The Effects of Market Structure and EVRRs Adjustment on the Economic Exposure of Exporting Firms in China

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ABSTRACT

A firm is subject to "economic exposure" if its value is affected by changes in exchange rates. This paper aims to investigate the effects of Chinese Yuan (renminbi (RMB)) appreciation on the value of exporting firms in China by examining how market structure and Export Value-Added Tax Refund Rates (EVRRs) adjustment affect the economic exposure of an exporting firm in China. This study shows that the effect of RMB appreciation on the value of an exporting firm in China is simply a proportion of its net revenues based in USD if the exporting firm is a Stackelberg leader or operates in a market that is characterized by monopolistic competition. This proportion varies with different EVRRs adjusted for the exporting firm. The higher the EVRR for the exporting firm, the greater the proportion will be. This study also shows that the effect of RMB appreciation on the value of an exporting firm in China is more complex if the exporting firm operates in a market structure that is characterized by Cournot competition or where Stackelberg leadership is exercised by a foreign firm. Therefore, market structure and EVRRs adjustment are crucial in determining the effects of RMB appreciation on the value of exporting firms in China.

Keywords: Economic exposure; RMB appreciation; Market structure; EVRRs adjustment.

INTRODUCTION

Mainland China has pursued an "open door" policy since its economic reform in 1978. It implemented rapid trade and direct investment liberalization policies in the 1990s and joined the WTO in 2000 (Kwack, Ahn, Lee and Yang, 2007). To enhance the competitive advantage of its exporting firms in international markets, China also implemented an Export Value-Added Tax Refund policy on its export goods. Export Value-Added Tax Refund Rates (EVRRs) were used to determine the rate of the Value-Added Tax (VAT) rebate on the exportation of goods, and ranged from 0 (non-refundable) to 17 percent (fully refundable). China's liberalization policies have helped it to speed up the country's export growth. Thus, China has registered a huge surplus with the United States and other countries in recent years.

As its national economy continues to grow, China's exchange rate policy has attracted increasing attention. Consequently, pressure has built up for the Chinese yuan (renminbi (RMB)) to be revalued since 2004. The RMB appreciated from 8.28 to 8.11 per U.S. dollar (2%) on July 21, 2005. This appreciation in percentage terms was believed to be small enough to avoid expectations of further appreciation. However, many studies suggest that the RMB was seriously undervalued (Eichengreen, 2004; Goldstein and Lardy, 2006). Hence, the RMB's revaluation continues to be a key exchange rate policy issue. China's excessive foreign trade surplus has given rise not only to aggravated trade frictions but also to a huge domestic liquidity that had brought more pressure to bear on to the RMB to appreciate. In 2007, China's trade surplus surged by 48 percent to a record $262.2 billion which added to the pressure on the government to let the RMB appreciate more rapidly to prevent the economy from overheating and keep inflation in check. Therefore, the RMB has continued to appreciate during the last three years. As of October 31, 2008, the RMB had appreciated from 8.11 to 6.84 per U.S. dollar (more than 15%) in a little over three years. The RMB will probably continue to appreciate.

In order to reduce its excessive trade surplus and encourage more balanced foreign trade, the Chinese government announced the adjustment of its Export Value-Added Tax Refund Rates (EVRRs) for certain items on June 19, 2007. This adjustment in the EVRRs removed or reduced the Value-Added Tax (VAT) rebate for more than 2,800 specific commodities, and took effect on July 1, 2007. This major adjustment differs from the earlier adjustments both in the size of the refund rate reductions, and in the inclusion of a large number of low value products and controversial goods that tend to trigger international trade disputes. This reduction in the EVRRs will increase the firm's VAT costs and reduce the excessive trade surplus. The Chinese government believes that the increases in cost will bolster capital investment in higher technology and help the country develop economically.

However, in the first half of 2008, while China's trade surplus increased, its export growth rate declined. Thus, the Chinese government announced several changes in its export tax policies on August 1, 2008. The export VAT rebate for textiles and clothing was increased from 11% to 13% to increase the competitiveness of exporting firms. This occurred during a period characterized by a global economic downturn, rocketing raw material prices, the newly-released Labor Contract Law and the appreciation of the Chinese Yuan (RMB). This increase in the EVRRs will decrease the firm's VAT costs and increase the export growth rate. Therefore, it is quite obvious that the EVRRs

adjustment is being used as an important tool in implementing China's governmental policies.

A firm is subject to "economic exposure" if its value, as measured by the present value of its expected future cash flows, is affected by the changes in exchange rates. The value of an exporting firm is likely to fall if the domestic currency appreciates, while the value of an importing firm is likely to rise with that same appreciation. Many previous studies on economic exposure have investigated various determinants of exposure or the hedging policies adopted to mitigate it, such as Shapiro (1975), Adler and Dumas (1984), Hekman (1985), Flood and Lessard (1986), von Ungern-Sternberg and von Weizsacker (1990), Levi (1994), Marston (2001) and so on. Most of these studies emphasize the importance of supply and demand conditions in determining the economic exposure, but none of these studies has focused on the effects of both the competitive market structure and EVRRs adjustments on the economic exposure of an exporting firm. Although von Ungern-Sternberg and von Weizsacker (1990) examine the industry structure, they only examine industries where all firms produce a single homogeneous product or where competition follows the spatial model developed by Salop (1979).

As Marston (2001) indicated, competition form is an important determinant of economic exposure because the form of competition between firms determines how exchange rates affect their cash flows. A firm of monopoly in the foreign market will have a different economic exposure than a firm that faces competition in that market. A firm in an industry with multiple firms will also have a very different exposure if one of the firms is dominant than if all firms compete in a symmetric fashion. Furthermore, as mentioned above, a reduction in the EVRRs will increase the firm's VAT costs and then decrease the firm's net revenues from foreign sales. On the contrary, an increase in the EVRRs will decrease the firm's VAT costs and then increase the firm's net revenues from foreign sales. Thus, both the competitive market structure and the EVRRs adjustment will first affect the profits and then the value of the exporting firms.

