Intra-Industry Competition: A MGARCH Approach

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We extend prior empirical work by examining the impact of global industry-specific shocks on industry returns. We find that although both exchange rate and global industry-specific shocks explain industry performance, the impact of global industry-specific shocks is much stronger both economically and statistically. We also find that it is the global industry-specific shock instead of cross-country industry-specific shock that has a common effect on the relative performance of industries across all countries. Our tests of robustness include alternative measures of industry returns, firm data, and MGARCH model. The results are in general robust.

INTRODUCTION

Dornbusch and Fischer (1980) show that exchange rate movements affect international competitiveness and trade balance. An increase in currency value makes a country less competitive in international trade which reduces cash flows and stock returns of businesses in that country. Prior empirical studies, however, fail to observe a significant and pervasive impact of exchange rate on stock prices at either industry or firm level (Jorion, 1990; Bodnar and Gentry, 1993; Amihud, 1994; He and Ng, 1998; Allayannis and Ihrig, 2001; Williamson, 2001; and Doidge et al., 2003; Koutmos and Martin, 2003a & 2003b); or a significant economic exposure of exchange rate (Jorion, 1991; and Griffin and Stulz, 2001).

Using data from developed countries, Griffin and Stulz (2001, henceforth GS) examine the impact of exchange rate movements and cross-country industry shocks on industry returns after controlling for market-wide effects. They conclude that cross-country industry shocks explain industry returns better than competitive shocks when exchange rates change. Their R-squared ($\hat{R}^2$) estimates on industry and exchange rate shocks are, however, too small to draw any meaningful conclusions. In particular, their data show almost no impact of exchange rate shocks on the relative performance of industries. Also, their findings show that U.S. industry return impacts only 14 of the 58 Japanese industries.

A possible reason for the weak findings in GS is that their regression model does not include global shocks for industries, which provides the motivation for our study. In a recent study on intersectoral allocation of resources, Fisman and Love (2004) introduce the concept of global shocks which can affect an industry across all countries. In this paper, we add a global component to the GS regressions that can control for industry-specific shocks common to all countries. When the performance of an industry is compared in different countries, it is important that a global industry index which measures global shocks should be included in the regression model.[1]

Positive global shocks could arise for a number of reasons. For example, the aging of the baby boom generation and increasing life expectancy rates are expected to increase the demand for prescription drugs which will benefit the global pharmaceutical industry. Advances in information technology will have positive shocks on the so-called "new economy" including telecom, media, and technology sectors because of reduction in trading costs via online networks and information sharing. Finally, financial and trade liberalization in most emerging markets will benefit a number of industries worldwide. Global shocks can also be negative such as global shifts in factor prices (i.e., oil shocks). The recent subprime mortgage crisis and financial meltdown provide strong examples of how global shocks can have significant and negative impact on real estate and banking industries across countries.

Our regression findings indicate that global industry-specific shocks increase the $\hat{R}^2$ values significantly, especially for the Japanese and U.S. data. Furthermore, contrary to the findings in GS, the cross-country industry shock has a competitive rather than a common effect mainly for Japanese industries. More importantly, it is the global industry-specific shock not the cross-country industry shock that has a common effect on the relative performance of industries across countries. To test for the robustness of the results, we use alternative measures of industry returns, use industry data from major developed countries, use firm data from a single industry, and apply MGARCH to control for heteroskedasticity problem in financial time-series data. The results are in general very robust.

The remainder of the paper is organized as follows. Section 2 describes empirical models and data used in our study. The main results using excess industry returns are reported in Section 3. Section 4 provides the robustness of the results obtained in Section 3. Section 5 provides concluding remarks.

EMPIRICAL MODELS AND DATA DESCRIPTIONS

Empirical Models

As our first step in the empirical analysis, we examine whether exchange rate shock explains the relative performance of industries in Japan. The following regression models are estimated:

$$r_{JPi,t} = \beta_{0i} + \beta_{fxi} R_{fx,t} + \varepsilon_{i.t} \quad \forall i = 1 \cdots\cdots N \tag{1}$$

where $r_{JPi,t}$ is excess Japanese industry return computed as stock return on industry *i* in Japan minus market return in Japan at time t[2]; $R_{fx,t}$ is the change in the exchange rate; β_{fxi} is the relative exposure of the excess Japanese industry return to the USD/Yen exchange rate.[3] If an unexpected appreciation of the yen lowers the excess return on industry i in Japan, the sign of β_{fxi} will be negative.

We examine the impact of a U.S. industry-specific shock on the relative performance of a Japanese industry by adding excess U.S. industry return ($r_{USi,t}$) to the regression:

$$r_{JPi,t} = \beta_{0i} + \beta_{fxi} R_{fx,t} + \beta_{USi} r_{USi,t} + \varepsilon_{i,t} \quad \forall i = 1 \cdots\cdots N \tag{2}$$

where $r_{USi,t}$ is excess U.S. industry return computed as stock return on industry *i* in the U.S. minus market return in the U.S. at time t. A positive β_{USi} would indicate that industry performance in Japan improves when the same industry performs well in the U.S. This is the common effect observed in GS. A negative β_{USi} would indicate a competitive effect, i.e., an industry performs poorly in Japan when the same industry performs well in the U.S.

In the third set of regressions, which is our main contribution, we add excess global industry return as an explanatory variable. The excess global industry return ($r_{WDi,t}$) is computed as the return on a global industry index *i* minus the return on the world market index:[4,5]

$$r_{JPi,t} = \beta_{0i} + \beta_{fxi} R_{fx,t} + \beta_{USi} r_{USi,t} + \beta_{WDi} r_{WDi,t} + \varepsilon_{i,t} \quad \forall i = 1 \cdots\cdots N \tag{3}$$

A positive β_{WDi} would indicate that returns on an industry in Japan increase when returns on the same industry increase globally. In other words, what's good for the global auto industry is also good for Toyota. A negative β_{WDi} would indicate that global industry-specific shocks have a competitive rather than a common effect on the domestic industries in Japan.

Data Descriptions

Weekly industry returns, market returns, and exchange rates are obtained from *Datastream International* from January 3, 1975 to December 29, 2006. *Datastream* uses the same criteria to define industries for all countries which helps capture low cross-country industry movements resulting from misclassified firms. Throughout the study, we examine those industries whose returns are available for both countries in the regression. For example, in the regression involving the U.S. and Japan, we analyze returns for 53 industries whose data are available for both the U.S. and Japan. The returns are calculated as the difference between the log of the *Datastream* return index. The industry index returns are value-weighted return indices adjusted for dividends and stock splits. We obtain excess industry returns by subtracting the return on the *Datastream* national market index from the industry return.

Tables 1A, 1B, and 1C display the mnemonics of the industries for each country, the sample means and standard deviations of the excess industry returns, and the corresponding excess global industry returns during 1975-2006. The sample means and standard deviations of changes in exchange rates are also reported in the tables. Since we express exchange rates in dollar per unit of local currency, an increase in exchange rate indicates an appreciation of the local currency. The data in the tables show that the U.S. dollar depreciated against the Japanese yen and Euro, but appreciated against the British pound.

