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Abstract

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Keywords: corporate finance, risk management, exposure, foreign exchange rates, hedging

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Abstract

This paper estimates the foreign exchange rate exposure of 6,917 U.S. nonfinancial firms on the basis of stock prices and corporate cash flows. The results show that several firms are significantly exposed to at least one of the foreign exchange rates Canadian Dollar, Japanese Yen and Euro, and significant exposures are more frequent at longer horizons. The percentage of firms for which stock price and earnings exposures are significantly different is relatively low, though it increases with time horizon. Overall, the impact of exchange rate risk on stock prices and cash flows is similar and determined by a related set of economic factors.

1 Introduction and Motivation

One of the phenomena in financial economics that has recently attracted significant interest consists of the fact that nonfinancial firms do not seem to be significantly affected by foreign exchange rate risk, even if they have substantial international business or competition (e.g. Bodnar and Wong, 2003; Griffin and Stulz, 2001; He and Ng, 1998). In this context, it is important to note that virtually all existing empirical studies estimate currency exposures on the basis of stock prices. In contrast, the estimation of cash flow exposures pursued in this paper represents a sensible alternative to the common analysis of stock price exposures. In fact, it is the impact of exchange rate risk on corporate cash flows rather than equity prices per se, that is emphasized in the theoretical literature on corporate risk management, either for tax reasons, bankruptcy, investment decisions, managerial performance or compensation purposes. The empirical literature on exchange rate exposure, however, has focused on equity prices primarily since cash flow data for a large sample of firms are not readily available, and changes in stock prices are used as a proxy for changes in cash flows. In contrast, corporate managers will also be interested in the exposures of corporate cash flow measures such as sales, operating cash flow and earnings for reasons of corporate planning and risk management.

To this end, this paper contributes to the literature by performing the first comprehensive, large scale investigation of cash flow exposures of nonfinancial firms, using a new data set. In particular, it analyzes the foreign exchange rate exposures of unexpected changes in earnings based on analysts' forecasts from I/B/E/S and matched stock returns for 6,917 U.S. nonfinancial firms.[1] Estimating both cash flow as well as stock price exposures and relating

[1] Martin and Mauer (2005, 2003) use a cash flow approach to estimate exposure for U.S. banking firms which, as other financial institutions, however have fundamentally different business objectives with regard to financial risks.

these to firm characteristics, the paper offers a new perspective and provides new evidence on the foreign exchange rate exposure of nonfinancial firms. It thus adds to our understanding of the effect of exchange rate risk on nonfinancial firms and how it can be measured, which is an essential prerequisite for effective hedging decisions. The results suggest that the impact of exchange rate risk on stock prices and aggregate cash flows is comparable and determined by a related set of economic factors, which is an important finding for the validity of theoretical exposure models and their application for exposure estimation.

Specifically, the paper shows that exposures based on earnings and stock prices are relatively similar for short horizons. To illustrate, significant exposures are identified for 5.6% (13.2%) of the sample firms based on changes in earnings (stock prices) with a one-month horizon. Moreover, cash flow and stock price exposures are significantly different in only about 10% of all cases. This is likely a consequence of foreign exchange rate exposures being both statistically and economically small, as documented in previous research (e.g. Koutmos and Martin, 2003; Griffin and Stulz, 2001; Khoo, 1994; Jorion, 1990). At the same time, cash flow exposures increasingly diverge from equity exposures over longer horizons, indicating that accounting measures become worse proxies for economic exposure.

While the number of firms with significant foreign exchange rate exposure is generally low, more nonfinancial firms show a significant exposure to at least one of the foreign exchange rates of the most important trading partners of the United States. Moreover, the fraction of firms with significant exposure increases with time horizon for earnings as well as stock prices. Finally, the results show that industry classification, the percentage of foreign sales, and market capitalization are important economic factors that determine the size of exposure of both earnings and stock prices in a way suggested by theory.

The layout of the paper is as follows. Section 2 reviews the literature on foreign ex-

change rate exposure. In Section 3, the concepts of exposure of cash flows and stock prices to exchange rate risk are discussed. Section 4 describes the sample and data sources. Section 5 presents and discusses the empirical results, while Section 6 concludes.

2 Related Literature

A large number of empirical studies analyze the foreign exchange rate exposure of nonfinancial corporations.[2] The typical approach consists of regressing stock returns on exchange rate innovations in the presence of control variables. Overall, there is relatively weak evidence of statistically significant currency exposures, and also the economic significance of the estimated exposures is low (Griffin and Stulz, 2001). A first major study of the foreign exchange exposure phenomenon by Jorion (1990) finds a significant impact of foreign exchange rate risk on stock prices for only 5.2% of the analyzed 287 U.S. multinationals at the 5% level. In a study by Choi and Prasad (1995), 14.9% of the individual firms in the United States and 10% of the industry portfolios show a significant foreign exchange rate exposure at the 10% level, corroborating earlier findings.

