ISSN 1745-8587

Department of Economics, Mathematics and Statistics

Birkbeck Working Papers in Economics & Finance

BWPEF 1306

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September 2013

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October 21, 2013

Abstract

This paper contributes to a recent debate about the structural and institutional conditions under which discretion may be superior to timeless perspective. We show this is unlikely when the policy maker relies on a welfare-theoretic loss function obtained as a second-order approximation of households' utility, even in the presence of features that should enhance the relative performance of discretionary policy-making in the baseline New Keynesian model. This result stands in contrast to the existing studies, whose analysis has typically relied on *ad hoc* welfare criteria that reflect neither households' preferences, nor the degree of rigidity in price-setting.

JEL classification: E23; E32; E52

Keywords: Monetary Policy, Discretion, Timeless Perspective, Loss of Social Welfare

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1 Introduction

Woodford (1999, 2003) has influentially argued that monetary policy should be conducted from a timeless perspective, a policy that helps overcoming both the traditional inflation bias (Barro and Gordon, 1983) and the stabilization bias (Svensson, 1997 and Clarida et al., 1999). Despite the direct advantages of such a commitment technology, Sauer (2010a, 2010b) reports situations in which, depending on the initial conditions of the economy, timeless perspective may be inferior to discretion. Dennis (2010) details similar findings, proposing a conditional loss function as a valid metric to assess the relative performance of alternative policy regimes.[1] These results hinge on the role of elements that reduce the slope of the New Keynesian Phillips curve (NKPC hereafter), such as nominal price rigidities, firm-specific labor/capital, and Kimball (1995) aggregation, as well as on the policy maker's preference for output stabilization. The common trait of these factors is to raise the conditional volatility of the auxiliary state variables that track the value of commitments under timeless perspective, so that discretion becomes the superior policy.

This paper shows that comparing the performance of discretionary policy-making relative to that of timeless perspective should necessarily rest on a welfare-theoretic function that is consistent with the underlying structure of the model economy. In other words, to avoid a spurious welfare ranking the policy maker's objective function should accurately represent households' preferences, as well as potential sources of real and nominal rigidity. The existing studies have not taken such a standpoint, as their analysis has typically dealt with linear-quadratic problems where the Central Bank's preferences are de-linked from the deep parameters of the model. This point turns out to be of crucial importance for reporting situations in which discretion dominates timeless perspective. To show this, we examine the baseline New Keynesian model that has been used by Dennis (2010) and Sauer (2010a, 2010b). Along with considering a standard microfoundation for this model economy, we replace their policy makers' objective functions with a welfare criterion obtained as a second-order approximation of households' utility (Rotemberg and Woodford, 1998). Within this setting most of the factors that affect the slope of the NKPC also influence the policy maker's preferences for alternative stabilization objectives. For instance, increasing the degree of nominal rigidity has the joint effect of reducing the slope of the NKPC and increasing the relative importance of inflation stabilization in the 'model-consistent' welfare criterion. The second effect reduces the short run cost of being tough on inflation already in the initial period, so that timeless perspective is favored over discretion.

In light of our analysis, discretion should have higher chances of dominating timeless perspective if we can envisage structural elements that lower the slope of the NKPC while not increasing the relative weight attached to inflation stabilization (or *vice versa*). To this end, Petrella and Santoro (2011) have shown that allowing for input materials in the production technology lowers the slope of the NKPC without affecting the Central Bank's objective function. Input materials also correspond to the largest determinant of the total cost of production in various industries[2] and, as such, they exert strong influence on the

[1] Since timeless perspective involves the existence of auxiliary state variables that discretion does not feature, comparing their relative performance requires an appropriate welfare metric. Instead of assigning initial values to the auxiliary state variables or using unconditional losses, Dennis (2010) employs a measure of conditional loss that integrates out the auxiliary state variables, conditional upon the predetermined state variables.

[2] Dale Jorgenson's data on input expenditures by US industries show that materials (including energy) account for roughly 50% of outlays, while labor and capital account for 34% and 16%, respectively.

slope of the aggregate supply schedule (Basu, 1995). We show that input materials enhance the performance of discretion relative to timeless perspective. However, even strong degrees of strategic complementarity stemming from input-output interactions are ineffective at making discretion the superior policy when welfare is evaluated through a model-consistent metric.

