Exchange rate exposure: A nonparametric approach ☆

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ABSTRACT

The typical conclusion reached when researchers examine exchange rate exposure is that only a few firms are exposed. This finding is puzzling since institutional knowledge and theory suggests a larger effect. In this paper, we compare results obtained using a linear approach with those from nonlinear and nonparametric models. Among firms that don't have a linear exposure, we find that a considerable proportion of these are exposed when nonlinear or nonparametric models are used. This exposure is most striking when a nonparametric model is used. We also find that firms' hedging activities decrease linear exposure but don't affect nonparametric exposure.

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1. Introduction

In the aftermath of the emerging market currency crises, linked mainly to speculative attacks on fixed exchange rate regimes, countries have announced limited commitments, if at all, to pegging their exchange rates. Even so, substantial evidence shows that these countries intervene heavily in foreign exchange markets to limit the volatility of exchange rates. Balance sheet effects have been argued as one of the main reasons for this intervention. More specifically, the large amounts of unmatched foreign currency denominated liabilities firms carry have been a source of concern for emerging market central banks. Therefore, it is important to understand the effects of exchange rate risk on firms' balance sheets and value, and develop methods to measure firms' exposures to such risks.

While it is well established that exchange rate fluctuations are an important source of risk for a firm, the literature does not agree on a benchmark methodology to be used in measuring exposure. One branch of the literature quantifies the idiosyncratic effects of exchange rate fluctuations on a firm's stock return by using various extensions of the Adler and Dumas (1984) model. The main conclusion of this line of work (c.f. Jorion, 1990; Griffin and Stulz, 2001) is that exchange rate exposure, measured by the proportion of firms with significant exposure, is trivial. This finding contrasts with the predictions of finance theory and substantial anecdotal evidence suggesting a considerable vulnerability to exchange rate movements. Indeed, Bartram and Bodnar (2007) define the inability to find exposure – even for firms that have extensive operations abroad – as the exchange rate exposure puzzle.

Empirical studies using various estimation techniques, sample selection, and different exchange rates report limited success in capturing exchange rate exposure. Most of this literature agrees that the linear relationship between exchange rates and stock returns assumed under the Adler and Dumas (1984) model may understate the level of exposure. This is especially agreed to be true if exchange rates have nonlinear effects on a firm's cash flow or firms' operational decisions. Indeed, some studies (Allayannis, 1997; Allayannis and Ihrig, 2001; Bartram, 2004; Bodnar et al., 2002; Bodnar and Wong 2003; Broll et al., 2001; Doidge et al., 2000; Griffin and Stulz, 2001; Odegaard and Priestley, 2007, Taylor and Peel, 2000; Taylor et al., 2001) show that using various functional forms such as quadratic and cubic can more effectively capture, for some firms, the degree of exposure when a linear model cannot. Nevertheless, the use of different functional forms does not change the conclusions considerably and does not solve the exchange rate exposure puzzle. It is important to point out further that these studies do not agree on a specific functional form to use in estimating exchange rate exposures.

In the literature, we identified three important reasons why conventional models may not capture exchange rate exposure accurately or why there may be a lack of exposure. First, using the same functional form for each firm can be restrictive and could generate low levels of exchange rate exposure. This is especially true if firms differ in the way they are affected by exchange rate movements. Indeed, it is agreed that the degree of exposure depends on firm and industry characteristics such as size, monopoly power, external orientation, degree of import penetration and the substitutability between domestically produced and imported inputs. More importantly, the theoretical studies mentioned above suggest that these characteristics not only determine the degree of exposure but also have implications for the functional relationship between exchange rate movements and firms' value.

Second, there are a large number of studies (c.f. Allayannis and Ihrig, 2001; Jorion, 1990, Koutmos and Knif, 2002; Brunner et al., 2000; Williamson, 2001) arguing or finding that exchange rate–stock return relationship does not follow a time invariant functional form. Exchange rate exposures in these studies vary over time as firm and market characteristics such as markup and market shares change. Therefore, the time invariant functional form assumption of the Adler–Dumas model can falsely predict that exposure is insignificant.

Third, some studies argue that firms use foreign currency derivatives (c.f. Allayanis and Ofek, 2001; Bartram and Bodnar, 2007) and pass through part of currency changes to customers (Bartram et al., 2010) effectively to protect against unanticipated exchange rate fluctuations. Therefore, it is possible that the lack of exposure does not reflect the inadequacy of the methodology but may be due to the hedging behavior and exchange rate pass through.

In this paper, we offer a different approach and estimate exchange rate exposure nonparametrically. In so doing, we are able to account for two of the main shortcomings of the conventional methods mentioned above. Specifically, a nonparametric (NP) approach allows us to estimate a different functional form for each firm and allows this functional form to change over time. We choose to use the local linear regression method developed by Stone (1977) as our NP estimation strategy due to its high asymptotic efficiency compared to alternative NP methods. Although we are not the first to use this approach to study exchange rate exposure,[1] our paper makes a first attempt at comparing the results from NP models with those from parametric and partially parametric (PP) models.

Using stock return data from firms in five emerging market countries and the U.S., we provide a comparison of the number of firms with exchange rate exposure where we have computed exposure using

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[1] Guo and Wu (1998) study the effect of financial liberalization on the exchange rate exposure of Taiwanese industries using a nonparametric model.