Effects of a Labor Market Reform on the Efficiency of Monetary Policy

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Abstract

In spite of being mainly concerned with stabilization policies, Central Banks in many developed countries often advocate the necessity of reforms in the labor market. In fact, in addition to the more direct gains in macroeconomic efficiency, institutional reforms like those in the labor market may also affect the costs and benefits of monetary policy.

In the context of a currently standard New Keynesian rational expectations model for monetary policy analysis, we add specific stylized institutional features capturing the functioning of the labor market. In order to identify the channels through which the effects of the reform impinge on the efficiency of monetary policy, we build alternative scenarios for the goods market, corresponding to alternative sources of inertia. In this framework, a labor market reform is modeled as a structural change inducing a permanent shift in the flexible prices unemployment and output levels. The reform-induced adjustments are then compared across different monetary policy rules.

We find that, in general, labor market reform reduces the costs of monetary policy as a demand management instrument. However, conditional on the presence of inertia in the goods market, the reform process can bring about transition stabilization costs, depending on the monetary policy rule. Choosing a particular monetary policy rule, as well as the business cycle timing of the reform, are means to reduce such costs.

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1 Introduction

In spite of being mainly concerned with stabilization policies, Central Banks in many developed countries often advocate the necessity of reforms in the labor market. In fact, in addition to the more direct gains in macroeconomic efficiency, institutional reforms like those in the labor market may also affect the costs and benefits of monetary policy. From monetary policy literature we learn that independent and optimizing central banks do not care about the impacts on potential output, as Loss functions reflect pure price and output stabilization goals. Therefore, the implementation and permanent effects of the reform can affect monetary policymaking only to the extent of their impact on the stabilization role of the monetary authorities. In this context, our aim is to quantitatively evaluate the impact of a labor market reform on the efficiency of the monetary policy.

As a starting point, in section 2, we develop a macro model directly based on the New Keynesian rational expectations model widely used in monetary policy analysis. We modify the standard model with some specific institutional features aimed at capturing the functioning of the labor market. In particular, we assume that nominal gross wages are established in a right-to-manage process of collective bargain, which, unlike the standard New Keynesian models, yields a non-labor market clearing flexible price output level in equilibrium. The implied flexible price equilibrium level of employment is inefficient, as a result of several institutional features - including labor markets' - of the economy.

In terms of optimization, the model captures the representative agent behaviors - firm and household -, and the centralized behavior of the monetary authority. In what regards the monetary policy rule we allow for four alternative hypotheses: optimal monetary policy, under commitment and under discretion, and the non-optimal original Taylor rule, simple and with interest rate smoothing.

We conclude that this slightly modified standard New Keynesian framework fails to produce costly labor reform adjustments and, as such, is not appropriate to explain why these reforms often experience resistance. This is not very surprising, in view of the fact that in monetary policy literature these models are severely criticized for their inability in reproducing data persistency effects exhibited in output and price adjustments, and for some of their counterintuitive dynamics. By following some of the ideas to overcome such criticisms, we find that such persistency effects also fundament reform costs.

In spite of its shortcomings, the New Keynesian framework, serves as a baseline scenario in which we can already identify some sources of labor market reform. In particular, we choose, as an example, the reduction of the unemployment benefit replacement ratio. The baseline reform process assumes a one-shot decrease in the unemployment benefit, previously announced by the government. In section 3, we briefly review some of the theoretical motivations for the cut in the unemployment benefit ratio.

In order to overcome the sterility of the standard New Keynesian framework, we explore alternative ways of slowing down the adjustments after reform implementation. Two extensions are related to the reform process: (i) considering a one-shot but unexpected reform; and (ii) considering an announced gradual implementation of the reform.

The other extensions refer to changes in the structure of the economy, now quite standard in monetary policy analysis: (iii) the habit formation model and (iv) the introduction of inflation inertia in price setting. Section 3 also reviews the main microfoundations behind the theoretical/empirical feasibility of the proposed scenarios.

In Section 4, we first establish the criteria for measurement of the effects of the reform on stabilization costs, and then proceed with its computation, for different scenarios and different monetary policy rules. On the one hand, impacts on stabilization costs may arise during the adjustment periods after reform implementation - reform induced transition costs. On the other hand, by affecting the unemployment - inflation trade-off, the reform, once fully implemented, improves the efficiency of monetary policy in stabilizing the economy in face of shocks - permanent effects. Evaluation of these impacts is carried out by computing the central bank's Loss function, in face of reform implementation and in face of demand-side, technology or cost push shocks.

Final remarks are presented in section 5. We find that, in general, labor market reform reduces the costs of monetary policy as a demand management instrument. However, conditional on the presence of inertia in the goods market, the reform process can bring about transition stabilization costs, depending on the monetary policy rule. Choosing a particular monetary policy rule, as well as the business cycle timing of the reform, are means to reduce such costs.

2 The Baseline Model

In this section we proceed with the description of the baseline model for the analysis of labor market reform. We adopt the standard framework of the so called New Keynesian models. In particular, as we want to capture the interaction between labor market reforms and monetary policy, we follow closely the models used by Galí (2002a; 2002b) and McCallum and Nelson (1998) for monetary policy analysis. However, differently from the usual models for monetary policy analysis, the one proposed below allows for non-labor market clearing through the introduction of a right-to-manage wage bargaining process. This implies a non-efficient flexible price output level, the feasible output level towards which demand-side management policies, namely monetary policy, should be targeted at.

2.1 Behavior of Decentralized Agents

We start by characterizing the behavior of the decentralized agents in the economy - firms and households. Their decisions arise from the sum of strict individual decisions of the representative household and of the representative firm.

2.1.1 Households

Consider a continuum of infinitely-lived individual (*ie*, household), representative of the consumers' behavior in the economy. Each risk averse individual has preferences defined over consumption and leisure and seeks to:

$$\underset{N^s_{t+j},C_{t+j}}{Max}\ E_t\left\{\sum_{j=0}^{\infty}\beta^{t+j}U_{t+j}(C_{t+j},N^s_{t+j})\right\} \tag{1}$$
$$with \quad U_t = Log(C_t)\exp(g_t) - \frac{N_t^{s1+\varphi}}{1+\varphi}.$$

C_t stands for *per capita* consumption of a composite final good, N_t^s for the hours of labor supplied by the individual, g_t defines a shock to preferences and β $(0<\beta<1)$ is a discount factor.

In spite of the defined homogenous utility function, we assume that the representative individual reflects the average behavior of the labor force, being partially employed and partially unemployed. This is a simple way of weightily averaging across employed and unemployed to yield a representative consumer of the economy where C_t and N_t^s are better described as "homogenized" units of *per capita* consumption and supplied working hours, respectively. Such a purely technical device allows to keep the nature of the representative agent while still using (heterogeneous) individual behavior to influence the aggregate dynamics of the unemployment rate. If *per capita* "homogenized" units of labor supply exceeds "homogenized" units of labor demand (N_t^d) then, $\frac{N_t^s-N_t^d}{N_t^s}$ can be used as a proxy of the unemployment rate (u_t) of the economy. For instance if $N_t^s = 1.05N_t^d$, the unemployment rate is of 5% and should be interpreted as: 95% of the labor force works N_t^s hours at a given nominal wage rate, (W_t), while the remaining 5% are being paid an unemployment benefit rate,(B_t), also over N_t^s hours. The unemployment benefit rate is defined as a fixed percentage (the unemployment benefit replacement ratio, b) of the current aggregate average nominal wage such that $B_t = bW_t$.[1]

The representative individual faces a budget constraint that limits real consumption per period to the real incomes raised during current production activity plus the changes in savings. Production output is distributed either under the form of labor-related income or as profit earnings, Π_t. Henceforth, labor-related income respects to all incomes raised through the employment relationship, including wages as well as other incomes substituting for wages in the out of work situations. Within our framework these include only W_t and B_t but, in fact, they should refer to all social benefits such as injury or sickness benefits and old age or disability pensions as employment-based rights - see Harvey and Maier (2004) on this terminology. Changes in savings decisions are captured through the changes in real riskless government bond (GB) investment, evaluated by $[GB_{t+1}(1+rr_t)^{-1} - GB_t]$. In particular, the "homogenized" budget constraint results

[1] This is a simplification because the unemployment benefit replacement ratio is usually applied to a weighted average of the most recent wages the individual received before becoming unemployed.

from a weighted average of restrictions facing the employed and the unemployed:

$$\begin{aligned} C_t &= (1-u_t)\overbrace{\left[\frac{\Pi_t}{P_t}+\frac{W_t}{P_t}(1-\tau_t)N_t^s - GB_{t+1}(1+rr_t)^{-1}+GB_t\right]}^{employed}+ \\ &+u_t\overbrace{\left[\frac{\Pi_t}{P_t}+\frac{bW_t}{P_t}N_t^s - GB_{t+1}(1+rr_t)^{-1}+GB_t\right]}^{unemployed} \qquad (2) \end{aligned}$$

where rr_t stands for the real interest rate, P_t for the aggregate price level, τ_t for the tax rate on labor income and $(1-u_t)$ and u_t are used as proxies for the probability an individual has of being employed and unemployed at t, respectively. Both the employed and the unemployed are assumed to get the same *per capita* profits from firms and to save the same *per capita* amount on riskless bonds. Heterogeneity applies only to labor related incomes. It is also assumed that unemployment benefits are fully tax-financed (pure Bismarkian system) by the employed, as to keep the government budget permanently balanced:

$$\begin{aligned} \frac{W_t}{P_t}\tau_t N_t^d &= \frac{bW_t}{P_t}(N_t^s - N_t^d) \Leftrightarrow \\ \tau_t &= \frac{bu_t}{1-u_t}. \qquad (3) \end{aligned}$$

Putting together equations (2) and (3) to get the *per capita* aggregate budget constraint, the optimizing problem of the "homogenized" individual is defined, in Lagrangian form, as:

$$\begin{aligned} \underset{N_{t+j}^s, C_{t+j}, GB_{i+j+1}}{Max} \quad \mathcal{L} = E_t \sum_{j=0}^{\infty} \beta^{t+j}\left(Log(C_{t+j})\exp(g_{t+j}) - \frac{N_{t+j}^{s1+\varphi}}{1+\varphi}\right)+ \\ +\lambda_{t+j}\left(\frac{\Pi_{t+j}}{P_{t+j}}+\frac{W_{t+j}}{P_{t+j}}(1-u_{t+j})N_{t+j}^s - GB_{t+j+1}\frac{1}{(1+rr_{t+j})}+GB_{t+j}-C_{t+j}\right). \qquad (4) \end{aligned}$$

2.1.2 Firms

In what concerns the productive side, we consider monopolistic competition in the production of intermediate goods and perfect competition in the final good.

There is a continuum of intermediate goods producers indexed by $i \in [0,1]$, each of which producing a differentiated good, Y_{it}, according to the following production function:

$$Y_{it} = A_t \left(N_{it}^d\right)^{\alpha}, \quad \alpha < 1. \qquad (5)$$

Where A_t is a technology index common to all firms and N_{it}^d respects to the hours of labor in use by the firm producing the intermediate good i.

We also consider the existence of many producers of the composite final good, Y_t, through a Dixit and Stiglitz (1977) CES-type aggregation of intermediate goods:

$$Y_t = \left[\int_0^1 Y_{it}^{\frac{\varepsilon-1}{\varepsilon}} di\right]^{\frac{\varepsilon}{\varepsilon-1}}, \varepsilon > 1. \tag{6}$$

Where $\varepsilon > 1$ refers to the absolute value of the relative price elasticity of the demand for the intermediate good i. The relative demand for each intermediate good i, Y_{it}, is given by the final good producer optimal choice of inputs, and is derived as:

$$Y_{it} = \left[\frac{P_{it}}{P_t}\right]^{-\varepsilon} Y_t. \tag{7}$$

The aggregate price level, P_t, is perfectly competitive. Using equation (7) and the profit condition under perfect competition, the general price index can also be defined as an aggregation of intermediate goods prices (see, for example, Ireland, 2000):

$$P_t = \left[\int_0^1 P_{it}^{(1-\varepsilon)} di\right]^{\frac{1}{1-\varepsilon}} \Leftrightarrow 1 = \int_0^1 \left[\frac{P_{it}}{P_t}\right]^{1-\varepsilon} di. \tag{8}$$

In order to define the intermediate good firm's problem, we have first to introduce assumptions on the price setting mechanism. To start with, assume that a firm can set its prices optimally at any period - the flexible price (FP) decision of firms. The problem faced by the i^{th} firm can be represented by:

$$\begin{aligned} & \underset{Y_{it}}{Max}\ \Pi_{it} = P_{it}Y_{it} - W_t N_{it}^d \\ & s.t. \\ & Y_{it} = \left[\frac{P_{it}}{P_t}\right]^{-\varepsilon} Y_t, \\ & Y_{it} = A_t \left(N_{it}^d\right)^{\alpha}. \end{aligned} \tag{9}$$

The solution yields a constant mark-up, μ, of prices over nominal marginal costs. Assuming symmetry across firms, $P_{it} = P_t$ and $Y_{it} = Y_t$, the aggregate price is given by:

$$P_t = \mu \left[\frac{1}{\alpha} W_t Y_t^{\frac{1-\alpha}{\alpha}} A_t^{-\frac{1}{\alpha}}\right], \quad \mu = \frac{\varepsilon}{\varepsilon - 1}, \quad \alpha < 1, \quad \varepsilon > 1. \tag{10}$$

However, the assumption that firms can optimally reset prices at any period is not compatible with real effects of the demand side policies, because full price adjustment crowds out, instantaneously, any demand pressure. In fact, some price rigidity in general equilibrium models is a *sine qua non* assumption for the model to produce real effects from monetary policy conducting. As Taylor (1999b, p. 1027) refers, what we observe is that prices (and nominal wages) are set for some periods ahead, usually not conditioned upon conjuncture actualizations and in a non-synchronized manner. The "near rationality behavior" argument *a la* Akerlof and Yellen (1985) and the existence of menu costs that make price adjustments costly (see, among others, Barro, 1972, and Blanchard and Kiyotaki,1987) are the main arguments that have been advanced to justify such behavior of the firms.

In this context, one of the most widespread approaches to introduce price rigidity is to allow time-dependent staggering in price setting as in Calvo (1983)[2].

To introduce price rigidity we follow a discrete version of Calvo's (1983) price adjustment mechanism as proposed in Galí (2002b). Let the constant $(1-\theta)$ denote the probability a firm has of adjusting prices in period t, such that the probability is independent of the past, namely, independent of when the firm last adjusted prices. In any period, the fraction of firms that have last adjusted prices (to the optimum value, P^*, conditioned upon the expected average duration of price stickiness) j periods earlier, is given by the probability of price adjustment $(1-\theta)$ times the probability of not having changed prices during the last j periods (θ^j). We then define the (log of) aggregate price level (p_t) as in King (2000):

$$\begin{aligned} p_t &= (1-\theta)\sum_{j=0}^{\infty}\theta^j p_{t-j}^* \Leftrightarrow \\ p_t &= \theta p_{t-1} + (1-\theta)\, p_t^*, \quad \text{using} \quad p_{t-1} = (1-\theta)\sum_{j=0}^{\infty}\theta^j p_{t-j-1}^*. \end{aligned} \tag{11}$$

This establishes the sticky price dynamics. As expected, the optimal price to be set at t must drive the best profit results conditional on the possibility that the firm's price may not be changed for some periods ahead. Taking $E_t\left\{\Pi_{t+j,j}\right\}$ as the profits expected in t for j periods ahead, with prices frozen since t, P_t^* must satisfy:

$$\underset{P_t^*}{Max}\, E_t \sum_{j=0}^{\infty}\left\{(\theta\beta)^j\, \Pi_{t+j,j}\right\}. \tag{12}$$

Following, among others, Goodfriend and King (1997) and Galí *et al* (2001) on the above problem, when inflation is low, the optimal price to be set at t can be expressed in the approximate (log) form:

$$p_t^* - p_t = \log\mu + (1-\theta\beta)\frac{\alpha}{\alpha+\varepsilon(1-\alpha)}\sum_{j=0}^{\infty}(\theta\beta)^j\, E_t\left\{mc_{t+j}\right\} + \sum_{j=1}^{\infty}(\theta\beta)^j\, E_t\left\{\pi_{t+j}\right\}, \tag{13}$$

with $E_t\left\{mc_{t+j}\right\}$ and $E_t\left\{\pi_{t+j}\right\}$ standing, respectively, for the (log of) expected real marginal costs and the expected inflation rate for period $t+j$, conditional on the information available at time t.

[2] Calvo's approach seems to be more technically appealing than the seminal Fischer's (1977) and Taylor's (1979), which explains why it is so often used in recent general equilibrium models - for instance, in Christiano *et al* (2000) and in Galí (2002a). Underlying price dynamics is similar to that of Rotemberg's (1982). Other related approaches are the state-dependent price staggering proposed by Caplin and Spulber (1987) and the combined state and time dependent staggering proposed by Conlon and Liu (1997).

