

Countercyclical fiscal policy in a low r^* world*

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Abstract

If the natural rate of interest is lower in the future, monetary policy may be more constrained and discretionary fiscal policy may come with larger multipliers. Does this imply that countercyclical fiscal policy should be more active, or that there should be a larger role for automatic stabilizers? This paper investigates if this is so by analyzing a business cycle model with heterogeneous agents and nominal rigidities, which frequently hits the zero lower bound. If markets are complete, then fiscal policy should be more active in a low r^* world only if its precision is large enough. If markets are incomplete, there may be a tradeoff between more active policy or more aggressive automatic stabilizers. We quantify these effects in a model calibrated to the U.S. economy.

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1 Introduction

The natural real interest rate (r^*) appears to have significantly fallen over the past decade or more (Rachel and Smith, 2017). Insofar as this makes the lower bound on nominal interest rates bind more frequently, and this constrains monetary policy from stabilizing the business cycle, then perhaps fiscal policy must become the main tool for countercyclical stabilization policy. This is the view of Williams (2016) who writes: “One solution to this problem is to design stronger, more predictable, systematic adjustments of fiscal policy that support the economy during recessions and recoveries” and then suggests both enhancing the automatic stabilizers, like unemployment insurance, and making fiscal policy more active through income tax rates that adjust to the state of the business cycle. Is this justified? Should fiscal policy be more activist when r^* is lower? Should the role of the automatic stabilizers in the business cycle become stronger in the future?

At first, it may appear that the finding that the government purchases multiplier is larger at the lower bound, both in theory (Farhi and Werning, 2017) and in the data (Nakamura and Steinsson, 2014), would answer these questions affirmatively. Yet, jumping from the size of multipliers to unexpected shocks to infer the effectiveness of systematic countercyclical policy is a logical mistake well understood by macroeconomists. For instance, in the celebrated Lucas (1972) islands’ model, the smaller the variance of monetary shocks, the smaller their role in the business cycle, yet the larger their impact on output. Moreover, active fiscal policy and strong automatic stabilizers are distinct concepts that have quite different business-cycle effects (McKay and Reis, 2016b). This paper uses a business-cycle model with which to evaluate systematic fiscal policy, of both types, and uses it to answer the question.

We make three contributions to the literature. First, we write a simple model with incomplete markets and aggregate shocks where both active fiscal policy and the automatic stabilizers are present. We adapt strategies for second-order approximations of welfare to these class of models to derive analytical results on optimal policy. Second, we study the three-way interaction between monetary policy, active fiscal rules, and automatic stabilizers, showing when they are complements and substitutes, and especially how this relationship changes when r^* is low. Third, we numerically solve for the ergodic distribution of output in a model where the zero lower bound sometimes binds, and optimize over the choice of fiscal instruments.

Our first, baseline, result is that if monetary policy is unconstrained then fiscal policy should not be activist. On the one hand, active monetary policy can take care of countercyclical stabilization by itself. On the other hand, having government purchases or tax rates

respond to the state of the business cycle introduces extra shocks in the economy due to political uncertainty or measurement errors. Combining the two, it is best to smooth out taxes and purchases over time. In turn, if monetary policy is unconstrained, the extent of the automatic stabilizers is independent of the variability of aggregate shocks. The stabilizers can be focussed on providing social insurance, while monetary policy takes the role of aggregate stabilization.

At the zero lower bound, instead, fiscal policy is activist, and the extent of activism depends positively on the amplitude of the business cycle and on its social costs. Moreover, we show that the optimal level of the automatic stabilizers is higher.

Our third result is quantitative [...still to come...]

Drawing from the literatures on the zero lower bound, fiscal policy rules, and automatic stabilizers, the questions analysed in this paper on the one hand have not been investigated before, while on the other hand they rely on insights from too many papers to mention. The closest are perhaps Bhandari et al. (2017b,a), who also study optimal fiscal policy in economies with incomplete markets, and combine numerical solutions with analytical approximations. However, they do not consider the zero lower bound, and they focus on Ramsey policy with commitment as opposed to policy rules. Correia et al. (2013) take a very different approach to the problem by allowing for an unrestricted set of fiscal instruments at the zero lower bound. Yet, they assume a representative agent thus ruling out the automatic stabilizers that play a central role in our study.