Similar results are found outside the United States. For instance only some multinational firms in Japan (26.3% and 53.8% for different time periods) show a significant foreign exchange rate exposure with regard to a multilateral exchange rate index (He and Ng, 1998). Some studies investigate the exposure of industry portfolios in several countries, yielding percentages of firms with significant exposure of 15 % (United States), 4% (Japan) and 6% (United Kingdom) (Prasad and Rajan, 1995), or 23% (United States), 21% (Canada) and 25% (Japan) (Bodnar and Gentry, 1993) at the 5% level. Bartram and Karolyi (2006) find that the foreign exchange rate exposure of nonfinancial firms is systematically related to firm charac-

[2] See Bartram and Bodnar (2005) for a comprehensive review of this literature.

teristics (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). Allayannis and Ihrig (2001) relate stock price exposure to exporting and importing activities of U.S. industries, and Bodnar, Dumas and Marston (2002) document the importance of pass-through for exposure. Starks and Wei (2006) find that the magnitude of exchange rate exposure is related to proxies for probabilities of financial distress, growth opportunities and product uniqueness.

In contrast, the evidence of corporate foreign exchange rate exposures on a cash flow basis is very sparse and limited to individual case studies. A study by Garner and Shapiro (1986) investigates the foreign exchange rate exposure of Vulcan Materials Company by regressing changes of its quarterly operating cash flows on changes in the USD/GBP exchange rate, showing only small and statistically insignificant foreign exchange rate exposures. Oxelheim and Wihlborg (1995) use quarterly changes of total cash flow, commercial cash flow and sales revenue as dependent variables in the exposure analysis of Volvo Cars. The results indicate that the financial position of the firm reduces exposures with regard to changes in the DEM/SEK exchange rate only to a modest degree. Finally, Bartram (2005) investigates the exposure of a large nonfinancial firm based on proprietary internal as well as external capital markets data. The analysis illustrates that the insignificance of foreign exchange rate exposures of comprehensive performance measures such as total cash flow or stock price can be explained by hedging at the firm level. For 105 U.S. banking firms, Martin and Mauer (2003) use both a cash flow and a market model approach, and Martin and Mauer (2005) compare the performance of the two methods.

3 Exposures of Stock Prices and Cash Flows to Exchange Rate Risk

The classical framework for exposure estimation employs regression analysis to investigate the relationship between financial risk variables and stock prices. More precisely, foreign exchange rate exposures are commonly assessed with the following 2-factor model (see e.g. Jorion, 1990):

$$R_{jt} = \alpha_j + \beta_j R_{Mt} + \delta_j R_{St} + \varepsilon_{jt}\,, \tag{1}$$

where R_{jt} denotes the stock return of company j in period t, R_{Mt} the return on a capital market index M in period t, and R_{St} the percentage change of currency S in period t. While most of the empirical literature on foreign exchange rate exposure has employed this approach, the theoretical risk management literature focuses actually on the impact of exchange rate risk on corporate cash flows, rather than stock prices, motivating corporate risk management in the presence of capital market imperfections such as bankruptcy costs, a convex tax schedule (Smith and Stulz, 1985), or underinvestment problems (Bessembinder, 1991; Froot, Scharfstein, and Stein, 1993). As a matter of fact, much of the seminal research on corporate exchange rate exposures is based on cash flows and the impact of exchange rates on cash flow volatility (Shapiro, 1975; Hodder, 1982; Adler and Dumas, 1984; Flood and Lessard, 1986).

Consequently, as an alternative to the traditional approach of estimating exposures, this paper also uses a firm's cash flows as corporate performance measures instead of stock prices. In order to investigate the relationship between cash flow changes and the relevant financial risks, the literature suggests regressing corporate cash flow variables (R_{CFjt}) on changes in exchange rates (R_{St}):

$$R_{CFjt} = \alpha_j + \delta_j R_{St} + \varepsilon_{jt}\,. \tag{2}$$

In particular, Stulz and Williamson (1997) regress changes in the cash flow of a manufacturing firm on changes in the prices of aluminum and copper. Similarly, changes in corporate cash flow variables are regressed on contemporaneous and lagged exchange rate changes in Oxelheim and Wihlborg (1995), Bartov and Bodnar (1994), and Garner and Shapiro (1984).

The exposures of cash flows and stock prices are related through the fact that stock prices are the most aggregate measure of corporate performance as the present value of all current and future cash inflows and outflows. In a simple model of the firm with a constant perpetual cash flow, the exposures of firm value and total (net) cash flow are identical. Therefore, structural models of the foreign exchange rate exposure of firms as in Bodnar and Marston (2002) or Bodnar, Dumas and Marston (2002) typically assume the following relationship:

$$\frac{d \ln V}{d \ln S} = \frac{d \ln CF}{d \ln S}, \tag{3}$$

where V is firm value, S is the exchange rate, and CF is a cash flow measure of the firm (see Bodnar et al. (2002), p. 208). While this relationship relies on various simplifying assumptions, it is useful as it generally motivates the relationship between the exposures of firm value (i.e. stock prices) and aggregate corporate cash flows. As the foreign exchange rate exposure of stock prices reflects the effect of corporate hedging, it is likely economically and statistically small, though it might be challenging to fully hedge the majority of uncertain future cash flows.[3]

