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MONETARY POLICY, JOB FLOWS, AND UNEMPLOYMENT IN A STICKY PRICE FRAMEWORK

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Resumen

Este trabajo presenta un modelo de equilibrio general que combina un mercado laboral no Walrasiano con firmas que fijan precio de manera escalonada. El modelo se utiliza para analizar el impacto de distintos choques sobre un conjunto de variables bajo dos reglas de política monetaria alternativas. La principal característica del mercado laboral es la existencia de una fricción en el proceso de búsqueda que resulta en un nivel de desempleo de equilibrio positivo. Por otra parte, la existencia de precios rígidos introduce un mecanismo de transmisión para la política monetaria que opera a través de la demanda agregada. El modelo permite generar una relación positiva entre inflación y empleo (la curva de Phillips) y también permite replicar el patrón observado en la correlación entre la tasa de creación de empleos y la tasa de empleo, y entre la tasa de destrucción de empleos y la tasa de empleo. El modelo también permite replicar la relación negativa que se observa entre creación y destrucción de empleos.

Abstract

The paper presents a general equilibrium model that combines a non-Walrasian labor market with firms setting prices on a staggered basis. The model is utilized to analyze the impact of different shocks on a set of variables under two alternative monetary policy rules. The main characteristic of the labor market is the existence of a search friction that results in a positive equilibrium rate of unemployment. Sticky prices, on the other hand, introduce a demand-sided transmission mechanism for the monetary policy that allows analysis of the effects of different shocks. The model is able to generate a positive correlation between inflation and employment (the Phillips curve) as well as the observed correlation pattern between job creation and employment and job destruction and employment. It also replicates the contemporaneous negative correlation between job creation and job destruction that is observed in the data.

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1 Introduction

The assumption that labor is perfectly divisible is standard in general equilibrium models with sticky prices -the New Keynesian paradigm. In this framework, labor fluctuations correspond to changes in hours rather than changes in the number of people employed. Unemployment, as we know it, can, thus, not be captured by this type of model. While these models are successful at explaining a number of phenomena and have been widely adopted to analyze different monetary policies, their lack of implications about unemployment and the underlying job flows is a drawback.

This paper addresses this issue by integrating a non-Walrasian labor market into a general equilibrium model with money and sticky prices. Here unemployment and gross job flows – job creation and job destruction – are explicitly modeled; both arise as a consequence of search frictions in the labor market. This framework, thus, allows us to analyze in a more detailed way the impact of different shocks on the labor market.

Recently, a number of authors have suggested that by incorporating a search theoretic model of the labor market into a non-monetary RBC model, important aspects of U.S. economic fluctuations can be better matched (Mertz (1995), Andolfatto (1997), and den Haan, Ramey, and Watson (1997)). Cooley and Quadrini (1998, 1999), in turn, introduce money in a limited participation model where labor market is characterized by a search process. In this context they analyze the optimal monetary policy. Their model, however, is characterized by fully flexible prices. Monetary policy affects real activity through the cost of borrowing faced by firms.

The novel feature of this paper is the introduction of a demand-side transmission mechanism for the monetary policy in the spirit of the New Keynesian literature. By doing so, we can better understand how monetary and expenditure shocks affecting aggregate demand are transmitted to the labor market.

The model is an extension of the Mortensen-Pissarides (1994) matching model, embedded in an otherwise standard general equilibrium dynamic economy with sticky prices. A set of heterogenous firms produce a single homogenous intermediate good that is then used by retailing firms to produce differentiated final goods. Intermediate firms are subject to idiosyncratic shocks and a number of them go out of business each period. At the same time new firms are created at every moment. This gives rise to a constant process of job creation and job destruction. Retailing firms, on the other hand, are infinitely lived and adjust their prices as in Calvo (1984). Monetary policy is conducted by the central bank by using the nominal interest rate as the instrument of policy. By changing the nominal rate of interest, the central bank alters the consumption decisions of households and, thereby, affects aggregate demand. Fluctuations in aggregate demand, in turn, have an indirect impact on the price of the intermediate good that alters the job destruction margin and affects the entry decision of firms. Both, job destruction and job creation, determine the evolution of the unemployment rate.

Fluctuations in this economy are driven by interest rate shocks, productivity shocks and government expenditure shocks. With these three shocks, and under a plausible parametrization, the model is able to replicate the cyclical properties of a set of variables for the U.S. economy.

When the economy is hit by a productivity shock or by a negative expenditure shock, the model predicts that the economy faces a period of increased restructuring. This does not happen when the economy is hit by a monetary shock. In this case, employment returns to its steady state level both by a rise in job creation and a fall in job destruction

The paper is organized as follows. Section 2 describes the basic structure of the model. Section 3 describes the parametrization of the model. In particular, the model is solved in its log-linearized version by using the Blanchard and Khan (1980) approach. Section 4 evaluates the model and presents impulse-response functions for the three different types of shocks, both under flexible and sticky prices. Section 5 summarizes the main conclusions and indicates further directions of research.

2 The Model

The two main building blocks of the model are the following: First, the labor market is non Walrasian; it is characterized by a matching process as in Mortensen and Pissarides (1994). Second, prices are sticky as in the New Keynesian literature (Yun (1994), Rotemberg and Woodford(1997), King and Wolman (1997), among others).

There are two sets of firms. One set produces a homogeneous intermediate good that can not be consumed. A second group of firms produces a set of differentiated final goods. Firms producing the intermediate good are heterogeneous and are subject to idiosyncratic productivity shocks. Each one of these firms employs just one worker that works a variable number of hours. A job is destroyed when the idiosyncratic shock falls below a certain threshold level. In that case, the worker enters an unemployment spell and starts looking for a new job.

At the same time, new firms are created in every period. Entrepreneurs willing to create a firm must post a vacancy in order to attract workers. A firm is created when an unemployed worker is matched with a posted vacancy.

The rate at which vacancies are filled depends on the number of posted vacancies and the number of unemployed workers looking for jobs. The decision of posting a new vacancy will depend on the cost of posting vacancies, the likelihood of filling a posted vacancy, and on the expected profit given a successful match.

Firms producing final goods are infinitely lived and produce differentiated varieties by labelling the intermediate good. They are monopolistically competitive and set nominal prices on a staggered basis. The retailing sector in this model is only a device to introduce nominal price stickiness.

2.1 Demand Side

2.1.1 Households

There is a continuum of households indexed by j on the interval $[0,1]$. Each household is composed by a large number of workers. At any moment in time workers can be employed or unemployed.

Within a particular household, each member consumes exactly the same amount independently of its employment status (We may think of workers pooling resources before consuming in an egalitarian way, or that there is an insurance mechanism that ensures the same consumption for each worker).

The utility function of household j is the following:

$$E_t \sum_{i=0}^{\infty} \beta^i \left\{ \frac{\sigma}{\sigma - 1} \left(C_{t+i}^j \right)^{\frac{\sigma}{\sigma-1}} + \Gamma \left(\frac{M_{t+i}^j}{P_{t+i}} \right) - \Phi \left(H_t^j \right) \right\}, \tag{1}$$

where, the consumption bundle C_t^j corresponds to the consumption of the average worker within household j. The term $\Phi\left(H_t^j\right)$ corresponds to the labor effort disutility. It is a function of H_t^j which represents the total number of hours worked by employed members of household j. The consumption bundle is composed by a continuous variety of differentiated goods indexed by $i \in [0,1]$:

$$C_t^j = \left(\int_0^1 C^j(i)_t^{\frac{\varepsilon-1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon-1}} \qquad \varepsilon > 1. \tag{2}$$

Let WH_t^j be the total nominal wage income received by all workers of household j. The budget constraint of the household is given by

$$\frac{M_t^j}{P_t} + \frac{B_t^j}{P_t} \leq \frac{M_{t-1}^j}{P_t} + (1+i_t)\frac{B_{t-1}^j}{P_t} + \frac{WH_t^j}{P_t} + D_t^j + \varrho_t^j + \tau_t^j - C_t^j, \tag{3}$$

where M_t^j denotes the stock of nominal balances held by household j, τ_t^j are net real lump sum transfers from the government, ϱ_t^j represent dividends from firms net of the expenses associated with posting vacancies. The term D_t^j captures unemployment benefits received by household members that are unemployed.[1] The aggregate price index, P_t, is given by

$$P_t = \left(\int_0^1 P(i)_t^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}. \tag{4}$$

The representative household chooses a consumption path for its average member, the composition of the consumption bundle, and a path for real balances in order to maximize (1) subject to (2) and (3).

