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Lack of divine coincidence in New Keynesian models ☆

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ABSTRACT

The literature has long agreed that the divine coincidence holds in standard New Keynesian models: the monetary authority is able to simultaneously stabilize inflation and output gap in response to preference and technology shocks. I show that the divine coincidence holds only when inflation is stabilized at exactly zero. Even small deviations from zero generate policy trade-offs. I demonstrate this result using the model's non-linear equilibrium conditions to avoid biases from log-linearization. When the model is log-linearized, a non-zero steady state level of inflation gives rise to what I call the endogenous trend inflation cost-push shock in the New -Keynesian Phillips curve.

1. Introduction

The theoretical literature on the trade-off between price inflation variability and output gap variability has long agreed that the standard New Keynesian model exhibits what Blanchard and Gali (2007) called a *divine coincidence*: under price stickiness, any monetary policy rule that stabilizes the inflation rate, in the face of preference or technology shocks, also stabilizes the output gap. Yet in practice, most central banks perceive that they face a trade-off between stabilizing inflation and output gap. Hence, a puzzle arises in reconciling these two perspectives.

The literature has responded either by artificially adding shock terms to the Phillips curve (e.g. Clarida et al., 1999; Gali, 2002) or by extending the standard New Keynesian model with additional frictions that allow the gap between output under flexible prices and the efficient output to vary over time. Those frictions take the form of time varying taxes (e.g. Woodford, 2003, Chapter 6; Benigno and Woodford, 2005), time varying markups (e.g. Benigno and Woodford, 2005), wage rigidities (e.g. Erceg et al., 2000; Blanchard and Gali, 2007) and cost channels (e.g. Ravenna and Walsh, 2006), among others.

In this paper, I show that we do not need to extend the standard New Keynesian model in order to obtain the policy trade-off. Using the model's non-linear equilibrium conditions to avoid biases from log-linearizations, my main result is that it is impossible for monetary policy to simultaneously stabilize the inflation rate and output gap in response to preference and technology shocks, except in special cases in which either policy stabilizes the inflation rate at exactly zero or firms follow an exact full indexation mechanism when not reoptimizing their prices. Independently of the values of structural parameters, a few composite parameters converge to the same level in those particular cases. This coincidence is sufficient to prevent preference and technology shocks from affecting the output gap. And hence, the divine coincidence holds. At any other non-zero level for the stabilized inflation rate, the output gap moves in response to those shocks, generating a policy trade-off.

☆ This paper has been previously circulated as "Is the Divine Coincidence Just a Coincidence?".

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Previously, the literature assessing the divine coincidence focused on log-linearized versions of New Keynesian models. Given the fact that the benchmark approach is to log-linearize the models about a steady state equilibrium with zero inflation, it is no surprise that the literature has concluded that the monetary authority faces no trade-off in the standard New Keynesian model.

When the model is log-linearized around a steady state equilibrium with non-zero trend inflation,[1] the main result of this paper translates into what I call the endogenous *trend inflation cost-push shock*, which ultimately depends only on the technology and preference shocks. The level of trend inflation acts as a shock amplifier: it is zero when the trend inflation is zero and increases as trend inflation rises.

In order to assess the welfare effects of the trend inflation cost-push shock, I derive the fully-fledged welfare-based loss function under trend inflation (TIWeB) and obtain optimal policy rules under discretion and commitment. The TIWeB loss function differs from the trend inflation welfare-based loss function obtained by Coibion et al. (2012), as their approximation about the steady state with trend inflation is only partial. They approximate some components of the welfare function around the steady state with zero inflation.

For assessing how different optimal policies perform and test whether they are able to at least mitigate the effects of the trend inflation cost-push shock, I employ simulations as in Ascari and Ropele (2007) and investigate how macro-volatility and impulse responses to exogenous shocks vary with trend inflation. As it rises, the main finding is that the trade-off between inflation and output gap becomes more and more apparent, the unconditional variances of both variables and the amplitude of their responses to shocks increase.

