International Competition and Exchange Rate Shocks: A Cross-Country Industry Analysis of Stock Returns

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This article systematically examines the importance of exchange rate movements and industry competition for stock returns. Common shocks to industries across countries are more important than competitive shocks due to changes in exchange rates. Weekly exchange rate shocks explain almost nothing of the relative performance of industries. Using returns measured over longer horizons, the importance of exchange rate shocks increases slightly and the importance of industry common shocks increases more substantially. Both industry and exchange rate shocks are more important for industries that produce internationally traded goods, but the importance of these shocks is economically small for these industries as well.

Economists, journalists, and politicians around the world argue that some of the industries in their country compete vigorously with the same industries in other countries and that exchange rate shocks affect their competitiveness. In the United States it is routinely stated that some U.S. industries compete with Japanese industries and that a depreciation of the yen is bad for these U.S. industries and good for the rival Japanese industries: "If the yen falls, trade tensions could intensify between the U.S. and Japan as autos and machinery from Japan gain a competitive edge."[1] Further, the exchange rate literature shows that exchange rate shocks lead to persistent deviations from purchasing power parity.[2] Froot and Klemperer (1989) and Knetter (1989, 1993), among others, demonstrate that deviations from purchasing power parity lead to sharp changes in price markups and profit margins for exporters.

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[1] "If the yen is any guide, Asia's crisis isn't over," by Bernard Wysocki, Jr., *Wall Street Journal*, June 15, 1998, A1.

[2] See Froot and Rogoff (1995) for a review of this literature.

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In this article we explore the stock price impact of competition between similar industries located in different countries and address the question of whether the competitive effects of bilateral exchange rate shocks are economically significant for shareholders. We utilize a unique dataset of industry indices from the United States, Canada, United Kingdom, France, Germany, and Japan from 1975 to 1997. We find that, after controlling for marketwide effects, the average impact on U.S. industries of shocks to their foreign counterparts is of little economic importance. However, this effect is several times larger than the effect of exchange rate shocks on the U.S. industries after taking into account marketwide effects. For the other countries, the industry and exchange rate effects are larger but still generally small. Furthermore, there is no evidence that the growth of international trade over our sample period has increased these effects. When there is a relation between the industry in one country and the industry in another country, this relation is generally positive, indicating that common industry effects dominate competitive effects.

The article is related to two literatures that have received much attention recently. One literature investigates the relation between foreign exchange changes and stock returns. With the exception of Williamson (2000), this literature uses trade-weighted exchange rates and ignores industry effects. It does not speak, therefore, to the concerns discussed earlier about the impact of the dollar/yen exchange rate on competition between U.S. and Japanese industries. Williamson finds statistically significant competitive effects of exchange rate shocks between Japan and the U.S. in a specification that regresses the difference in automotive industry returns between the two countries on the dollar/yen exchange rate return. His results hold for our sample and industry classifications. However, our evidence indicates that the automotive industry is more sensitive to exchange rate shocks than the typical industry and that even for autos the economic importance of exchange rate shocks is small. After accounting for industry and market effects, exchange rate shocks explain only about 2.4% of the variation of weekly excess returns of the automotive assembly industry in Japan. This is a small effect, but it turns out that, across more than 300 industry pairs worldwide, exchange rate shocks have greater explanatory power in only 12 industries over our sample period.

The remainder of the literature on exchange rate exposure generally uses trade-weighted exchange rates and does not control for industry effects. Such an approach does not make it possible to evaluate competitive effects directly. Much of this literature focuses on U.S. firms and finds weak contemporaneous relationships between exchange rates and stock returns. Jorion (1990) shows that these exposures are greater for U.S. multinational firms and are increasing in the percentage of foreign operations. Bodnar and Gentry (1993) find more significant exchange rate exposures for Canada and Japan using industry returns. He and Ng (1998) also find more significant exchange rate exposures in Japanese firms. Likewise, in our study, the United States is quite different from other countries. Exchange rate shocks explain a lower fraction of the excess returns of U.S. industries (defined as industry returns minus U.S. market returns) than of non-U.S. industries. One potential explanation for this result is that international trade is simply less important for U.S. firms. However, we examine single industry segment U.S. firms with high levels of foreign sales and still find that the economic importance of exchange rate shocks is low. Another potential explanation is that the signal: noise ratio is too low with weekly data. Though recent work shows for the United States that there may be lags in the relation between firm returns and exchange rate returns [Bartov and Bodnar (1994)] and that this relation may be stronger when measured over longer intervals [Allayannis (1996) and Chow, Lee, and Solt (1997)], our assessment of the economic importance of this relation for value-weighted portfolios holds for longer measurement intervals. In regressions of excess industry returns on exchange rate changes, using yearly instead of weekly returns increases the average adjusted R^2 across all country/industry pairs from less than 0.005 to 0.015.

The second related literature is the one that focuses on the importance of country, industry, and currency factors in stock returns.[3] This literature often estimates the fraction of the variance of a country index that can be explained by one of these three factors. The general conclusion is that country shocks explain more of the return of country indices than cross-country industry shocks. This literature does not attempt to understand directly how industry returns are related across countries, whereas we investigate whether competitive shocks within industries that lead a country's industry to benefit at the expense of another country's industry dominate common shocks. We find almost no industry where competitive shocks are dominant. Perhaps more importantly, we find that common shocks to an industry across countries are more important than competitive effects from exchange rate shocks.

The article proceeds as follows. In Section 1, we describe the industry classifications and characterize the market returns and exchange rates used in the analysis. In Section 2, we examine the impact of exchange rates and U.S. industry returns on Japanese excess industry returns. In Section 3, we extend our analysis to include the United Kingdom, Germany, France, Canada, and the United States. In Section 4, we show that lengthening the measurement interval has little impact on our results. Section 5 shows that our results still hold if we look at industry returns rather than industry returns in excess of the market. We also show that estimates from alternate exchange rate and industry classifications strengthen our conclusions. Section 6 examines the exposure at the individual firm level for U.S. single business segment firms

[3] This literature has been marked by controversy on the relative importance of industry and country factors. See Roll (1992), Heston and Rouwenhorst (1994), and Griffin and Karolyi (1998).

with foreign operations. Section 7 explores whether allowing for interactions between exchange rate shocks and industry shocks uncovers competitive effects potentially obscured in the regressions that we use throughout the article. Section 8 provides a brief conclusion.

1. Empirical Methodology and Data Description

1.1 Empirical framework

There exists a substantial literature that attempts to understand how firm value is related to exchange rates. At the simplest level of a single exporter, an unexpected real depreciation of the local currency increases profits because it amounts to an upward shift of the demand for its products in local currency. However, the total effect of a foreign exchange shock on firm value can be quite complex. Firms have been shown to vary in terms of the ability to "pass through" changes in exchange rates into prices. In particular, Froot and Klemperer (1989) show that the impact of exchange rate changes depends on the persistence of the exchange rate shock. Shapiro (1975) concludes that export sales, the amount of domestic competition, and the substitutability in using domestic or foreign inputs are all determinants of exposure. Marston (1998) argues that the key determinant of operating cash flow exposure is the competitive structure of the industry. Bodnar, Dumas, and Marston (1999) model both exchange rate pass-through and exposure jointly as they argue that many of the same industry characteristics drive both effects. The effect of exchange rate shocks on firm value is made even more complex because firms often hedge some of their foreign exchange exposures. As a result, a firm could increase its operating income following a devaluation of its currency, but this increase could be offset by losses on hedges, so that firm value would be unaffected.

The complexity of the effects on firm value of exchange rate shocks means that there is little hope for structural models that specify how equity value is affected by exchange rate changes as a function of firm operating and financial characteristics. To evaluate whether shareholders benefit from exchange rate changes, a reduced-form approach that examines the relation between stock returns and exchange rate changes is more promising. Unfortunately, even such an approach can run into difficulties. The central thesis is that some firms will perform relatively better as a result of exchange rate depreciation. Regressing stock returns on exchange rate changes does not allow us to investigate this thesis easily. One might find, in such a regression, that firms in all industries benefit from an exchange rate depreciation simply because depreciation is associated with an expansionary monetary policy that promotes greater economic activity from which all firms benefit. Such an outcome would be predicted if one were to use a typical exchange rate determination model, such as Dornbusch (1976).

