Unconditionally Optimal Ramsey Policy*

Tatiana Damjanovic[†], Vladislav Damjanovic and Charles Nolan[‡]

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Abstract

We discuss a time invariant policy which delivers the unconditionally optimal outcomes in purely forward-looking models and Ramsey outcomes in purely backward-looking models. This policy is a product of interaction between two institutions with distinct responsibilities. Motivated by Brendon and Ellison (2015), we think of them as arms of government. One institution is responsible for 'forward guidance', setting rules which are necessary and sufficient to determine private expectations. The second institution implements optimal policy taking expectations as given. The forward guidance rules are designed to maximise the unconditional expectation of the social objectives.

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†Durham University
‡University of Glasgow

1 Introduction

Ramsey policy is time inconsistent in models with forward-looking behaviour (Kydland and Prescott, 1977). That is because the government can affect the economy via its current and future actions. Future policy influences current outcomes via an expectations channel, whilst current policy only affects the economy contemporaneously. Therefore the optimal policy at 'period zero' is different from future optimal policy. That property of optimal Ramsey rules is known as time inconsistency and typically implies that it will not be optimal for policymakers to make good on policy promises when the time arrives to deliver on those promises.

To deal with time inconsistency, two types of time invariant rules are often considered in the literature. The first analyses policies which maximise the unconditional expectation of the social objective (unconditionally optimal, or UO, policy) proposed by Taylor (1979).[1] The second analyses policies that are optimal from a Timeless Perspective (TP policy) introduced by Giannoni and Woodford (2002), which assumes commitment to Ramsey policy designed many periods ago. Commitment to these invariant rules is tantamount to assuming that institutions have been devised which deliver the outcomes associated with these rules although that assumption is rarely, if ever, made explicit. We discuss this issue in a little more detail below.

In many cases UO and TP policies perform very similarly. Indeed, Blake (2001) and Damjanovic, Damjanovic and Nolan (2009) proved that TP can be converted to UO policy if the government were accounting for all generations equally: that is if it sets the social discount rate equal to zero. Nevertheless, TP and UO policies have important theoretical and sometimes quantitative differences and neither obviously dominates the other.

On the one hand, TP policy can lead to non-stationary outcomes in models with forward-looking constraints (Blake and Kirsanova, 2004; Benigno and Woodford, 2012). In particularly, Schmitt-Grohe and Uribe (2004) demonstrate that TP policy results in non-stationary dynamics of government debt. Unlike the TP, the UO policy implies stationarity by design, since any non-stationarity would result in infinitely large expected value of the loss function[2]. Moreover, TP policy may put an unreasonably large weight on a relatively distant event in the past, which is not the case for UO policy (Jensen and McCallum, 2010).

[1] Since then, unconditional welfare optimisation has been widely used in the literature. Whiteman (1986), Rotemberg and Woodford (1997, 1998), Clarida, Gali and Gertler (1999), Erceg, Henderson and Levin (2000), Kollman (2002) and McCallum (2005) are some prominent examples.

[2] Horvath (2011) has shown that government debt dynamics are stationary when UO policy is implemented

On the other hand, TP policy has a number of attractive features in models with only backward looking constraints. Thus, it coincides with Ramsey optimal discretionary policy. That is not the case for UO policy which requires a commitment device even in purely backward looking models. And whilst it is true that the UO policy would dominate TP policy conditional on the fact that all generations had followed it in the past, since the current generation would have had a better start in terms of economic environment[3], even in this case, it is still optimal for the current generation to deviate towards TP. Therefore, there is a sense in which TP policy is more stable and could be preferable in models with backward-looking constraints.

As UO policy performs better in forward-looking models whilst TP/Ramsey policy is sometimes more desirable in backward-looking models, the question is which policy to use if an economy has both types of constraints. In this paper we discuss a time invariant policy which inherits properties of the TP policy in backward-looking and UO in forward-looking models. We will call this policy UO-Ramsey. Our paper shows an easy, intuitive and transparent way to design such a policy.