This study aims to investigate the effects of RMB appreciation on the value of exporting firms in China by examining how the market structure and the EVRRs adjustment affect the economic exposure of an exporting firm in China. In an international operating environment, most of the exporting firms face imperfectly competitive markets. Therefore, the analysis in this study will focus on the effects of RMB appreciation on the value of an exporting firm operating in a market structure characterized by monopolistic competition and other forms of imperfect competition.

The remainder of this paper is organized as follows. Section 2 presents a basic model to measure the economic exposure of an exporting firm. The effects of RMB appreciation on the value of an exporting firm operating in different forms of imperfect market competition are analyzed and summarized in Section 3. Section 4 closes with concluding remarks and implications.

MEASURING MODEL FOR ECONOMIC EXPOSURE

To measure the economic exposure of exporting firms in China, we start with an operational definition of a firm's value using a discounted cash flow (DCF) model. According to this model, the value of a firm may be expressed in terms of a stream of present and future cash flows as follows:

$$V = \sum_{i=1}^{\infty} \frac{CF_i}{(1+k)^i} \quad (1)$$

where CF_i represents the cash flows (dividends) of the firm and k is the discount rate.

Although the *zero growth model* is applicable to some companies, the cash flows of most companies are expected to increase each year. While the expected growth rates vary from company to company, the cash flow growth in general is expected to continue in the future at a constant rate g. This *constant growth model* is the most widely cited dividend valuation approach (Megginson, 1997), and is commonly referred to as the *Gorden growth Model* (Copeland, Weston and Shastri, 2005) after M. J. Gorden did much to develop and popularize it. Therefore, in order to keep the model tractable so that the effects of market structure can be examined, the present value of the exporting firm can, based on this *constant growth model*, be expressed as follows:

$$V = \frac{(1+g)}{k-g} \times CF = [(1+g)/(k-g)] \times (1-t) \times \pi = [(1-t) \times (1+g)/(k-g)] \times \pi \quad (2)$$

where t is the tax rate, g is the constant growth rate, k is the discount rate, and π is the firm's profit before taxes.

The simplest measure of economic exposure is *dv/ds*, where *s* is the exchange rate expressed as home currency / foreign currency. By letting the tax rate and the discount rate remain constant, the economic exposure of an exporting firm can be measured by the derivative *dv/ds*:

$$dv/ds = dv/d\pi \times d\pi/ds = [(1-t) \times (1+g)/(k-g)] \times d\pi/ds \quad (3)$$

Therefore, the economic exposure of an exporting firm is proportional to the derivative of current profits with respect to the exchange rate. The proportion is $[(1-t) \times (1+g)/(k-g)]$. In the special case where g = 0, referred to as the *zero growth model*, the present value of the exporting firm will be $V = [(1-t)/k] \times \pi$, and the proportion will be $[(1-t)/k]$. The latter derivative in Eq. (3), $d\pi/ds$, will be measured explicitly below according to the market structure in which the exporting firm operates.

THE EFFECTS ON THE VALUE OF EXPORTING FIRMS

A perfectly competitive market is based on four conditions: (1) firms sell a homogeneous product, (2) a large number of independent buyers and sellers exist, (3) there are no barriers to enter or exit the market, and (4) the market offers perfect information to buyers and sellers. Although the perfect competition model may give us an analytical framework for what might be loosely described as the ideal working of an economy, these four assumptions may seem unrealistic. For example, products are rarely homogeneous. On the other hand, a pure monopoly is an industry composed of a single seller of a product with no close substitutes and with high barriers to entry. Such a

definition and assumptions may also seem unrealistic. For instance, all products exhibit some degree of substitutability. In an international operating environment, most of the exporting firms face other imperfectly competitive markets. Therefore, the analysis in this study will focus on the economic exposure of exporting firms operating in different types of competition between firms: a general duopoly, Cournot competition, Stackelberg leadership exercised by the exporting firm, Stackelberg leadership exercised by the foreign firm and monopolistic competition.

Most notably, in studying the economic exposure of firms competing in an industry, there are two important features. First, the goods produced by the firms in the industry should be heterogeneous so that the goods are substitutes. Second, the industry should include firms from different countries and hence with costs based in different currencies. These two features are our assumptions in analyzing the effects of the RMB's appreciation on the value of exporting firms operating in various imperfectly competitive markets.

Operating in the Market Structure of a General Duopoly

To analyze the effect of the RMB's appreciation on the value of an exporting firm operating in a market structure characterized by a general duopoly, we may choose a model of a duopoly that consists of a renminbi-based exporter and a foreign firm in the dollar-based foreign (export) market. Both firms are assumed to sell products only to the dollar-based foreign market. Moreover, each firm has costs based only in its own currency; the exporter's costs are in renminbi and the foreign firm's costs are in dollars. This basic duopoly model is taken from Dixit (1986).

In this model, the exporting firm (firm 1) produces q^1 units of its good at a price in dollars of P^1, while the foreign firm (firm 2) produces q^2 units at a price in dollars of P^2. Their respective inverse demand functions are given by the following equations:

$$P^1 = D^1(q^1,\ q^2),\ D_1^1 < 0 \tag{4a}$$

$$P^2 = D^2(q^1,\ q^2),\ D_2^2 < 0 \tag{4b}$$

The two goods are assumed to be substitutes, so that $D_2^1 < 0$ and $D_1^2 < 0$. The total cost for the exporting firm measured in RMB is given by $C^1(q^1)$, and the total cost in dollars for the foreign firm is $C^2(q^2)$. The profits of the two firms can then be measured in each firm's own currency, respectively, as follows:

$$\pi_1^{¥} = (1+\tau_0)\times Sq^1D^1(q^1,\ q^2) - C^1(q^1) \tag{5a}$$

$$\pi_2^{\$} = q^2D^2(q^1,\ q^2) - C^2(q^2) \tag{5b}$$

where S is the RMB /dollar exchange rate and τ_0 is the EVRR for the exporting firm. Notice that the exchange rate explicitly enters only the profit function of the exporting firm.