Cash flow and stock price exposures are estimated with equations (1) and (2) for forecast horizons between 1 and 9 months. Subsequently, firms are sorted into quartiles based on firm size and the percentage of foreign sales in order to investigate cross-sectional differences

[3] See also Martin and Mauer (2005) for a discussion of different approaches to estimate exposure.

of exposures. Firms with important foreign activities, i.e. a high percentage of foreign sales, are expected to have larger (i.e. more positive) exposures. With regard to firm size, the relationship to exposure is an empirical question, since larger firms may be more exposed due to the fact that they tend to be operating more globally, but they may also be more geographically diversified, have real options and the resources for professional risk management.

4 Sample Definition and Data Sources

The sample comprises all U.S. nonfinancial firms with data available for the period 1/1976 - 5/2000. In particular, data from the I/B/E/S summary history database is used to calculate the change in analysts' median consensus forecasts and the forecast error (normalized by stock price).[4] Analysts' forecasts of earnings are used since data on sales and cash flows from operations are available only for a much smaller number of firms. Daily stock return data from CRSP is used to calculate stock returns that match the period of each cash flow change. Data to calculate the exchange rate returns for the Canadian Dollar (CAD), Japanese Yen (JPY), and the Euro (EUR) as well as the trade-weighted exchange rate index of the Bank of England (in U.S. Dollar per unit of foreign currency) are from Datastream.[5] Firm size is measured by market capitalization, calculated as the average of the product of the number of shares outstanding and share prices from I/B/E/S. The percentage of foreign sales is calculated as the average ratio of foreign sales relative to total sales from Compustat.

[4] Different cash flow variables as well as alternative scaling methods by total assets or the standard deviation of the forecast yield similar results.

[5] The Euro exchange rate provided by Datastream represents a synthetic Euro exchange rate for dates before the introduction of the common currency.

5 Empirical Results and Discussion

5.1 Cash Flow and Stock Price Exposures

Firm-by-firm regressions of stock returns on changes in the multilateral exchange rate index yield a percentage of 13.2% of the sample firms with significant foreign exchange rate exposure at the 5% significance level (Table 1).[6] At the same time, the fraction of firms with significant earnings exposure turns out to be somewhat smaller but of similar order of magnitude (5.6%). In both cases, there are more firms with significant negative than positive exposures, but for the earnings exposure, the mean positive coefficient is larger than the negative one. Apparently, the size of the estimated exposure coefficients is so small and the precision of the estimates so low that exposures of neither type are significant for many firms.[7] In line with theoretical suggestions of a close relationship between cash flow and stock price exposures, the coefficients are significantly different for only 10.7% of the sample firms, and the sign of the coefficients is the same in 68.8% of all cases where both estimates are significantly different from zero. Nevertheless, there is some variation of the results across industries: Earnings and stock price exposures are particularly different in the industries public utilities (24.8%), miscellaneous (15.1%), consumer services (13.0%) and consumer durables (11.8%).

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[6] All results are corrected for autocorrelation and heteroskedasticity with the Newey-West procedure.

[7] In related work, Hung (1992) and Clarida (1997) find some, though not always significant association between (levels of) aggregate U.S. manufacturing profits and the real exchange rate using cointegration, VAR and simulation frameworks. These findings are not necessarily consistent with the results of the large number of studies on foreign exchange rate exposure that generally find little relationship between corporate performance (measured by stock returns) and exchange rates. Nevertheless, the above two studies use significantly different methodologies, variable definitions and aggregate data that may reduce the noise of firm-level cash flow and stock return analyses, but also potentially mask important details of the relationships between corporate performance measures and exchange rates.

One may argue that small exchange rate changes are less important than large exchange rate changes and that consequently market participants will take primarily large movements of exchange rates into account when determining the impact of exchange rate risk on stock prices. Similarly, analysts may only change their forecasts as a result of major movements in exchange rates. In order to investigate this issue, the analysis is replicated using only observations where the exchange rate movement exceeds one standard deviation from the median. Interestingly, the results are qualitatively similar to those in Table 1, as 14.7% (8.4%) of all stock price (earnings) exposures are significant at the 5% level, in 14% of all cases the exposures are significantly different, and 73.9% of all significant coefficients have the same sign. Thus, it appears that large exchange rate movements are only slightly more important to market participants and that the empirical relationship between exposures of cash flows and stock prices is relatively robust to the size of exchange rate movements. Overall the low percentages of firms with significant exposures as well as the insignificant differences between exposures of different corporate performance measures are consistent with the effective use of corporate hedging that reduces the foreign exchange rate exposure to levels that make it difficult to identify the residual exposure (Bartram et al., 2005).[8]

