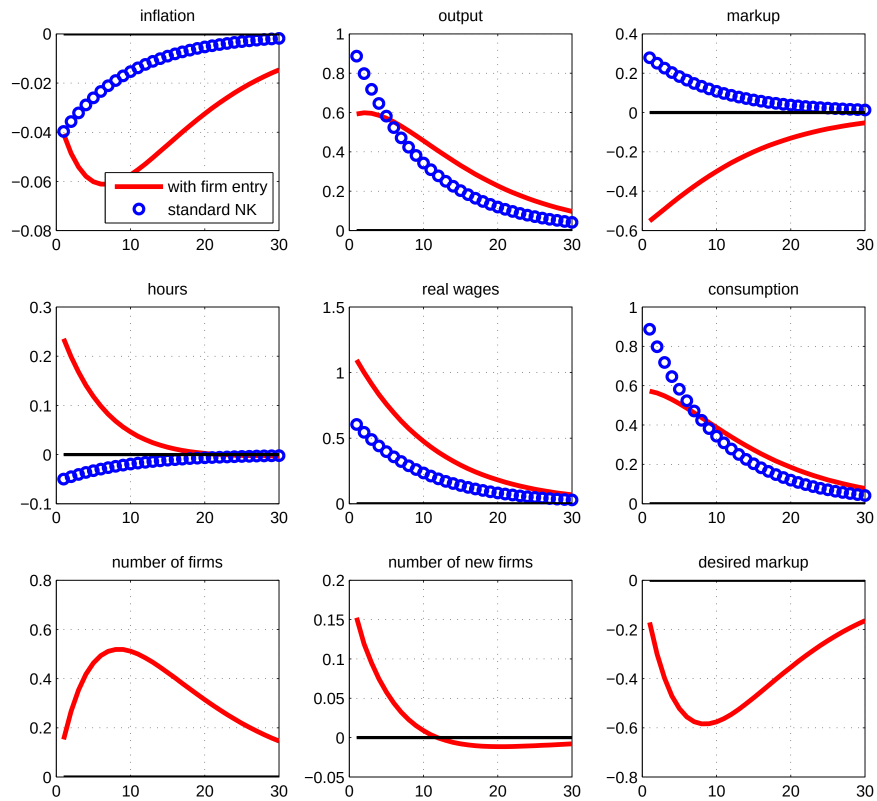
β	0.99	Subjective discount factor
δ	0.03	Exit rate of firms
φ	3	Inverse of the labor supply elasticity
θ	165	Degree of price stickiness
ϕ	0.127	Fixed cost of production
τ	17	Elasticity of substitution across goods
ω	2.001	Elasticity of substitution across sectors
Ψ	2.424	Entry cost
ρ_z	0.9	Persistence of the technology shock
ψ_π	1.5	Taylor rule coefficient

The inverse elasticity of labor supply ξ is set to 3 and the discount factor β to 0.99. The average exit rate δ is computed from annual data on firms' death, as explained in section 3.1, and it is equal to 3%. The degree of price stickiness θ can be inferred from the estimates presented in the previous section. Given that κ is estimated to be equal to 0.03 and assuming a steady state markup of 30%, the price elasticity of demand in steady state is equal to 4.33. Knowing that $\kappa = \frac{\varepsilon-1}{\theta}$ I thus set θ equal to 165, a somewhat higher value than the one estimated in the context of a full-fledged DSGE model with maximum likelihood by Ireland (2001). The parameter τ is chosen to match the estimated elasticity of desired markup to changes in the number of competitors η. I estimate $\eta = 1.1$; using the ε specified above, I set τ equal to 17. I then choose ω equal to 2 in order to have the steady state number of firms consistent with a steady state markup μ of 1.3. The entry cost Ψ is determined in the steady state equilibrium. The persistence parameter of the technology shock is calibrated to 0.9. The monetary policy response to inflation, that is the Taylor rule coefficient ψ_π, is set to 1.5 in order to guarantee the uniqueness of the equilibrium.

Figure 2 shows the impulse response functions to a one standard deviation positive technology shock in a standard New Keynesian model with Rotemberg price adjustment cost and in the model presented above with endogenous firm entry.

A positive technology shock boosts output and consumption. In the model with endogenous firm entry output increases both at the intensive

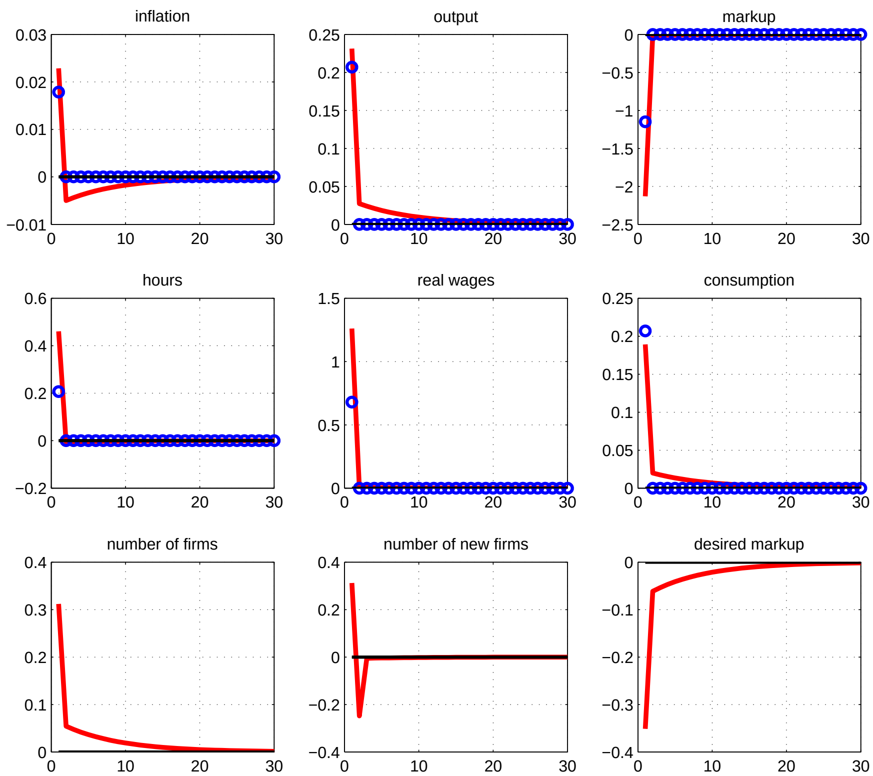
Figure 2: Impulse response functions to a 1% st. dev. positive technology shock



