



## Resolving the exposure puzzle: The many facets of exchange rate exposure <sup>☆</sup>

Söhnke M. Bartram <sup>a,\*</sup>, Gregory W. Brown <sup>b</sup>, Bernadette A. Minton <sup>c</sup>

<sup>a</sup> Lancaster University and SSgA, Management School, Department of Accounting and Finance, Lancaster LA1 4YX, UK

<sup>b</sup> Kenan-Flagler Business School, The University of North Carolina at Chapel Hill, CB 3490, McColl Building, Chapel Hill, NC 27599-3490, USA

<sup>c</sup> Fisher College of Business, The Ohio State University, 834 Fisher Hall, 2100 Neil Avenue, Columbus, OH 43210-1144, USA

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### ABSTRACT

Theory predicts sizeable exchange rate (FX) exposure for many firms. However, empirical research has not documented such exposures. To examine this discrepancy, we extend prior theoretical results to model a global firm's FX exposure and show empirically that firms pass through part of currency changes to customers and utilize both operational and financial hedges. For a typical sample firm, pass-through and operational hedging each reduce exposure by 10–15%. Financial hedging with foreign debt, and to a lesser extent FX derivatives, decreases exposure by about 40%. The combination of these factors reduces FX exposures to observed levels.

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### 1. Introduction

Given the globalization of many industries, foreign exchange rate (FX) fluctuations are a source of uncertainty for many corporations. Empirical studies show significant

effects of exchange rate changes on firm cash flows, sales, and competitive positions in product markets (e.g., Hung, 1992; Williamson, 2001). Similarly, theoretical models (such as Bodnar, Dumas, and Marston, 2002) predict that many firms should have significant exchange rate

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\* Corresponding author. Tel.: +44 15 24 592 083; fax: +44 425 952 1070.

E-mail addresses: [s.m.bartram@lancaster.ac.uk](mailto:s.m.bartram@lancaster.ac.uk) (S.M. Bartram), [gregwbrown@unc.edu](mailto:gregwbrown@unc.edu) (G.W. Brown), [minton\\_15@cob.osu.edu](mailto:minton_15@cob.osu.edu) (B.A. Minton).

URL: <http://www.lancs.ac.uk/staff/bartras1/> (S.M. Bartram).

exposures. However, empirical studies have tended to point out weak (or non-existent) relations between exchange rate changes and firms' stock prices.<sup>1</sup>

In this paper, we examine the discrepancy between theoretical predictions and observed levels of exchange rate exposure in a broad cross-section of global corporations. Our analysis investigates how firms combine three different mechanisms at their disposal for mitigating exchange rate risk. First, firms can (to varying degrees) pass through to customers the changes in costs due to exchange rate movements. Second, firms can often affect their exchange rate exposure by choosing the location and currency of costs (e.g., where factories are located). Third, firms can utilize an array of financial products, such as foreign currency denominated (FC) debt and FX derivatives, as exchange rate risk management tools. Our results show that each of these factors plays an important role in mitigating observed exchange rate exposure, and together they account for the vast majority of the discrepancy between prior theoretical predictions and observed exposures.

Our analysis has two primary parts. First, we expand the theoretical model of Bodnar, Dumas, and Marston (2002) (hereafter BDM) to examine the exchange rate exposures of a global firm that can compete and produce in both a foreign and local market. In the BDM model, the exporting firm cannot sell in its own market and the local firm cannot produce abroad. By assuming that global foreign exchange rate exposure is a weighted average of a firm's foreign exchange exposure in the foreign market and the domestic market, we can derive optimal pass-through decisions and the resulting foreign exchange exposures of global firms in globally competitive industries. Our model generates exposures as a function of market share, product substitutability, pass-through, sales and costs in foreign currency that are smaller than the original BDM model under most conditions, and in some cases, the model generates negative foreign exchange rate exposures. Overall, our global competition model allows for a richer, more realistic, set of FX exposures since it allows firms to sell and source both at home and abroad.