The paper is structured as follows. The next section introduces active fiscal policy and the automatic stabilizers to distinguish them and characterize their interaction. Section 3 then writes down the full business-cycle model in which we will evaluate these policies, and section 4 describes our approach to calculating optimal policies. Section 5 starts the analysis for the case where there is a representative agent. In this case, the stabilizers are redundant, allowing us to focus solely on activist fiscal policy. Section 6 then studies the case with heterogeneity, using throughout analytical approximations to discuss different drivers of the results. Section 7 then solves the model numerically calibrated to explain the U.S. business cycle before 2008. As a validation exercise, we show that the model can match some features of the data while the United States was at the zero lower bound. We then show how varying r^* changes the desired extent of activist fiscal policy and automatic stabilizers.

2 Active fiscal policy and automatic stabilizers

A fiscal authority with a rich enough set of instruments, full information, ability to commit, and absolute freedom to reset them every instant of time could, in principle, perfectly stabilize the economy from inefficient aggregate fluctuations. Instead, we incorporate limits to state-contingent fiscal policy through simple rules that are meant to capture the limitations of the fiscal authority that arise out of political or information frictions.

In particular, let G_t denote government purchases, Y_t aggregate income, $Y_{i,t}$ the after-tax income of household i , and $Z_{i,t}$ its pre-tax income, all in real terms. Also, define Y_t^n to be the natural flexible-price level of output. Then the fiscal system is characterized by a system of three rules:

$$\frac{G_t}{Y_t} = \mathcal{G} \left(\frac{Y_t}{Y_t^n} \varepsilon_t \right)^{-\tau_y} \quad (1)$$

$$Y_{i,t} = \Lambda_t Z_{i,t}^{1-\tau_z} \quad (2)$$

$$\Lambda_t = (1 - \tau_b) \Lambda_t^T + \tau_b \Lambda_t^P \quad (3)$$

Starting from a benchmark where $\tau_y = \tau_z = \tau_b = 0$, then the first equation states that purchases over GDP are equal to a constant $\mathcal{G}$. Spending is passive in the sense of not responding to the state of the business cycle. The second equation states that, relative to the balanced-growth path, all households pay a flat tax rate $1 - \Lambda_t$. There are no automatic stabilizers. Finally, the third equation states that the tax rate is equal to Λ_t^T , which is the tax rate such that the level of government debt relative to the balanced growth trend, B_t is constant: $B_{t+1} = \bar{B}$. Taxation is passive in the sense of balancing public finances every period.

Active fiscal policy corresponds to $\tau_y > 0$. In this case, whenever there is an output gap, then government purchases respond. At the same time, activism comes with errors ε_t . From one perspective, these can be interpreted as information shocks, since the measurement of the actual output gap is difficult in real time. From another perspective, these are the discretionary shocks to policy that inevitably arise due to changes in policymakers and policy orientations in the democratic process. Either way, active policy must contend with these errors which we take to have a mean 1 and a positive variance. The study of τ_y is the study of how fiscal spending systematically responds to the state of the economy.

The *automatic stabilizers* refer instead to $\tau_z > 0$. The higher is τ_z the more redistributive is the policy, up to the extreme where $\tau_z = 1$ and everyone gets the same after-tax income

regardless of their pre-tax income. The stabilizers capture the redistributive policies, like unemployment insurance or progressive income taxes, which while primarily designed to provide social insurance have side-effects on the macroeconomy. The social programs this captures are automatic in the sense that they do not adjust to the state of the business cycles but to individual circumstances. While τ_y captures a rule in a rational-expectations sense of systematic policy, τ_z are typically legal rules that are hard to change.

Finally, fiscal *deficit* policies (or their opposite austerity policies) refer to $\tau_b > 0$. We denote by λ_t^P the level of taxes such that innovations to the public debt become permanent $\mathbb{E}_t(B_{t+1}) = B_t$. The higher is $\tau_b > 0$ the higher are deficits during the business cycle, and the slower they are reversed towards stabilizing the public debt and ruling out Ponzi schemes. In a purely Keynesian model of aggregate demand, and in many popular discussions, this is what is often meant by countercyclical fiscal policy, even though in modern macroeconomic models the emphasis in representative agent economies is rather on active fiscal policy, and the emphasis in heterogeneous-agent models is on the automatic stabilizers.

The question that this paper is devoted to is the optimal choice of the triplet (τ_y, τ_z, τ_b) , and especially whether all or some of the three are higher when r^* is lower. To do so requires a model where agents respond to the use of resources by the government and to the marginal tax rates they face, where there is heterogeneity and a desire for social insurance, and where deficits affect economic activity via aggregate demand. We present such a model next.

3 The model

There is a balanced growth path in our economy, such that all relevant variables grow at the rate of productivity growth γ . All variables are expressed relative to that balanced growth path. There are three types of agents in the economy: households, firms and the government. We present the problem that each solves in turn.

