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Monetary policy with heterogeneous agents and borrowing constraints ☆

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ABSTRACT

We show that the long-run neutrality of inflation on capital accumulation obtained in complete market models no longer holds when households face binding credit constraints. Borrowing-constrained households are not able to rebalance their financial portfolio when inflation varies, and thus adjust their money holdings differently compared to unconstrained households. This heterogeneity leads to a new precautionary savings motive, which implies that inflation increases capital accumulation. We quantify the importance of this new channel in an incomplete market model where the traditional redistributive effects of inflation are also introduced. We show that this model provides a quantitative rationale for the observed hump-shaped relationship between inflation and capital accumulation.

1. Introduction

The long-run relationship between inflation, capital accumulation and growth, is one of the most celebrated issue in modern macroeconomics. This tradition dates back at least to the classic monetary neutrality result of Sidrauski (1967), who showed that money has no long-run effect on capital accumulation and output in the neoclassical growth model. This result has been challenged by recent empirical studies which conclude on the existence of a hump-shaped relationship between long-run inflation and capital accumulation. At low level of inflation, there is a positive relationship between inflation and capital accumulation as shown by Fischer (1993), Loayza et al. (2000) or Khan et al. (2006). But this relationship becomes negative at higher rate of inflation, as stressed by Bullard and Keating (1995) and Barro (1995).

These evidences on the non-neutrality of money have fueled many theoretical contributions. The literature has provided a rationale for the non-neutrality of money by including frictions such as distorting capital taxes (Phelps, 1973 and Chari et al., 1996 among others) and search frictions (Shi, 1999). The literature has also looked at redistributive issues of the seigniorage rents across households (Grandmont and Younès, 1973; Kehoe et al., 1992; and Erosa and Ventura, 2002) or across generations (Weiss, 1980; Weil, 1991). But all these studies have maintained the convenient assumption of the absence of binding borrowing constraints. They have thus abstracted from the possibility that saving decisions in capital and

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money, following changes in monetary policy could depend on the extent of binding borrowing constraints and incomplete markets.

The aim of this paper is to contribute towards filling this gap by investigating the role of binding borrowing constraints and heterogeneity in standard macroeconomic monetary models. The focus on borrowing constraint is motivated by two main considerations. First, this friction is empirically relevant. The tightness of borrowing constraints is a well-established empirical fact (Jappelli, 1990) and it is thus important to understand to what extent it interacts with monetary policy. Second, this friction challenges some key predictions of the standard neoclassical monetary growth model. In particular we show that the existence of borrowing constraints and incomplete markets can provide a rationale not only for the non-neutrality of money but also for the hump-shaped relationship between inflation and capital. This result is the product of two opposite effects of inflation that are only due to borrowing constraint and incomplete markets.

The positive effect of inflation on capital accumulation stems from the heterogeneity in household portfolio adjustment depending on their capacity to borrow. If households can use both money and capital to partially self-insure against idiosyncratic shocks, they substitute away money for capital if inflation rises and the real return on money falls. This is the traditional portfolio substitution effect that Tobin (1965) has shown in a world without credit constraint. But in presence of financial market imperfections, borrowing-constrained households are not able to undertake such portfolio adjustment and they adjust their money holdings differently compared to unconstrained households. Inflation triggers endogenous heterogeneity in money holdings in presence of borrowing constraints. This heterogeneity provides incentives for unconstrained households with positive income shocks to increase their precautionary savings in financial assets. As a consequence, inflation directly affects the aggregate stock of capital and output in the long-run. This new effect due to borrowing constraint has been ignored so far in the literature.

The negative effect of inflation on capital accumulation is the result of the redistributive impact of the inflation tax. Lump-sum monetary transfers from the inflation tax provide additional insurance when markets are incomplete. The redistribution of the inflation tax can thus decrease precautionary savings and the aggregate capital stock in the long-run. This redistributive effect is not new and was already assessed by Scheinkman and Weiss (1986), Kehoe et al. (1992) and more recently by Erosa and Ventura (2002). But these papers do not show that incomplete markets can provide a rationale for a hump-shaped relationship between inflation and capital accumulation since they do not investigate the so-called Tobin effect in presence of binding credit constraints.

The first contribution of this paper is theoretical. To the best of our knowledge, we provide a new channel for the non-neutrality of money on capital accumulation and output only due to borrowing constraints. In an economy with deterministic income shocks à la Woodford (1990), we show that inflation has a long-run effect as long as borrowing constraints are binding. Inflation affects in a different way the real balances demanded by constrained and unconstrained households. This leads to higher precautionary savings and increase capital accumulation and output. This real effect occurs even in the absence of any other potential channels proposed so far in the literature, such as tax distortions or leisure–labor supply distortions. Importantly, this non-neutrality result also shows up when we shut down the redistributive effect of the seigniorage rent which could provide insurance against idiosyncratic risks and could lead to a real effect of inflation.

The second contribution of this paper is quantitative. We show that the interplay between this new positive effect of inflation on capital accumulation and the negative redistributive effect of the inflation tax can match the hump-shaped relationship between inflation and capital. We run this quantitative analysis in an incomplete markets production economy à la Aiyagari (1994). *Ex-ante* identical infinitely-lived agents can accumulate interest-bearing financial assets in the form of capital to partially insure against individual income risks, but they face borrowing constraints. In this framework we embed money in the utility function (MIU). Money is valued both for its liquidity service and as a store of value which provides additional insurance against labor-market risks. Assuming money in the utility function is a reduced form to provide motives for money demand. But it has the key advantage to introduce simple departures, namely incomplete market and borrowing constraints, from the textbook MIU model in which money is neutral absent frictions. The analysis is carried on in an economy in which the wealth distribution and the fraction of borrowing-constrained households closely resemble that of the United States.

The benchmark model predicts a hump-shaped response of capital accumulation to inflation. At low values of the inflation rate, the model predicts that the Tobin effect will offset the redistributive effect. For higher values of inflation, the redistributive effect dominates as the lump-sum monetary transfers providing insurance increase with inflation. The maximum is reached at an annual inflation rate around 6 percent. This value is close to the empirical result of Bullard and Keating (1995) who find that the level of inflation maximizing the capital stock ranges between 3 percent and 6 percent in cross-country comparison. Moreover, an increase in the annual inflation rate from 0 percent to 6 percent raises the aggregate capital stock by 1 percent. In absolute terms, this result is quantitatively modest. But relatively to complete markets, this effect is significant since inflation would be neutral in this latter case.

We also investigate the quantitative importance of the different channels at work by looking at various redistributive schemes of the inflation tax. We first shut down the redistributive effect of the inflation tax to assess the quantitative impact of the Tobin effect. We find that the capital stock increases continuously with inflation. An increase in the annual inflation rate from 0 percent to 6 percent is associated with a rise in the capital stock by 0.9 percent. We also assume that the inflation tax might be used to decrease the distortionary taxes rather than being redistributed by lump-sum transfers. This possibility was suggested in particular by Phelps (1973). In this case, the capital stock increases with inflation even in the complete market environment. But we find that incomplete markets and credit constraints amplify the Phelps effect. An