

The exchange rate exposure puzzle: the long and the short of it.

Stuart Snaith^{a,*}, Santi Termprasertsakul^b, Andrew Wood^c

^a*Peter B. Gustavson School of Business, University of Victoria, Canada*

^b*Department of Business Administration, Srinakharinwirot University, Bangkok, Thailand*

^c*Essex Business School, University of Essex, UK*

Abstract

The exchange rate exposure puzzle has remained robust to empirical scrutiny however evidence suggests the puzzle abates when longer horizons are considered. This paper applies inference that is appropriate in a long horizon setting and finds this evidence is illusory.

Keywords:

Exchange rate exposure, Economic exposure, Long horizon regression, Overlapping data.

JEL:

C13, C22, F23, F31.

1. Introduction

Financial theory indicates that there should be a relationship between exchange rate movements and firm returns. The failure to find this relationship empirically has been termed the exchange rate exposure puzzle (for a review of the literature see [Bartram and Bodnar, 2007](#)). For the most part, the literature has examined the puzzle from a short horizon perspective but there is a branch of the exchange rate exposure literature that suggests the puzzle is less pervasive at longer horizons (for example see: [Chow et al., 1997](#); [Dominguez and Tesar, 2006](#); [Aggarwal and Harper, 2010](#)). The rationale here is that it may be possible to hedge against transaction exposure (exposure at shorter horizons) but hedging economic exposure (exposure at longer horizons) is far more difficult. While the effort to understand transaction exposure continues in the literature, the evidence of economic exposure has become a stylized fact cited by many studies (for example see: [Jongen et al., 2012](#); [Joseph et al., 2015](#)). By deploying the transformed regression (TR) method of [Britten-Jones et al. \(2011\)](#) this paper goes further than the extant literature in addressing the empirical difficulties surrounding the estimation of long horizon exposure regressions, and in doing so provides new evidence that shows that economic exchange rate exposure is illusory and therefore the puzzle is worse than previously thought.

Section 2 presents the TR method, Section 3 discusses the data and results, while Section 4 concludes.

*Corresponding author. Email: ssnaith@uvic.ca. Telephone: 1-250-721-6646. Address: Peter B. Gustavson School of Business, PO Box 1700 STN CSC, Victoria BC, V8W 2Y2, Canada.

2. Exchange rate exposure regression and the transformed regression method

20 Exchange rate exposure for horizon k is typically tested using the following regression (for example see [Dominguez and Tesar, 2006](#)):

$$r_{i,t,t+k} = \beta_{0,i} + \beta_{1,i}r_{m,t,t+k} + \beta_{2,i}\Delta s_{t,t+k} + \epsilon_{i,t+1}, \quad (1)$$

where $r_{i,t,t+k}$ is the k -period return for firm i , $r_{m,t,t+k}$ is the k -period return on the market index and $\Delta s_{t,t+k}$ is the k -period change in the relevant exchange rate. Controlling for the movement in the market, exchange rate exposure is found when $\beta_{2,i}$ is significant.

25 When testing for long horizon exposure the issue of overlapping data needs to be addressed. This paper does this by applying the TR method of [Britten-Jones et al. \(2011\)](#) to Equation (1). This method aggregates the matrix of explanatory variables transforming the original (overlapping) regression into an equivalent representation of non-overlapping variables.¹

Adopting the notation of [Britten-Jones et al. \(2011\)](#) we re-express Equation (1) as the following
30 overlapping regression:

$$Ar = X\beta + u \quad (2)$$

where r denotes the $T \times 1$ vector of one period log firm returns, A the $(T - k + 1) \times T$ transformation matrix with 1's on the main diagonal and the first $k - 1$ right off-diagonals and 0's otherwise, and X a matrix of explanatory variables and constant from Equation (1). [Britten-Jones et al. \(2011\)](#) show that $\hat{\beta}$ from Equation (2) can be rewritten in terms of the one period non-overlapping returns, and
35 be estimated using standard OLS on the following TR with transformed explanatory variables \tilde{X} :

$$r = \tilde{X}\beta + \tilde{u} \quad (3)$$

$$\tilde{X} \equiv A'X(X'AA'X)^{-1}X'X \quad (4)$$

It can be shown that $\hat{\beta}$ using OLS from Equations (2) and (3) are identical and is shown in Equation (5):

$$\hat{\beta} = (X'X)^{-1}X'Ar \quad (5)$$

Crucially while $\hat{\beta}$ from the overlapping and transformed regressions are the same, using the transformed regression should result in improved inference as $\hat{\beta} - \beta$ from the latter depends on the
40 autocorrelation structure of noise from the transformed regression (\tilde{u}) as opposed to the noise in the overlapping regression (u). [Britten-Jones et al. \(2011\)](#) shows that inference for the TR can be garnered by estimating regression (3) using conventional standard errors. Further, their finite sample analysis indicates substantial improvements in inference when using the TR with inference from conventional OLS, [White \(1980\)](#), and [Newey and West \(1987\)](#) standard errors as compared
45 with the same inference on the untransformed data.