To assess the impact of exchange rate shocks on the relative performance of industries, we have to account for common effects of exchange rate shocks across all industries. Since our focus is to understand whether exchange rate shocks explain the performance of industries relative to the aggregate economy, the easiest approach to take into account the common effects of exchange rate shocks is to focus on the performance of industries relative to the market. Since industries vary widely in terms of the nature of importing and exporting activities, the terms of competition, and the sensitivity of input and output prices to exchange rates, one might expect wide cross-sectional variation in exposures across industries. If exchange rate effects are important for some industries, they should affect the performance of these industries after controlling for common factors across industries within a country captured by that country's market return.

The use of excess returns is also crucial in allowing us to focus on the cross-country relation between industries. We want to understand whether an unexpected positive shock to a Japanese industry is bad news for the same U.S. industry. Using the Japan and U.S. pair as an example, the Japanese market index in yen and the U.S. market index in dollars have a correlation of 0.24 over our sample period. When considering the returns of an industry in the United States and the same industry in Japan, one would therefore expect these two industries to have a similar correlation as that between the indices. This correlation does not reflect industry factors but rather the effect of business cycles and other aggregate macroeconomic variables.[4]

To purge a country's industry return from the return on the market in that country, we can proceed in several different ways.[5] In particular, we could estimate a regression of the industry return on the market return and use the residual from that regression in our tests. Alternatively, we could simply assume a beta of one and subtract the market return from the industry return. We implemented our tests using these two approaches but focus our discussion on regressions that use net of market returns.[6]

[4] One might argue that the market return as a whole includes the industry effects. However, Griffin and Karolyi (1998) show that only a relatively small proportion of country returns can be explained by industry effects estimated at a low level of aggregation. This is because industry effects are smaller than country effects, but more importantly because country indices (particularly in developed markets) are composed of a diverse range of industries, so that industry effects tend to get diversified within the market portfolio of a country.

[5] An alternative to using excess returns is to use raw industry returns and include the domestic and foreign market returns as explanatory variables. We perform this analysis with quarterly returns, focusing on the incremental R^2 to adding industry returns and changes in exchange rates, and find similar conclusions. For single-segment U.S. firms, the incremental adjusted R^2 due to adding exchange rates are displayed in Table 6.

[6] We have three concerns with using residuals from the market model. First, this is not a strategy that is implementable since it uses the sample period to estimate the market model. We could estimate the parameters of the market model on past data, but doing so would create estimation error that might be correlated with exchange rate shocks. Fama and French (1997) show that for industry indices this estimation error would be substantial. Second, if we estimate the market model within sample, an industry that benefits from exchange rate shocks might have a larger beta if exchange rate shocks are correlated with the market during the sample period. As a result, we might give too much weight to market shocks and not enough to the exchange rate shocks. Third, to a first-order approximation, unexpected excess returns are invariant to the currency of denomination of returns while market model residuals are not [see, for instance, Stulz (1981)].

Below we use the regressions with Japanese industries to demonstrate the nature of the analysis. In the first set of regressions the Japanese industry excess return (r_{JAi}) is regressed on the change in the exchange rate (R_{FX}) for each industry i :

$$r_{JAi} = \alpha_i + b_i R_{FX} + \eta_i \quad \text{for } i = 1, \ldots 58. \tag{1}$$

Note that b_i measures the *relative* exposure of the excess industry return to the yen/dollar exchange rate.[7] While there are clearly more complicated ways to model the exposure (some of which we will examine in Section 7), Equation (1) intuitively estimates the average impact of the exchange rate movement on a Japanese industry's excess return assuming that all of this impact is incorporated into stock prices contemporaneously. If an unexpected depreciation of the yen makes industry i worse off relative to the market in Japan, we expect a negative coefficient b_i. The regression is therefore well-suited to address the question the article tries to answer. Since we are concerned with the relative performance of industries that is explained by exchange rate shocks, it would make no sense for us to focus on the average of the slope coefficients across industries. The value-weighted average of the slope coefficients across industries should be zero. A final point is in order. The theoretical models discussed at the beginning of this section all emphasize the importance of real exchange rate changes. Most of our analysis uses nominal weekly exchange rate changes. For low inflation countries, real and nominal exchange rates are so highly correlated that the choice of which exchange rate to use has no material relevance.[8]

To evaluate the relation with the U.S. industry, we estimate a second set of regressions where the excess return of the U.S. industry (r_{USi}) is added as an explanatory variable:

$$r_{JAi} = \alpha_i + b_i R_{FX} + d_i r_{USi} + \eta_i \quad \text{for } i = 1, \ldots 58. \tag{2}$$

We interpret a positive regression coefficient on the foreign exchange return in Equation (1) to imply that an unexpected depreciation of the yen makes the Japanese industry better off relative to the market. Similarly, we interpret a negative coefficient on the foreign industry return in Equation (2) to mean that the domestic industry's performance relative to the domestic market is worse when the foreign industry does better relative to its market.[9]

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[7] See Adler and Dumas (1984) for an analysis of exposure measures. One could make the exposure depend on firm and/or industry characteristics. Our intent, however, is not to model the dynamics of exposures, but rather to understand the economic importance of exchange rate shocks on average.

[8] For instance, Bodnar and Gentry (1993) report that nominal and real trade-weighted exchange rates have correlations of 0.97, 0.95, and 0.98 in the United States, Canada, and Japan, respectively, during their 1979–1988 monthly sample period.

[9] This interpretation is correct provided that the assumptions that we rely on for our regression specification are appropriate. If we do not account for market effects correctly, our estimates of exchange rate and industry

1.2 Data description and preliminary statistics

The analysis of country/industry pairs requires a highly detailed dataset spanning a long time period. Weekly returns for the industries, market returns, and exchange rates are obtained from Datastream International from January 8, 1975 to June 23, 1997. A major strength of this data source is that Datastream applies the same criteria for defining industries across countries. Consequently, this minimizes the risk of finding low cross-country industry comovements because of misclassification of firms. Datastream classifies indices into one of six levels. At each additional level there are more disaggregated industry definitions until the most disaggregated industry classification, level 6. Griffin and Karolyi (1998) argue that using broad industrial classifications leads to lumping together heterogeneous industries, and that disaggregated industry indexes should be used to examine industry effects. Following their recommendation, we only report results for level 6 industries.

Throughout the study we use industry indexes that are common to the foreign country examined and the United States. For instance, for the United States there are 72 level 6 industries and in Japan there are 59. However, since we focus on cross-country industry relationships, when examining Japanese industry returns we only examine the 58 industries that are common to the United States and Japan. Table 1 displays the relatively large number of level 6 industries for which data are available in each of the six countries used in the analysis in 1985.

A number of industries produce goods traded internationally, but other industries have no underlying internationally traded commodity. We call the former industries "traded goods" industries and the later "nontraded goods" industries.[10] For the United States, dividing our sample into traded and nontraded goods industries yields 21 traded and 51 nontraded goods industries. Admittedly, such classifications are somewhat subjective since many industries have a small traded goods component. The numbers of traded and nontraded goods industries in each country in our sample with availability in the United States are displayed in Table 1. Of the 301 industry indexes that have coverage in 1985, 208 are nontraded goods industries, while 93 are traded goods industries. Even though there are more than twice as many nontraded goods industries, the combined market value of the traded goods industries

effects are biased because they will be affected by the correlation between market returns. All the conclusions of this article hold up if we use market model residuals as the dependent variable or use raw industry returns as our dependent variable and add the market return as an independent variable.

[10] Bodnar and Gentry (1993) examine equally weighted industry portfolios and find that Canadian and Japanese non-traded goods industries gain relative to traded goods industries with an appreciation of the domestic currency. Griffin and Karolyi (1998) find that traded industries exhibit higher industry effects. As discussed by Froot and Rogoff (1995), the exchange rate literature also assigns traded and nontraded goods different roles in explaining deviations from PPP. The 21 traded industries are auto assemblers, three chemical industries, computer software, electrical equipment, electronic equipment, footwear and leather, gold mining, metallurgy, three oil industries, other mining, paper and packaging, pharmaceuticals, steel, textiles/other, tobacco, vehicle components and vehicle distribution.

