International Capital Market, Currency Forward Contract and the Export Decision

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1. INTRODUCTION

Since the advent of flexible exchange rates in 1973 the decisions of international firms have been made in an environment of highly uncertain exchange rates. Thus for international firms the need to manage foreign exchange rate uncertainty has increased substantially (see for example KRUGMAN [1989], VON UNGERN-STERNBERG and VON WEIZ-SÄCKER [1990], DONNENFELD and ZILCHA [1991], FRANKE [1991] and others). However at the same time a variety of hedging instruments such as currency forwards, futures and options are being offered by financial agents.

Due to the high volatility of exchange rate changes each firm involved in exports (or imports) experiences a considerable amount of uncertainty regarding its future profit from international trade. A risk-averse firm will respond to these risks by adjusting its production decision and by taking hedging opportunities into account. These considerations have led to the intensified use of risk sharing markets such as currency forward and currency option markets.

Recently several studies have been derived the separation theorem for international firms facing exchange rate (or price) uncertainty when hedging markets are available. Namely, if a currency forward (or futures) market exists the firm’s optimal production becomes independent of the firm’s attitude towards risk and independent of the exchange rate distribution function (see for example DANTHINE [1978], FEDER, JUST and SCHMITZ [1980], KAWAI and ZILCHA [1986], BROLL and ZILCHA [1991a], ZILCHA and ELDOR [1991], BROLL and WAHL [1992] and others). In the following this separation result is examined in a two-period model and in the presence of domestic interest rate uncertainty as well. A potential change in interest rates is a risk faced by almost any investor or firm in many countries. Introducing interest rate risk, which is nondiversifiable, affects the export production, i.e., the separation property does not hold. However, we show that the adverse effect of the missing interest rate futures markets disappears when international borrowing is available.

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In section 2 we present the model and it is shown that when the exporting firm can borrow at the domestic capital market only and if the interest rate is stochastic the separation theorem does not hold with a currency forward market. In section 3 we introduce foreign capital markets with nonrandom interest rate. Therefore allowing the firm to borrow (or lent) at the currency of the importing country, the separation theorem holds. The availability of international capital markets will eliminate the adverse effects of the random domestic interest rate. Finally, the paper's conclusions are noted.

2. RANDOM EXCHANGE RATE AND INTEREST RATE

Consider a competitive, risk-averse firm which produces a commodity to be exported. Two types of uncertainties affect the firm's behavior. First, the foreign exchange rate $\tilde{e}_1$ is random. Second, the interest rate $\tilde{r}$ is another random variable. The exporting firm is a price taker in the output and input markets. We denote by $p^*$ the given foreign commodity price and $w, q$ the factor rentals for domestic labor $L$ and capital $K$ inputs.\(^1\) The production process is described by a strictly concave production function $F(K,L)$. The firm must choose the capital investment $K$ in the planning period (first period), while labor $L$ is determined at the outset of the second period, when production takes place but before the exchange rate is known.

We assume that the firm maximizes expected utility of profits denominated at local currency. Let $U$ be its von Neumann-Morgenstern utility function where $U' > 0, U'' < 0$, i.e., we assume risk aversion. The firm's income $Y_t$ at each period $t = 0, 1$ is given by

$$Y_0 = \bar{W} + B - qK,$$
$$Y_1 = \tilde{e}_1 p^* F(K, L) - wL - (1 + \tilde{r}) B + h (e_f - \tilde{e}_1),$$

where $\bar{W}$ is the initial wealth, $B$ is the amount borrowed (or lent), and $h$ (hedging amount) is the currency forward commitment. The forward exchange rate is denoted by $e_f$. The exporting firm has to choose $B, K, L$ and $h$ before the exchange rate is known. Thus the optimization problem is

$$\max_{(B, K, L, h)} [U(Y_0) + \delta EU(\tilde{Y}_1)].$$

(1)

where $\delta$ is the rate of time preference and the expectation is with respect to the joint distribution of $\tilde{e}_1, \tilde{r}$. The necessary and sufficient conditions for optimum are

\(^1\) Suppose the wage rate $w$ is determined in $t = 0$ by a contract for the whole industry. The effect of an uncertain wage rate is studied in KAWAI and ZILCHA [1991].
\[ U'(Y_0) - \delta EU' (\tilde{Y}_1) (1 + \tilde{r}) = 0, \]  
\[ -qU'(Y_0) + \delta P^* F_K(K, L) EU' (\tilde{Y}_1)\tilde{e}_1 = 0, \]  
\[ \delta EU' (\tilde{Y}_1) (e_1 p^* F_L(K, L) - w) = 0, \]  
\[ \delta EU' (\tilde{Y}_1) (ef - \tilde{e}_1) = 0. \]

From equations (2)—(5) it is easy to derive that

\[ F_K(K, L) = \frac{qU'(Y_0)}{\delta p^* ef EU' (\tilde{Y}_1)}, \]  
\[ F_L(K, L) = \frac{w}{ep^*}. \]

However condition (6) cannot be expressed independently of \( EU' (\tilde{Y}_1) \) since interest rate futures are missing.

**Definition:** We say that the separation theorem holds if the export production of the firm is independent of its attitude towards risk and independent of the exchange rate distribution function.

Now we prove that the separation theorem does not hold in this case.

**Proposition 1** Assume that the exchange rate \( \tilde{e}_1 \) and the interest rate \( \tilde{r} \) are random variables. Then the existence of a currency forward market does not imply the separation theorem.

The proof is a direct result of equation (6) and (7).