In formulating the first-order conditions for profit maximization, it is important to consider the possible interaction between the decisions of the two competing firms. If

firm *i* believe that its output decision will affect the decision of the other firm, then its first-order condition will include a "conjectural variations" term. These two conjectural variations are as follows:

$$dq^2 / dq^1 = v^1(q^1,\ q^2) \tag{6a}$$

$$dq^1 / dq^2 = v^2(q^1,\ q^2) \tag{6b}$$

The first-order conditions of the two firms will therefore take the following form:

$$\begin{aligned} & d\pi_1^Y / dq^1 \\ &= (1+\tau_0)\times SD^1(q^1,\ q^2) + (1+\tau_0)\times S\, q^1 D_1^1 + (1+\tau_0)\times S\, q^1 D_2^1 v^1 - C_1^1 \\ &= (1+\tau_0)\times S\,[D^1(\ ) + q^1 D_1^1 + q^1 D_2^1 v^1] - C_1^1 = 0 \end{aligned} \tag{7a}$$

$$\begin{aligned} d\pi_2^{\$} / dq^2 &= D^2(q^1,\ q^2) + q^2 D_2^2 + q^2 D_1^2 v^2 - C_2^2 \\ &= D^2(\ ) + q^2 D_2^2 + q^2 D_1^2 v^2 - C_2^2 = 0 \end{aligned} \tag{7b}$$

The exact form of the conjectural variations term will depend on the nature of the competition between the two firms. For example, in the case of Cournot competition, these v^i terms are equal to zero.

The second-order conditions can be written in compact form as follows:

$$R_1^1 + v^1 R_2^1 < 0 \tag{8a}$$

$$R_2^2 + v^2 R_1^2 < 0 \tag{8b}$$

where R_j^i is the derivative of the *i*th firm's first-order condition with respect to the output of firm *j*. For example, R_1^1 and R_2^1 for the exporting firm are as follows:

$$\begin{aligned} R_1^1 &= d(d\pi_1^Y / dq^1) / dq^1 \\ &= (1+\tau_0)\times[SD_1^1 + SD_1^1 + Sq^1 D_{11}^1 + SD_2^1 v^1 + Sq^1 D_{21}^1 v^1 + Sq^1 D_2^1 v_1^1] - C_{11}^1 \\ &= (1+\tau_0)\times S\,[2D_1^1 + q^1 D_{11}^1 + D_2^1 v^1 + q^1 D_{21}^1 v^1 + q^1 D_2^1 v_1^1] - C_{11}^1 \end{aligned} \tag{9a}$$

$$\begin{aligned} R_2^1 &= d(d\pi_1^Y / dq^1) / dq^2 \\ &= (1+\tau_0)\times[SD_2^1 + Sq^1 D_{12}^1 + Sq^1 D_{22}^1 v^1 + Sq^1 D_2^1 v_2^1] - 0 \\ &= (1+\tau_0)\times S\,[D_2^1 + q^1 D_{12}^1 + q^1 D_{22}^1 v^1 + q^1 D_2^1 v_2^1] \end{aligned} \tag{9b}$$

As Dixit (1986) shows, the duopoly model is stable if $R_1^1 < 0,\ R_2^2 < 0,$ and $R = R_1^1 R_2^2 - R_2^1 R_1^2 > 0$.

The RMB appreciation will decrease the renminbi value of the marginal revenue of the Chinese exporting firm. Therefore, the RMB appreciation has an asymmetric effect on market equilibrium. Let $M = (1+\tau_0) \times [D^1( ) + q^1 D_1^1 + q^1 D_2^1 v^1]$ be the perceived marginal revenue of the exporting firm measured in renminbi. Then an appreciation of RMB decreases the renminbi value of this revenue by *M dS*. The effects on output can be examined by differentiating the first-order conditions with respect to output as follows:

$$\begin{bmatrix} R_1^1 & R_2^1 \\ R_1^2 & R_2^2 \end{bmatrix} \begin{bmatrix} dq^1 \\ dq^2 \end{bmatrix} = \begin{bmatrix} -Mds \\ 0 \end{bmatrix} \tag{10}$$

According to equation (10), $R_1^1 dq^1 + R_2^1 dq^2 = -Mds$ and $R_1^2 dq^1 + R_2^2 dq^2 = 0$; that is, $R_2^1 dq^2 + Mds = -R_1^1 dq^1$ and $R_2^2 dq^2 = -R_1^2 dq^1$. Thus, the changes in output for the two firms are given by the following equations:

$$dq^1 / ds = -R_2^2 M / R \tag{11a}$$

$$dq^2 / ds = R_1^2 M / R \tag{11b}$$

The stability conditions ($R = R_1^1 R_2^2 - R_2^1 R_1^2 > 0$ and $R_2^2 < 0$) ensure that $dq^1 / ds > 0$, but the sign of dq^2 / ds depends on the sign of the term R_1^2.

As Marston (2001) indicated, the duopoly model can also be analyzed in terms of two reaction functions whose slopes are given by the following equations:

$$r_1 = -R_2^1 / R_1^1 \tag{12a}$$

$$r_2 = -R_1^2 / R_2^2 \tag{12b}$$

Each slope is defined with respect to the particular firm's output, so $r_1 = dq^1/dq^2$ for the exporting firm and $r_2 = dq^2/dq^1$ for the foreign firm. The slopes of these reaction functions depend on the cross partial derivatives R_2^1 and R_1^2 since the stability conditions ensure that $R_1^1 < 0$ and $R_2^2 < 0$. The reaction functions have negative slopes if and only if these two cross derivatives are negative. According to Bulow et al. (1985), if R_2^1 and R_1^2 are negative, the goods are said to be "strategic substitutes". Thus two goods are strategic substitutes if a rise in one firm's output lowers the marginal profit of the other firm.