TABLE 1A
INDUSTRY DEFINITIONS AND SUMMARY STATISTICS OF EXCESS JAPAN INDUSTRY RETURNS

		Japanese		U.S.		World	
Industry definition	**Mnemonic**	***Mean***	***Std.***	***Mean***	***Std.***	***Mean***	***Std.***
Airlines	AIRLN	-0.079	3.002	-0.074	3.341	-0.036	1.997
Auto Parts	AUPRT	0.044	2.070	-0.069	1.913	-0.040	1.574
Automobiles	AUTOS	0.070	2.589	-0.064	2.785	-0.048	1.884
Banks	BANKS	-0.020	2.390	0.035	1.671	0.015	1.157
Beverages	BEVES	0.002	1.989	0.033	2.192	0.031	1.706
Build Mat/Fixt	BMATS	-0.019	1.853	-0.005	2.650	0.013	1.470
Brewers	BREWS	0.020	2.498	0.025	2.961	0.023	1.791
Bus Sup Svs	BUSUP	-0.018	3.693	0.007	1.899	-0.005	1.333
Commodity Chem	CHEMS	-0.011	2.064	-0.038	2.207	-0.018	1.409
Chemicals	CHMCL	-0.005	1.705	-0.023	1.813	-0.011	1.234
Spec Chem	CHMSP	0.007	1.827	0.007	1.773	-0.001	1.423
Cloth & Access	CLTHG	-0.018	2.319	0.086	3.026	0.086	2.567
Consumer Fin	CNFIN	0.016	2.791	0.027	2.411	0.014	2.469
Consumer Gds	CNSMG	0.038	1.854	-0.042	1.635	-0.038	1.235
Comp Hardware	COMPH	-0.020	2.709	-0.038	2.282	-0.051	2.363
Distil & Vint	DISTV	-0.034	3.677	0.092	3.039	0.047	2.587
Div Inds	DIVIN	0.022	3.235	-0.038	1.766	-0.038	1.153
Electricity	ELECT	0.039	2.770	-0.008	2.049	0.000	1.519
Eltro/Elec Eq	ELTNC	0.025	1.946	0.047	1.613	0.034	1.287
Food Products	FDPRD	-0.014	1.804	0.029	1.776	0.028	1.340
Fd Producers	FOODS	-0.018	1.781	0.029	1.757	0.028	1.324
Forestry & Pap	FSTPA	-0.039	2.542	-0.081	2.376	-0.081	1.872
Furnishings	FURNS	-0.027	2.618	-0.029	2.659	-0.015	2.359
Gas Dst	GASDS	0.026	3.036	-0.034	2.287	-0.001	1.667
General Inds	GNIND	0.029	2.474	-0.043	1.593	-0.038	1.067
Household Gds	HHOLD	0.022	2.033	-0.010	2.106	-0.014	1.637
Hotels	HOTEL	0.020	4.346	0.105	3.562	0.018	1.836
Nonlife Insur	NLINS	-0.003	2.406	0.027	1.682	0.012	1.293

Insurance	INSUR	-0.001	2.390	0.033	1.583	0.018	1.194
Leisure Gds	LEISG	-0.011	1.956	-0.011	1.654	-0.028	1.279
Media	MEDIA	0.016	1.883	-0.038	1.388	-0.035	1.190
Explore & Prdn	OILEP	-0.009	3.296	-0.045	3.066	-0.020	2.405
Oil & Gas	OILGS	-0.008	3.179	0.016	2.289	0.031	1.743
Int Oil & Gas	OILIN	-0.001	3.581	0.041	2.308	0.052	1.899
Paper	PAPER	-0.039	2.544	-0.066	2.481	-0.067	1.821
Pers & H/H Gds	PERHH	0.005	1.744	0.014	1.736	0.010	1.330
Pharm & Bio	PHARM	0.069	2.381	0.015	1.855	0.018	1.550
Pharm	PHRMC	0.069	2.382	0.004	1.927	0.013	1.592
Personal Prd	PRSNL	0.008	2.292	0.011	1.956	0.017	1.664
Publishing	PUBLS	-0.002	2.281	0.016	1.526	0.020	1.190
Real Estate	RLEST	0.002	2.589	0.078	2.543	0.041	1.925
Retail	RTAIL	-0.014	1.936	0.013	1.977	0.006	1.616
Toys	TOYSG	-0.017	3.075	0.003	3.391	-0.012	3.174
Semiconductors	SEMIC	0.097	3.887	0.018	3.961	0.019	3.964
Soft Drinks	SOFTD	-0.058	2.603	0.035	2.429	0.027	2.442
Steel	STEEL	-0.009	2.693	0.106	3.911	-0.083	2.492
Support Svs	SUPSV	0.070	3.192	0.010	1.759	-0.011	1.274
Telecom	TELCM	0.040	3.836	-0.031	1.916	-0.014	1.492
Telecom Eq	TELEQ	0.012	3.285	0.021	3.336	-0.018	2.533
Financials	FINAN	-0.012	1.807	0.040	1.238	0.021	0.897
Transpt Svs	TRNSV	-0.003	2.706	0.036	3.703	0.020	3.763
Tires	TYRES	0.021	3.260	-0.108	4.209	-0.050	2.290
Utilities	UTILS	0.037	2.685	-0.013	1.903	0.004	1.397
MARKET	TOTMK	0.146	2.280	0.245	2.081	0.254	1.802
Bilateral dollar/Yen exchange rate	USD/Yen	0.056	1.493				

TABLE 1B
INDUSTRY DEFINITIONS AND SUMMARY STATISTICS OF EXCESS U.K. INDUSTRY RETURNS

		U.K.		**U.S.**		**World**	
Industry definition	**Mnemonic**	***Mean***	***Std.***	***Mean***	***Std.***	***Mean***	***Std.***
Aerospace	AEROS	0.039	2.858	0.061	2.076	0.065	2.171
Aero/Defence	AERSP	0.036	2.764	0.052	1.914	0.050	1.981
Auto Parts	AUPRT	-0.072	3.066	-0.069	1.913	-0.027	1.436
Auto & Parts	AUTMB	-0.041	2.907	-0.061	2.062	-0.016	1.445
Banks	BANKS	0.045	2.048	0.035	1.671	0.019	1.364
Beverages	BEVES	0.000	2.464	0.033	2.192	0.030	1.693
Build Mat/Fixt	BMATS	0.018	1.999	-0.005	2.650	0.002	1.277
Basic Resource	BRESR	0.029	2.965	-0.058	2.281	-0.021	1.565
Bus Sup Svs	BUSUP	0.028	1.953	0.007	1.899	-0.027	1.592
Chemicals	CHMCL	-0.039	1.915	-0.023	1.813	-0.015	1.168
Spec Chem	CHMSP	-0.070	2.557	0.007	1.773	-0.007	1.267
Computer Svs	CMPSV	-0.090	4.208	-0.065	2.033	-0.062	2.151
Consumer Fin	CNFIN	0.097	3.121	0.027	2.411	-0.003	2.123
Con & Mat	CNSTM	0.036	1.795	-0.001	2.304	-0.002	1.380
Defense	DEFEN	0.079	4.252	0.035	2.699	0.023	2.476
Distil & Vint	DISTV	0.001	2.610	0.092	3.039	0.035	2.121
Dur Hh Prd	DURHP	0.005	3.698	-0.048	2.055	-0.026	1.985

Eltro Eq	ELETR	-0.012	3.261	0.016	2.874	0.024	2.177
Eltro/Elec Eq	ELTNC	-0.039	3.011	0.047	1.613	0.023	1.314
Fd Rtl & W	FDRET	0.040	2.649	0.120	2.150	0.078	1.518
Fd & Drug Rtl	FDRGR	0.033	2.477	0.049	1.897	0.054	1.438
Financials	FINAN	0.018	1.211	0.040	1.238	0.022	1.051
Fd Producers	FOODS	-0.016	1.719	0.029	1.757	0.025	1.273
Furnishings	FURNS	0.052	5.170	-0.029	2.659	-0.029	1.825
General Inds	GNIND	-0.019	2.710	-0.043	1.593	-0.019	1.183
Household Gds	HHOLD	0.028	2.029	-0.010	2.106	-0.021	1.438
Health Care	HLTHC	0.010	1.453	0.017	1.339	0.018	1.200
Inds Machinery	IMACH	0.058	2.826	-0.009	2.060	-0.044	1.833
Inds Transpt	INDTR	-0.019	1.960	-0.005	1.853	-0.019	1.287
Insurance	INSUR	-0.005	2.079	0.033	1.583	0.024	1.194
Investment Svs	INVSV	0.079	2.665	0.110	3.606	0.023	2.647
Leisure Gds	LEISG	-0.064	3.759	-0.011	1.654	-0.026	1.413
Life Insurance	LFINS	0.034	2.410	0.064	1.940	0.042	1.719
Marine Transpt	MARIN	0.011	2.864	-0.071	5.204	-0.023	1.990
Media Agencies	MEDAG	0.025	4.003	0.148	2.695	0.114	2.421
Medical Eq	MEDEQ	-0.013	2.499	0.011	1.760	0.020	1.907
Media	MEDIA	-0.037	1.966	-0.038	1.388	-0.025	1.196
Heavy Con	HVYCN	-0.003	2.501	0.006	3.090	-0.014	1.938
Mining	MNING	0.039	3.046	-0.118	4.778	0.016	2.703
Nondur Hh Prd	NDRHP	0.013	3.029	-0.002	2.779	0.001	2.725
Nonlife Insur	NLINS	-0.050	2.622	0.027	1.682	0.020	1.264
Oil/Eq Svs/Dst	OILES	-0.217	7.798	-0.049	3.104	-0.036	2.961
Oil & Gas Prod	OILGP	0.026	2.402	0.020	2.305	0.045	1.975
Prop/Cas Insur	PCINS	-0.056	2.757	0.026	2.045	0.009	1.571
Pers & H/H Gds	PERHH	0.054	2.133	0.014	1.736	-0.004	1.186
Personal Goods	PERSG	0.017	3.012	0.011	2.047	0.008	1.714
Pharm & Bio	PHARM	0.049	2.542	0.015	1.855	0.022	1.527
Publishing	PUBLS	-0.035	1.987	0.016	1.526	0.023	1.211
Recreatnal Prd	RECPR	0.019	5.897	-0.142	2.995	-0.092	2.088
Recreatnal Svs	RECSV	-0.065	3.203	0.063	2.560	0.034	2.112
Rest & Bars	RESTS	0.024	2.048	0.038	2.554	0.025	2.348
Real Estate	RLEST	-0.015	2.107	0.078	2.543	0.035	1.830
Retail	RTAIL	-0.022	2.057	0.013	1.977	0.003	1.590
S/W & Comp Svs	SFTCS	-0.087	3.948	0.016	2.353	0.015	2.396
Soft Drinks	SOFTD	0.050	3.364	0.035	2.429	0.030	2.390
Speciality Fin	SPFIN	0.031	2.513	0.094	1.642	0.020	1.383
Support Svs	SUPSV	0.016	1.828	0.010	1.759	-0.013	1.447
Technology	TECNO	-0.102	3.966	-0.018	2.131	-0.010	1.991
Tobacco	TOBAC	0.092	3.275	0.097	3.256	0.087	2.832
Travel & Leis	TRLES	0.010	2.161	0.061	2.111	0.033	1.474
Transpt Svs	TRNSV	0.003	2.223	0.036	3.703	-0.020	4.052
Trucking	TRUCK	-0.079	2.484	0.010	2.037	-0.020	1.613
MARKET	TOTMK	0.322	2.380	0.245	2.081	0.238	1.819
Bilateral dollar/BP exchange rate	USD/BP	-0.011	1.363				

