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International trade and firms' attitude towards risk

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ABSTRACT

This paper examines the optimal production and trade decisions of the domestic firms facing uncertainties owing to the exchange rate volatility under mean-variance preferences. The impact of uncertain exchange rate fluctuations on trade is evaluated in a partial equilibrium framework, using the concept of risk-aversion elasticities. These elasticities measure how sensitive the firms are towards substituting between return and risk at the margin, with respect to changes in the distribution of the spot exchange rate. This simplest possible analytical framework is useful for explicit empirical estimation of risk-aversion elasticities in the literature of international economics.

1. Introduction

One of the most contentious issues in international economics is the effect of the uncertainties associated with the exchange rate fluctuations on the international firms, and therefore, on the entry and exit into export market (extensive margin) as well as on the volume of international trade (intensive margin). There is relatively little evidence on the responses of exports, due to the exchange rate volatilities, at the level of firms or individual producers. Exceptions include Cheung and Sengupta (2013), Berman et al. (2012), Broll and Eckwert (2009), Arize et al. (2008), Greenaway et al. (2007), Cheung (2005), Bernard and Jensen (2004a, 2004b), Forbes (2002), and Franke (1991). Among these, Cheung and Sengupta (2013) examined the impact of exchange rate changes on the volume of exports of the Indian manufacturing firms, i.e. at the intensive margin. They have found negative and significant effects on firm's export shares of exchange rate appreciation. Cheung and Sengupta (2013) have also noted, for their sample of Indian firms from 2000 to 2010, that the exchange rate fluctuations have differential firm–specific effects on the export shares, with an asymmetric response towards the exchange rate movement.

However, these empirical studies fail to explain how and why should uncertainties associated with the distribution of foreign exchange rate contribute towards the individual firms decisions on diversifying productions into domestic and export sales, at the intensive margin. The study of an exporting firm under exchange rate uncertainty has been the subject of considerable research in decision making under uncertainty.[1] These papers examined the production and export decisions of the exporting firm using the standard von Neumann–Morgenstern expected utility representation. But, in all of these theoretical contributions, the exporting firm under consideration cannot simultaneously serve both domestic and foreign markets. Given this, this paper applies the two–moment decision model,[2] which is based on the utility of the expected value and the standard deviation of the uncertain final profit in order to examine the optimal production decision for an international firm that serves simultaneously both domestic and foreign markets. Risk preferences only contribute to alter the allocation of production between these two activities, keeping the total production unchanged. Therefore, we do not impose any specific *a priori* assumption about the firm, for the sake of simplicity and ease of interpretation.

In order to characterise the attitude towards risk, various concepts of risk aversion have been introduced; such as standard risk aversion, prudence, risk vulnerability, and shifts in the first–order stochastic dominance. Two–moment decision making (i.e., mean–standard deviation) model is an alternative and simple technique to analyse decisions to participate in the international market in the presence of external shocks. Albeit this modelling technique sometimes is misperceived as the special case of the expected utility framework, the

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[1] See, for example, Kawai and Zilcha (1986), Viaene and Zilcha (1998), Broll and Eckwert (1999), to name just a few.

[2] See, for example, Saha (1997), Ormiston and Schlee (2001), Eichner and Wagener (2011, 2014), Broll et al. (2015).

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latter is completely different from the two-moment decision making modelling approach. This is due to the fact that when the random variables under some choice set differ only in terms of the scale (standard deviation) and location (mean) parameters of the distribution, then an expected utility ranking of these random variables can be based on the means and standard deviations of the alternatives' risky outcomes, if uncertainty represented by a stochastic variable and the decision maker's decision variable interact in a linear way (Meyer, 1987).

The decision problem of a risk–averse firm can also be characterised by such a linear interaction between random influence of the (spot) foreign exchange rate and the production decision using mean–standard deviation modelling approach. This approach allows us to model the firm being linked to both domestic and the world market simultaneously, in contrast to the existing theoretical contributions.

Therefore, this paper examines the optimal production and export decisions of a risk–averse firm facing exchange rate uncertainty under mean–variance preferences, where the revenue risk is stemmed from the uncertain movements in foreign (spot) exchange rate.[3]

Recent literature,[4] supports the fact that the export intensity of the firms, even at the intensive margin, often depends on the different specific characteristics (such as product–quality differences, cost advantages, market transparency) among the firms, which will contribute to the mark–up adjustments by these firms in response to the exchange rate volatilities in the international market.[5] Hence, the attitude towards risks owing to the uncertainties associated with the distribution of foreign exchange rate should be worthy to study. Therefore, while the increase in such risks arising from the external shock leads to unambiguous substitution effect (the decision maker reacts by switching to less risky alternative), and an ambiguous income effect (Davis, 1989). Both effects should matter for a risk–averse exporter at the intensive margin. Using the concept of risk aversion elasticity we show how changes in the mean or the standard deviation of the exchange rate distribution affect an individual firm's decisions on domestic production and trade, i.e. exports. In fact, our paper shows that the substitution and income effects together may induce a risk–averse firm to optimally export more, depending on the magnitude of the risk–aversion elasticity.