Notes: The dotted blue lines are the responses of each variables in the standard NK model; the solid red lines are those in the model with endogenous firm entry

and extensive margin on impact. In the next periods however output per firm is below the steady state. After the shock, it becomes more profitable for firms to enter the market and the total number of firms increases. Interestingly, the model predicts that total hours increase after an improvement in the labor productivity. Such increase is at the extensive margin, while hours per firm decline (not shown in the figure) as in the basic NK model. This suggests that some of the evidence found on the positive response of hours to a technology shock (see Christiano et al., 2003) is still consistent

Figure 3: Impulse response functions to a iid 1% st. dev. expansionary monetary policy shock



Notes: The dotted blue lines are the responses of each variables in the standard NK model; the solid red lines are those in the model with endogenous firm entry

with the existence of nominal rigidities once we endogenize the dynamics of firm entry. Real wages increase since the producers must offer a higher wage in order to induce households to work. The response of markups is dramatically different from the baseline model. Conditional on a technology shock, the actual markups are countercylical in my model, consistently with the evidence provided by Colciago and Etro (2010), while they are procyclical in the baseline NK model. In the model presented above, the drop in the desired markup generated by the entry of new firms when technology improves drives down the actual markup. While in the standard NK model the real marginal costs decline because of the increased productivity, in the model with firm entry the rise of real wages offsets the downward effect of the technology shock on the real marginal costs. Inflation nevertheless declines because of the competitiveness pressures coming from the increased number of firms in the market.

Figure 3 displays the impulse response functions to an expansionary monetary policy shock. The decrease of the real interest rate implies an increase of output, hours worked and consumption. The model predicts that loosening monetary policy implies an expansion of the entry of new firms.[25] The positive response of the number of competitors in the market to the shock generates a decline in the desired markup that dampens the increase of inflation relative to the baseline model.

6 Conclusions

Although the inflation dynamics has been thoroughly studied, there is still some uncertainty surrounding the determinants of inflation. While Galí and Gertler (1999) and Sbordone (2002) found an important role of the real unit labor cost as one of the main driving forces of inflation, Rudd and Whelan (2005) questioned such result. The paper claims that neglecting the effect of changes in the competitiveness across firms at business cycle frequency results in underestimating the importance of the marginal cost on the inflation dynamics. In a model of monopolistic competition, price stickiness and free entry in which the desired markup fluctuates in response to changes in the number of active firms in the economy, the implied NKPC inflation depends not only on the marginal cost, but also on the number of firms, a proxy for the changes in market power. The curve is empirically tested using the methodology of Guerrieri et al. (2008). The pass-through of the real marginal costs on aggregate inflation is higher than in baseline estimates in which the number of firms is not considered. Furthermore the elasticity of the desired markup with respect to the number of firms in the market is estimated to be significantly different from zero. Using the estimated parameters, I calibrate the general equilibrium model to compare the responses to a technology and monetary policy shock with those of a basic New Keynesian

[25] This is in line with evidence found by Lewis (2009), who shows that a monetary policy contraction induces a drop in the number of new firms in the medium term.

model. Endogenous time-varying markups affect the transmission mechanism of a technology shocks, while it affects almost negligibly the transmission of monetary policy impulses. Interestingly, the model predicts that total hours increase after an improvement in the labor productivity. Such increase is due to the extensive margin, while hours per firm decline as in the basic NK model. This suggests that some of the evidence found on the positive response of hours to a technology shock (see Christiano et al., 2003) is still consistent with the existence of nominal rigidities once we endogenize the dynamics of firm entry.

References

[1] Altig, David, Larry Christiano, Martin Eichenbaum and Jasper Lindé (2005), "Firm specific capital, nominal rigidities and the business cycle", NBER Working Paper No. 11034

[2] Bergin, Paul and Giancarlo Corsetti (2005), "Towards a Theory of Firm Entry and Stabilization Policy", NBER WP No. 11821

[3] Bilbiie, Florin O., Fabio Ghironi and Marc J. Melitz (2005), "Endogenous Entry, Product Variety and Business Cycles", mimeo University of Oxford, Boston College and Princeton University

[4] Bilbiie, Florin O., Fabio Ghironi and Marc J. Melitz (2007), "Monetary Policy and Business Cycle with Endogenous Entry and Product Variety", *NBER Macroeconomics Annual*, **22**

[5] Bresnahan, T.F. and P.C. Reiss (1991), "Entry and Competition in Concentrated Markets", *Journal of Political Economy*, **99** (5): 977-1009