Following Brendon and Ellison (2015) we consider a little more explicitly the issue of institutional design. In particularly, policies are designed by two authorities with distinct and distinctive responsibilities–we think of these two authorities as arms of government. One arm of government ("*outer*" government in Brendon and Ellison), is responsible for forward guidance[4]. The outer government makes promises and determines private expectations about future policy outcomes. The second arm of government ("*inner*" government) implements policy taking promises and corresponding private expectations as given. In this framework, expectations are taken as exogenous and therefore cannot be changed by the inner government. As the inner government cannot use the expectations channel to affect the economy, the inner policy maker does not face any problem related to time consistency.

Our main contribution compared to Brendon and Ellison (2015) is that we propose an alternative way to design the problem of the forward-guiding outer government, which is responsible for expectations formation. In this paper we show that the outer government maximises the unconditional expectations of social objectives. Hence, although the policy outcome is the same as Brendon and Ellison (2015), our approach serves to illuminate the fundamental objectives of the outer government in

[3] According to Ramsey (1928), discounting future generations welfare is unethical. See also Pigou (1932), who thought that private discount rates are excessive. For a detailed discussion about the advantages of UO policies in backward-looking models Damjanovic, Damjanovic and Nolan (2015).

[4] In terms of monetary policy, forward guidance is defined as communication about the likely future course of monetary policy and the FOMC began using forward guidance in its post-meeting statements in the early 2000s. Since then forward guidance has attracted attention among academics and policymakers. See for example Svensson (2014).

an intuitive and transparent way.

After presenting the design of UO-Ramsey policy an interesting application. We design UO-Ramsey policy in a linear-quadratic model with a so-called hybrid Phillips curve. This case can easily be nested to either the purely forward-looking new Keynesian model or to the purely backward-looking model where Ramsey policy is time consistent. Our policy will deliver UO policy in the first case and Ramsey policy in the second.

Finally we evaluate the welfare gain. The policy delivers a negligible welfare gain in a time of low volatility. However, the welfare gain can be significant in a time of higher uncertainty, high private discounting, and when the government increases the weight of the output gap in the loss function.

The paper is structured as follows. Section 2 describes and explains the design of UO Ramsey policy. Section 3 applies the UO-Ramsey policy to a linear-quadratic model with hybrid Phillips curve. Section 4 concludes.

2 The model

Following Brendon and Ellison (2015) we introduce two arms of governments. The first makes promises about future policy outcomes which become part of the forward-looking constraints of the policy problem. This may reflect decisions by parliament or the executive branch of government determining, say, the legal framework for monetary policy (e.g., the inflation target) or of an independent committee responsible for forward policy guidance. Brendon and Ellison (2015) name that government "outer" or "promise - making" government. The second arm of government maximises social welfare choosing among the policy rules which are consistent with expectations about promises. This is the "inner" government and it takes both promises and expectations as given. Note, that without an assumption of forward-looking behaviour, there will be no scope for outer government as nothing will depend on expectations. On the other hand, if all constraints were forward looking, "inner" government would have no choices to make; it will be completely constrained by the promises made by "outer" government. The inner government takes promises as exogenous constraints which have to be respected. Within that framework, inner government has no power to alter expectations, and from its perspective, the environment is purely backward-looking and there is no problem with time inconsistency. Therefore, the inner government acts as a fully effective Ramsey policymaker whose actions are credible and time consistent.

The actions of the outer government are easy to describe: it makes promises which maximise the unconditional expectation of the social welfare function.

2.1 Formal set up

Consider a model where social welfare is the discounted stream of utilities,

$$W = E_0 \sum_{t=0}^{\infty} \gamma^t u(x_t).$$

There are certain dynamic constraints described as

$$x_t = F\left(x_{t-1}, x_t, E_t x_{t+1}, \mu_t\right), \tag{1}$$

where x_t is a vector of endogenous variables, including policy tools, and μ_t is an exogenous shock, γ is the policymaker's time discount factor. Following Brendon and Ellison (2015) we decompose constraint (1) into its forward-looking and backward-looking parts. The expectations part will be managed by the outer, promise-making, government. The promise-making government sets state-dependent promises about all variables which are included in the expectations part of (1). That promise is in the form $E_t x_{t+1} = \omega_{t+1}$. In other words, we will replace constraint (1) with

$$x_t = F\left(x_{t-1}, x_t, E_t \omega_{t+1}, \mu_t\right), \tag{2}$$

$$x_t = \omega_t. \tag{3}$$

The inner government will be responsible for setting x_t but will take promises ω_t as given. The inner government will not be able to affect the economy through the expectations channel and will treat expectations as exogenous. Therefore their optimisation problem has no forward looking part and their fully optimal Ramsey policy will be time-consistent. Up to that step, we follow Brendon and Ellison (2015). Formally, the Lagrangian for the inner government is

