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Stock prices and monetary policy shocks: A general equilibrium approach

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ABSTRACT

Empirical literature documents that unexpected changes in the nominal interest rates have a significant effect on real stock prices: a 100-basis point increase in the nominal interest rate is associated with an immediate decrease in broad real stock indices that may range from 2.2 to 9%, followed by a gradual decay as real stock prices revert towards their long-run expected value. We assess the ability of a general equilibrium New Keynesian asset-pricing model to account for these facts. We consider a production economy with elastic labor supply, staggered price and wage setting, as well as time-varying risk aversion through habit formation. We find that the model predicts a stock market response to policy shocks that matches empirical estimates, both qualitatively and quantitatively. Our findings are robust to a range of variations and parametrizations of the model.

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1. Introduction

The reaction of the stock market to monetary policy shocks has been the subject of much empirical research in the last 10–15 years. In particular, this literature documents that an unexpected change in the nominal interest rates has significant and persistent effects on real stock prices. Papers focusing on the instant stock market response to such a shock report that a normalized 100-basis points increase in the Fed funds rate is associated with an immediate decrease in broad US stock indices that ranges from 2.2 to 9%, depending on the sample and estimation method being used (e.g. Craine and Martin, 2003; Rigobon and Sack, 2004; Bernanke and Kuttner, 2005; Bjørnland and Leitemo, 2009). Moreover, various authors document the dynamic effects of policy shocks and report a gradual mean reversion of real stock prices and returns following the shock (e.g. Lastrapes, 1998; Rapach, 2001; Neri, 2004). Such estimated reactions of the stock market to policy shocks are of potential interest for researchers in macro-finance for two reasons. First, they convey important information on the transmission channels of monetary policy, since policy shocks affect financial variables immediately, while they only have delayed effects on macroeconomic variables. Second, these estimates provide raw stylized facts against which the quantitative predictions of alternative theoretical frameworks can be evaluated.

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The present paper has two goals. First, we assess the ability of a standard New Keynesian asset-pricing model to account for the impact and dynamic adjustment of the stock market following a nominal interest rate shock. Second, we use the model to disentangle the economic channels that may jointly contribute to the observed stock-price multiplier. The decomposition that we propose is motivated by the following simple observation. Stock prices are the expected discounted value of future dividends, hence they respond to nominal interest rate shocks because the latter affect the course of dividends and/or that of discount rates, i.e. the entire term structure. Since the discount rate can in turn be decomposed into a riskless rate and a risk premium, we ultimately end up with three potential channels, namely *dividend*, *riskless rate* and *risk premium*, via which policy shocks may affect stock prices. Our general-equilibrium framework thus makes the necessary assumptions for all these three channels to be operative and potentially affects stock prices.

First and foremost, a surprise increase in the nominal interest rate directly affects the real risk-free rates under the assumption that nominal prices are sticky. This directly raises the rate at which future dividends are discounted, so the *risk-free rate channel* contributes to take stock prices down after the policy shock.

Another implication of rising real interest rates is that they affect intertemporal substitution, as summarized by the consumption Euler equation, so that current aggregate demand falls. In our New Keynesian framework, firms are in a monopolistically competitive environment and the fall in aggregate demand affects profits and ultimately paid out dividends, in two conflicting ways. First, it directly impact sales, which consequently reduces profits. Second, firms respond to the shock by producing less, which exerts a downward pressure on the equilibrium wage and thereby on the marginal cost that all firms face. This indirect, general-equilibrium effect contributes to an increase in profits. As we show, when wages are fully flexible and for standard parameter values, the general equilibrium effect dominates the direct effect, implying that dividends counterfactually rise after an increase in the policy rate. However, we show that a plausible level of nominal wage stickiness mutes down the general-equilibrium effect sufficiently to make the direct effect on sales dominate. Hence, profits and dividends fall after an increase in the policy rate, so that the *dividend channel* also contributes to a reduction in stock prices after the shock.[1]

Finally, in addition to changes in the risk-free rate, changes in risk premia or expected excess returns may also affect the discount rate and thus contribute to variations in stock prices and ex post returns (see, e.g. Campbell and Shiller, 1988; Campbell, 2003; Bernanke and Kuttner, 2005). We therefore introduce an active role for time-varying risk premia in the stock market reaction to policy shocks, by assuming that households form consumption habits, with a specification for habit formation that generates time-variations in households′ risk aversion. Our utility specification implies that risk aversion and the implied risk premia are countercyclical. Hence, the *risk aversion channel* concurs with the risk-free rate and dividend channels in taking stock prices down after the shock.

We establish our basic results in two steps. First, we solve the full model with a third-order perturbation method that preserves time-variations in risk premia (as in, e.g. Rudebusch and Swanson, 2012).[2] Using a standard parameterization, we find that the predicted stock price and ex post return multipliers are well inside the range of available empirical estimates. Moreover these numbers are broadly robust to a variety of parametrizations, and variations of the model including one that allows for capital accumulation. Our results thus suggest that the baseline New Keynesian model provides a plausible general equilibrium explanation for the observed stock market reaction to monetary policy shocks.

In a second step, we use the model to quantitatively measure the contributions of the three channels discussed above to the overall stock-price multiplier. This cannot be done with the third-order approximation used to compute the overall multiplier, because the non-linearities involved make it hard to disentangle and isolate the contribution of each of the potential channels for the transmission of shocks. We thus propose a hybrid of the log-linear log-normal approach that allows us to express real stock prices as a linear function of future dividends, real interest rates and time-varying risk aversion, in the spirit of Campbell and Shiller (1988). The method is based on a log-linear approximation of the stochastic discount factor that makes it possible to track time-variations in risk aversion along the business cycle. This method yields stock price and return multipliers that are almost identical to those produced using a third-order approximation to the model, whilst allowing for an analytical breakdown of the three channels that contribute to the overall multiplier.

Our work relates to various strands of the literature. We have already mentioned the empirical papers on which our quantitative investigation is based (more details are provided in Section 2). Of course, there is also a long tradition in assessing the asset pricing implications of dynamic macroeconomic models, particularly within the Real Business Cycle tradition (see, for example, Jermann, 1998; Boldrin et al., 2001; Lettau, 2003). Within the New Keynesian tradition, Blanchard (1981) and Svensson (1986) provide early theoretical analyses of the stock market response to a monetary shock using rational expectations models with sticky goods prices and flexible asset prices. Some papers have studied the implications of sticky prices and non-neutral monetary policy for the shape and business cycle properties of the yield curve (e.g. Rudebusch and Wu, 2008; Doh, 2009; Bekaert et al., 2010; Rudebusch and Swanson, 2012; Amisano and Tristani, forthcoming). Some more recent theoretical contributions that broadly analyze positive questions regarding asset prices in New Keynesian settings include Milani (2008), Li and Palomino (2009), Wei (2009), De Paoli et al. (2010), Castelnuovo and

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[1] Christiano et al. (2005) and Bernanke and Kuttner (2005) have shown that the responses of profits and dividends conditional on a monetary policy shock are procyclical. Of course, this procyclicality need not hold conditionally on other shocks or unconditionally.

[2] As is well known, standard log-linearizations of asset pricing models around the deterministic steady state eliminate higher order terms that are important when analyzing equity premia and asset returns; second order approximations or the usual log-linear log-normal approach bring back second order terms but imply constant risk premia.

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