[6] Broda, Christian and David E. Weinstein (2007), "Product Creation and Destruction: Evidence and Price Implications,", NBER Working Papers No. 13041

[7] Campbell, Jeffrey R. and Hugo A. Hopenayn (2005), "Market Size Matters", *Journal of Industrial Economics*, **53**(1): 1-25

[8] Campbell, J. Y. and Shiller, R. (1987), "Cointegration and tests of the present value relation", *Journal of Political Economy*, **95** (5): 1062-1088

[9] Christiano, Lawrence J., Martin Eichenbaum and Charles L. Evans (2005), "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy", *Journal of Political Economy*, **113** (1): 1-45

[10] Christiano, Lawrence J., Martin Eichenbaum and Robert Vigfusson (2003), "What Happens After a Technology Shock?,"NBER Working Papers No. 9819

[11] Colciago, Andrea and Federico Etro (2010), "Endogenous Market Structure and the Business Cycle, "*Economic Journal*, forthcoming

[12] Dixit, Avinash and Joe Stiglitz (1977), "Monopolistic Competition and Optimum Product Diversity", *American Economic Review*, **67**(3): 297-308

[13] Eichenbaum, Martin and Jonas D.M. Fisher (2007), "Estimating the frequency of price re-optimization in Calvo-style models", *Journal of Monetary Economics*, **54** (7): 2032-2047

[14] Floetotto, Max and Nir Jaimovich (2008), "Firm Dynamics, Markup Variations and the Business Cycle", *Journal of Monetary Economics*, **55** (7): 1238-1252.

[15] Fujiwara Ippei (2007), "Rethinking Price stability in an economy with endogenous firms entry: real imperfections under product variety", mimeo Bank of Japan

[16] Galí, Jordi and Mark Gertler (1999), "Inflation Dynamics: A Structural Econometric Analysis", *Journal of Monetary Economics*, **44** (2): 195-222

[17] Guerrieri, Luca, Christopher Gust and David López-Salido (2008), "International competition and inflation: a New Keynesian perspective ", International Finance Discussion Papers No. 918, Board of Governors of the Federal Reserve System

[18] Imbs, Jean, Eric Jondeau and Florian Pelgrin (2007), "Aggregating Phillips curves", CEPR Discussion paper no. 6184

[19] Ireland, Peter (2001), "Sticky-price model of the business cycle: Specification and stability", *Journal of Monetary Economics*, **47**(1): 3-18

[20] Kimball, Miles S. (1995), "The Quantitative Analytics of the Basic Neomonetarist Model", *Journal of Money, Credit and Banking*, **24**(4)

[21] Küster Keith, Gernot Müller and Sarah Stölting (2007), "Is the New Keynesian Phillips Curve Flat?", *Economics Letters*,**103**(1): 39-41

[22] Lewis, Vivien (2009), "Macroeconomic Fluctuations and Firm Entry: Theory and Evidence", *Macroeconomic Dynamics*,**13**(05): 605-624

[23] Oliveira Martins, Joaquim, Stefano Scarpetta and Dirk Pilat (1996), "Mark-up pricing, market structure and the business cycle", *OECD Economic Studies* no. 27

[24] Naples, Michele I. and Arben Arifaj (1997), "The Rise in U.S. Business Failures: Correcting the 1984 data discontinuity", *Contributions to Political Economy*, **16**(1): 49-59

[25] Rotemberg, Julio (1982), "Sticky Prices in the United States", *Journal of Political Economy*, **90**(6): 1187-1211

[26] Rotemberg, Julio and Michael Woodford (1999), "The Cyclical Behavior of Prices and Costs", NBER Working paper No. 6909

[27] Rudd, J. and K. Whelan (2005), "New Tests of the New Keynesian Phillips Curve", *Journal of Monetary Economics*, **52** (6):1167-1181

[28] Rudd, J. and K. Whelan (2006), "Can Rational Expectations Sticky-Price Models Explain Inflation Dynamics? ", *American Economic Review*, **96**(1): 303-320

[29] Sbordone, Argia (2002), "Prices and Unit Labor Costs: A New Test of Price Stickiness", *Journal of Monetary Economics*, **49** (2): 265-292

[30] Smets, Frank and Raf Wouters (2003), "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area" *Journal of the European Economic Association*, **1** (5): 1123-1175

[31] Steinsson, Jón (2003), "Optimal Monetary Policy in an Economy with Inflation Persistence", *Journal of Monetary Economics*, **50** (7): 1425-1456

[32] Stock, James H. and Motohiro Yogo (2005), “Testing for Weak Instruments in Linear IV Regression ”, in D.W.K. Andrews and J. H. Stock, eds., *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, Cambridge University Press, pp. 80-108