As demonstrated in Goldberg et al. (2010), for a large developing country like India, expansion in the sales of domestic products by the Indian manufacturing firms during the liberalised regime, even at the intensive margin, can be attributed largely to the increased imports of intermediate inputs from abroad by the domestic firms. Therefore, an immediate subsequent question that should arise in our mind is how far the uncertainties in the distribution of foreign exchange rate at the import market would affect domestic production* This paper, for the first time, also devotes itself to the analysis of the risk–taking behaviour (i.e. the optimal import decision) for a representative risk–averse competitive domestic firm that imports intermediate input from abroad for domestic production and facing external shocks in the import market, using mean–standard deviation model. Hence, the firm in this case, is facing uncertainties surrounding the cost of production due to the volatilities in (spot) foreign exchange rate of the import market. This is analysed in Section 4 of this paper.

We aim at systematic analyses of economic response in the mean–variance framework. All comparative static effects are described in relative terms, i.e. risk–aversion elasticities. Elasticities measure how sensitive risk aversion of the firm is with respect to changes in the distribution of the random variable.

The rest of this paper is organised as follows. Section 2 delineates the model for a firm, serving both domestic and export markets, with some monopoly power under revenue risk, owing to the uncertain movements in foreign (spot) exchange rate. Section 3 demonstrates how risk–aversion elasticity affects optimal production allocation decision for such exporting domestic firm. In Section 4, we examine the effect of cost uncertainties, owing to the exchange rate volatilities in the import market, on the optimal import decision for a domestic firm that uses imported inputs for its production. We bring in the empirical relevance of our results in Section 5. The final Section 6 concludes.

2. The firm serving both domestic and export markets

Let us consider a firm that serves both the domestic market and a foreign country market under exchange rate uncertainty, facing a downward sloping residual demand curve at home and abroad. There is a single period horizon with two dates, i.e. t=0 and t=1. To start with, let us assume at t=0, the firm produces a single product in the home country according to a known cost function, $C(q)$, with $C'(q) > 0$, and $C''(q) > 0$, i.e. marginal costs are increasing (i.e. the firm's production technology exhibits decreasing returns to scale). We suppress the riskless interest rate by compounding all operating profits to their future values at the end of the period. We assume that the firm chooses different prices in home and abroad: the firm faces $p(x)$ as the price schedule of the exportable x in units of foreign currency; while $p(y)$ is the price schedule of the product y sold in domestic market, in units of domestic currency, faced by the firm. Revenue functions $R(x)$, $R(y)$ in both home and foreign markets (in units of their respective currencies) are concave; i.e. $R'(y) > 0, R''(y) < 0$, and $R'(x) > 0, R''(x) < 0$. The firm regards the spot exchange rate, $\tilde{e}$, as a random variable that is distributed according to a know cumulative distribution function (CDF), over support $[\underline{e}, \bar{e}]$.[6] The exchange rate, $\tilde{e}$, is expressed in units of the home currency per unit of foreign currency. With total output $q = x + y$, the random operating profit of the firm reads

$$\tilde{\pi} = \tilde{e}R(x) + R(y) - C(x + y).$$

The domestic firm's preferences are given by a two-parameter utility function:

$$V = V(\mu, \sigma), \tag{1}$$

where $\mu = \mu_e R(x) + R(y) - C(x + y)$ and $\sigma = \sigma_e R(x)$ denote, respectively, the expected value and the standard deviation of random profit π. We require the following properties to be satisfied for all μ, σ: $V_\mu(\mu, \sigma) > 0$, $V_\sigma(\mu, \sigma) < 0$. The marginal rate of substitution (MRS) between risk and return is defined by

$$S = -\frac{V_\sigma(\mu, \sigma)}{V_\mu(\mu, \sigma)} > 0. \tag{2}$$

The marginal rate of substitution between risk and return, $S(\mu, \sigma)$, is the two–parameter equivalent to Arrow-Pratt measure of absolute risk–aversion. Indifference curves in (σ, μ)-space are upward-sloping, with their slopes measuring risk–aversion.

The domestic firm's ex-ante decision problem as such is given by

$$\max_{x\geq 0,\ y\geq 0} V(\mu(x, y), \sigma(x, y)). \tag{3}$$

When we consider interior solutions of this decision problem,[7] the optimum is then determined by

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[3] It should be worthwhile to mention that Broll and Wong (2015) explicitly model ambiguity for an exporting firm that sells in both the home country and a foreign country under smooth ambiguity aversion. However, our paper uses the simplest possible analytical framework without modelling ambiguity aversion using simple portfolio theory to illustrate the risk–taking behaviour, not only for the similar type of exporting firm, but also for another type of risk–averse firm that produces for the domestic market, using imported input from abroad.

[4] Wong (2003), Mallick and Marques (2016a, 2016b), Wagner (2016) and Mukherjee (2016).

[5] We are grateful to the Editor of this journal to point us out this.

[6] All random variables are denoted by a tilde, while their realisations are not.

[7] Corner solution would have been relevant only if we would allow for zero exports. This point is illustrated after Eq. (6).

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