The effects of the RMB appreciation on the profits of the two firms are determined by differentiating the profit expressions ((5a) and (5b)) with respect to *S*:

$$
\begin{aligned}
d\pi_1^Y / ds &= (1+\tau_0)\, q^1 D^1(\,) + (1+\tau_0)\left\{ S[D^1(\,) + q^1 D_1^1] - C_1^1 \right\}(dq^1/ds) + (1+\tau_0)\, Sq^1 D_2^1 (dq^2/ds) \\
&= (1+\tau_0)\, q^1 D^1(\,) + (1+\tau_0)\,[(-Sq^1 D_2^1 v^1)(-R_2^2 M/R) + Sq^1 D_2^1 (R_1^2 M/R)] \\
&= (1+\tau_0)\, q^1 D^1(\,) + (1+\tau_0)\,[Sq^1 D_2^1 M(R_2^2 v^1 + R_1^2)]/R
\end{aligned} \tag{13a}
$$

$$
\begin{aligned}
d\pi_2^\$ / ds &= [D^2(\,) + q^2 D_2^2 - C_2^2](dq^2/ds) + q^2 D_1^2 (dq^1/ds) \\
&= (-q^2 D_1^2 v^2)(R_1^2 M/R) + q^2 D_1^2 (-R_2^2 M/R) \\
&= -q^2 D_1^2 M(R_2^2 + v^2 R_1^2)/R \;<0
\end{aligned} \tag{13b}
$$

The second equality in each expression of Eqs. (13a) and (13b) is obtained by substituting in the first-order conditions in Eqs. (7a) and (7b), and the expressions for dq^1/ds and dq^2/ds in Eqs. (11a) and (11b).

From Eqs. (13a) and (13b), in the general model of duopoly, the effect of RMB appreciation on the profits of the foreign firm is determinate because the second-order condition ensures that $R_2^2 + v^2 R_1^2 < 0$ and the stability conditions ensure that $R > 0$. If the two goods are substitutes ($D_1^2 < 0$), then $d\pi_2 / ds < 0$. However, the effect on the profits of the exporting firm is indeterminate, depending on the exact form of the competition between the two firms. Therefore, in the following we will discuss the effect of RMB appreciation on the profits of the exporting firm operating based on the competition forms of Cournot competition, Stackelberg leadership exercised by the exporting firm and Stackelberg leadership exercised by the foreign firm.

To discuss the effect of RMB appreciation on the profits of the exporting firm for these types of competition, we may first rewrite the economic exposure expressions in terms of the slopes of the foreign firm's reaction function ($r_2 = -R_1^2 / R_2^2$) as follows:

$$
\begin{aligned}
d\pi_1^Y / ds &= (1+\tau_0)\, q^1 D^1(\,) + (1+\tau)\, Sq^1 D_2^1 M(R_2^2 v^1 + R_1^2)/R \\
&= (1+\tau_0)\, q^1 D^1(\,) + (1+\tau)\, Sq^1 D_2^1 M(R_2^2 v^1 - r_2 R_2^2)/R \\
&= (1+\tau_0)\, q^1 D^1(\,) + (1+\tau)\, Sq^1 D_2^1 M R_2^2 (v^1 - r_2)/R
\end{aligned} \tag{14a}
$$

$$
\begin{aligned}
d\pi_2^\$ / ds &= -q^2 D_1^2 M (R_2^2 + v^2 R_1^2)/R \\
&= -q^2 D_1^2 M (R_2^2 - v^2 r_2 R_2^2)/R \\
&= -q^2 D_1^2 M R_2^2 (1 - v^2 r_2)/R
\end{aligned} \tag{14b}
$$

where $r_2 < 0$ if and only if $R_1^2 < 0$.

Operating in the Market Structure of Cournot Competition

In the form of Cournot competition, each of the firms will take the other firm's output as given, and so the conjectural variation terms are equal to zero; that is, $v^1 = 0$ and $v^2 = 0$. Then, the economic exposure expressions (Eqs. (14a) and (14b)) can be simplified to obtain the following equations:

$$
d\pi_1^Y / ds = (1+\tau_0) \times [q^1 D^1(\,) + (-Sq^1 D_2^1 M R_2^2 r_2 / R)] > 0 \quad (r_2 < 0) \tag{15a}
$$

$$d\pi_2^{\$} / ds = -q^2 D_1^2 MR_2^2 / R < 0 \tag{15b}$$

From Eqs. (15a) and (15b), the profits of the foreign firm rise in the general case, while the profits of the exporting firm fall as long as the reaction function of the foreign firm is negatively sloped ($r_2 < 0$), because $(-Sq^1 D_2^1 MR_2^2 r_2 / R) > 0$.

Therefore, the economic exposure of this exporting firm depends on its renminbi-based export revenues, $q^1 D^1(\ )$. However, since changes in exchange rates induce changes in the other firm's price and output, the exporting firm's economic exposure also depends implicitly on the price elasticities of demand, marginal costs and other derivatives of the demand and cost functions. Thus, the demand and supply behavior has an impact on the economic exposure that is independent of the initial level of export revenues.