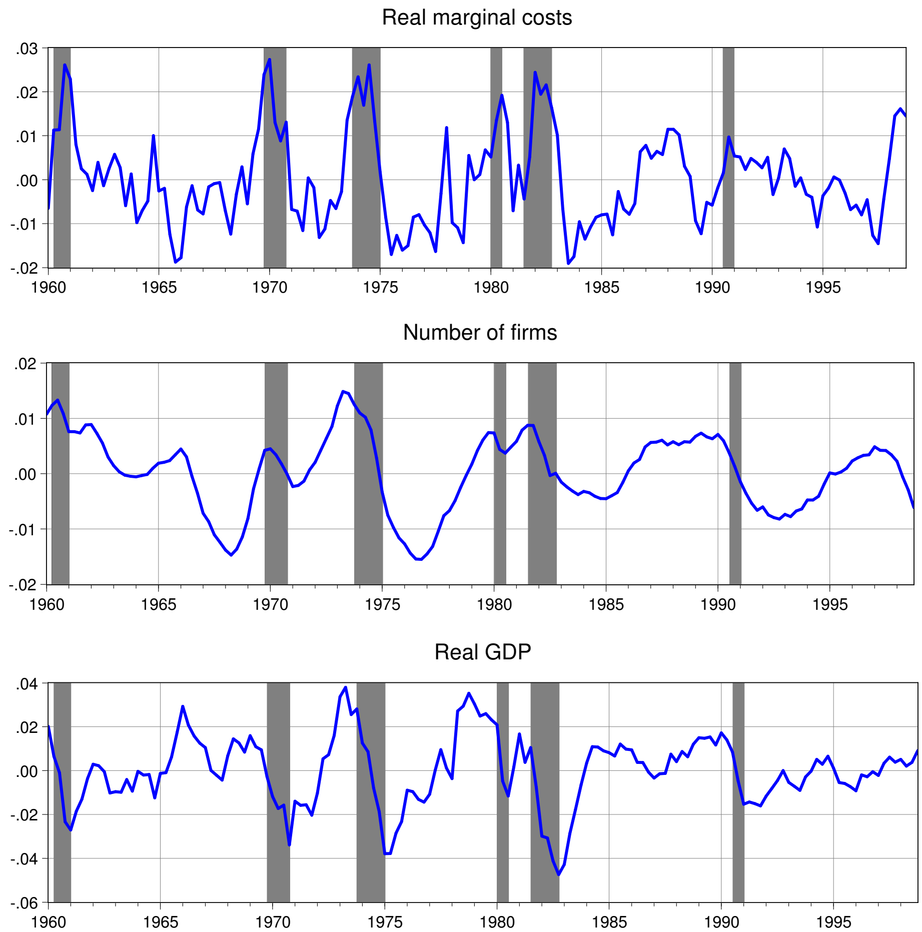
Appendix

A The data

Table 8: Data sources

	Name	*Explanation*	*Source*
P_t	Price level	GDP deflator	FRED
Y_t	Output	Real GDP	FRED
S_t	Real unit labor costs	Nonfarm business sector unit labor cost divided by the implicit price deflator	FRED
x_t	Output per firms	Real GDP over the constructed number of firms	-
N_t^e	New incorporations	Number of new firms created	Dun & Bradstreet, BEA
W_t	Nominal wages	Nominal hourly compensation in the nonfarm business	FRED

Figure 4: The real marginal costs, the number of firms and the real GDP.



Notes: Data are in logs and they have been HP-filtered. Sample period: 1960q1-1998q4.

B Derivation of the closed form of the NKPC for estimation

The inflation and the dynamics of the number of firms are represented, in log linear terms, by the following equations

$$\pi_t = \beta(1-\delta)E_t\pi_{t+1} + \kappa\widehat{rmc}_t - \kappa\eta\hat{n}_t + u_t \quad (24)$$
$$\hat{n}_t = (1-\delta)\hat{n}_{t-1} + \delta\hat{n}_t^e \quad (25)$$

Solving forward both equations and plugging (25) into (24) I obtain

$$\pi_t = \kappa\sum_{j=0}^{\infty}\beta^j(1-\delta)^j E_t\widehat{rmc}_{t+j} - \delta\kappa\eta\sum_{j=0}^{\infty}\beta^j(1-\delta)^j E_t\sum_{h=0}^{\infty}(1-\delta)^h\hat{n}^e_{t+j-h} + u_t$$

By rearranging terms I obtain

$$\pi_t = \kappa\sum_{j=0}^{\infty}\beta^j(1-\delta)^j E_t\widehat{rmc}_{t+j} - \frac{\delta\kappa\eta}{1-\beta(1-\delta)^2}\left[\sum_{h=1}^{\infty}(1-\delta)^h\hat{n}^e_{t-h} + \sum_{j=0}^{\infty}\beta^j(1-\delta)^j E_t\hat{n}^e_{t+j}\right] + u_t$$

Using the VAR defined on (22) to compute the expectations of real marginal costs and new incorporations I obtain

$$\pi_t = \kappa e_1'[I-\beta(1-\delta)A]^{-1}x_t - \frac{\delta\kappa\eta}{1-\beta(1-\delta)^2}\left\{e_2'[I-\beta(1-\delta)A]^{-1}x_t + \sum_{h=1}^{L}(1-\delta)^h e_2' x_{t-h}\right\} + u_t$$

where e_1' and e_2' are vectors that select respectively the first and second element of the vector x_t, I is a conformable identity matrix and A is the companion matrix of the forecasting VAR.

Accordingly, the expectation term on the real marginal cost and the new incorporations are given by

$$E_t\widehat{rmc}_{t+j} = \frac{[1-\beta(1-\delta)a_{22}]\,\widehat{rmc}_t + \beta(1-\delta)a_{12}\hat{n}_t^e}{1-\beta(1-\delta)(a_{11}+a_{22}) + \beta^2(1-\delta)^2(a_{11}a_{22}-a_{12}a_{21})}$$
$$E_t\hat{n}^e_{t+j} = \frac{[1-\beta(1-\delta)a_{11}]\,\hat{n}_t^e + \beta(1-\delta)a_{21}\widehat{rmc}_t}{1-\beta(1-\delta)(a_{11}+a_{22}) + \beta^2(1-\delta)^2(a_{11}a_{22}-a_{12}a_{21})}.$$