TABLE 1C
INDUSTRY DEFINITIONS AND SUMMARY STATISTICS OF EXCESS GERMANY INDUSTRY RETURNS

		Germany		U.S.		World	
Industry definition	**Mnemonic**	***Mean***	***Std.***	***Mean***	***Std.***	***Mean***	***Std.***
Airlines	AIRLN	0.013	3.582	-0.074	3.341	-0.029	1.948
Auto & Parts	AUTMB	0.002	2.107	-0.061	2.062	-0.015	1.634
Auto Parts	AUPRT	-0.023	2.929	-0.069	1.913	-0.029	1.439
Automobiles	AUTOS	0.002	2.212	-0.064	2.785	-0.007	1.999
Banks	BANKS	-0.026	1.445	0.035	1.671	0.030	1.473
Basic Mats	BMATR	0.020	1.486	-0.031	1.709	-0.023	1.134
Beverages	BEVES	-0.214	3.853	0.033	2.192	0.031	1.668
Build Mat/Fixt	BMATS	0.010	2.908	-0.005	2.650	0.005	1.346
Brewers	BREWS	0.009	3.606	0.025	2.961	0.027	1.667
Commodity Chem	CHEMS	0.027	1.817	-0.038	2.207	-0.026	1.477
Chemicals	CHMCL	0.025	1.724	-0.023	1.813	-0.019	1.224
Spec Chem	CHMSP	-0.024	2.803	0.007	1.773	-0.010	1.247
Consumer Gds	CNSMG	0.002	2.014	-0.042	1.635	-0.021	1.382
Consumer Svs	CNSMS	-0.045	1.742	-0.011	1.059	-0.017	0.698
Con & Mat	CNSTM	-0.001	2.392	-0.001	2.304	-0.006	1.444
Drug Retailers	DGRET	0.021	4.000	0.086	3.437	0.082	3.391
Div Inds	DIVIN	0.057	2.057	-0.038	1.766	-0.017	1.570
Eltro/Elec Eq	ELTNC	-0.008	2.080	0.047	1.613	0.031	1.382
Elec Compo/Eq	ELEQP	0.008	2.195	0.064	1.659	0.038	1.376
Electricity	ELECT	0.043	2.119	-0.008	2.049	0.005	1.633
Food & Bev	FDBEV	-0.062	2.582	0.030	1.708	0.026	1.278
Financials	FINAN	-0.004	1.210	0.040	1.238	0.028	1.129
Full Lin Insur	FLINS	0.015	2.162	0.031	1.958	0.037	2.062
Fd Producers	FOODS	-0.026	2.764	0.029	1.757	0.024	1.295
Food Products	FDPRD	-0.028	2.773	0.029	1.776	0.025	1.313
Forestry & Pap	FSTPA	0.005	3.253	-0.081	2.376	-0.075	1.766
Inds Machinery	IMACH	-0.065	1.947	-0.009	2.060	-0.029	2.141
Inds Eng	INDEN	-0.013	1.641	-0.010	1.823	-0.023	1.295
Insurance	INSUR	0.032	1.790	0.033	1.583	0.030	1.225
Industrial Met	INDMT	0.012	3.437	-0.009	3.115	-0.028	2.033
Inds Transpt	INDTR	0.001	3.074	-0.005	1.853	-0.019	1.287
Leisure Gds	LEISG	-0.041	2.773	-0.011	1.654	-0.035	1.518
Life Insurance	LFINS	0.031	3.228	0.064	1.940	0.054	1.803
Medical Eq	MEDEQ	0.013	3.809	0.011	1.760	0.019	1.885
Multiutilities	MTUTL	0.046	1.940	0.002	2.310	0.035	2.127
Nonlife Insur	NLINS	0.030	1.896	0.027	1.682	0.021	1.368
Paper	PAPER	0.005	3.253	-0.066	2.481	-0.055	1.679
Prop/Cas Insur	PCINS	0.019	2.648	0.026	2.045	0.014	1.641
Pers & H/H Gds	PERHH	0.021	1.961	0.014	1.736	0.001	1.231
Personal Goods	PERSG	0.035	2.215	0.011	2.047	0.003	1.862
Pharm & Bio	PHARM	0.024	2.127	0.015	1.855	0.026	1.513
Pharm	PHRMC	0.027	2.168	0.004	1.927	0.021	1.547
Personal Prd	PRSNL	0.056	2.676	0.011	1.956	-0.004	1.694
Retail	RTAIL	-0.072	2.377	0.013	1.977	0.006	1.512
Steel	STEEL	0.034	3.638	0.106	3.911	-0.020	2.603

Telecom	TELCM	-0.085	2.688	-0.031	1.916	-0.032	1.765
Mobile T/Cm	TELMB	-0.047	3.780	0.017	3.373	0.041	2.512
Travl & Toursm	TRAVL	-0.007	3.306	0.061	2.111	-0.046	2.531
Tires	TYRES	0.047	3.432	-0.108	4.209	-0.042	2.532
Utilities	UTILS	0.057	2.031	-0.013	1.903	0.008	1.529
Water	WATER	0.009	3.138	0.107	3.249	0.111	3.038
MARKET	TOTMK	0.189	2.218	0.245	2.081	0.240	1.831
Bilateral US$/Euro exchange rate	US$/Euro	0.017	1.352				

EMPIRICAL RESULTS

Japanese Industries

Panel A of Table 2 summarizes the distributions of the regression coefficients and the adjusted $\hat{R}^2$ for 53 Japanese industries. The results in the first row show that β_{fx} coefficients are significant in 32 of the 53 industries.[6] Among the 32 industries with significant exchange rate exposure, 18 of them have negative exposure and the other 14 have positive exposure, suggesting that the impact of the exchange rate shocks on the relative performance of the Japanese industry is mixed. In one hand, a positive β_{fx} coefficient indicates that the Japanese industry gains from a yen appreciation. On the other hand, a negative β_{fx} coefficient suggests that Japanese industry suffers from a yen appreciation. As a result, the impact of exchange rate shocks on the Japanese industries is inconclusive.

In addition to the sign of the β_{fx} coefficients, we can also evaluate the impact of exchange rate shocks by looking at the size of the β_{fx} coefficient. Among those industries with significant positive β_{fx} coefficient, gas distribution industry (GASDS) has the highest β_{fx} coefficient of 0.242, indicating that a 1% exchange rate shock leads to an excess return of 0.242%. On the other hand, among the 18 industries with significantly negative β_{fx} coefficients, the tire industry (TYRES) has the highest negative β_{fx} coefficient of –0.369, suggesting that a 1% appreciation of the Japanese yen leads to a decrease in excess return by 0.369%. Finally, we can also examine how much of the variation in excess returns is explained by exchange rate shocks by looking at $\hat{R}^2$. The highest $\hat{R}^2$ is 5.08% for the consumer goods industry with an average $\hat{R}^2$ of 0.9% for the Japanese industry as a whole. Like the findings in GS, our findings show that exchange rate shocks explain little variations in the relative performance of the Japanese industries.