$$V(\omega) = \max_{x_t} E_0 \sum_{t=0}^{\infty} \gamma^t \left\{ u(x_t) + \lambda_t \left[-x_t + F\left(x_{t-1}, x_t, E_t \omega_{t+1}, \mu_t\right)\right] + \rho_t \left(x_{t+1} - \omega_{t+1}\right)\right\}. \tag{4}$$

And the first order condition is

$$\frac{\partial V}{x_t} = u'(x_t) + \lambda_t \left[-1 + \frac{\partial}{x_t} F\left(x_{t-1}, x_t, E_t \omega_{t+1}, \mu_t\right)\right] + \gamma E_t \lambda_{t+1} \frac{\partial}{x_t} F\left(x_t, x_{t+1}, E_{t+1}\omega_{t+2}, \mu_t\right) + \frac{1}{\gamma}\rho_{t-1} = 0. \tag{5}$$

Our contribution is to suggest that the promise-making government should set promises ω_t in such a way that they will maximise the unconditional expectation of the social value function. So the problem of the outer government is

$$\max_{\omega} J = E_u V(\omega), \tag{6}$$

where E_u denotes the unconditional expectation. Plugging in the value function of the outer government, we get

$$J = \max_{\omega} E_u \left(\sum_{t=0}^{\infty} \gamma^t \left\{ u(x_t) + \lambda_t \left[-x_t + F\left(x_{t-1}, x_t, E_t\omega_{t+1}, \mu_t\right) \right] + \rho_t \left(x_{t+1} - \omega_{t+1} \right) \right\} \right).$$

Applying the UO maximisation algorithm in Damjanovic, Damjanovic and Nolan (2008) we obtain the first order condition for the promise-making government

$$\frac{\partial J}{\partial \omega_t} = \lambda_{t-1} \frac{\partial}{\omega_t} F\left(x_{t-2}, x_{t-1}, \omega_t, \mu_{t-1}\right) - \rho_{t-1} = 0. \tag{7}$$

The policy we propose solves problem (6), subject to constraints (2, 3). The solution satisfies the first order conditions (5), and (7). In purely backward looking models it coincides with Ramsey-optimal policy. In purely forward-looking models it coincides with UO policy. The next section shows that result in a transparent way using a model that has been popular in applied monetary policy analysis.

3 Hybrid Phillips Curve

In this section we show how to derive the UO Ramsey policy in a model with a hybrid Phillips curve. The government has a conventional loss function which consists of output and inflation gap terms

$$\min_{\pi_t, y_t} L = \sum \gamma^t \left(\pi_t^2 + \alpha y_t^2 \right). \tag{8}$$

The behaviour of the private sector is described by a hybrid Phillips curve:

$$\pi_t = \kappa y_t + (1-\phi)\beta E_t \pi_{t+1} + \phi \pi_{t-1} + \mu_t, \tag{9}$$

where β is the discount factor of the private sector and μ_t is an exogenous cost-push shock.

Let s_t denote the state of the economy which consists of the history of exogenous shocks. To design an UO Ramsey policy the outer government creates a menu of state-dependent promises about future inflation

$$\pi(s_t) = \omega(s_t). \tag{10}$$

This condition implies that $E_0 \pi_t = E_0 \omega_t$. Then, the Hybrid Phillips curve is transformed into

$$\pi_t = \kappa y_t + (1-\phi)\beta E_t \omega_{t+1} + \phi \pi_{t-1} + \mu_t, \tag{11}$$

where promise ω_t is given by the outer government and taken as an exogenous variable by the inner government. The inner government minimises loss (8) taking promises as given. The Lagrangian is

$$J = E_0 \left[\sum_{t=0}^{+\infty} (\gamma)^t \frac{1}{2} \left(\pi_t^2 + \alpha y_t^2 \right) + \lambda_t \left(-\omega_t + \kappa y_t + (1-\phi)\beta E_t \omega_{t+1} + \phi \pi_{t-1} + \mu_t \right) + \rho_t \left(\omega_t - \pi_t \right) \right].$$