Considering an hybrid Phillips curve that includes lagged inflation as a determinant of the current inflation the closed form of the inflation dynamics that incorporates the projections of the VAR is given by

$$\begin{aligned}\pi_t &= \gamma_1\pi_{t-1} + \kappa\frac{1}{\gamma_2\beta(1-\delta)}e_1'\left[1-\beta(1-\delta)A\right]^{-1}x_t - \\ &\frac{\delta\kappa\eta}{1-\beta(1-\delta)^2}\frac{1}{\gamma_2\beta(1-\delta)}\left\{e_2'\left[I-\beta(1-\delta)A\right]^{-1}x_t + \sum_{h=1}^{L}(1-\delta)^h e_2' x_{t-h}\right\} + u_t\end{aligned} \tag{26}$$

γ_1 and γ_2 are respectively the stable and unstable roots of the second order difference equation in (19). They are equal to

$$\begin{aligned}\gamma_1 &= \frac{1-\sqrt{1-4\beta(1-\delta)\lambda}}{2\beta(1-\delta)} \\ \gamma_2 &= \frac{1+\sqrt{1-4\beta(1-\delta)\lambda}}{2\beta(1-\delta)}\end{aligned}$$

N. 749 – *An analysis of the determinants of credit default swap spread changes before and during the subprime financial turmoil*, by Antonio Di Cesare and Giovanni Guazzarotti (March 2010).

N. 750 – *Estimating DSGE models with unknown data persistence*, by Gianluca Moretti and Giulio Nicoletti (March 2010).

N. 751 – *Down the non-linear road from oil to consumer energy prices: no much asymmetry along the way*, by Fabrizio Venditti (March 2010).

N. 752 – *Information technology and banking organization*, by Sauro Mocetti, Marcello Pagnini and Enrico Sette (March 2010).

N. 753 – *The pricing of government-guaranteed bank bonds*, by Aviram Levy and Andrea Zaghini (March 2010).

N. 754 – *Misure di valore aggiunto per le scuole superiori italiane: i problemi esistenti e alcune prime evidenze*, by Piero Cipollone, Pasqualino Montanaro and Paolo Sestito (March 2010).

N. 755 – *Asset-based measurement of poverty*, by Andrea Brandolini, Silvia Magri and Timothy M. Smeeding (March 2010).

N. 756 – *Credit supply, flight to quality and evergreening: an analysis of bank-firm relationships after Lehman*, by Ugo Albertazzi and Domenico J. Marchetti (April 2010).

N. 757 – *A note on rationalizability and restrictions on belief*, by Giuseppe Cappelletti (April 2010).

N. 758 – *A non-parametric model-based approach to uncertainty and risk analysis of macroeconomic forecasts*, by Claudia Miani and Stefano Siviero (April 2010).

N. 759 – *Financial innovation and risk: the role of information*, by Roberto Piazza (June 2010).

N. 760 – *Switching costs in local credit markets*, by Guglielmo Barone, Roberto Felici and Marcello Pagnini (June 2010).

N. 761 – *The determinants of teacher mobility. Evidence from a panel of Italian teachers*, by Gianna Barbieri, Claudio Rossetti and Paolo Sestito (June 2010).

N. 762 – *A public guarantee of a minimum return to defined contribution pension scheme members*, by Giuseppe Grande and Ignazio Visco (June 2010).

N. 763 – *Debt restructuring and the role of lending technologies*, by Giacinto Micucci and Paola Rossi (June 2010).

N. 764 – *Disentangling demand and supply in credit developments: a survey-based analysis for Italy*, by Paolo Del Giovane, Ginette Eramo and Andrea Nobili (June 2010).

N. 765 – *Information uncertainty and the reaction of stock prices to news*, by Paolo Angelini and Giovanni Guazzarotti (July 2010).

N. 766 – *With a little help from abroad: the effect of low-skilled immigration on the female labor supply*, by Guglielmo Barone and Sauro Mocetti (July 2010).

N. 767 – *Real time forecasts of inflation: the role of financial variables*, by Libero Monteforte and Gianluca Moretti (July 2010).

N. 768 – *The effect of age on portfolio choices: evidence from an Italian pension fund*, by Giuseppe G. L. Cappelletti, Giovanni Guazzarotti and Pietro Tommasino (July 2010).

N. 769 – *Does investing abroad reduce domestic activity? Evidence from Italian manufacturing firms*, by Raffaello Bronzini (July 2010).

N. 770 – *The EAGLE. A model for policy analysis of macroeconomics interdependence in the euro area*, by Sandra Gomes, Pascal Jacquinot and Massimiliano Pisani (July 2010).

(*) Requests for copies should be sent to:
Banca d’Italia – Servizio Studi di struttura economica e finanziaria – Divisione Biblioteca e Archivio storico – Via Nazionale, 91 – 00184 Rome – (fax 0039 06 47922059). They are available on the Internet www.bancaditalia.it.