The first order condition with respect to bonds yields the standard Euler equation for consumption:

$$1 = \beta E_t (1 + r_{t+1}) \left(\frac{C_t^j}{C_{t+1}^j}\right)^{\frac{1}{\sigma}}, \tag{5}$$

where $(1 + r_{t+1}) = (1 + i_{t+1}) \frac{P_t}{P_{t+1}}$ corresponds to the ex-ante real interest rate. The demand for specific variety i is given by,

$$C^j(i)_t = \left(\frac{P(i)_t}{P_t}\right)^{-\varepsilon} C_t^j. \tag{6}$$

2.1.2 Government and Aggregate Constraint

The government consumes a bundle of final goods similar to (2). It chooses different varieties by minimizing the cost of the bundle subject to a given expenditure level, G_t. Then, government's demand for variety i is given by,

$$G(i)_t = \left(\frac{P(i)_t}{P_t}\right)^{-\varepsilon} G_t, \tag{7}$$

[1] Total unemployment benefits received by household j are $D_t^j = \left(1 - n_{t-1}^j\right) d$, where n_{t-1}^j is the number of employed members of household j at the end of $t-1$.

where total government expenditure is given exogenously in the model. The government must satisfy the following budget constraint:

$$G_t = \int_0^1 \frac{M_{t+1}^j - M_t^j}{P_t} dj + \int_0^1 \tau_t^j dj + \int_0^1 D_t^j dj. \tag{8}$$

In equilibrium the excess of supply of bonds across households must be zero, $\int_0^1 B_t dj = 0$. At the same time, aggregate real profits and wage income add up to Y_t, the national income. Then, using the government budget constraint (8), the aggregate constraint can be reduced to:

$$Y_t = C_t + G_t. \tag{9}$$

2.2 Labor Market

2.2.1 Matching Technology

Before forming a firm, entrepreneurs must post vacancies in order to attract workers. Let v_t be the number of vacancies posted by entrepreneurs at the beginning of period t, and let u_{t-1} be the total number of unemployed workers at the end of period $t-1$. Each period a number m_t of matches are formed between workers and vacancies. This number is determined by the following matching function:

$$m_t = m(v_t, u_{t-1}). \tag{10}$$

Let us define labor market tightness as $\theta_t \equiv \frac{v_t}{u_{t-1}}$. By assuming that the matching function has constant returns to scale we can fully characterize the matching process with the variable θ_t.

The probability that a vacancy is filled is just the number of new matches divided by the number of vacancies posted: $\frac{m_t}{v_t} \equiv \varphi(\theta_t)$. The function $\varphi(.)$ satisfies $\varphi' < 0$, i.e., the tighter the labor market, the lower the chance that a particular vacancy is filled. Analogously, the probability that an unemployed worker find a job is given by the number of matches divided by the number of unemployed people: $\frac{m_t}{u_{t-1}} \equiv \gamma(\theta_t) = \theta_t \varphi(\theta_t)$. In this case we have that $\gamma' > 0$, i.e., the tighter the labor market, the higher the chances that a worker find a job.

2.2.2 Intermediate Firms

Firms producing intermediate goods are created when a posted vacancy is filled. Each firm produces the same homogenous intermediate good; each one employs one worker and is characterized by its productivity level, x, which is drawn each period from a stationary distribution $F(x)$. After a successful match a firm keeps producing until separation occurs. A match is destroyed when the idiosyncratic productivity falls below a certain cut-off level x_t (the subindex shows the dependence of the cutoff on the state of the economy at time t).

The relevant decision for an entrepreneur is whether to post a vacancy. Posting vacancies entails a cost in terms of consumption units. This cost has to be paid each period the vacancy is not filled. Once a vacancy is filled a new firm must wait until the next period to start producing. At that moment, the firm will know its productivity and decide whether to produce or not. If the productivity is above the threshold, the firm produces and the match continues. If it is below the cutoff, then the match is dissolved without any production. The value of posting a vacancy is thus given by the following expression:

$$V_t = -\kappa + \beta E_t \Delta_{t+1} \left(\varphi(\theta_t) \int_{x_{t+1}} J_{t+1}(x') dG + (1 - \varphi(\theta_t)) V_{t+1} \right), \quad (11)$$

where $\Delta_{t+1} = (C_t/C_{t+1})^{\frac{1}{\sigma}}$.[2]

Let q_t be the price of the intermediate good in terms of units of consumption (the relative price of the intermediate good with respect to final goods). Firms take as this price as given. The value of a firm with idiosyncratic productivity x, given q_t is,

$$J_t(x,h) = (q_t x - w_t(x,h))\, h + \beta E_t \Delta_{t+1} \int_{x_{t+1}} J_{t+1}(x',h') dF\left(x'\right), \quad (12)$$

where h is the number of hours the worker must work, $w_t(x,h)$ is the real wage -which depends on both the idiosyncratic productivity of the firm and the number of hours- and where x_{t+1} is the productivity cutoff in period $t+1$. The first term in the LHS are current profits, and the second term is the discounted continuation value of the match. Notice that in principle it is possible to have a match with a positive value, even if current profits are negative. This is due to the fact that forming a match is costly.

[2] Firms are ultimately owned by households. Then, the relevant discount factor is $\beta\Delta_{t+1}$.

2.2.3 Workers

From the household's perspective the value of a job depends on the contribution of that job to the budget of household, and the disutility that it conveys. Thus, the value of a job in a firm with idiosyncratic productivity x, and where the worker must work h hours, is given by the following expression:

$$W_t(x,h) = w_t(x,h)h - \phi(h)C_t^{1/\sigma} + \beta E_t \Delta_{t+1} \left(\int_{x_{t+1}} \left(W_{t+1}(x',h') - U_{t+1} \right) dF\left(x'\right) \right) + \beta E \Delta_{t+1} U_{t+1} \quad (13)$$

where $\phi(h)C_t^{1/\sigma}$ corresponds to the disutility associated with working h hours normalized by the marginal utility of consumption.

The second term on the RHS corresponds to the continuation net value of the job. If next period productivity shock falls above the cutoff level x_{t+1}, the firm continues producing and the worker receives $W_{t+1}(x',h')$. If the productivity falls below the cutoff, separation occurs and the worker returns to an unemployment spell.

The continuation value reflects the rents associated with a match. This is analogous to the case of the firm. An unemployed worker does not get matched immediately with a firm but it does only with a certain probability each period. Once the worker is matched, she will remain inside the match even if current wage falls below her disutility. By doing so she can eventually receive a higher wage in the future without paying the cost of having to be matched again.

Unemployed workers looking for a job are matched with probability $\gamma(\theta_t)$. While unemployed, workers' contribution to the household budget is d, which corresponds to the unemployment benefit that the worker receives from the government. Therefore, the value of unemployment from the household perspective is given by:

$$U_t = d + \gamma(\theta_t)\beta E_t \Delta_{t+1} \left(\int_{x_{t+1}} \left(W_{t+1}(x',h') - U_{t+1} \right) dF\left(x'\right) \right) + \beta E_t \Delta_{t+1} U_{t+1} \quad (14)$$

2.2.4 Wage and Hours

As in Mortensen and Pissarides (1994), Cooley and Quadrini (2000) and others, I assume that the wage rate within a match is determined through a Nash bargaining process. Let's define the surplus of a match with productivity x and h hours as the sum of the value of the firm plus the net value for the worker:

$$S_t(x,h) = J_t(x,h) + (W_t(x,h) - U_t) \tag{15}$$

If η is labor's relative bargaining strength then the Nash solution implies:

$$W_t(x,h) - U_t = \eta S_t(x,h), \text{ and, } J_t(x,h) = (1-\eta) S_t(x,h). \tag{16}$$

Given (15), and (16), the wage rate per hour is given by,

$$w_t(x,h) = \eta q_t x + (1-\eta)\frac{\phi(h)}{h} C_t^{1/\sigma} - \frac{d}{h} + \eta\kappa \frac{\gamma(\theta_t)}{\varphi(\theta_t)} \frac{1}{h}. \tag{17}$$

Notice that the wage rate is a share η of current profits, plus a compensation for labor effort disutility and the outside option of the job. This is the last term on the RHS and corresponds to a share η of the surplus of a new match in t, times the probability of being matched, $\gamma(\theta_t)$.

Utilizing (17) the surplus of a match can be written as:

$$S_t(x,h) = q_t x h - (\phi(h)) C_t^{1/\sigma} - d - \frac{\eta}{1-\eta}\kappa\frac{\gamma(\theta_t)}{\varphi(\theta_t)} + \beta E_t \Delta_{t+1} \int_{x_{t+1}} S_{t+1}(x', h') dF(x').$$

The Nash bargaining solution (16) implies that the value of a firm and the net value of a job for a worker are increasing functions of the total surplus of the match. Therefore, both parties are interested in maximizing the surplus of the match. The number of hours is then determined by maximizing the total surplus of a match:

$$h_t(x) = \arg\max_h S_t(x,h) \tag{18}$$

Therefore, the number of hours is a function of the productivity level of the firm. The subindex reflects the fact that this function also depends on the state of the economy at time t.