2.2 Labor Market Equilibrium

This section introduces the main difference to standard general equilibrium models used in monetary policy analysis. Standard models usually assume labor market clearing, that is, zero equilibrium unemployment rate. Instead, we introduce an additional source of inefficiency to the equilibrium result: flexible price equilibrium output is inefficient not only due to the existence of monopolistic competition among producers, but also because labor market functioning leads to unemployment. We call this the flexible price-full effect reform (*FP-FER*) equilibrium because it refers to the flexible price output under a specific set of institutional features characterizing the labor market. Also, the model should capture the effects of labor market reforms: (i) on the adjustment mechanism to shocks hitting the economy, as reforms improve real wage flexibility, and (ii) on equilibrium unemployment.

2.2.1 Labor Supply

Labour supply is typically defined by the optimizing decision of households with respect to hours of labor supplied and consumption (see problem 4, above). The result refers to the "notional labor supply" (as in Ambler *et al*, 1999, and Bovenberg *et al*, 2000) - and reflects the household choice between hours of leisure and consumption. Instead, we assume that labor supply is perfectly inelastic, that is, an individual works a fixed amount of hours irrespective of its preferences over consumption and leisure. This has a twofold objective: first it captures the empirical regularity that labor supply is relatively inelastic in the short run (see, for instance, Burda and Wyplosz, 1997, p. 140)[3]; second, if defined in the typical way, and given our unemployment benefit rate definition, the model would predict the awkward result that the more the labor supplied by the unemployed the more they would collect as unemployment benefit (assuming that an unemployed has no leisure costs in supplying additional hours of work).[4] So, we normalize $N_t^s = 1$, $\forall t$ or, in log form,

$$n_t^s = 0, \forall t. \tag{14}$$

2.2.2 Collective Bargaining

The existence of involuntary unemployment means that there is job rationing in the economy. Firms could set lower wages and get more workers into jobs but mechanisms of wage formation may prevent this. In particular, and among the models of wage formation that may lead to unemployment, we follow a class of the "insider-outsider" models where workers of a given firm join a labor union to negotiate over wages. The union protects its members, meaning the actual employees, who are insiders to the labor market, as opposed

[3] Short-run wage inelasticity can be due, among other causes, to the existence of labor market legislation establishing a fixed number of weekly working hours.

[4] This is also a simplifying assumption because we could attach some leisure costs to the unemployed's supply of working hours. Usually, to be eligible to get the unemployment benefit, the unemployed has to actively get involved in searching for a new job or may even be asked to engage in some services of public utility.

to the unemployed, the outsiders. Workers organize themselves in an union in order to getting higher bargaining power relatively to individual negotiation. For simplicity, we can assume that unions bargain solely over contractual wage. Usually, permanent labor contracts are subject to legally pre-established amount of working hours; this makes labor supply inelastic and supports the assumption that unions do not interfere, at least in the short run, with working time (or worker's effort) negotiations.

According to Calmfors and Driffil (1988) higher wage claims are achieved when collective bargaining operates at an intermediate level, where both firms and employees of a given activity are organized, respectively, into an employers' organization and a labor union. At firm or at national levels (*ie*, Social Pacts) wage claims are refrained by negative externalities unperceived at the intermediate level. At the firm level, employees have the perception of the implications of their wage claims on the firm's competitiveness, and thus on the threat to their jobs; at a centralized level, workers' representatives gain the perception that higher wages mean both higher unemployment and higher taxes.

We follow here the right-to-manage model of wage formation in which a union bargains with a firm over wages and then each firm sets employment taking wages as given.[5] The bargaining is over gross nominal wages because it is assumed that, at such decentralized level, the employed have no perception about the negative tax externalities and because nominal wage is the one usually set in collective bargaining agreements. As in Layard *et al* (1991), we can treat the problem of bargaining as that of dividing a cake between two parties. To apply this, consider the following Nash maximand:

$$(\Pi - \overline{\Pi})^{(1-\Gamma)}(V - \overline{V})^{\Gamma}, \tag{15}$$

where Γ reflects the union's bargaining power and V and Π refer to the objective functions of the union and the firm, respectively. $\overline{V}$ and $\overline{\Pi}$ refer to the corresponding "fallbacks", that is, the extra income either part will get if disagreement prevails. As so, $\overline{V}$ is a function of the income an insider of firm i is expected to get if he becomes an outsider. $\overline{\Pi}$ equals 0 because if no agreement is put forward, the firm has no operating surplus. The higher a party's "fallback" or the higher its bargaining power, the most willing will it be to tolerate a disagreement and thus it will be able to put more pressure to get a bigger "slice" of the "cake".

Following Layard *et al* (1991), Bovenberg *et al* (2000) and Bèlot and van Ours (2000), we admit that collective wage bargain reflects the maximization of the following Nash function with respect to nominal wage. We also assume that wage bargaining takes place every period, so that no nominal wage stickiness occurs, and that unions, unlike households, are risk neutral. Given its simpler operationality, this last assumption is not particularly relevant for the results because household's utility is also increasing with the wage. In particular, firm and union try to

$$\underset{W_{it}}{Max} \quad \left[P_{it}Y_{it} - W_{it}N_{it}^{d}\right]^{(1-\Gamma)}\left[W_{it} - Wout_{it}\right]^{\Gamma}\left[S_{it}(W_{it})\right]^{\Gamma}. \tag{16}$$

[5] This contrasts with the monopoly union model and the efficient bargaining model [see, for instance, Saint-Paul (2000)]. In the monopoly union model, a special case of the right-to-manage model, the union sets wages unilaterally and then firms set employment taking wages as given. In the efficient bargaining model firms and workers jointly bargain over both employment and wages.

For a given price, P_{it}, the optimizing condition yields a relation between the nominal (and thus the real) wage and the hours a firm wishes to employ (*per capita* "homogenized" hours of work). The terms in brackets capture the instantaneous utility for the individual firm and for the union.[6] This objective function tries to capture the above-mentioned features characterizing the collective bargaining. First, and differently from Bovenberg *et al* (2000), the parties bargain over nominal wages and not over hours of work, for a constant labor supply is assumed. Second, and following Layard *et al* (1991), workers do take into account that their wage claims may have adverse effects on their survival probability inside the firm (externality effects). This also conforms to Bèlot and van Ours (2000), where the Nash maximand is also weighted by the probability of keeping the job in firm i. S_{it} stands for the expected probability an insider working in firm i at $t-1$ has of remaining employed in the same firm in period t (survival probability). S_{it} can be defined as a negative function of the nominal wage, reflecting that the lower the wage the larger will be the number of employees hired by the firm, and so the higher is the probability an insider has of maintaining his current job. As so, by capturing the costs of high wage claims, S_{it} reflects the competitiveness externality effect at the decentralized level of bargaining.

Finally, $Wout_{it}$ refers to the employed's outside option *per capita* earnings. We consider the outside earnings as an average weighted by the probability of finding a job in other than the i^{th} firm (F_{it}), paid at the average gross wage rate, W_t, and the probability of a displaced worker not finding a job elsewhere $(1-F_{it})$, and thus receive the unemployment benefit rate, B_t.

$$Wout_{it} = F_{it}W_t + (1-F_{it})B_t \tag{17}$$

In general, $(1-F_{it})$ is better specified as a function of factors that affect the competitiveness that unemployed face when in search for jobs. Layard *et al* (1991) consider that the probability of being unemployed increases with aggregate unemployment rate - u -, and decreases with other factors that reduce competitiveness among the unemployed - such as the unemployment benefit generosity and the percentage of long term unemployed over total unemployment. We assume, for simplicity, that $(1-F_{it})$ equals the unemployment rate as in Bovenberg *et al* (2000), capturing that single factor affecting competitiveness among the unemployed.[7] We are assuming that the unemployment rate is a good proxy for the probability of not finding a job in other (continuum of) firms besides the i^{th} one; $Wout$ can now be defined as:

$$Wout_t = (1-u_t)W_t + u_t bW_t. \tag{18}$$

[6] For a detailed exposition on the derivation of the Nash bargaining, see Bélot and van Ours (2000).

[7] One way of indirectly capture the other determinants is to consider not only the unemployment rate but also the change in the unemployment rate. The larger the increase in unemployment, the stronger competitiveness between unemployed - reflecting an incoming of newly unemployed with better skills and work habits, unwilling to lose current labor income.

The bargaining problem can now be fully re-written as:

$$\begin{aligned} &\underset{W_{it}}{Max} \quad \left[P_{it}Y_{it} - W_{it}N_{it}^{d}\right]^{(1-\Gamma)} \left[W_{it} - Wout_{t}\right]^{\Gamma} \left[S_{it}(W_{it})\right]^{\Gamma} \\ &s.t. \\ &Y_{it} = A(N_{it}^{d})^{\alpha} \\ &Wout_{t} = (1 - u_{t} + u_{t}b)W_{t}. \end{aligned} \tag{19}$$

Assuming symmetry across firms, through making $P_{it} = P_t$, $N_{it}^d = N_t^d$ and $W_{it} = W_t$, we get the optimal solution:

$$(1-b)(1-\Gamma)u_t\frac{W_t}{P_t}(-N_t^d) + \left[A\left(N_t^d\right)^{\alpha} - \frac{W_t}{P_t}N_t^d\right]\left[1-(1-b)u_t\varepsilon_{SN}\varepsilon_{NW}\right]\Gamma = 0. \tag{20}$$

Equation (20) is derived under the simplifying assumption of a constant absolute elasticity of the survival probability relatively to wage, $\varepsilon_{SW} = \varepsilon_{SN}\varepsilon_{NW}$, at the (flexible price) *steady state* level; ε_{SN} stands for the elasticity of the survival probability with respect to employment and ε_{NW} stands for the nominal wage elasticity of labor demand. According to Layard *et al* (1991), ε_{SN} is typically less than 0.5 while the (flexible price) *steady state* level of ε_{NW} is given by:

$$\varepsilon_{NW} = \left|\frac{\frac{\partial N}{N}}{\frac{\partial W}{W}}\right| = (1 - \frac{\alpha}{\mu})^{-1} > 0. \tag{21}$$

Using both equations, (20) and (21), we get the following wage offer curve, relating real wage to the employment level:

$$\frac{W_t}{P_t} = \left[1 + \frac{1}{\frac{\Gamma}{(1-\Gamma)}\left[\frac{1}{(1-b)u_t} - \varepsilon_{SN}(1-\frac{\alpha}{\mu})^{-1}\right]}\right]^{-1} A_t\left(N_t^d\right)^{(\alpha-1)}. \tag{22}$$

Real wages increase with:

(i) the union's relative bargaining power, $\Gamma/(1-\Gamma)$;

(ii) the union's "fallback", which, in turn, increases with b and with a lower u_t;

(iii) the survival probability, which, in turn, increases with μ, and with a lower ε_{SN} and a lower α;[8]

(iv) the marginal productivity of labor, that is, with a lower N^d.

[8] The effects of μ on the real wage claims seem to be in line with arguments of Saint-Paul (1996) and Blau and Kahn (1999) - the higher the elasticity of labor demand, the lower the support for bid up wages. This conclusion seems at odds with Blanchard (2004, p. 23), for he argues that a lower mark up incentives higher real wages. However, as we shall see below, our labor demand and unemployment rate are also functions of the markup; for instance, a lower μ leads to lower unemployment, which, in turn, has positive effects on real wages.

2.2.3 Flexible Price-Full Effect Reform Equilibrium

The *FP-FER* equilibrium output is defined as the long run *steady state* level of output. It refers to the output level achieved under the flexible price (FP) adjustment and for a given set of institutional arrangement characterizing the labor market (FER).

Satisfying the right-to-manage model for wage formation, we start by combining the wage offer curve and the labor demand under the flexible price hypothesis to get the *FP-FER* equilibrium output level.[9] Looking first at labor demand, we derive it from equation (10). Log linearization of the pricing decision under FP yields:

$$(w_t - p_t) = -\log \mu + \log \alpha + (\alpha - 1) n_t^d + a_t, \tag{23}$$

where labor demand reacts negatively to the real wage rate.

Log-linearizing the wage offer curve (equation 22) around the *FP-FER* equilibrium, together with the assumption of labor supply inelasticity, we get:

$$(w_t - p_t) = \bar{d}_0 + \bar{d}_1(\Delta\Gamma) + \left[\bar{d}_{21} + (\alpha - 1)\right](n_t^d - \bar{n}_t^d) + \bar{d}_3(\Delta b_t), \quad \bar{d}_{21} > (\alpha - 1), \tag{24}$$

$$\begin{aligned} \textit{where} \qquad & \bar{d}_0 \equiv -\log\left(1 + \frac{1}{\bar{q}}\right) + a_t + (\alpha - 1)\bar{n}_t^d; \quad \bar{d}_1 \equiv \left[\frac{1}{(\bar{q}+1)} \frac{1}{(1-\bar{\Gamma})\bar{\Gamma}}\right]; \\ & \bar{d}_{21} \equiv \left[\frac{1}{(\bar{q}^2 + \bar{q})} \frac{\bar{\Gamma}}{(1-\bar{\Gamma})} \frac{1}{(1-\bar{b})\bar{u}^2}\right]; \quad \bar{d}_3 \equiv \left[\frac{1}{(\bar{q}^2 + \bar{q})} \frac{\bar{\Gamma}}{(1-\bar{\Gamma})} \frac{1}{(1-\bar{b})^2 \bar{u}}\right]; \\ & \Delta\Gamma_t = \Gamma_t - \overline{\Gamma}_t; \quad \Delta b_t = b_t - \overline{b}_t; \quad \bar{q} = q(\bar{\Gamma}, \bar{b}, \bar{u}). \end{aligned}$$

The dashed variables refer to values at the respective *FP-FER* equilibrium levels. Usually, $\Delta b_t = \Delta\Gamma_t = 0$, unless an unexpected reform affecting either of the parameters occurs. Under no reform or if it is fully announced, $b_t = \overline{b}_t$ and $\Gamma_t = \overline{\Gamma}_t$. As expected, real wages are higher, the stronger the pressure on labor demand. Under FER ($n_t^d = \bar{n}_t^d$, $\Delta b_t = \Delta\Gamma_t = 0$), putting together the labor demand function and the wage offer curve at the *FP-FER* levels, we get the following results for $\bar{u}_t$, $\bar{n}_t^d$ and $\bar{y}_t$, respectively:

$$\bar{u}_t = \frac{(\mu - \alpha)\bar{\Gamma}}{\left[\alpha(1-\bar{\Gamma}) + \bar{\Gamma}\epsilon_{SN}\mu\right](1-\bar{b})} = \overline{u}; \tag{25}$$

$$\bar{n}_t^d = n_t^s - \bar{u} = -\bar{u} = \overline{n}^d; \tag{26}$$

$$\bar{y}_t = -\alpha\bar{u} + a_t. \tag{27}$$

The *FP-FER* equilibrium is a function of the inefficiencies (both in the labor as well in the goods and services markets) present in the economy.[10] The *FP-FER* unemployment rate (also the *steady state* unemployment rate) increases with the unemployment benefit replacement ratio, the relative power of the union in wage bargaining, and the degree of monopolistic competition in the market for intermediate goods.

[9] The wage offer curve is the institutionally meaningful labor supply because bargaining is the institutional channel through which wages are set. Even under low unionization rates, it is a generalised practice that collective bargaining agreements are extended to cover most of the non-unionized workers.

[10] Hereafter, dashed variables with time subscript refer to $FP - FER$ equilibrium levels while dashed variables without time subscript stand for its respective *steady state* levels.

2.3 Centralized Behavior - the Monetary Authority

This subsection is devoted to the centralized behavior of the policy maker. In particular, the relevant policy maker is the central bank (CB) as we assume that monetary policy is the only demand-side management policy available.[11]

Theoretically, the policy maker should optimally behave in a way to maximize the utility of the representative agent. However, the literature on monetary policy conducting shows a widespread consensus that central banks follow simple rules instead. Nontheless, optimal policy rules perform a useful role in benchmarking simple rules. For instance, and for our purposes, optimal policy rules provide results on welfare costs, that are useful for the evaluation of simple rules.