2008

P. ANGELINI, *Liquidity and announcement effects in the euro area*, Giornale degli Economisti e Annali di Economia, v. 67, 1, pp. 1-20, **TD No. 451 (October 2002).**

P. ANGELINI, P. DEL GIOVANE, S. SIVIERO and D. TERLIZZESE, *Monetary policy in a monetary union: What role for regional information?*, International Journal of Central Banking, v. 4, 3, pp. 1-28, **TD No. 457 (December 2002).**

F. SCHIVARDI and R. TORRINI, *Identifying the effects of firing restrictions through size-contingent Differences in regulation*, Labour Economics, v. 15, 3, pp. 482-511, **TD No. 504 (June 2004).**

L. GUISO and M. PAIELLA,, *Risk aversion, wealth and background risk*, Journal of the European Economic Association, v. 6, 6, pp. 1109-1150, **TD No. 483 (September 2003).**

C. BIANCOTTI, G. D'ALESSIO and A. NERI, *Measurement errors in the Bank of Italy's survey of household income and wealth*, Review of Income and Wealth, v. 54, 3, pp. 466-493, **TD No. 520 (October 2004).**

S. MOMIGLIANO, J. HENRY and P. HERNÁNDEZ DE COS, *The impact of government budget on prices: Evidence from macroeconometric models*, Journal of Policy Modelling, v. 30, 1, pp. 123-143 **TD No. 523 (October 2004).**

L. GAMBACORTA, *How do banks set interest rates?,* European Economic Review, v. 52, 5, pp. 792-819, **TD No. 542 (February 2005).**

P. ANGELINI and A. GENERALE, *On the evolution of firm size distributions*, American Economic Review, v. 98, 1, pp. 426-438, **TD No. 549 (June 2005).**

R. FELICI and M. PAGNINI, *Distance, bank heterogeneity and entry in local banking markets*, The Journal of Industrial Economics, v. 56, 3, pp. 500-534, **No. 557 (June 2005).**

S. DI ADDARIO and E. PATACCHINI, *Wages and the city. Evidence from Italy*, Labour Economics, v.15, 5, pp. 1040-1061, **TD No. 570 (January 2006).**

S. SCALIA, *Is foreign exchange intervention effective?,* Journal of International Money and Finance, v. 27, 4, pp. 529-546, **TD No. 579 (February 2006).**

M. PERICOLI and M. TABOGA, *Canonical term-structure models with observable factors and the dynamics of bond risk premia*, Journal of Money, Credit and Banking, v. 40, 7, pp. 1471-88, **TD No. 580 (February 2006).**

E. VIVIANO, *Entry regulations and labour market outcomes. Evidence from the Italian retail trade sector*, Labour Economics, v. 15, 6, pp. 1200-1222, **TD No. 594 (May 2006).**

S. FEDERICO and G. A. MINERVA, *Outward FDI and local employment growth in Italy*, Review of World Economics, Journal of Money, Credit and Banking, v. 144, 2, pp. 295-324, **TD No. 613 (February 2007).**

F. BUSETTI and A. HARVEY, *Testing for trend*, Econometric Theory, v. 24, 1, pp. 72-87, **TD No. 614 (February 2007).**

V. CESTARI, P. DEL GIOVANE and C. ROSSI-ARNAUD, *Memory for prices and the Euro cash changeover: an analysis for cinema prices in Italy*, In P. Del Giovane e R. Sabbatini (eds.), The Euro Inflation and Consumers' Perceptions. Lessons from Italy, Berlin-Heidelberg, Springer, **TD No. 619 (February 2007).**

B. H. HALL, F. LOTTI and J. MAIRESSE, *Employment, innovation and productivity: evidence from Italian manufacturing microdata*, Industrial and Corporate Change, v. 17, 4, pp. 813-839, **TD No. 622 (April 2007).**

J. SOUSA and A. ZAGHINI, *Monetary policy shocks in the Euro Area and global liquidity spillovers,* International Journal of Finance and Economics, v.13, 3, pp. 205-218, **TD No. 629 (June 2007).**

M. DEL GATTO, GIANMARCO I. P. OTTAVIANO and M. PAGNINI, *Openness to trade and industry cost dispersion: Evidence from a panel of Italian firms,* Journal of Regional Science, v. 48, 1, pp. 97-129, **TD No. 635 (June 2007).**

P. DEL GIOVANE, S. FABIANI and R. SABBATINI, *What's behind "inflation perceptions"? A survey-based analysis of Italian consumers,* in P. Del Giovane e R. Sabbatini (eds.), *The Euro Inflation and Consumers' Perceptions. Lessons from Italy,* Berlin-Heidelberg, Springer, **TD No. 655 (January 2008).**

R. BRONZINI, G. DE BLASIO, G. PELLEGRINI and A. SCOGNAMIGLIO, *La valutazione del credito d'imposta per gli investimenti,* Rivista di politica economica, v. 98, 4, pp. 79-112, **TD No. 661 (April 2008).**

B. BORTOLOTTI, and P. PINOTTI, *Delayed privatization,* Public Choice, v. 136, 3-4, pp. 331-351, **TD No. 663 (April 2008).**

R. BONCI and F. COLUMBA, *Monetary policy effects: New evidence from the Italian flow of funds,* Applied Economics , v. 40, 21, pp. 2803-2818, **TD No. 678 (June 2008).**

M. CUCCULELLI, and G. MICUCCI, *Family Succession and firm performance: evidence from Italian family firms,* Journal of Corporate Finance, v. 14, 1, pp. 17-31, **TD No. 680 (June 2008).**

A. SILVESTRINI and D. VEREDAS, *Temporal aggregation of univariate and multivariate time series models: a survey,* Journal of Economic Surveys, v. 22, 3, pp. 458-497, **TD No. 685 (August 2008).**

2009

F. PANETTA, F. SCHIVARDI and M. SHUM, *Do mergers improve information? Evidence from the loan market*, Journal of Money, Credit, and Banking, v. 41, 4, pp. 673-709, **TD No. 521 (October 2004).**

M. BUGAMELLI and F. PATERNÒ, *Do workers' remittances reduce the probability of current account reversals?,* World Development, v. 37, 12, pp. 1821-1838, **TD No. 573 (January 2006).**

