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Market structure and multiperiod hedging

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Abstract

This paper develops a multiperiod hedging model for a competitive risk-averse international firm. We study the optimal sequential hedging strategy and analyze the impact of the structure of available risk sharing markets on the firm's export decision. As a main result, we find that the number of risk sharing markets critically affects the export level while the timing of these markets is inconsequential.

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1. Introduction

Most of the literature which links risk aversion and exchange rate uncertainty to allocation and hedging decisions by international firms is based on the assumption that the firm is concerned with a single period. There is only a single period during which hedging and investment take place (e.g., Danthine, 1978; Kawai & Zilcha, 1986; Broll & Eckwert, 1999). However, in many circumstances the distribution of profits over time and the structure of available risk sharing markets is important to the management of the firm. In this case, a multiperiod framework for decision making is needed (e.g., Benninga, Eldor, & Zilcha, 1985; Zilcha & Eldor, 1991; Froot, Scharfstein, & Stein, 1993; Moschini & Hennessy, 2000).

In the literature about international firms under uncertainty, hedging policies in the static case have been discussed by Benninga, Eldor, and Zilcha (1985); Kawai and Zilcha (1986); and Zilcha and Broll (1992), to name just a few. They show that

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introducing unbiased currency futures markets results in a separation and a full-hedge property. An intertemporal hedging model has been introduced by Zilcha and Eldor (1991). They study risk sharing arrangements in the form of currency futures markets in each period. It is shown that introducing unbiased currency futures markets results in a decline of the capital-labor ratio in all periods, and in some cases that production increases at all dates (i.e., the separation property does not hold). Contrary to Zilcha and Eldor (1991), the purpose of our paper is to analyze a multiperiod hedging model of an exporting firm in which the hedge policy can be updated over time. We consider an international firm which produces and exports a commodity at some fixed date in the future. The spot exchange rate at the date when the commodity will be sold is uncertain. Hence, the profits from the firm's production and export activity are stochastic. The firm takes a position in the futures market at the initial date, and may adjust its portfolio at various intermediate dates. At the final date, the firm offsets the futures position and sells the commodity on the world market.

As a main result, we find that an optimal hedging policy requires future commitments at all dates, although the risky sales revenues accrue only in the last period. The intuition for this result lies in the observation that the firm faces an uncertain spot exchange rate not only at the time when the output is sold. Rather, at the time when the output decision is made, the forward rates at the intermediate trading dates are also uncertain. A sequential hedging strategy allows the firm to hedge both the exchange rate risk on the spot market at the time when the output is sold and the forward rate risk at the intermediate trading dates.

We also demonstrate that the structure of available risk sharing markets critically affects the export decision of the firm. If the market structure is incomplete (i.e., if some futures markets are missing), then the firm exports less, as compared to a situation where the firm has access to a complete system of risk sharing markets. Surprisingly, with an incomplete market structure the export level does not depend on the specific dates at which the futures markets are organized. Only the degree of incompleteness of the market structure (i.e., the number of missing futures markets) matters.

The paper is organized as follows. Section 2 introduces a model of export production and intertemporal hedging under random spot exchange rates and a complete set of currency futures markets. The firm chooses an export level and a sequential hedging strategy. Section 3 analyzes the firm's production and hedging policy when the system of futures markets is incomplete. Section 4 contains some concluding remarks.

2. Hedging with a complete set of futures markets

We develop an intertemporal framework with three trading dates. Consider a firm which produces a commodity x domestically at cost $C(x)$ and exports its output to a foreign country. The cost function is increasing and strictly convex: $C'(x) > 0$, $C''(x) > 0$. The firm makes the production decision at date 0. Date 1 is the production period. At date 2, the output will be ready for sale on the foreign country's market at a known price p. The exchange rates $\tilde{e}_1$ (at $t = 1$) and $\tilde{e}_2$ (at $t = 2$) are random variables with