2.3.1 Defining Optimal Monetary Policy

Following a standard procedure in the relevant literature, we define the optimal monetary policy conducting as maximizing the welfare of the "homogenized" representative agent. In here, we follow a version of Woodford's (2001) methodology as presented in Galí's (2002b), to derive the objective function of the monetary authority according to the specificities of the model we have exposed throughout. Differently from standard derivations, the following takes into account $\alpha \neq 1$ (see the production function 5, above) as well as the non-labor market clearing due to the wage bargain process. We start by maximizing the representative agent instant utility relative to the correspondent *FP-FER* level:

$$U_t - \overline{U}_t = Log(C_t) - \frac{N_t^{d(\varphi+1)}}{(\varphi+1)} - \overline{U}_t. \tag{28}$$

N^d substitutes for N^s because effective hours of work are determined by labor demand and, under non labor market clearing, they do not match, in general, the labor supplied at the bargained equilibrium wage. Despite the fact that N^s differs from N^d, hours of labor supplied by the unemployed are not welfare consuming, according to the assumption of costless job search (see 2.2.1, above). Using a second order Taylor approximation to the utility function around the *FP-FER* level, we get:

$$U_t - \overline{U}_t = \overline{U}_{c,t}\overline{C}_t\left(\widetilde{c}_t\right) + \overline{U}_{n,t}\overline{N}_t^d\left(\widetilde{n}_t^d + \frac{1+\varphi}{2}\left(\widetilde{n}_t^d\right)^2\right) + o(||a||^3). \tag{29}$$

Where a second order approximation of relative deviations in terms of log deviations was used.[12] Lower case variables represent variables in the log form, with $\widetilde{x}_t = \log\left(\frac{X_t}{\overline{X}_t}\right)$; $\widetilde{x}_t$ is assumed to be of order $o(||a||)$. Using the definition

$$\widetilde{n}_t^d = \frac{1}{\alpha}\left(\widetilde{y}_t + s_t\right), \quad s_t = \log\int_0^1\left(\frac{P_{it}}{P_t}\right)^{-\varepsilon} di \tag{30}$$

[11] The government is assumed to be neutral, with a passive role exclusively related with income distribution - it collects taxes to pay for the unemployment benefits, constrained to keeping the budget balanced.

[12] *I.e.*, $\left(\frac{C_t - \overline{C}_t}{\overline{C}_t}\right) = \widetilde{c}_t + \widetilde{c}_t^2 + o(||a||^3)$.

and the goods market clearing condition $Y_t = C_t$, we have

$$U_t - \overline{U}_t = \overline{U}_{c,t}\overline{Y}_t\left(\widetilde{y}_t\right) + \overline{U}_{n,t}\overline{N}_t^d\left[\frac{1}{\alpha}\left(\widetilde{y}_t + s_t\right) + \frac{1+\varphi}{2\alpha^2}\widetilde{y}_t^2\right] + o(||a||^3), \tag{31}$$

where $\overline{U}_{n,t}\overline{N}_t^d = \left[-\overline{U}_{c,t}\overline{Y}_t\left(\overline{N}_t^d\right)^{(\varphi+1)}\alpha\right]/\alpha$.

Disregarding, for now, the s_t term, define:

$$[1-\Phi] = \frac{\left(\overline{N}_t^d\right)^{(\varphi+1)}}{\alpha} = \frac{(1-\overline{u})^{(\varphi+1)}}{\alpha}, \tag{32}$$

where Φ can be seen as an inefficiency measure of the economy, that is, a measure of how far the *FP-FER* equilibrium is from the efficient level, y_t^e (the *FP-FER* output level observed under full resource utilization). A first order approximation to Φ yields:

$$\begin{aligned}\Phi &= (\varphi+1)\overline{u} + \log\alpha + o(||a||^2) \Leftrightarrow \\ \Phi &\simeq (\varphi+1)\frac{(y_t^e - \overline{y}_t)}{\alpha} + \log\alpha, \quad y_t^e - \overline{y}_t = \alpha\overline{u}.\end{aligned} \tag{33}$$

It is straightforward that Φ is an increasing function of economic inefficiency. If labor market clears in *steady state* ($\overline{u} = 0$) then, for α close to one, Φ is close to zero.

Using (33) we redefine the monetary authority's optimization problem as:

$$\begin{aligned}&\overline{U}_t - U_t = \frac{1}{2}\overline{U}_{c,t}\overline{Y}_t\left[2s_t + \frac{1+\varphi}{\alpha}\left(\widetilde{y}_t - z\right)^2\right] + t.i.p. + o(||a||^3), \\ &z = (y_t^e - \overline{y}_t) + \frac{\alpha\log\alpha}{(1+\varphi)}.\end{aligned} \tag{34}$$

Since z depends only on structural variables characterizing the economy, such as those characterizing labor market functioning, the degree of competition between firms and the features of the production function technology, it is quite straightforward to assume that monetary policy does not affect such variable. In this context, z can be classified as terms independent of policy ($t.i.p$); in particular, $t.i.p$ in equation (34) refers to $-z^2$.

Now, in what refers to s_t, it is related to individual price variability. As shown in Woodford (2001),

$$s_t = \frac{\varepsilon}{2}var_i\left\{p_{it}\right\} + o(||a||^3). \tag{35}$$

Deriving a first order approximation to $\overline{U}_{c,t}\overline{Y}_t$ around the *steady state* (U_cY) and using both equations (34) and (35), we can write a second order approximation to the consumer's welfare loss, expressed as a fraction of *steady state* consumption (income):

$$L = \frac{\overline{U}_t - U_t}{U_cY} = E_0\sum_{t=0}^{\infty}\beta^t\left[s_t + \frac{1+\varphi}{2\alpha}\left(\widetilde{y}_t - z\right)^2\right]. \tag{36}$$

Using the following Lemma, applied under the assumption of Calvo's price setting mechanism, and proved in Woodford (2001)[13],

$$\sum_{t=0}^{\infty}\beta^{t}\left(var_{i}\left\{p_{it}\right\}\right)=\frac{1}{\lambda_{L}}\sum_{0}^{\infty}\beta^{t}\pi_{t}^{2}+t.i.p.+o(||a||^{3}), \tag{37}$$

where $\lambda_L = \frac{(1-\beta\theta)(1-\theta)}{\theta}$, we get the following monetary authority's Loss function:

$$L=\frac{1}{2}E_{0}\sum_{t=0}^{\infty}\beta^{t}\left[\pi_{t}^{2}+\omega_{\widetilde{y}}\left(\widetilde{y}_{t}-z\right)^{2}\right], \quad \omega_{\widetilde{y}}=\frac{(1+\varphi)\lambda_{L}}{\alpha\varepsilon}. \tag{38}$$

The components of this Loss function are the standard ones - central banks minimize a weighted sum of the square deviations of inflation and output gap from the respective targets, 0 and z. A final remark to the above Loss function is worth mentioning. It relies on Clarida *et al* (1999)'s argument that the monetary policy is unable to affect the natural level of output (here taken as the *FP-FER* level of output). They prove that efforts to equalize $\widetilde{y}_t$ to z put pressure on long run inflation rate without affecting $\overline{y}_t$ (inflation bias problem). Taking this result into account, we assume that a rational central bank should never push output to values different from the flexible price level outcome, and so we set $z = 0$. This is the same as assuming that the monetary authority is perfectly aware of this constraint, or even that there are more appropriate policies - for instance, one enforced by the government - to overcome structural inefficiencies in the economy.[14]

Minimization of the Loss function usually faces the constraint imposed by cost-push shocks as they lead to inflation - output gap stability trade-off. A useful - although *ad hoc* - way to introduce such trade-off is to consider a disturbance term that augments the aggregate supply (AS) equation. Maintaining the Calvo price staggering assumption in firms' behavior, the standard inflation dynamics results in the so called "New Keynesian Phillips" curve, augmented by a cost-push shock ($\mathtt{u}_t$):[15]

$$\pi_{t}=\beta E_{t}\left\{\pi_{t+1}\right\}+k\widetilde{y}_{t}+\mathtt{u}_{t}. \tag{39}$$

As will shall see below, k is a function of the usual parameters in a model under labor market clearing (that is, those characterizing the goods and services markets) as well as of the parameters related to the institutional working of wage bargaining. Cost-push shocks may reflect anything that affects firms' nominal marginal costs irrespectively of the cycle fluctuations. It can also reflect mark-up shocks in either prices or wages, due,

[13] This identity is particular of the Calvo's (1983) price setting mechanism. If price setting differs from such specification, the definition of price variability will also change. An example of how the price setting may change the s_t definition is provided below, in 3.2, where an "hybrid" AS curve replaces the baseline New Keynesian AS relation.

[14] In this respect, Galí (2002a) and Woodford (2003) assume that there is a government subsidy that pushes the flexible price level of output to the efficient level, so that the monetary authority is not to worry about efficiency targets.

[15] Derives from the firm's optimizing behavior as will be shown below.

for instance, to inputs price shocks or to shocks in wage growth claims. In what respects the latter, it will be shown below that an unexpected reform process may also fundament the existence of cost-push shocks.

The relevant problem facing monetary authorities is, then,

$$\begin{aligned}
&\underset{\pi_{t+j},\widetilde{y}_{t+j}}{Min} \qquad E_t\sum_{j=0}^{\infty}\beta^j(\pi_{t+j}^2+\omega_{\widetilde{y}}\widetilde{y}_{t+j}^2), \qquad \omega_{\widetilde{y}}=\frac{\lambda_L(1+\varphi)}{\varepsilon\alpha}\\
&s.t. \\
&\pi_t=\beta E_t\{\pi_{t+1}\}+k\widetilde{y}_t+\mathtt{u}_t, \qquad k>0.
\end{aligned} \tag{40}$$

For which solution, first order conditions (FOCs) include:

$$E_1(2\omega_{\widetilde{y}}\widetilde{y}_t+k\lambda_t)=0, \qquad t=1,2,... \tag{41}$$

$$E_1(\pi_t+\lambda_{t-1}-\lambda_t)=0, \qquad t=2,3,... \tag{42}$$

$$2\pi_1-\lambda_1=0, \qquad t=1. \tag{43}$$

Under these FOCs, and following Clarida *et al* (1999), McCallum and Nelson (2000) and Galí (2002a), we can scope two sets of solutions for the optimal policy. On the one hand, there is the discretionary solution: the monetary authority takes private sector expectations of future output gap and inflation as given, in the sense that it fails to commit to any future policy actions. On the other hand, there is the commitment solution that arises when the central bank's strong credibility enables it to pursue an optimal intertemporal plan and thus influence private sector expectations. In 2.4, below, we derive the optimal monetary policy considering both these solutions.

2.3.2 Taylor Rules

It is usually argued that, in practice, central banks fail to design and implement optimal policy rules (Galí, 2002a). One of the stronger arguments refers that optimal policy rule is not robust across model specifications. On the one hand, the correct application of optimal monetary policy depends on the knowledge of the true model (as well as the underlying parameters) governing the economy. On the other hand, it requires that the CB observes and currently responds to several different shocks that, by definition, are unexpected. In addition, there are several measurement problems, namely those related with output gap measurement or the failure to detect shifts in some parameters that are unobservable by nature (such as preferences). To overcome such lack of robustness, several authors have proposed a variety of simple rules as a guideline for monetary policy conducting and for assessing its performance across different models. This is the aim of the studies compiled in Taylor (1999a) where, among other main findings, it is concluded that simple rules performance are surprisingly close to that of the optimal policies, and that they are more robust than complex rules across a variety of models.

Another reason for the use of simple rules is that these are more public-friendly, in the sense that they are easier to understand by the private sector; this makes the central banks more accountable and, more importantly, it provides a stronger influence of monetary policy conducting on private sector expectations.

Furthermore, there is strong empirical evidence that simple rules mimic rather well the monetary policy conducting, because historical analysis finds a significant correlation between such rules and economic performance.

Finally, and speaking strictly of the European case, to most of the small countries joining the EMU, monetary policy of the European Central Bank (ECB) is far from the optimal policy that should be directed towards the specificities of those economies. For most of these countries, monetary policy works more like a non optimal rule, enforced by a supra-national institution.

Simple rules, as those widely explored in Taylor's (1999a) volume, are usually extensions to the simple Taylor rule and can, in general, be represented by the following instrument rule (*ie*, McCallum, 2001):

$$r_t = (1-\rho_r)\left[\rho + \phi_\pi(\pi_t - \pi^*) + \phi_y(y_t - \overline{y}_t)\right] + \rho_r r_{t-1} \qquad \phi_\pi, \phi_y > 0, \quad \rho_r \in (0,1)\,. \quad (44)$$

r_t stands for the nominal interest rate, π_t and π^* for the inflation rate and its target value, ρ is the constant *steady state* real interest rate, and ρ_r stands for the nominal interest rate smoothing parameter. With slightly variations, a simple interest rule of this type became quite standard in the literature as a monetary policy rule, especially for closed economies (such as the U.S or the EMU area), as it is supported on both theoretical and empirical grounds in a sticky price environment. The rule combines the interest rate feedback Taylor rule, $\left[\rho + \phi_\pi(\pi_t - \pi^*) + \phi_y(y_t - \overline{y}_t)\right]$, with interest rate smoothing. On the one hand, the Taylor rule is of successful use in mimicking central banks' behavior and it exhibits the above-mentioned properties relative to the optimal policy. On the other hand, and in spite of its weak theoretical support, interest rate smoothing has strong empirical support from central banks' practice.

2.4 Reduced-form Specification

The model, in reduced-form, is characterized by an aggregate demand function derived from the households' behavior, an aggregate supply function reflecting firms' optimal price setting decisions, a monetary policy rule describing the central bank's stabilization behavior and the flexible price-full effect reform (*FP-FER*) output dynamics.

As to the latter, under our assumption of constant *per capita* labor supply and the existence of labor market institutions *(LMI)* that prevent labor market clearing, we have shown, in 2.2 (equation 27, above) that, the *FP-FER* output level, $\bar{y}_t$, depends on the *steady state* unemployment level. Unless a supply side policy is enforced, so as to push the *FP-FER* closer to its efficient level - $y_t^e = a_t$, the long run output level will not be higher than $\bar{y}_t < y_t^e$. The labor market reform is an example of a supply side policy that improves the equilibrium unemployment rate, thereby moving $\bar{y}_t$ closer to y_t^e.

2.4.1 Decentralized Behavior

In what respects decentralized decisions, we start with the households' to get the aggregate demand dynamics. Under an inelastic labor supply, optimization described in (4) defines the Euler equation for consumption, that is, a standard IS function:

$$\widetilde{y}_t = E_t\{\widetilde{y}_{t+1}\} - (r_t - E_t\{\pi_{t+1}\} - \rho) + E_t\{\Delta a_{t+1}\} + v_t. \tag{45}$$

Where $\widetilde{y}_t$ is the output gap defined as $(y_t - \bar{y}_t)$; and $v_t = -E_t\{\Delta g_{t+1}\}$ is a demand-side disturbance, with g_t defined above, in (1). The constant $\rho = -\log\beta$ is the time discount rate and corresponds to the equilibrium real interest rate in the absence of secular growth (see, below, equation 47).

By using real interest rate (rr_t) definition and (45), we derive the *FP-FER* equilibrium real interest rate ($\overline{rr}_t$),

$$\begin{aligned} rr_t &= r_t - E_t\{\pi_{t+1}\} = \rho + E_t\{\Delta y_{t+1}\} + v_t, && (46)\\ \overline{rr}_t &= \rho + E_t\{\Delta\overline{y}_{t+1}\} + v_t = \rho + E_t\{\Delta a_{t+1}\} + v_t, && (47)\end{aligned}$$

and express the IS function in the following final form:

$$\widetilde{y}_t = E_t\{\widetilde{y}_{t+1}\} - (r_t - E_t\{\pi_{t+1}\} - \overline{rr}_t)\,. \tag{48}$$

As to the firm's behavior, the price decision is derived from equation (13) where the log of the real marginal costs, mc_t, are defined using the log linearization of the profit maximization condition (10), yielding

$$mc_t = -\log\mu + \frac{\overline{d}_{21}}{\alpha}y_t - \frac{\overline{d}_{21}}{\alpha}a_t + \overline{d}_{21}\overline{u} + \overline{d}_1\Delta\Gamma + \overline{d}_3\Delta b. \tag{49}$$

Putting together equation (13), the aggregate price level definition in (11) and the real marginal cost deviations from the *FP-FER* level ($\widehat{mc}_t = mc_t - \overline{mc}_t$), the AS/inflation dynamics equation follows:

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \lambda\frac{\overline{d}_{21}}{\alpha}\widetilde{y}_t + \lambda(\overline{d}_1\Delta\Gamma + \overline{d}_3\Delta b),\ \lambda = \frac{(1-\theta)(1-\beta\theta)\alpha}{\theta\left[\alpha + \varepsilon(1-\alpha)\right]}. \tag{50}$$

Inflation is thus determined by future expected inflation, by the output gap and by the "unexpected reform processes". The inflation rate is related to the output gap through the features characterizing both the goods and the labor market. As to the former, the higher the price elasticity of demand (ε) and the stronger the nominal inertia in prices (θ), the less inflation will react to the output gap. Concerning the ways through which the institutions of the labor market determine the reaction of inflation to the output gap, in general, features that improve the outside option or the wage bargaining power of the unions, make nominal wage growth, and thus inflation, less responsive to the cycle fluctuations. In particular, an unexpected change in the unemployment benefit ratio or in the relative wage bargaining power of the parties affect inflation as a cost-push shock. Other factors that affect real marginal costs can also be included in an u_t disturbance - adding such disturbance to (50), our general equilibrium derived AS satisfies the *ad hoc* New Keynesian Phillips curve (39).

2.4.2 Monetary Authority Behavior

We review now the discretionary and commitment solutions for the optimal monetary policy *(OMP)* conduction.