Table 1
Traded goods and nontraded goods industries for each country

Country	Nontraded Industries Number	MV	Traded industries Number	MV	All industries Number	MV
United States	51	13,254	21	24,234	72	37,488
Japan	40 (43)	7,889	16	14,700	56	22,589
United Kingdom	42 (46)	2,545	17	3,435	59	5,980
Germany	20 (21)	1,727	11	2,929	31	4,656
France	24 (26)	577	12	855	36	1,432
Canada	31 (33)	1,409	16	2,063	47	3,472
Total	208	27,401	93	48,216	301	75,617

To be included in the analysis the Datastream value-weighted, level 6 industry returns must be available for a minimum of two years. Industrial indexes that have no representation in the United States are excluded from the analysis. The number of industries prior to the U.S. availability restriction is included in parentheses. The dollar market values (MV) are in millions and taken as of January 7, 1985.

is 63.7% of the total dollar-denominated market value in January 1985.[11] Further details regarding the data are discussed in the appendix.

2. Exchange Rate and Industry Effects in Japan

2.1 Japanese results

Table 2 provides estimates for the regressions of Equations (1) and (2) for the whole sample and various subsamples. The distributions of the regression coefficients for those regressions, their t-statistics, and the adjusted R^2s for the whole sample period are summarized in Table 2. Since the currency is expressed in yen per dollar, a positive b coefficient indicates that the Japanese industry gains from a yen depreciation. In panel A, we report ordinary least squares (OLS) regression estimates for each of the traded goods industries over our whole sample period. We do not report individually the regressions for the nontraded goods industries.

We can evaluate the impact of foreign exchange rate shocks in two different ways. First, we can look at the slope coefficient. For the automotive industry, we learn that a 1% exchange rate shock leads to an excess return of 0.25%. With the exception of the electronic equipment industry, the auto assembly and vehicle component industries have the highest absolute value slope coefficients among traded goods industries. Viewed from this perspective, large exchange rate shocks have little impact on the industry. Second, we can look at how much of the variation in excess returns is explained by exchange rate shocks. For the automotive industry, we have an R^2 of 2.4%. This implies that exchange rate shocks explain little of the variation in automotive industry excess returns. A model of the firm and its foreign exchange rate exposure could help us in understanding whether the slope coefficient makes economic

[11] The ratio of the total value of traded industries to the total value of nontraded industries does not materially change from the beginning to the end of the sample period.

Table 2
Japanese industry excess weekly returns regressed on the exchange rate and U.S. industry excess returns

	January 8, 1975 to June 23, 1997								
Panel A	*a*	*b*	*d*	Adj. R^2		*a*	*b*	*d*	Adj. R^2
Market index	0.00	0.24			Oil explo. & prod.	0.00	−0.04		
	(2.35)	(5.44)		0.024		−(0.47)	−(0.39)		−0.001
	0.00	0.23	0.25			0.00	−0.03	0.30	
	(1.33)	(5.29)	(8.25)	0.077		−(0.25)	−(0.33)	(4.82)	0.018
Auto assemblers	0.00	−0.25			Oil integrated	0.00	0.18		
	(0.88)	−(5.41)		0.024		−(0.13)	(2.89)		0.006
	0.00	−0.25	0.05			0.00	0.19	0.21	
	(0.92)	−(5.43)	(1.77)	0.025		−(0.16)	(3.06)	(4.38)	0.022
Chems commodity	0.00	−0.08			Other mining	0.00	−0.11		
	−(0.45)	−(2.56)		0.005		−(0.14)	−(1.44)		0.001
	0.00	−0.08	0.01			0.00	−0.11	0.10	
	−(0.45)	−(2.55)	(0.41)	0.004		(0.00)	−(1.51)	(2.44)	0.005
Chems specialty	0.00	−0.13			Paper & packaging	0.00	−0.06		
	−(0.33)	−(3.10)		0.007		−(0.43)	−(1.59)		0.001
	0.00	−0.12	−0.05			0.00	−0.06	0.03	
	−(0.34)	−(3.06)	−(1.50)	0.008		−(0.41)	−(1.62)	(0.83)	0.001
Chems mats tech	0.00	−0.12			Pharmaceutical	0.00	−0.10		
	(0.21)	−(3.35)		0.009		(1.09)	−(2.37)		0.004
	0.00	−0.12	−0.01			0.00	−0.10	0.00	
	(0.20)	−(3.35)	−(0.37)	0.008		(1.09)	−(2.37)	−(0.03)	0.003
Computer software	0.00	−0.21			Steel	0.00	0.13		
	−(0.60)	−(1.99)		0.004		−(0.91)	(3.13)		0.008
	0.00	−0.21	0.03			0.00	0.13	0.03	
	−(0.64)	−(2.00)	(0.44)	0.003		−(0.83)	(3.13)	(1.31)	0.008
Electrical equip.	0.00	−0.19			Textiles other	0.00	−0.01		
	(0.90)	−(5.17)		0.022		−(0.37)	−(0.23)		−0.001
	0.00	−0.19	0.06			0.00	−0.01	0.01	
	(0.85)	−(5.19)	(1.52)	0.023		−(0.40)	−(0.21)	(1.01)	−0.001
Electronic equip.	0.00	−0.33			Vehicle component	0.00	−0.21		
	(0.78)	−(6.72)		0.036		(0.67)	−(5.73)		0.027
	0.00	−0.33	0.14			0.00	−0.21	0.11	
	(0.85)	−(6.83)	(3.49)	0.045		(0.64)	−(5.82)	(3.42)	0.035
Metallurgy	0.00	−0.02			Vehicle distrib.	0.00	−0.07		
	−(0.53)	−(0.34)		−0.001		(0.33)	−(0.46)		−0.002
	0.00	−0.02	0.03			0.00	−0.06	−0.31	
	−(0.52)	−(0.36)	(0.98)	−0.001		(0.18)	−(0.38)	−(2.74)	0.012

Table 2
(continued)

	Average coefficient				No. sign.					Average coefficient				No. sign.			
	b	$\|b\|$	d	Adj. R^2		a	b	d		b	$\|b\|$	d	Adj. R^2		a	b	d
N-Trad.	−0.02	0.12			−	0	16		Trad.(17)	−0.09	0.13			−	0	9	
(41)	−(0.33)	(2.53)		0.007	+	1	11			−(2.05)	(2.76)		0.009	+	0	2	
	−0.02	0.12	0.02		−	0	16	0		−0.09	0.13	0.04		−	0	9	1
	−(0.33)	(2.52)	(0.64)	0.008	+	1	11	7		−(2.05)	(2.78)	(1.31)	0.013	+	0	2	6
All	−0.04	0.13			−	0	25										
(58)	−(0.83)	(2.60)		0.008	+	1	13										
	−0.04	0.13	0.03		−	0	25	1									
	−(0.83)	(2.60)	(0.84)	0.009	+	1	13	13									

Panel B

	1975 to Dec. 1979				1980 to Dec. 1984				1985 to Dec. 1989				1990 to June 1997		
	$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2
All	0.13			*All*	0.14			*All*	0.31			*All*	0.13		
(53)	(1.15)		0.004	(56)	(1.48)		0.009	(56)	(2.61)		0.003	(58)	(1.84)		0.011
	0.13	0.04			0.14	0.04			0.31	0.04			0.12	0.02	
	(1.15)	(0.50)	0.005		(1.48)	(0.51)	0.010		(2.62)	(0.41)	0.035		(1.84)	(0.36)	0.012

Panel A presents coefficient estimates, t-statistics (in parentheses), and adjusted R^2 from regressions for the Japanese yen-denominated weekly market return regressed on the dollar/yen exchange rate and separately for both the exchange rate and the U.S. dollar denominated market return for the period from January 8, 1975 to June 23, 1997. These estimates are also displayed for 17 traded goods industry indexes in excess of the value-weighted Japanese market index ($r_{JAi} = R_{JAi} - R_{JAM}$) regressed separately on the exchange rate and the corresponding U.S. dollar denominated return index return in excess of the U.S. market return ($r_{USi} = R_{USi} - R_{USM}$). Average coefficients, t-statistics, and adjusted R^2 are provided for the 17 traded goods and 41 nontraded goods Datastream level 6 disaggregate industries that exist both in Japan and the United States. The absolute value of the exchange rate coefficients and t-statistics are also taken before averaging to gauge the magnitude of these coefficients. The number of coefficients that are significantly positive at the upper and lower 5% level for traded goods and nontraded goods industries is also presented. Panel B provides these summary statistics for four subperiods beginning in January of each year, starting in 1975. The OLS regressions with the exchange rate and the industry returns in excess of their respective market return are as follows:

$$r_{JAi} = \alpha_i + b_i R_{FX} + d_i r_{USi} + \eta_i \quad \textit{for each industry } i.$$

sense, but such a model could not change the fact that exchange rate shocks have little economic importance when looking at industry excess returns.