The remainder of the paper is organized as follows. The model is described in Section 2. Key results on policy trade-offs are derived in Section 3. The effect of trend inflation on welfare is discussed in Section 4, while Section 5 assesses how optimal policies perform in mitigating the effects of the trend inflation cost-push shock. Section 6 summarizes the paper's conclusions.

2. The model

For simplicity, I follow (Woodford, 2003, Chapter 4) to describe the standard New Keynesian model with Calvo (1983) price setting and flexible wages. The economy consists of a representative infinite-lived household that consumes an aggregate bundle and supplies differentiated labor to a continuum of differentiated firms indexed by $z \in (0,1)$, which produce and sell goods in a monopolistic competition environment.

2.1. Households

Household's workers supply $h_t(z)$ hours of labor to each firm z, at nominal wage $W_t(z) = P_t w_t(z)$, where P_t is the consumption price index and $w_t(z)$ is the real wage. Disutility over hours worked in each firm is $\upsilon_t(z) \equiv \chi h_t(z)^{1+\nu}/(1+\nu)$, where ν^{-1} is the Frisch elasticity of labor supply. The household's aggregate disutility function is $\upsilon_t \equiv \int_0^1 \upsilon_t(z)\,dz$. Consumption $c_t(z)$ over all differentiated goods is aggregated into a bundle C_t, as in Dixit and Stiglitz, 1977, and provides utility $u_t \equiv \epsilon_t C_t^{1-\sigma}/(1-\sigma)$, where σ^{-1} is the intertemporal elasticity of substitution and ϵ_t is a preference shock. Aggregation and expenditure minimization relations are described by

$$C_t^{(\theta-1)/\theta} = \int_0^1 c_t(z)^{(\theta-1)/\theta}\,dz; \quad P_t^{1-\theta} = \int_0^1 p_t(z)^{1-\theta}\,dz$$
$$c_t(z) = C_t\left(\frac{p_t(z)}{P_t}\right)^{-\theta}; \quad P_t C_t = \int_0^1 p_t(z) c_t(z)\,dz \tag{1}$$

where $\theta > 1$ is the elasticity of substitution between goods.

Financial markets are complete and the budget constraint is $P_t C_t + E_t q_{t+1} B_{t+1} \le B_t + P_t \int_0^1 w_t(z) h_t(z)\,dz + d_t$, where B_t is the state-contingent value of the portfolio of financial securities held at the beginning of period t, d_t denotes the nominal dividend income, and q_{t+1} is the stochastic discount factor from $(t+1)$ to t. The household chooses the sequence of C_t, $h_t(z)$ and B_{t+1} to maximize its welfare measure $\mathcal{W}_t \equiv \max E_t \sum_{\tau=t}^{\infty} \beta^{\tau-t}(u_\tau - \upsilon_\tau)$, subject to the budget constraint and a standard no-Ponzi condition, where β denotes the subject discount factor. In equilibrium,[2] optimal labor supply satisfies $w_t(z) = \upsilon_t'(z)/u_t'$, where $u_t' \equiv \partial u_t/\partial C_t$ is the marginal utility to consumption and $\upsilon_t'(z) \equiv \partial \upsilon_t(z)/\partial h_t(z)$ is the marginal disutility to hours. The optimal consumption plan and dynamics of the stochastic discount factor are described as follows:

$$1 = \beta E_t\left(\frac{u_{t+1}'}{u_t'}\frac{I_t}{\Pi_{t+1}}\right); \quad q_t = \beta\frac{u_t'}{u_{t-1}'}\frac{1}{\Pi_t} \tag{2}$$

[1] Good references on the trend inflation literature are found in e.g. Ascari (2004), Ascari and Ropele (2007, 2009, 2013), Ascari and Sbordone (2013), Coibion and Gorodnichenko (2011), Coibion et al. (2012), Alves (2012), Amano et al. (2007), Cogley and Sbordone (2008), Fernandez-Corugedo (2007), Kichian and Kryvtsov (2007), and Sahuc (2006).

[2] Equilibrium is defined as the equations describing the first-order conditions, a transversality condition $\lim_{T\to\infty} E_T q_{t,T} B_T = 0$, where $q_{t,T} \equiv \Pi_{\tau=t+1}^{T} q_\tau$, and the market clearing conditions.