Optimal policy under discretionary behavior Occurs whenever the monetary authority cannot commit to any future policy actions. Because the central bank can not influence current expectations on output and inflation, it takes private sector expectations as given when solving the optimization problem (40). The optimal target rule results from the combination of FOCs (41) and (43) above, yielding

$$\pi_t = -\frac{\omega_{\widetilde{y}}}{k}\widetilde{y}_t, \forall t. \tag{51}$$

Optimal policy under commitment Another form of OMP may emerge when the monetary authority has enough credibility to stick to an announced plan of actions defined at a certain time and to be applied in future periods. The central bank recognizes that its policy choice effectively influences private sector expectations regarding inflation and output. The optimization uses again equations (41) to (43), yielding the following solution:

$$\pi_1 = -\frac{\omega_{\widetilde{y}}}{k}\widetilde{y}_1, \quad t = 1 \tag{52}$$

$$\pi_t = -\frac{\omega_{\widetilde{y}}}{k}\left(\widetilde{y}_t - \widetilde{y}_{t-1}\right), \quad t = 2, 3, 4, ... \tag{53}$$

The straightforward solution involves monetary authority behaving differently in the first period and in the following periods. But, if the central bank was to re-optimize in period 2, it would choose a solution of type (52) again. This situation involves a "time-inconsistency", because in the first period the central bank behaves just like in the discretionary case. For instance, if a cost-push shock occurs in period 1, in period 2 both inflation and output gap are stabilized and thus the optimal choice would be the discretionary solution once again.

A much more attractive equilibrium under commitment is, according to McCallum and Nelson (2000), the one derived from Woodford's "timeless perspective": to implement a "systematic" control regime, the central bank should behave the same way in all periods such that (53) should apply for all t.[16]

Summing up, the reduced form of the baseline model combines equations (27), (45), (50) and, for the monetary policy conducting we consider both the discretion and the commitment ("timeless perspective") solutions, (51) and (53), respectively. In addition, as argued in 2.3.2 above, we also consider two non-OMP policy rules - namely the original feedback interest rate rule proposed by Taylor, and the one with interest rate smoothing (equation 44).

[16] Jensen and McCallum (2002) have found that optimality condition (53) fails to yield the smallest average Loss. However, we have decided to stick to it, because it is of standard use and, in any case, drives better welfare results than discretion (a result confirmed by Clarida *et al*, 1999, and Galí, 2002a, among others).

3 Scenarios for a Labor Market Reform

Labor market reforms have two major positive macroeconomic effects; one is through the adjustment mechanism to shocks hitting the economy, as reforms improve stabilization of costs-push shocks and thus favor monetary policy efficiency; the other is that reforms reduce equilibrium unemployment. Saint-Paul and Bentolila (2000) call these the "increasing the economy's adjustment potential" and "increasing the economy's average performance" effects, respectively.

Blanchard (1991) and Blanchard and Wolfers (2000) argue that even if rigid labor market institutions *(LMI)* do not exert a clear-cut effect on equilibrium unemployment in the aftermath of shocks, they may lead to higher duration of the unemployment spell and to marginalization. Both effects yield self-fulfilling unemployment persistence, as real wage flexibility diminishes with the proportion of long term unemployed. In fact, increasing real wage flexibility is one of the aims of the reform, particularly if countries face demand-side management policy restrictions such as in the EMU.[17]

According to Pissarides (1997), labor market reform is more strongly justified in countries with either low or high inflation. In contrast with moderate inflation, low and high inflation environments exhibit high degrees of inertia. And the higher is inflation inertia, the more it reduces wage flexibility, making response to shocks costlier.

In this section we first present arguments for using unemployment benefits reduction as a relevant example of labor market reform and propose three different implementation processes. Then, we define alternative structures for the economy and report the calibration values for the different alternatives.

3.1 A Labor Market Reform Example - The case of Unemployment Benefits

According to the Job Search Model (Mortensen and Pissarides, 1999), changing unemployment benefits, in contrast with other *LMI* reforms, has unambiguous effects on equilibrium unemployment. The Insider Wage Bargaining Model in Layard *et al* (1991), closely followed in 2.2 above, also predicts that a reduction in the unemployment benefit unambiguously reduces equilibrium unemployment.

Unemployment benefits are characterized by working as a state-provided insurance device, and also by playing a role in wage formation, providing a lower bound for wage setting.

As an insurance device, unemployment benefits can hardly generate harmful effects on employment through real wage rigidity. In contrast to other labor market institutions, this one - as an insurance device - redistributes welfare from the employed to the

[17] This is the TINA (there is no alternative) argument, based on Mundell's (1961) labor market flexibility argument of the Optimum Currency Areas theory, for why the EMU environment may be prone to labor market reform. This argument is particularly critical for small countries (Corricelli *et al*, 2001). There are, however, a set of arguments that make reform process more difficult to operate in the EMU (see, for instance, Sibert and Sutherland, 1997, Calmfors, 2001, and Hallett and Viegi, 2001).

unemployed (Saint-Paul, 2000), which incentives the decisive voter (employed) to claim low levels of unemployment benefits - insurance effect. Such redistribution results from the combination of five effects: (i) insurance is far more important to the unemployed; (ii) exposure, and thus the need for insurance, decreases with the level of employment; (iii) financing of unemployment benefits is a tax burden to the employed; (iv), by reducing search efforts, unemployment benefits increase unemployment duration and, thus, the associated tax burden and (v), a higher tax burden may lead to higher gross wage claims; this, in turn, will lead to lower job creation, increasing employed's exposure to unemployment the higher the elasticity of labor demand.

However, through its influence in wage formation, unemployment benefits affect real wage flexibility and thus equilibrium unemployment. This may incentive employed to claim high levels of unemployment benefits. On one hand, a rise in unemployment benefits improves the outside option for the employed, thus raising the bargained wage - wage effect. But, on the other hand, firms respond to higher bargained wages with lower demand for labor, raising unemployment, which increases exposure as well as the tax burden associated with the benefits - employment effect.

Summing up, the wage effect incentives high benefits claims by the employed while the insurance and employment effects incentive the opposite. If the former is strong enough to dominate, a reduction in the unemployment benefit is expected to increase real wage flexibility, reduce equilibrium unemployment and improve adjustments to shocks.

Finally, from monetary policy literature we learn that independent and optimizing central banks do not care about the impacts on potential output, as Loss functions reflect pure price and output stabilization goals. Therefore, the implementation and permanent effects of the reform can affect monetary policy making only to the extent of their impact on the stabilization role of the monetary authorities. In fact, structural effects of reform can promote higher macroeconomic efficiency without inflation bias, helping central banks management if they target output to its full efficient level. On the other hand, central banks in many developed countries often advocate the necessity of reforms in the labor market on these grounds (see, for instance, ECB, 2002).

We now model the reform process consisting of a reduction in the unemployment benefit ratio, b. For that we take three types of implementation processes: the baseline reform process consisting of a one-shot, pre-announced reform; a reform gradually implemented and an unexpected reform process.

Baseline - one-shot, pre-announced reform We start by considering a reform process characterized by three assumptions. First, the process respects to a one-shot reform, that is, reform is fully implemented in one period t. Second, reform is announced previously to implementation, so that decentralized agents can adjust their expectations accordingly. And third, rational agents perceive the long run effects of reform on potential output and on the related parameters of the model describing the economy. In particular, we assume that b takes a new permanent lower value at the time of reform implementation. Therefore, the reform is modelled as a permanent change in $\overline{y}$, such that:

$$\widetilde{y}_t = y_t - (\overline{y}_{0t} + \frac{\partial \overline{y}_t}{\partial b} * \Delta b_t), \tag{54}$$

where $\overline{y}_{0t}$ is the pre-reform *steady state* equilibrium output level. The reform has permanent effects on the *FP-FER* output; we describe Δb_t as

$$\Delta b_t = \Delta b_{t-1} + reform_t, \tag{55}$$

where $reform_t$ stands for a shock term, with $reform_1 < 0$ (implementation period) and $reform_t = 0 \Leftarrow t > 1$. We set a baseline pre-reform value of $b = 0.7$, such that, combined with the baseline model calibration, it yields an equilibrium unemployment rate near the recently observed in the EMU area. Reform is defined as a reduction in b by 10 percentage points (pp), *ie* $reform_1 = -0.1$.

Gradual reform As an alternative reform process, we model the reduction in the unemployment benefit ratio that is to be put in place during a certain number of periods instead of operating instantaneously. To capture a gradual path of reform, we proceed an analogy with a permanent, but gradual, technological change. This is appropriate, since permanent technology shocks have, like reforms, long lasting gradual effects over potential FP output.

Following the literature on modelling permanent technological shocks (as, for instance, in Blanchard and Quah, 1989, and in Galí *et al*, 2003), a gradual reform path which impacts on the *FP-FER* equilibrium output is modelled as

$$\Delta \overline{y}_t = \rho_{\overline{y}} \Delta \overline{y}_{t-1} + \varepsilon_{\overline{y}_t}, 0 < \rho_{\overline{y}} < 1 \begin{cases} \varepsilon_{\overline{y}_t} = f(\Delta b_t) \Leftarrow t = 1 \\ \varepsilon_{\overline{y}_t} = 0 \Leftarrow t > 1 \end{cases}, \tag{56}$$

where f stands for $\frac{\partial \overline{y}_t}{\partial b}$.

Equation (56) describes a gradual path for b (the reform process) that can be translated in terms of $\overline{y}_t$ through the structural relationship between the two variables (see equations 25 and 27). This is, of course, a particular description of a gradual reform; it produces diminishing impacts as time goes by; and a higher correlation parameter, $\rho_{\overline{y}}$, corresponds to a longer implementation period and to a smaller first impact of the reform. In this respect, the first change in b must verify $f(\Delta b_1) = \Delta \overline{y}(1 - \rho_{\overline{y}})$, where $\Delta \overline{y}$ is the cumulated *FP-FER* output change once reform is fully implemented - when Δb attains -0.1. This particular description of the reform process is useful in accounting for the fact that private agents are aware of the gradual reform effects ($\rho_{\overline{y}} > 0$ in contrast with $\rho_{\overline{y}} = 0$ for the one-shot reform) and that it has fully expected *steady state* permanent effects on potential output. Accordingly,

$$\overline{y}_t = \overline{y}_{t-1} + \Delta \overline{y}_t. \tag{57}$$

Also, as economic agents are aware of the *FP-FER* effects over the parameters of the model, we assume that the parameters depending on the reform take their final *FP-FER* values since the first period of reform implementation.

In this case the problem faced by the monetary authority remains unchanged relatively to the baseline scenario - the *FP-FER* output changes gradually in the standard CB objective function and in the AS restriction.

Unexpected reform A second extension considers the implementation of the reform as a surprise to the economic agents. It could apply to the case where a reform is discussed between the relevant parties in time t, previously to being implemented by the regulatory authority. So, economic agents are not aware on how much their suggestions will be taken into account by the policy authority and the reform will be, at least, partially unexpected. We simplify by considering a totally unexpected reform, thus neglecting the reform negotiation process and the ex-post possibility of non-implementation.

Without the announcement of the reform, economic agents can not perceive its impacts in period t: firms and consumers have no *a priori* incentive to adjust supply and demand to the new $\overline{y}$. A non-announced reform works as a shock to the agents in period t, the effects being then fully perceived after implementation - that is, the new $\overline{y}$ is fully perceived in $t+1$. In order to capture these effects, it is assumed a temporary shock in b (agents expect pre-reform $\overline{b}$ level to be observed in period t, but the unemployment benefit ratio is effectively reduced): $(b_t - \overline{b}) < 0$, while $\overline{y}_t$ remains at its pre-reform level with $\Delta\overline{y}_t = E_t\left\{\Delta\overline{y}_{t+1}\right\} = 0$. From $t+1$ onwards, adjustments will combine the temporary shock effects with those of a permanent change in $\overline{y}$.

Recalling the wage offer curve (24), the unexpected reduction in b reduces real wages claims by $(0.1\overline{d}_3)$. In the first period, the reform implementation effects are thus similar to those of a positive cost-push shock. Acordingly, the aggregate supply curve is now described by

$$\begin{aligned} &\pi_t = \beta E_t\{\pi_{t+1}\} + k\left(y_t - \overline{y}_{t(old\ FP-FER)}\right) + \lambda\left[\overline{d}_3(b_t - \overline{b})\right] + \mathtt{u}_t \Leftarrow t = 1 \\ &\pi_t = \beta E_t\{\pi_{t+1}\} + k\left(y_t - \overline{y}_{t(new\ FP-FER)}\right) + \mathtt{u}_t \Leftarrow t > 1 \\ &with \quad b_t - b = -0.1 \Leftarrow t = 1; \quad b_t - b = 0 \Leftarrow t > 1. \end{aligned} \tag{58}$$

Also, for simplification, the parameters are set at their new *FP-FER* levels when evaluating the path of the adjustments to reform. Effects of this assumption are negligible because there is only one period during which decentralized agents are not aware of the reform.

Once again, the definition of the reform process does not alter the optimization problem faced by the central banker.

3.2 Alternative Scenarios for the Structure of the Economy

Habit formation One of the problems raised with the use of standard New Keynesian models as our own baseline is the lack of persistence in the dynamics of the endogenous variables in response to shocks. One source of the problem is the specification of the IS derived from the standard time-separable households' preferences. The standard consumption equation implies that the sign of the correlation between the expected real interest rate and the current level of consumption is the opposite of that of the correlation between the expected real interest rate and the growth rate of consumption. As Estrella and Fuhrer (2002) note, if the expected real interest rate rises above *steady state* equilibrium, the current level of output must decrease while the expected change in consumption must increase. The only way for this to happen is through an immediate downward jump in consumption. However, such "jump variable" behavior is at odds with empirical evidence. Instead, the data on real consumption and output exhibits not only a significant delay, but also a hump shape response to shocks - see, for instance, the impulse responses to a monetary policy shock based on VAR estimates for the U.S in Christiano *et al*, 2001.

One suggestion to overcome such dynamic inconsistencies is the inclusion of habit formation in the consumer's utility function, as proposed by Fuhrer (2000). Habit formation relies on a non time-separable utility function for household i,

$$U_t = \frac{1}{1-\sigma}\left[\frac{C(i)}{C_{t-1}^{h}(i)}\right]^{(1-\sigma)}, h \leq 1. \tag{59}$$

This utility function captures the consumers' wish to smooth both the level and the change in consumption, slowly changing habits behavior. The relative importance of habit formation is indexed by h. If $h = 0$, the utility function reduces to the standard time-separable utility function, whereas $h = 1$ means that the consumer cares only about consumption growth.[18]

This kind of utility function produces a gradual hump-shaped response of consumption to shocks and thus has a much more appealing form, in terms of fitting the data. In addition to this argument, Fuhrer (2000) thoroughly supports his proposal, by reviewing the relevant literature on consumption and on the equity premium puzzle.

Several variants relying on Fuhrer's approach have emerged, leading to different IS specifications. To the purpose of integration with the rest of the model, our preference goes to Christiano *et al*'s (2001). Their utility function, very similar to Fuhrer's, is

$$U_t = Log\left[C_t(i) - hC_{t-1}(i)\right]. \tag{60}$$

The resulting IS function is

$$\begin{aligned}(1+\beta h^2)E_t\{\Delta y_{t+1}\} = \; & h\Delta y_t + \beta h E_t\{\Delta y_{t+2}\} + \\ & +(1-\beta h)(1-h)(r_t - E_t\{\pi_{t+1}\} - \rho) - \\ & -(1-h)(v_t - \beta h E_t\{v_{t+1}\}). \end{aligned} \tag{61}$$

Besides the IS, the introduction of habit persistence may lead to additional changes in the model, namely in the aggregate supply and in the welfare function, as Amato and Laubach (2001) show. The changes in aggregate supply do not apply to our case, though, since such changes take effect only when labor supply is variable, which we have ruled out as argued above in 2.2.1. As to the other changes, we adapt the habit formation utility

[18] Note that if $h = 0$, this utility function fits in our baseline formulation in equation (1).

function in such a way that no impacts on the welfare function arise.[19] The adaptation consists of the following first order Taylor approximation around the *steady state*:

$$\begin{aligned} Log(C_t - hC_{t-1}) &= Log(1-h) + LogC + \frac{1}{(1-h)}(LogC_t - LogC) \\ & -\frac{h}{(1-h)}(LogC_{t-1} - LogC) + o(||a||^2) \end{aligned} \tag{62}$$

where C stands for the *steady state* level of consumption. The resulting intertemporal utility - adding the leisure argument - is approximated by

$$E_0 \sum_{0}^{\infty} \beta^t \left\{ \left[Log(1-h) + \frac{1}{1-h}(c_{t+j} - hc_{t+j-1}) + g_t \right] - \frac{N^{s(\varphi+1)}}{\varphi+1}, \right\}. \tag{63}$$

With β close to 1, the utility derived from period t consumption - *ie* including the contribution of period t consumption to the utility in the following period due to habit formation -, simplifies as follows:

$$\frac{1-\beta h}{1-h}(c_t) + g_t - \frac{N^{d(\varphi+1)}}{\varphi+1} \simeq c_t + g_t - \frac{N^{d(\varphi+1)}}{\varphi+1}. \tag{64}$$

Inflation inertia The introduction of a backward looking rule in price setting is another form to introduce persistence in the New Keynesian framework. The derivation of the New Phillips curve based on the Calvo-Rotemberg price setting specification (see 2, above) fails to account for the observed inflation persistence, leading to counterfactual dynamics. Estrella and Fuhrer (2002) point out that, in spite of the positive correlation between output gap and inflation rate, it leads to a negative correlation between output gap and expected change in inflation; this contradicts the data, particularly during disinflation processes (Fuhrer and Moore, 1995) as it implies that inflation must behave as a "jump variable": when output falls below potential, the inflation rate first must jump downwards, and then rise gradually to its new, lower equilibrium level.