Therefore, in determining labor and capital input, the exporting firm takes into account its attitude towards risk and the joint distribution functions of \( \tilde{e}_1, \tilde{r} \). Thus, when an additional risk factor such as interest rate risk is added to the model, a single hedging instrument is not capable and effective in hedging two kinds of risk, hence, the separation property cannot be obtained. Or in other words, uncertainty in the exchange rate and interest rate have real adverse effects on production and international trade.

3. INTERNATIONAL CAPITAL MARKET

Assume now that international borrowing is possible and let us examine the implication of this hedging instrument for the export decision. We denote by \((B^*, r^*)\) the loan contract made by this firm at the importing country. Now we prove

2. See BROLL and ZILCHA [1991b].
**Proposition 2 (Separation).** Assume that the domestic interest rate is random and that a currency forward market exists. If international borrowing is available (at nonrandom interest rate) then the optimal export can be determined independently of the utility function and the probability beliefs.

*Proof.* Let us rewrite income $Y_0$ and $Y_1$ when the firm can make a loan contract in the foreign country at a given interest rate (and let the exchange rate at $t = 0$ be $e_0$):

$$
Y_0 = W + B + e_0 B^* - qK,
$$
$$
Y_1 = e_1 [p^* F(K, L) - (1 + r^*) B^*] - wL - (1 + r) B + h (ef - e_1).
$$

The firm maximizes as in (1) choosing optimally $B^*$ as well. The additional equation to the first order conditions (2)—(5) is,

$$
e_0 U' (Y_0) = \delta (1 + r^*) EU' (\bar{Y}_1) e_1.
$$

Thus from (5) and (8) we obtain, $e_0 U' (Y_0) = \delta (1 + r^*) ef EU' (\bar{Y}_1)$. Therefore equation (6) can be rewritten as,

$$
F_K (K, L) = \frac{q(1 + r^*)}{e_0p^*}.
$$

Thus (7) and (9) imply that the firm’s optimal choice of $L$ and $K$ is independent of the utility $U$ and the joint distribution function of $\bar{e}_1, \bar{r}$. This proves the separation result of Proposition 2.

As in the case of certainty, maximization in the presence of currency forward contracts and international borrowing requires that the exporting firm sets the value of the marginal product of each factor equal to its factor rental rate (see condition (7) and (9)).

The separation theorem demonstrates that the firm’s decisions about resource allocations are independent of the utility function or the joint probability distribution. This means that any two exporting firms with identical technologies and costs but with different attitudes towards risk and different probability beliefs will choose the same levels of inputs. This observation, that without interest futures the possibility to borrow on international capital markets leads to the separation theorem, is interesting. As one can

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3. To exclude corner solutions we assume that the optimization problem satisfies $B > 0, B^* > 0$.

4. Note however, that the hedging behavior will depend on the attitude towards risk and the joint distribution function, see BROLL and ZILCHA [1991a,b] and others.
see such a financial instrument plays the role of interest futures due to the fixed interest rate in the foreign capital market.

4. CONCLUDING REMARKS

In this paper we have examined the optimal behavior of a risk—averse firm who supplies a commodity invoiced in foreign currency. Under exchange rate and interest rate uncertainties, the firm decides on the level of export production, loan contracting and the extent of currency forward commitments. It was shown that the existence of currency forward market does not imply the widely recognized separation theorem since interest rate futures are missing. However, when international borrowing is possible then the firm’s export decision is independent of its attitude towards risk and the joint distribution of the exchange rate and the domestic interest rate.

The reason for this result is the following. When a currency forward market exists and when the foreign interest rate is nonrandom the availability to this foreign capital market creates a hedging device against the uncertain domestic interest rate. Although borrowing abroad has a stochastic nature due to the random exchange rate however the existence of currency forward market creates a capital market with a certain rate of interest. Therefore, allowing exporting firms to borrow in the foreign capital market constitute a substitute for the missing interest rate futures market. Thus providing them with a hedging device which reduces the risk and promote international trade.
REFERENCES


SUMMARY

This paper examines the behavior of a competitive risk—averse exporting firm, facing exchange rate and interest rate uncertainty. It is shown that the existence of a currency forward market does not imply the widely recognized “separation theorem”. However, when international borrowing is possible then the firm’s export decision is independent of its attitude towards risk and the joint distribution of the exchange rate and the domestic interest rate. Therefore, allowing firms to borrow in the importing country’s capital market constitute a substitute for missing interest rate futures.

ZUSAMMENFASSUNG

In diesem Beitrag wurde der Einfluss der Wechselkursvolatilität und des Zinsänderungsrisikos auf den internationalen Handel am Beispiel der Exportproduktion untersucht. Als Ergebnis lässt sich festhalten: Maximiert ein risikoavser Exporteur seinen erwarteten Gewinnutzen, dann führt ein Hedging mittels Terminkontrakt und internationalem Kreditvertrag zur “Separation”, d.h., die optimale Exportproduktion ist sowohl unabhängig vom Ausmass der Risikoaversion des Exporteurs, als auch von seinen Wechselkurserwartungen. Der Risikoeffekt unsicherer Wechselkurse und Zinsen in bezug auf die Produktionsentscheidung wird damit eliminiert und vollständig auf die Hedgingentscheidung (Termin-Kontrakt und internationaler Kreditvertrag) verlagert.

RESUME

Cet article traite de l’analyse concernant les conséquences des marchés terme sur devises pour la décision d’exportation des multinationales. Les résultats obtenus indiquent que les décisions d’exportation et de couverture à terme peuvent être séparées. L’incertitude des cours de change n’a donc aucun effet sur la production mais uniquement sur la couverture à terme.