3.1 Households

Households are indexed by i in the unit interval. They have preferences given by:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta_i^t Q_t \left[\log(C_{i,t}) - \frac{H_{i,t}^{1+\psi}}{1+\psi} + \chi \log(G_t) \right], \quad (4)$$

so they enjoy more consumption $C_{i,t}$, less work $H_{i,t}$, and more publicly-provided goods G_t . There is a common preference shock, Q_t such that $Q_t = Q_{t-1}q_{t-1}$ with $Q_0 = 1$ and q_t following a stationary exogenous stochastic process. Shocks to this rate of time preference will drive shocks to the natural rate of interest.

There are two types of household according to their time-preference type: a mass Ω of impatient households have β^I , while a mass $1 - \Omega$ of patient households have $\beta^P > \beta^I$. This division in types allows the model to capture the highly skewed wealth distribution in the data. Moreover, because patient households accumulate a great deal of wealth with which to insure against idiosyncratic shocks, they approximately behave as if there was a representative agent. For simplicity, we assume that this approximation is exact, so there is a representative patient household that receives the income of the patient group, and has a common productivity normalized to one. By taking the limit as Ω goes to zero, we can consider a complete-markets economy that ignores household heterogeneity as a special case.

Impatient households face uninsurable idiosyncratic risk. Households sell their labor to Walrasian labor market for a real wage W_t per effective unit of labor. Their productivity is given by $\exp\{m_{i,t} + n_{i,t}\}$, where the two components stand for two sources of exogenous income risk. They evolve according to:

$$m_{i,t+1} = \rho_m m_{i,t} + \eta_{m,i,t+1} \quad (5)$$

$$n_{i,t+1} = \rho_n n_{i,t} + \eta_{n,i,t+1} \quad (6)$$

For $x \in \{m, n\}$ the innovations $\eta_{x,i,t+1}$ are drawn from a distribution that depends on the level of economic activity at date t :

$$\eta_{x,i,t+1} \sim F_x(\eta_{x,i,t+1}; Y_t, \mathcal{E}_t), \quad (7)$$

where $\mathcal{E}_t$ is a vector of aggregate shocks. This specification allows idiosyncratic risk to fluctuate exogenously, due to the $\mathcal{E}_t$ shocks, and endogenously, due to movements in Y_t . m and n play similar roles qualitatively but have separate roles quantitatively. We think of m as a slow-moving measure of skill and the variation in $F_m(\eta_{m,i,t+1}; Y_t, \mathcal{E}_t)$ over the cycle reflects the long-lasting distributional consequences of aggregate fluctuations of the type documented by Davis and von Wachter (2011) and Guvenen et al. (2014). Storesletten et al. (2001), Krebs (2007), Krebs (2003), and De Santis (2007) show this type of counter-cyclical idiosyncratic risk has important implications for the welfare cost of the business cycle. We think of n as being a more transitory, but possibly large, income shock that

becomes more likely or more severe in a recession reflecting the type of income dynamics that arise out of time-varying unemployment risk. McKay and Reis (2016a), Ravn and Sterk (2017), and Den Haan et al. (2015) show that cyclical fluctuations in unemployment risk and the precautionary savings response can have important implications for the volatility of the business cycle in the presence of nominal rigidities.

Aside from labor income, households receive dividends paid by firms in the total amount D_t . As emphasized by Broer et al. (2016), the division of labor and profit income can have important consequences for dynamics in a heterogeneous-agent New Keynesian model. We assume that a share ω of the dividends of is allocated to the impatient households in proportion to their labor productivity. The remaining share $1 - \omega$ is allocated to the patient households. All combined, the pre-tax income of an impatient household then is:

$$Z_{i,t} = (W_t H_{i,t} + \omega D) e^{m_{i,t} + n_{i,t}} \quad (8)$$

Households can trade a risk-free real bond with gross interest rate R_{t+1} between periods t and $t + 1$. There is a borrowing limit $B' \geq \underline{B}$. Impatient households have no markets for insuring their idiosyncratic income shocks. Their budget constraint then is:

$$C_{i,t} + \gamma B_{i,t+1} = R_t B_{i,t} + Y_{i,t} \quad (9)$$

All combined, the impatient households solve

$$\begin{aligned} V^I(B, m, n; \mathcal{S}) &= \max_{C, B', H} \left\{ \log C - \frac{H^{1+\psi}}{1+\psi} + \beta^I q \mathbb{E} [V^I(B', m', n'; \mathcal{S}')] \right\} \\ \text{such that} \quad C + \gamma B' &= R B + \Lambda_t [(W_t H + \omega D) e^{m+n}]^{1-\tau_z} \\ B' &\geq \underline{B}, \end{aligned}$$

where $\mathcal{S}$ captures the relevant set of state variables describing equilibrium.