Turn to the second row of Panel A, which reports the results for regressions that include when excess U.S. industry returns. With this additional explanatory variable, the results are virtually unchanged compared to those reported in the first row. For example, β_{fx} coefficients are still significant in 32 of 53 industries, and among the 32 industries with significant exchange rate exposure, 18 are negative and the other 14 are positive. In terms of the size of β_{fx} coefficient, it is the highest for gas distribution industry (β_{fx} = 0.242), and the lowest for tire industry (β_{fx} = –0.369). As for $\hat{R}^2$, consumer goods industry still has the highest $\hat{R}^2$ of 0.054, with an average $\hat{R}^2$ of 0.011 for the Japanese industry as a whole, suggesting that the U.S. excess industry return doesn't help in explaining the variations of the relative performance of the Japanese industries. The results reported in the first two rows of Panel A basically confirm what have been found in GS.

We now turn to the regression results in Eq. (3) which includes excess global industry returns. The results shown in the last row of Panel A are very encouraging. First, the number of significant β_{fx}

coefficients increases from 32 to 38 suggesting that more Japanese industries are exposed to the USD/Yen movements when global shocks are considered. The mean β_{fx} is –0.03 indicating that a 1% appreciation in yen is associated with a 0.3% decrease in Japanese industry return. Second, the number of significant β_{US} coefficients increases from 13 to 21, and 17 are negative, suggesting that the Japanese industries suffer from the strong performance of their U.S. counterparts. These results are contrary to those reported in GS that only a small number of Japanese industry returns can be explained by the U.S. industry returns. Third, global industry shock not only increases the explanatory power of exchange rate and U.S. industry shocks on the Japanese industries, global shock itself seems to have a significant impact on Japanese industries. Our results show that the β_{WD} values are significant both statistically and economically. For example, 48 of 53 (90.57%) Japanese industries are significantly positively exposed to the global industry shocks. The mean β_{WD} value of 0.674 indicates that a 1% increase in excess global industry return increases excess Japanese industry return by 0.674%.[7] Among the 48 industries with significant exposure to common global shocks, the support services industry (SUPSV) has the highest exposure with a β_{WD} value of 1.276. Finally, the $\hat{R}^2$ increases from 0.9% to 37.4% when excess global industry return is included in the regressions, suggesting that there is a significant global industry effect on the relative performances of the Japanese industries.

To examine if global shocks continue to impact Japanese industries remains without the influence of U.S. industry returns, we estimate Eq. (2) excluding $r_{US,i}$. The results reported in the third row of Panel A confirm the earlier results that global shocks impact Japanese industries and that the impact is positive. Forty-nine of the 53 β_{WD} values are positive and significant.

TABLE 2
SUMMARY OF SUR RESULTS – EXCESS INDUSTRY RETURNS

Average coefficient [average $t-stat$]						**No. of Significant**		
β_{fx}	$\lvert\beta_{fx}\rvert$	β_{US}	β_{WD}	$\hat{R}^2$		β_{fx}	β_{US}	β_{WD}
Panel A: Japan (53 industries)								
-0.019	0.120				negative	18		
[-0.637]	[2.920]			0.009	positive	14		
-0.019	0.119	0.012			negative	18	0	
[-0.639]	[2.921]	[0.939]		0.011	positive	14	13	
-0.029	0.162		0.670		negative	21		0
[-2.638]	[5.862]		[49.481]	0.372	positive	23		49
-0.030	0.161	-0.016	0.674		negative	19	17	0
[-2.205]	[4.903]	[-1.070]	[30.474]	0.374	positive	19	4	48
Panel B: U.K. (62 industries)								
0.037	0.086				negative	8		
[0.752]	[1.782]			0.004	positive	15		
0.035	0.087	0.044			negative	8	0	
[0.700]	[1.834]	[2.616]		0.017	positive	15	33	
0.011	0.081		0.302		negative	11		0
[0.025]	[1.750]		[10.530]	0.126	positive	13		55
0.011	0.081	0.027	0.298		negative	11	2	0
[0.015]	[1.769]	[1.410]	[10.284]	0.130	positive	13	29	55

Panel C: Germany (51 industries)								
-0.055	0.100				negative	22		
[-1.157]	[2.121]			0.004	positive	0		
-0.055	0.100	0.018			negative	22	2	
[-1.157]	[2.113]	[0.286]		0.009	positive	6	16	
-0.049	0.098		0.124		negative	23		0
[-1.033]	[2.093]		[7.042]	0.042	positive	5		46
-0.049	0.097	0.013	0.123		negative	21	1	0
[-0.986]	[1.963]	[0.849]	[5.351]	0.045	positive	4	11	45
Panel D: U.S. (53 industries)								
β_{fx}	$\lvert\beta_{fx}\rvert$	β_{JP}	β_{WD}	$\hat{R}^2$		β_{fx}	β_{JP}	β_{WD}
0.010	0.035				negative	0		
[0.220]	[0.911]			0.001	positive	4		
0.011	0.035	0.014			negative	0	2	
[0.231]	[0.897]	[0.920]		0.004	positive	2	15	
0.008	0.067		1.105		negative	13		0
[1.381]	[3.759]		[118.94]	0.660	positive	24		53
0.007	0.067	-0.002	1.105		negative	12	3	0
[1.238]	[3.361]	[-0.140]	[76.527]	0.660	positive	23	4	53

Industries in Other Developed Industries

We now consider regressions similar to those of previous section using the other countries (U.K., Germany, and U.S.) in our sample. The results are similar to those for Japan that global industry shocks have a positive influence on industries in these countries. The findings on U.K. in Panel B of Table 2 show that exchange rate shocks explain little variations in the relative performance of the U.K. industries. The $\hat{R}^2$ value for the U.K. regressions is only 0.4%, and the mean β_{fx} is 0.037.[8] When $r_{USi,t}$ is included, the $\hat{R}^2$ increases to only 1.7%, and the mean β_{US} increases to only 0.044, implying that U.S. industry return has weak explanatory power.

When excess global industry return, $r_{WDi,t}$, is included in the regressions, the $\hat{R}^2$ increases to 13%. In addition, 55 of the 62 β_{WD} values are significant and positive with a mean of 0.298, suggesting that the global industry-specific shock is both statistically and economically significant. A point worthy of mention is that the only difference between the Japanese and U.K findings is the sign of the β_{US} coefficients. The β_{US} values are mostly negative for the Japanese industries indicating a competitive effect, but mostly positive for the U.K. industries indicating a common effect. The common effect for the U.K. industries is, however, small compared to the global industry shock.

The findings for the German industries in the last row of Panel C in Table 2 show that 45 of the 51 β_{WD} values are significant and positive with a mean of 0.123. This suggests once again a strong positive impact of the global industry-specific shocks on the relative performance of the cross-country industries. In addition, the $\hat{R}^2$ increases from 0.009 to 0.045 when $r_{WDi,t}$ is included in the regressions implying a strong incremental explanatory power of global industry shocks. The findings on the β_{US} coefficients show that 12 U.S. industries are significant, and 11 of them show a positive impact on German industries. Of the 25 German industries that are significantly related to USD/EURO movements, 4 have a positive exposure and 21 have a negative exposure with a mean of -0.049 indicating that on average the exchange rate shock has a competitive effect on German industries.

In the U.S. regressions, we use $r_{USi,t}$ as dependent variable and $r_{JPi,t}$ as explanatory variable in Eq. (1)-(3). The findings presented in Panel D of Table 2 show that only 7 β_{JP} coefficients are significant and that the explanatory power of the Japanese industry shocks is weak as indicated by a low $\hat{R}^2$ value. Also, 35 U.S. industries are significantly exposed to USD/Yen movements, and 23 are positive and the other 12 are negative. These results indicate that the impact of exchange rate shocks on the relative performances of U.S. industries is inconclusive. Finally, all the β_{WD} values in Panel D of Table 2 are significant with the signs indicating a positive effect of global shocks on U.S. industries. The $\hat{R}^2$ increases from 0.4% to 66% when $r_{WDi,t}$ is included in the regressions.

ROBUST TESTS

Raw Industry Returns

Assuming that industry beta is one, we subtracted market return from industry return and used the net returns to examine cross-country relations between industries in previous section.[9] The use of these net returns will be appropriate if market effect is accounted for correctly. Otherwise, correlations between market returns can bias the empirical results.

To address this issue, we use raw industry return as the dependent variable and market return as an explanatory variable in a new regression model. The results are summarized in Panels A-D of Table 3. Similar to Table 2, we report the regression results in each panel starting with the market model in the first row, and then augment the model by adding independent variables in subsequent rows: exchange rate changes in the second row, excess U.S. industry return in the third row, and excess global industry return in the final row.