A straightforward way to overcome such inconsistencies is to include lagged inflation in the determinants for current inflation. This *ad hoc* specification of the AS curve is current practice in much of the empirical research on monetary policy issues (see, for instance, Rudebusch and Svensson, 1999). Concomitantly, there have been some efforts to develop theoretical foundations for such specification. One, implemented by Furher and Moore (1995), with overlapping real wage contracting substituting for Taylor's (1979) overlapping nominal wage contracting. Galí and Gertler (1999) refer another approach due to Roberts (1997), according to which a subset of price setters behave under adaptive expectations. The approach we rely on, is the one followed by Galí and Gertler (1999), Galí *et al* (2001) and Amato and Laubach (2003) who, among others, allow for non optimizing price setters. The argument is based on costly re-optimization, which incentives

[19] However, this adaptation is applied only to welfare evaluation. For general equilibrium derivation, we use the IS function (61).

agents to use simple rules of thumb, occasionally, as an alternative to optimization. This approach is quite convenient for the purpose at end: first, because it uses Calvo's (1983) price setting structure, which accords with our baseline structure and, second, because it includes the New Phillips curve, like our baseline equation (39), as a particular case of a broader definition of an hybrid Phillips curve.

Followin Calvo's price setting structure, it is assumed that, at any period, a firm has a fixed probability $(1-\theta)$ of changing prices. The only departure from Calvo's framework is that only a fraction $(1-\omega)$ of firms resetting prices at t optimize in a forward looking manner. The remaining firms - fraction ω - changing prices at t follow, instead, a "backward looking" rule of thumb, the chosen price P_t^r being

$$P_t^r = P_{t-1}^{*'} \frac{P_{t-1}}{P_{t-2}}, \tag{65}$$

where $P_t^{*'}$ stands for the aggregate price level.

$$P_t^{*'} = [(1-\omega)(P_t^o)^{1-\varepsilon} + \omega(P_t^r)^{1-\varepsilon}]^{\frac{1}{1-\varepsilon}}, \tag{66}$$

where ω stands for the probability a firm has of following a rule of thumb when it has the possibility of resetting prices in a given period and P_t^o is the price set by fully optimizing firms in period t.

And P_t defines the average price level as in Calvo (1983),

$$P_t = [(1-\theta)(P_t^{*'})^{1-\varepsilon} + \theta(P_{t-1})^{1-\varepsilon}]^{\frac{1}{1-\varepsilon}}. \tag{67}$$

Log-linearizing equation (65), it follows:

$$\widehat{p}_t^r = \widehat{p}_{t-1}^{*'} + \pi_{t-1} - \pi_t. \tag{68}$$

where $\widehat{p}_t^r = \log(P_t^r/P_t)$ and $\widehat{p}_t^{*'} = \log(P_t^{*'}/P_t)$.

Combining equations (66), (67) and (68), the optimal price decision is obtained,

$$\widehat{p}_t^o = \frac{\theta + \omega(1-\theta)}{(1-\theta)(1-\omega)}\pi_t - \frac{\omega}{(1-\theta)(1-\omega)}\pi_{t-1}, \tag{69}$$

with $\widehat{p}_t^o = \log(P_t^o/P_t)$. Since the optimal price setting is equivalent to Calvo's (1983) original one, we can combine equations (69) and (13), and derive the transformed expression for the AS curve,

$$\begin{aligned} \pi_t &= \gamma^f E_t\{\pi_{t+1}\} + \gamma^b \pi_{t-1} + k_1 \widetilde{y}_t + \mathrm{u}_t, \qquad (70) \\ \textit{where} \quad k_1 &\equiv \lambda_1 \frac{\overline{d}_{21}}{\alpha}; \\ \lambda_1 &\equiv \frac{(1-\theta)(1-\beta\theta)(1-\omega)\alpha}{\{\theta + \omega[1-\theta(1-\beta)]\}[\alpha + \varepsilon(1-\alpha)]}; \\ \gamma^b &\equiv \frac{\omega}{\theta + \omega[1-\theta(1-\beta)]}; \quad \gamma^f \equiv \frac{\beta\theta}{\theta + \omega[1-\theta(1-\beta)]}. \end{aligned}$$

As expected, it is clear that the baseline AS specification (70) is a particular case of this hybrid, inflation inertia, formulation, when ω is set at 0.[20]

Besides impacting on the structure of the AS, inflation inertia also affects the relevant Loss function of a welfare maximizing central bank, through the definition of price variability. Following the demonstration by Amato and Laubach (2003), the baseline Loss function, under inflation inertia, is replaced by

$$L = \frac{\overline{U}_t - U_t}{U_c Y} = \frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta^t \left[\varepsilon \left[\frac{1}{\lambda_L} \pi_t^2 + \frac{\omega}{(1-\theta\beta)(1-\omega)(1-\theta)} (\pi_t - \pi_{t-1})^2 \right] + \frac{1+\varphi}{\alpha} (\widetilde{y}_t - z)^2 \right], \tag{71}$$

Not surprisingly, the OMP rules also change with the AS. The OMP solutions are obtained by solving the problem faced by the monetary authorities, now described by

$$\begin{aligned} &\underset{\pi_{t+j},\ \ \widetilde{y}_{t+j}}{Min} E_t \sum_{j=0}^{\infty} \beta^j \left[\pi_{t+j}^2 + \omega_{\widetilde{y}} \widetilde{y}_{t+j}^2 + \omega_\pi (\pi_{t+j} - \pi_{t+j-1})^2 \right] \\ &s.t. \\ &\pi_t = \gamma^f E_t \{\pi_{t+1}\} + \gamma^b \pi_{t-1} + k_1 \widetilde{y}_t + \mathrm{u}_t, \qquad k_1 > 0 \\ &with \quad \omega_{\widetilde{y}} \equiv \frac{(1+\varphi)\lambda_L}{\varepsilon\alpha}; \omega_\pi \equiv \frac{\omega}{(1-\omega)\theta}. \end{aligned} \tag{72}$$

Derivation of the relevant FOCs for the discretionary solution yields the rule

$$\pi_t + \omega_\pi(\pi_t - \pi_{t-1}) - \beta\omega_\pi(E_t\{\pi_{t+1}\} - \pi_t) = -\frac{\omega_{\widetilde{y}}}{k_1} \widetilde{y}_t (1-\gamma^b) + \frac{\omega_{\widetilde{y}} \gamma^b}{k_1} (\beta E_t\{\widetilde{y}_{t+1}\} - \widetilde{y}_t), \tag{73}$$

while FOCs respecting the rule under the "timeless perspective" commitment lead to

$$\pi_t + \omega_\pi(\pi_t - \pi_{t-1}) - \beta\omega_\pi(E_t\{\pi_{t+1}\} - \pi_t) = -\frac{\omega_{\widetilde{y}}}{k_1} \left(\widetilde{y}_t - \frac{\gamma^f}{\beta} \widetilde{y}_{t-1} - \beta\gamma^b E_t\{\widetilde{y}_{t+1}\} \right). \tag{74}$$

3.3 Model Calibration

The values for the set of parameters are chosen with a view to the Euro area. We start by combining the calibration proposed in Moyen and Sahuc (2004) with Galí (2002a), and then use other additional sources. Table 1 presents the values.

For the labor market specific parameters, we set an indicative European after-reform replacement ratio of 60% and also a value of 0.4 for the elasticity of survival with respect to the expected number of insiders - based on Layard *et al* (1991), pages 514 and 105,

[20] A similar specification for the "hybrid" AS curve have also been achieved following Woodford (2001), who introduces inflation inertia through price indexation to a lagged price index. In particular, Woodford assumes that, in periods when prices can not be optimized, they are updated according a rule where the price is "automatically" revised taking into account the recent evolution of the general price index (π_{t-1}).

Description	Parameter	Value
Price elasticity of demand	ε	11
Quarterly discount factor	β	0.99
Probability of firms not changing prices in a given period	θ	0.83
Unemployment benefit replacement ratio	b	0.6
Elasticity of the survival probability with respect to employment	ε_{SN}	0.4
Labor intensity	α	0.9
Union's bargaining power	Γ	0.1
Gradual reform correlation parameter	ρ_y	0.7
Low/High habit persistence	h	0.5 / 0.7
Low/High inflation inertia	γ^b	0.27 / 0.5
Low/High loss relative weight on output stabilization	ω_y	0.01 / 1
Inflation feedback parameter	ϕ_π	0.5
Output gap feedback parameter	ϕ_y	0.125
Interest rate smoothing parameter	ρ_r	0.8

Table 1: Baseline Parameter Calibration

respectively. With the technology index normalized to 1, labor intensity and the relative power of unions in the bargaining process are chosen as to get a reasonable equilibrium unemployment rate - $\overline{u}$ in equation (25) -, around 6%. The low value for Γ is supported by the low and decreasing degree of unionism in European countries (see, for instance, Blanchard, 2004, p. 26).[21] As for α, instead of the more commonly used value of 1, we set it slightly below, since we need a decreasing marginal productivity of labor for wage bargaining to exhibit a trade-off between real wage and employment level.

For the gradual reform process, we consider a long implementation period and a shorter one, reflected in the values of $\rho_{\overline{y}}$. As for the alternative scenario of habit formation, the evidence in Christiano *et al* (2001) and in Fuhrer (2000) clearly point to a high degree of persistence. Our values have been chosen closer to Christiano *et al*'s (2001), given that we adopt their theoretical formulation.

For the calibration of the inflation inertia scenario, the lower value of the AS coefficient in Table 1 has been chosen in coherence with Galí *et al*'s (2001, p.1257) value of $\omega = 0.3$ (fraction of firms that follow the "rule of thumb") which they show to ensure a good replication of the European inflation dynamics. Whereas the higher one, implying $\omega = 0.82$, follows Fuhrer and Moore (1995).

In what respects monetary policy, we consider two types of central banks: an inflation

[21] Cahuc *et al.* (2002) estimate a bargaining power of about 0.2 in France, a result consistent with others using Canadian and British datasets. Note, however, that the average unemployment rate was, during the estimation period, around 10% in France (see, for instance, Nickell and Layard, 1999).

averse CB, that attaches a high value to price stabilization, and an inflation prone CB, that mostly cares about output stabilization. These values are taken from McCallum and Nelson (2000). For the non-optimal interest rate rule we chose the original Taylor's feedback parameters, while taking the interest rate smoothing parameter from McCallum and Nelson (1998; 2000).

4 Effects of Labor Market Reform on Monetary Policy Efficiency

In this section we evaluate the impact of the reform on the stabilization role of monetary policy, under the baseline and the additional scenarios described, just above, in previous section. The methodology for measuring stabilization costs relies on the evaluation of the Loss function.

4.1 Transition Stabilization Costs

The evaluation of transition costs considers the impact that the adjustments exclusively induced by reform implementation have on stabilization costs.

We explore the adjustments to a reduction by 10 percentage points in the unemployment benefit replacement ratio, for the three reform processes as exposed above. Also, the adjustments are studied under different assumptions for monetary policy conducting: following OMP rules, either through discretionary or commitment behavior, or following the non-optimal simple or smoothed Taylor rule. In what respects OMP conducting we assume, as default, $\omega_{\widetilde{y}} = 0.01$, which corresponds to a 3.8% annualized weight put on output gap stabilization. When results are expected to be sensible to the relative weight put on price stabilization, we also consider outcomes under the extreme opposite case - $\omega_{\widetilde{y}} = 1$, a 80% annualized weight put on output gap stabilization.

Table 2 shows the evaluation of the stabilization costs implied by the adjustments to the reform, with values referring to the Loss times 10^5. The arguments of the Loss functions are calculated through reform-induced impulse responses, computed up until the new *FP-FER* equilibrium is achieved.

In the case of the one-shot, pre-announced process, reform implementation leads to short run adjustments similar to those implied by a negative demand-side shock- this view of reform as a recession is also noted by Saint-Paul (2002). The announced reduction in b directs expectations to a higher *FP-FER* output level, thus increasing the output gap, and leads to price reduction due to a fall in nominal bargained wages caused by the unemployment benefit reduction. Gradual and unexpected reforms, in contrast, exhibit patterns of cost-push shock adjustments.

Next we analyze in detail, the adjustments under each case.

Adjustments in the baseline scenario - one-shot, pre-announced reform Being announced, the reform has not a surprise nature, and so agents expect b_t to take the new

	Description		OMP		TR	
			D	C	simple	smoothing
1	**Baseline**	ω_y=0.01 / 1	0	0	0	0
2	**Low IS inertia (h=0.5)**	ω_y=0.01	0	0	0.157	0.118
		ω_y=1	*0*	*0*	*7.466*	*7.268*
3	**High IS inertia (h=0.7)**	ω_y=0.01	0	0	0.697	0.430
		ω_y=1	*0*	*0*	*20.433*	*18.700*
4	**AS Inertia**	ω_y=0.01 / 1	0	0	0	0
5	**Low IS inertia (h=0.5) + Low AS inertia (γ^b=0.27)**	ω_y=0.01	0	0	0.059	0.030
		ω_y=1	*0*	*0*	*0.097*	*0.057*
6	**Low IS inertia (h=0.5) + High AS inertia (γ^b=0.5)**	ω_y=0.01	0	0	0.024	0.007
		ω_y=1	*0*	*0*	*0.025*	*0.009*
7	**High IS inertia (h=0.7) + Low AS inertia (γ^b=0.27)**	ω_y=0.01	0	0	0.404	0.186
		ω_y=1	*0*	*0*	*0.566*	*0.295*
8	**High IS inertia (h=0.7) + High AS inertia (γ^b=0.5)**	ω_y=0.01	0	0	0.259	0.059
		ω_y=1	*0*	*0*	*0.268*	*0.066*
9	**Gradual Reform (ρ_y=0.3)**	ω_y=0.01	0	0	0.030	0.028
		ω_y=1	*0*	*0*	*1.766*	*2.020*
10	**Gradual Reform (ρ_y=0.7)**	ω_y=0.01	0	0	0.387	0.237
		ω_y=1	*0*	*0*	*8.246*	*10.135*
11	**Unexpected Reform**	ω_y=0.01	0.232	0.251	0.328	0.332
		ω_y=1	*30.748*	*30.753*	*27.582*	*28.552*

Table 2: Transition Stabilization Costs

FP-FER value such that $\Delta b_t = 0$ (see equations 24 and 50 in 2, above). In this case, optimal monetary policy simply implies $\pi_t = \widetilde{y}_t = 0$, and so the AS does not constrain the monetary authority optimization problem. The reform does not produce a trade-off between price and output gap stabilization, thus making the distinction between discretionary and commitment behavior irrelevant. Private agents fully internalize that the monetary authorities will ensure a zero output gap for the sake of price stabilization and thus reform brings about no transition stabilization costs (see line 1, Table 2).

On the supply-side, firms expect demand to rise to the new *FP-FER* output equilibrium level ($\overline{y}$). Higher real wages, due to employment pressure, fully crowd out the effects of lower unemployment benefit on firms' paid wages, and thus on marginal costs; as current and expected marginal costs are constant, there is no incentive for price changes in t nor in the subsequent periods - $\pi_t = 0$.

On the demand-side, current demand is immediately driven to the new *FP-FER* output equilibrium level as current and expected inflation remains at zero through monetary policy ensuring both price and output gap stabilization; while the expectations of future output gap and inflation are zero, the long run real interest rate ($\overline{rr}_t$) remains constant (ρ) because the reform is one-shot, leaving no expectations of future changes in the *FP-FER* equilibrium unemployment rate (see equation 47, above).

Even under the non-optimal Taylor rule, which does not allow nominal interest rate to (optimally) fluctuate with the *FP-FER* real interest rate, there is full adjustment to the new *FP-FER* equilibrium. The reason, again, as noticed above, is that real interest rate does not change as reform is fully implemented in period t.

Figure 1 shows output, nominal interest and inflation rates and output gap responses to a permanent change in the *FP-FER* output level induced by a decrease in b. The responses are common to optimal and non-optimal monetary policy conducting.

