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Inflation, output and markup dynamics with purely forward-looking wage and price setters[☆]

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ABSTRACT

Medium-scale New Keynesian models are sometimes criticized for their use of backward-looking wage and price setting mechanisms, and for assuming several types of disturbances, including some that would be difficult to interpret economically. We propose a DSGE model with purely forward-looking wage and price setters and parsimoniously chosen disturbances. Our model emphasizes an interplay between production firms networking and working capital. Firms can use working capital to finance all (or a fraction) of their outlays on production factors, and use the output of other firms as an input in a what is often called a “roundabout” production structure. Our model generates a response of inflation which is mute on impact of a monetary policy shock, but highly persistent and very hump-shaped afterwards. It also yields a large contract multiplier for output, two times larger than the one implied by a model relying on indexation only. We also show that the response of the price markup can be positive on impact of an expansionary monetary policy shock, which differs from the standard countercyclical markup channel emphasized in conventional New Keynesian models. In contrast to models relying on indexation to past inflation, our model produces non-inertial responses of inflation to productivity and investment shocks, a finding which is broadly consistent with the existing VAR evidence.

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1. Introduction

Medium-scale DSGE models (e.g. [Christiano et al. \(2005\)](#) or [Smets and Wouters \(2007\)](#)) are commonly employed by academics and policymakers for counterfactual policy analysis and forecasting simulations. A useful test of these models is whether or not they can generate conditional responses to shocks which are broadly consistent with available empirical evidence. So as to match the inertial inflation response to identified monetary shocks from the VAR literature, these models often rely upon ad-hoc backward-looking price and wage-setting mechanisms such as the indexation of prices and wages

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to the previous period's rate of inflation. The use of indexation has been criticized by a number of researchers.¹ Backward indexation also generates inertial, hump-shaped inflation responses to non-policy shocks. This is inconsistent with the non-inertial responses of inflation to productivity and investment shocks typically found in the empirical literature.

This paper proposes a framework which does not rely upon backward-looking price and wage-setting at all but which can nevertheless generate persistent, inertial inflation responses to monetary shocks and non-inertial inflation responses to non-policy shocks. We also use our model to discuss some issues related to the cyclicity of markups and the measurement of markups in the data. The core of our model is quite similar to the standard medium-scale DSGE model. In particular, the model features nominal price and wage stickiness in the form of Calvo (1983) staggered contracts, variable capital utilization, habit formation in consumption, and investment adjustment costs. Monetary policy is characterized by a conventional Taylor type rule for the nominal interest rate.

Our model departs from conventionally specified medium-scale models along several dimensions. First, unlike for example Christiano et al. (2005), it does not feature backward price and wage indexation. Second, our model features production networking, or the use by firms of intermediate goods in an input-output production structure. This is a feature of U.S. production which is well documented empirically, with a typical firm selling 50 percent or more of its output to other firms (Basu, 1995; Huang et al., 2004). This is often referred to as a “roundabout production structure.” Following Christiano (2015), we refer to this production structure as one of “firms networking.” Firms networking introduces strategic complementarities and makes marginal cost less sensitive to input factor prices.

Third, in our model firms must borrow to finance some or all of their payments to all factors of production – intermediate inputs, capital services, and labor. In Christiano and Eichenbaum (1992), Christiano et al. (1997, 2005), Ravenna and Walsh (2006), and Tillmann (2008), working capital serves only to finance wage payments before the proceeds of sale are received. There are a few exceptions to models where working capital finances only the wage bill. Assuming that working capital is used to purchase commodities and finance wage payments, Chowdhury et al. (2006) provide VAR evidence for the G7 countries supporting their specification. In Christiano et al. (2011), working capital is used to finance payments to labor and materials input, with the intent of showing that intermediate inputs and working capital can possibly lead to indeterminacy even if the central bank complies with the Taylor principle. In our model, working capital can be used in an extended form to finance the cost of all inputs, a case to which we refer as “extended borrowing.” It can also be used in a limited form, a case we call “limited borrowing,” to finance only subsets of these three inputs. For our baseline specification, we focus on the extended borrowing case. As we later show, varying the extent to which working capital finances inputs has rich consequences for the short-run dynamics of inflation and output, as well as for the cyclical behavior of the price markup conditioned on a monetary policy shock.

A fourth dimension along which our model differs from many medium scale DSGE models is that we focus on a limited number of structural disturbances. This is in part motivated by the critique in Chari et al. (2009) that medium-scale New Keynesian models often rely on a number of “dubiously structural” shocks in way that renders them unsuitable for policy analysis. It is also driven by our desire to focus on understanding mechanisms in our model and how they relate to the conventionally-specified medium scale model without trying to force the model to match all dimensions of the data.

We use our model with forward-looking price and wage setting to address four main questions. A first question is: can it generate a highly persistent and hump-shaped response of inflation to a monetary policy shock without assuming backward-looking elements in price and wage setting? A second question is: does it deliver “large” contract multipliers for output in the terminology of Chari et al. (2000)? The third question is: what does our model imply about the cyclicity of the price markup conditioned on a monetary shock and on the measurement of markups more generally? Finally, the fourth question is: can our model generate impulse responses to non-policy shocks which are broadly consistent with available empirical evidence?

Our baseline model predicts a response of inflation which is nearly mute on impact of a monetary policy shock and very persistent and hump-shaped thereafter. Absent firms networking and working capital, the response of inflation is largest on impact and only weakly persistent thereafter. Our model is also able to address the “persistence problem” emphasized by Chari et al. (2000). Output responds significantly to a monetary policy shock and in a hump-shaped and inertial fashion. In our model, the half-life of output conditional on a monetary shock is fourteen quarters. This is substantially larger than the half-life of output in a model without extended borrowing and firms networking, and is larger than a version of our model with backward price and wage indexation. Our model delivers all of these results without relying upon empirically implausible average waiting times between price and wage adjustments.

The key ingredient accounting for these findings is the interaction between firms networking and working capital. Firms networking introduces strategic complementarity into price setting, making inflation less sensitive to changes in real marginal cost by a factor of proportionality reflecting the share of intermediate inputs in production. Firms networking therefore makes the inflation response to a policy shock smaller on impact and more persistent, while at the same time making the output response to a policy shock larger. Working capital in its extended form contributes to making the inflation response to a policy shock very hump-shaped. Because of working capital, the nominal interest rate has a direct effect

¹ For example, Woodford (2007) argues that “the model's implication that prices should continuously adjust to changes in prices elsewhere in the economy flies in the face of the survey evidence,” while Cogley and Sbordone (2008) mention that backward wage and price setting mechanisms “lack a convincing microeconomic foundation.”

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