The results in Panel A are stronger than those reported earlier for the Japanese industries. For example, when excess global industry return is included, more Japanese industries are exposed to the impact of exchange rate changes and U.S. industries. In addition, about 49 of the 53 Japanese industries are positively affected by global shocks. Also, our findings show that the $\hat{R}^2$ values increase slightly when exchange rate and U.S. industry return are included but increases significantly when excess global industry return is included. The $\hat{R}^2$ results indicate that global industry-specific shocks are key to explaining the variability of the Japanese industry returns. Finally, we find that the mean β_{WD} is 0.673 and that this value is higher than the means of β_{fx} and β_{US} which suggests that global shocks are more dominant than exchange rate or U.S. industry shocks.

Next, we present regression results for U.K., Germany, and U.S. The results reported for U.K. in Panel B of Table 3 are similar to those reported in Panel B of Table 2. For example, among the 62 β_{WD} coefficients, 55 are significant with the signs indicating a positive impact of global shock on the U.K. industries. Additional results show that average $\hat{R}^2$ increases from 0.424 to 0.486 when excess global industry return is considered and that the β_{WD} mean continues to be higher than the β_{fx} and β_{US} means.

The data on the 51 German industries show that 43 β_{WD} values are significant, and that all of these values show a positive impact of global shocks. Also, the mean β_{WD} is 0.121, and $\hat{R}^2$ increases by about 1.8% (from 0.369 to 0.387) when excess global industry return is included in the regression. Although this mean is smaller than that reported in Panel A for the Japanese case, it is still higher than the β_{fx} and β_{US} means.

The findings on the U.S. industries are similar to those reported in Panel D of Table 2. For example, the impact of global industry shock, β_{WD}, are significant and positive for all 53 industries. The average

$\hat{R}^2$ increases from 44.5% to 80.5% when $r_{WDi,t}$ is included in the regression. Also, a mean β_{WD} value of 1.102 indicates that a 1% increase in the excess global industry return results in a 1.102% increase in the corresponding U.S. industry return.

The results using raw returns in this section indicate that our conclusion on the statistical and economical significance of the global industry-specific shocks on the cross-country industry returns is very robust. It is the global industry-specific shocks not the cross-country industry shock that has a common effect on the relative performance of the Japanese industries.

Finally, our results show that the market betas β_m are significant and positive for all industries across all countries, implying a positive impact of the local market return on its domestic industries. The β_m means are all very close to one suggesting that it is reasonable to use net market return for purging a country's industry return from the return on the market in that country.

TABLE 3
SUMMARY OF SUR RESULTS – RAW INDUSTRY RETURNS

Average coefficient [average $t-stat$]							**No. of Significant**			
β_m	β_{fx}	$\lvert\beta_{fx}\rvert$	β_{US}	β_{WD}	$\hat{R}^2$		β_m	β_{fx}	β_{US}	β_{WD}
Panel A: Japan (53 industries)										
0.849						negative	0			
[33.047]					0.384	positive	53			
0.849	0.000	0.124				negative	0	14		
[33.095]	[-0.145]	[3.064]			0.389	positive	53	18		
0.848	0.000	0.124	0.012			negative	0	14	1	
[33.072]	[-0.144]	[3.065]	[0.858]		0.390	positive	53	18	13	
0.850	-0.011	0.158		0.669		negative	0	19		0
[45.426]	[-2.309]	[5.993]		[48.559]	0.603	positive	53	24		49
0.851	-0.011	0.158	-0.017	0.673		negative	0	19	21	1
[45.511]	[-2.322]	[6.002]	[-1.522]	[48.500]	0.604	positive	53	24	1	49
Panel B: U.K. (62 industries)										
0.901						negative	0			
[35.763]					0.416	positive	62			
0.902	0.029	0.084				negative	0	8		
[35.818]	[0.629]	[1.757]			0.417	positive	62	14		
0.902	0.028	0.085	0.043			negative	0	8	0	
[36.075]	[0.580]	[1.812]	[2.580]		0.424	positive	62	14	32	
0.881	0.001	0.080		0.302		negative	0	13		0
[37.977]	[-0.205]	[1.867]		[16.742]	0.484	positive	62	12		56
0.881	0.001	0.081	0.026	0.298		negative	0	13	0	0
[38.008]	[-0.216]	[1.889]	[1.694]	[16.193]	0.486	positive	62	12	31	55
Panel C: Germany (51 industries)										
0.777						negative	0			
[33.698]					0.367	positive	51			
0.778	-0.008	0.056				negative	0	6		
[33.482]	[-0.247]	[1.312]			0.368	positive	51	5		
0.778	-0.008	0.056	0.016			negative	0	6	2	
[33.480]	[-0.250]	[1.309]	[1.297]		0.369	positive	51	5	14	
0.777	-0.003	0.054		0.122		negative	0	5		0

[34.109]	[-0.101]	[1.258]		[6.872]	0.386	positive	51	6		47
0.777	-0.003	0.054	0.010	0.121		negative	0	5	3	0
[34.070]	[-0.099]	[1.258]	[0.879]	[6.735]	0.387	positive	51	6	12	43
Panel D: U.S. (53 industries)										
β_m	β_{fx}	$\mid\beta_{fx}\mid$	β_{JP}	β_{WD}	$\hat{R}^2$		β_m	β_{fx}	β_{JP}	β_{WD}
0.947						negative	0			
[37.771]					0.443	positive	53			
0.948	0.009	0.034				negative	0	0		
[37.780]	[0.185]	[0.911]			0.444	positive	53	3		
0.947	0.000	0.034	0.013			negative	0	0	2	
[37.760]	[0.197]	[0.897]	[0.843]		0.445	positive	53	2	14	
0.997	0.008	0.065		1.103		negative	0	13		0
[79.377]	[1.466]	[3.803]		[115.913]	0.805	positive	53	23		53
0.997	0.007	0.064	-0.002	1.102		negative	0	13	4	0
[79.292]	[1.433]	[3.776]	[-0.139]	[115.529]	0.805	positive	53	23	4	53

MGARCH

The regression results presented so far are based on OLS or SUR methodologies. Although the SUR estimates account for cross-sectional dependencies between industries, they ignore the possibility of conditional heteroskedasticity. To address this issue and as a check of robustness of the results reported in the previous sections, we re-estimate Eq. (3) for the Japanese data using Multivariate GARCH (MGARCH) approach. Specifically the mean equation is specified as[10]:

$$r_{JP,i,t} = \beta_{fxi} R_{fx,t} + \beta_{USi} r_{USi,t} + \beta_{WDi} r_{WDi,t} + \varepsilon_{i,t} \quad \forall i \tag{4}$$

For the GARCH process, we employ the parameterization of the conditional variance-covariance structure of industry returns proposed by Ding and Engle (1994).[11] Under Ding and Engle's (1994) parameterization, the conditional second moment is assumed to follow a diagonal process and the system is assumed to be covariance stationary; therefore, the GARCH process for the conditional variance-covariance matrix of excess industry returns can be written as,

$$\mathbf{H}_t = \mathbf{H}_0 * (\boldsymbol{\iota\iota}^{\mathrm{T}} - \mathbf{aa}^{\mathrm{T}} - \mathbf{bb}^{\mathrm{T}}) + \mathbf{aa}^{\mathrm{T}} * \boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}_{t-1}^{\mathrm{T}} + \mathbf{bb}^{\mathrm{T}} * \mathbf{H}_{t-1} \tag{5}$$

where $\mathbf{H}_t \in \mathbf{R}^{N\times N}$ is a time-varying variance-covariance matrix of N excess industry returns. $\mathbf{H}_0$ is the unconditional variance-covariance matrix of innovations. $\boldsymbol{\iota}$ is a $N \times 1$ vector of ones, $\mathbf{a}, \mathbf{b} \in \mathbf{R}^{N\times 1}$ are vectors of unknown parameters, and * is the element-by-element matrix product. $\mathbf{H}_0$ is unobservable and has to be estimated. As suggested by De Santis and Gerard (1997, 1998), $\mathbf{H}_0$ can be consistently estimated using iterative procedure. In particular, $\mathbf{H}_0$ is set equal to the sample covariance matrix of the excess industry returns in the first iteration and then updated using the covariance matrix of the estimated residual at the end of each iteration.

