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Owning capital or being shareholders: An equivalence result with incomplete markets ☆

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ABSTRACT

Many recent papers in macroeconomics have studied the implications of models with household heterogeneity and incomplete financial markets under the assumption that households own the stock of physical capital and undertake the intertemporal investment decisions. In these models, production exhibits constant returns to scale, households maximize expected discounted utility, and firms rent capital and labor from households to maximize period by period profits. This paper considers the case in which infinitely lived firms, rather than households, make the intertemporal investment decisions. Under this assumption, it shows that there exists an objective function for firms that results in the same equilibrium allocation as in the standard setting with one period lived firms. The objective requires that firms maximize their asset value, which is defined as the discounted value of future cash flows using present value processes that do not allow for arbitrage opportunities.

1. Introduction

Dynamic stochastic general equilibrium models with an infinite horizon and incomplete financial markets have been used extensively in the macroeconomic literature to study a variety of issues (see e.g. Aiyagari, 1994 and Krusell and Smith, 1997, 1998). In these models, an homogeneous output good is produced with a constant returns to scale technology that uses capital and labor. Firms rent these two inputs from households to maximize short-run (period by period) profits, while households own and accumulate the stock of physical capital.

In contrast, the traditional general equilibrium literature with incomplete financial markets (GEI henceforth) models the firm as an infinitely lived entity that owns and accumulates its capital stock and is owned by its shareholders, who trade equity shares in a stock market rather than accumulating physical capital (see Magill and Quinzii, 1996, Chapter 6, for a review of this literature). Whereas this provides a more realistic description of the intertemporal behavior of firms, an important result of the GEI literature is that there can be disagreement among shareholders on the path of capital accumulation that

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the firm should adopt if financial markets are incomplete. This issue has been evaded in the macroeconomic literature by postulating that firms are one period lived entities, in which case the capital accumulation path is well-defined and can be characterized relatively easily.

In this paper we establish a link between these two literatures by showing that the equilibrium allocation in the class of models typically studied in macroeconomics can also be obtained as the equilibrium of a GEI model with a stock market and infinitely-lived firms. A key condition to obtain this result is that the firm objective in the GEI model is "value" maximization. This objective requires that firms discount cash flows with present value processes that are consistent with security prices, in the sense that they satisfy a no-arbitrage relation between security prices and their payoffs. An important finding is that the equivalence of allocations in the macroeconomic and the GEI settings holds for any such present value process and for general portfolio restrictions, regardless of whether they are binding or not. Moreover, when borrowing limits are effectively never binding, we show that shareholders unanimously agree on the investment decision of value maximizing firms.

The proof of our result hinges on two properties: that the production function has constant returns to scale in capital and labor and that agents in the economy exhibit uniform impatience. The latter assumption guarantees convergence of present value sums and it rules out stock price bubbles in equilibrium for all present value processes that are consistent with security prices. In the absence of price bubbles, the assumption of constant returns to scale guarantees that the capital stock that is chosen by a value maximizing firm is equal to its stock market value. Given that the stock market value of the firm coincides with the capital stock, a shareholders' choice of how many shares of the firm to hold in the economy with dynamic firms is formally equivalent to a consumer's choice of how many units of capital to accumulate in the economy with static firms. Hence, the equivalence of equilibrium allocations in these two settings.

Our work is related to the GEI literature in multiperiod settings (see e.g. Hernandez and Santos, 1996; Levine, 1989; Magill and Quinzii, 1994a, 1994b; and Levine and Zame, 1996). It relates more closely to the work of DeMarzo (1988, 1993) and Duffie and Shaffer (1986) who employ the assumption of value maximization. The former author demonstrates the validity of the Modigliani–Miller theorem while the latter study the issue of shareholder disagreement and prove existence of equilibria. Differently from these authors, who focus exclusively on firms as intertemporal decision-makers, we study the relationship between the allocations obtained in settings in which firms accumulate physical capital and the allocations obtained in the standard macroeconomic setting in which firms rent the physical capital and solve static decision problems.

The paper is also related to the literature on production-based asset pricing (see e.g. Cochrane, 2008, for a review). This literature has pointed out that in a standard real business cycle model the relative price of capital is one. Thus, all variations in stock returns over time are, somehow counterfactually, associated with variations in dividends rather than stock prices. Jermann (1998) was the first to evaluate the asset pricing implications of a setting with capital adjustment costs, which give rise to variations in the relative price of installed capital. Interestingly, we show that our equivalence result holds even in the presence of capital adjustment costs, as long as the adjustment cost function is linearly homogeneous. This finding should prove useful for the analysis of heterogeneous-agent incomplete markets economies with adjustment costs in capital. This class of models has not been explored much due to the fact that the presence of adjustment costs makes the representative firm's problem inherently dynamic, in which case the issue of disagreement among the firms' shareholders could make the problem potentially intractable. But this paper shows that the allocation of an economy with a value-maximizing dynamic firm facing capital adjustment costs is the same as the allocation of a two-sector economy with static firms in which consumers accumulate the stock of capital without directly facing any costs of adjustment.

Finally, the present paper relates to Carceles-Poveda and Coen-Pirani (2009), where we determine the level of investment that a firm's shareholders would want to implement when financial markets are incomplete. In particular, we show that if production exhibits constant returns to scale and shareholders' borrowing constraints are not binding, initial shareholders are unanimous in their choice of the firm's capital stock. The present paper differs from our previous work in a couple of important dimensions. First, we sidestep the issue of shareholders' preferences about the investment decision of the firm but ask instead whether there is a "reasonable" objective for the dynamic firm that would yield the same allocation as in the economy in which firms are static. The advantage of this approach is that the objective of value maximization we postulate yields the equivalence of allocations between these two economies, independently of whether the firm's shareholders are borrowing constrained or not. Second, our previous work focuses on a two-period model and only sketches the proof of how the unanimity results would carry through in a multiperiod economy. In contrast, the present paper explicitly focuses on an infinite horizon economy. In this context asset prices might deviate from their fundamental value and the possibility of asset bubbles has to be explicitly ruled out in order to establish our equivalence results.

The rest of the paper is organized as follows. The following section introduces the model and Section 3 presents the main equivalence results. These results and some extensions are further discussed in Section 4. Section 5 summarizes and concludes.

2. The model economies

In this section, we first introduce a common general environment and then present the two different model economies. The first economy is the one typically considered in the macroeconomic literature, where households own the stock of physical capital and make intertemporal investment decisions, whereas the representative firm simply rents capital and labor from the households to maximize profits on a period by period basis. In this sense, the firm can be considered as