For completeness, the patient household solves:

$$\begin{aligned} V^P(b; \mathcal{S}) &= \max_{C, B', H} \left\{ \log C - \frac{H^{1+\psi}}{1+\psi} + \beta^P q \mathbb{E} [V^P(B'; \mathcal{S}')] \right\} \\ \text{such that} \quad C + \gamma B' &= R B + \Lambda_t (W H + (1 - \omega) D)^{1-\tau_z} \\ B' &\geq \underline{B}. \end{aligned}$$

3.2 Firms

Households consume a final good produced by a representative competitive firm by assembling a Dixit-Stiglitz aggregate of intermediate inputs indexed by j :

$$Y_t = \left(\int_0^1 Y_{j,t}^{1/\mu} dj \right)^\mu \quad (10)$$

leading to price index:

$$P_t = \left(\int_0^1 P_{j,t}^{1/(1-\mu)} dj \right)^{1-\mu}. \quad (11)$$

As usual the demand for variety j is:

$$Y_{j,t} = \left(\frac{P_{j,t}}{P_t} \right)^{\mu/(1-\mu)} Y_t. \quad (12)$$

Intermediate goods are produced by monopolistic firms from labor alone with $Y_{j,t}\gamma^t = A_t\gamma^t L_{j,t}$ where $L_{j,t}$ is production employment of effective units of labor, and A_t is an exogenous, stationary productivity process.

Turning to nominal rigidities, for the analytical analysis we assume that a fraction of firms does not observe the aggregate shock in the current period. That is, a fraction θ of firms set their price to the true-profit maximizing price while the remaining firms set their price to maximize profits based on lagged information. This canonical sticky-information model is useful for tractability. For quantitative analysis, we use a standard Calvo-pricing friction in which each firm has a probability θ of updating its price.

Finally, for some of our analytical results it is convenient to consider an economy without monopoly distortions. To facilitate this, we introduce a subsidy for intermediate goods producers in amount $1 + \tau_I$. We do not treat this as a parameter of interest and we set it to zero in the quantitative analysis. We assume that this subsidy is financed with a proportionate tax on dividend income. Therefore, the total dividends D_t are net of taxes to finance the sales subsidy, which is equal to the total dividends before the subsidy, as the taxes and subsidy offset: $D_t = Y_t - W_t H_t$

All combined, the firm profit-maximization problem in the sticky-information model is

$$\begin{aligned} \max_{P_{j,t}, Y_{j,t}, L_{j,t}} \quad & \tilde{\mathbb{E}}_j \left[(1 + \tau_I) \frac{P_{j,t} Y_{j,t}}{P_t} - W_t L_{j,t} \right] \\ \text{s.t.} \quad & Y_{j,t} = \left(\frac{P_{j,t}}{P_t} \right)^{\mu/(1-\mu)} Y_t \\ & Y_{j,t} = A_t L_{j,t}, \end{aligned}$$

where $\tilde{\mathbb{E}}_j$ is the expectation of firm j given its information. The first-order condition is:

$$\tilde{\mathbb{E}}_j \left[(1 + \tau_I) \left(\frac{P_{j,t}}{P_t} \right)^{\mu/(1-\mu)} \frac{Y_t}{P_t} \right] = \tilde{\mathbb{E}}_j \left[\mu \frac{W_t}{A_t} \left(\frac{P_{j,t}}{P_t} \right)^{\mu/(1-\mu)-1} \frac{Y_t}{P_t} \right]. \quad (13)$$

3.3 Interest rates and the public debt

When developing intuition, we consider two extreme views of monetary policy. In the first, policy is unconstrained and is able to replicate the flexible-price equilibrium. The details of how it achieves this are unimportant, so we leave them unspecified. In the second view, policy is constrained so the nominal interest rate is completely rigid, perhaps due to a binding lower bound. For the quantitative analysis, we assume a standard Taylor rule of the form:

$$i_t = \max \left\{ r^* + \phi_\pi \pi_t + \phi_y \left(\frac{Y_t}{Y_t^n} \varepsilon_t \right), 0 \right\}.$$

Note that we assume that the same shocks that appeared in the activist fiscal rule also appears when monetary policy actively follows a Taylor rule. Again, political disturbances or difficulties in measuring output gaps, are behind it. By assuming they are perfectly correlated between monetary and fiscal policy, we make sure that we are not privileging one relative to the other by assumption.