In order to investigate the foreign exchange rate exposure of nonfinancial firms in the United States with regard to the currencies of its major trading partners, i.e. Canada, Europe and Japan, multivariate regressions with three bilateral exchange rates are performed. At the

[8] Firms use various forms of hedging, such as pass-through, financial hedging (e.g. foreign currency debt and foreign currency derivatives) and operational hedging to reduce their exposures to exchange rate risk (Allayannis and Ofek, 2001; Bartram et al., 2006; Kim et al., 2006). In the presence of capital market imperfections (e.g. costly bankruptcy, taxes, underinvestment problems), hedging activities at the firm level can increase shareholder value (Kim et al., 2006; Deshmukh and Vogt, 2005; Nelson et al. 2005; Spanò, 2004; Haushalter et al., 2002).

same time, the effect of the length of the forecast horizon on exposure is examined. Estimating exposures over longer horizons may be useful since it is possible that they can be estimated more accurately given the complexities of the factors determining exposure and the noise in high-frequency exchange rates relative to the persistence of movements with low frequency (Bodnar and Wong, 2003; Chow et al., 1997). In fact, most of the exposure of a firm to exchange rate risk stems not from current, but future cash flows, suggesting that longer horizon exposures should provide better estimates.[9]

The resulting percentage of nonfinancial firms with significant exposure increases with time horizon for all exchange rates (Table 2). This phenomenon can be observed for cash flow exposures based on earnings as well as stock price exposures: For a 1-month forecast horizon, the percentage of firms with significant earnings (stock price) exposure is 8.5% (11.7%), 7.7% (11.3%) and 9.6% (13.7%) for the Canadian Dollar, Euro and Japanese Yen, respectively, while these percentages are 24.7% (20.8%), 18.8% (24.7%) and 18.2% (26.6%) for the 9-months return horizon. At the same time, the percentage of firms with significant stock price exposure is typically somewhat larger than the percentage of firms with significant earnings exposure for all currencies, which may reflect the fact that firm value captures all future cash flows that are uncertain and thus difficult to hedge.[10]

While all regressions are run in a multivariate framework, it is realistic to expect that not every firm is exposed to all exchange rates. Nevertheless, the lack of availability of detailed data on the foreign operations (including foreign currency costs, foreign sourcing, foreign com-

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[9] Evidence in Chow et al. (1997) and Bodnar and Wong (2003) suggest that stock price exposures can be detected better at longer horizons.

[10] Martin and Mauer (2005) find for a sample of 104 U.S. banks that a somewhat higher fraction of firms exhibit a significant exposure in their cash flow-based approach compared to capital market-based approaches.

petition, exports, imports) as well as limited information regarding the currency denomination of debt and the extent of derivatives use, it is generally difficult to identify the most important currencies for each individual firm, particularly in large samples. Therefore, the percentage of firms with significant exposure to at least one of the three exchange rates is calculated. When using 1-month (9-months) returns, 22.8% and 27.7% (46.1% and 55.2%) of the firms in the sample have a significant exposure to one or more of the three currencies based on earnings and stock prices, respectively. This suggests that some firms are sensitive to one exchange rate, while others are sensitive to another. Using an exchange rate index that is representative for the economy as a whole may not be appropriate for the individual firm and thus mask some of the underlying exposure of firms that can be identified when considering individual exchange rates.

The results exhibit some interesting patterns across industry sectors: for short-term measures, high percentages of firms with significant earnings exposure occur in the industries transportation (JPY: 23.1%), basic industries (CAD: 15.1%), consumer durables (CAD: 12.1%, EUR: 12.1%) and public utilities (EUR: 13.7%). In addition, the pattern of higher percentages of firms with significant earnings exposure for longer time horizons is also apparent at the industry level. The strongest exposure can be identified for long-term returns, in particular for the sectors consumer non-durables (CAD: 53.8%), basic industries (CAD: 42.9%, EUR: 42.9%, JPY: 42.9%), transportation (JPY: 37.5%), and health care (CAD: 36.0%). The percentage of firms with at least one significant exposure increases for longer forecast horizons as well and reaches high values for basic industries (78.6%), consumer non-durables (69.2%) and transportation (62.5%).

Across industries, somewhat more firms show foreign exchange rate exposures based on stock prices compared to earnings. Specifically, many firms have significant exposures of

their stock price in public utilities (CAD: 27.5%, EUR: 17.6%, JPY: 29.4%), technology (JPY: 22.9%), basic industries (CAD: 18.6%), consumer durables (CAD: 18.2%, EUR: 15.2%) and consumer non-durables (EUR: 16.1%) for 1-month horizons. Similar to earnings exposures, however, the impact of exchange rate risk is statistically more important at longer horizons. For returns over 9 months, high exposures can be observed in the industries technology (JPY: 51.4%), consumer non-durables (EUR: 46.2%), health care (EUR: 44.0%), energy (CAD: 42.9%), and basic industries (JPY: 42.9). More than 70% of the sample firms in health care and basic industries have significant stock price exposures to at least one exchange rate.