Under the assumption of conditional normality, the log-likelihood to be maximized under both processes can be written as,

$$\ln L(\boldsymbol{\theta}) = -\frac{\mathrm{T}\times(\mathrm{N}+\mathrm{K})}{2}\ln 2\pi - \frac{1}{2}\sum_{t=1}^{\mathrm{T}} \ln|\mathbf{H}_t(\boldsymbol{\theta})| - \frac{1}{2}\sum_{t=1}^{\mathrm{T}} \boldsymbol{\varepsilon}_t(\boldsymbol{\theta})^{\mathrm{T}}\ \mathbf{H}_t(\boldsymbol{\theta})^{-1}\boldsymbol{\varepsilon}_t(\boldsymbol{\theta}) \tag{6}$$

where $\boldsymbol{\theta}$ is the vector of unknown parameters in the model. Since the normality assumption is often violated in financial time series, the quasi-maximum likelihood estimation (QML) proposed by Bollerslev and Wooldridge (1992) which allows inference in the presence of departures from conditional normality is employed. Under standard regularity conditions, the QML estimator is consistent and asymptotically normal and statistical inferences can be carried out by computing robust Wald statistics. The QML estimates can be obtained by maximizing Eq. (6), and calculating a robust estimate of the covariance of the parameter estimates using the matrix of second derivatives and the average of the period-by-period outer products of the gradient. Optimization is performed using the Broyden et al. (BFGS) algorithm, and the robust variance-covariance matrix of the estimated parameters is computed from the last BFGS iteration.

Because MGARCH models are prone to the 'curse of dimensionality', including additional variables in the state vector greatly increases the number of parameters to be estimated. Given the nonlinear structure of the model and the computationally intensive nature of the estimation we restrict the analysis to 12 Japanese industries. The 12 industries are automobile (AUTOS), chemicals commodity (CHEMS), chemicals (CHMCL), chemicals specialty (CHMSP), clothing and footwear (CLTHG), commercial vehicles (COMMV), electronic equipment (ELETR), oil integrated (OILIN), oil & gas product (OILEP), paper (PAPER), pharmaceutical & biotech (PHARM), and steel (STEEL). The MGARCH results are reported in Table 4.[12]

First, the findings indicate that 10 β_{fx} values are significant, 8 with a negative sign and 2 with a positive sign. CLTHG industry has the highest negative β_{fx} value of -0.203. Second, 8 β_{US} coefficients are significant, 7 with a negative sign, implying a strong competitive effect of the U.S. industry on the Japanese industries. Finally, the β_{WD} coefficients are significant and positive in all cases, indicating a strong common effect of the global industry-specific shocks on the excess Japanese industry returns. In terms of the size, β_{WD} has the largest mean of 0.915 indicating that a 1% increase in the excess global industry return increases the corresponding excess Japanese industry return by 0.915%. These MGARCH results reinforce earlier results that global industry-specific shocks explain performance of Japanese industries.

Next, we consider the estimated parameters for the conditional variance-covariance processes. All the elements in the vectors $\mathbf{a}$ and $\mathbf{b}$ are statistically significant at the 1% level indicating that a strong GARCH effect is present in all the return series. In addition, the estimates satisfy stationarity conditions for all the variance and covariance processes.[13]

The empirical results reported in Table 4 based on the MGARCH approach are consistent with those found in the previous sections when SUR is employed. Although exchange rate shocks are statistically significant in our study, they are economically small in determining the relative performances of industries across countries, which is consistent with the findings in GS. However, there is strong evidence that common global industry-specific shocks are both statistically and economically significant in explaining these relative performances. Finally, contrary to the findings in GS, the U.S. industry shocks have a competitive rather than a common effect on the relative performances of Japanese industries.

TABLE 4A
MGARCH RESULTS – EXCESS JAPAN INDUSTRY RETURNS

	Conditional Mean Process						Conditional Variance Process			
	β_{fx}		β_{US}		β_{WD}		a		b	
AUTOS	-0.309	(0.025)**	-0.369	(0.015)**	1.389	(0.032)**	0.176	(0.007)**	0.983	(0.002)**
CHEMS	-0.060	(0.008)**	-0.313	(0.032)**	0.946	(0.070)**	0.179	(0.007)**	0.981	(0.002)**
CHMCL	-0.065	(0.005)**	-0.307	(0.031)**	0.847	(0.062)**	0.177	(0.007)**	0.981	(0.002)**
CHMSP	-0.086	(0.015)**	-0.304	(0.028)**	0.701	(0.047)**	0.173	(0.007)**	0.982	(0.002)**
CLTHG	-0.169	(0.041)**	-0.325	(0.023)**	1.114	(0.028)**	0.177	(0.006)**	0.983	(0.001)**
COMMV	-0.097	(0.034)**	-0.962	(0.039)**	1.751	(0.046)**	0.176	(0.004)**	0.983	(0.001)**
ELETR	-0.372	(0.026)**	-0.155	(0.015)**	1.044	(0.032)**	0.172	(0.007)**	0.984	(0.001)**
OILIN	0.180	(0.052)**	0.092	(0.036)*	0.134	(0.044)**	0.087	(0.014)**	0.995	(0.003)**
OILEP	0.183	(0.044)**	-0.673	(0.027)**	1.542	(0.055)**	0.129	(0.007)**	0.991	(0.001)**
PAPER	0.139	(0.035)**	-0.795	(0.032)**	1.714	(0.057)**	0.144	(0.006)**	0.988	(0.001)**
PHARM	0.133	(0.032)**	-1.196	(0.046)**	2.028	(0.074)**	0.157	(0.008)**	0.986	(0.002)**
STEEL	-0.316	(0.033)**	-0.040	(0.010)**	1.011	(0.023)**	0.183	(0.006)**	0.982	(0.001)**

Notes: Estimations are based on weekly Japanese yen-denominated excess industry returns from 01/13/1975 through 12/29/06. Each mean equation relates the excess Japanese industry returns $r_{JP,i,t}$ to the excess U.S. industry return, $r_{US,i,t}$, excess global industry return excluding U.S., $r_{WD,i,t}$, and USD/Yen exchange rate changes, $R_{fx,t}$.

$$r_{JP,i,t} = \beta_{fxi} R_{fx,t} + \beta_{USi} r_{USi,t} + \beta_{WDi} r_{WDi,t} + \varepsilon_{i,t} \quad \forall i$$

where $\boldsymbol{\varepsilon}_t \mid \Omega_{t-1} \sim N(0, \mathbf{H}_t)$

The conditional covariance matrix $\mathbf{H}_t$ is parameterized as follows:

$$\mathbf{H}_t = \mathbf{H}_0 * (\boldsymbol{\iota\iota}^T - \mathbf{aa}^T - \mathbf{bb}^T) + \mathbf{aa}^T * \boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}_{t-1}^T + \mathbf{bb}^T * \mathbf{H}_{t-1}$$

Where $\mathbf{H}_t \in \mathbf{R}^{12\times12}$ is the conditional covariance matrix of twelve excess Japanese industry returns. The elements of vectors $\mathbf{a,b} \in \mathbf{R}^{12\times1}$ are the GARCH parameters, $\boldsymbol{\iota}$ is a 12 x 1 unit vector and * denotes the Hadamard product (element-by-element multiplication). QML standard errors are reported in parentheses.
**Significant at the 1% level. *Significant at the 5% level.

TABLE 4B
MGARCH RESULTS – EXCESS US INDUSTRY RETURNS

	Conditional Mean Process						Conditional Variance Process			
	β_{fx}		β_{JP}		β_{WD}		a		b	
AUTOS	-0.281	(0.038)**	-0.712	(0.024)**	1.741	(0.032)**	0.168	(0.008)**	0.984	(0.001)**
CHEMS	-0.010	(0.005)*	-0.322	(0.008)**	1.580	(0.023)**	0.183	(0.003)**	0.982	(0.001)**
CHMCL	-0.019	(0.004)**	-0.351	(0.008)**	1.479	(0.021)**	0.183	(0.003)**	0.982	(0.001)**
CHMSP	-0.053	(0.007)**	-0.411	(0.010)**	1.285	(0.019)**	0.183	(0.003)**	0.982	(0.001)**
CLTHG	-0.093	(0.032)**	-0.556	(0.032)**	1.649	(0.033)**	0.209	(0.003)**	0.977	(0.001)**
COMMV	0.032	(0.018)	-0.379	(0.015)**	1.395	(0.022)**	0.203	(0.004)**	0.979	(0.001)**
ELETR	-0.173	(0.042)**	-0.465	(0.036)**	0.944	(0.048)**	0.141	(0.004)**	0.988	(0.001)**
OILIN	0.187	(0.022)**	-0.003	(0.009)	1.006	(0.025)**	0.153	(0.005)**	0.987	(0.001)**
OILEP	0.087	(0.043)*	-0.328	(0.019)**	1.391	(0.030)**	0.160	(0.005)**	0.986	(0.001)**
PAPER	0.102	(0.026)**	-0.289	(0.019)**	1.402	(0.027)**	0.170	(0.004)**	0.985	(0.001)**
PHARM	0.067	(0.013)**	-0.284	(0.006)**	1.283	(0.013)**	0.181	(0.001)**	0.983	(0.000)**
STEEL	-0.128	(0.071)	-0.232	(0.052)**	0.492	(0.059)**	0.130	(0.004)**	0.988	(0.001)**

