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Uncertainty-dependent effects of monetary policy shocks: A new-Keynesian interpretation[☆]

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ABSTRACT

We estimate a nonlinear VAR model to study the real effects of monetary policy shocks in regimes characterized by high vs. low macroeconomic uncertainty. We find unexpected monetary policy moves to exert a substantially milder impact in presence of high uncertainty. We then exploit the set of impulse responses coming from the nonlinear VAR framework to estimate a medium-scale new-Keynesian DSGE model with a minimum-distance approach. The DSGE model is shown to be able to replicate the VAR evidence in both regimes thanks to different estimates of some crucial structural parameters. In particular, we identify a steeper new-Keynesian Phillips curve as the key factor behind the DSGE model's ability to replicate the milder macroeconomic responses to a monetary policy shock estimated with our VAR in presence of high uncertainty. A version of the model featuring firm-specific capital is shown to be associated to estimates of the price frequency which are in line with some recent evidence based on micro data.

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1. Introduction

Two of the main facts of the global financial crises are the dramatic increase in uncertainty occurred starting in 2007 and the spectacular drop in the federal funds rate engineered by the Federal Reserve in the attempt of slowing down the fall of real GDP in the United States. According to [Jurado et al. \(2015\)](#), the 2007–09 recession represents the most striking episode of heightened uncertainty in the post-WWII period. The Federal Reserve slashed the effective federal funds rate by

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more than 500 basis points in the period July 2007–December 2008 before hitting the zero lower bound and moving to unconventional policies. But how effective is expansionary monetary policy in presence of high uncertainty?

A recent strand of the empirical literature points to a weak impact of monetary policy shocks on real activity in presence of high uncertainty (see, among others, [Aastveit et al., 2017](#); [Eickmeier et al., 2016](#); [Pellegrino, 2017](#); [Pellegrino, 2018](#)).¹ This paper's contribution to the literature is twofold. First, it offers fresh empirical estimates on the nonlinear macroeconomic effects of monetary policy shocks in presence of high uncertainty by estimating a medium-scale Threshold VAR (TVAR) model. High and low uncertainty states are identified by appealing to the macroeconomic uncertainty indicator recently proposed by [Jurado et al. \(2015\)](#). Such indicator, constructed via a data-rich strategy involving more than 130 time-series, can be interpreted as a broad measure of macroeconomic uncertainty that is likely to proxy the type of uncertainty that households and firms consider when determining their optimal consumption, investment, and pricing plans. Second, and more importantly, we offer a new-Keynesian interpretation of the impulse responses produced by our TVAR. We do so by estimating key-structural parameters of the state-of-the-art medium-scale new-Keynesian model by [Altig et al. \(2011\)](#) in a state-contingent fashion to replicate the impulse responses of the “data”, i.e., those coming from the TVAR model. The estimation of the [Altig et al. \(2011\)](#) model, which is an evolution of the [Christiano et al. \(2005\)](#) and [Smets and Wouters \(2007\)](#) workhorse frameworks, is conducted by appealing to the Bayesian minimum-distance estimator recently proposed by [Christiano et al. \(2011\)](#). This empirical step is implemented to unveil changes in the values of structural parameters which are crucial for the medium-scale DSGE model to replicate our state-dependent TVAR impulse responses. Importantly, the [Altig et al. \(2011\)](#) nests two cases. In the first one firms' capital is homogeneous and, therefore, immediately transferrable from a firm to another in response to a shock. This case is very standard in the literature. The second one is a case in which capital is firm-specific and, therefore, firms cannot adjust their level of capital in the short-run. As shown by [Altig et al. \(2011\)](#), firm-specific capital helps their estimated DSGE model to match the persistence of aggregate inflation without imposing an implausibly high degree of price stickiness (see also [Eichenbaum and Fisher, 2007](#)).²