In order to assess how closely the foreign exchange rate exposures of earnings and stock prices are related, both types of exposure are estimated for each firm and tested for equality with a Wald test (Table 3). The results reveal that across different industries and currencies, the percentage of firms where the earnings exposure is significantly different from the stock price exposure for the same firm is above the significance level of 5%, but only marginally so for short forecast horizons. To illustrate, for a horizon of 1 month, earnings and stock price exposures are statistically different for 11.5% (CAD), 11.7% (EUR) and 13.4% (JPY) of the sample firms, respectively, and for 29.2% of the firms at least one coefficient is significantly different. The strongest differences exist in the industries public utilities (CAD: 25.5%) and consumer durables (EUR: 21.2%). The exposure discrepancies become slightly more pronounced for longer horizons, where 20.1%, 26.0% and 29.2% of the coefficients are significantly different for the Canadian Dollar, Euro and Japanese Yen, respectively, while at least one exposure is different for more than every other firm (57.1%). This suggests that earnings

exposures are similar to stock price exposures for short horizons, but they become worse proxies for economic exposure over longer horizons.[11]

5.2 Exposure determinants

While the results so far indicate differential exposure effects across industries, the percentage of foreign sales and firm size are likely further important factors that determine whether a firm has a big or small exposure.[12] This issue is studied for individual firms by quartiles of firm characteristics (Table 4). Most of the median exposures in tests for small and large firms in Panel A are significant, and the *Z*-statistic also indicates significance of foreign exchange rate exposures across forecast horizons and currencies, though the effects are slightly weaker for the Japanese Yen and for exposures of earnings in general. The results also document significant differences in the exposure by firm size for all three currencies in the Wilcoxon rank sum tests and Chi-squared tests. In line with the ambiguous relationship between firm size and exposure, large firms have larger exposures for some currencies and smaller exposures for others. Specifically, firms with high market capitalization (4th quartile) tend to have larger (more positive) exposures for the Canadian Dollar and the Euro, but smaller (more negative) exposures for the Japanese Yen.

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[11] Note that studies that use cash flow variables as regressand generally do not include a market variable in the estimation in order to assess the impact of the financial risks of interest on these cash flows as in Eq. (2). In contrast, regressions with stock returns as in Eq. (1) typically include the return on a market index in order to control for correlated economic effects affecting stock markets that may have nothing to do with exchange rate risk. As such, they estimate exposure over and above what is captured by the market (Bodnar and Wong, 2003). These methodological issues could potentially represent an additional source of differences between stock price and cash flow exposures.

[12] Previous work on stock price exposures suggests that an industry's exports and imports (Allayannis and Ihrig, 2001), foreign sales (Jorion, 1990) or size (Bodnar and Wong, 2003) may be important in explaining foreign exchange rate exposure.

The analysis based on the percentage of foreign sales (Panel B) shows that exchange rate risk significantly affects the earnings and the stock prices particularly for firms with high sales abroad (4th quartile), as indicated by significant median coefficients and *Z*-statistics. Some domestic firms (1st quartile) show significant foreign exchange rate exposures as well. Tests between the first and fourth quartile indicate significant differences in exposure, with multinational firms generally showing larger (more positive) exposures compared to domestic firms.

Taken as a whole, these results indicate that industry classification, firm size and the percentage of foreign sales are significant determinants of foreign exchange rate exposures. Consistent with the finding that exposures based on stock prices and earnings are closely related for most firms, the analysis of exposure determinants suggests that a similar set of economic factors is important for influencing the size of the impact of foreign exchange rate risk on these corporate performance measures.

6 Summary and Conclusion

In contrast to the literature that typically uses stock returns as a measure of firm performance to assess the effect of foreign exchange rate risk on nonfinancial firms, an alternative approach is taken in this paper by estimating the foreign exchange rate exposure of a large sample of U.S. nonfinancial firms on the basis of corporate cash flows. Both approaches can also be interpreted as taking somewhat different perspectives: Stock price regressions assess exposure from an investor's point of view, while cash flow regressions take more of a corporate viewpoint where the sensitivity of different cash flows to exchange rate risk is important information for financial risk management and corporate planning. Moreover, the use of different cash flow variables can offer insights into the sources and components of the exposures towards financial

risks.

The empirical results show that exposures based on aggregate cash flows are similar to exposures based on stock prices. In particular, tests of earnings and stock price exposures indicate that exposures are significantly different in only about 10% of all cases. At the same time, the percentage of firms with significantly different earnings and stock price exposures increases with forecast horizon. While not all firms have a significant exposure to all foreign exchange rates, several nonfinancial firms are significantly exposed to at least one of the currencies of the most important trading partners of the United States. At the same time, the percentage of nonfinancial firms with significant foreign exchange rate exposure increases with time horizon for regressions based on earnings as well as stock prices, indicating better precision of exposures at longer horizons.