The remainder of the paper is laid out as follows: Section 2 presents the model; Section 3 compares the relative performance of discretionary and timeless perspective policy-making: we check the robustness of our results over a wide range of values for the deep parameters of the model economy, as well as alternative institutional settings for the conduct of monetary policy; Section 4 concludes.

2 The Model

This section presents the equations to be employed in the normative analysis. These are derived from a dynamic general equilibrium New Keynesian model that accommodates the presence of input materials in the production technology.[3] Firms operate within a monopolistically competitive setting and set prices according to a Calvo (1983) scheme. As in Basu (1995) the production technology embodies both labor and intermediate goods, so that the gross product of each firm is both consumed and used in the production of all other goods in the economy. It is important to recognize that setting the income share of input materials to zero renders the model economy identical to the standard New Keynesian setting popularized by, e.g., Woodford (2003).

Households derive income from working in firms, investing in bonds, and from the stream of profits generated by firms in the economy. The government serves two purposes in the economy. First, it delegates monetary policy to an independent Central Bank. The second task of the government consists of taxing households and providing subsidies to firms to eliminate distortions arising from monopolistic competition in the goods market.[4] This task is pursued via lump-sum taxes that maintain a balanced fiscal budget.

2.1 Solution and Calibration

Prior to step into our normative analysis, we log-linearize structural equations and resource constraints around the non-stochastic steady state and then take the deviation from their counterparts in the efficient equilibrium. The difference between the logarithm of a generic variable X_t under sticky prices and its counterpart in the efficient equilibrium, X_t^*, is denoted by x_t.[5] The rate of inflation, π_t, evolves in accordance with the following NKPC:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa (\sigma + \nu)(1 - \alpha) c_t + \eta_t, \quad (1)$$

where c_t represents the consumption gap, β denotes the discount factor, σ denotes the inverse of the intertemporal elasticity of substitution, ν denotes the inverse of the

[3] A detailed description of the framework is available in the Technical Appendix.

[4] For the sake of making a correct welfare ranking between discretion and timeless perspective within our linear-quadratic framework, steady state efficiency is mandatory (Woodford, 2003). Otherwise, in the presence of no subsidy the steady state would be distorted, leading to a spurious welfare analysis.

[5] To denote variables in the non-stochastic steady state we omit the time subscript.

Frisch elasticity of labor supply, α denotes the income share of input materials, θ denotes the probability that firms are not able to adjust their price in each period, $\kappa \equiv (1-\beta\theta)(1-\theta)\theta^{-1}$ and $\eta_t \equiv -\kappa(\varepsilon-1)^{-1}\ln(\varepsilon_t/\varepsilon)$. Therefore, a negative shock to the degree of competition (i.e., a lower ε_t) translates into a positive cost-shifter. We impose $\ln(\varepsilon_t/\varepsilon) = \rho\ln(\varepsilon_{t-1}/\varepsilon) + \epsilon_t$, where $\rho \in (0,1)$ and ϵ_t is assumed *i.i.d.* with zero mean and unit variance.

The income share of input materials is a key determinant of the slope of the supply schedule.[6] In a hypothetical situation with intermediate goods as the only production input (i.e., $\alpha = 1$) current inflation would be insulated from movements in the real wage, so that strategic complementarities in the market for intermediate goods would render the NKPC completely flat.

To evaluate the influence of the structural coefficients on the performance of discretion relative to timeless perspective, each of them will be varied while leaving the other parameters at the following values: $\beta = 0.9913$, $\sigma = 1$, $\nu = 0.2$, $\theta = 0.75$, $\varepsilon = 6$, $\rho = 0.2$.[7] Finally, we set $\alpha = 0$ in the baseline parameterization, so as to collapse the model to the baseline New Keynesian setting and enhance the comparison with previous studies in the same strand of the literature.