The first-order conditions for inner government are

$$(\gamma)^{-t} \frac{\partial J}{\partial \pi_t} = \gamma \pi_t + \phi \gamma E_t \lambda_{t+1} - \rho_t = 0; \tag{12}$$

$$(\gamma)^{-t} \frac{\partial J}{\partial y_t} = \alpha y_t + \kappa \lambda_t = 0. \tag{13}$$

Now the outer government needs to minimise the unconditional expectation of loss (8) subject to private behaviour and beliefs (11), and the promise-keeping condition (10). To solve it we follow Damjanovic, Damjanovic and Nolan (2008) who show that UO policy is similar to TP/Ramsey policy if the government time discount rate is set equal to zero ($\gamma = 1$). The first-order condition for outer government is

$$\frac{\partial J}{\partial \omega_t} = -\lambda_t + (1-\phi)\beta \lambda_{t-1} + \rho_t = 0. \tag{14}$$

The combination of (12), (13) and (14) results in the following combined policy rule

$$\pi_t = \phi \left(\gamma E_t y_{t+1} - y_t \right) + (1-\phi) \frac{\alpha}{\kappa} \left(\beta y_{t-1} - y_t \right).$$

Table 1 compares UO, Ramsey and UO-Ramsey policies for an economy with a hybrid Phillips curve. As can be seen, UO-Ramsey policy is identical to UO policy when the Phillips curve is purely forward-looking ($\phi = 0$); and it coincides with the Ramsey policy for the backward-looking case ($\phi = 1$).

Table 1. The optimal monetary policy from different perspectives

	Backward-looking	**Forward-looking**
Phillips curve	$\pi_t = \kappa y_t + \pi_{t-1} + \mu_t$	$\pi_t = \kappa y_t + \beta E_t \pi_{t+1} + \mu_t$
Ramsey/ TP	$\pi_t = \frac{\alpha}{\kappa}\left(\gamma E y_{t+1} - y_t\right)$	$\pi_t = \frac{\alpha}{\kappa}\left(\frac{\beta}{\gamma} y_{t-1} - y_t\right)$
UO	$\pi_t = \frac{\alpha}{\kappa}\left(E y_{t+1} - y_t\right)$	$\pi_t = \frac{\alpha}{\kappa}\left(\beta y_{t-1} - y_t\right)$
UO-Ramsey	$\pi_t = \frac{\alpha}{\kappa}\left(\gamma E y_{t+1} - y_t\right)$	$\pi_t = \frac{\alpha}{\kappa}\left(\beta y_{t-1} - y_t\right)$

	Hybrid Phillips Curve
Phillips curve	$\pi_t = (1-\phi)\beta E_t \pi_{t+1} + \phi \pi_{t-1} + \kappa y_t + \mu_t$
Ramsey/ TP	$\pi_t = \frac{\alpha}{\kappa}(1-\phi)\left(\frac{\beta}{\gamma} y_{t-1} - y_t\right) + \phi \frac{\alpha}{\kappa}\left(\gamma E y_{t+1} - y_t\right)$
UO	$\pi_t = \frac{\alpha}{\kappa}(1-\phi)\left(\beta y_{t-1} - y_t\right) + \phi \frac{\alpha}{\kappa}\left(E y_{t+1} - y_t\right)$
UO-Ramsey	$\pi_t = \frac{\alpha}{\kappa}(1-\phi)\left(\beta y_{t-1} - y_t\right) + \phi \frac{\alpha}{\kappa}\left(\gamma E_t y_{t+1} - y_t\right)$

3.1 Welfare implications

The welfare implications for standard DSGE models are rather modest. The reason is that the typical assumption for the time discount rate in Ramsey/TP policy is $\gamma = \beta = 0.99$ and the UO approach implies zero discounting $\gamma = 1$. Given that the empirical estimation of the shock may be that it is rather small, the difference between TP and UO policy is also small. The Unconditional Ramsey policy discussed in this paper implies $\gamma = \beta = 0.99$ for backward-looking constraints and $\gamma = 1$ for forward-looking constraints.