Industry classification, the percentage of foreign sales and market capitalization are documented as important determinants of these foreign exchange rate exposures. In particular, stock price and earnings exposures are positively related to the foreign share of sales, and large firms tend to have larger exposures to the Canadian Dollar and the Euro, but smaller (more negative) exposures to the Japanese Yen. On the whole, the results suggest that the impact of exchange rate risk on stock prices and cash flows is similar and that a related set of economic factors determines these types of exposures in a way that is consistent with economic theory and anecdotal evidence.

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Table 1: Multilateral exchange rate exposures of cash flows and stock prices

The table reports results from exposure estimations by firm. For each industry, the first line refers to earnings exposures, while the second line refers to stock price exposures to a trade-weighted exchange rate index. The table reports the percentage of significant positive and negative coefficients (5% significance level), and the number of firms (N).

	Exposure type	% sig. pos. coeff.	% sig. neg. coeff.	N
Health care	earnings	2.0	3.0	868
	stock price	1.6	8.9	868
Consumer non-durables	earnings	1.3	3.1	478
	stock price	4.8	10.5	478
Consumer services	earnings	1.8	4.0	1,262
	stock price	2.0	13.4	1,262
Consumer durables	earnings	1.9	3.9	363
	stock price	1.1	16.3	363
Energy	earnings	1.4	5.8	499
	stock price	5.8	2.6	499
Transportation	earnings	1.0	5.1	195
	stock price	1.5	7.2	195
Technology	earnings	1.5	4.3	1,309
	stock price	2.2	9.2	1,309
Basic industries	earnings	1.4	2.6	642
	stock price	4.8	7.6	642
Capital goods	earnings	1.6	3.4	774
	stock price	1.2	11.4	774
Public utilities	earnings	0.8	5.4	355
	stock price	16.1	3.1	355
Miscellaneous	earnings	3.5	7.6	172
	stock price	16.9	2.3	172
All nonfinancial firms	earnings	1.6	4.0	6,917
	stock price	3.7	9.5	6,917

Table 2: Bilateral exchange rate exposures of cash flows and stock prices

The table reports results from multivariate exposure regressions by firm. For each industry and forecast horizon, the table shows the percentage of significant exposures of earnings and stock prices, respectively, to a set of bilateral exchange rates (5% significance level). EUR, JPY, CAD represent the Euro, Japanese Yen and Canadian Dollar, respectively. The table further reports the percentage of firms for which at least one of the foreign exchange rate exposures is significant (≥1 FX).

		Forecast horizon = 1 month				Forecast horizon = 5 months				Forecast horizon = 9 months			
	Exposure type	CAD	EUR	JPY	≥1 FX	CAD	EUR	JPY	≥1 FX	CAD	EUR	JPY	≥1 FX
Health care	earnings	4.3	10.6	6.4	19.1	15.6	15.6	9.4	37.5	36.0	16.0	24.0	52.0
	stock price	8.5	10.6	4.3	19.1	25.0	25.0	15.6	50.0	28.0	44.0	32.0	76.0
Consumer non-durables	earnings	9.7	3.2	6.5	19.4	4.3	13.0	0.0	17.4	53.8	23.1	15.4	69.2
	stock price	6.5	16.1	9.7	29.0	21.7	21.7	4.3	47.8	15.4	46.2	7.7	61.5
Consumer services	earnings	10.9	3.1	10.9	23.4	19.4	12.9	6.5	25.8	4.2	8.3	8.3	20.8
	stock price	4.7	6.3	7.8	18.8	22.6	19.4	19.4	48.4	12.5	20.8	8.3	37.5
Consumer durables	earnings	12.1	12.1	9.1	24.2	10.5	21.1	10.5	36.8	0.0	0.0	0.0	0.0
	stock price	18.2	15.2	9.1	30.3	26.3	5.3	5.3	36.8	33.3	33.3	0.0	66.7
Energy	earnings	10.7	7.1	10.7	25.0	27.8	11.1	5.6	44.4	28.6	28.6	14.3	42.9
	stock price	0.0	7.1	14.3	17.9	16.7	5.6	0.0	22.2	42.9	0.0	14.3	42.9
Transportation	earnings	7.7	11.5	23.1	34.6	33.3	5.6	61.1	72.2	25.0	12.5	37.5	62.5
	stock price	0.0	0.0	3.8	3.8	5.6	11.1	11.1	16.7	12.5	25.0	0.0	25.0
Technology	earnings	1.9	6.7	7.6	14.3	10.0	10.0	13.3	26.7	18.9	21.6	16.2	45.9
	stock price	11.4	10.5	22.9	31.4	5.0	15.0	35.0	40.0	13.5	24.3	51.4	62.2
Basic industries	earnings	15.1	7.0	11.6	30.2	27.7	17.0	17.0	46.8	42.9	42.9	42.9	78.6
	stock price	18.6	12.8	12.8	33.7	25.5	23.4	12.8	48.9	28.6	21.4	42.9	71.4
Capital goods	earnings	5.0	6.7	8.3	16.7	15.2	0.0	12.1	27.3	18.8	12.5	12.5	37.5
	stock price	8.3	13.3	8.3	23.3	15.2	18.2	9.1	30.3	25.0	6.3	18.8	37.5
Public utilities	earnings	11.8	13.7	7.8	31.4	12.5	18.8	0.0	31.3	14.3	14.3	0.0	28.6
	stock price	27.5	17.6	29.4	49.0	31.3	50.0	6.3	56.3	28.6	0.0	14.3	42.9
All firms	earnings	8.5	7.7	9.6	22.8	17.2	12.1	13.1	35.0	24.7	18.8	18.2	46.1
	stock price	11.7	11.3	13.7	27.7	18.2	19.2	15.5	41.1	20.8	24.7	26.6	55.2