3 Monetary Policy

The next step consists of taking a second-order Taylor approximation to the representative household's lifetime utility (see Rotemberg and Woodford, 1998).[8] In line with the analysis of Petrella and Santoro (2011), the following intertemporal social loss function is obtained:

$$\mathcal{W}_0 \approx -\frac{U_C C}{2} E_0 \sum_{t=0}^{\infty} \beta^t \left[(\sigma+\nu) c_t^2 + \mu\pi_t^2\right] + t.i.p. + O\left(\|\xi\|^3\right), \tag{2}$$

where C denotes the steady state level of consumption, U_C is the (steady state) marginal utility with respect to C_t, t.i.p. collects the terms independent of policy stabilization and $O\left(\|\xi\|^3\right)$ summarizes all terms of third order or higher. A peculiarity of (2) is that the preference for inflation stabilization, $\mu \equiv \varepsilon\kappa^{-1}$, does not depend on α. This is an inherent property of the model-consistent welfare criterion, which weighs inflation variability with consumption gap variability, rather than output gap variability (Petrella and Santoro, 2011 and Petrella et al., 2013).

Under discretionary policy-making the Central Bank faces a sequence of static optimization problems, disregarding the impact of her policies on inflation expectations.

[6] We should stress that the presence of a subsidy that neutralizes the steady state inefficiency emanating from monopolistic competition implies that the consumption gap equals the labor gap (i.e., $c_t = l_t$) under any value of the income share of input materials, and not only for $\alpha = 0$. In this respect, the slope of our NKPC is coherent with the derivations of Bergin and Feenstra (2000), Woodford (2003, Eq. 2.13, Ch. 3) and Huang and Liu (2004).

[7] This value for the autoregressive process of the cost-shifter is chosen in line with Dennis (2010).

[8] We assume that shocks that hit the economy are not big enough to lead to paths of the endogenous variables distant from their steady state levels. This means that shocks do not drive the economy too far from its approximation point and, therefore, a linear-quadratic approximation to the policy problem leads to reasonably accurate solutions.

Minimizing (2) subject to (1) – taking inflation expectations $E_t \pi_{t+1}$ as given – results into:

$$\pi_t = -\frac{1}{\varepsilon (1-\alpha)} c_t. \tag{3}$$

Should the policy maker be able to credibly commit herself to some future policy path, she can minimize (2) by internalizing the impact of her actions on expectations. The optimality conditions in this case involve (3) for $t = 0$, together with

$$\pi_t = -\frac{1}{\varepsilon (1-\alpha)} (c_t - c_{t-1}), \qquad t = 1, 2, ... \tag{4}$$

Equation (4) accounts for the possibility to spread the effects of shocks over several periods. Yet, commitment is time inconsistent in two ways: first, the policy maker can switch from (4) to (3) in any period after $t = 0$, exploiting given inflation expectations. Second, as argued by McCallum (2003) each period the policy maker faces an incentive to depart from its previous optimized plan, so that 'strategic incoherence' characterizes the policy path.

Woodford (1999, 2003) has originally proposed a 'timeless perspective' approach to overcome the second form of time inconsistency. This involves ignoring the conditions that prevail at the regime's inception, thus imagining that the commitment to apply the rules deriving from the optimization problem had been made in the distant past. Under timeless perspective (4) applies from $t = 0$ onwards.

3.1 Policy Evaluation

The short run costs from adhering to the timeless perspective policy are generally amplified in the presence of elements that reduce the slope of the NKPC, or when the monetary authority poses increasing emphasis on consumption stabilization. Under these circumstances the Central Bank must generate greater volatility in the real marginal costs, so as to stabilize inflation. According to the existing literature, to the extent that real marginal costs are correlated with the Central Bank's other policy objectives, higher volatility in real marginal costs raises the volatility of the commitments that characterize timeless perspective, so that discretion may become the superior policy.

In the present setting timeless perspective policy-making involves one auxiliary state variable, c_{t-1}. Rather than assigning initial values or using unconditional losses, we follow Dennis (2010), who has formulated a measure of conditional loss that integrates out the auxiliary state variables conditional upon the known predetermined state variables. This strategy is consistent with the conditioning assumptions that describe the optimization problems and provides a consistent treatment of the initial conditions in the equilibria under alternative regimes. Finally, to assess the relative loss induced by alternative policies we follow Sauer (2010a, 2010b) and compute

$$RL = \left(\frac{\mathcal{W}^{tp}}{\mathcal{W}^{d}} - 1 \right) \times 100, \tag{5}$$

where $\mathcal{W}^d$ denotes the conditional loss under discretion and $\mathcal{W}^{tp}$ is the conditional loss under timeless perspective. RL measures the percentage gain from implementing discretion over timeless perspective. In each panel of Figure 1 we report both the relative loss under the microfounded welfare criterion, as well as under a loss function with fixed preferences similar to that considered by Dennis (2010) and Sauer (2010a, 2010b).[9]