At this point it is convenient to specify the functional form of the disutility function. I assume this function is given by

$$\phi(h) = \frac{1}{1+\zeta} h^{1+\zeta}$$

with $\zeta > 0$. This parameter corresponds to the elasticity of labor disutility with respect to the number of hours worked. With this functional form for $\phi(.)$ the optimal number of hours in a match with productivity x is given by:

$$h_t(x) = (q_t x)^{\frac{1}{\zeta}} C_t^{-\frac{1}{\zeta\sigma}}, \tag{19}$$

and the associated disutility:

$$\phi(h_t) = \frac{1}{1+\zeta} (q_t x)^{\frac{1+\zeta}{\zeta}} C_t^{-\frac{1+\zeta}{\sigma\zeta}}$$

The number of hours is an increasing function of both the price of the intermediate good, and the idiosyncratic productivity level of the match. The per-period profit function $\psi_t(.)$ can be written as follows

$$\psi_t(x) = \frac{\zeta}{1+\zeta} (q_t x)^{\frac{1+\zeta}{\zeta}} C_t^{-\frac{1+\zeta}{\zeta\sigma}} - d - \frac{\eta}{1-\eta} \kappa \theta_t$$

where I have utilized the assumption that the matching function has constant return to scale, which implies that $\frac{\gamma(\theta_t)}{\varphi(\theta_t)} = \theta_t$.

2.2.5 Job creation, Job Destruction and Employment Dynamics

The economy is subject to a permanent process of restructuring. Every period some firms are destroyed and new firms are created. The number of firms destroyed -*job destruction*- corresponds to the mass of firms that are hit by a idiosyncratic shock below a cutoff level x_t: $F(x_t)n_{t-1}$, where $n_{t-1}$is the number of surviving firms at the end of period $t-1$. The number of new firms -*job creation*- is just the number of matches every period: $m_t = \theta_t \varphi(\theta_t) u_{t-1}$ where u_{t-1} is the unemployment rate at the end of $t-1$.[3]

New Vacancies: As mentioned before, the relevant decision of an entrepreneur is whether to post a vacancy. With free entry the value of posting a vacancy in equilibrium has to be zero: $V_t = 0$. This equilibrium condition

[3] Remember that each firm employs only one worker. Thus, the number of firms created (destroyed) corresponds exactly to the number of jobs created (destroyed).

pins down the number of vacancies posted at each moment and, given u_{t-1}, also the labor market tightness θ_t. From (11) we have that θ_t must satisfy:

$$\frac{\kappa}{\varphi(\theta_t)} = \beta E_t \left\{ \Delta_{t+1} \int_{x_{t+1}} J_{t+1}(x') dF\left(x'\right) \right\}. \tag{20}$$

Notice that the LHS of this expression is just the cost of posting vacancies times the expected time the vacancy is not filled. In other words, this condition states that, in equilibrium, the total expected cost of posting a vacancy must be equal to the expected benefit of forming a match. Since $\varphi(\theta_t)$ is a decreasing function of θ_t, the larger the expected benefit the larger the number of posted vacancies for a given κ and for a given rate of unemployment.

Separation: Separation occurs when a firm is hit by an idiosyncratic shock below the cutoff level, x_t. This cutoff corresponds to the productivity level that solves the following condition:

$$\begin{aligned} 0 &= \left(q_t x_t - w_t(x_t, h_t(x_t))\right) h_t(x_t) + \\ &\quad \beta E_t \left\{ \Delta_{t+1} \int_{x_{t+1}} J_{t+1}(x') dF\left(x'\right) \right\}, \end{aligned} \tag{21}$$

where $h_t(x_t)$ is the policy function defined in (18) evaluated at the productivity level x_t.

From (20) it is clear that the continuation value of the firm is always positive. Thus, separation necessarily occurs when idiosyncratic productivity is low enough so that the firm has negative profits.

Employment dynamics For a given price of the intermediate good the job creation condition (20) and the job destruction condition (21) define a dynamic system in two unknowns: The cutoff level, x_t, and labor market tightness, θ_t. These two variables, in turn, determine the evolution of employment as follows:

$$n_t = \gamma(\theta_t)\left(1 - n_{t-1}\right) + \left(1 - F\left(x_t\right)\right) n_{t-1}. \tag{22}$$

Unemployment is the difference between the labor force and employment:

$$u_t = 1 - n_t. \tag{23}$$

where the labor force is normalized to 1.

Let $n_{t-1}(x)$ be the number of firms with idiosyncratic productivity x in period t that survived from period $t-1$. Then, total supply of the intermediate good is given by:[4]

$$Q_t = \int_{x_t} x h_t(x) n_{t-1}(x) dF(x). \tag{24}$$

2.3 Retailing Sector

There is a continuum of retailing firms. Each firm is infinitely lived and produces a differentiated final good $Y(i)$ with a technology that transforms one unit of intermediate into Z_t units of a final good. This technology requires no labor to operate. Variable Z_t is a stochastic process that captures productivity shocks in the final goods sector.

To introduce price stickiness, I assume that retailing firms can adjust their price only with probability $1-\chi$ each period. As it is usually assumed in this setting, if a firm does not adjust its price it must satisfy demand at the given price.

Let $Q_t(i)$ be the quantity of intermediate goods demanded by firm i at time t. The marginal cost faced by this firm is just the price of the intermediate, q_t divided by the level of the technology. When a firm get the possibility of changing its price it will choose a price to maximize the expected discounted value of its stream of profits conditional on keeping that price fixed,

$$\max_{P_t^*} E_t \sum_{j=0}^{\infty} \left((\beta\chi)^j \Delta_{t+j} \frac{P_t^* Y(i)_{t+j}}{P_{t+j}} - q_{t+j} Q(i)_{t+j} \right),$$

subject to the demand for the good i,

$$Y(i)_{t+j} = \left(\frac{P_t^*}{P_{t+j}} \right)^{-\varepsilon} (C_{t+j} + G_{t+1}) \qquad j = 0, 1, ..$$

and the production technology,

$$Y(i)_{t+j} = Z_{t+j} Q(i)_{t+j} \qquad j = 0, 1, ..$$

From the FOC we obtain the following expression for the resetting price:

$$P_t^* = \frac{\varepsilon}{\varepsilon - 1} \frac{1}{\alpha} \frac{E_t \sum_j (\beta\chi)^j \Delta_{t+j} q_{t+j} Y_{t+j} P_{t+j}^{\varepsilon}}{E_t \sum_j (\beta\chi)^j \Delta_{t+j} Y_{t+j} P_{t+j}^{\varepsilon-1}}. \tag{25}$$

[4] Remember that new matches in period t start producing in $t+1$.

By the law of large numbers a fraction χ of the firms cannot reset price at time t. The average price of those firms is just P_{t-1} The remaining $1-\chi$ fraction set optimally their price to P_t^*. Then, the aggregate price index can be expressed as follows:

$$P_t^{1-\varepsilon} = (1-\chi)P_t^{*1-\varepsilon} + \chi P_{t-1}^{1-\varepsilon}. \tag{26}$$

2.4 Evolution of the Marginal Cost and Phillips Curve

The price of the intermediate good determines the relevant marginal cost for firm setting prices. The market clearing condition in the market for intermediate goods is:

$$Y_t = Z_t Q_t, \tag{27}$$

where Q_t is given by (24) and Y_t is aggregate demand.

At this point it is convenient to specify the way idiosyncratic shocks are distributed. I assume these shocks are uniformly distributed on the interval $[0, 1]$. With this assumption, and using (19), and (24) total production of the intermediate good is given by:

$$Q_t = \left(\frac{q_t}{C_t^{1/\sigma}} \right)^{\frac{1}{\zeta}} n_{t-1} \int_{x_t}^{1} x^{\frac{1+\zeta}{\zeta}} dx$$

Replacing this expression in the market clearing condition (27) and reorganizing terms we obtain the following expression for the equilibrium price of the intermediate good:

$$q_t = \left(\frac{Y_t}{Z_t n_{t-1}} \right)^{\zeta} C_t^{1/\sigma} \left(\int_{x_t}^{1} x^{\frac{1+\zeta}{\zeta}} dx \right)^{-\zeta}$$

The price of the intermediate good is an increasing function of both aggregate output and consumption. An increase in aggregate output raises demand for the intermediate good, which raises its price. The positive relation between consumption and q_t is due to the fact that a rise in C_t lowers the marginal utility of consumption. Therefore, to compensate the labor effort disutility of a given number of hours relative to the marginal utility of consumption the wage rate must increase. This, in turn, raises the equilibrium price of the intermediate good.

A productivity shock has a negative impact on q_t since it lowers the demand for the intermediate good. Finally, notice that an increase in the productivity cutoff reduces the number of firms that get to produce the intermediate good in period t. This induces a rise q_t.

Notice that employment in this model is an endogenous state variable that depends on the evolution of job creation and job destruction. Therefore, the marginal cost faced by retailing firms depends on a predetermined variable. This could introduce more persistence on inflation. However, this process also is affected by the evolution of the productivity cutoff which is a jumpy variable. Thus, ex-ante it is difficult to determine whether this specification will introduce more persistence in inflation as compared to more traditional New Keynesian models.

By log-linearizing both the price setting equation (25) and the aggregate price index (26) we obtain the following expression for the inflation rate:

$$\pi_t = \lambda mc_t + \beta E_t \pi_{t+1}. \tag{28}$$

where $\lambda = \frac{(1-\chi)(1-\chi\beta)}{\chi}$, and the marginal cost is given by: $mc_t = \widehat{q}_t - \widehat{z}_t$. Here π_t and $\widehat{q}_t$ correspond to the log deviation of inflation and the price of the intermediate input with respect their steady state levels, respectively.