In this case, the profits of the exporting firm fall more than in proportion to the exporting firm's net revenues from its export sales, $q^1 D^1(\ )$. As a result, the effect of RMB appreciation on the value of the exporting firm in China is as follows:

$$dv/ds = [(1-t)\times(1+g)/(k-g)]\times(d\pi_1^Y / ds)$$

$$= [(1-t)\times(1+g)/(k-g)]\times(1+\tau_0)\times[(q^1 D^1) + (-Sq^1 D_2^1 MR_2^2 r_2 / R)] \tag{16}$$

Based on Eq. (16), if the original EVRR for the exporting firm is τ_0, the effect of RMB appreciation on its value is equal to

$$[(1-t)\times(1+g)/(k-g)]\times(1+\tau_0)\times[(q^1 D^1) + (-Sq^1 D_2^1 MR_2^2 r_2 / R)].$$

If the EVRR for this exporting firm is reduced from τ_0 to τ_1, the firm's VAT costs will first increase and then decrease the firm's value of $[(1-t)\times(1+g)/(k-g)]\times(\tau_0 - \tau_1)\times S(q^1 D^1)$. However, the effect of RMB appreciation on its value after the EVRR adjustment will decrease to $[(1-t)\times(1+g)/(k-g)]\times(1+\tau_1)\times[(q^1 D^1) + (-Sq^1 D_2^1 MR_2^2 r_2 / R)]$, because $\tau_1 < \tau_0$. The difference is

$$[(1-t)\times(1+g)/(k-g)]\times(\tau_1 - \tau_0)\times[(q^1 D^1) + (-Sq^1 D_2^1 MR_2^2 r_2 / R)].$$

Therefore, the EVRR reduction will decrease the value of the exporting firm but will also reduce the degree of its economic exposure as a result of the RMB appreciation. On the contrary, an increase in EVRR will not only increase the value of this exporting firm but will also increase the extent of its economic exposure due to the RMB appreciation. The net effect of the EVRR reduction on the value of the exporting firm is negative, $[(1-t)\times(1+g)/(k-g)]\times(\tau_1 - \tau_0)\times[(S-1)\times(q^1 D^1) + (Sq^1 D_2^1 MR_2^2 r_2 / R)] < 0$, because $\tau_1 < \tau_0$. On the contrary, the net effect of an increase in EVRR on the value of the exporting firm is positive, $[(1-t)\times(1+g)/(k-g)]\times(\tau_1 - \tau_0)\times[(S-1)\times(q^1 D^1) + (Sq^1 D_2^1 MR_2^2 r_2 / R)] > 0$, because $\tau_1 > \tau_0$.

Stackelberg Leadership by the Exporting Firm

In the case where the exporting firm dominates the foreign market, the exporting firm will formulate its output decision only after taking into account the reaction of the foreign firm. In this case where Stackelberg leadership is exercised by the exporting firm, the foreign firm will continue to pursue a Cournot strategy but the exporting firm will

take into account the foreign firm's output decision by setting its conjectural variation parameter equal to the slope of the foreign firm's reaction function, that is, $v^1 = r_2$ and $v^2 = 0$. In this case, the two profit functions will be simplified as follows:

$$d\pi_1^Y / ds = (1+\tau_0)\, q^1 D^1(\,) + (1+\tau_0)\, Sq^1 D_2^1 MR_2^2 (v^1 - r_2)/R$$

$$= (1+\tau_0)\, q^1 D^1(\,) > 0$$

$$(v^1 = r_2 \Rightarrow v^1 - r_2 = 0) \tag{17a}$$

$$d\pi_2^{\$} / ds = -q^2 D_1^2 MR_2^2 (1 - v^2 r_2)/R$$

$$= -q^2 D_1^2 MR_2^2 / R < 0 \qquad (v^2 = 0) \tag{17b}$$

Thus, when the exporting firm is the Stackelberg leader, its profits will fall in proportion to the exporter's renminbi-based revenues. The reason why there are no terms stemming from the foreign firm's output response as in the Cournot case is that the exporting firm has already taken the foreign firm's output response into account in its profit-maximizing strategy. As a result, the effect of RMB appreciation on the value of this exporting firm is as follows:

$$dv/ds = [(1\text{-}t)\times(1+\mathrm{g})/(k\text{-}g)]\times(d\pi_1^Y / ds) = [(1\text{-}t)\times(1+\mathrm{g})/(k\text{-}g)]\times(1+\tau_0)\times q^1 D^1(\,) \tag{18}$$

By comparing the relative economic exposure of the exporting firm when it is a Stackelberg leader and when it is a Cournot competitor, we may find that the difference in profit responses and the difference in terms of the impact on its value are respectively as follows:

$$(d\pi_1^Y / ds)_{Cournot} - (d\pi_1^Y / ds)_{Stackelberg\,1} = (1+\tau_0)\times(-Sq^1 D_2^1 MR_2^2 r_2 / R) > 0$$

$$(\text{if } r_2 < 0) \tag{19a}$$

$$\text{and } (dv/ds)_{Cournot} - (dv/ds)_{Stackelberg\,1} = [(1\text{-}t)\times(1+\mathrm{g})/(k\text{-}g)]\times(1+\tau_0)\times$$

$$(-Sq^1 D_2^1 MR_2^2 r_2 / R) > 0 \quad (\text{if } r_2 < 0) \tag{19b}$$

Obviously, the profit response and the effect of RMB appreciation on the value of the exporting firm in the case of Cournot competition are both greater than those in the case where Stackelberg leadership is exercised by the exporting firm. Thus, if the exporting firm can act as a Stackelberg leader in the export market, it will mitigate the impact of RMB appreciation on its profits and firm value.

According to Eq. (18), if the EVRR for this exporting firm is τ_0, the effect of the RMB's appreciation on its value is equal to $[(1\text{-}t)\times(1+\mathrm{g})/(k\text{-}g)]\times(1+\tau_0)\times q^1 D^1(\,)$. If the EVRR for this exporting firm is reduced from τ_0 to τ_1, the firm's VAT costs will increase and the firm's value will then decrease to $[(1\text{-}t)\times(1+\mathrm{g})/(k\text{-}g)]\times(\tau_0 - \tau_1)\times S(q^1 D^1)$. However, the effect of RMB appreciation on its value after the EVRR adjustment will also decrease to $[(1\text{-}t)\times(1+\mathrm{g})/(k\text{-}g)]\times(1+\tau_1)\times q^1 D^1(\,)$, because $\tau_1 < \tau_0$. Therefore, in this case where Stackelberg leadership is exercised by the exporting firm, the EVRR reduction will decrease the firm's value but will also decrease the extent of its economic exposure due to the RMB's appreciation. The net effect of the EVRR reduction on the value of the

exporting firm will be $[(1-t)\times(1+g)/(k-g)]\times(\tau_1-\tau_0)\times(S-1)\times(q^1D^1)<0$, because $\tau_1 < \tau_0$. Of course, an increase in the EVRR will increase the value of this exporting firm but will also increase the degree of its economic exposure from RMB appreciation. The net effect of the EVRR increase on the value of the exporting firm will be $[(1-t)\times(1+g)/(k-g)]\times(\tau_1-\tau_0)\times(S-1)\times(q^1D^1)>0$, because $\tau_1 > \tau_0$.