Insert Figure 1 here

We first focus on the role of price stickiness, whose importance has been very much emphasized due to its effect on the slope of the NKPC. Our simulation shows that the relative loss under fixed preferences for the policy maker increases monotonically, while the one consistent with (2) displays a U-shaped pattern over the domain of θ. Most importantly, timeless perspective is dominated by discretion only at implausibly high values of θ and when the policy maker considers an *ad hoc* welfare criterion. Otherwise, this is never the case when the relative loss is evaluated through a model-consistent metric. To explain this result we need to consider that increasing θ has three main effects: first, firms attach greater importance to future profits, as they have fewer chances to adjust their prices. This incentive favors timeless perspective over discretion, as the former optimally incorporates forward-looking expectations. Second, more rigid prices reduce the pass-through from the real marginal cost to the rate of inflation, so that timeless perspective entails higher costs of being tough on inflation already in the initial period. The third effect – which has not been explored by the literature available to date – is that increasing θ lowers the relative weight attached to consumption gap variability in (2), so that the short run cost of being tough on inflation in the initial period decreases. The importance of the last effect may be inferred from the wedge between the two relative losses in the first panel of Figure 1. Under the *ad hoc* function the weight on consumption stabilization does not depend on θ, so that the second effect tends to prevail over the first one (though at extremely high values of θ). By contrast, with the microfounded welfare function the third effect comes into play and, adding up to the first one, it makes timeless perspective prevail over discretion throughout the entire range of values of θ. This general principle also applies to the parameters governing households' relative risk aversion and the elasticity of labor supply. As a matter of fact, alternative values of these coefficients never induce a better performance of discretion. Yet, increasing σ and/or ν improves the performance of discretion relative to timeless perspective under a microfounded welfare criterion, while the opposite holds true under the *ad hoc* loss function. In the first case, the increase in the weight attached to consumption stabilization overcomes the positive effect on the slope of the NKPC, while in the second case the slope of the NKPC increases in both σ and ν, so that discretion is penalized. It should also be noted that, consistent with Sauer (2010a), discretion loses relative to timeless perspective if β increases. This is because the so-called 'expectations channel' becomes increasingly important, overcoming the rise in the short run costs associated with timeless perspective, which arise from β exerting a negative effect on the slope of the NKPC. This effect is magnified when (2) is accounted for, as increasing β also translates into increasing the relative weight attached to inflation stabilization, through κ.

We also examine the role of parameters that do not have direct influence on the slope of the NKPC. In this respect, we note that the relative loss decreases with ρ: Sauer

[9] Specifically, we follow Dennis (2010) and set the preference for consumption stabilization to 0.5, while normalizing the weight on inflation stabilization to one.

(2010a) suggests that timeless perspective has to be preferred when shocks dissipate more slowly and exert greater influence on the future, though he also shows that appropriate combinations of other parameters may even revert the influence of ρ on RL. It is also worth noting that RL is insulated from movements in ε under the *ad hoc* welfare function,[10] while it decreases when we consider the microfounded metric. This is because higher competition necessarily increases the weight attached to inflation stabilization in (2), thus favoring timeless perspective over discretion.

The last panel of Figure 1 evaluates the effect of increasing α on the relative performance of timeless perspective. When input materials are part of the production technology and prices are sticky, firms face constant costs for their inputs, so that the sensitivity of the real marginal cost to variations in aggregate demand are rather small. In turn, firm-level incentives to cut prices and increase output are reduced (Basu, 1995). Therefore, input-output interactions have the potential to turn small price-setting frictions into considerable degrees of real rigidity. In addition, α has no impact on (2). Altogether, these factors turn out to be important in that they induce the relative loss to increase over a range of plausible values of the income share of input materials.[11] However, strategic complementarities stemming from input-output interactions never prevent timeless perspective from dominating discretion, even when the policy maker has a strong preference for consumption stabilization.[12]