2.5 Monetary Policy

The Central Bank implements monetary policy by using the nominal interest rate as its instrument. It follows a simple feedback rule that mandates raising the interest rate whenever inflation increases or when output is above its flexible price equilibrium level.

Let $\widetilde{y}_t$ be the output gap, defined as the difference between the log deviation from steady state of current output and flexible prices output. Then, the policy rule is given by,

$$\bar{\imath}_t = \alpha_z \widetilde{y}_t + \alpha_\pi \pi_t + \varepsilon_t \qquad \alpha_\pi > 1,\ \alpha_z \geq 0. \tag{29}$$

Following Clarida, Gali and Gertler (1998) I assume that the monetary authority adjusts the effective interest rate smoothly to its target level defined in (29). In particular, I assume that actual interest follows an AR process,

$$i_t = (1-\rho_i)\bar{\imath}_t + \rho_i i_{t-1} + \varepsilon_t, \tag{30}$$

This functional form is consistent with the empirical evidence that shows persistence in interest rate movements.[5] The error term ε_t captures misforecasts of the economy by the monetary authority or randomness in the

[5]Clarida, Gali and Gertler (1998) present empirical evidence of the persistence in interest rate movements for the U.S. economy. Their estimate of the coeficient ρ_i in the specification above is 0:7.

conduction of the monetary policy, and the fact that the central bank has imperfect control over the interest rate (see Clarida, Gali and Gertler (2000)).

3 Model Parametrization

This section describes the parametrization of the model. The next section evaluates the model and presents impulse-response function simulations for the exogenous shocks.

The economy is subject to three different types of shocks: (i) an interest rate shock, and (ii) a productivity shock in the final good sector, and (iii) an government expenditure shock. The processes for the exogenous disturbances are given by,,

$$
\begin{aligned}
\varepsilon_t &= \rho_f \varepsilon_{t-1} + \xi_{\varepsilon t} \\
z_t &= \rho_z z_{t-1} + \xi_{zt} \\
g_t &= \rho_g g_{t-1} + \xi_{gt}
\end{aligned}
$$

where ε_t, ψ_t, and g_t are a shock to the interest rate, a productivity shock, and a shock to government expenditure, respectively. Here $\xi_{\varepsilon t}$, $\xi_{\psi t}$, and ξ_{gt} are i.i.d innovations with zero mean and standard deviation: $\sigma_{\xi_\varepsilon} = 0.75$, $\sigma_{\xi_\psi} = 0.25$ and $\sigma_{\xi_g} = 0.5$. The standard deviation of the interest rate shock corresponds to a 75 basis point deviation from the interest rate target. The standard deviation for the cost push shock is selected in order to match the standard deviation of output with actual U.S. data.

It is assumed that the three shocks are persistent. In the case of the monetary policy shock, Clarida et. al. (2000) show that by construction it obeys an MA process and therefore is persistent. In our case, the degree of persistence is assumed to be $\rho_i = 0.5$. For the case of both productivity and government expenditure shocks, I assume that the auto-regresive parameter is 0.9.

Idiosyncratic shocks affecting intermediate producers are uniformly distributed on the interval $[0, 1]$. This assumption is made in order to simplify calculations.

Labor force is normalized to 1. The matching function is specified as a constant return to scale function, $m(u, v) = \mu u^{\vartheta} v^{1-\vartheta}$. Parameter ϑ represents the elasticity of the matching function with respect to unemployment. Blanchard and Diamond (1989) present empirical evidence supporting this Cobb-Douglas specification with an elasticity of 0.4. I take this value for both, the parameter ν and the labor bargaining coefficient η.[6] Parameter μ is a scaling factor. Under this specification the probability of a match for a vacancy is given by $\varphi(\theta) = \mu\theta^{-\vartheta}$ and the probability that an unemployed worker find a job is given by $\gamma(\theta) = \mu\theta^{1-\vartheta}$. Parameter μ is a scaling factor that ensures that both probabilities are less than one. Given the distribution of the idiosyncratic shocks and the matching technology, the steady state value of this probability is related to the steady state level for the productivity cutoff, $\overline{x}$, and the steady state level of the unemployment rate u, by the following expression:

$$u = \frac{\bar{x}}{\bar{x} + \mu\theta^{1-\nu}}, \tag{31}$$

I assume that this probability is 0.603. The same figure is utilized by Cole and Rogerson (1998) and Cooley and Quadrini (2000) and corresponds to an unemployment spell of 1.52 quarters or 20.5 weeks, approximately. Notice that $\overline{x}$ in expression (31) stands for the job destruction rate.[7] In the data, the average job destruction rate over the period 1972.2 -1993.4 is 5.6% (Davis, Haltiwanger, Schuh (1996)). Therefore, in order to be consistent with the figures in Davis et. al. the steady state value of $\overline{x}$ must satisfy: $\overline{x}/n = 0.055$. Replacing this into (31) we obtain the following value for unemployment that is consistent with a labor matching probability of 0.603: $u = 0.093$.[8]

To determine the value of μ I assume that the probability $\varphi(\theta)$ is also 0.6. This is similar to the value used by Den-Haan, Ramey and Watson (1997) and by Cooley and Quadrini (2000). With that probability, parameter μ takes a value of 0.5.

The values of other parameters of the model are the following: I assume that $\sigma = 1$ which corresponds to a log utility specification. The elasticity of the labor disutility is set to 2. The fraction of firms with staggered prices, χ, is assumed to be equal to 75%; the discount factor in the utility function, β, which is set to 0.99. Finally, the policy rule assigns the following coefficients to the output gap and inflation: $\alpha_y = 0.5$ and $\alpha_\pi = 1.5$.

[6] The assumption that $v = \eta$ ensures that separation is ex-post efficient (see Hosios, 1990).

[7] Given the distribution of idiosyncratic shocks, the job destruction rate is $G(\overline{x}) = \overline{x}$.

[8] This unemployment rate is above the average U.S. unemployment rate for the period (1970-2000) which is 6.7%. However, figures for the job destruction rate in Davis et. al., covers only manufactures. If at aggregate level the rate of job destruction is lower than the figures for the manufacturing sector then the steady state unemployment rate consistent with a probability of 0.603 is also lower.

Table 1 in the appendix summarizes the parametrization chosen to calibrate the model.

4 Results

As usual in the Business Cycle literature, the model is evaluated by contrasting its cyclical properties with those arising from actual data. Table 2 presents standard deviations generated with the model and the corresponding ones for the U.S. economy for the period 1955:1-2000:4. To obtain the moments for the artificial economy, the model was simulated 100 times for 200 periods each. Model statistics correspond to average statistics for those 100 simulations.

In general, the calibrated model replicates well the volatility of unemployment, employment, hours, and inflation (obviously output volatility is not a relevant dimension to evaluate the model). When compared with the data the model also generates a similar volatility for job creation. However, the model does not generate enough volatility for job destruction. This variable appears to be approximately 30% more volatile in the data as compared with the model.

Table 3 presents cross-correlations at different leads and lags between a set of variables. Notice first that the model replicates the positive correlation between employment (EMP) and inflation (INF), the Phillips curve. However, in the model, the contemporaneous correlation between these two variables is considerably larger than in the data. This is basically explained by the effect of monetary and productivity shocks on both employment and inflation. As we will see below, government expenditure shocks also induce positive co-movments between these two variables. However, in this case the response of inflation is much less persistent.

On the other hand, when considering employment and two periods' lead inflation then the model does not generate the large correlation that is observed in the data. This is explained by the difficulty of the model in generating a persistent response of inflation to monetary shock, as we will see below.

As in the data, the contemporaneous correlation between job creation (JC) and job destruction (JD) in the model is negative. However, the correlation coefficient between contemporaneous job creation and one period lagged job destruction is positive and high. This contradicts the data.[9] The

[9] See Davis, Haltiwanger and Schur (1996). Gourrinchas (1998) present evidence that sectorial (reallocation) shocks produce positive comovements between job creation and job

reason for this strong correlation between one period lagged job destruction and job creation is the feedback mechanism operating in the labor market: When job destruction increases, unemployment also raises, and the contact rate between vacancies and workers increases. In other words, the probability of filling a vacancy increases and the expected return from posting vacancies goes up. As a result, more vacancies are posted and job creation in the next period raises. An important assumption that generates this strong feedback mechanism is the assumption that the labor force is fixed. As Cooley and Quadrini point out, this assumption necessarily implies that when the number of employed people decreases, the number of searchers (unemployed workers) increases one-to-one. A different result would be obtained with a variable labor force. In particular, if the participation rate depends negatively on the unemployment rate, an increase in unemployment would not imply a one-to-one increase in searchers and job creation could be negatively correlated with job destruction.