Stackelberg Leadership by a Foreign Firm

On the contrary, if the foreign firm rather than the exporting firm is the Stackelberg leader, then the foreign firm will set its conjectural variation parameter equal to the slope of the reaction function of the exporting firm, that is, $v^2 = r_1$ and $v^1 = 0$. In this case, the profit functions of the two firms will be simplified as follows:

$$d\pi_1^Y / ds = (1+\tau_0)\, q^1 D^1(\ ) + (1+\tau_0)\, Sq^1 D_2^1 MR_2^2 (v^1 - r_2)/R$$
$$= (1+\tau_0)\, q^1 D^1(\ ) + (1+\tau_0)\,(-Sq^1 D_2^1 MR_2^2 r_2 / R) > 0 \ (\text{if } r_2 < 0, v^1 = 0) \tag{20a}$$

$$d\pi_2^\$ / ds = -q^2 D_1^2 MR_2^2 (1 - v^2 r_2)/R$$
$$= -q^2 D_1^2 MR_2^2 (1 - r_1 r_2)/R < 0 \quad (v^2 = r_1) \tag{20b}$$

From Eqs. (20a) and (20b), the profits of the foreign firm will rise, while the profits of the exporting firm will fall as long as $r_2 < 0$. As a result, the effect of the RMB's appreciation on the value of this exporting firm is as follows:

$$dv/ds = [(1-t)\times(1+g)/(k-g)]\times(d\pi_1^Y / ds)$$
$$= [(1-t)\times(1+g)/(k-g)]\times(1+\tau_0)\,[q^1 D^1(\ ) + (-Sq^1 D_2^1 MR_2^2 r_2 / R)] \ > \ 0$$
$$(\text{if } r_2 < 0) \tag{21}$$

According to Eq. (21), when the foreign firm is a Stackelberg leader, the effect of RMB appreciation on the value of the exporting firm is greater than that in the case where the Stackelberg leadership is exercised by the exporting firm. Therefore, which firm is the Stackelberg leader clearly makes a difference in terms of the economic exposure of the exporting firm.

By comparing the profit responses and the effect of RMB appreciation on the value of this exporting firm in the two Stackelberg cases, the differences are respectively as follows:

$$(d\pi_1^\$ / ds)_{Stackelberg2} - (d\pi_1^\$ / ds)_{Stackelberg1} = (1+\tau_0)\times(-Sq^1 D_2^1 MR_2^2 r_2 / R) > 0$$
$$(\text{if } r_2 < 0) \tag{22a}$$

$$\text{and } (dv/ds)_{Stackelberg2} - (dv/ds)_{Stackelberg1} =$$
$$[(1-t)\times(1+g)/(k-g)]\times(1+\tau_0)\times(-Sq^1 D_2^1 MR_2^2 r_2 / R) > 0 \ (\text{if } r_2 < 0) \tag{22b}$$

From Eqs. (22a) and (22b), if the exporting firm is the Stackelberg leader, then its economic exposure is smaller than in the case where the foreign firm is the Stackelberg leader, as long as $r_2 < 0$. Therefore, Stackelberg leadership may permit the exporting firm to mitigate the effect of RMB appreciation on its profits and firm value.

Based on Eq. (21), if the EVRR for this exporting firm is τ_0, the effect of RMB appreciation on its value is equal to

$$[(1-t)\times(1+g)/(k-g)]\times(1+\tau_0)[q^1 D^1(\ ) + (-Sq^1 D_2^1 MR_2^2 r_2 / R)],$$

which is same as in the case of Cournot competition but is greater than in the case where Stackelberg leadership is exercised by the exporting firm. If the EVRR for this exporting firm is reduced from τ_0 to τ_1, the firm's VAT costs will increase and its profits will then decrease. However, the effect of RMB appreciation on the firm's value after the EVRR adjustment will also decrease to

$$[(1-t)\times(1+g)/(k-g)]\times(1+\tau_1)\times[(q^1 D^1) + (-Sq^1 D_2^1 MR_2^2 r_2 / R)],$$

because $\tau_1 < \tau_0$. Therefore, in this case where Stackelberg leadership is exercised by the foreign firm, the EVRR reduction will decrease the firm's value, but will also decrease the degree of its economic exposure of RMB appreciation. The results are the same as those in the case of Cournot competition.

Operating in the Market Structure of Monopolistic Competition

Monopolistic competition is a market structure in which a large number of sellers sell similar but slightly different products and in which no barriers to entry or exit exist. Because the monopolistic competitor is selling slightly differentiated products, the firm will have a degree of control over price.

To analyze the effect of RMB appreciation on the value of an exporting firm operating in a market structure characterized by monopolistic competition, we may choose a model consisting of a renminbi-based exporter and many foreign firms in a dollar-based foreign (export) market. All firms are assumed to sell products only in the dollar-based foreign market. Moreover, each firm has costs based only on its own currency, that is, the exporter's costs are in renminbi and the foreign firms' costs are in dollars.