3.2 Delegation

The analysis so far has stressed the importance of measuring social welfare through a model-consistent metric when comparing alternative policies. However, it could be argued that such a metric is not known with certainty and/or the government may delegate monetary policy to an independent Central Banker whose preferences for alternative stabilization objectives differ from those of the public as whole (see, e.g., Rogoff, 1985). Under these circumstances we could envisage a de-linking between the deep parameters affecting the slope of the NKPC and the preferences of the policy maker. The aim of this section is to understand whether our key insight is robust to this critique. To this end, we retrieve the optimal rules under a welfare criterion where the weight on consumption stabilization – which will be denoted by ω – is allowed to vary, while the one on inflation stabilization is normalized to one. In turn, welfare is evaluated both under the model-consistent metric (2), as well as under the loss function of the delegated Central Banker. The results of this exercise are graphed in Figure 2.

Insert Figure 2 here

It turns out that under the baseline calibration timeless perspective dominates discretion even when the Central Banker faces an *ad hoc* criterion and welfare is evaluated accordingly (i.e., when the policy maker evaluates the loss of social welfare in accordance

[10] This is because under the *ad hoc* welfare function ε only affects the elasticity of π_t to the stochastic cost-shifter. Therefore, varying ε results into the same effect on both $\mathcal{W}^{tp}$ and $\mathcal{W}^{d}$, so that RL is not influenced by changes in the degree of monopolistic competition.

[11] Under the *ad hoc* criterion RL increases monotonically. Otherwise, the relative loss displays an increasing path only for α greater than about 0.3.

[12] To appreciate a better performance of discretion relative to timeless perspective under the *ad hoc* welfare criterion we would need to couple a plausible degree of input-output interactions ($\alpha \approx 0.6$) with an implausibly high degree of nominal rigidity ($\theta \approx 0.9$).

with her preferences, while disregarding those of the public). Introducing input materials ($\alpha = 0.6$) allows discretion to outperform timeless perspective under a strong preference for consumption stabilization (i.e., ω greater than about 7), but only when welfare is computed through the *ad hoc* function. Otherwise, this is never the case when the optimal policies are derived from the loss function of the delegated Central Banker and welfare is evaluated through the model-consistent metric.