Adjustments under habit formation - one-shot, pre-announced reform In this scenario we allow for consumption smoothing, as described above in 3.2. Figure 2 shows adjustment responses to the reform under the optimal and the simple Taylor rule (TR) with h set at 0.5 (recall equation 61).

The main implication of this scenario is that the private demand impulse is not sufficient to immediately promote the new $\overline{y}$. As *FP-FER* unemployment rate falls, long run real interest rate now decreases in the period of reform implementation as can be seen in the expression below, that results from adapting the equilibrium real interest rate equation (47), above, to the case of habit persistence.

$$\begin{aligned} \overline{rr}_t &= \rho + h_1 E_t\{\Delta\overline{y}_{t+1}\} + h_2 E_t\{\Delta\overline{y}_{t+2}\} + \\ &+ h_3\{\Delta\overline{y}_t\} + \frac{1}{(1-\beta h)}[v_t - \beta h E_t\{v_{t+1}\}], \qquad (75) \\ with \quad h_1 &\equiv \frac{(1+\beta h^2)}{(1-\beta h)(1-h)}; h_2 \equiv -\frac{\beta h}{(1-\beta h)(1-h)}; h_3 \equiv -\frac{h}{(1-\beta h)(1-h)}; \\ & h_1 + h_2 + h_3 = 1. \end{aligned}$$

In the reform implementation period, $t = 1$, $\Delta\overline{y}_t > 0$, while in the subsequent periods, $E_t\{\Delta\overline{y}_{t+1}\} = E_t\{\Delta\overline{y}_{t+2}\} = 0$. The change in $\overline{rr}_t$ keeps current real interest rate above the *FP-FER* equilibrium level, refraining consumption and causing a negative output gap. When compared to the baseline scenario, the conduct of optimal policy works exactly in the same way to influence demand and supply behavior - yielding, as well zero Loss -, but now private demand inertia requires active expansionary monetary policy alongside with the reform. The only way to promote a zero output gap consistent with price stabilization is to lower the nominal interest rate. Recall that, in this case there is no trade-off between price and output gap stabilization, making the question commitment *vs* discretionary behavior irrelevant. The conduct of the optimal monetary policy, pushing the desired demand to the new $\overline{y}$ keeps, as in the baseline scenario, firms from changing prices and ensures equilibrium in t with $\pi_t = \widetilde{y}_t = 0$. Optimal monetary policy eliminates the effects of inertia in private demand and so nominal interest rate recovers, in $t+1$, to the pre-reform level (Figure 2, solid line).

Under TR, adjustment to the new *FP-FER* output level is slower thereby originating stabilization costs. Immediate adjustment under the TR would only occur if the *FP-FER* real interest rate did not change, which is not the case. As we have seen just above, immediate adjustment requires an active monetary policy. But TR nominal interest rate adjustment can only be triggered by inflation or output pressures, which contradicts full adjustment. Since this is understood by the agents, firms do not expect policy to fully push demand to the new $\overline{y}$, thereby laying the ground for inertia effects to operate. Real wages remain lower than the new *FP-FER* level because employment pressure is only gradual whereas unemployment benefits reduction is immediate. Therefore, actual and expected marginal costs are lower and prices follow. Summing up, the effects of reform, shown in Figure 2 (dashed line), are: gradual adjustment to the new *FP-FER* output level, deflation, and expansionary monetary policy.

The stronger demand-side inertia is, the more expansionary should optimal policy behave and the costlier is any departure from the optimal policy rule: stabilization costs are proportional to the degree of habit formation, with smoothing procedures yielding lower costs (Table 2, lines 2 and 3).

Adjustments under inflation inertia - one-shot, pre-announced reform The economy is now characterized by a hybrid AS function in which inflation includes a backward looking determinant. It turns out that, in this set up, inflation inertia plays no role in the adjustments to the reform. With any policy rule that penalizes deviations of inflation and/or output from targets, demand fully adjusts to the new $\overline{y}$ and firms have no incentive for changing prices. Adjustments coincide with the baseline scenario - Table 2, line 4.

However, the mix of inflation inertia, habit persistence and non-optimal policy produces differences in adjustment costs. Figure 3 compares, under TR, the adjustment path when both IS and AS exhibit inertia - TR(solid) - with the one with IS inertia only - TR1(dashed). As we had concluded, the TR leads to gradual adjustment in the presence of IS inertia. With the addition of inflation inertia, deflation effects and the fall in the nominal interest rate are smaller, output overshoots, but adjustment takes longer - Figure 3. The expansion period results from real interest rate overshooting, related to the slow inflation response.

Lines 5 to 8 of Table 2 allows some conclusions regarding stabilization costs in this mixed scenario. With habit formation, the higher inflation inertia, the lower the costs - inflation is less sensible to the output gap when inflation inertia is strong, thus lowering inflation variability. As expected, habit persistence is costly. And interest rate smoothing dampens stabilization costs.

As in the previous case, OMP yields instantaneous adjustment through fully expansionary policy, as the zero Loss in lines 5 to 8 of Table 2 implies. Thus, we can conclude that, as before, under TR and the mixed habit formation / inflation inertia scenario, a more expansionary policy - closer to the OMP - speeds up the adjustment to the new *FP-FER* equilibrium.

Adjustments to a gradual reform process - baseline scenario Figure 4 depicts the adjustment paths to the gradual reform defined in equation (56), above. Optimal monetary policy ensures, as in the previous cases, the adjustment to the new $\overline{y}$ but, because reform is gradual, output takes longer to stabilize. With pre-announcement, each step-change in b during reform implementation is concomitant with the economy's adjustment to the entire process. The economy fully adjusts to the successive changes in $\overline{y}$, but, in contrast with previous cases, nominal and real interest rates rise together. This restrictive monetary policy is required because expectations of future increases in *FP-FER* output drive *FP-FER* real interest rate up - equation (47), above - which incentives current consumption, putting upward pressure in prices.[22]

The TR response to the rise in the *FP-FER* real interest rate is not as restrictive, therefore accommodating some inflation, with output temporarily above the *FP-FER* equilibrium level. In this case, interest rate smoothing is less painful, but only if CB attaches stronger weight to inflation stabilization - see Table 2, lines 9 and 10.

Adjustments to an unexpected reform - baseline scenario In this case, differences in adjustment are to be expected not only between optimal and non-optimal monetary policy, but also between optimal discretionary and optimal with commitment.

The reform works as a cost-push shock that reduces marginal costs in period t - real wages fall with the reduction of the outside option, while labor demand pressure rises, but not as much as the new *FP-FER* level. This combination leads a fraction of the firms to lower prices in period t. The more average price falls, the closer is output to the new *FP-FER* level.

Firms that can only adjust prices in the following periods have no incentives to do so, because the effects of the reform are, by then, completely perceived. If it were not for the impacts of the first period surprise, adjustment would be just as with pre-announced reform. In the case of discretionary optimal policy, the impact of the surprise vanishes after the first period, since agents are aware that the monetary authority will respond fully to the shock in the current period.

Under commitment, the impact of the first period surprise extends to the following periods. As occurs with any other positive cost-push shock, in order to change private expectations, and get an improved inflation - output gap trade-off in the first period, the monetary authority generates a transitory expansion in the following periods. Expected positive output gaps lead to weaker downward pressure in prices, and, thus, to a smaller increase in output in period t. Figures 5 and 6 represent adjustments under OMP, respectively under commitment and discretion, compared with TR.

In line 11 of Table 2, discritionary OMP is better than commitment OMP. This may seem at odds with standard results in the literature - see, among others, McCallum and Nelson (2000) and Galí (2002a). Our result is explained by the fact that the reform is also unexpected to the monetary authority, which, accordingly, responds, in the first period, to the output gap relative to the pre reform *FP-FER* level; while the evaluation of stabilization costs refers to the new *FP-FER* level.

Comparison of Figure 7 with Figures 5 and 6, highlights the differences in adjustments resulting from differences in CBs' preferences regarding the relative weight of output gap

[22] This effect is consistent with the permanent income hypothesis, which states that consumption rises with current as well as with expected future incomes.

stabilization. OMP implies lower stabilization costs than (simple or smoothed) TR, if the CB cares primarily about price stabilization, while the opposite occurs if the CB is inflation prone - line 11, Table 2. The reason behind this dominance is related, again, to the reform being unexpected to the monetary authority. The effect of responding to the output gap relative to the pre reform *FP-FER* level, is amplified when more weight is attached to output gap stabilization.

Line 11 of Table 2 also shows that, in contrast with the previous cases, interest rate smoothing increases stabilization costs. In a context where the more expansionary the policy is, the faster is the recovery to the new *FP-FER* equilibrium, smoothing dampens the magnitude of the policy response in the first period; since active policy does not extend to the following periods, smoothing is unambiguously less expansionary than simple TR.

4.2 Permanent Effects on the Costs of Stabilization Policy

Over the long run, the reform yields the target inflation rate with higher *FP-FER* output. Although the latter is not a primary concern for the CB, the labor market reform also permanently impacts on the efficiency of monetary policy as a demand management device. Reform affects demand-side management because it improves real wage flexibility and the inflation - output gap trade-off, thus reducing stabilization costs in face of cost-push shocks. This positive, permanent, reform effect occurs regardless of the policy rule. As to other types of shocks - demand-side and technology -, the permanent effects of the reform depend on the policy rule - if non-optimal, reform may not increase policy efficiency.

In what follows, we compute the stabilization costs faced by the CB, in order to assess if they are reduced or amplified once reform takes full effect. Assuming that economies are hit by the same shocks, we evaluate stabilization costs across alternative scenarios and under different monetary policy rules.

Unlike transition stabilization costs of the adjustments to the reform, to evaluate the permanent effects on stabilization costs we need to evaluate the infinite horizon intertemporal Loss function for given properties of the shocks. For this purpose we re-scaled the Loss function, as proposed in Rudebusch and Svensson (1999). With $\beta \rightarrow 1$, Svensson (2003) shows that

$$\lim_{\beta \rightarrow 1}(1-\beta)(L) = E(L_t) = var(\pi_t) + \omega_{\widetilde{y}} var(\widetilde{y}_t). \tag{76}$$

Where L_t stands for the period loss function, with $L = E_0\left[\sum_{t=0}^{\infty}\beta^t(L_t)\right]$.

The above form applies for the baseline and the habit formation scenarios. For the inflation inertia case,

$$\lim_{\beta \rightarrow 1}(1-\beta)(L) = E(L_t) = var(\pi_t) + \omega_{\widetilde{y}} var(\widetilde{y}_t) + \omega_{\pi}\left[var(\pi_t - \pi_{t-1})\right]. \tag{77}$$

In order to evaluate $E[L_t]$ output gap and inflation variability must be determined conditioned upon the variability of shocks. We follow the standard practice, by considering three types of shocks: (i) demand-side (v_t) and (ii) cost-push shocks (u_t), assumed to follow a white noise process with zero mean and standard deviations of σ_v and σ_u, respectively; and a (iii) temporary technological shock (a_t), modelled as a first order autoregressive process, with innovation characterized by a zero mean and standard deviation of σ_a - see, for instance, McCallum and Nelson (1998, 2000).[23] The values for the parameters characterizing these processes are taken from McCallum and Nelson (2000), and they respect to a model close to our baseline. Values for σ_v and σ_u are set at 0.02 and 0.005, respectively, while the autocorrelation parameter and the standard deviations of the technology shock innovation are set at 0.95 and 0.007, respectively.

To compute Losses, we have analytically determined the second moments of the endogenous variables, applying the asymptotic formulas presented in Hamilton (1994, pp. 264-6). The methodology requires the definition of the endogenous variables as a function of the predetermined and the exogenous ones, that is, the standard form of the solution to rational expectations models. Table 3, shows the stabilization costs of the simple combination of the three types of shocks, under different rules of monetary policy, comparing the *steady state* with ($b = 0.6$) and without ($b = 0.7$) reform.

In general, the reform improves the efficiency of monetary policy - most of the changes in Loss in Table 3 are welfare improving. The patterns in Table 3, though, show that the magnitude, and sometimes the sign of the permanent effects of the reform on stabilization costs, depend not only on the policy rule and on the relative weight that the CB puts on price stabilization, but also on the scenarios for economic inertia. In addition, different combinations of the three types of shocks may result in different reform gains which are not accounted for in Table 3. A more detailed view of the reform effects, including the analysis of each type of shock is, thus, in order. In what follows, we proceed, comparing the impacts under optimal monetary policy with those under the Taylor rule.

Optimal policy Under optimal plans, either with discretionary or commitment behavior, the labor market reform has positive effects across all the scenarios. These gains, related exclusively to the cost-push shocks, arise from the improved trade-off between inflation and output gap stabilization.

Table 3 shows that, as expected, since cost-push are the only relevant shocks, the discretionary solution delivers always higher stabilization costs than those under commitment. Across all scenarios, reform stabilization gains increase with the relative weight put on price stabilization - *ie*, the improvement in the trade-off is sharper when the CB is more inflation averse, as inflation control comes at lower output stabilization costs. When inflation inertia is also present, gains under commitment are unambiguously higher than under discretion; otherwise, discretion yields higher gains, if more weight is put on inflation stabilization.

Gains from reform do not depend on IS inertia, but they change with inflation inertia.

[23] The temporary nature of the technology shock is appropriate in the context of macroeconomic stabilization.

Description	Stabilisation costs *(0.1 reduction in b)*											
	without reform					with reform					change in Loss	% change in Loss
	sdp	sdygap	sddp	sdr	loss*10^5	sdp	sdygap	sddp	sdr	loss*10^5		
Baseline												
OMP-C												
ω_y**=0.01**	0.004	0.019		0.021	157.8	0.003	0.020		0.021	142.4	-15.444	-9.78
ω_y**=1**	0.005	0.001		0.020	246.5	0.005	0.001		0.020	238.5	-8.000	-3.25
OMP-D												
ω_y**=0.01**	0.004	0.019		0.027	211.4	0.004	0.022		0.030	185.3	-26.069	-12.33
ω_y**=1**	0.005	0.000		0.020	249.5	0.005	0.000		0.020	249.1	-0.390	-0.16
TR												
ω_y**=0.01**	0.005	0.018		0.007	262.4	0.005	0.018		0.007	261.4	-1.065	-0.41
ω_y**=1**					3434.5					3328.0	-106.500	-3.10
TR-S												
ω_y**=0.01**	0.005	0.019		0.002	238.2	0.005	0.019		0.002	237.1	-1.125	-0.47
ω_y**=1**					3774.6					3662.1	-112.500	-2.98
Low IS inertia (h=0.5)												
OMP-C												
ω_y**=0.01**	0.004	0.019		0.064	157.8	0.003	0.020		0.075	142.4	-15.444	-9.78
ω_y**=1**	0.005	0.001		0.045	246.5	0.005	0.001		0.045	238.5	-8.000	-3.25
OMP-D												
ω_y**=0.01**	0.004	0.019		0.142	211.4	0.004	0.022		0.165	185.3	-26.069	-12.33
ω_y**=1**	0.005	0.000		0.045	249.5	0.005	0.000		0.045	249.1	-0.390	-0.16
TR												
ω_y**=0.01**	0.005	0.011		0.008	261.9	0.005	0.011		0.008	261.4	-0.432	-0.16
ω_y**=1**					1438.1					1394.9	-43.200	-3.00
TR-S												
ω_y**=0.01**	0.005	0.012		0.002	234.1	0.005	0.011		0.002	224.4	-9.756	-4.17
ω_y**=1**					1543.4					1488.5	-54.900	-3.56
High IS inertia (h=0.7)												
OMP-C												
ω_y**=0.01**	0.004	0.019		0.195	157.8	0.003	0.020		0.236	142.4	-15.444	-9.78
ω_y**=1**	0.005	0.001		0.101	246.5	0.005	0.001		0.101	238.5	-8.000	-3.25
OMP-D												
ω_y**=0.01**	0.004	0.019		0.476	211.4	0.004	0.022		0.558	185.3	-26.069	-12.33
ω_y**=1**	0.005	0.000		0.101	249.5	0.005	0.000		0.102	249.1	-0.390	-0.16
TR												
ω_y**=0.01**	0.005	0.009		0.008	267.8	0.005	0.009		0.008	277.8	9.952	3.72
ω_y**=1**					1034.5					1010.0	-24.500	-2.37
TR-S												
ω_y**=0.01**	0.005	0.009		0.002	238.7	0.005	0.009		0.002	238.3	-0.360	-0.15
ω_y**=1**					1058.5					1022.5	-36.000	-3.40
High AS inertia (γ^b**=0.5)**												
OMP-C												
ω_y**=0.01**	0.005	0.035	0.006	0.022	557.3	0.004	0.037	0.006	0.024	482.5	-74.750	-13.41
ω_y**=1**	0.007	0.002	0.008	0.020	845.3	0.007	0.002	0.008	0.020	831.6	-13.620	-1.61
OMP-D												
ω_y**=0.01**	0.006	0.026	0.007	0.033	727.2	0.006	0.031	0.007	0.037	643.4	-83.800	-11.52
ω_y**=1**	0.007	0.000	0.008	0.020	877.0	0.007	0.000	0.008	0.020	875.5	-1.450	-0.17
TR												
ω_y**=0.01**	0.007	0.020	0.008	0.009	810.9	0.007	0.019	0.008	0.009	782.3	-28.570	-3.52
ω_y**=1**					4662.3					4505.8	-156.480	-3.36
TR-S												
ω_y**=0.01**	0.006	0.021	0.008	0.003	735.9	0.006	0.021	0.008	0.003	701.8	-34.070	-4.63
ω_y**=1**					5108.6					4898.6	-210.000	-4.11
High IS/AS inertia (h=0.7;γ^b**=0.5)**												
OMP-C												
ω_y**=0.01**	0.005	0.035	0.006	0.287	557.3	0.004	0.037	0.006	0.362	482.5	-74.750	-13.41
ω_y**=1**	0.007	0.002	0.008	0.101	845.3	0.007	0.002	0.008	0.101	831.6	-13.620	-1.61
OMP-D												
ω_y**=0.01**	0.006	0.026	0.007	0.604	727.2	0.006	0.031	0.007	0.735	643.4	-83.800	-11.52
ω_y**=1**	0.007	0.000	0.008	0.102	877.0	0.007	0.000	0.008	0.102	875.5	-1.450	-0.17
TR												
ω_y**=0.01**	0.007	0.009	0.008	0.011	858.1	0.007	0.009	0.008	0.011	854.4	-3.760	-0.44
ω_y**=1**					1655.2					1624.7	-30.480	-1.84
TR-S												
ω_y**=0.01**	0.007	0.011	0.008	0.004	769.4	0.007	0.010	0.008	0.003	751.8	-17.610	-2.29
ω_y**=1**					1854.2					1768.4	-85.810	-4.63

Table 3: Permanent Effects on Stabilization Costs

The reason is straightforward - OMP insures against demand-side inertia and, thus, the CB's optimal response is independent of the degree of habit-formation;[24] however, because inflation inertia directly affects the CB's restriction, policy responses to cost-push shocks depend on the degree of AS inertia. For example, if the CB is inflation averse, inflation inertia increases gains under commitment (from 9.8% to 13.4%) while lowering gains under discretion (from 12.3% to 11.5%).