In this model, the exporting firm (firm 1) produces q^1 units of its good at a price in dollars of P^1, while foreign firms produce a total of q^2 units. The inverse demand function of the exporting firm is given by the following equation:

$$P^1 = D^1(q^1,\ q^2),\ D_1^1 < 0 \tag{23}$$

Then the total cost for the exporting firm measured in RMB is given by $C^1(q^1)$. If the EVRR for this exporting firm is τ_0, the profits of this exporting firm can be measured in renminbi as in the following equation:

$$\pi_1^Y = (1+\tau_0)\times Sq^1 D^1(q^1,\ q^2) - C^1(q^1) \tag{24}$$

where S is the RMB /dollar exchange rate and the definitions of other variables are the same as those mentioned above.

In the case of monopolistic competition, the output decision of any firm can not affect the decision of other firms. Therefore, its first-order condition will not include a "conjectural variations" term. The first-order condition of this exporting firm is as follows:

$$d\pi_1^Y / dq^1 = (1+\tau_0)\times SD^1(q^1,q^2) + (1+\tau_0)\times Sq^1D_1^1(q^1,q^2) - C_1^Y$$

$$= (1+\tau_0)\times S[D^1(\ ) + q^1D_1^1(\ )] - C_1^Y = 0 \tag{25}$$

Thus, the derivative of the profits with respect to the exchange rate is as follows:

$$d\pi^Y / ds = (d\pi^Y / dq^1)\times(dq^1 / ds) + \partial\pi^Y / \partial s$$

$$= [(1+\tau_0)\, S(D^1 + q^1D_1^1) - C_1^Y]\times(dq^1 / ds) + (1+\tau_0)\times(q^1D^1) \tag{26}$$

If the exporting firm is at a profit-maximizing equilibrium, the first term in the square brackets on the right-hand side of equation (26) is equal to zero based on the first-order condition; that is, $dq^1/ds = 0$. If the exporting firm produces output optimally, only the direct effect of the exchange rate on profits remains. Equation (26) may also be simplified to the following equation:

$$d\pi^Y / ds = (1+\tau_0)\times(q^1D^1) \tag{27}$$

Thus, if the RMB appreciates ($ds < 0$), the profits will fall in proportion to the initial level of dollar-based net revenue. As a result, the effect of RMB appreciation on the value of this exporting firm is as follows:

$$dv/ds = [(1-t)\times(1+g)/(k-g)] \times d\pi/ds =$$

$$[(1-t)\times(1+g)/(k-g)]\times (1+\tau_0)\times(q^1D^1) \tag{28}$$

It is quite obvious that the profit responses and the effect of RMB appreciation on the value of the exporting firm in the case of monopolistic competition are the same as those in the case where Stackelberg leadership is exercised by the exporting firm, but are less than those in the cases of Cournot competition and Stackelberg leadership by a foreign firm.

According to Eq. (28), the effect of RMB appreciation on the firm's value is the same as that in the case where Stackelberg leadership is exercised by the exporting firm. If the EVRR for the exporting firm is reduced from τ_0 to τ_1, the firm's VAT costs will increase and then the firm's value of $[(1-t)\times(1+g)/(k-g)]\times(\tau_0 - \tau_1)\times S(q^1D^1)$ will decrease, and will also result in a decrease in the effect of RMB appreciation on the profits of the exporting firm. On the contrary, an increase in the EVRR of the exporting firm will not only increase the firm's value, but will also increase the degree of its economic exposure to the RMB appreciation. The results are also the same as those in the case where Stackelberg leadership is exercised by the exporting firm.

Summary of Results

In this section we analyze the effects of RMB appreciation on the value of exporting firms in China by examining how market structure and an adjustment in the EVRR affect the economic exposure of such firms in China. The results can be summarized in Table 1.

From the second column of Table 1, if an exporting firm with an EVRR of τ_0 is a Stackelberg leader or operates in a market structure characterized by monopolistic competition, the effect of RMB appreciation on its value is proportional to the initial level of the dollar-based net export revenue. This proportion is $[(1-t)\times(1+g)/(k-g)]\times(1+\tau_0)$, based on the financial concept of the constant growth model. However, if the exporting firm with an EVRR of τ_0 is operating in a market structure of Cournot competition or Stackelberg leadership by a foreign firm, the effect of RMB appreciation on its value is equal to $[(1-t)\times(1+g)/(k-g)]\times(1+\tau_0)\times \quad [q^1D^1(\ ) + (-Sq^1D_2^1MR_2^2r_2/R)]$. The results are more complex and greater than those in the cases where Stackelberg leadership is exercised by the exporting firm or where there exists monopolistic competition.

From the third column of Table 1, the EVRR adjustment also affects the economic exposure of the exporting firm in China when it is facing RMB appreciation. If the exporting firm with an EVRR of τ_0 is a Stackelberg leader or is operating in a market structure characterized by monopolistic competition, the reduction in the EVRR from τ_0 to τ_1 will decrease the degree of the firm's economic exposure of $[(1-t)\times(1+g)/(k-g)]\times(\tau_1-\tau_0)\times(q^1D^1)$ (because $\tau_1<\tau_0$), and an increase in the EVRR from τ_0 to τ_1 will increase the degree of its economic exposure of $[(1-t)\times(1+g)/(k-g)]\times(\tau_1-\tau_0)\times(q^1D^1)$ (because $\tau_1>\tau_0$). However, if the exporting firm with an EVRR of τ_0 is operating in a market structure characterized by Cournot competition or where Stackelberg leadership is being exercised by a foreign firm, the reduction in the EVRR from τ_0 to τ_1 will decrease the degree of its economic exposure of $[(1-t)\times(1+g)/(k-g)]\times(\tau_1-\tau_0)\times[(q^1D^1)+(-Sq^1D_2^1MR_2^2r_2/R)]$ (because $\tau_1<\tau_0$), and an increase in the EVRR from τ_0 to τ_1 will also increase the degree of the exporting firm's economic exposure of $[(1-t)\times(1+g)/(k-g)]\times(\tau_1-\tau_0)\times[(q^1D^1)+(-Sq^1D_2^1MR_2^2r_2/R)]$ (because $\tau_1>\tau_0$). The results are also more complex and greater than those in the cases where Stackelberg leadership is exercised by the exporting firm or there exists monopolistic competition.