Our results are the following. First, we find monetary policy shocks to exert a statistically and economically weaker effect on output and other real activity indicators when uncertainty is high. This result, which is obtained with a medium-scale VAR and the use of [Jurado et al.'s \(2015\)](#) state-of-the-art macroeconomic uncertainty indicator, confirms the ones previously put forth by [Eickmeier et al. \(2016\)](#), [Aastveit et al. \(2017\)](#), and [Pellegrino \(2017; 2018\)](#) on the weak influence of unexpected policy easings in periods of heightened uncertainty. With respect to these contributions, we use a larger scale VAR model, which is informationally richer and, therefore, less likely to deliver inconsistent responses due to informational insufficiency ([Forni and Gambetti, 2014](#)). Moreover, the use of the uncertainty indicator constructed by [Jurado et al. \(2015\)](#), which is based on a large set of macroeconomic and financial indicators, ensures that the definition of uncertainty we consider is a broad one, and therefore captures different types of uncertainty considered by agents in the economic system (say, the one surrounding future technological evolutions, fiscal and monetary policy, the stock market, and so on). Finally, the identification assumptions behind the estimation of the effects of monetary policy shocks in our VAR – i.e., those behind a triangular economy – are fully consistent with the structure of [Altig et al.'s](#) DSGE model, something which is clearly desirable for our exercise. Going back to our impulse responses, we find the response of inflation to be positive and statistically significant only in presence of high uncertainty. This result, coupled with the one on the response of output, points to a trickier inflation-output trade-off to deal with when uncertainty is high.

Second, we find the model developed by [Altig et al. \(2011\)](#) to possess a remarkably good ability to fit our state-contingent responses no matter what the level of uncertainty is. This is due to the flexibility of our estimation strategy, which allows the structural parameters of the DSGE model to take state-contingent values in the estimation phase. In particular, our results point to a steeper new-Keynesian Phillips curve (NKPC) as the key ingredient to match the TVAR impulse responses in uncertainty times. This result, which is obtained with a full-system estimation of a medium-scale DSGE model, echoes the one in [Vavra \(2014b\)](#), who focuses on a single equation estimation of a battery of new-Keynesian Phillips curves. In his paper, the slope of the supply curve is influenced by a Calvo parameter whose value may depend on the level of uncertainty. With respect to [Vavra \(2014b\)](#), we show that a purely macro-related approach dealing with a DSGE model that features firm-specific capital is able to generate a worsening of the inflation-output trade-off in uncertain times. Importantly, we find that the change in this trade-off occurs for state-contingent estimates of the Calvo parameter whose values are close to the recent evidence on price duration based on micro data (see [Eichenbaum et al., 2011](#); [Kehoe and Midrigan, 2015](#); [Nakamura and Steinsson, 2008](#)). This is due to the connection between the value of the Calvo parameter and that of the slope of the Phillips curve. Such connection is much tighter in models with homogeneous capital than in models with firm specific capital. The latter ones are able to generate a flatter slope of the Phillips curve conditional on the same calibration of the

¹ A related paper is [Tillmann \(2017\)](#), who shows that monetary policy shocks lead to a significantly smaller increase in long-term bond yields in presence of high policy uncertainty. This literature focuses on uncertainty as a conditioning element. A different literature scrutinizes the effects of monetary policy shocks and the role of systematic monetary policy in recessions and expansions – see, e.g., [Mumtaz and Surico \(2015\)](#), [Tenreiro and Thwaites \(2016\)](#), and [Caggiano et al. \(2017a\)](#). For an empirical paper dealing with uncertainty shocks in different monetary policy regimes, see [Caggiano et al. \(2017b\)](#).

² The key contribution of firm-specific capital in this set up is that it implies strong effects on output by monetary policy shocks in presence of a reasonable frequency with which firms re-optimize prices. While sticking to firm-specific capital for comparability reasons with [Altig et al. \(2011\)](#), it is important to stress that alternative mechanisms are able to generate a similar result. A non-exhaustive list includes firm- and sector-specific labor, strategic complementarities due to an elasticity of firm demand that is increasing in the firm's price, sector-specific frequency of price changes, intermediate inputs, rational inattention, and state-dependent pricing. In general, any mechanism that causes a firm's marginal cost to increase with its output would be able to deliver the result delivered by firm-specific capital. For a discussion, see [Altig et al. \(2011\)](#).

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