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Global dynamics in a model with search and matching in labor and capital markets ☆

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ABSTRACT

In this paper global macroeconomic dynamics are studied when search frictions are present in both labor and capital markets. On the basis of the Merz (1995) macroeconomic model with labor market frictions and capital accumulation, our paper offers an extension to frictions in capital markets, analogously modeled as a search and matching process. Using the Merz model as limit case, we consider exogenous as well as endogenous borrowing constraints. We also allow the cost of issuing bonds to change endogenously. As we show, capital market frictions exacerbate and accentuate the interaction between the two markets and magnify the effects of shocks on output, consumption, employment, and welfare. This interaction of the frictions in labor and capital markets are also shown to give rise to multiple equilibria. On the basis of numerical solution techniques, instead of relying on first or second order approximations around a (unique) steady state, our paper uses dynamic programming techniques to compute decision variables and the value function directly and assess the local and global dynamics of the model. The steady state solutions are studied by using the Hamiltonian and the dynamics are assessed for various model variants by using dynamic programming techniques.

1. Introduction

Labor market search and matching has been increasingly used in the literature on dynamic stochastic general equilibrium models (DSGE), starting with the seminal paper by Merz (1995) that models labor market frictions in a Real Business Cycle (RBC) model. This approach has proved to be very fruitful to understand the dynamics of output and employment in an intertemporal decision framework. Here consumption, the search effort for jobs by workers, and vacancies posted by firms, are decision variables and both the capital stock and employment are state variables. In this way employment adjustments are costly, and sudden jumps in the employment level of firms are excluded. Nevertheless, the first generation of such search and matching models for the labor market has not been particularly successful in matching empirical facts on volatility of unemployment and vacancies. By modifying the basic model, recent models have

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performed better in terms of explaining the volatility of unemployment and vacancies (e.g. see Hagedorn and Manovskii, 2008).[1]

DSGE models have also been extended to include more realistic features of the capital market, such as the financial accelerator. The research on capital markets since the 1980s has pointed out that imperfections and frictions in the capital market prevent supply and demand for financial funds to match easily. Research conducted, for instance, by Bernanke and Gertler (1989) or Stigltiz and Greenwald (2003) demonstrates that there are informational asymmetries and search efforts involved in obtaining credit that makes capital markets behave markedly different from what has been perceived in standard theory. In particular, capital market borrowing may be subject to constraints and financing costs (such as costs to issue new corporate bonds). Those constraints and costs may be given exogenously (from the point of view of the firm) or endogenously, depending on the financial conditions of the firm, such as its net worth.

One step toward including more realistic features of capital markets has been to model capital markets in analogy to the labor market as a search and matching process, introducing a market for loanable funds in the spirit of the Wicksellian tradition. Due to such search frictions the supply and demand for bonds are not matched completely and savings may be left unused or there may be an excess demand of savings. Models along this line have recently been developed by Becsi et al. (2000), Den Haan et al. (2003), and Wasmer and Weil (2004). Credit constraints for firms are exogenous in these models since firms credit constraints are given through an aggregate search and matching process.

Following this strand of the literature, our model presented here, combines both search and matching in the labor market as well as in the capital market in a model with capital accumulation.[2] Yet, going a step further to reflect the work on imperfect capital markets and the financial accelerator, we endogenize financial market frictions and link them to financial conditions of firms. In this context, frictions arising in search and matching are called exogenous financial frictions (exogenous to the firm). On the other hand the frictions arising from collateralized borrowing will be called endogenous financial frictions, since they arise from endogenous credit constraints of firms. We then show that there are exacerbating and accentuating interactions of the two markets that exert—similar to the financial accelerator theory—strong effects on output, consumption, employment, and welfare. In particular, we demonstrate that multiple equilibria and low level steady states can easily arise in such a framework. In contrast to the labor market search literature, in our approach, financial market frictions can significantly alter the global dynamics and global outcomes, possibly leading to severe financial and real contractions.[3]

In contrast to some recent papers that have used default premia to construct financial accelerator models, we prefer the mechanism of endogenous credit constraints to demonstrate such magnifying mechanism of finance for the real economy. We want to take this as a starting point since the use of default premia in consumption-based macro-economic models is in an early stage and their success is still debated.[4] We can justify the use of endogenous credit constraints instead of default premia in such models, as both yield similar results but models based on credit constraints have a more solid base in the academic literature (see, for instance, Grüne et al., 2008a).

A further innovation of our paper relates to the numerical solution methodology, which attempts to meet the challenges of the particular characteristics and the out-of-steady-state behavior of such models. Typically, when intertemporal decision models are numerically solved, current approaches have used first or second order approximation methods to solve the model around a (unique) steady state.[5] Since in our context the global dynamics needs to be explored we use dynamic programming techniques that allow to better understand the global dynamics of the economy and to account for the possibility of destabilizing mechanisms, bifurcations and multiple steady states.[6] Yet, in order to usefully employ dynamic programming it is helpful to explore steady states by the use of the Hamiltonian and the computed steady states thereby.

The remainder of the paper is organized as follows. In Section 2 some further literature on search and matching in labor and capital markets are discussed. Section 3 presents our numerical solution technique. Section 4 introduces and solves a basic labor market search and matching model, the Merz (1995) model. Section 5 adds capital market search and matching in addition to the one on the labor market. Hereby the Merz model is considered the limit case of our extended model variants. Section 6 explores the global dynamics of our model variants by using dynamic programming techniques, assuming that credit constraints are exogenous. Section 7 studies two model variants with endogenous credit frictions, the first with endogenous credit constraints and the second with endogenous bond issuing costs. In both cases financial conditions of firms matter when borrowing from capital markets. A final section concludes the paper.

[1] Yet those types of models seem to be far from explaining some drift in unemployment or vacancies. For a number of further puzzles that can arise in this type of models see Krause and Lubik (2006, 2008).

[2] Note that we follow here the standard practice by using the term financial market "frictions". In contrast, recent research would rather suggest to speak about the magnifying effect of financial intermediation.

[3] Financial market frictions not only affect the transmission speed of shocks but also the long-run behavior of the economy.

[4] For the use of finance or default premia in those models, see De Fiore and Tristani (2008). In most of the literature it is stated that the quantitative effect of the default premia is small.

[5] For a more general evaluation of the accuracy of first and second order approximation methods see Becker et al. (2007).

[6] Along those lines Brunnermeier and Sannikov (2009) have recently argued that the destabilizing mechanisms, arising through nonlinearities, cannot be captured by local linearization techniques.