To measure the welfare gain from the UO-Ramsey policy as compared to the TP policy we adopt the unconditional expectation of the Benigno and Woodford (2003) second-order approximation of welfare. Welfare from the timeless perspective approximation can then be wrtten as (15)

$$W_{tp,0} = -\frac{1}{\alpha} E_0 \sum_{t=0,+\infty} \beta^t \frac{1}{2}\left[\pi_t^2 + \alpha y_t^2\right]. \tag{15}$$

The unconditional measure of welfare is written as follows

$$W_{uo} = \lim_{\beta \to 1}(1-\beta) W_{tp,0} = -\frac{1}{\alpha}(var(\pi_t^2) + \alpha \times var(y_t^2)), \tag{16}$$

and this is the measure we will employ for the welfare comparison. The benefit of the UO-Ramsey policy will depend on the model parametrization and the variance of the shock. In the next section, we will assess this benefit using estimated parameters and then perform a sensitivity analysis using a more conventional parameterization.

Estimation. First we will perform Bayesian estimation for an economy that consists of the hybrid Phillips curve (below) and policy response function. For this purpose we use quarterly data for the de-meaned GDP deflator for the USA over the period 1990-2019 (which was accessed via the FRED database at the St Louis Fed).

$$\pi_t = \kappa y_t + (1-\phi)\beta E_t \pi_{t+1} + \phi \pi_{t-1} + \mu_t \tag{17}$$

Theoretical micro-based values for the parameters are as follows $\phi = \xi/\Phi$; $\kappa = (1-\theta)(1-\xi)(1-\beta\theta)/\Phi$; $\Phi = \theta(1+\beta\xi) + (1-\theta)\xi$, where β is household discount factor, ξ is the proportion of the firms that are backward looking, and $(1-\theta)$ is the Calvo (1983) probability of price change.

Table 2 reports the result of Bayesian estimation of this three equations model, which consists of the Phillips curve (17) TP-style policy reaction (18) and autoregressive shock process (19), where ε_t is white noise.

$$\pi_t = \frac{\alpha}{\kappa}(1-\phi)(y_{t-1} - y_t) + \phi\frac{\alpha}{\kappa}(\beta E y_{t+1} - y_t) \tag{18}$$

$$\mu_t = \rho_\mu \mu_{t-1} + \sigma_\mu \varepsilon_t \tag{19}$$

Table 2. Bayesian estimation

	Prior				Posterior	
Parameters	Range	Density	Mean	S.D.	mean	90% confidence
Calvo θ	[0,1)	Beta	0.7	0.2	0.5712	0.2748 ; 0.8036
Inflation inertia ξ	[0,1)	Beta	0.3	0.2	0.1557	0.0731; 0.2503
Output stabilisation, α	[0, inf)	Inv Gamma	0.5	0.5	0.0698	0.0657 ; 0.0745
Shock Persistence, ρ_μ	[0,1)	Beta	0.7	0.2	0.9714	0.9470 ; 0.9977
Shock S.D., σ_μ	[0, inf)	Inv Gamma	0.03	0.03	0.0038	0.0031 ; 0.0036

Implied values: κ =0.1573 ϕ =0.2145

The estimated Calvo parameter is somewhat smaller than reported in the literature. Gali and Gertler (1999) estimated $\theta_{GG} = 0.803, 0.838$, Chen, Kirsanova and Leith (2017) found $\theta_{CKL} = 0.811$, Gertler, Sala, Trigani (2008) reported $\theta = 0.85$. Inflation inertia $\xi = 0.1557$ is consistent with the with Chen, Kirsanova and Leith estimation ($\xi_{CKL} = 0.1530$) while Gali and Gertler found it to be slightly higher ($\xi \in 0.244 - 0.522$). The output stabilisation weight in our estimation $\alpha = 0.0698$, is much smaller than reported in Chen, Kirsanova and Leith ($\alpha_{CKL} = 0.866$)). However it is much larger than the implied theoretical value calculated in Benigno and

Woodford (2003) $\alpha_{BW} = \kappa/\eta$, where η is the price elasticity of demand, which implies the steady state price mark up $\mu^p = \eta/(\eta - 1)$. The estimation of η can vary from 4 ($\mu^p = 1.3$, Gertler, Sala, Trigari) to 10 ($\mu^p = 1.1$ in Benigno and Woodford, 2003). We find that $\kappa = 0.1573$ and $\kappa/\alpha = 2.3$ which is twice as small as the smallest value of η. The persistence of the cost-push shock $\rho_\mu = 0.97$ is slightly higher than in Chen, Kirsanova and Leith's (0.94). The quarterly volatility of the cost-push shock is $\sigma_\mu = 0.0038$, while Chen, Kirsanova and Leith's estimated $\sigma_\mu = 0.0015$ for the periods of low inflation and $\sigma_\mu = 0.0045$ during times of higher uncertainty. Below we compute the welfare gain of the UO-Ramsey policy for different estimations drawing on our and others' estimation results.

