Economic Modelling 26 (2009) 974–977

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/econbase

Modelling information and hedging: The exporting firm

Udo Broll [a,*], Bernhard Eckwert [b,1]

[a] Department of Economics, Dresden University of Technology, Germany
[b] Department of Economics, Bielefeld University, Germany

ARTICLE INFO

Article history:
Accepted 4 March 2009

JEL classification:
D81
D83
F11
F31

Keywords:
Information
Transparency
Exchange rate risk
Hedging
Trade

ABSTRACT

The paper examines the economic role of modelling information on the decision problem of an exporting firm under exchange rate risk and hedging. Information is described in terms of market transparency, i.e., a publicly observable signal conveys more information about the random foreign exchange rate. We analyze the interaction between market transparency and the ex ante expected utility of the exporting firm. It is shown that more transparency on the foreign exchange market may result in higher or lower export production.

1. Introduction

The uncertainty to which decision makers are exposed in a global economy depends on the amount and the precision of information available to them. More reliable information, e.g. about exchange rates, interest rates, prices, technology, or market conditions, allows market participants to make better decisions. When the information is of public nature, rather than privately owned by the individual, it will be used by other agents, too. Under such circumstances the information may affect endogenous market mechanisms (Burnside et al., 2001).

The precision of information revealed to agents through an information system has recently been conceptually linked to the notion of market transparency. The policy oriented literature stresses the role of transparency for a functioning economy. This paper suggests a different notion of transparency for the financial market and analyzes its role for the decision problem of an exporting firm under exchange rate uncertainty. The risk averse exporting firm has access to a currency futures market where it can hedge its net exposure connected with its export (see, for example, Broll et al., 1999; Wong, 2003). Prices and contracts traded on the currency forward market depend upon market transparency.

In our study the market transparency is linked to the informativeness of a publicly observable signal which is correlated with the random foreign exchange rate. The signal conveys some noisy information about the unknown exchange rate and, therefore, allows the firm to update its beliefs. The uncertainty to which the exporting firm is exposed when it decides about resource allocation for production depends on the observed signal as well as on the information system within which the signal can be interpreted. We characterize the foreign exchange market as more transparent if the signal conveys more precise information about the unknown foreign exchange rate. Thus, more information means that the exchange rate uncertainty is reduced through the disclosure of more reliable information.

In the literature there are mainly three analytical concepts measuring the degree of information and proposing an order of the underlying information systems. They were proposed by Blackwell (1953), Lehmann (1988), and Kim (1995). The notion of transparency used in our study is adopted from the work by Drees and Eckwert (2003). They characterize market transparency by using a criterion which is conceptually related to the literature that emerged from the seminal works by Blackwell (1953). For other concepts of transparency that have been used in the economic literature, see Heinemann and Illing (2002), Krebs (2005).

There is a large body of related literature which analyzes the welfare effects of public information. When individuals make decisions in isolation from others, more reliable information is generally beneficial (Blackwell, 1953). Yet, more information can have detrimental effects if the information affects risk sharing arrangements in

* Corresponding author. Tel.: +49 351 463 33230; fax: +49 351 463 37736.
E-mail addresses: udo.broll@tu-dresden.de (U. Broll), beckwert@wiwi.uni-bielefeld.de (B. Eckwert).
[1] Tel.: +49 521 106 5119.

0264-9993/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.econmod.2009.03.005

the economy (Hirshleifer, 1971, 1975; Schlee, 2001) or if agents interact strategically using private information and public information simultaneously (e.g. Morris and Shin, 2002). In this paper we abstract from informational asymmetries but we allow for some risk sharing through a competitive futures market. While market transparency does not affect the risk premium on this market, it does have implications for the amount of risks that will be shared in equilibrium.

We demonstrate that the impact of more precise information on the exporter's ex ante expected utility depends on the degree of risk aversion and on the firm's technology. In particular, more transparency reduces the exporter's ex ante expected utility, if the firm is highly risk averse and if marginal productivity is decreasing rapidly. The exporting firm benefits from more transparency on the foreign exchange market if it is moderately risk averse and/or marginal productivity is slowly decreasing. We find that more transparency may increase or decrease the export production of the firm. The impact depends on the exporter's technology. It is also shown that more transparency may result in less average output even though on average more resources, i.e. labor, has been used in the production process.

The rest of the paper is organized as follows. Section 2 develops a two period model of the exporting firm's decision problem. We introduce the concept of market transparency which underlies the analysis. Section 3 derives the main results. The final section concludes.

2. The model: export, hedging and information

We consider the model of a competitive risk averse exporting firm which extends over two periods, $t=0,1$. The firm employs labor, L, as an input factor for the production of a homogenous good in period 0 and sells its product at a given world price in foreign currency p per unit. The wage rate, w, is given. The foreign exchange rate $\tilde{e}$ is random in $t=0$. The tilde refers to the stochastic nature of the exchange rate which assumes values in $\Omega=[\underline{e},\bar{e}]$, where $0<\underline{e}<\bar{e}<\infty$. The production technology of the firm is described by a strictly concave function $F(L)$ with $F'(L)>0$, $F''(L)<0$. The firm has access to a currency forward market where it can hedge the spot exchange rate risk.