Besides the positive correlation between contemporaneous job creation and one period lagged job destruction, the rest of the correlation coefficients between job creation and job destruction in the model are consistent with those in the data. Also, the correlation between job destruction and employment in the model are similar to those in the U.S. economy. The same is true for different correlations between job creation and employment, except for the large negative correlation between one period lagged employment and job creation. This large negative correlation just reflects the feedback mechanism in the labor market discussed before.

Figures 1 to 5 present the impulse-response functions to the three exogenous shocks of the model. For each simulation two outcomes are compared: A baseline case, where prices are sticky, and the responses of different variables under flexible prices

Figure 1 present the responses to a 75 basis point increase in the nominal interest rate. Notice that this shock is a perturbation of the policy rules and, therefore, it triggers the endogenous correction mechanisms implied by the rule itself. Of course, under flexible prices, variables do not respond to the shock.

As we can see, both output and inflation drop as a consequence of the shock. Initially, the increase in the interest rate lowers consumption. Lower consumption also means a lower demand for the intermediate good. As a consequence, the price of this type of good falls. In the absence of a

destruction. Aggregate shocks, however, would generate a negative correlation between these flows.

productivity shock, the fall in the price of the intermediate good implies a one-to-one fall in the relevant marginal cost for firms producing final goods. Therefore, inflation drops. This is the standard transmission mechanism in a new Keynessian framework.

How does the monetary shock translate into the labor market? In Figure 4 presents the impulse-response functions for the ratio between vacancies and unemployment (our measure of labor market tightness), the productivity cutoff, and job flows for each one of the three shocks. The evolution of employment in Figure 1 follows directly from the responses of both job creation and job destruction in Figure 4. Basically, a monetary shock, by lowering the profitability of firms in the intermediate sector, raises the rate at which firms are destroyed and lowers the job creation rate (by reducing the number of vacancies posted). However, job destruction falls below its steady state level fairly quickly and job creation raises soon after the shock. The low persistence of job destruction and the rise in job creation are explained by the low persistence of the shock on the price of the intermediate good, and also by the feedback mechanism implicit in the matching process: The rise in unemployment that follows the shock reduces labor market tightness, and the contact rate between vacancies and unemployed workers increases. In other words, the chances that a given vacancy is filled raises. This creates incentives to post vacancies. Job creation also increases after some periods. This is a consequence of both the increase in the number of vacancies and the higher contact rate between these vacancies and unemployed workers.

Notice from Figure 1 that the response of inflation to the monetary shock is not very persistent. As I mentioned before, this is a drawback of the model. Empirically it has been shown that a monetary shock has a persistent effect on inflation (see Gali and Gertler, 1999). In the model, inflation depends on the evolution of the marginal cost that is relevant for firms producing final goods which, in turn, determined by the evolution of the price of the intermediate good. This price depends -negatively- on employment and the average productivity of surviving firms. As we saw, an increase in the interest rate lowers employment and raises the productivity cutoff -reducing even further the number of surviving firms and lowering the number of hours worked. Both the fall in employment and the number of hours reduce supply of intermediate goods fairly quickly. Therefore, the equilibrium price of the intermediate good returns rapidly to its steady state level.

Figure 2 presents the responses to a productivity shock in the final goods sector. Solid lines show the responses under sticky prices while dotted lines show how the different variables would respond if prices were flexible.

Under both flexible and sticky prices, the productivity shock raises output and consumption. This is a direct consequence of productivity on the final goods sector. However, under sticky prices the response of both variables is lower than under flexible prices. In the first case, aggregate demand does not expand enough so as to boost output up to its natural level (remember that under sticky prices output is demand determined).

Notice that employment falls as a consequence of the shock. Again, the fall in this variable is explained by a rise in job destruction together with a fall in job creation (Figure 4). The responses of these two variables to the productivity shock, in turn, are a direct consequence of the evolution of the price of the intermediate good and consumption: First, the productivity shock lowers the demand for the intermediate good and the equilibrium price of this variable falls. Second, the increase in consumption raises the utility of leisure relative to the utility of consumption. This raises the wage rate. Both the fall in the price of the intermediate good and the increase in the wage rate reduce the profitability of firms in the intermediate sector. As a result, job creation falls and job destruction increases. At the same time, there is a large drop in hours.

Figure 3 presents impulse-reponse functions for the government expenditure shock. Since government expenditure is a component of the aggregate demand, this shock has a direct impact on this variable and, therefore, on output. Notice that under flexible prices output also raises, but by less than in the sticky prices case. As a result, the output gap increases after the shock. Accordingly, the monetary policy authority raises the interest rate. This explains the fall in consumption. In other words, government expenditure crowds-out private consumption.

The expansion in output raises the demand for the intermediate good. Thus, the price of this type of good increases. At the same time, lower consumption means that the marginal utility of leisure relative to the marginal utility of consumption decreases, and wages fall. Both the increase in the price of the intermediate good together with this reduction in wages increase the profitability of firms in the intermediate sector. As a result, job destruction falls: matches that were not profitable before the shock and would have been destroyed become viable (Figure 4). At the same, time there is a surge in job creation and employment raises. Together with the rise in employment, there is also an increase in the number of hours worked. Both the increase in the number of hours and the rise in employment increase the supply of the intermediate good, and the equilibrium price of this type of good falls back to its steady state soon after the shock.

Together with the fall in the price of the intermediate good, the marginal cost for firms producing final goods also increases. Since inflation depends on the marginal cost, this variable also raises as a result of the shock.

Notice that the response of job destruction is larger that the response of job creation for all cases. This is a robust fact in the empirical literature about job flows (see Davis, Haltiwanger and Schuh, 1996) and implies that the adjustment process in employment is initially governed by the exit margin (job destruction). However, when the economy is hit by a productivity shock or by a (negative) government expenditure shock, the recovery in employment is led by job creation. This implies that the economy faces a period of restructuring. In the case of a monetary shock, employment returns to its steady state through both an increase in job creation and a reduction in job destruction. Therefore, in this case the shock does not lead to a process of restructuring.

5 Conclusions and Directions for Further Research

This paper presents a general equilibrium monetary model with two main features: A non Walrasian labor market and sticky prices. The non Walrasian labor market is characterized by a search-theoretic model with endogenous job creation and job destruction. By incorporating this type of labor market in an otherwise standard New Keynesian model, we can analyze the impact of monetary policy on unemployment and gross job flows.

The model replicates the cyclical properties of a set of variables for the U.S. economy. It generates a positive correlation between employment and inflation as well as the observed correlation pattern between job creation and employment and job destruction and employment. It also replicates the negative contemporaneous correlation between job creation and job destruction that is observed in the data. When the economy is hit by a productivity shock or by a negative expenditure shock, the model predicts that the recovery in employment is led by an increase in job creation (rather than a decrease in job destruction). This implies that the economy faces a period of increased restructuring after the shock. This does not happen when the economy is hit by a monetary shock. In this case, employment returns to its steady state level both by a rise in job creation and a fall in job destruction.

One of the limitations of the model is its difficulty in generating a persistent response of inflation to a monetary shock. This is a common feature of most of the New Keynesian models where firms are forward-looking. In this setup, firms that set prices are also forward-looking but their marginal cost depends on both forward-looking and backward looking variables. However, the forward-looking component dominates and monetary shocks have only a temporary impact on inflation. Finally, one possible direction for further research is to set this model in the context of an open economy. In an open economy there is an extra transmission mechanism for monetary policy, which is the exchange rate. Until now the literature has focused on the effect of the exchange rate on aggregate demand. However, this variable not only affects aggregate demand, but it could also affect its composition. Changes in the composition of the aggregate demand, in turn, may affect labor reallocation. This opens new questions about the transmission mechanism of monetary policy and also about its impact.

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Appendix A. Households

Present discounted utility of the representative household:

$$E_t \sum_{i=0}^{\infty} \beta^i \left\{ \frac{\sigma}{\sigma - 1} (C_{t+i})^{\frac{\sigma}{\sigma-1}} + \Gamma \left(\frac{M_{t+i}}{P_{t+i}} \right) - \Phi (H_t) \right\}, \tag{32}$$

where $\Phi (H_t) = \int_{x_t} n_{t-1}(x)\phi (h_t (x))\, dx$, and where $n_{t-1}(x)$ is the total number of members of the representative household working in a firm with productivity x. At time t only firms with idiosyncratic productivity in the range $(x_t, 1]$ are producing.