CONCLUSION AND IMPLICATIONS

In the recent years, China's excessive foreign trade surplus has given rise not only to aggravated trade frictions but also to bloat domestic fluidity surplus that has brought more pressure to bear on the appreciation of the RMB. Therefore, RMB appreciation has continued in recent years and will probably continue to appreciate. In order to reduce the excessive trade surplus and foster more balanced foreign trade, the Chinese government reduced the EVRRs for a large number of export products starting July 1, 2007. On the contrary, in order to maintain its economic growth rate, the Chinese government has reconsidered raising the EVRRs for some types of export products after China's export growth rate started to slow down in 2008. The adjustment in the EVRRs has served as an important tool in implementing China's governmental policies.

Table 1: The Effects of Market Structure and EVRR Adjustment on Economic Exposure of the Exporting Firm

Type of market structure	The effect of market structure on economic exposure (due to RMB appreciation) of the exporting firm	The effect of EVRR adjustment on economic exposure (due to RMB appreciation) of the exporting firm
Cournot competition	$dv/ds = [(1-t)\times(1+g)/(k-g)] \times (1+\tau_0) \times [(q^1D^1) + (-Sq^1D_2^1MR_2^2r_2 / R)]$	$[(1-t)\times(1+g)/(k-g)] \times (\tau_1-\tau_0) \times [(q^1D^1) + (-Sq^1D_2^1MR_2^2r_2 / R)]$
Stackelberg leadership by the exporting firm	$dv/ds = [(1-t)\times(1+g)/(k-g)] \times (1+\tau_0)\times(q^1D^1)$	$[(1-t)\times(1+g)/(k-g)]\times(\tau_1-\tau_0)\times(q^1D^1)$
Stackelberg leadership by a foreign firm	$dv/ds = [(1-t)\times(1+g)/(k-g)] \times (1+\tau_0) \times [(q^1D^1) + (-Sq^1D_2^1MR_2^2r_2 / R)]$	$[(1-t)\times(1+g)/(k-g)] \times (\tau_1-\tau_0) \times [(q^1D^1) + (-Sq^1D_2^1MR_2^2r_2 / R)]$
Monopolistic competition	$dv/ds = [(1-t)\times(1+g)/(k-g)] \times (1+\tau_0)\times(q^1D^1)$	$[(1-t)\times(1+g)/(k-g)]\times(\tau_1-\tau_0)\times(q^1D^1)$

Where v is the firm's value; $S = ¥/\$$ is the exchange rate expressed as the home currency / foreign currency; dv/ds is the measure of economic exposure which represents the effect of RMB appreciation on the value of the exporting firm; t is the tax rate; g is the long-run growth rate of the firm's cash flows; k is the discount rate; τ_0 is the original EVRR for the exporting firm; τ_1 is the adjusted EVRR for the exporting firm; q^1 is the output the exporting firm produced for selling to the foreign market; D^1 is the inverse demand function of the exporting firm; (q^1D^1) is the initial level of dollar-based net revenue; $D_2^1 < 0$ is the derivative of the exporting firm's inverse demand function with respect to the output of the foreign firm; M is the perceived marginal revenue of the exporting firm measured in renminbi; r_2 is the slope of the foreign firm's reaction function; R_j^i is the derivative of the ith firm's first-order condition with respect to the output of firm j; and the duopoly model is stable if $R_1^1 < 0$, $R_2^2 < 0$ and $R = R_1^1R_2^2 - R_2^1R_1^2 < 0$.

This paper investigates the effects of RMB appreciation on the value of exporting firms in China by examining how market structure and EVRRs adjustment affect the economic exposure of exporting firms. From the results of four cases analyzed in this study, it is quite clear that the effects of RMB appreciation on the value of an exporting firm in China varies widely depending on the nature of market structure and the EVRRs adjusted for the exporting firms.

If the exporting firm is a Stackelberg leader or is operating in a market structure characterized by monopolistic competition, RMB appreciation will lead to a decrease in its profits. The effect of RMB appreciation on the firm's value is proportional to its dollar-based net revenue, and the exporting firm need not know its elasticity of demand or marginal cost in order to estimate its exposure. On the other hand, a reduction (increase) in the EVRR of the exporting firm will not only decrease (increase) its profits,

but will also decrease (increase) the degree of its economic exposure to the RMB appreciation. However, if the exporting firm and the foreign firm follow a Cournot strategy or in the case where Stackelberg leadership is exercised by the foreign firm, the effect of RMB appreciation on the value of the exporting firm is more than proportional to its net revenues (as long as the two firms' goods are strategic substitutes). Under these forms of competition, the economic exposure of the exporting firm will depend on demand and cost parameters which must be estimated. Furthermore, in these cases the adjustment in the EVRR for the exporting firm will also decrease the degree of its economic exposure to the RMB appreciation, but the results are more complex than those in the cases where Stackelberg leadership is exercised by the exporting firm or there exists monopolistic competition.

Therefore, market structure and EVRRs adjustment have major effects on economic exposure. They are no doubt crucial in determining the effects of RMB appreciation on the value of exporting firms in China. The implications for empirical research and risk management on the economic exposure to the RMB appreciation are evident: (1) Without knowing the market structure in which an exporting firm operates and the EVRR adjusted for the exporting firm, it is impossible to know whether data on the exporting firm's revenues or costs are sufficient to measure its economic exposure arising from RMB appreciation. In some cases, detailed knowledge of the demand and cost parameters is required for assessing this economic exposure. (2) If an exporting firm in China desires to mitigate the impacts of RMB appreciation on its profits or its firm value, it should be enabled to act as a Stackelberg leader in the export market.

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