P. PAGANO and M. PISANI, *Risk-adjusted forecasts of oil prices*, The B.E. Journal of Macroeconomics, v. 9, 1, Article 24, **TD No. 585 (March 2006).**

M. PERICOLI and M. SBRACIA, *The CAPM and the risk appetite index: theoretical differences, empirical similarities, and implementation problems,* International Finance, v. 12, 2, pp. 123-150, **TD No. 586 (March 2006).**

U. ALBERTAZZI and L. GAMBACORTA, *Bank profitability and the business cycle,* Journal of Financial Stability, v. 5, 4, pp. 393-409, **TD No. 601 (September 2006).**

S. MAGRI, *The financing of small innovative firms: the Italian case*, Economics of Innovation and New Technology, v. 18, 2, pp. 181-204, **TD No. 640 (September 2007).**

V. DI GIACINTO and G. MICUCCI, *The producer service sector in Italy: long-term growth and its local determinants,* Spatial Economic Analysis, Vol. 4, No. 4, pp. 391-425, **TD No. 643 (September 2007).**

F. LORENZO, L. MONTEFORTE and L. SESSA, *The general equilibrium effects of fiscal policy: estimates for the euro area*, Journal of Public Economics, v. 93, 3-4, pp. 559-585, **TD No. 652 (November 2007).**

R. GOLINELLI and S. MOMIGLIANO, *The Cyclical Reaction of Fiscal Policies in the Euro Area. A Critical Survey of Empirical Research*, Fiscal Studies, v. 30, 1, pp. 39-72, **TD No. 654 (January 2008).**

P. DEL GIOVANE, S. FABIANI and R. SABBATINI, *What's behind "Inflation Perceptions"? A survey-based analysis of Italian consumers,* Giornale degli Economisti e Annali di Economia, v. 68, 1, pp. 25-52, **TD No. 655 (January 2008).**

F. MACCHERONI, M. MARINACCI, A. RUSTICHINI and M. TABOGA, *Portfolio selection with monotone mean-variance preferences,* Mathematical Finance, v. 19, 3, pp. 487-521, **TD No. 664 (April 2008).**

M. AFFINITO and M. PIAZZA, *What are borders made of? An analysis of barriers to European banking integration,* in P. Alessandrini, M. Fratianni and A. Zazzaro (eds.): The Changing Geography of Banking and Finance, Dordrecht Heidelberg London New York, Springer, **TD No. 666 (April 2008).**

A. BRANDOLINI, *On applying synthetic indices of multidimensional well-being: health and income inequalities in France, Germany, Italy, and the United Kingdom,* in R. Gotoh and P. Dumouchel (eds.), Against Injustice. The New Economics of Amartya Sen, Cambridge, Cambridge University Press, **TD No. 668 (April 2008).**

G. FERRERO and A. NOBILI, *Futures contract rates as monetary policy forecasts,* International Journal of Central Banking, v. 5, 2, pp. 109-145, **TD No. 681 (June 2008).**

P. CASADIO, M. LO CONTE and A. NERI, *Balancing work and family in Italy: the new mothers' employment decisions around childbearing,* in T. Addabbo and G. Solinas (eds.), Non-Standard Employment and Qualità of Work, Physica-Verlag. A Sprinter Company, **TD No. 684 (August 2008).**

L. ARCIERO, C. BIANCOTTI, L. D'AURIZIO and C. IMPENNA, *Exploring agent-based methods for the analysis of payment systems: A crisis model for StarLogo TNG,* Journal of Artificial Societies and Social Simulation, v. 12, 1, **TD No. 686 (August 2008).**

A. CALZA and A. ZAGHINI, *Nonlinearities in the dynamics of the euro area demand for M1*, Macroeconomic Dynamics, v. 13, 1, pp. 1-19, **TD No. 690 (September 2008).**

L. FRANCESCO and A. SECCHI, *Technological change and the households' demand for currency*, Journal of Monetary Economics, v. 56, 2, pp. 222-230, **TD No. 697 (December 2008).**

G. ASCARI and T. ROPELE, *Trend inflation, taylor principle, and indeterminacy*, Journal of Money, Credit and Banking, v. 41, 8, pp. 1557-1584, **TD No. 708 (May 2007).**

S. COLAROSSI and A. ZAGHINI, *Gradualism, transparency and the improved operational framework: a look at overnight volatility transmission*, International Finance, v. 12, 2, pp. 151-170, **TD No. 710 (May 2009).**

M. BUGAMELLI, F. SCHIVARDI and R. ZIZZA, *The euro and firm restructuring*, in A. Alesina e F. Giavazzi (eds): Europe and the Euro, Chicago, University of Chicago Press, **TD No. 716 (June 2009).**

B. HALL, F. LOTTI and J. MAIRESSE, *Innovation and productivity in SMEs: empirical evidence for Italy*, Small Business Economics, v. 33, 1, pp. 13-33, **TD No. 718 (June 2009).**

2010

A. PRATI and M. SBRACIA, *Uncertainty and currency crises: evidence from survey data*, Journal of Monetary Economics, v, 57, 6, pp. 668-681, **TD No. 446 (July 2002).**

S. MAGRI, *Debt maturity choice of nonpublic Italian firms* , Journal of Money, Credit, and Banking, v.42, 2-3, pp. 443-463, **TD No. 574 (January 2006).**

R. BRONZINI and P. PISELLI, *Determinants of long-run regional productivity with geographical spillovers: the role of R&D, human capital and public infrastructure,* Regional Science and Urban Economics, v. 39, 2, pp.187-199, **TD No. 597 (September 2006).**