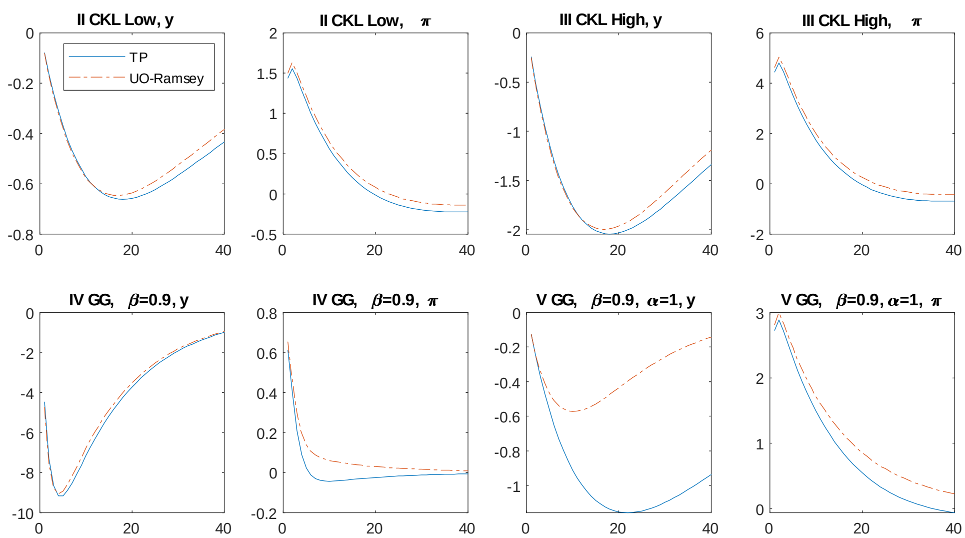
Table 3.
The welfare gain from zero discounting of the promise-making government

	I	II	III	IV	V
	Estimated	CKL Low	CKL High	GG	GG
in %				β=0.9	β=0.9, α=1
Welfare gain	2.22E-05	0.004	0.038	0.25	0.34
SD inflation, TP	0.266	3.854	11.9	0.78	7.85
SD inflation, $UO\text{-}R$	0.267	3.997	12.3	0.92	8.83
SD output, TP	7.213	3.814	11.8	31.8	7.52
SD output, $UO\text{-}R$	7.212	3.585	11.1	30.7	2.53
Parameters					
Calvo, θ	0.571	0.811	0.811	0.843	0.843
Inflation inertia ξ	0.156	0.153	0.153	0.116	0.116
Persistence, ρ_μ	0.971	0.936	0.936	0.936	0.936
Volatility, σ_μ, %	0.385	0.15	0.45	0.45	0.45
Output targeting, α	0.070	0.866	0.866	0.006	1
Time discount, β	0.99	0.99	0.99	0.9	0.9

Table 3 presents welfare gain as in (16) above for 5 different scenarios. We can see that the UO-Ramsey policy in every scenario delivers higher volatility of inflation but lower volatility of output. Scenario I is based on our simple estimation and it gives a rather negligible welfare gain of $2.22E - 05\%$. Scenario II explores Chen, Kirsanova and Leith's (CKL thereafter) estimation that has more price stickiness, but a smaller cost push shock. The welfare gain, in this case, is also negligible 0.004% in consumption equivalent. However, given the current conjuncture as of writing (Spring 2021) one might reasonably assume a period of elevated uncertainty. Scenario III therefore investigates the CKL economy during a period of volatile shocks (like the period of high inflation in the 1970-80's). The welfare gain now is 0.038%.

