



Investment and the Taylor rule in a dynamic Keynesian model[☆]

Steven M. Fazzari^{a,*}, Piero Ferri^b, Edward Greenberg^a

^a Department of Economics, Campus Box 1208, Washington University, St. Louis MO 63130-4899, USA

^b Hyman P. Minsky Department of Economic Studies, University of Bergamo, via dei Caniana 2, 24100 Bergamo, Italy

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ABSTRACT

We study monetary policy in a reduced-form dynamic model with bounded rationality and an empirically motivated investment function. Investment has important dynamic effects in our model. In particular, the cost of capital effect on investment is more important for monetary transmission than the more widely studied intertemporal substitution parameter in consumption. Furthermore, a strong Taylor rule response to unemployment in this model is more effective in stabilizing demand-induced fluctuations than a strong response to inflation. Indeed, an excessively aggressive response to inflation destabilizes the simulated output and inflation fluctuations.

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1. Introduction

The effects of monetary policy rules, especially the Taylor rule, on the dynamics of small macroeconomic models have been widely studied in recent research. Most of this work employs some version of the New Keynesian or “new neoclassical synthesis” model (see Goodfriend and King, 1997; Woodford, 2003), and the monetary transmission mechanism usually works through an “IS” equation derived from the consumption Euler equation for a representative consumer. In these models, the real interest rate affects aggregate demand through intertemporal substitution in consumption. Recent models usually neglect the effect of interest rates on aggregate demand through investment spending, which represents a change from “Old” Keynesian models.

The suppression of an explicit investment specification in the modern workhorse models for evaluating monetary policy is somewhat puzzling. While abstracting from investment may improve tractability, this modeling choice eliminates a cyclically volatile component of aggregate demand, an important channel through which interest rates affect demand, and the most widely studied linkage between financial markets and macroeconomic performance. We introduce an explicit investment function, motivated by empirical research, into a reduced-form version of the new neoclassical synthesis model.¹

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* Corresponding author.

E-mail addresses: fazz@wustl.edu (S.M. Fazzari), peferri@tin.it (P. Ferri), edg@wustl.edu (E. Greenberg).

¹ Recent research that models investment in a similar context include Bullard and Eusepi (2005), Woodford (2005), and the symposium in *The Journal of Economic Theory* summarized by Benhabib et al. (2005). Much of this work focuses on the problem of indeterminacy caused by multiplicity of equilibria. Roberts (2003) explores the effects of empirical features of the investment function with a focus on adjustment costs. Gilchrist and Saito (2008) include investment in their model to study, in particular, the effect of capital market imperfections and an asset-price response to monetary policy. Flaschel et al. (2001) consider the impact of the Taylor rule on economic stability in a Keynesian model with investment.

Because new neoclassical synthesis models emphasize the importance of expectations, the analysis requires a specification of expectation formation. Although our model has a straightforward rational expectations representation, the dynamics that arise from that assumption do not conform to empirical regularities observed in the economy. This difficulty has been recognized by others; see [Estrella and Fuhrer \(2002\)](#) in particular. We model expectations with a version of “boundedly rational” econometric forecasts. Expectations are determined by AR(1) forecasts that are calibrated to be consistent with simulated time-series generated by the model, so that the AR(1) forecasting equations change when other model parameters change. In this sense, the forecasting rules used to generate expectations are “model consistent” without requiring the strong information assumptions necessary for rational expectations.²

We study the properties of the nonlinear model by analyzing short-run simulations that result from a single deterministic shock and period-by-period stochastic shocks to steady state. The deterministic shock allows us to trace, in detail, the economic factors that determine the model dynamics resulting from a single disturbance.

Our main findings are:

- The presence of an investment function with empirically motivated effects of output, the cost of capital, and cash flow significantly affects the qualitative model dynamics.
- The parameters of the investment function have an important impact on the dynamics and influence the performance of the Taylor rule. Indeed, the interest elasticity of investment is much more important for the model dynamics than the interest elasticity of consumption, even though the latter has received much more attention in recent research.
- While some responsiveness of investment to interest rates enhances the stability of the system, high values of this interest elasticity, like the value associated with the widely used Cobb–Douglas technology assumption, significantly reduce stability.
- In this model, the response of nominal interest rates to the output gap or unemployment term of the Taylor rule is more effective at stabilizing the model's dynamics than the response of nominal interest rates to the inflation target term. In addition, a more aggressive response to inflation is usually destabilizing for output and often does not improve dynamic inflation performance.

2. The simulation model

2.1. Elements of new neoclassical synthesis models

The canonical new neoclassical synthesis model consists of three equations (see [Woodford, 2003, Ch. 4](#)):

1. An aggregate supply or Phillips Curve equation that links the gap between actual and expected inflation to the gap between actual and potential output.
2. A Taylor rule that endogenously sets the nominal interest rate as a function of deviations of the inflation rate and the output gap from their target values.
3. An IS equation that incorporates the elasticity of aggregate expenditure to the real rate of interest.

In these models the fundamentals of taste and technology define a dynamic path that represents, according to [Woodford \(2003, p. 9\)](#), “...a sort of virtual equilibrium for the economy at each point of time, the equilibrium that one would have if wages and prices were not in fact sticky.” The possibility that output may deviate from its “natural rate” is motivated by price stickiness, derived from the behavior of firms in monopolistically competitive markets with barriers to instantaneous price adjustments. Our model largely follows a reduced-form representation of this structure, except that we augment the IS function to include investment.

In addition, to produce results that capture empirical regularities in the data, some models introduce lagged inflation into the Phillips Curve, lagged consumption into the IS equation, and lagged nominal interest rates into the Taylor rule. Parameter values for these lagged effects are often obtained from econometric estimation. The presence of these lagged variables is difficult to defend from a strict microfoundations viewpoint, which explains why models that include them are considered “hybrid” models. [Ehrmann and Smets \(2003\)](#), for example, discuss the need for inertia in both the Phillips Curve and the IS equation to capture observed persistence in U.S. data. In our model we find that including a lagged variable in the consumption Euler equation, which may be interpreted as capturing habit formation, is necessary to obtain robust, stable results. We also consider the effects of including lagged inflation in the Phillips Curve and lagged interest rates in the Taylor rule, but these modifications are less important to our findings.

The forward-looking Phillips Curve equation is

$$\pi_t = -\sigma_1(\bar{E}_{t-1}u_t - u^*) + [(1-\sigma_2)\bar{E}_{t-1}\pi_{t+1} + \sigma_2\pi_{t-1}] + \varepsilon_{PC,t}, \quad (1)$$

² For further discussion about related procedures see [Sargent \(1993\)](#), [Conlisk \(1996\)](#), and [Hommes and Sorger \(1998\)](#).

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