E. IOSSA and G. PALUMBO, *Over-optimism and lender liability in the consumer credit market,* Oxford Economic Papers, v. 62, 2, pp. 374-394, **TD No. 598 (September 2006).**

S. NERI and A. NOBILI, *The transmission of US monetary policy to the euro area,* International Finance, v. 13, 1, pp. 55-78, **TD No. 606 (December 2006).**

A. CIARLONE, P. PISELLI and G. TREBESCHI, *Emerging Markets' Spreads and Global Financial Conditions*, Journal of International Financial Markets, Institutions & Money, v. 19, 2, pp. 222-239, **TD No. 637 (June 2007).**

M. IACOVIELLO and S. NERI, *Housing market spillovers: evidence from an estimated DSGE model,* American Economic Journal: Macroeconomics, v. 2, 2, pp. 125-164, **TD No. 659 (January 2008).**

A. ACCETTURO, *Agglomeration and growth: the effects of commuting costs,* Papers in Regional Science, v. 89, 1, pp. 173-190, **TD No. 688 (September 2008).**

A. B. ATKINSON and A. BRANDOLINI, *On analysing the world distribution of income,* World Bank Economic Review , v. 24, 1 , pp. 1-37, **TD No. 701 (January 2009).**

R. CAPPARIELLO and R. ZIZZA, *Dropping the Books and Working Off the Books,* Labour, v. 24, 2, pp. 139-162 ,**TD No. 702 (January 2009).**

V. DI GIACINTO, G. MICUCCI and P. MONTANARO, *Dynamic macroeconomic effects of public capital: evidence from regional Italian data,* Giornale degli economisti e annali di economia, v. 69, 1, pp. 29-66, **TD No. 733 (November 2009).**

F. COLUMBA, L. GAMBACORTA and P. E. MISTRULLI, *Mutual Guarantee institutions and small business finance,* Journal of Financial Stability, v. 6, 1, pp. 45-54, **TD No. 735 (November 2009).**

A. GERALI, S. NERI, L. SESSA and F. M. SIGNORETTI, *Credit and banking in a DSGE model of the Euro Area,* Journal of Money, Credit and Banking, v. 42, 6, pp. 107-141, **TD No. 740 (January 2010).**

S. FEDERICO, *Outsourcing versus integration at home or abroad and firm heterogeneity,* Empirica, v. 37, 1, pp. 47-63, **TD No. 742 (February 2010).**

V. DI GIACINTO, *On vector autoregressive modeling in space and time*, Journal of Geographical Systems, v. 12, 2, pp. 125-154, **TD No. 746 (February 2010).**

A. DI CESARE and G. GUAZZAROTTI, *An analysis of the determinants of credit default swap spread changes before and during the subprime financial turmoil,* Journal of Current Issues in Finance, Business and Economics, v. 3, 4, pp., **TD No. 749 (March 2010).**

A. BRANDOLINI, S. MAGRI and T. M SMEEDING, *Asset-based measurement of poverty,* Journal of Policy Analysis and Management, v. 29, 2 , pp. 267-284, **TD No. 755 (March 2010).**

FORTHCOMING

L. MONTEFORTE and S. SIVIERO, *The Economic Consequences of Euro Area Modelling Shortcuts*, Applied Economics, **TD No. 458 (December 2002).**

M. BUGAMELLI and A. ROSOLIA, *Produttività e concorrenza estera*, Rivista di politica economica, **TD No. 578 (February 2006).**

G. DE BLASIO and G. NUZZO, *Historical traditions of civicness and local economic development,* Journal of Regional Science, **TD No. 591 (May 2006).**

G. FERRERO, A. NOBILI and P. PASSIGLIA, *Assessing Excess Liquidity in the Euro Area: The Role of Sectoral Distribution of Money,* Applied Economics, **TD No. 627 (April 2007).**

Y. ALTUNBAS, L. GAMBACORTA and D. MARQUÉS, *Securitisation and the bank lending channel*, European Economic Review, **TD No. 653 (November 2007).**

F. BALASSONE, F. MAURA and S. ZOTTERI, *Cyclical asymmetry in fiscal variables in the EU*, Empirica, **TD No. 671 (June 2008).**

M. BUGAMELLI and F. PATERNÒ, *Output growth volatility and remittances*, Economica, **TD No. 673 (June 2008).**

F. D'AMURI, O. GIANMARCO I.P. and P. GIOVANNI, *The labor market impact of immigration on the western german labor market in the 1990s,* European Economic Review, **TD No. 687 (August 2008).**

C. NICOLETTI and C. RONDINELLI, *The (mis)specification of discrete duration models with unobserved heterogeneity: a Monte Carlo study,* Journal of Econometrics, **TD No. 705 (March 2009).**

L. FORNI, A. GERALI and M. PISANI, *Macroeconomic effects of greater competition in the service sector: the case of Italy,* Macroeconomic Dynamics, **TD No. 706 (March 2009).**

Y. ALTUNBAS, L. GAMBACORTA, and D. MARQUÉS-IBÁÑEZ, *Bank risk and monetary policy,* Journal of Financial Stability, **TD No. 712 (May 2009).**

L. FORNI, A. GERALI and M. PISANI, *The macroeconomics of fiscal consolidations in euro area countries,* Journal of Economic Dynamics and Control, **TD No. 747 (March 2010).**

A. DI CESARE and G. GUAZZAROTTI, *An analysis of the determinants of credit default swap spread changes before and during the subprime financial turmoil*, in C. V. Karsone (eds.), Finance and Banking Developments, Nova Publishers, New York., **TD No. 749 (March 2010).**