¹In this setting the main issue is the proper calculation of standard errors when using overlapping data as the use of such data results in strong serial correlation in regression residuals. As discussed in the literature, commonly used methods to deal with this are inadequate given the strength of the serial correlation.

3. Data and Results

We estimate the exchange rate exposure regression using data from 1996:01-2015:12 from Datastream for 2011 firms sampled across 10 economies with varying degrees of development (Australia, Canada, China, India, Indonesia, Japan, South Africa, Thailand, United States, and United Kingdom).²

50 Appendix A shows the number of firms per economy. We use monthly data, trade weighted exchange rates and a valued weighted market index for each economy.³ We consider horizons ranging from 1 month to 5 years.

Table 1 summarizes the exchange rate exposure results from Equation (1) using OLS as well as Newey and West (1987) heteroskedasticity autocorrelation consistent (HAC) standard errors. Unreported results using White (1980) standard errors yield similar results. The first observation to make is that both methods indicate some evidence of predictability at the 1-month horizon that increases as a function of k . The proportion of significant OLS results across all countries indicates approximately 26% of firms exhibit exchange rate exposure when $k = 1$ month, and this grows to over 80% when $k = 5$ years. As expected these proportions are higher than those documented in the early literature as more recent data is used (see Inci and Lee, 2014). Overall, the results of Table 1 are in keeping with earlier studies indicating it is harder to hedge exchange rate exposure at longer horizons.

The results in Table 2 repeat the analysis but address the issue of data overlapping by applying the TR method. Strikingly, the results of Table 2 overturn Table 1 and the extant view in the literature. The table shows that as k increases the proportion of firms that exhibit exposure using either TR method is far below that indicated in Table 1 and thus there is less evidence of exposure. This is true for each country, with the proportion of significant results calculated across all countries dropping below 10% at the 2-year horizon and beyond. These striking results suggest a revision of the prevailing view that exposure becomes more evident at longer horizons.⁴

70 4. Conclusion

This paper examines the prevailing view in the literature that firms are subject to economic (long horizon) exchange rate exposure. It applies the approach of Britten-Jones et al. (2011) to address the problem of overlapping data to 2011 firms across 10 diverse economies and over a variety of horizons. Results clearly indicate that the evidence in favor of economic exposure is overturned when properly accounting for the effect of overlapping observations. This suggests the exchange rate exposure puzzle is more perplexing than ever.

²We do this as Bartram and Bodnar (2012) show emerging economies are more likely to exhibit exposure than developed countries.

³The literature discusses the use of an equally weighted market index as an alternative. Results using these data do not qualitatively change our findings. This is also true when using data sampled at weekly instead of monthly intervals.

⁴We note that Australia, Canada, and to a lesser extent South Africa have notably higher exposure at longer horizons than other economies. This we attribute to a commodity currency effect (as Chen et al., 2010 note these three currencies are viewed as major commodity currencies). Unreported results showing firm exposure by industry type supports this finding for Australia and Canada.

Appendix A Data

Table A1
Data composition: number of firms by country

Country	Number of firms
Australia	78
Canada	110
China	167
India	241
Indonesia	172
Japan	255
South Africa	67
Thailand	243
United Kingdom	321
United States	357
Total	2011

References

- 80 Aggarwal, R., Harper, J. T., 2010. Foreign exchange exposure of domestic corporations. *Journal of International Money and Finance* 29 (8), 1619–1636.
- Bartram, S. M., Bodnar, G. M., 2007. The exchange rate exposure puzzle. *Managerial Finance* 33 (9), 642–666.
- Bartram, S. M., Bodnar, G. M., 2012. Crossing the lines: The conditional relation between exchange rate exposure and stock returns in emerging and developed markets. *Journal of International Money and Finance* 31 (4), 766–792.
- 85 Britten-Jones, M., Neuberger, A., Nolte, I., 2011. Improved inference in regression with overlapping observations. *Journal of Business Finance & Accounting* 38 (5-6), 657–683.
- Chen, Y.-C., Rogoff, K. S., Rossi, B., 2010. Can exchange rates forecast commodity prices? *The Quarterly Journal of Economics* 125 (3), 1145–1194.
- 90 Chow, E. H., Lee, W. Y., Solt, M. E., 1997. The economic exposure of US multinational firms. *Journal of Financial Research* 20 (2), 191–210.
- Dominguez, K. M., Tesar, L. L., 2006. Exchange rate exposure. *Journal of International Economics* 68 (1), 188–218.
- Inci, A., Lee, B. S., 2014. Dynamic relations between stock returns and exchange rate changes. 95 *European Financial Management* 20 (1), 71–106.
- Jongen, R., Muller, A., Verschoor, W., 2012. Using survey data to resolve the exchange risk exposure puzzle: Evidence from US multinational firms. *Journal of International Money and Finance* 31 (2), 148–169.
- Joseph, N. L., Lambertides, N., Savva, C. S., 2015. Short-horizon excess returns and exchange rate and interest rate effects. *Journal of International Financial Markets, Institutions and Money* 37, 100 54–76.
- Newey, W. K., West, K. D., 1987. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica* 55 (3), 703–08.
- White, H., 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for 105 heteroskedasticity. *Econometrica: Journal of the Econometric Society*, 817–838.