The budget constraint of the representative household is given by:

$$\begin{aligned} \frac{M_t}{P_t} + b_{t+1,t} \quad \leq \quad & \frac{M_{t-1}}{P_t} + b_t + \int_{x_t} n_{t-1}(x) w_t(x) h_t (x)\, dx \\ & + \left(1 - \int_{x_t} n_{t-1}(x) dx \right) d \end{aligned} \tag{33}$$

Appendix B. Steady State

Without loss of generality, lets assume that in steady state $Z = 1$. I also assume that the relative price of the intermediate good in steady state is 1. Equilibrium level of final goods output is given by:

$$Y = Q = C^{-\frac{1}{\zeta\sigma}} n \frac{\zeta}{2\zeta + 1} \left(1 - x_t^{2+1/\zeta} \right)$$

From the aggregate constraint we have that $Y = \frac{1}{1-\varkappa_G} C$, where $\varkappa_G = \frac{G}{Y}$ is the steady state ratio of public expenditure to GDP. From () and the previous relation between output and consumption we obtain:

$$C = \left[(1 - \varkappa_G)\, n \frac{\zeta}{2\zeta + 1} \left(1 - x_t^{2+1/\zeta} \right) \right]^{\frac{\zeta\sigma}{1+\zeta\sigma}}$$

The steady state level of employment is given by:

$$n = \frac{\gamma(\theta)}{\overline{x}\,(1 - \delta) + \delta + \gamma(\theta)} \tag{34}$$

where θ and $\overline{x}$ are the steady state levels of the labor market tightness and the productivity cutoff, respectively. Finally, from the steady state version of (20) and (21) we obtain θ and $\overline{x}$:

$$\frac{\kappa}{\varphi (\theta)} = \beta\Omega (\overline{x}) \left[(1 - \eta) \frac{\zeta}{1 + \zeta} C^{-\frac{1+\zeta}{\zeta\sigma}} \right]$$

$$(1-\eta)\,d = \frac{\kappa}{\varphi\,(\theta)}\left[\frac{1}{\beta\Omega\,(\overline{x})}\overline{x}^{\frac{1+\zeta}{\zeta}} + (1-\eta\gamma(\theta_t))\right]$$

where $\Omega\,(\overline{x}) = \left[\frac{\zeta}{1+2\zeta} + \left(\frac{1+\zeta}{1+2\zeta}\right)\overline{x}^{\frac{1+2\zeta}{\zeta}} - \overline{x}^{\frac{1+\zeta}{\zeta}}\right]$.

Appendix C. Full Linearized Model

Monetary policy rule:

$$i_t = \rho_i i_{t-1} + (1-\rho_i)\alpha_y \widetilde{y}_t + (1-\rho_i)\alpha_\pi E\pi_{t+1} + \varepsilon_t \tag{35}$$

Evolution of employment:

$$\widehat{n}_t = \overline{x}\widehat{\theta} - \overline{x}\widehat{x}_t + \left(1 - \frac{\overline{x}}{1-n}\right)\widehat{n}_{t-1} \tag{36}$$

Aggregate demand:

$$\widehat{y}_t = \frac{C}{Y}\widehat{c}_t + \frac{G}{Y}\widehat{g}_t \tag{37}$$

Intermediate good market equilibrium:

$$\frac{1}{\zeta}\widehat{q}_t = \widehat{y}_t - \widehat{n}_{t-1} + \frac{1}{\zeta\sigma}\widehat{c}_t + \omega_x\widehat{x}_t - \widehat{z}_t \tag{38}$$

Inflation dynamics:

$$\pi_t = \lambda\left(\widehat{q}_t - \widehat{z}_t\right) + \beta E\pi_{t+1} \tag{4}$$

Euler equation for consumption:

$$\widehat{c}_t = -\sigma(\hat{\imath}_t - \hat{\pi}_{t+1}) + E\widehat{c}_{t+1} \tag{39}$$

Job creation condition:

$$\vartheta\widehat{\theta}_t = \widehat{\Delta}_{t+1} + \frac{1+\zeta}{\zeta}\widehat{q}_{t+1} - \frac{1+\zeta}{\zeta\sigma}\widehat{c}_{t+1} + \frac{\Omega_x}{\Omega\left(\overline{x}\right)}\widehat{x}_{t+1} \tag{40}$$

Job destruction condition:

$$\frac{\overline{x}^{\frac{1+v}{v}}}{\beta\Omega\left(\overline{x}\right)}\left(\frac{1+\zeta}{\zeta}\widehat{q}_t - \frac{1+\zeta}{\zeta\sigma}\widehat{c}_t + \frac{1+\zeta}{\zeta}\widehat{x}_t\right) + \left(\vartheta - \eta\gamma(\theta)\right)\widehat{\theta}_t = 0 \tag{41}$$

Total number of hours:

$$\widehat{H}_t = \frac{1}{\zeta}\widehat{q}_t - \frac{1}{\zeta\sigma}\widehat{c}_t - \frac{1+\zeta}{\zeta}\frac{\overline{x}^{\frac{1+\zeta}{\zeta}}}{1-\overline{x}^{\frac{1+\zeta}{\zeta}}}\widehat{x}_t \tag{42}$$

where $\Omega_x = -\overline{x}^{\frac{1+\zeta}{\zeta}}\frac{1+\zeta}{\zeta}\left(1-\overline{x}\right)$ is a function of the productivity cutoff, and $\lambda = \frac{(1-\beta\chi)(1-\chi)}{\chi}$, $\omega_x = \frac{\overline{x}^{2+\frac{1}{\zeta}}}{1-\overline{x}^{2+\frac{1}{\zeta}}}\left(2+\frac{1}{\zeta}\right)$.

Table 1: Model Parametrization

Parameter	Value	Description
η	0.2	Labor bargaining strength
ν	0.2	Elasticity of the matching w/r to unemployment
μ	0.75	Scaling parameter for the matching function
β	0.99	Discount factor
σ	1	Log utility specification
ζ	2	Labor disutility elasticity
χ	0.75	Fraction of firms with staggerd prices
ρ_i	0.7	AR coefficient for the monetary policy rule
ρ_f	0.25	AR coefficient for the monetary shock
ρ_ψ	0.9	AR coefficient for the productivity shock
ρ_g	0.9	AR coefficient for the expenditure shock

Table 2 :Cyclical properties Model economy and U.S. economy
Standard deviations (%)

	Model Economy	U.S. Economy
Output	1.60	1.60
Employment	1.14	0.99
Unemployment	10.27	11.04
Hours	1.55	1.53
Inflation	0.75	0.63
Job Creation	10.40	12.05
Job Destruction	16.06	22.67

Source: Author´s calculation. U.S.data, except for job flows, corresponds to HP detrended quarterly data for the period 1955:1-2000:4. Job flows data correspond to the updated data from Davis, Haltiwanger, Schuh (1996) that covers the period 1972:2 - 1993:4. The model was simulated 100 times for 200 periods each. Model statistics correspond to average statistic for those 100 simulations.

Table 3: Cross-correlations Model economy and U.S. economy

	Correlations at lags and leads k						
	-3	-2	-1	0	1	2	3
corr($EMPL_t, INF_{t+k}$)							
U.S. Economy	0.06	0.21	0.39	0.55	0.60	0.56	0.53
Model Economy:	0.02	0.24	0.56	0.91	0.49	0.19	-0.01
corr($JC_t, EMPL_{t+k}$)							
U.S. Economy	-0.41	-0.41	-0.34	-0.11	0.04	0.12	0.19
Model Economy:	-0.31	-0.63	-0.94	-0.31	-0.05	0.08	0.15
corr($JD_t, EMPL_{t+k}$)							
U.S. Economy	0.28	0.16	-0.04	-0.22	-0.36	-0.41	-0.42
Model Economy:	0.17	0.13	-0.01	-0.80	-0.58	-0.31	-0.12
corr(JC_t, JD_{t+k})							
U.S. Economy	0.02	0.20	-0.21	-0.15	-0.44	-0.11	-0.31
Model Economy	0.33	0.56	0.71	-0.33	-0.17	-0.14	-0.13

Source: Author´s calculation. U.S.data, except for job flows, corresponds to HP detrended quarterly data for the period 1955:1-2000:4. Job flows data correspond to the updated data from Davis, Haltiwanger, Schuh (1996) that covers the period 1972:2 - 1993:4. The model was simulated 100 times for 200 periods each. Model statistics correspond to average statistic for those 100 simulations.