Notes: Estimations are based on weekly USD-denominated excess industry returns from 01/13/1975 through 12/29/06. Each mean equation relates the excess US industry returns $r_{US,i,t}$ to the excess Japan industry return, $r_{JP,i,t}$, excess global industry return excluding U.S., $r_{WD,i,t}$, and USD/Yen exchange rate changes, $R_{fx,t}$.

$$r_{JP,i,t} = \beta_{fxi} R_{fx,t} + \beta_{USi} r_{USi,t} + \beta_{WDi} r_{WDi,t} + \varepsilon_{i,t} \quad \forall i$$

where $\boldsymbol{\varepsilon}_t \mid \Omega_{t-1} \sim N(0, \mathbf{H}_t)$

The conditional covariance matrix $\mathbf{H}_t$ is parameterized as follows:

$$\mathbf{H}_t = \mathbf{H}_0 * (\boldsymbol{\iota\iota}^{\mathrm{T}} - \mathbf{aa}^{\mathrm{T}} - \mathbf{bb}^{\mathrm{T}}) + \mathbf{aa}^{\mathrm{T}} * \boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}_{t-1}^{\mathrm{T}} + \mathbf{bb}^{\mathrm{T}} * \mathbf{H}_{t-1}$$

Where $\mathbf{H}_t \in \mathbf{R}^{12\times 12}$ is the conditional covariance matrix of twelve excess Japanese industry returns. The elements of vectors $\mathbf{a},\mathbf{b} \in \mathbf{R}^{12\times 1}$ are the GARCH parameters, $\boldsymbol{\iota}$ is a 12 x 1 unit vector and * denotes the Hadamard product (element-by-element multiplication). QML standard errors are reported in parentheses.
**Significant at the 1% level. *Significant at the 5% level.

TABLE 4C
MGARCH RESULTS – EXCESS UK INDUSTRY RETURNS

	Conditional Mean Process						Conditional Variance Process			
	β_{fx}		β_{US}		β_{WD}		a		b	
AUTMB	-0.088	(0.042)*	-0.062	(0.021)**	0.317	(0.044)**	0.176	(0.047)**	0.941	(0.027)**
BEVES	0.136	(0.035)**	-0.697	(0.052)**	1.436	(0.076)**	0.137	(0.004)**	0.986	(0.002)**
BMATS	-0.097	(0.029)**	-0.043	(0.017)*	0.608	(0.045)**	0.120	(0.003)**	0.989	(0.001)**
CHMCL	-0.060	(0.026)*	-0.331	(0.029)**	0.881	(0.059)**	0.157	(0.004)**	0.980	(0.001)**
ELETR	0.056	(0.048)	-0.023	(0.022)	0.407	(0.029)**	0.150	(0.002)**	0.986	(0.000)**
HHOLD	0.079	(0.036)*	0.064	(0.028)*	0.157	(0.034)**	0.134	(0.004)**	0.986	(0.002)**
OILGS	-0.178	(0.030)**	-0.163	(0.025)**	0.967	(0.037)**	0.168	(0.001)**	0.985	(0.000)**
OILEP	-0.005	(0.062)	0.027	(0.025)	0.687	(0.038)**	0.132	(0.022)**	0.987	(0.005)**
MINES	-0.188	(0.037)**	0.012	(0.010)	0.653	(0.019)**	0.172	(0.003)**	0.982	(0.001)**
PHARM	-0.092	(0.045)*	-0.791	(0.043)**	1.587	(0.055)**	0.119	(0.008)**	0.988	(0.002)**
SFTCS	0.090	(0.057)	-0.286	(0.043)**	0.487	(0.046)**	0.230	(0.002)**	0.967	(0.001)**
TOBAC	-0.072	(0.066)	-0.959	(0.052)**	1.880	(0.068)**	0.191	(0.002)**	0.978	(0.001)**

Note: Estimations are based on weekly pound-denominated excess industry returns from 01/13/1975 through 12/29/06. Each mean equation relates the excess UK industry returns $r_{UK,i,t}$ to the excess U.S. industry return, $r_{US,i,t}$, excess global industry return excluding U.S., $r_{WD,i,t}$, and USD/BP exchange rate changes, $R_{fx,t}$.

$$r_{UK,i,t} = \beta_{fxi} R_{fx,t} + \beta_{USi} r_{USi,t} + \beta_{WDi} r_{WDi,t} + \varepsilon_{i,t} \quad \forall i$$

where $\boldsymbol{\varepsilon}_t \mid \Omega_{t-1} \sim N(0, \mathbf{H}_t)$

The conditional covariance matrix $\mathbf{H}_t$ is parameterized as follows:

$$\mathbf{H}_t = \mathbf{H}_0 * (\boldsymbol{\iota\iota}^T - \mathbf{aa}^T - \mathbf{bb}^T) + \mathbf{aa}^T * \boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}_{t-1}^T + \mathbf{bb}^T * \mathbf{H}_{t-1}$$

Where $\mathbf{H}_t \in \mathbf{R}^{12\times 12}$ is the conditional covariance matrix of twelve excess Japanese industry returns. The elements of vectors $\mathbf{a}, \mathbf{b} \in \mathbf{R}^{12\times 1}$ are the GARCH parameters, $\boldsymbol{\iota}$ is a 12 x 1 unit vector and ***** denotes the Hadamard product (element-by-element multiplication). QML standard errors are reported in parentheses.
**Significant at the 1% level. *Significant at the 5% level.

TABLE 4D
MGARCH RESULTS – EXCESS GERMANY INDUSTRY RETURNS

	Conditional Mean Process						Conditional Variance Process			
	β_{fx}		β_{US}		β_{WD}		a		b	
AUTOS	-0.104	(0.038)**	-0.109	(0.020)**	0.379	(0.042)**	0.168	(0.023)**	0.977	(0.007)**
CHMCL	-0.003	(0.001)**	0.000	(0.001)	0.007	(0.004)	0.320	(0.002)**	0.945	(0.000)**
CHEMS	-0.002	(0.001)**	0.001	(0.001)	0.004	(0.003)	0.320	(0.001)**	0.945	(0.000)**
CHMSP	-0.007	(0.014)	-0.003	(0.011)	0.036	(0.018)*	0.324	(0.002)**	0.942	(0.001)**
ELEQP	0.000	(0.024)	-0.354	(0.039)**	0.705	(0.063)**	0.166	(0.007)**	0.984	(0.001)**
PHARM	0.010	(0.034)	-0.098	(0.045)*	0.332	(0.061)**	0.104	(0.006)**	0.992	(0.001)**
STEEL	-0.101	(0.057)	0.009	(0.022)	0.151	(0.034)**	0.141	(0.013)**	0.981	(0.003)**
TYRES	-0.111	(0.061)	-0.019	(0.021)	0.368	(0.045)**	0.097	(0.024)**	0.957	(0.014)**
BEVES	0.093	(0.066)	-0.268	(0.111)*	0.316	(0.164)	0.122	(0.015)**	0.988	(0.002)**
RTAIL	0.052	(0.036)	-0.252	(0.061)**	0.437	(0.081)**	0.100	(0.012)**	0.989	(0.002)**
TRNSP	-0.211	(0.044)**	0.094	(0.035)**	0.047	(0.032)	0.147	(0.017)**	0.976	(0.006)**
UTILS	0.078	(0.034)*	-0.058	(0.038)	0.351	(0.056)**	0.153	(0.009)**	0.985	(0.002)**

Note: Estimations are based on weekly euro-denominated excess industry returns from 01/13/1975 through 12/29/06. Each mean equation relates the excess Germany industry returns $r_{GM,i,t}$ to the excess U.S. industry return, $r_{US,i,t}$, excess global industry return excluding U.S., $r_{WD,i,t}$, and USD/Euro exchange rate changes, $R_{fx,t}$.

$$r_{GM,i,t} = \beta_{fxi} R_{fx,t} + \beta_{USi} r_{USi,t} + \beta_{WDi} r_{WDi,t} + \varepsilon_{i,t} \quad \forall i$$

where $\boldsymbol{\varepsilon}_t \mid \Omega_{t-1} \sim N(0, \mathbf{H}_t)$

The conditional covariance matrix $\mathbf{H}_t$ is parameterized as follows:

$$\mathbf{H}_t = \mathbf{H}_0 * (\boldsymbol{\iota\iota}^T - \mathbf{aa}^T - \mathbf{bb}^T) + \mathbf{aa}^T * \boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}_{t-1}^T + \mathbf{bb}^T * \mathbf{H}_{t-1}$$

Where $\mathbf{H}_t \in \mathbf{R}^{12\times12}$ is the conditional covariance matrix of twelve excess Japanese industry returns. The elements of vectors $\mathbf{a,b} \in \mathbf{R}^{12\times1}$ are the GARCH parameters, $\boldsymbol{\iota}$ is a 12 x 1 unit vector and * denotes the Hadamard product (element-by-element multiplication). QML standard errors are reported in parentheses.
**Significant at the 1% level. *Significant at the 5% level.