Second, we analyze a sample of 1,150 manufacturing firms in 16 countries using our global competition model. We show that pass-through and operational hedging are important for reducing the level of exchange rate exposure. However, after accounting for pass-through and operational hedging, theoretical exposures are still larger than observed exposures on average.<sup>2</sup> We show that firms with high theoretical exposures are both more likely to have FC debt and more likely to use FX derivatives.

We also conduct an attribution analysis that estimates the magnitude of the reduction in exposure due to

each channel for a typical firm. Depending on the level of product substitutability, pass-through reduces exposure by about 10–15%. Operational hedging reduces exposure by similar amounts, while financial risk management (FC debt and FX derivatives) accounts for about a further 40% reduction in exposure. Altogether, firms reduce their gross exchange rate exposure by about 70% via the three channels. This reduction results in average exposure values very similar to those estimated from regression models. Consequently, for reasonable parameter values, it is not possible to reject our global competition model after correcting for the estimated effects of financial risk management.

Our analysis augments an empirical literature that examines FX exposure. A number of studies estimate the exchange rate sensitivity of stock prices and typically find small exposures. The results of this paper suggest that these observed estimates are reasonable once the three channels which firms have to mitigate exposure are considered. Other studies report differences in exposures across industry classes and countries (Campa and Goldberg, 1999; Bodnar and Gentry, 1993; Marston, 2001; Allayannis and Ihrig, 2001; Williamson, 2001).<sup>3</sup> These findings are also consistent with the range of exposure estimates obtained from our model.

A separate strand of literature examines exchange rate risk premiums. Several studies (Dumas and Solnik, 1995; De Santis and Gerard, 1998; and Carrieri, Errunza, and Majerbi, 2006) show significant risk premiums at the aggregate market level, but not the industry level. Francis, Hasan, and Hunter (2008) claim that this is not due to firms hedging currency risk but instead the result of model misspecification which they correct by estimating a conditional pricing model at the industry level. While seemingly contradictory to our results, our model and evidence are actually consistent with both views. For example, we find that, on average, many firms retain some exchange rate exposure which could carry a risk premium. However, we find significant negative correlations when we compare our measures of hedging with the Francis, Hasan, and Hunter (2008) estimates of the currency risk premium. This is consistent with evidence from our analysis (as well as others) that firms reduce risk with financial hedging.

<sup>1</sup> These studies include, among others, Jorion (1990), Amihud (1994), Bodnar and Gentry (1993), Bartov and Bodnar (1994), Bartov, Bodnar, and Kaul (1996), Choi and Prasad (1995), He and Ng (1998), Chow, Lee, and Solt (1997), Griffin and Stulz (2001), and Dominguez and Tesar (2006). See Bartram and Bodnar (2007) for a review.

<sup>2</sup> In our analysis we consider larger exposures to be simply larger values of calculated exposures, not absolute values. This definition of exposure has little practical effect on our results because the vast majority of the theoretical exposures we calculate are greater than zero.

<sup>3</sup> Williamson (2001) shows that auto manufacturers have higher foreign exchange rate exposures if they have high levels of foreign sales and face foreign competition. Consistent with theoretical predictions, changes in exposure are related to changing industry structure (e.g., competition) as well as "large and extended" movements in real exchange rates. Bartram and Karolyi (2006) find that the foreign exchange rate exposure of nonfinancial firms is systematically related to firm characteristics (sales, the percentage of foreign sales in general and in Europe in particular), regional factors (geography, strength of currency), and industry characteristics (competition, traded goods). Bartram and Bodnar (2008) show that the effect of exchange rate exposure on stock returns is conditional and show evidence of a significant return impact to firm-level currency exposures when conditioning on the exchange rate change. Other studies examine the association between foreign exchange exposures, macroeconomic conditions, and firm activities. For example, Parsley and Popper (2006) and Dahlquist and Robertsson (2001) find significant associations between exchange rate exposures and currency arrangements.

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