All of the traded goods industries except for integrated oil and steel have a negative exchange rate coefficient. This is consistent with exporting industries losing from an appreciation in the currency and importing industries (oil and steel) gaining from a currency appreciation. In contrast, the coefficients of the nontraded goods industries are more evenly balanced between positive and negative. The average coefficient is −0.09, meaning that a 1% appreciation of the yen decreases the value of a traded goods industry in excess of market movements by 0.09% on average. More importantly, the adjusted R^2 coefficient of 0.009 indicates that exchange rate shocks on average explain less than 1% of the variation of the returns of a traded goods industry.

When we add the U.S. industry excess return to the regression, auto assemblers, electronic equipment, both oil industries, other mining, and vehicle component and distribution have positive and significant coefficients on the U.S. excess industry return. This implies that competitive effects are dominated by common cross-country industry effects. For nontraded goods (traded goods) industries, a 1% excess return for the U.S. industry implies a 0.02% (0.04%) excess return for the average Japanese industry. None of the nontraded goods industries have an industry coefficient that exceeds 0.1 in absolute value. Four traded goods industries have such coefficients: the two oil industries and two vehicle industries.

Adding the industry excess return to the regression has almost no impact on the adjusted R^2 in nontraded goods industries and only minimal impact in traded goods industries. The adjusted R^2 for nontraded goods (traded goods) industries is 0.007 (0.009) on average for the regressions with the exchange rate variable alone, and 0.008 (0.013) for regressions with the U.S. industry excess return included as well.

We also examine four subperiods in panel B of Table 2. We choose three subperiods of five years and use the 1990s as one subperiod. The only subperiod that stands out is the subperiod from January 7, 1985 to December 25, 1989, during which the yen appreciated sharply. In this subperiod, the traded goods industries have much larger coefficients on the change in the exchange rate.[12] Also, over this period, the adjusted R^2 is substantially higher for both traded goods and nontraded goods industries. At the same time, however, for the subperiod in which the exchange rate effects are the largest, they are still of limited importance, particularly in nontraded goods industries. The last subperiod, 1990–1997, provides no evidence supportive of the view that exchange rate effects and industry effects have become more important over time.

[12] Removing the month of the October 1987 crash does not materially change the coefficient estimates.

2.2 Interpretation

Our finding that exchange rates are relatively unimportant for the performance of Japanese industries relative to the Japanese market is consistent with many possible explanations. A first possible explanation is that we average across periods where the importance of international trade differs for Japanese industries. However, if that is the case, it should be that foreign exchange effects should be more important in the 1990s since this is the period where international trade is most important for these industries. However, we do not find that foreign exchange effects are higher in the 1990s. A second explanation is that the exchange rate effects are small in Japan because of characteristics of Japanese firms. For instance, it is often argued that Japanese firms pay less attention to shareholder wealth than Anglo-Saxon firms. It could be, therefore, that Japanese shareholders do not benefit from exchange rate depreciations as they would in countries where firms pay more attention to shareholder wealth. We therefore examine in Section 3 whether the impact of exchange rate shocks differs in five other countries. A third explanation is that exposure is low at the industry level because of offsetting exposures within an industry. In Section 6 we examine this possibility by focusing on exposure for single segment U.S. firms with significant foreign sales.

Though one can never fully rule out the possibility that we measure exposures incorrectly, we investigate it by focusing on alternative specifications. First, one could also argue that the market reflects the impact of exchange rate shocks at the industry level, so that we underestimate the impact of exchange rate shocks at the industry level by using excess returns. We therefore discuss results using raw returns in Section 5.1. In Section 7 we also investigate alternative regressions that allow the exposures to be nonlinear. A second related possibility is that our measures of exchange rate changes and industry effects are too noisy. For instance, it could be that transitory foreign exchange movements have little impact but permanent foreign exchange movements have a higher impact. If this explanation is right, we should find a greater impact of exchange rate shocks if we extend the measurement interval. Extending the measurement interval could also resolve another problem, namely that exchange rate shocks are incorporated into stock prices with a lag. In Section 4 we discuss estimates of our regressions using monthly, quarterly, and yearly intervals. In Section 5.2., we examine the possibility that bilateral exchange rate movements are not important while broader exchange rate movements are. Because industry indices often have a small number of firms, it could be that they have too much idiosyncratic risk to measure the impact of exchange rate shocks. However, we use broader industry measures (level 3 Datastream indexes) in regressions not reported here and our results are similar.[13]

[13] With quarterly data for Datastream level 3 industries, we find that exchange rates explain a similar proportion of the variation in the excess industry returns as in level 6 industries.

3. Exchange Rate and Industry Effects Across Countries

We now consider regressions similar to those of Section 2 using the other countries in our sample. These regressions lead to similar conclusions as the ones obtained for Japan, except that generally the economic importance of exchange rate shocks is even smaller. We report summary statistics in Table 3 and plot the coefficients, their t-statistics, and the adjusted R^2s in Figure 1. For completeness, we include the results for Japan discussed in Section 2 as well. The results for the United States use the yen price of the dollar to compute the exchange rate return. This implies that in all our regressions a positive exchange rate return corresponds to an appreciation of the local currency relative to the currency of the foreign country and therefore we can average coefficients across countries.

The results for the world are striking. We have 320 industry pairs. For these industry pairs, the average adjusted R^2 is 0.004 for the regressions including only changes in exchange rates. Of interest, adding the industry excess returns increases the adjusted R^2 to 0.01. A useful way to understand the economic relevance of exchange rate shocks is to note that no regression for the United States with the exchange rate as the only explanatory variable has an adjusted R^2 in excess of 0.01. For Canada, France, Germany, the United Kingdom, and Japan, respectively, 1, 2, 5, 12, and 14 industries have adjusted R^2s in excess of 0.01. Using this measure, exchange rate effects are most important in Japan. As a further gauge of the economic magnitude of either the positive or negative exposure relative to the market, we take the absolute value of the exchange rate coefficient and then average across industries. The average absolute value of the coefficients is less than 0.13 for our broad categories in all countries except for Canada. Figure 1 confirms that for most industries the relative magnitude of the exchange rate coefficients is small, indicating that exchange rate movements cannot lead to large differences in industry performance. Of the 320 industries, only 26, or 8.1%, have exchange rate coefficients that are greater than 0.3 in absolute value. Traded goods industries are more likely to have a negative coefficient and nontraded goods industries are more likely to have a positive coefficient. Industry effects are generally positive and significantly so for 89 industry pairs. Only six industry pairs have a significantly negative industry slope coefficient. As expected, the industry effects explain more for traded goods industries than for nontraded goods industries. For traded goods industries, the average adjusted R^2 increases from 0.003 to 0.021 as the excess return of the foreign industry is added. In contrast, the average adjusted R^2 of the nontraded goods industries increases from 0.004 to 0.006. Our results show that the economic significance of exchange rate shocks is particularly small for the United States. The highest exchange rate slope coefficient for the whole sample for a U.S. industry is 0.10. No adjusted R^2 exceeds 0.007 and the average adjusted R^2 is approximately zero in the absence of industry effects.