Figure 1: Monetary Shock

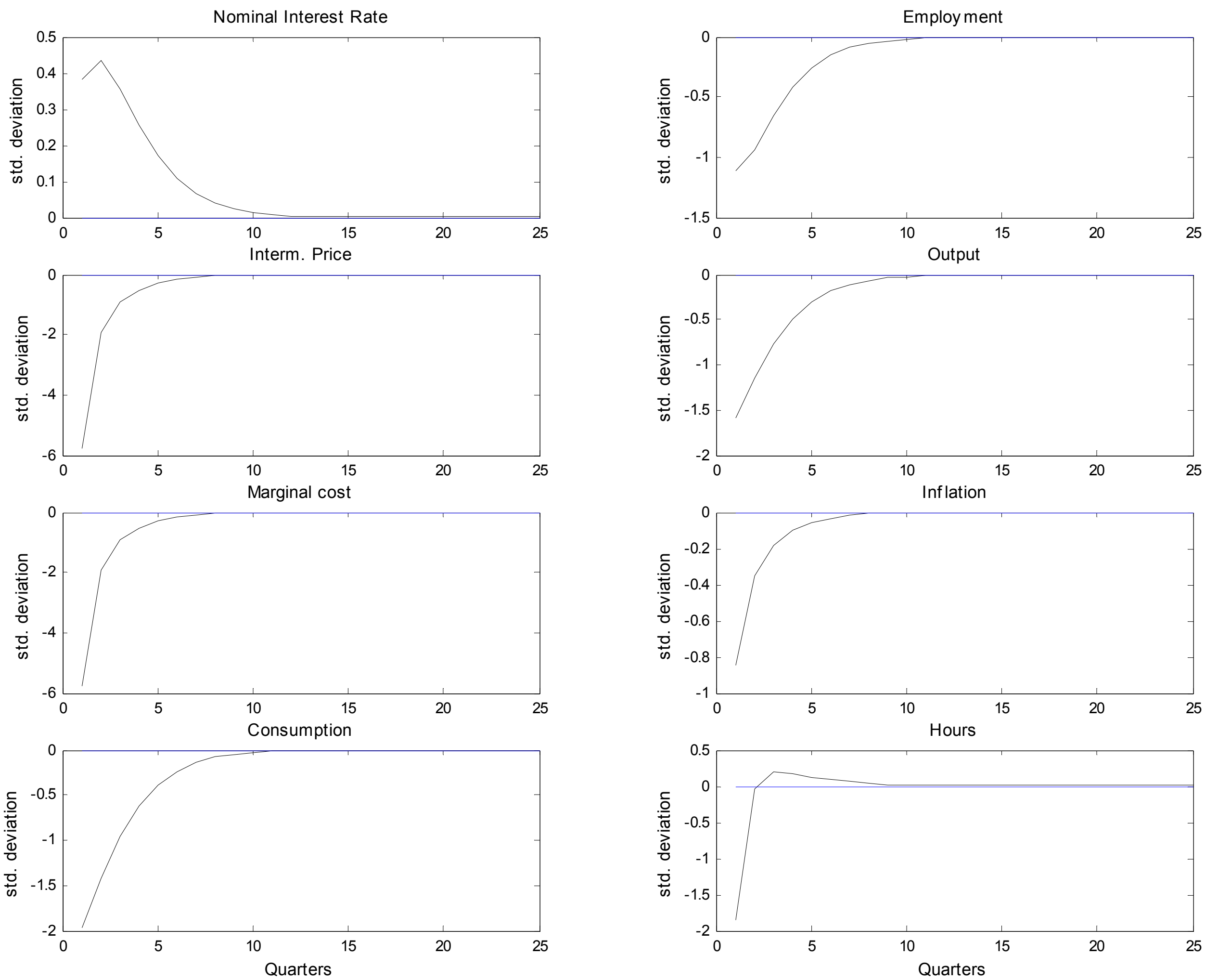


Figure 2: Productivity Shock

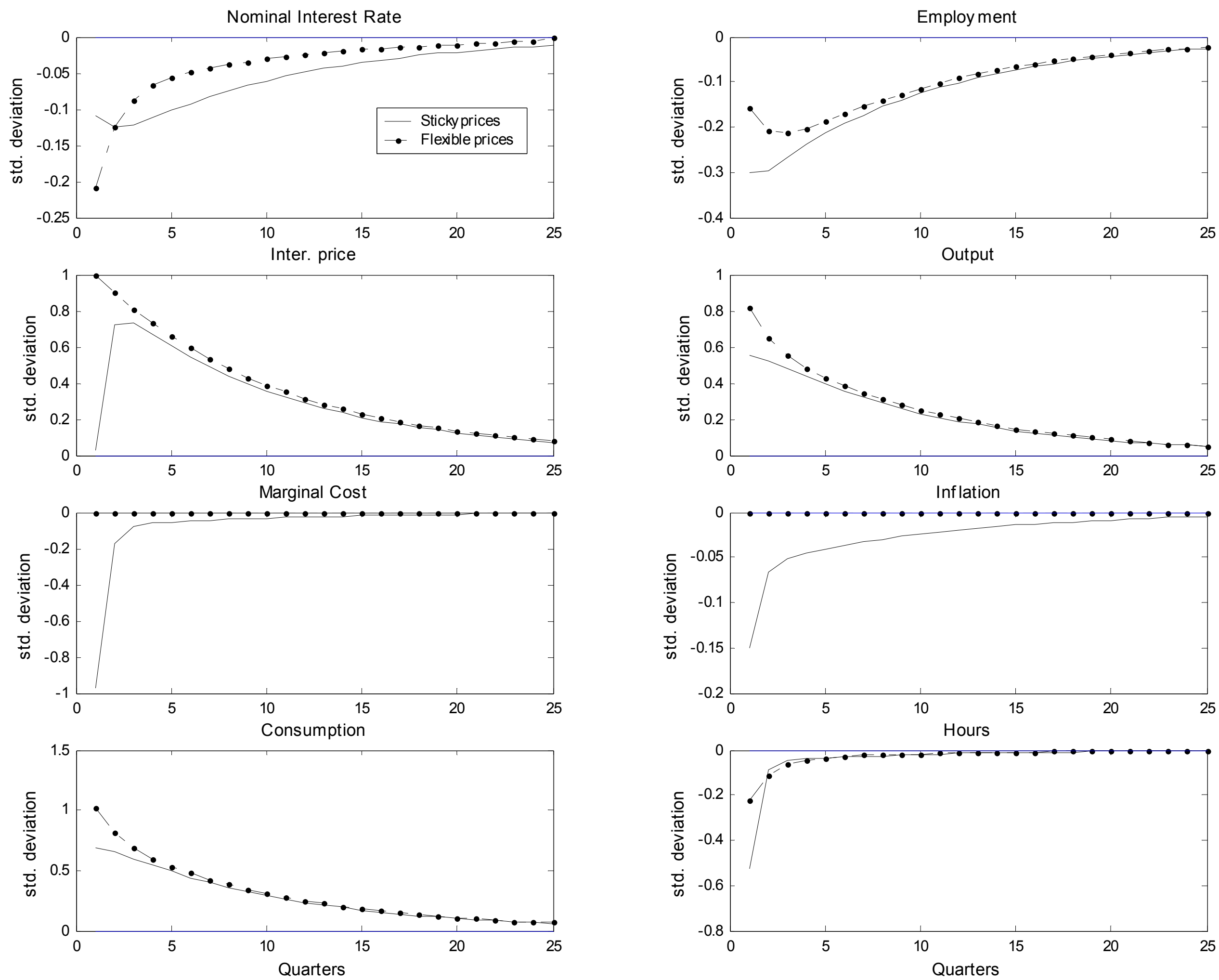


Figure 3: Expenditure Shock

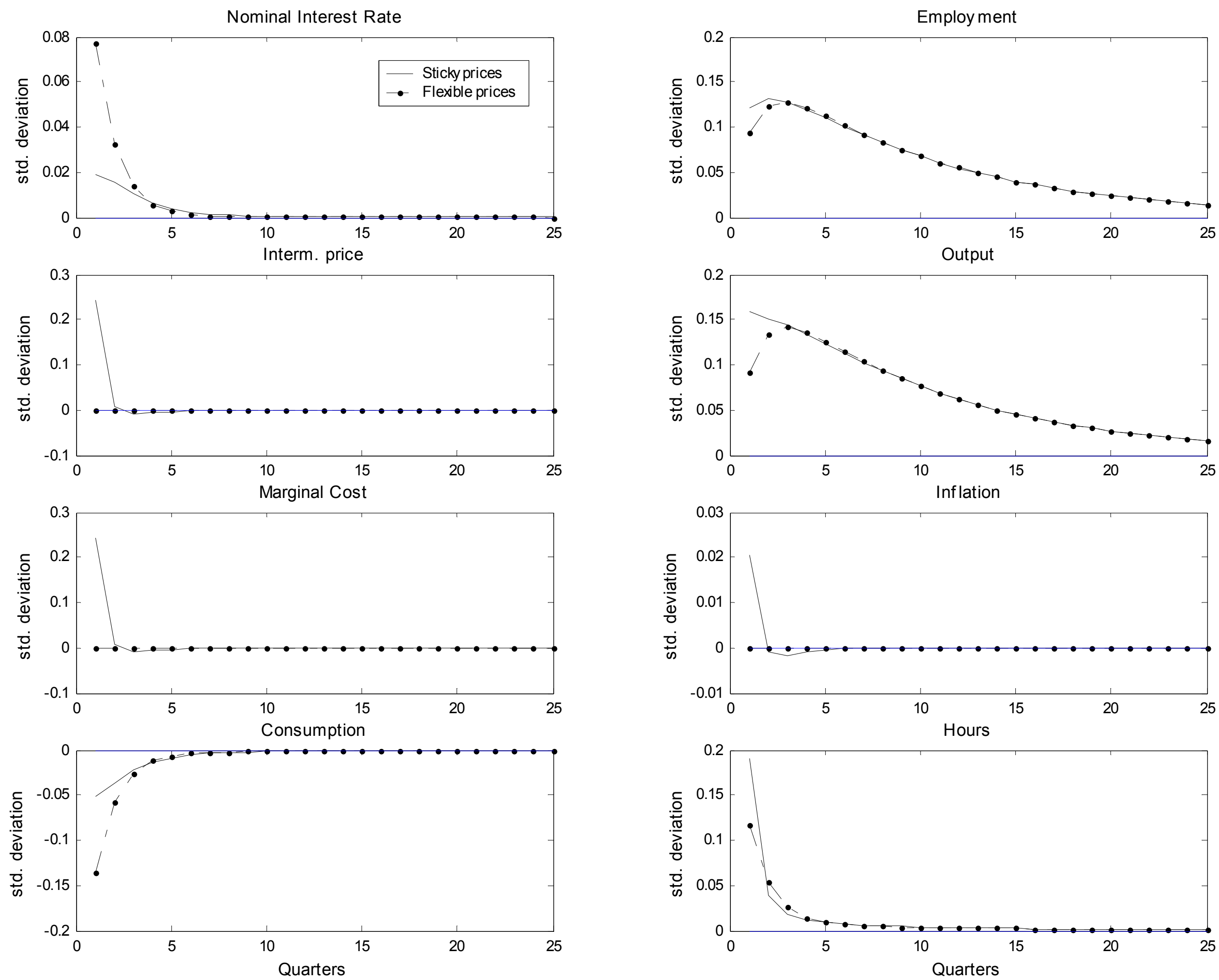