Government debt, B_t , evolves in accordance with the government budget constraint

$$G_t + R_t B_t = \gamma B_{t+1} + \int (Z_{i,t} - \Lambda_t Z_{i,t}^{1-\tau_z}) di, \quad (14)$$

so there are only one-period government bonds, which, by the absence of arbitrage, pay the same interest rate as private riskless bonds. As long as $\tau_b < 1$, debt is trend-stationary.

3.4 Equilibrium

What follows is a sequential equilibrium definition. It consists of:

- Consumption functions and labor supply policy rules, $C^I(B, m, n; S_t)$ and $H^I(B, m, n; S_t)$, for the impatient households that solve their decision problem.
- A distribution of wealth for the impatient households, $\Gamma_t(B, m, n)$, that evolves according to their budget constraints, policy rules, and idiosyncratic shock processes.
- Aggregate impatient household variables:

$$\begin{aligned} C_t^I &\equiv \int C^I(B, m, n; S_t) d\Gamma_t(B, m, n) \\ H_t^I &\equiv \int \exp\{m + n\} H^I(B, m, n; S_t) d\Gamma_t(B, m, n) \\ B_t^I &\equiv \int B d\Gamma_t(B, m, n). \end{aligned}$$

- In addition there are 14 variables in 14 equations. The variables are: $C_t^P, H_t^P, H_t, B_t^P, q_t, Y_t, S_t, G_t, B_t, R_t, W_t, D_t, A_t, \pi_t$. The equations are: (i) the Euler equation for patient households; (ii) the intra-temporal labor supply rule for patient households; (iii) the budget constraint for patient households; (iv) aggregate effective labor supply $H_t = \Omega H_t^I + (1 - \Omega) H_t^P$; (v) the aggregate production function: $S_t Y_t = A_t H_t$, where S_t reflects price dispersion; (vi) the evolution of price dispersion as a function of nominal rigidities, noting that S_t is a state variable in the Calvo model; (vii) the definition of dividends; (viii) the active fiscal policy rule; (ix) the government budget constraint; (x) the aggregate resource constraint (or the bond-market clearing condition by Walras' law); (xi) the determination of real interest rates via the Fisher equation and monetary policy; (xii) the price-setting first-order condition and price index determining inflation; (xiii) the exogenous process for q_t ; (xiv) the exogenous process for A_t .

4 Analytical methods

In representative-agent economies, it is customary to use log-linear approximations in order to evaluate optimal policy. As developed by Benigno and Woodford (2004), these methods typically rely on approximating the dynamics of economy by log-linear fluctuations around a steady state, and on approximating the normative goals by a second-order approximation of

the social welfare function around a social optimum. These methods for evaluating optimal policy have been extended to deal with cases where the steady state is inefficient (Benigno and Woodford, 2005), but not to consider cases where the inefficiency comes from incomplete markets and the policy instruments (in our case, the fiscal policy parameters) affect the inefficiency of the steady state. In this section, we explain our simple approach to deal with these cases, as this will allow us to analytically study the factors affecting the determination of fiscal policy before moving on to our quantitative study. To develop the intuition, we cover here only the case of a single endogenous variable and a single shock, relegating to Appendix ?? the generalization to vectors of endogenous variables and shocks.

Let the endogenous variable of the economy be X_t and the shock E_t , and x_t, e_t their log value. Then, hatted variables denote the log-deviations from the steady state $\bar{X}$, which in turn depends on the vector of policy parameters τ we want to optimize over. When there are no endogenous state variables, the log-linearized dynamics of the economy are given by

$$\hat{x}_t = \mathbb{V}(\tau) \hat{e}_t \quad (15)$$

where the scalar $\mathbb{V}(\tau)$ summarizes all the equilibrium relations in the reduced-form of the structural economy. Also, recall that $\mathbb{E}_0 \hat{e}_t = 0$ and $\mathbb{E}_0 \hat{e}_t^2 = \sigma^2$.

The social welfare function is:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \mathcal{W}(e^{x_t}; \tau). \quad (16)$$

We want to approximate this function around the steady state point $\bar{X}$. Let $\mathcal{W}(\tau) \equiv \mathcal{W}(\bar{X}(\tau), \tau)$, and $\mathcal{W}_X(\tau) \equiv \frac{\partial \mathcal{W}}{\partial X} |_{\bar{X}(\tau)}$, and $\mathcal{W}_{XX}(\tau) \equiv \frac{\partial^2 \mathcal{W}}{\partial X^2} |_{\bar{X}(\tau)}$. Then, taking a second order expansion of $\mathcal{W}(\cdot)$ with respect to x_t gives:

$$\mathcal{W}(X_t, \tau) \approx \mathcal{W}(\tau) + \mathcal{W}_X(\tau) \bar{X}(\tau) \hat{x}_t + \frac{1}{2} (\mathcal{W}_{XX}(\tau) \bar{X}(\tau)^2 + \mathcal{W}_X(\tau) \bar{X}(\tau)) \hat{x}_t^2, \quad (17)$$