Table 3
Industry excess weekly returns regressed on the exchange rate and the U.S. industry excess returns from 1975 to 1997 for all countries in the sample

	World				US				Japan				UK		
	$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2
N-Trad.	0.12			N-Trad.	0.03			N-Trad.	0.12			N-Trad.	0.10		
(220)	(1.58)		0.004	(41)	(0.76)		0.000	(41)	(2.53)		0.007	(46)	(1.87)		0.006
	0.12	0.03			0.03	0.02			0.12	0.02			0.10	0.04	
	(1.57)	(0.80)	0.006		(0.74)	(0.64)	0.000		(2.52)	(0.64)	0.008		(1.86)	(0.98)	0.008
Traded	0.11			Traded	0.03			Traded	0.13			Traded	0.12		
(100)	(1.47)		0.003	(17)	(0.66)		−0.001	(17)	(2.76)		0.009	(19)	(1.85)		0.005
	0.11	0.08			0.04	0.03			0.13	0.04			0.13	0.12	
	(1.51)	(2.46)	0.021		(0.78)	(1.31)	0.004		(2.78)	(1.31)	0.013		(1.97)	(3.22)	0.028
All	0.12			All	0.03			All	0.13			All	0.11		
(320)	(1.55)		0.004	(58)	(0.73)		0.000	(58)	(2.60)		0.008	(65)	(1.86)		0.005
	0.12	0.05			0.03	0.02			0.13	0.03			0.11	0.06	
	(1.55)	(1.31)	0.010		(0.75)	(0.84)	0.001		(2.60)	(0.84)	0.009		(1.90)	(1.63)	0.014

	Germany				France				Canada		
	|b|	d	Adj. R^2		$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2
N-Trad.	0.10			N-Trad.	0.11			N-Trad.	0.26		
(24)	(1.82)		0.005	(33)	(1.30)		0.003	(35)	(1.15)		0.002
	0.10	0.02			0.11	0.00			0.26	0.11	
	(1.80)	(0.35)	0.005		(1.27)	(0.08)	0.003		(1.14)	(1.91)	0.009
Traded	0.11			Traded	0.07			Traded	0.19		
(15)	(1.37)		0.004	(15)	(0.89)		−0.001	(17)	(1.16)		0.001
	0.11	0.02			0.07	0.05			0.18	0.21	
	(1.35)	(0.71)	0.006		(0.89)	(0.96)	0.004		(1.10)	(6.67)	0.065
All	0.10			All	0.10			All	0.24		
(39)	(1.65)		0.005	(48)	(1.17)		0.002	(52)	(1.15)		0.001
	0.10	0.02			0.10	0.01			0.23	0.14	
	(1.63)	(0.49)	0.006		(1.16)	(0.35)	0.003		(1.13)	(3.46)	0.027

For Japan, the United Kingdom, Germany, France, Canada, and the United States, the average coefficient estimates, t-statistics (below coefficients), and adjusted R^2 are presented from regressions over the period from January 8, 1975, to June 23, 1997. The local currency denominated industry return in excess of the corresponding local weekly market return ($r_i = R_i - R_M$) is regressed on the dollar/currency exchange rate or both the exchange rate and the U.S. industry return in excess of the value-weighted U.S. market return ($r_{USi} = R_{USi} - R_{USM}$). For the U.S. regressions the foreign market excess industry return is from Japan. The number in parentheses corresponds to the number of traded goods, nontraded goods, or total industries within a country. For the exchange rate coefficients and t-statistics, the absolute values of these numbers are taken before averaging.

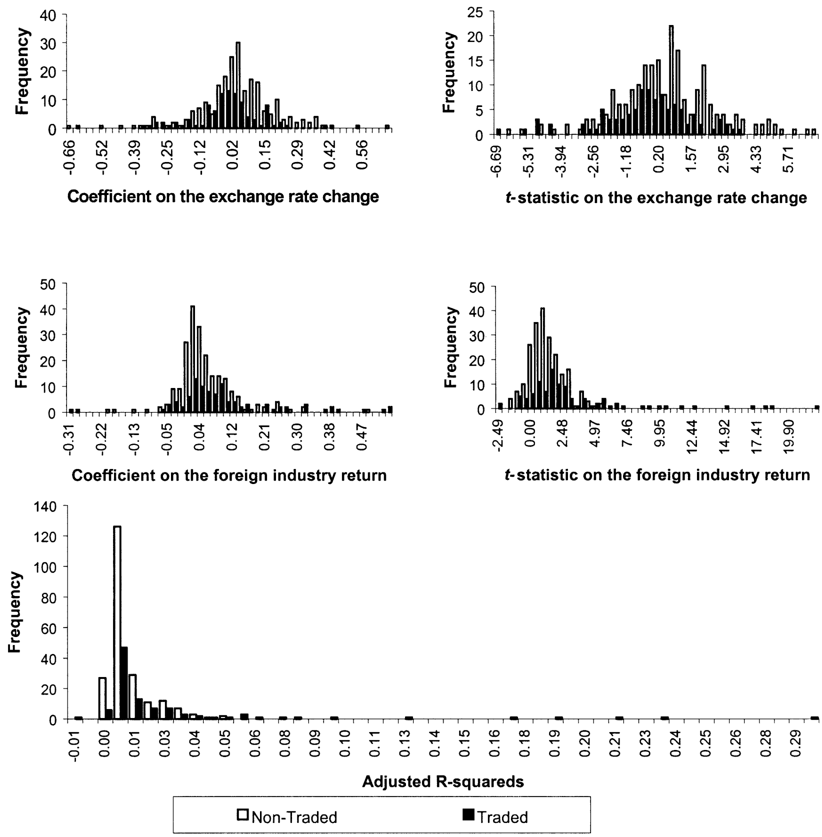

Figure 1
All countries: Summary statistics for regressions of industry excess weekly returns
The distribution of industry excess weekly returns in the United States, Japan, the United Kingdom, Germany, France, and Canada regressed on the dollar/currency exchange rate and the U.S. industry (or Japanese industry for U.S. industries) excess return for the period January 8, 1975, to June 23, 1997 are displayed. Plots for the coefficient estimates, the *t*-statistics, and the adjusted R^2s are shown for traded (black) and nontraded (white) industries.

The U.S. automotive assembly industry has a slope coefficient of −0.01 and an adjusted R^2 of −0.001. No traded goods industry in the United States has a significant foreign exchange coefficient.

We saw in our discussion of the Japanese results that exposures were larger during the period from 1985 to 1989, when the yen appreciated sharply. During that period the deutsche mark and the French franc also sharply appreciated relative to the dollar. The exchange rate returns do not explain more during that period for French industries. For German industries, exchange rate exposures explain slightly more for nontraded goods industries. The average slope coefficient for nontraded goods industries is 0.13 with an adjusted R^2 of 0.017. Twelve German industries have an adjusted R^2 in excess of 0.01, but none has an adjusted R^2 in excess of 0.10. Consequently, it may well be that the sharp appreciation of the yen explains why the 1985–1989 period has unique characteristics in Japan, but the equally sharp appreciation for some European currencies does not make that period stand out for their countries.

Our sample period covers a long period of time where the importance of international trade grew dramatically and financial markets became much more integrated. It could therefore be that our results for the whole sample period are not representative of the current importance of industry and exchange rate shocks. However, results for the 1990s are remarkably similar for those of the whole sample period. The exception is Canada, where industry effects increased for the traded goods industries. For all other countries, the results for the whole sample are not distinguishable from results for the 1990s.

4. Does the Economic Importance of Exchange Rate and Industry Shocks Increase when the Measurement Interval is Extended?

In the previous two sections we showed that the economic importance of exchange rate shocks is small and that on average industry shocks are common across countries. All our regressions were estimated using weekly returns. As mentioned earlier, there are reasons to be concerned that changes in the measurement interval could affect our conclusions. We therefore investigate in this section whether our results are affected if we measure returns over longer periods of time.