Non-optimal TR Table 3 shows that, as predicted by the definition of OMP, TR policy yields higher stabilization costs. As for changes in Loss, under TR policy, the reform affects stabilization costs arising from the three types of shocks. The impacts are not uniform, though, across shocks. Therefore, we need to complement Table 3 with a more detailed analysis for each shock.

Figure 8 shows the adjustment to a demand-side shock in the baseline scenario: while reform reduces output gap variability, it increases inflation variability. In what concerns responses to a technology shock, the reform may have ambiguous effects as well - in Figure 9, reform improves output gap variability and worsens inflation variability. As for cost-push shocks, the reform impacts are unambiguously positive - in Figure 10 both inflation and output gap variability are reduced.

Combining the three shocks in the baseline scenario, losses may occur for a CB that attaches a large weight to price stabilization, or if demand and(or) technology shocks dominate.

Regarding the other scenarios, in Table 3, the degree of habit formation reduces, and inflation inertia amplifies, the gains of the reform. For sufficiently high IS inertia and large weight put on price stabilization, the reform may even increase costs - as in the case of $h = 0.7$ and $\omega_{\tilde{y}} = 0.01$ in the table, with a 3.72% increase in Loss; adding inflation inertia reverts this loss - reform gains of 0.44% in the last panel of the table.

Figures 11 to 13 show the responses to the three types of shocks under habit formation. As in baseline, responses to cost-push shocks are improved by the reform - Figure 13. Considering the demand shock - and comparing Figures 11 and 8 -, habit formation dampens the output gap, yielding, as expected, longer adjustments; *ie* the gap is smaller but lasts longer, which explains why the impacts on inflation are similar to the baseline scenario. Responses to technology shocks - Figure 12 compared with 9 - show that the inflation stabilization costs of the reform are clearly higher under habit formation. We can also conclude that, as in the baseline, losses may occur for a strongly inflation averse CB, or if demand and(or) technology shocks dominate.

The responses to the three shocks under the scenario of inflation inertia are depicted in Figures 14 to 16. Comparing with baseline, (i) the permanent (negative) impacts of the reform on inflation variability in face of demand shocks are smaller, but adjustment takes longer, as expected with inflation inertia; and (ii) higher gains - in output gap and price stabilization - occur in the responses to cost-push and technology shocks.

As for the influence of CB preferences under inflation inertia, Table 3 suggests that the gains from reform (i) increase with the relative weight of inflation stabilization;

[24] As argued above in 3.2, this irrelevance relies on the assumption of constant labor supply.

and (ii) are higher under TR than under OMP, when the relative weight of output gap stabilization is large.

Regarding the smoothed TR, Table 3 shows that, across all scenarios, interest rate smoothing not only reduces interest rate volatility - as expected - but also improves stabilization costs relative to simple TR when the CB is strongly inflation averse. In addition, the more inflation averse the CB is, the larger is the advantage of smoothing. The table also shows that the advantage of smoothing over simple TR extends to the changes in Loss - in particular, with smoothing, reform always improves demand-side management.

5 Final Remarks

Using a reduction in the unemployment benefit replacement ratio as a representative labor market reform, we find that, in general, once fully implemented, it permanently increases the efficiency of monetary policy. However, reform implementation may generate transition stabilization costs. We show that reform impacts on stabilization costs are sensible to the inertias characterizing aggregate demand and supply, the reform processes, the policy rule and the relative weight central banks put on price stabilization.

Unless the reform is unexpected, following an optimal policy rule avoids transition costs. However, transition costs arise under the non-optimal Taylor-type rule. These stabilization costs rise with (i) the time it takes for reform implementation, (ii) the degree of uncertainty about reform enforcement, and (iii) the importance of habit persistence in consumption; while decreasing with the degree of inflation inertia.

Considering the permanent effects on stabilization costs, we conclude that, in general, central banks gain from the reform. Negative effects may emerge only for economies with a high degree of habit persistence coupled with a large relative weight put on price stabilization by the central bank. In this case, under non optimal rules, reform may reduce monetary policy efficiency.

Our results also uncover three additional motivations for smoothing interest rates: (i) under inflation averse central bank preferences, it reduces the Loss, even when it is not an objective *de per se*; (ii) smoothing reduces transition stabilization costs of the announced, one-shot, reform; and, (iii) smoothing dominates the simple Taylor rule in what respects the permanent monetary policy efficiency gains from reform.

In balance, higher gains from reform arise in an economy exhibiting high inflation inertia and where the central bank, with strong preferences for price stabilization, is able to enforce an optimal commitment rule - in this case, there are no transition costs, and permanent positive effects are maximized. Even when transition costs are present - under non optimal rules -, these turn out to be outweighed by permanent gains, in general. In our case, this balance is maximized when:

(i) the non-optimal rule includes smoothing, and

(iia) the central bank is strongly inflation averse and inflation inertia is high, or

(iib) the central bank is strongly inflation prone and habit persistence is high.

Although reform induces net positive stabilization gains - with exception of the high habit formation scenario -, some notes are in order.

First, the balance between permanent effects and transition costs depends on the magnitude and the frequency of the different types of shocks hitting the economy as well as on the magnitude of the reform - which has not been systematically scrutinized yet. This argument is in line with the conclusions of Saint-Paul and Bentolila (2000), who argue that reforms are often of a larger magnitude than the shocks hitting the economy.

Second, in addition to improving monetary policy as a demand-side management device, reform permanently improves macroeconomic efficiency as well, even though this is not considered in central banks' objectives.

In any case, transition stabilization costs can be dampened through transitory changes in monetary policy rules and by choosing the right phase of the cycle to implement reform. For instance, moving closer to optimal rules lowers, in general, stabilization costs; and the most favorable phase of the cycle occurs when stabilization effects of the shocks hitting the economy are opposite to the ones arising from reform implementation.

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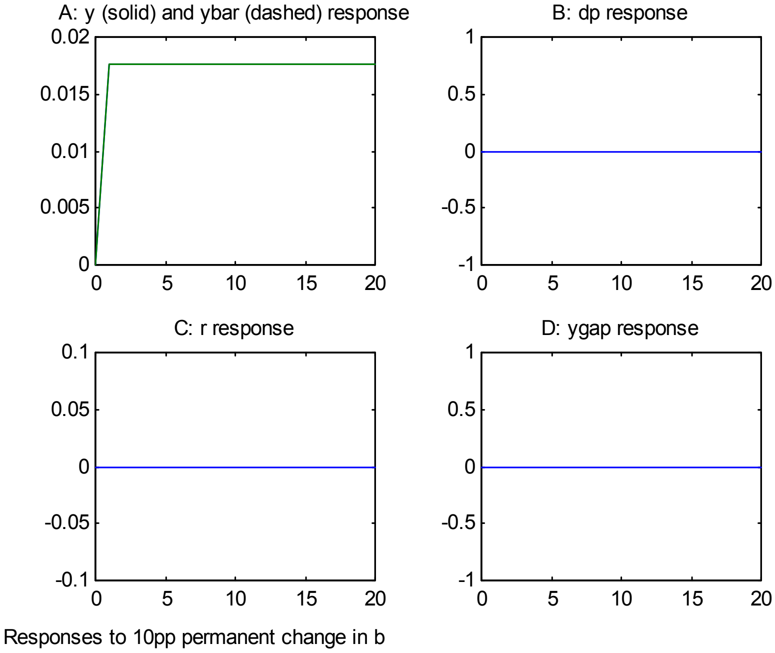

Figure 1: Adjustments to Reform - Baseline Scenario

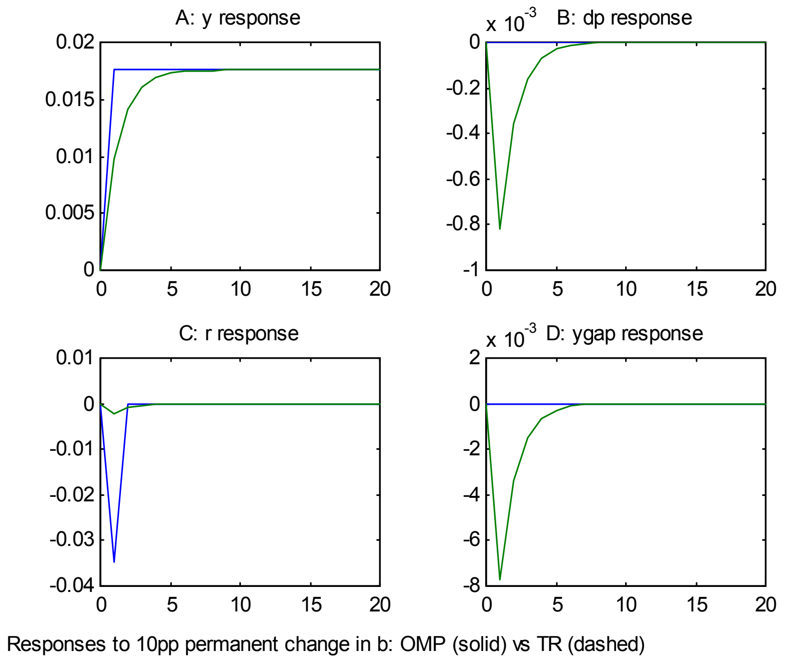

Figure 2: Adjustments to Reform - Habit Formation ($h = 0.5$)

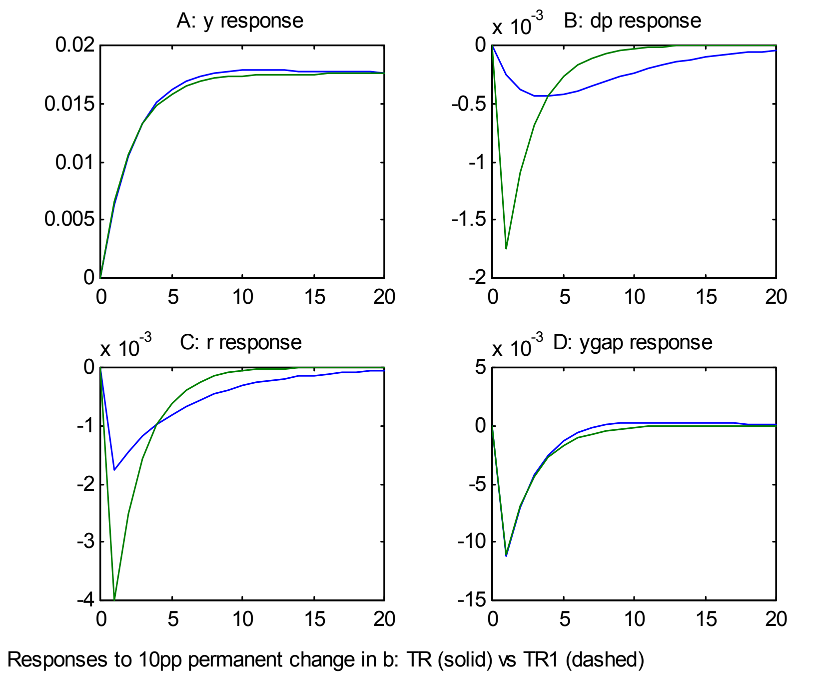

Figure 3: Adjustments to Reform - Habit Formation ($h = 0.7$) *vs* Habit Formation ($h = 0.7$) and Inflation Inertia ($\gamma = 0.5$)

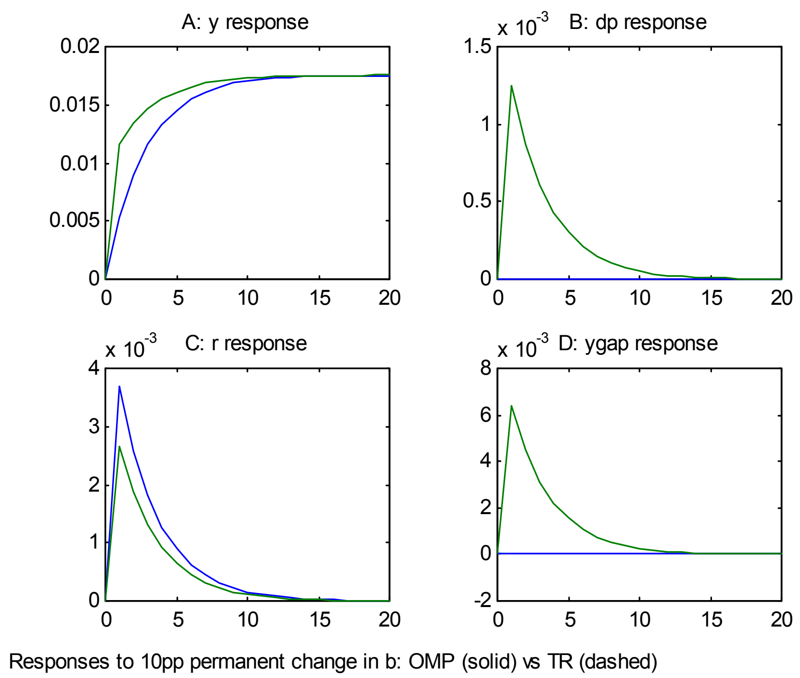

Figure 4: Adjustments to Reform - Gradual Reform Process ($\rho_{\overline{y}} = 0.7$)