Table 3: Differences of exchange rate exposures of cash flows and stock prices

The table reports results from multivariate exposure regressions by firm. For each industry and forecast horizon, the table shows the percentage of firms where the exposures of earnings and stock prices to a set of bilateral exchange rates are significantly different (Wald test, *p*-value ≤ 0.05). EUR, JPY, CAD represent the Euro, Japanese Yen and Canadian Dollar, respectively. The table further reports the fraction of firms for which earnings and stock price exposures are significantly different for at least one of the foreign exchange rates (≥1 FX).

	Forecast horizon = 1 month				Forecast horizon = 5 months				Forecast horizon = 9 months			
	CAD	EUR	JPY	≥1 FX	CAD	EUR	JPY	≥1 FX	CAD	EUR	JPY	≥1 FX
Health care	12.8	17.0	6.4	25.5	21.9	31.3	12.5	50.0	28.0	44.0	36.0	76.0
Consumer non-durables	6.5	9.7	9.7	22.6	26.1	21.7	8.7	52.2	15.4	38.5	0.0	53.8
Consumer services	9.4	4.7	9.4	21.9	19.4	22.6	16.1	45.2	16.7	16.7	8.3	37.5
Consumer durables	12.1	21.2	15.2	39.4	36.8	10.5	0.0	42.1	33.3	33.3	0.0	66.7
Energy	10.7	10.7	14.3	28.6	27.8	0.0	5.6	33.3	14.3	0.0	14.3	28.6
Transportation	3.8	3.8	0.0	3.8	5.6	27.8	16.7	38.9	25.0	37.5	25.0	50.0
Technology	9.5	9.5	20.0	31.4	3.3	16.7	33.3	40.0	18.9	27.0	56.8	73.0
Basic industries	15.1	12.8	16.3	37.2	14.9	19.1	14.9	40.4	14.3	35.7	35.7	64.3
Capital goods	5.0	16.7	11.7	25.0	12.1	12.1	6.1	27.3	25.0	6.3	31.3	50.0
Public utilities	25.5	11.8	15.7	39.2	18.8	50.0	12.5	62.5	14.3	0.0	0.0	14.3
All nonfinancial firms	11.5	11.7	13.4	29.2	16.2	20.2	15.5	42.1	20.1	26.0	29.2	57.1

Table 4: Determinants of cash flow and stock price exposures

The table reports results from multivariate exposure regressions by firm. Results are shown by forecast horizon and for the 1st and 4th quartile of firms (Qrt), based on firm size as measured by market capitalization (Panel A), and the percentage of foreign sales (Panel B), respectively. Results are reported separately for earnings and stock price exposures to a set of bilateral exchange rates. EUR, JPY, CAD represent the Euro, Japanese Yen and Canadian Dollar, respectively. For each exchange rate variable (FX rate), the median coefficient and the *p*-value of a two-sided sign test are reported. The *Z*-statistic column (Z-stat.) reports a unit normal statistic for a test of the joint significance of the parameter estimates based upon the *t*-statistics for that parameter for each firm in the quartile. It is calculated as $Z = \left(\frac{1}{\sqrt{N}}\right)\sum_{i=1}^{N}\frac{t_i}{\sqrt{k_i(k_i-2)}}$, where t_i is the *t*-statistic of the coefficient of firm *i*, k_i are the degrees of freedom of firm *i*, and *N* is sample size. The corresponding probability of significance is reported in the next column. The tables report further the probability of a two-sided Wilcoxon rank sum test of equal coefficients of firms in the 1st and 4th quartile (Wilcox), as well as a Chi-squared test of equal medians (Chi).