In Table 4 we report results using yearly measurement intervals. Looking at all industries together, we see that exchange rate coefficients are higher using yearly measurement intervals than using weekly measurement intervals. For the whole world, the average of the absolute value of the exchange rate coefficient increases from 0.12 with weekly intervals to 0.37 using yearly intervals. Further, exchange rate shocks explain more of the variation in returns as the measurement interval increases.[14] However, the effect is small. For the whole world, the average adjusted R^2 for regressions using only the exchange rate returns increases from 0.004 to 0.008 and 0.015 as one goes from weekly to quarterly and annual data. For traded goods industries, the adjusted R^2 changes from 0.003 to 0.016. However, for the traded goods industries for the regressions that have both exchange rate shocks and industry shocks the adjusted average R^2 increases from 0.02 to 0.10. The main conclusion, therefore, is that as we use longer measurement intervals the industry effects grow much more than the exchange rate effects. The United States is an exception to this conclusion in that the impact of exchange rate shocks is trivial for

[14] In results not reported here, we also estimate our regressions on monthly and quarterly data. The general conclusion is that the importance of exchange rates and industry effects is increasing in the observation interval.

any measurement interval since regressions with exchange rate returns only have negative adjusted R^2s on average regardless of the measurement interval. At the other extreme, using yearly data, the average R^2 for the United Kingdom traded goods industries is 0.06 for regressions with the exchange rate returns only and 0.198 for regressions with exchange rate returns and industry returns. Using weekly and monthly data, we found weak evidence that lagged exchange rate exposure increases explanatory power (particularly at the weekly level), but the effect is economically trivial. This suggests that most of the increase in explanatory power from increasing the measurement interval is simply due to a stronger signal:noise ratio—exchange rates and industry effects represent a larger proportion of the variation in stock returns at longer horizons.

5. Do the Results Change with Alternate Returns Definitions?

5.1 Exchange rates and market returns

All the previous analysis is conducted with industry returns in excess of their respective local market indexes. The benefit from this approach is that we do not confound market shocks with industry or foreign exchange shocks. Our procedure provides an accurate assessment of how exchange rate shocks affect the performance of an industry relative to the market. One might argue, however, that exchange rate shocks have a common effect on all industries that we ignore and that may be economically important. To assess this common effect is difficult because market movements can affect exchange rates. Nevertheless, attributing all market moves correlated with exchange rate shocks to exchange rate shocks provides an upper-bound to the economic importance of exchange rate shocks. To investigate this upper bound, we estimate the relation between market returns and exchange rates in Table 5 for various measurement intervals. The adjusted R^2 for regressions with only the exchange rate are generally largest at the quarterly and smallest at the yearly interval. One could view these regressions with only the exchange rate as taking the extreme view that exchange rates exogeneously determine market returns. However, even under this view, the results in Table 5 indicate surprisingly little ability for exchange rates to influence marketwide returns, particularly at weekly and yearly intervals. Again, the United States seems insulated from exchange rate shocks, as these shocks have no explanatory power for the market returns.

With the extreme view that all the correlation between the market and the exchange rate is attributable to the exchange rate causing changes in the market, one would estimate the impact of exchange rate shocks on industries without controlling for the return of the market. With this view, the regressions in Table 5 estimate the exchange rate exposure of the market and the regressions displayed in Tables 3 and 4 estimate the incremental relation

Table 4
Industry excess yearly returns regressed on the exchange rate and the U.S. industry excess returns

	World				US				Japan				UK		
	Avg. coeff.				Avg. coeff.				Avg. coeff.				Avg. coeff.		
	$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2
N-Trad.	0.35			N-Trad.	0.22			N-Trad.	0.33			N-Trad.	0.34		
(181)	(0.97)		0.014	(38)	(0.70)		−0.016	(38)	(1.15)		0.036	(40)	(1.09)		0.023
	0.36	0.08			0.20	−0.08			0.32	0.02			0.36	0.23	
	(0.97)	(0.31)	0.031		(0.63)	(−0.16)	−0.009		(1.10)	−(0.16)	0.044		(1.18)	(0.97)	0.065
Traded	0.41			Traded	0.15			Traded	0.34			Traded	0.51		
(81)	(1.00)		0.016	(15)	(0.67)		−0.017	(15)	(1.17)		0.036	(17)	(1.35)		0.060
	0.45	0.32			0.20	0.32			0.34	0.27			0.52	0.34	
	(1.11)	(1.33)	0.103		(0.73)	(1.25)	0.046		(1.17)	(1.25)	0.093		(1.62)	(1.49)	0.198
All	0.37			All	0.20			All	0.33			All	0.39		
(262)	(0.98)		0.015	(53)	(0.69)		−0.017	(53)	(1.16)		0.036	(57)	(1.17)		0.034
	0.38	0.15			0.20	0.03			0.32	0.09			0.41	0.26	
	(1.01)	(0.63)	0.053		(0.65)	(0.24)	0.007		(1.12)	(0.24)	0.058		(1.31)	(1.12)	0.103

	Germany				France				Canada		
	Avg. coeff.				Avg. coeff.				Avg. coeff.		
	$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2		$\|b\|$	d	Adj. R^2
N-Trad.	0.30			N-Trad.	0.40			N-Trad.	0.61		
(18)	(1.07)		0.020	(22)	(1.10)		0.033	(25)	(0.71)		−0.009
	0.35	0.10			0.36	0.10			0.63	0.14	
	(1.23)	(0.53)	0.046		(1.01)	(0.21)	0.031		(0.71)	(0.64)	0.005
Traded	0.25			Traded	0.36			Traded	0.79		
(10)	(0.91)		0.001	(10)	(0.95)		0.008	(14)	(0.83)		−0.005
	0.27	0.21			0.41	0.25			0.91	0.50	
	(0.96)	(0.94)	0.015		(1.09)	(0.77)	0.056		(0.99)	(2.01)	0.166
All	0.28			All	0.38			All	0.67		
(28)	(1.02)		0.013	(32)	(1.05)		0.025	(39)	(0.76)		−0.008
	0.32	0.14			0.38	0.15			0.73	0.27	
	(1.14)	(0.67)	0.035		(1.04)	(0.39)	0.039		(0.81)	(1.13)	0.062

For Japan, the United Kingdom, Germany, France, Canada, and the United States, average coefficients, t-statistics, adjusted R^2s, and the number of statistically significant coefficients are presented from regressions with yearly data over the period from January 1, 1976 to January 1, 1997. The local currency denominated industry return in excess of the corresponding local market return ($r_i = R_i - R_M$) is regressed on the dollar/currency exchange rate and the U.S. industry return in excess of the value-weighted U.S. market return ($r_{USi} = R_{USi} - R_{USM}$). For the U.S. regressions the foreign market excess industry return is from Japan. For the exchange rate coefficients and t-statistics, the absolute values of these numbers are taken before averaging.

Table 5
Market returns regressed on the exchange rate

	Weekly			Quarterly			Yearly		
	a	*b*	Adj. R^2	*a*	*b*	Adj. R^2	*a*	*b*	Adj. R^2
U.S.	0.00	−0.05		0.04	0.05		0.12	0.08	
	(4.44)	−(1.25)	0.001	(4.56)	(0.39)	−0.010	(3.96)	(0.32)	−0.041
Japan	0.00	0.24		0.02	0.06		0.06	0.35	
	(2.35)	(5.44)	0.024	(1.73)	(0.35)	−0.010	(1.28)	(1.01)	0.001
U.K.	0.00	0.05		0.04	−0.29		0.15	−0.41	
	(5.35)	(1.01)	0.000	(5.01)	−(1.92)	0.030	(3.95)	−(1.43)	0.044
Germany	0.00	−0.09		0.03	−0.38		0.10	−0.30	
	(3.54)	−(2.36)	0.004	(3.04)	−(2.69)	0.067	(2.22)	−(0.89)	−0.009
France	0.00	−0.10		0.04	−0.24		0.13	−0.25	
	(3.87)	−(1.90)	0.002	(3.26)	−(1.27)	0.007	(2.28)	−(0.55)	−0.031
Canada	0.00	0.55		0.03	0.99		0.12	0.51	
	(4.47)	(6.02)	0.029	(4.33)	(2.92)	0.080	(3.25)	(0.68)	−0.025

For the United States, Japan, the United Kingdom, Germany, France, and Canada, the coefficients, t-statistics, and the adjusted R^2s are presented from weekly, quarterly, and yearly regression over the entire January 8, 1975, to June 23, 1997 time period. The local currency market return (R_M) is regressed on the dollar/currency exchange rate. For the U.S. regressions the exchange rate is the yen/dollar exchange. The OLS regressions is as follows:

$$R_{Mi} = \alpha_i + b_i R_{FX} + \eta_i \quad \text{for each market } i.$$

between market returns and exchange rates as well as the industry exchange rate exposure. To evaluate the effect of exchange rates with this view more formally, we regress industry returns on changes in exchange rates using quarterly data but do not report the results. The average adjusted R^2 across all industry regressions is only 0.018 compared to 0.008 when we use excess returns. It follows that our conclusions hold irrespective of whether we use industry excess returns or industry returns. A formal analysis of the pricing of exchange rate risk is beyond the scope of this article. Nevertheless, our results imply that it would be difficult to find out whether exchange rate risk is priced in stocks because exchange rate shocks have so little impact on stock returns.[15]