Individual Firm Return

Finally, we check the robustness of our results using individual firm return instead of industry return. Our purpose is to examine how exchange rate movements, cross-country industry shock, and global industry-specific shock affect the relative performance of firms within an industry. We select 12 U.S. banks to perform this robustness check. [14] Since GS conclude that industry and exchange rate shocks are stronger for industries that produce goods traded internationally, it would be interesting to see if global industry-specific shock is pervasive and impacts industries such as the banking industry that do not engage in international trade.

The OLS results reported in Table 5 show that all the β_{WD} values for the excess global banking industry return are significant and positive with a mean of 0.898, implying that a 1% increase in the excess global banking industry return is associated with a 0.898% increase in excess U.S. bank stock return.[15] The excess Japanese banking industry return does not seem to have any significant impact on domestic U.S. bank stock returns – only two β_{JP} values are significant. The slope coefficients for the USD/Yen movements are all negative except for Bank of Granite, but are significant in only two cases, indicating that the U.S. banks benefit from a strong domestic currency. In summary, the results for the individual firms further reinforce our previous conclusions that global industry-specific shocks have stronger effects than exchange rate and cross-country industry shocks, and these global industry-specific shocks have a common effect on industries across all countries.

TABLE 5
OLS RESULTS – EXCESS US BANK STOCK RETURNS

U.S. Bank	β_0	$t-stat$	β_{fx}	$t-stat$	β_{JP}	$t-stat$	β_{WD}	$t-stat$	$\hat{R}^2$
ARBN	-0.005	-0.937	-0.160	-0.555	0.472	1.652	0.679	1.979*	0.010
BAC	0.000	0.311	-0.240	-3.566**	-0.016	-0.410	1.364	10.771**	0.198
GRAN	0.000	-0.225	0.071	0.869	0.026	0.474	0.600	4.497**	0.032
BOH	0.000	0.122	-0.019	-0.253	0.075	2.001*	1.166	10.383**	0.169
BK	0.000	0.137	-0.069	-0.812	0.012	0.269	1.168	9.097**	0.139
BKUNA	-0.001	-0.569	-0.157	-0.826	0.031	0.433	0.987	6.065**	0.052
BMTC	0.000	0.041	-0.033	-0.431	-0.053	-0.917	0.478	2.999**	0.016
CORS	0.001	1.037	-0.185	-2.237*	0.138	2.675**	0.615	5.280**	0.055
CFR	0.000	0.381	-0.147	-1.642	0.057	0.862	1.173	7.936**	0.101
MASB	0.000	0.233	-0.105	-1.086	0.009	0.179	0.611	5.582**	0.054
MBWM	0.000	-0.186	-0.021	-0.301	-0.022	-0.532	0.978	11.048**	0.135
STI	0.000	0.047	-0.052	-0.935	-0.005	-0.110	0.956	7.788**	0.145
Mean	0.000		-0.093		0.060		0.898		0.092

Note: OLS model: $r_{USi,t} = \beta_{0i} + \beta_{fxi} R_{fx,t} + \beta_{JPi} r_{JP,t} + \beta_{WDi} r_{WD,t} + \varepsilon_{i,t}$

The above OLS estimations are based on weekly excess US bank stock returns, and the three explanatory variables are the excess Japanese banking industry return, $r_{JP,t}$, excess global banking industry return excluding Japan (to avoid potential multicollinearity between $r_{JP,t}$ and $r_{WD,t}$), $r_{WD,t}$, and USD/Yen exchange rate changes, $R_{fx,t}$. $\hat{R}^2$ is the adjusted R-squared value.

**Significant at the 1% level. *Significant at the 5% level.

CONCLUSIONS

The weak empirical results in GS provide the motivation for this paper. We re-examine intra-industry returns in relation to exchange rate movements and global industry-specific shocks. Our data from four major developed countries show that global industry-specific shocks have more pronounced effects than exchange rate shocks. The $\hat{R}^2$ values increase significantly for the Japanese and U.S. cases when global industry-specific shocks are included in the regression models. Our findings provide possible explanations for the weak findings in GS where global industry-specific shock was not accounted for.

Our additional findings on the signs of the regression coefficients show that cross-country industry shocks have a competitive rather than a common effect for the Japanese industries. That is, a Japanese industry performs poorly when its U.S. counterpart performs well.

ENDNOTES

1. Several studies e.g., Lessard (1974), Roll (1992), Heston and Rouwenhorst (1994), and Griffin and Karolyi (1998) examine industry and country effects on global stock returns, but did not consider global effects on intra-industry performance across countries.
2. Since we explain industry performance relative to the economy, a simpler approach to measuring the common effects of exchange rates shocks is to examine the performance of industries relative to the market. As suggested by GS, there are several ways to purge a country's industry return from the return on the market in that country. The use of net of market return seems to be a reasonable strategy and feasible.
3. We disregard firm and industry characteristics because, like GS, we focus on the direction and magnitude of exchange rate shock and not on its dynamics.
4. To avoid potential multicollinearity between $r_{USi,t}$ and $r_{WDi,t}$ in regression equation (3), we exclude U.S. industry from the global industry return index.
5. Recognizing that excess U.S. industry return $r_{USi,t}$ may not trigger common industry shock across all countries, GS use a 5-country value-weighted industry excess return index replacing $r_{USi,t}$ in equation (2). Their average $\hat{R}^2$ did not improve, however.
6. We do not report β_0 values in Table 2 because they are not statistically significant.
7. To avoid underestimating the impact of exchange rate shock on the relative performance of industries based on the size of the estimated β_{fx} coefficients, in Table 2 we also report the mean absolute value of β_{fx} coefficients ($|\beta_{fx}|$) whose signs are more or less evenly divided between positive and negative especially in Japanese case. However, comparing the mean β_{WD} to the mean $|\beta_{fx}|$ (0.674 vs. 0.161), we still can see the dominant role played by the global industry shock.
8. We summarize the regression results in Table 3 to save space. Detailed results are available upon request.
9. As pointed out by GS, to purge a country's industry return from the return on the market in that country, one could also estimate a regression of the industry return on the market return and use the residual from the regression in the tests. However, they have several concerns of using residuals from the market model. First, this is not an implementable strategy since it uses the sample period to estimate the market model. Second, if one estimates 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.
10. Since the constant term (β_{i0}) is insignificant in all the regressions, we do not include it in the MGARCH model.
11. Ding and Engle's (1994) parameterization provides a significant reduction of the parameters to be estimated. For example, in a diagonal system with N assets, the number of unknown parameters in the conditional variance equation is reduced from $2N^2 + \frac{N(N+1)}{2}$ under BEKK specification to $2N$ under Ding and Engle's specification.
12. To save space, the MGARCH results for the other countries are not reported here but are available upon request.

13. For the process in $\mathbf{H}_t$ to be covariance stationary, the condition $a_i a_j + b_i b_j < 1 \;\; \forall i, j$ has to be satisfied. (see, e.g., Bollerslev (1986), and De Santis and Gerard (1997, 1998))
14. These 12 banks are American Banknote (ARBN), Bank of America (BAC), Bank of Granite (GRAN), Bank of Hawaii (BOH), Bank of New York Co. (BK), Bankunited Finl. CP. (BKUNA), Bryn Mawr Bank (BMTC), Corus Bankshares (CORS), Cullen Frost Bankers (CFR), Massbank CP. (MASB), Mercantile Bankshares (MBWM), and Suntrust Banks (STI).
15. Since the three right-hand-side variables are the same across 12 equations, we use OLS instead of SUR to estimate the slope coefficients.

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