Substituting into this expression the linearized dynamics for $\hat{x}_t$ and taking expectations gives:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \mathcal{W}(e^{x_t}; \tau) \approx \sum_{t=0}^{\infty} \beta^t \left(\mathcal{W}(\tau) + \frac{1}{2} \tilde{\mathcal{W}}_{XX}(\tau) V(\tau)^2 \sigma \right). \quad (18)$$

Maximizing this expression with respect to τ gives the optimal policy regime.

Beyond the fact that we can use algebra to evaluate $\mathcal{W}(\tau)$, $\tilde{\mathcal{W}}_{XX}(\tau)$, and $\mathbb{V}(\tau)$, this

expression provides a clear statement of the policy tradeoffs involved. For concreteness, consider the automatic stabilizers element of τ , the progressivity of the tax system, and refer to X_t as the level of output. A more progressive tax system on the one hand, distorts the steady state $d\bar{X}/d\tau < 0$. On the other hand, by providing social insurance, it pools income risk, which raises welfare in the steady state: $\partial \mathcal{W}/\partial \tau > 0$. Thus, $\mathcal{W}(\tau)$ may rise or fall, as in the standard literature on social insurance programs since there is a tradeoff between insurance and incentives. Business cycles arise through the second term, as this multiplies σ . If the progressive tax system acts as an automatic stabilizer by reducing the amplitude of the business cycle, then $d\mathbb{V}/d\tau < 0$. At the same time, the welfare cost of a given level of fluctuations may be smaller if progressivity reduces the after-tax income risk in the population, which would be captured by $d\tilde{\mathcal{W}}_{XX}/d\tau > 0$.¹

These two considerations—or insurance-incentives in the steady state versus automatic stabilization of business cycles—will guide much of the discussion in the rest of the paper.

5 Active fiscal policy with a representative agent

We begin with a representative agent, which is a special case of our model with $\Omega = \omega = 0$. Under these circumstances, the automatic stabilizers are redundant, so we simply set $\tau_z = 0$. To further focus on active fiscal policy τ_y , we abstract from deficits by setting $\tau_b = 0$ so that the government always runs a balanced budget by having taxes adjust to the changes in purchases. We fix average purchases at the optimal steady state level: $\mathcal{G} = \chi/(1 + \chi)$.

5.1 Unconstrained monetary policy

In this economy, there are two non-policy shocks, to productivity and preferences, and distortions from the first best are caused by nominal rigidities and taxation. It is a well known result that the divine coincidence holds, so that optimal monetary policy should replicate the flexible price equilibrium and this both eliminates the welfare costs of inflation and closes any output gap at all times. If monetary policy is unconstrained, then it will do this, which means that active fiscal policy will only be left to introduce variability through the shocks ε_t . Monetary policy offsets the effects of these on the output gap as well, but there is a second-order welfare loss due to fiscal shocks that arises because of the associated

¹With multiple shocks, an additional policy tradeoff that appears in the vector-valued policy problem is that changes in τ may make the economy less exposed to some shocks while making the economy more exposed to others.

variability in government purchases around the optimum amount g . Eliminating these losses requires setting passive fiscal policy. The appendix elaborates this argument mathematically to show:

Proposition 1. *Under unconstrained monetary policy, $\tau_y = 0$.*

The power in this simple result is that it clearly shows the importance of taking monetary policy into account, and consequently of r^* , when designing fiscal policy for stabilization purposes. If monetary policy is unconstrained, and the economy is near to being efficient, then activist fiscal policy is solely a source of disturbance and inefficiency. This result and this intuition lies at the heart of Milton Friedman (1948)'s influential dismissal of activist fiscal policy that dominated the consensus for many decades.

5.2 Constrained monetary policy

Consider now the case where monetary policy is constrained. In particular, following Eggertsson and Woodford (2003), we assume that there is an aggregate shocks at date 0 that maintains constant values and keeps the economy with nominal interest rates constant, and which then disappears as a result of a Poisson event with rate $1 - \lambda$ every period. When the Poisson event hits, the economy jumps to the flexible-price unconstrained monetary policy steady state.