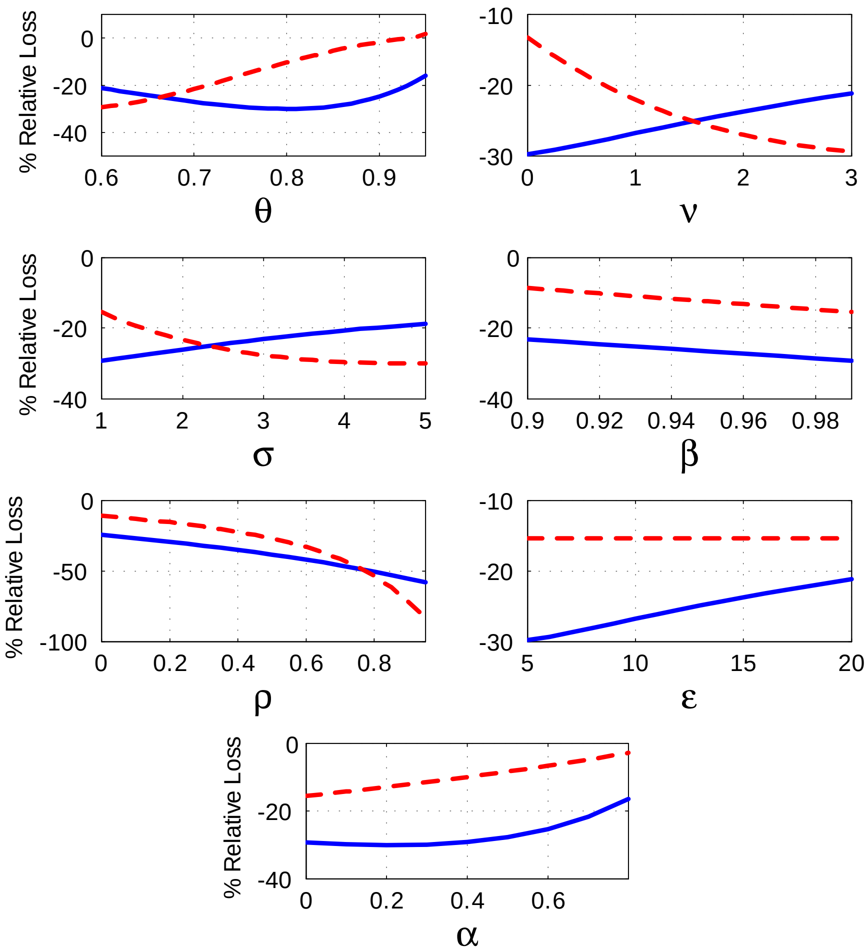
4 Conclusions

Recent contributions have reported situations in which the short run costs associated with timeless perspective policy-making dominate the long run gains with respect to discretion, so that the latter may become the superior policy (Dennis, 2010; Sauer, 2010a, 2010b).

The key finding of this paper is that measuring social welfare through a model-consistent metric is crucial for the sake of comparing different policies. In this respect, the superiority of timeless perspective relative to discretion is robust to variations in all the deep parameters of the baseline New Keynesian model, even when the government is uncertain about the form of the relevant welfare criterion or it delegates an independent Central Banker whose preferences for alternative stabilization objectives differ from those of the public as a whole.

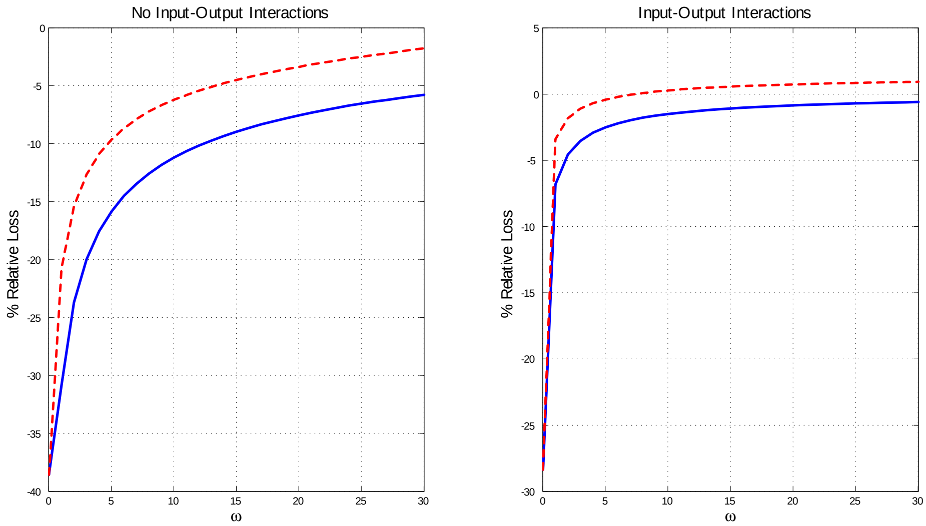
Figures

FIGURE 1: RELATIVE LOSSES



Notes. Each panel of the figure portrays the relative loss (RL) conditional on different values of θ, ν,σ, β, ρ, ε, α. The continuous line is obtained under $\mu \equiv \varepsilon\kappa^{-1}$. The dashed line is obtained by setting the weight on consumption stabilization to 0.5, while normalizing the weight on inflation stabilization to one.

FIGURE 2: RELATIVE LOSSES UNDER DELEGATION



Notes. Figure 2 portrays the relative loss (RL) conditional on different values of the delegated Central Banker's preference for consumption stabilization (the weight attached to inflation stabilization is set to one): the dashed line represents the relative loss for the delegated Central Banker, while the continuous line represents the relative loss from the perspective of the public. In the LHS panel all other parameters are set in line with the baseline parameterization described in Section 2.1, while in the RHS panel we set $\alpha = 0.6$.

Technical Appendix: The Model

We embed an input-output production structure into an otherwise standard dynamic general equilibrium New Keynesian model. Firms operate within a monopolistically competitive setting. Their production technology embodies both labor and intermediate goods, so that the gross product of each firm in the economy is both consumed and used in the production of all other goods in the economy.

Consumers

Households derive income from working in firms, investing in bonds, and from the stream of profits generated by firms in the economy. They have preferences defined over a composite of goods (C_t) and labor (L_t). They maximize the expected present discounted value of their utility:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\sigma}}{1-\sigma} - \varrho \frac{L_t^{1+\nu}}{1+\nu} \right], \; \varrho > 0 \tag{6}$$

where β is the discount factor, σ is the inverse of the intertemporal elasticity of substitution, ν is the inverse of the Frisch elasticity of labor supply.