Prior to the firm's decision on employment and hedging a publicly observable signal s is realized. This signal is the realization of a random variable $\tilde{s}$ which is correlated with the foreign spot exchange rate $\tilde{e}$. Hence, the signal s contains information about the unknown foreign exchange rate and, at the time when the firm chooses labor input for export production, the relevant expectation for $\tilde{e}$ is the updated (in a Bayesian way) posterior belief.

The currency forward market opens at date 0 after the signal has been observed. In this market futures contracts are traded each of which involves the obligation on the part of the seller to deliver e units of domestic currency to the buyer at date 1 if the exchange rate turns out to be e. Let H denote the number of futures contracts sold by the firm. We assume that the futures market is unbiased, which implies that the futures market clears at a price $e_f(s)$, that is equal to the conditional mean of a contract's payoff, i.e. $e_f(s)=E[\tilde{e}|s]$. Both the purchase price and the payoff of a futures contract fall due at time 1. The production decision is made after the signal has been observed, but before the foreign exchange rate is known. Therefore, the firm is subject to economic risk.

In order to hedge the risk exposure, the firm sells (buys) H units of the currency forward on the futures market. The random operating profit of the firm is $\tilde{\Pi}=\tilde{e}pF(L)-wL-(\tilde{e}-e_f(s))H$ and the firm's decision problem reads

$$\max_{L,H} E\left[U\left(\tilde{\Pi}\right)\middle|s\right],$$

where U is a strictly increasing, strictly concave and twice continuously differentiable utility function. The firm maximizes the expected utility with respect to labor input, L, and future commitment H. The necessary and sufficient first order conditions are

$$E\left[U'\left(\tilde{\Pi}^*\right)\left(\tilde{e}pF'\left(L^*\right)-w\right)\middle|s\right]=0,$$

$$E\left[U'\left(\tilde{\Pi}^*\right)\left(e_f(s)-\tilde{e}\right)\middle|s\right]=0.$$

From these two equations we obtain the optimal level of labor input, L^*, and the optimal forward commitment, H^*, as

$$e_f(s)pF'\left(L^*\right)=w \quad \text{and} \quad H^*=pF\left(L^*\right).$$

This implies that the optimal level of labor demand, L^*, is an increasing function of $e_f(s)$. Due to unbiasedness of the futures market risks are fully hedged and, consequently, the exporter's profit is certain: $\Pi=e_f(s)pF(L^*)-wL^*$.

We identify the transparency of the financial market with the informativeness of the signal $s\in S\subset\mathbb{R}$, which is publicly observable. The informativeness of the signal depends on the information system within which signals can be interpreted. An information system, denoted by g, specifies for each state of nature, e, a conditional probability function over the set of signals: $g(s|e)$. The positive real number $g(s|e)$ defines the conditional probability that the signal s will be observed if the true exchange rate is e. The function $g(s|e)$ is common knowledge. Using Bayes's rule, the firm revises its expectations and maximizes expected utility on the basis of the updated beliefs.

Let $\pi\colon \Omega\to\mathbb{R}_+$ be the density function for the prior distribution over Ω. The density for the prior distribution over signals in S is given by

$$\nu(s)=\int_\Omega g(s|e)\pi(e)\mathrm{d}e \quad \text{for all } s.$$

The density function for the updated posterior distribution over Ω is

$$\nu(e|s)=g(s|e)\pi(e)\,/\,\nu(s).$$

Blackwell (1953) suggested a criterion that ranks different information systems according to their informational contents. Suppose g^1 and g^2 are two information systems with associated density functions $\nu^1(\cdot)$ and $\nu^2(\cdot)$. The following criterion induces an ordering on the set of information systems.

Definition. Let g^1 and g^2 be two information systems. Information system g^1 is said to be more informative than information system g^2 (expressed by $g^1\succ_{\inf} g^2$), if there exists an integrable function $\lambda\colon S^2\to\mathbb{R}_+$ such that

$$\int_S \lambda(s',s)\mathrm{d}s'=1,$$

for all $s\in S$, and

$$g^2(s'|e)=\int_S g^1(s|e)\lambda(s',s)\mathrm{d}s$$

for all $e\in\Omega$.

According to this criterion, $g^1\succ_{\inf} g^2$ holds if g^2 can be obtained from g^1 through a process of randomization. The probability density $\lambda(s',s)$ transforms a signal s into a new signal s'. If the s' values are generated in this way, the information system g^2 can be interpreted as being obtained from the information system g^1 by adding random noise. Note that $\lambda(\cdot,\cdot)$ is independent of e. Therefore, the signals under information system g^2 convey no information about the value of $\tilde{e}$ that is not also conveyed by the signals under information system g^1.