5.2 Changing the benchmark exchange rate and industry return

In this article we study the impact of a country's exchange rate and industry shocks on the same industry in another country. The earlier literature focuses instead on analyses that use trade-weighted exchange rates and industry indexes constructed across countries. Analyses that rely on trade-weighted exchange rates and worldwide industry indexes cannot estimate directly the impact of bilateral competitive shocks, but they provide better estimates of the impact of some types of common shocks. To the extent that common shocks are important, it is therefore useful to evaluate their significance using broader industry return measures and exchange rate shocks than the bilateral measures. To examine this issue, we use Datastream's trade-weighted exchange rate as the relevant exchange rate.[16] In addition, for each industry in a particular country we use the local currency excess returns from the remaining (five) countries to form a value-weighted industry excess returns index.[17]

Quarterly return regressions are estimated similar to those in Table 4 except that a trade-weighted exchange rate and value-weighted industry excess return index are used as explanatory variables. On average, across all industries in all countries the adjusted R^2 for regressions with just the trade-weighted exchange rate is 0.008—a nearly identical adjusted R^2 as that obtained from regressions with bilateral dollar rates. This evidence suggests that using trade-weighted exchange rates may ignore valuable information in bilateral exchange rates, since trade-weighted exchange rates on average do not

[15] Adler and Dumas (1983) demonstrate the conditions under which each exchange rate term is a separate risk factor. See Jorion (1991), Dumas and Solnik (1995), and De Santis and Gerard (1998) for empirical analyses of these issues.

[16] This trade-weighted exchange reflects the trading pattern of the country rather than the industry. Constructing a trade-weighted exchange rate at the industry level is difficult because trade data does not match the Datastream industry classifications.

[17] The local currency industry returns are in excess of their local market index. The weights are the dollar market capitalization of each industry as a proportion of the total dollar market value of the industry at the beginning of the quarter.

explain more of industry returns than a single bilateral exchange rate. For regressions with the trade-weighted exchange rate and the industry index constructed from other countries, the average adjusted R^2 across all industry regressions in all countries is 0.040 and is 0.008 higher than the average adjusted R^2 with quarterly data discussed in Section 4. This evidence is consistent with the view that common shocks are most important at the industry level and that these shocks are measured more accurately using a portfolio of industry returns across countries.

6. Exposure at the Individual Firm Level

One possible explanation for the low explanatory power of exchange rates for industry returns is that firms have high exposure coefficients in absolute value, but these exposures cancel each other out within an industry because some are positive and others negative. With this explanation, exchange rate shocks would be important at the firm level, but diversified away at the industry level. In addition, there could be a diversification effect within firms as a firm may experience both positive and negative exposures from different divisions of the firm if the firm is engaged in several related businesses. To investigate this important issue we focus our attention on single industry segment firms with foreign sales. Because of data limitations we use only U.S. firms. Geographic segments are denoted as “Asian” or “European” if all of the reported foreign sales are in that region or “other foreign” if the reported foreign sales are not entirely in either of those regions. We use the yen/dollar rate for firms with Asian sales and the pound/dollar rate is used for firms with European sales. The trade-weighted exchange rate is used for the other firms. Because foreign operations may produce an offsetting exposure to foreign sales, firms are further classified as either having foreign assets or only domestic assets. Identifying U.S. firms with foreign operations through the use of geographic segment data is similar to Jorion (1990), but he focused on multinational corporations where exposures could be diversified within a firm, whereas we focus on single segment firms.[18]

Table 6 reports average foreign sales, profits, and assets for firms in each category with at least some foreign sales.[19] For firms with at least some foreign sales, the average foreign sales are between 25% and 30% of sales. To measure the economic significance of foreign exchange shocks, Table 6 reports the average adjusted R^2s from regressions of individual firm monthly returns in excess of the CRSP value-weighted market index regressed on

[18] Linck (1998) focuses on understanding cash flow exposure for single industry segment U.S. firms with foreign operations. As discussed by Jorion, the Financial Accounting Standards Board has left a variety of reporting options to the discretion of the firm, which introduces measurement error in the classifications.

[19] There are only two firms with Asian sales and purely domestic assets and thus results for this category are not included.

Table 6
Returns for single industry segment, U.S. firms with foreign sales regressed on changes in the exchange rate

	Average			R_{FX} coefficient		Adjusted R^2				N. signf		
	Sales	Profits	Assets	b	$t(b)$	(A)	(B)	(C)	Diff (5 − 4)	N	−	+
Foreign sales > 0 %												
Asia, for. assets	0.292	0.509	0.288	−0.023	−(0.14)	0.003	0.102	0.104	0.002	31	1	3
Eur, dom. assets	0.265	0.474	0.000	0.051	(0.07)	0.006	0.091	0.098	0.006	28	2	4
Eur, for. assets	0.260	0.351	0.223	0.064	(0.13)	0.002	0.111	0.112	0.001	204	12	14
Oth, dom. assets	0.243	0.005	0.000	−0.014	−(0.06)	0.006	0.114	0.120	0.006	89	6	4
Oth, for. assets	0.316	0.165	0.275	−0.024	−(0.01)	0.002	0.147	0.150	0.002	700	52	53
Foreign sales > 25 %												
Asia, for. assets	0.546	0.760	0.438	−0.086	−(0.13)	0.005	0.108	0.117	0.009	12	1	1
Eur, dom. assets	0.908	0.111	0.000	1.062	(1.43)	0.014	0.052	0.064	0.012	4	0	2
Eur, for. assets	0.447	0.345	0.365	0.157	(0.08)	0.007	0.107	0.110	0.003	74	6	8
Oth, dom. assets	0.665	0.040	0.000	0.166	(0.06)	0.019	0.038	0.058	0.020	19	2	3
Oth, for. assets	0.471	0.454	0.392	0.018	(0.05)	0.003	0.153	0.156	0.003	343	26	28
Foreign sales > 50 %												
Asia, for. assets	0.774	0.531	0.579	0.324	(0.59)	−0.009	0.085	0.078	−0.007	4	0	0
Eur, dom. assets	0.996	0.000	0.000	1.198	(1.33)	0.010	0.029	0.038	0.009	3	0	1
Eur, for. assets	0.746	0.510	0.588	0.068	(0.07)	0.000	0.076	0.080	0.005	12	1	1
Oth, dom. assets	0.858	0.028	0.000	0.827	(0.42)	0.022	0.050	0.072	0.023	9	1	2
Oth, for. assets	0.663	0.653	0.534	0.059	(0.11)	0.003	0.133	0.136	0.003	107	8	7

U.S. firms with returns from CRSP that are classified by COMPUSTAT as single industry segment firms are used in the analysis. According to COMPUSTAT geographic segment data, from 1978 to 1997, these firms are classified into Asian or European geographic region if they have foreign sales only in that region. Otherwise if a firm has reported foreign sales but it is not exclusively in Asia or Europe or if the firm has sales in both of those regions then the sales are simply denoted as foreign. In addition, firms are classified as having at least some foreign assets or domestic assets if no foreign assets are reported. Additional criteria for some of the analysis are that a firm has at least 25% or 50% of its sales abroad. The average fraction of foreign sales, profits, and assets are reported for each group. For each firm meeting the above criterion for at least three consecutive years, the following monthly time-series regressions are estimated:

$$R_i - R_M = \alpha_i + b_i R_{FX} + \eta_i \quad \text{for each } i \qquad \text{(A)}$$

$$R_i = \alpha_i + d_i R_M + \eta_i \qquad \text{(B)}$$

$$R_i = \alpha_i + b_i R_{FX} + d_i R_M + \eta_i \qquad \text{(C)}$$

where R_i is the monthly stock return, R_M is the CRSP value-weighted market return, and R_{FX} is the change in the monthly foreign currency per dollar exchange rate. The foreign currency is the yen for firms with Asian sales, the pound for firms with European sales, and the U.S. trade-weighted exchange rate for firms with other foreign sales. The average exchange rate coefficient and average t-statistic from regression (A) is reported along with the average adjusted R^2 for regressions (A), (B), and (C) as well as the average difference between the adjusted R^2 in regressions (B) and (C). The number of firms for which the equation is estimated as well as the number of exchange rate coefficients that are significantly positive or negative at the 10% level are also reported.

exchange rates. For all regions, the average adjusted R^2s are all less than 0.003 for firms with foreign sales in one of the three regions but with some foreign assets. For firms with foreign sales but no reported foreign assets the average adjusted R^2s are slightly higher at 0.006. Restricting attention to firms with at least 25% or 50% foreign sales increases the magnitude of the explanatory power of the exchange rate somewhat, but the increase is not large. For example, the average adjusted R^2s for firms with more than 50% of sales abroad are 0.01, 0.00, and 0.003 for firms with foreign assets and Asian, European, and other foreign sales, respectively. For firms with domestic assets and more than 50% foreign sales, the explanatory power of the exchange rate is larger but the averages are less reliable as there are only three European and nine other foreign firms meeting these criterion.