The following sequence of (nominal) budget constraints applies:

$$P_t C_t + B_t = R_{t-1} B_{t-1} + P_t W_t L_t - T_t + \Psi_t, \tag{7}$$

where P_t is the price of the composite good, B_t denotes a one-period risk-free nominal bond remunerated at the gross risk-free rate $R_t \equiv 1 + i_t$, W_t is the real wage rate, T_t is a lump-sum tax paid to the government and Ψ_t is the aggregate nominal flow of firm dividends.

Producers

The production side of the economy consists of one sector producing a continuum of differentiated goods $i \in [0, 1]$. We assume that the consumption composite takes the form of a Dixit-Stiglitz aggregator:

$$C_t = \left[\int_0^1 (C_{it})^{\frac{\varepsilon_t - 1}{\varepsilon_t}} \, di \right]^{\frac{\varepsilon_t}{\varepsilon_t - 1}}, \tag{8}$$

where ε_t denotes the time-varying elasticity of substitution between differentiated goods in the consumption composite. It is possible to show that a generic firm i faces the following demand schedule:

$$C_{it} = \left(\frac{P_{it}}{P_t} \right)^{-\varepsilon_t} C_t, \tag{9}$$

where P_{it} is the price of the generic good i.

As in Basu (1995), Bergin and Feenstra (2000) and Moro (2009) we assume a Cobb-Douglas production technology for a generic firm i:[13]

$$Y_{it} = Z_t M_{it}^{\alpha} L_{it}^{1-\alpha}, \tag{10}$$

where Z_t is a productivity shifter, L_{it} denotes the number of hours worked in the ith firm and M_{it} denotes the amount of material inputs employed by firm i. Material inputs are combined according to a CES aggregator:

$$M_{it} = \left[\int_0^1 (M_{kit})^{(\varepsilon_t-1)/\varepsilon_t}\, dk\right]^{\varepsilon_t/(\varepsilon_t-1)}, \tag{11}$$

where M_{kit} is the intermediate input produced by firm k and employed in the production process of firm i. This specification implies the following demand function for the kth intermediate good:

$$M_{kit} = \left(\frac{P_{kt}}{P_t}\right)^{-\varepsilon_t} M_{it}. \tag{12}$$

The gross product of the ith firm may be sold on the market for final consumption goods or used as an intermediate good by all firms in the economy, so that $Y_{it} = C_{it} + M_{it}$.

Firms are assumed to adjust their price with probability $1-\theta$ in each period. When they are able to do so, they set the price that maximizes expected profits:

$$\max_{P_{it}} E_t \sum_{n=0}^{\infty} (\beta\theta)^n \Omega_{t+n} \left[(1+\tau) P_{it} - MC_{it+n}\right] \frac{Y_{it+n}}{P_t} \tag{13}$$

where Ω_t is the stochastic discount factor consistent with households' maximizing behavior, τ is a steady state subsidy to producers[14] and MC_{it} denotes firm's i nominal marginal cost of production. In every period each firm solves a cost minimization problem to meet demand at its stated price, so that:

$$MC_{it} = \frac{P_t W_t L_{it}}{(1-\alpha) Y_{it}} = \frac{P_{it} M_{it}}{\alpha Y_{it}}. \tag{14}$$

The Government and the Monetary Authority

The government serves two purposes in the economy. First, it delegates monetary policy to an independent Central Bank. The second task of the government consists of taxing

[13] The key insights reported in the remainder of this paper are valid under more general production technologies, such as the CES specification of Dotsey and King (2006).

[14] The subsidy will be set so as to neutralize the monopolistic competition inefficiency in the steady state. In fact, for the sake of making a correct welfare ranking between discretion and timeless perspective within our linear-quadratic framework, steady state efficiency is mandatory (Woodford, 2003). Otherwise, in the presence of no subsidy the steady state would be distorted, leading to a spurious welfare analysis.

households and providing subsidies to firms to eliminate distortions arising from monopolistic competition in the markets for both classes of consumption goods. This task is pursued via lump-sum taxes that maintain a balanced fiscal budget.

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