Finally, we look at the case when the private sector suddenly starts discounting the future at a higher rate ($\beta = 0.9$). This experiment has two motivations. First, Gali and Gertler (1999) estimated β to be rather low, ($\beta_{GG} = 0.885$, s.d. 0.030). Second, and building on our earlier remark, during the COVID pandemic, with an elevated mortality rate[5] and business destruction rate[6], we might expect the private sector to behave as if it had a smallerler β than typically assumed. Scenario IV combines Gali and Gertler's (1999) economy with the CKL shock process. Now we obtain a more substantive welfare gain of a quarter percent. However, high private discounting results in extremely high volatility of output (about 30%) and modest volatility of inflation (less than 1%). This observation may add justification for government's decision to increase the focus on output stabilisation in such a scenario. Scenario V investigates the case with high volatility, low discounting, and high weight on the output gap, $\alpha = 1$. The welfare gain, in this case, can be as high as 0.34% and one clearly sees that the proposed UO-Ramsey policy results in much smaller volatility of output. Figure 1 shows the impulse responses to the cost-push shock for inflation and output under different scenarios..

Figure 1: Impulse response to cost-push shock



In figure 1 the (blue) continuous line shows the impulse response for TP policy

[5]See Poterba and Solomon, 2021 for estimation of the mortality rate and annuity discounting during the pandemic period.

[6]For firm exit rate during COVID 19 see Crane et al (2020)

and the (red) dashed line represents the policy where the promise-making government does not discount the future losses (UO Ramsey policy). Our simulation shows that the UO Ramsey policy delivers more volatile inflation but less volatile output. The simple model helps us to understand why the government needs to increase the output stabilization weight in the time of high discounting (low β). The same cost-push shock leads to a 2% fall in GDP when $\beta = 0.99$ and a 9% fall when private discounting is relatively high, $\beta = 0.9$. In this case, an increase in the output stabilization weight could reduce the fall in output to 1.2% for TP policy while it will still maintain inflation at a relatively restrained 3% level. The higher output weight in the policy objective is one way to capture the idea of "accommodative policy" that one observes more frequently in Fed speeches and discussion papers (e.g., Kiley (2020)).

The most interesting case is presented in the right lower corner corresponding to scenario V with high volatility $\sigma_\mu = 0.45\%$, high uncertainty about the future ($\beta = 0.9$) and when the government gives the same weights to output and inflation stabilization, $\alpha = 1$. In this case, the fall of output is only 0.5% under UO-Ramsey policy and the economy converges much faster to the initial steady state as compared to the TP policy. Therefore the UO Ramsey policy can be especially useful in a period of elevated uncertainty when the future may be highly discounted by the private sector, which may well be the case during the current pandemic.

4 Conclusion

We present a policy (UO Ramsey) that behaves as Ramsey optimal policy in backward-looking models but is similar to UO policy in forward-looking models. This policy is achieved when forward guidance authorities do not discount the future. We demonstrate how that policy works by considering a linear-quadratic model with a hybrid Phillips curve. The policy delivers the Ramsey policy when price setting is purely backward-looking, while it is the same as UO policy when the Phillips curve is purely forward-looking. Our simulations show that this policy results in slightly more volatile inflation but less volatile output. The policy delivers a negligible welfare gain in a time of low volatility and low private discounting ($\beta = 0.99$). However, the welfare gain can be significant in a time of higher uncertainty, high private discounting ($\beta = 0.9$), and when the government increases the weight of the output gap in the loss function. In this case, the design of forward guidance with zero discounting of future losses could be extremely helpful for output stabilization.

References

[1] Benigno, Pierpaolo, and Michael Woodford. 2003. “Optimal Monetary and Fiscal Policy: A Linear-Quadratic Approach.” NBER Macroeconomics Annual, vol. 18.

[2] Benigno, Pierpaolo and Michael Woodford, 2012, Linear-quadratic approximation of optimal policy problems, Journal of Economic Theory, Volume 147, Issue 1, January 2012, Pages 1–42.

[3] Blake, Andrew P., 2001. A "Timeless Perspective" on optimality in forward-looking rational expectations models, Papers 188, National Institute of Economic and Social Research.

[4] Blake, Andrew P. & Kirsanova, Tatiana, 2004. A note on timeless perspective policy design, Economics Letters, Elsevier, vol. 85(1), pp. 9-16, October.

[5] Brendon, Charles and Martin Ellison, 2015. Time-Consistent Institutional Design, 2015 Meeting Papers 495, Society for Economic Dynamics.