In general, the single segment analysis is surprising in that even for firms which primarily sell abroad, generally less than 1% of the variation in their stock returns can be explained by exchange rate movements. One potential explanation for these results is that U.S. firms organize themselves so that exchange rate exposure has little impact on their value, perhaps through the use of derivatives. Consistent with this view, Géczy, Minton, and Schrand (1997) find that firms with large foreign sales and profits are more likely to use currency derivatives. Allayannis and Weston (2001) find that the use of foreign currency derivatives is associated with higher relative market valuations.[20]

7. Alternative Regression Specifications

The earlier analysis does not allow for interactions between exchange rate shocks and industry shocks. A case can be made that ignoring such interactions might obscure both industry and exchange rate effects.[21] We evaluate this issue in the context of our regressions for Japanese industries. Consider the case of an industry with domestic inputs and foreign sales responding to an unexpected appreciation of the dollar. The competitive view of exchange rate shocks predicts that an unexpected appreciation of the dollar adversely affects the U.S. industry and positively affects the Japanese industry. This prediction implies that periods of volatile exchange rates are periods where shocks affect the two industries in opposite directions. One would therefore observe a negative relation between cross-country comovement and exchange rate volatility. Another concern is that exchange rate shocks might have an asymmetric effect, if for example, the Japanese government instituted subsidies to key export industries in response to a currency appreciation but allowed these exporters to benefit from currency depreciations.

[20] Simkins and Laux (1997) find evidence that the use of currency derivatives does reduce foreign exchange exposure for U.S. firms.

[21] For a discussion of how volatility affects cross-country correlations in the presence of competitive shocks, see Karolyi and Stulz (1996).

To address concerns that our regressions might be misspecified, obscuring the importance of exchange rate and country effects, we include additional explanatory variables that allow for asymmetries in exchange rate shocks and allow shocks to decrease the slope coefficient on the U.S. industry. The regressions we estimate are as follows:

$$r_{JAi} = \alpha_i + b_i R_{FX} + c_i |R_{FX}| + d_i r_{USi} + e_i [R_{FX}{}^* r_{USi}] + f_i [|R_{FX}|^* r_{USi}] + \eta_i \text{ for } i = 1, \ldots 58. \quad (3)$$

c_i allows for an effect of the absolute value of the exchange rate change. If the volatility of the exchange rate does not matter, one expects $c_i = 0$.[22] We allow for the exchange rate shock to affect the comovement between the Japanese and the U.S. industry. If competitive effects matter, one expects a U.S. industry shock to be less informative about the Japanese return if it is accompanied by a large exchange rate shock. Again, we allow for a level effect (e_i) and an absolute value effect (f_i). Though the additional variables sometimes have significant coefficients, the average adjusted R^2 across all industries is only 0.001 (0.006) higher at the weekly (quarterly) interval than those from regressions with simply the change in the exchange rate and the industry excess return (as displayed in Table 2). Thus we do not report the estimates of the regressions because nonlinear effects do not have a significant impact on our assessment of competitive effects.[23]

8. Conclusion

In this article we attempt to understand better the economic significance of exchange rate and industry shocks for industries across the world. The use of consistently classified disaggregated industry indices from 1975 to 1997 in six well-established capital markets allows for a thorough comparison across countries and time. The impact of exchange rate shocks is trivial in explaining the relative performance of U.S. industries and small even in the countries where international trade is much more important than in the United States. Industry effects are more important than exchange rate effects, especially when the measurement interval is lengthened. Even with yearly returns, however, exchange rate changes explain only 1.5% of the variation in the average industry's excess return as compared to common industry effects explaining an additional 3.8% of the variation. Industry shocks have common rather than competitive effects across countries. There is no evidence that an industry in a country benefits at the expense of the same industry in another country. In other words, what's good for GM is good for Toyota on average.

[22] We also allow for several other nonlinear measures of exchange rate volatility but find that they do not aid in modeling the dynamics beyond the simple absolute value of the exchange rate measure.

[23] We also investigated the effects of autocorrelation, heteroskedasticity, and endogeneity but found that they did not affect the results. They are discussed at length in the working paper version.

Our empirical analysis leads to the conclusion that exchange rate shocks have almost a negligible impact on the value of industries across the world. This conclusion turns out to be remarkably robust, since it holds across different regression specifications, levels of aggregation for industry indexes, exchange rate benchmarks, measurement intervals, and subperiods. It contrasts sharply with the presumption in public policy debates as well as findings from the exchange rate literature that exchange rate shocks have sharp effects on prices and profit margins. Since we focus on stock market valuations and not on economic activity, it could be that the stock market fails in taking exchange rate shocks into account, so that exchange rates are important but their impact is irrationally ignored by the stock market. Such an explanation is hard to believe since the patterns we document hold over a long period of time. Alternatively, it could be that the stock market is efficient in incorporating the impact of exchange rate shocks on stock prices, but exchange rate shocks are simply not economically important for shareholders. This could be because focusing on prices and profit margins of exports captures only part of the impact of exchange rates on firms. In particular, firms are complex and can be affected by exchange rate shocks in numerous ways. The local currency value of their assets and liabilities as well as their growth opportunities might be affected. It is therefore perfectly possible that exchange rate shocks have a significant impact on profit margins of exports and at the same time have economically trivial effects on shareholder wealth. This could further be the case because other sources of variation in stock prices are much more important than exchange rate shocks. Finally, this could also be because firms have many tools at their disposal to minimize the effect of exchange rate shocks on their value. Firms can hedge using financial instruments as well as their operations, but they can also quickly adjust their activities to changes in exchange rates. Our evidence is therefore perfectly consistent with the view that firms choose to organize themselves so that exchange rate changes have little effect on their value and are highly efficient at doing so.

Appendix

A.1 Returns

Returns are calculated as the difference between the log of the Datastream return index. The industry index returns are value-weighted return indexes adjusted for dividends and stock splits. The weekly return indexes for most countries begin on January 1, 1975, and thus the first return is on January 8, 1975. The weekly return series corresponds to the return from the previous Monday's close to the current Monday's close. Quarterly returns are calculated beginning with the return index value from January 1, 1975, such that the first quarterly return appears on April 1, 1975, and the last quarterly return is April 1, 1997. The yearly returns are from January 1, 1976, to January 1, 1997.

A.2 Exchange Rates

The change in the exchange rate is calculated as the logged difference between the current exchange rate and the previous month's dollar/currency exchange rate. For regressions involving U.S. industries or individual firms, the exchange rate is denoted in currency per dollar. All exchange rate data is obtained from Datastream. The direct U.S. dollar per currency exchange rate is taken from Barclays. For earlier years of the sample and for the dollar/pound exchange rate, the direct currency per dollar quote is not available, but the series is constructed from U.K. cross-rates quoted by National Westminster Bank. Simple correlations between the U.K./dollar cross-rate exchange changes and those obtained from the respective market quotes reveal that all corresponding series have correlations greater than 0.95 for the periods for which both currency rates are available. The trade-weighted exchange rate used here is the Bank of England's nominal trade-weighted exchange rate.

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