The analysis requires a parameter restriction, so that the Phillips curve is at the same time downward-sloping, while at the same time there is an equilibrium when fiscal policy is passive. Letting $\kappa \equiv \frac{\theta(1+\psi)}{(1-\theta)(1-\lambda)}$, then we require that $\kappa\lambda(1 - \lambda)^{-1} \in (0, 1)$. With this restriction, we obtain the result:

Proposition 2. *The optimal degree of fiscal policy activism is:*

$$\tau_y = -\chi^{-1} \left(\Xi - \frac{\Xi^2 + \Psi\tau_0}{\Xi} \left\{ 1 + \frac{\sigma_\varepsilon\tau_0\Psi}{\sigma_\varepsilon\Xi^2 + \sigma_a + \frac{\sigma_q}{(1-\lambda)^2}} \right\}^{-1} \right). \quad (19)$$

where $\Xi \equiv 1 - \frac{\kappa\lambda}{1-\lambda} > 0$ and $\Psi \equiv 1 + \psi + \frac{\kappa^2\mu(\lambda-1)^2(1-\theta)}{\theta(\mu-1)} > 0$.

When there are only fiscal shocks ($\sigma_a = \sigma_q = 0$, and $\sigma_\varepsilon > 0$), then the optimal $\tau_y = 0$, recovering the intuition from the previous proposition. Since there are only fiscal shocks in this case, then passive fiscal policy is better because it shuts these off and prevents the deviations from the optimal provision of publicly-provided goods.

If there are non-policy shocks, then the proposition shows that $\tau_y > 0$. Activist fiscal policy is countercyclical: in a recession, when the output gap is negative, then government purchases are increased relative to their steady-state level. When all shocks are present: $d\tau_y/d\sigma_A > 0$, $d\tau_y/d\sigma_q > 0$, and $d\tau_y/d\sigma_\varepsilon < 0$. Larger fluctuations in the business cycle call for more activist fiscal policy, while the more these fluctuations have their source in fiscal policy itself, the less activist it should be.

Taking the opposite polar case, if there are no fiscal shocks ($\sigma_\varepsilon = 0$) but some non-policy shocks (either $\sigma_a > 0$ or $\sigma_q > 0$), then the expression for the optimal amount of activism becomes simpler: $\tau_y = \Psi/(\Xi(1 + \chi))$. This shows clearly that the two composite parameter, Ξ and Ψ , defined in the proposition, are the crucial determinants of the optimal activism of fiscal policy.

The first of these, Ξ , is inversely related to the amplitude of the business cycle. This is particularly clear if $\tau_y = 0$: then, the variance of the output gap is $\Xi^{-2}(\sigma_a + \sigma_q/(1 - \lambda)^2)$. Therefore, the higher is Ξ^{-1} , the stronger the desire for very active fiscal policy, as the expression shows.

Second, Ψ captures the curvature of the social welfare function. In the case where $\tau_y = 0$ the social welfare function is precisely equal to Ψ times the variance of the output gap. Intuitively, the more costly is the business cycle, the more activist should fiscal policy be.

Structural parameters then affect the desirability of active fiscal policy through their effect on these two components: the amplitude of the business cycle and its cost. In particular, it follows from the proposition that:

Lemma 1. *The optimal degree of activism depends on the structural parameters according to: $d\tau_y/d\theta > 0$, $d\tau_y/d\psi > 0$, $d\tau_y/d\mu < 0$.*

Lowering the elasticity of labor supply (raising ψ) increases the slope of the Phillips curve. This raises Ξ^{-1} , as expected inflation falls more quickly in a recession, which amplifies the business cycle. At the same time, a less elastic labor supply makes economic fluctuations more painful to agents because the disutility of labor rises sharply in a boom. That is, a higher ψ , lowers Ψ . Both of these considerations therefore call for a more activist fiscal policy.

Making prices more flexible (raising θ) also increases the slope of the Phillips curve, but it decreases the efficiency cost of a given gap between the price level and the expected price level because fewer firms are stuck at the expected price level. The first consideration dominates and a larger θ calls for more active fiscal policy.

Finally, a larger elasticity of substitution between varieties (lower μ) makes price dispersion more costly because consumers substitute more aggressively towards goods with low relative prices, which raises Ψ , and thus calls for more active fiscal policy.

6 Fiscal policy with incomplete markets

A different special case of the model provides complementary analytical insights. We continue to assume $\tau_b = 0$ and $\bar{B} = 0$, so deficits and public debt continue to play no role, but now the automatic stabilizers are active since we assume that $\Omega = 0$ so there are only impatient households.