Table 1
Exchange rate exposure: overlapping data

	Transaction exposure			Economic exposure		
	1 month	3 months	12 months	2 years	3 years	5 years
Australia						
OLS	29.48	51.29	61.53	69.23	76.93	85.9
HAC	25.64	38.46	38.46	50.00	56.41	69.23
Canada						
OLS	18.18	40.9	68.19	81.81	80.00	81.82
HAC	12.73	29.09	51.82	54.55	63.63	59.09
China						
OLS	2.40	9.58	51.49	75.45	90.42	94.01
HAC	3.00	7.19	22.76	53.89	83.84	86.83
India						
OLS	7.05	21.58	38.17	54.36	65.98	78.43
HAC	9.13	13.69	14.94	27.38	48.14	65.14
Indonesia						
OLS	62.79	69.19	73.26	74.42	68.61	72.09
HAC	52.91	58.14	65.70	61.05	53.49	52.90
Japan						
OLS	23.14	44.31	78.82	81.18	84.32	83.92
HAC	18.04	27.84	51.38	60.00	65.10	65.89
South Africa						
OLS	53.73	59.70	70.15	73.14	77.61	83.58
HAC	53.73	50.75	49.26	53.74	65.67	62.69
Thailand						
OLS	38.27	51.85	59.26	55.96	66.66	77.37
HAC	28.39	27.99	36.63	31.28	45.67	58.02
United Kingdom						
OLS	22.74	41.74	63.24	73.83	79.13	83.49
HAC	19.63	23.36	31.78	49.53	58.26	67.92
United States						
OLS	24.93	41.46	64.43	70.87	77.59	84.88
HAC	23.81	28.85	45.38	52.10	62.19	73.39
All countries						
OLS	25.96	41.42	62.26	70.16	76.38	82.35
HAC	22.43	27.75	39.34	48.23	59.28	66.78

This table presents the exchange rate exposure results using Equation (1) with OLS and [Newey and West's \(1987\)](#) (HAC) standard errors. The results show the percentage of firms with significant exposure at the 5% level.

Table 2
Exchange rate exposure: transformed data

	Transaction exposure			Economic exposure		
	1 month	3 months	12 months	2 years	3 years	5 years
Australia						
OLS	29.48	24.35	19.23	16.67	19.23	17.95
HAC	25.64	23.07	21.79	17.95	21.79	19.23
Canada						
OLS	18.18	14.55	18.18	14.55	15.46	11.82
HAC	12.73	19.09	22.73	25.46	28.18	24.54
China						
OLS	2.40	0.00	0.00	0.60	1.20	1.20
HAC	3.00	3.00	4.79	4.79	4.19	7.19
India						
OLS	7.05	4.56	0.82	0.83	1.24	2.48
HAC	9.13	9.54	3.73	2.07	4.98	3.73
Indonesia						
OLS	62.79	56.39	19.19	10.46	2.90	4.65
HAC	52.91	48.26	12.79	6.40	1.16	1.16
Japan						
OLS	23.14	20.78	13.73	6.28	7.06	0.00
HAC	18.04	21.96	13.33	7.06	7.85	0.00
South Africa						
OLS	53.73	40.30	14.93	4.48	7.46	17.91
HAC	53.73	41.80	23.88	14.93	11.94	23.88
Thailand						
OLS	38.27	29.63	14.82	4.12	2.47	1.64
HAC	28.39	16.05	11.94	2.88	1.23	2.47
United Kingdom						
OLS	22.74	18.06	6.23	7.79	7.16	5.29
HAC	19.63	14.95	5.29	2.49	1.24	1.56
United States						
OLS	24.93	16.81	9.24	3.92	3.64	2.80
HAC	23.81	22.97	16.80	11.48	7.00	4.48
All countries						
OLS	25.96	20.53	10.14	5.87	5.32	4.27
HAC	22.43	20.04	11.78	7.46	6.41	5.37

This table presents the exchange rate exposure results using Equation (3) with OLS and [Newey and West's \(1987\)](#) (HAC) standard errors. The results show the percentage of firms with significant exposure at the 5% level.