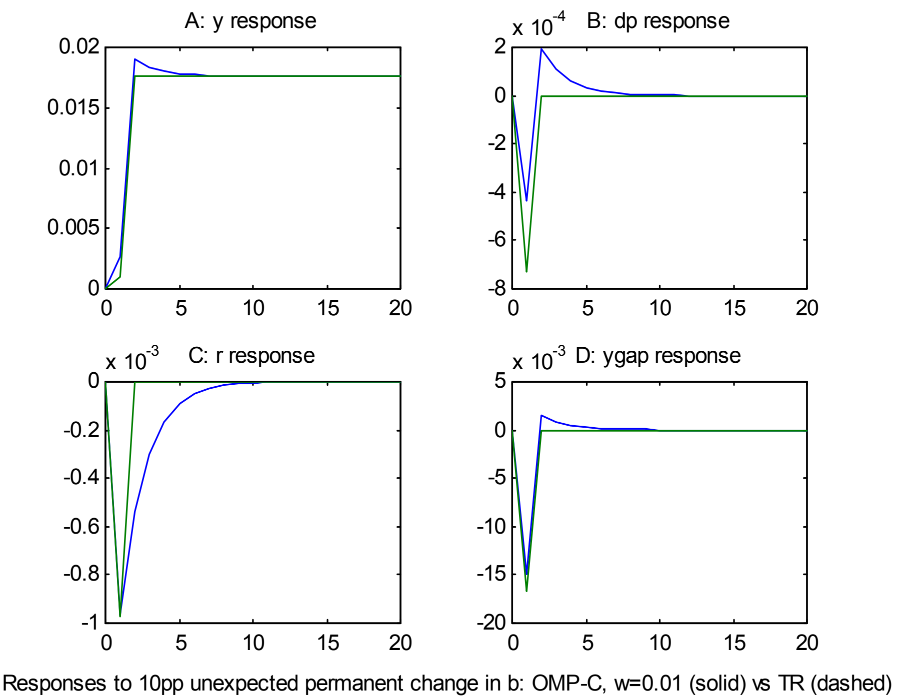

Figure 5: Adjustments to Reform - Unexpected Reform, I

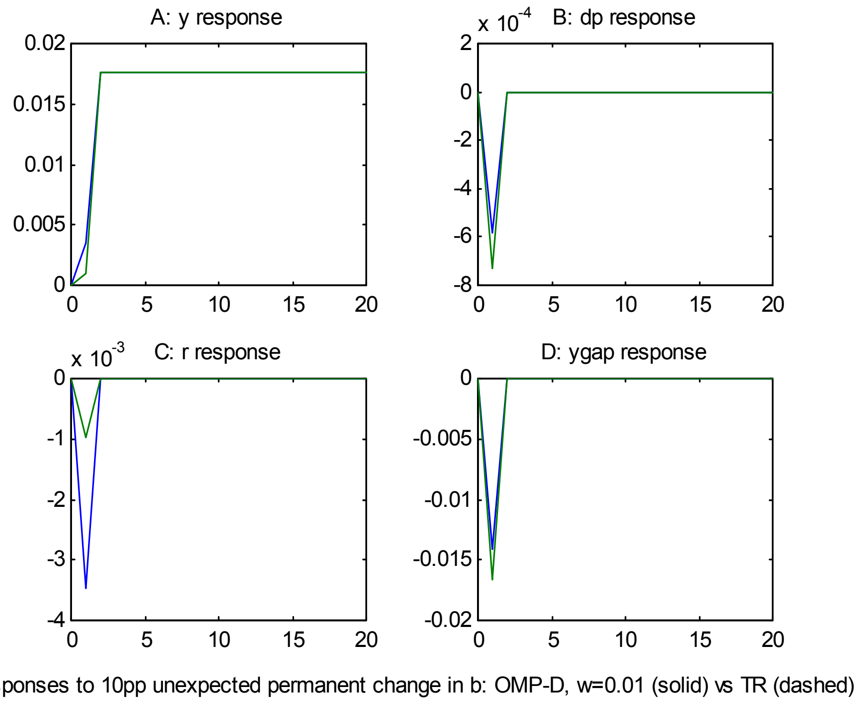

Figure 6: Adjustments to Reform - Unexpected Reform, IIA

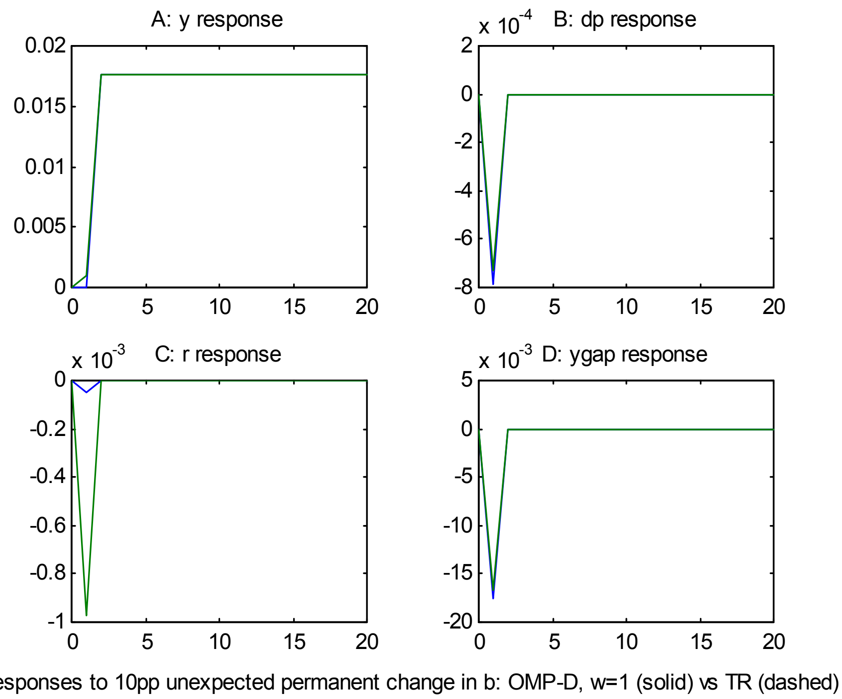

Figure 7: Adjustments to Reform - Unexpected Reform, IIB

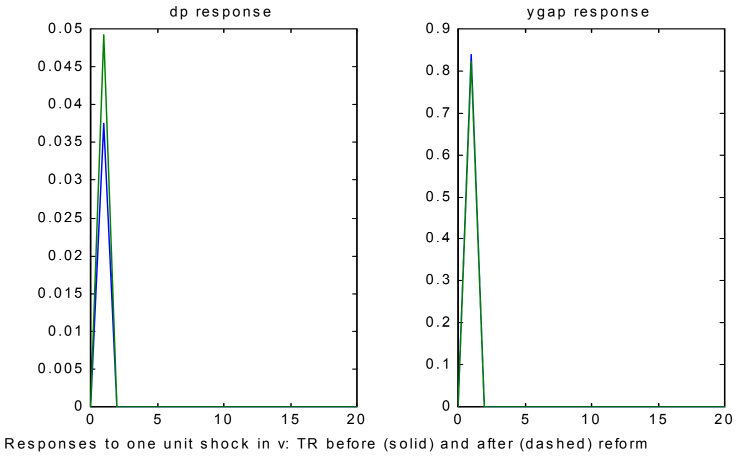

Figure 8: Responses to a demand-side shock - baseline scenario

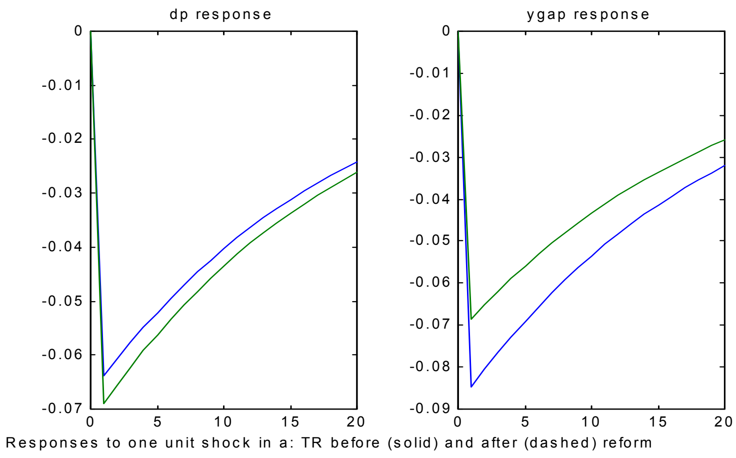

Figure 9: Responses to a technology shock - baseline scenario

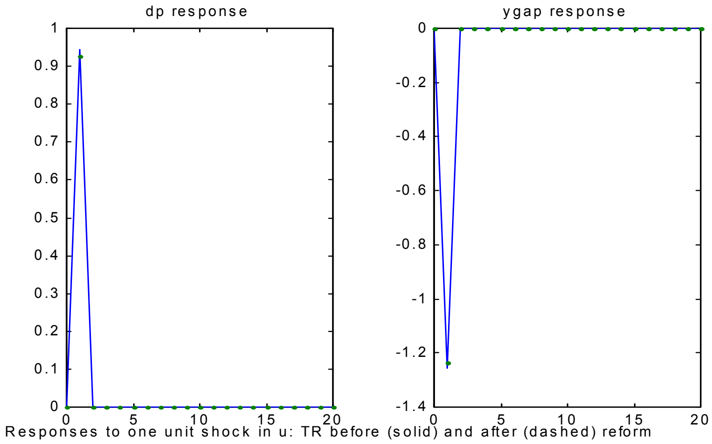

Figure 10: Responses to a cost-push shock - baseline scenario

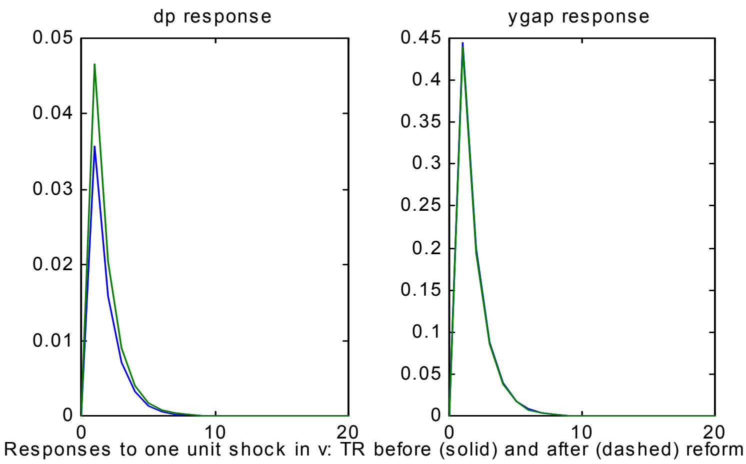

Figure 11: Responses to a demand-side shock - IS inertia ($h = 0.5$)

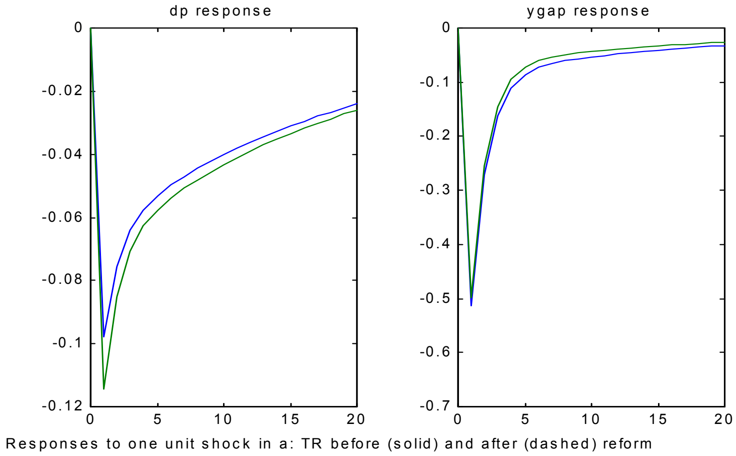

Figure 12: Responses to a technology shock - IS inertia ($h = 0.5$)

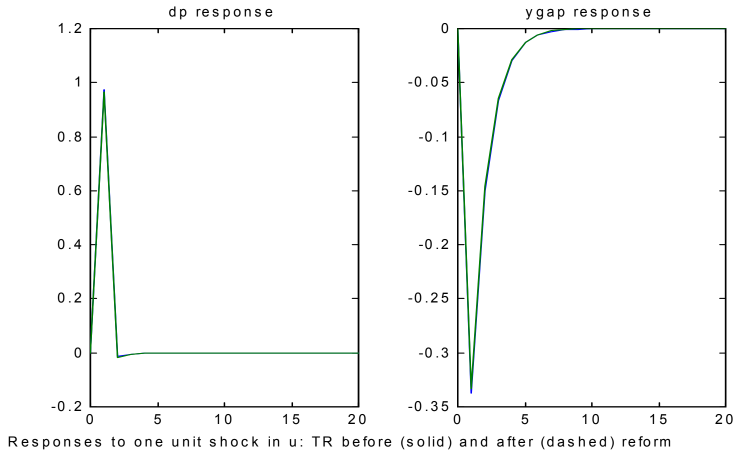

Figure 13: Responses to a cost-push shock - IS inertia ($h = 0.5$)

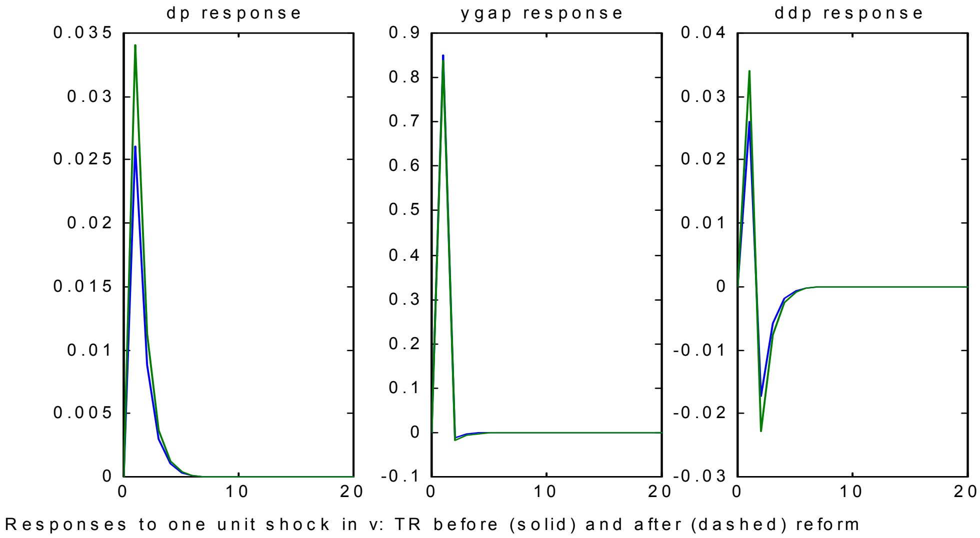

Figure 14: Responses to a demand side shock - AS inertia ($\gamma^b = 0.27$)

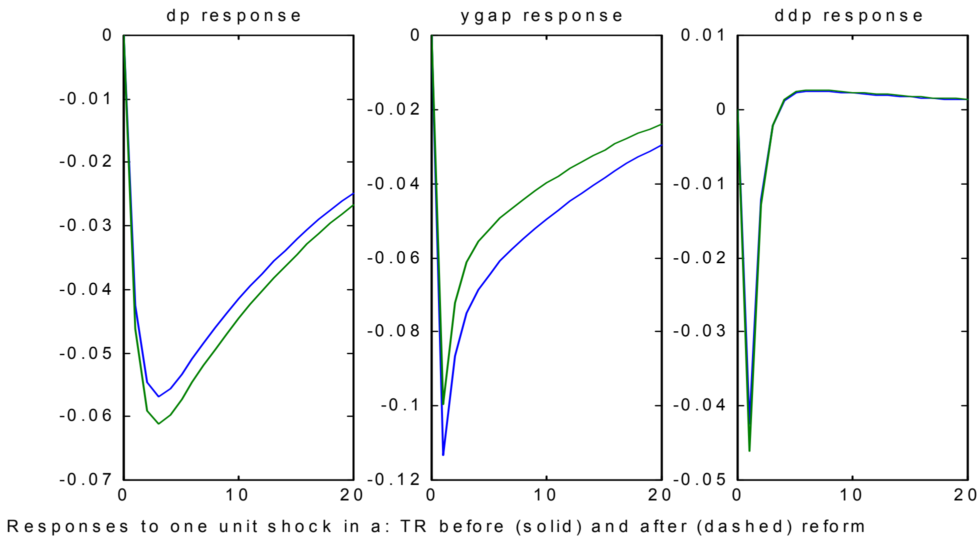

Figure 15: Responses to a technology shock - AS inertia ($\gamma^b = 0.27$)

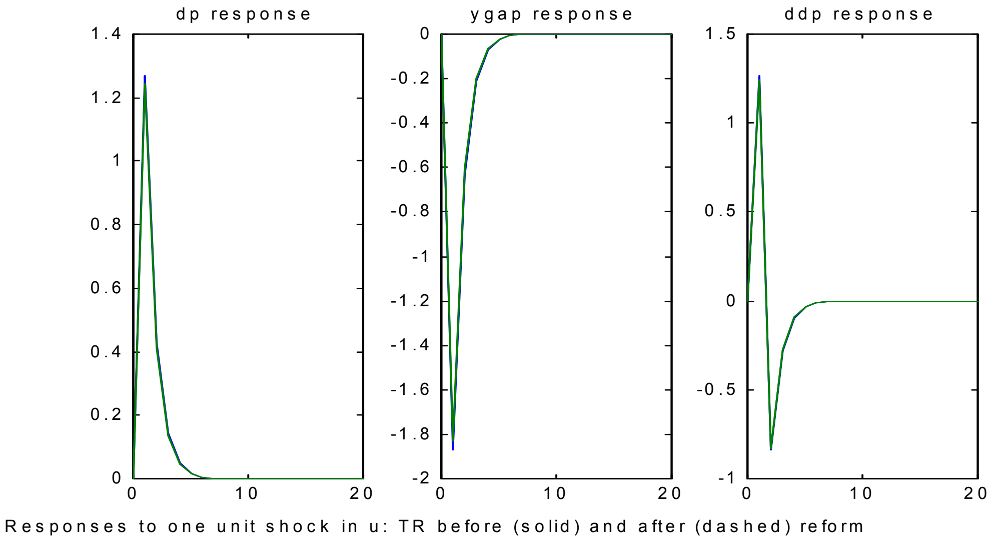

Figure 16: Responses to a cost-push shock - AS inertia ($\gamma^b = 0.27$)