We simplify the risk they face by assuming that $m_{i,t} = 0$ and $n_{i,t} \in \{\underline{m}, 0\}$. That is, there is only one source of risk now since $m_{i,t}$ is constant, and the risk in $n_{i,t}$ takes one of two values. We refer to this risk as “unemployment” with $\underline{m} < 0$, which is i.i.d. across households, with an incidence that varies with the business cycle since:

$$u(Y_t/Y_t^n) = \frac{1 - (1 - \bar{u}(1 - e^{\underline{m}}))(Y_t/Y_t^n)^\xi}{1 - e^{\underline{m}}}, \quad (20)$$

where $\bar{u}$ is the steady state unemployment rate and ξ is the sensitivity of the unemployment rate to the output gap. The assumption that the unemployment rate depends on the output gap is consistent with equation (7) because the natural rate of output is proportional to the exogenous productivity shock (see appendix). Notice that the total effective productivity of the workers falls as the unemployment rate rises because more workers receive the low productivity endowment. The specific functional form for the Okun’s law relationship implies that the average productivity of workers is log-linear in the output gap

$$M_t \equiv u(Y_t/Y_t^n)e^{\underline{m}} + 1 - u(Y_t/Y_t^n) = \bar{M}(Y_t/Y_t^n)^\xi,$$

where $\bar{M} = (1 - \bar{u}(1 - e^{\underline{m}}))$.

We further assume that $\underline{B} = 0$. This has an important implication in the presence of uninsurable idiosyncratic risk as established by Krusell et al. (2011) and expanded by Ravn and Sterk (2017) and McKay and Reis (2016a). When assets are in zero-gross-supply the incomplete markets economy features a no-trade equilibrium with a degenerate distribution of wealth. This equilibrium still features consumption dispersion as a result of the heterogeneity in income and it still captures precautionary savings motives.

6.1 Unconstrained monetary policy

In this economy, a larger τ_z has three important effects: (i) it reduces the consumption gap between employed and unemployed resulting in better risk sharing through social insurance, (ii) it raises the marginal tax rate resulting in larger distortions to labor supply, and (iii) it makes consumption decisions less sensitive to fluctuations in the expected unemployment rate because marginal utility is less sensitive to employment status. In the absence of business cycles, the optimal τ_z balances (i) and (ii). In the presence of business cycles, the automatic stabilizer nature of social insurance comes into play.

The first result of this section is that when monetary policy is unconstrained there is no reason to change fiscal policy.

Proposition 3. *Under unconstrained monetary policy, $\tau_Y = 0$ and τ_z is independent of the scale of aggregate shocks.*

The intuition for the benchmark is the same as in the previous section. When monetary policy can take care of stabilization, there is nothing for fiscal policy to do.

6.2 Constrained monetary policy

As before, we assume the economy is hit by an unexpected shock that persists with probability λ ; after the shock dissipates the economy returns to steady state. Monetary policy is constrained and does not react to the shock, leaving room for fiscal policy, and now the stabilizers, to play a role in stabilizing the business cycle.

Starting with the case where we impose that there is no active fiscal policy, $\tau_y = 0$, so as to focus on the automatic stabilizers, the appendix proves the following result:

Proposition 4. *Under constrained monetary policy and passive fiscal policy $\tau_y = 0$, the optimal policy satisfies:*

1. *More volatile shocks increase the extent of the automatic stabilizers: $\frac{d\tau_z}{d\sigma_q} > 0$ and $\frac{d\tau_z}{d\sigma_A} > 0$.*
2. *The optimal extent of the automatic stabilizers varies with structural parameters with the same signs as activist fiscal policy: $\frac{d\tau_z}{d\theta} > 0$, $\frac{d\tau_z}{d\psi} > 0$, and $\frac{d\tau_z}{d\mu} < 0$.*

The first point of the proposition follows the same logic as that of the previous section. Confirming the intuition by policymakers in the introduction, when monetary policy is no

longer available, then fiscal policy substitutes in for countercyclical stabilization. In the previous section, this came through more active fiscal policy, while in this section it comes through more aggressive automatic stabilizers.

The second point in the proposition follows the logic of section 4, as already used in section 5. When the amplitude of the business cycle is larger, and fluctuations are more costly, then fiscal policy reacts more. There is one important mechanism that comes through now, and was absent in the previous section. An increase in ψ makes labor supply less elastic. This reduces the steady state distortion from labor taxation and, especially, from progressive taxation. Thus, the distortions brought about by the automatic stabilizers in the incentives to work are smaller, thus enhancing the desirability of increasing progressivity.

To follow: the case where both types of fiscal policy are present and their complementarity/substitutability.

7 Quantitative analysis

8 Conclusion

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