Figure 4: Labor Market Dynamic: Sticky Prices

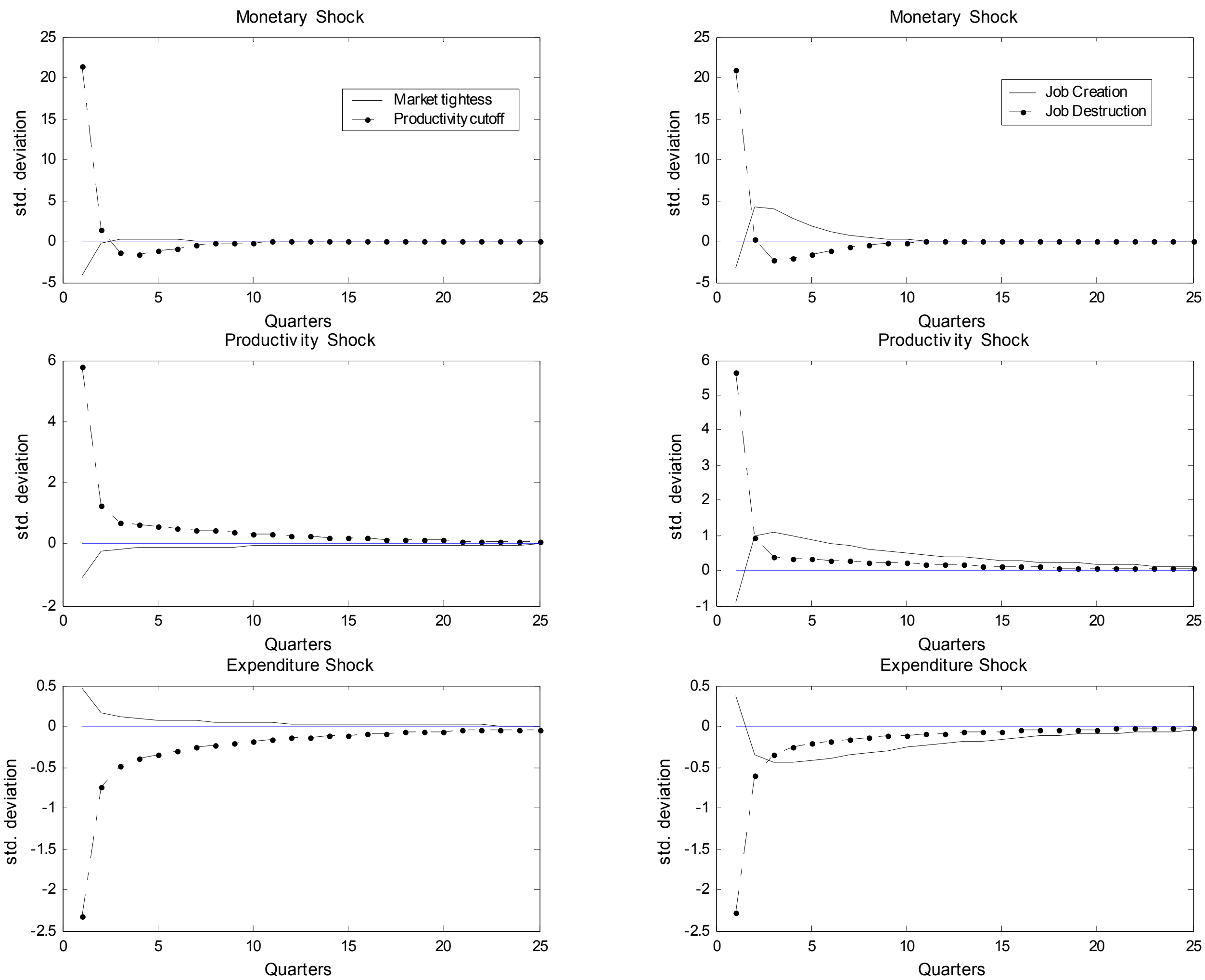
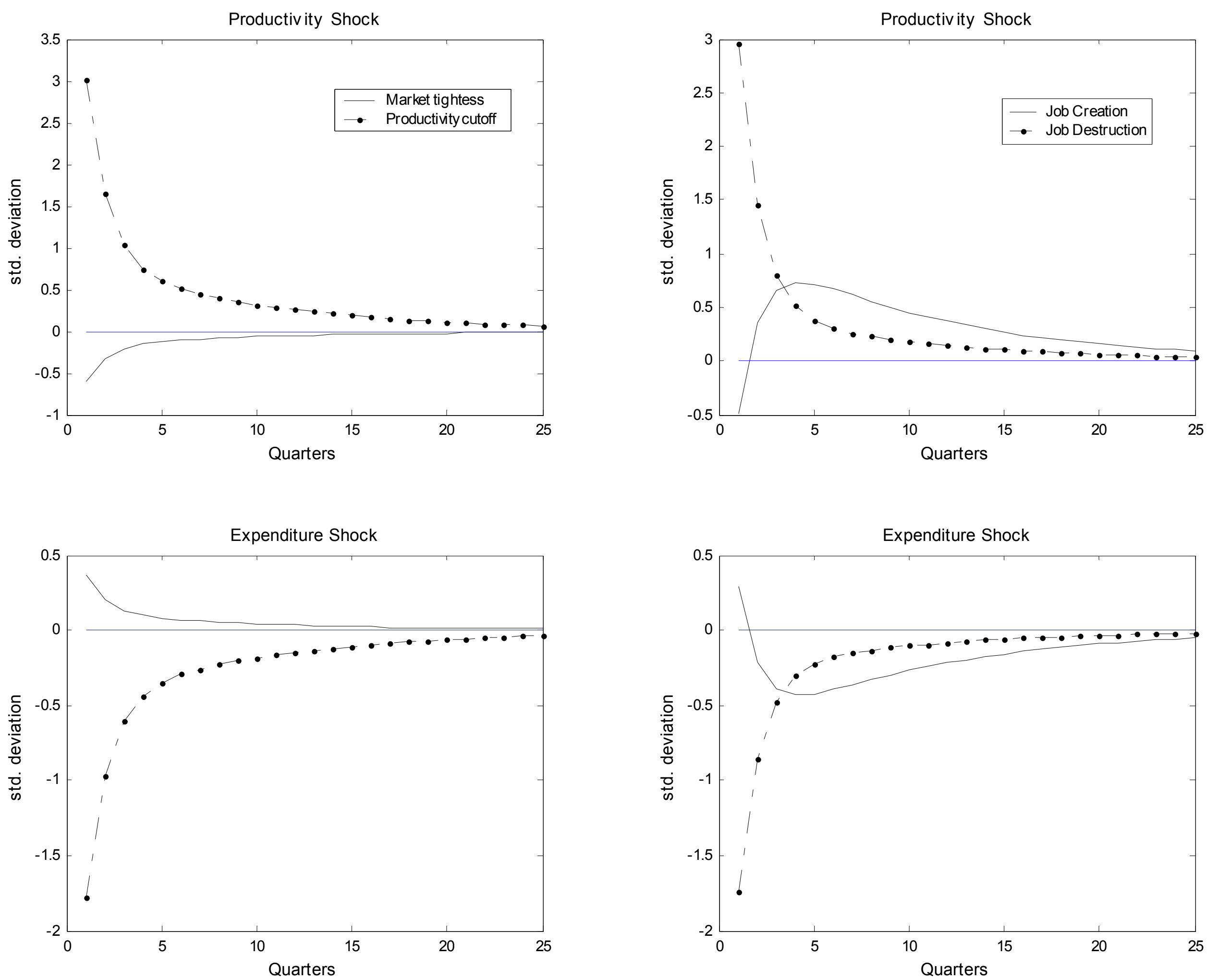


Figure 5: Labor Market Dynamics: Flexible Prices



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