[6] Chen, Xiaoshan & Kirsanova, Tatiana & Leith, Campbell, 2017. "How optimal is US monetary policy?," Journal of Monetary Economics, Elsevier, vol. 92(C), pages 96-111.

[7] Crane L., Decker R., & Flaaen A. & . Hamins-Puertolas A. and C. J. Kurz, 2020. "Business Exit During the COVID-19 Pandemic: Non-Traditional Measures in Historical Context," Finance and Economics Discussion Series 2020-089r1, Board of Governors of the Federal Reserve System (U.S.), revised 15 Apr 2021.

[8] Damjanovic, Tatiana, Vladislav Damjanovic and Charles Nolan, 2008, Unconditionally optimal monetary policy, The Journal of Monetary Economics, 55, 491-500.

[9] Damjanovic, Tatiana, Vladislav Damjanovic and Charles Nolan, 2015. Ordering Policy Rules with an Unconditional Welfare Measure, International Journal of Central Banking, vol. 11(1), pages 103-149, January.

[10] FED, 2015, What is forward guidance and how is it used in the Federal Reserve’s monetary policy?, Board of the Governors explanatory notes.

[11] Giannoni M. P., and M. Woodford, 2002, Optimal Interest-Rate Rules 1: General Theory, NBER Working Paper No. 9419.

[12] Gali, Jordi, and Mark Gertler. 1999. Inflation dynamics: A structural econometric analysis. Journal of Monetary Economics, 44,195-222.

[13] Gertler, M., Sala, L., & Trigari, A. (2008). An Estimated Monetary DSGE Model with Unemployment and Staggered Nominal Wage Bargaining. Journal of Money, Credit and Banking, 40(8), 1713-1764.

[14] Horvath, Michal, 2011, Alternative perspectives on optimal public debt adjustment, The B.E. Journal of Macroeconomics, Berkeley Electronic Press, vol. 11(1).

[15] Jensen, Christian and Bennett T. McCallum, 2010, Optimal continuation versus the timeless perspective in monetary policy, working paper, Journal of Money, Credit and Banking Volume 42, Issue 6, pages 1093–1107.

[16] Kiley, Michael T. , 2020. "Pandemic Recession Dynamics: The Role of Monetary Policy in Shifting a U-Shaped Recession to a V-Shaped Rebound," Finance and Economics Discussion Series 2020-083, Board of Governors of the Federal Reserve System (U.S.).

[17] Kydland, F. and E. Prescott, (1977), Rules rather than discretion: The inconsistency of optimal plans, Journal of Political Economy, 85, 473-490.

[18] Kollmann, Robert, 2002, Monetary policy rules in the open economy: Effect on welfare and business cycles, Journal of Monetary Economics, 49, pp. 989-1015.

[19] McCallum, Bennett T., 2005, What is the proper perspective for monetary policy optimality? Monetary and Economic Studies, Bank of Japan, 23, 13-24.

[20] Pigou, A. C., 1932, 'The Economics of Welfare', (4 th ed), London: Macmillan.

[21] Poterba James M. & Adam Solomon, 2021. "Discount Rates, Mortality Projections, and Money's Worth Calculations for US Individual Annuities," NBER Working Papers 28557

[22] Rotemberg Julio. J. and Michael Woodford, 1998, An optimization-based econometric framework for the evaluation of monetary policy: Expanded Version, NBER Technical Working Paper No. 233.

[23] Schmitt-Grohe, Stephanie and Martin Uribe, 2004, Optimal fiscal and monetary policy under sticky prices, Journal of Economic Theory, Elsevier, vol. 114(2), pages 198-230, February.

[24] Svensson, Lars E.O. 2014. Forward Guidance, NBER Working Papers 20796.

[25] Taylor, John B., 1979, Estimation and control of a macroeconomic model with rational expectations, Econometrica, 47, 5, pp. 1267-1286.

[26] Ramsey, F.P., 1928, A mathematical theory of saving, Economic Journal, 38, 543-559

[27] Whiteman, Charles H, 1986, An analytical policy design under rational expectations, Econometrica, 54(6), pp. 1387-1405, November.

[28] Woodford, Michael, 2002, Inflation stabilization and welfare, Contributions to Macroeconomics, vol. 2, issue 1, article 1.