Panel A: Firm size quartiles

		Forecast horizon = 1 month						Forecast horizon = 5 months						Forecast horizon = 9 months					
		Coefficients				Tests		Coefficients				Tests		Coefficients				Tests	
Qrt	FX rate	median	*p*-value	Z-stat.	*p*-value	Wilcox	Chi	median	*p*-value	Z-stat.	*p*-value	Wilcox	Chi	median	*p*-value	Z-stat.	*p*-value	Wilcox	Chi
Earnings exposure																			
1st	CAD	0.006	0.907	-1.6	0.059			-0.027	0.268	-2.9	0.002			-0.006	0.363	1.3	0.096		
	EUR	-0.026	<0.001	-5.0	<0.001			-0.025	<0.001	-4.5	<0.001			0.025	0.080	-3.0	0.001		
	JPY	0.014	0.001	4.4	<0.001			0.010	0.016	3.7	<0.001			-0.015	0.294	0.1	0.463		
4th	CAD	0.042	<0.001	8.3	<0.001	<0.001	0.001	0.017	0.014	12.5	<0.001	<0.001	0.105	0.045	<0.001	17.0	<0.001	0.359	0.191
	EUR	0.003	0.088	2.4	0.008	0.003	<0.001	-0.007	0.180	-0.4	0.328	0.047	<0.001	0.008	0.020	3.0	0.002	0.440	0.072
	JPY	-0.011	0.065	-3.3	0.001	0.001	0.001	-0.008	0.083	-1.6	0.050	0.192	0.001	0.004	0.289	-1.4	0.077	0.207	0.188
Stock price exposure																			
1st	CAD	0.259	<0.001	10.6	<0.001			-0.106	0.086	-1.3	0.097			-0.467	0.014	2.9	0.002		
	EUR	-0.131	<0.001	-10.0	<0.001			-0.348	<0.001	-18.9	<0.001			-0.385	<0.001	-5.4	<0.001		
	JPY	-0.001	0.871	1.6	0.051			0.186	<0.001	11.8	<0.001			0.279	<0.001	13.1	<0.001		
4th	CAD	-0.015	0.554	-0.2	0.406	<0.001	<0.001	-0.153	0.006	-1.1	0.131	0.165	0.563	0.127	0.082	5.1	<0.001	0.213	0.003
	EUR	0.101	<0.001	8.3	<0.001	<0.001	<0.001	0.135	<0.001	8.3	<0.001	<0.001	<0.001	0.137	<0.001	11.1	<0.001	<0.001	<0.001
	JPY	-0.033	<0.001	-3.1	0.001	0.157	<0.001	0.006	0.693	0.3	0.390	<0.001	<0.001	-0.058	0.525	1.4	0.080	<0.001	<0.001

(continued)

Table 4: Determinants of cash flow and stock price exposures (continued)

Panel B: Foreign sales quartiles

		Forecast horizon = 1 month						Forecast horizon = 5 months						Forecast horizon = 9 months					
		Coefficients				Tests		Coefficients				Tests		Coefficients				Tests	
Qrt	FX rate	median	*p*-value	Z-stat.	*p*-value	Wilcox	Chi	median	*p*-value	Z-stat.	*p*-value	Wilcox	Chi	median	*p*-value	Z-stat.	*p*-value	Wilcox	Chi
Earnings exposure																			
1st	CAD	0.009	0.029	-1.1	0.140			-0.001	0.629	-1.7	0.045			-0.025	0.569	-1.4	0.076		
	EUR	0.000	0.274	-1.8	0.032			-0.009	0.025	-1.8	0.040			0.002	0.487	-0.7	0.250		
	JPY	0.007	0.335	-1.4	0.077			-0.004	0.356	-1.9	0.032			-0.007	0.184	-2.5	0.006		
4th	CAD	0.044	0.029	10.0	<0.001	<0.001	0.287	0.060	<0.001	11.5	<0.001	<0.001	<0.001	0.064	<0.001	14.5	<0.001	<0.001	<0.001
	EUR	0.004	0.101	1.3	0.100	0.023	0.076	-0.013	0.120	-1.2	0.106	0.316	0.897	0.008	0.154	-0.4	0.346	0.202	0.630
	JPY	0.015	<0.001	0.0	0.496	0.253	0.076	-0.011	0.016	-2.6	0.005	0.431	0.155	0.004	0.074	0.2	0.410	0.003	0.060
Stock price exposure																			
1st	CAD	-0.248	<0.001	-8.6	<0.001			-0.626	<0.001	-15.7	<0.001			-0.605	<0.001	-6.6	<0.001		
	EUR	0.054	0.139	1.4	0.078			0.009	0.826	-1.0	0.170			-0.066	0.411	-1.7	0.046		
	JPY	-0.133	<0.001	-12.4	<0.001			-0.034	0.312	-0.4	0.353			0.064	0.850	6.0	<0.001		
4th	CAD	0.197	0.023	7.6	<0.001	<0.001	<0.001	0.450	<0.001	8.7	<0.001	<0.001	<0.001	0.324	<0.001	6.8	<0.001	<0.001	<0.001
	EUR	-0.019	0.061	-2.0	0.022	0.162	0.017	-0.085	0.172	0.4	0.333	0.079	0.052	0.305	<0.001	9.5	<0.001	<0.001	<0.001
	JPY	0.074	<0.001	12.4	<0.001	<0.001	<0.001	0.052	<0.001	4.4	<0.001	0.001	<0.001	0.168	0.002	11.3	<0.001	0.010	0.126