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What Industries Move the NT Ratio? Exploring the Linkage between the NT Ratio and Industry Returns in Japan

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ABSTRACT

This paper investigates which industries drive the recent high Nikkei 225-TOPIX ratio (NT ratio) in Japan. Our empirical examinations derive the following evidence. First, (1) for our first half sub-sample period before the US Lehman shock, it is only the return of transportation industry that is relatively strongly connected with the changes of the NT ratio. Second, we also find that (2) for our latter half sub-sample period, the industries which are relatively strongly connected with the recent higher NT ratio are foods, textiles and apparel, chemicals, pharmaceuticals, glass and ceramics, electric machinery, precision instruments, other manufacturing, retail, communications, and warehousing industries. This evidence after the US Lehman shock also suggests that the linkage between the NT ratio and the above eleven industry returns becomes stronger. On the other hand, we further clarify that (3) the returns of electric power industry always show the statistically significant negative correlations with the changes of the NT ratio regardless of the sample periods.

Keywords: Industry stock returns; Nikkei 225; NT ratio; TOPIX.

INTRODUCTION

Practitioners pay attention to the dynamics of the Nikkei 225-TOPIX (Tokyo Stock Price Index) ratio (NT ratio) since the time-series evolution is not stable over time. Regarding the research related with stock price indices, there exist many empirical studies. For example, Cho et al. (2007) investigated the Monday effect as to the Dow Jones and S&P 500 indices. Casas and Gao (2008) estimated the long-range dependent volatility models by using the volatility of the Dow Jones, S&P 500, and other stock price indices. Lu and Perron (2010) attempted to model and forecast stock return volatility by a random level shift model using the S&P 500, Dow Jones, and other stock price indices. Rosa (2011) investigated the effects of Federal Reserve's decisions and statements on US stock and volatility indices such as the Dow Jones and S&P 500. Mollick and Assefa (2013) examined the US stock returns such as the S&P 500 and Dow Jones based on the information included in the VIX volatility, inflation expectations, interest rates, gold prices, and the USD-Euro exchange rate. Further, Narayan and Thuraisamy (2013) investigated the common trends and common cycles in the S&P 500, Dow Jones and the NASDAQ.

As above, even in the US, there is little academic research on the stock index ratios constructed by using two index values. Moreover, for the Japanese stock markets, we cannot find the academic research on the stock index ratios, either. Whilst in the actual stock markets in Japan, the time-series of the NT ratio has some trends or cycles and it is important for us to clarify

what Industries move the NT ratio by considering the somewhat different industrial construction of the Nikkei 225 and TOPIX.

Based on the situation documented as above, this paper investigates which industries drive the recent high NT ratio observed in our analyzing sample period in Japan. Our empirical examinations derive the following evidence and contributions. First, (1) for our first half sub-sample period before the US Lehman shock, it is only the return of transportation industry that is relatively strongly associated with the changes of the NT ratio. Second, we also find that (2) for our latter half sub-sample period, the industries which are relatively strongly linked with the recent higher NT ratio are foods, textiles and apparel, chemicals, pharmaceuticals, glass and ceramics, electric machinery, precision instruments, other manufacturing, retail, communications, and warehousing industries. This evidence after the US Lehman shock also indicates that the linkage between the NT ratio and the above eleven industry returns becomes stronger. Contrary, we further reveal that (3) the returns of electric power industry always present the statistically significant negative correlations with the changes of the NT ratio regardless of the sample periods.

The rest of the paper is organized as follows. The second section documents our data and methodology undertaken in this paper, the third section describes our empirical results, and the final section concludes the paper.

DATA AND METHODOLOGY

This section documents regarding our data and research design. All data are supplied by the QUICK Corp. Our first variable DLTOPIX is the first log difference of the daily closing price of TOPIX. The variable is constructed as the percentage log return by multiplying 100. We note that we use the percentage log return for all variables used in this paper. Also, DLNIKKEI is the percentage log return calculated from the daily closing price of the Nikkei 225. Next, DLNT is the percentage log difference of the NT ratio, which is computed as the closing price of the Nikkei 225 divided by the closing price of TOPIX.

We also use 36 industry percentage log returns calculated similarly. Concretely, DLFISH is the percentage log return of fishery industry; DLMIN is that of mining industry; DLCONS denotes that of construction industry; DLFOOD is that of foods industry; DLTA means that of textiles and apparel industry; DLPP is that of pulp and paper industry; DLCHEM denotes that of chemicals industry; DLPHAR is that of pharmaceuticals industry; DLPETRO means that of petroleum industry; DLRUB is that of rubber industry; DLGC denotes that of glass and ceramics industry; DLSTL means that of steel industry in Japan.

Further, DLNM is the percentage log return of nonferrous metals industry; DLMACH denotes that of machinery industry; DLEMACH means that of electric machinery industry; DLSHIP denotes that of shipbuilding industry; DLAUTO is that of automobiles and auto parts industry; DLTRANS means that of transportation industry; DLPI represents that of precision instruments industry; DLOM is that of other manufacturing industry; DLTRAD shows that of trading companies industry; DLRETAIL is that of retail industry; DLBANK means that of banking industry; DLOFS denotes that of other financial services industry in Japan.

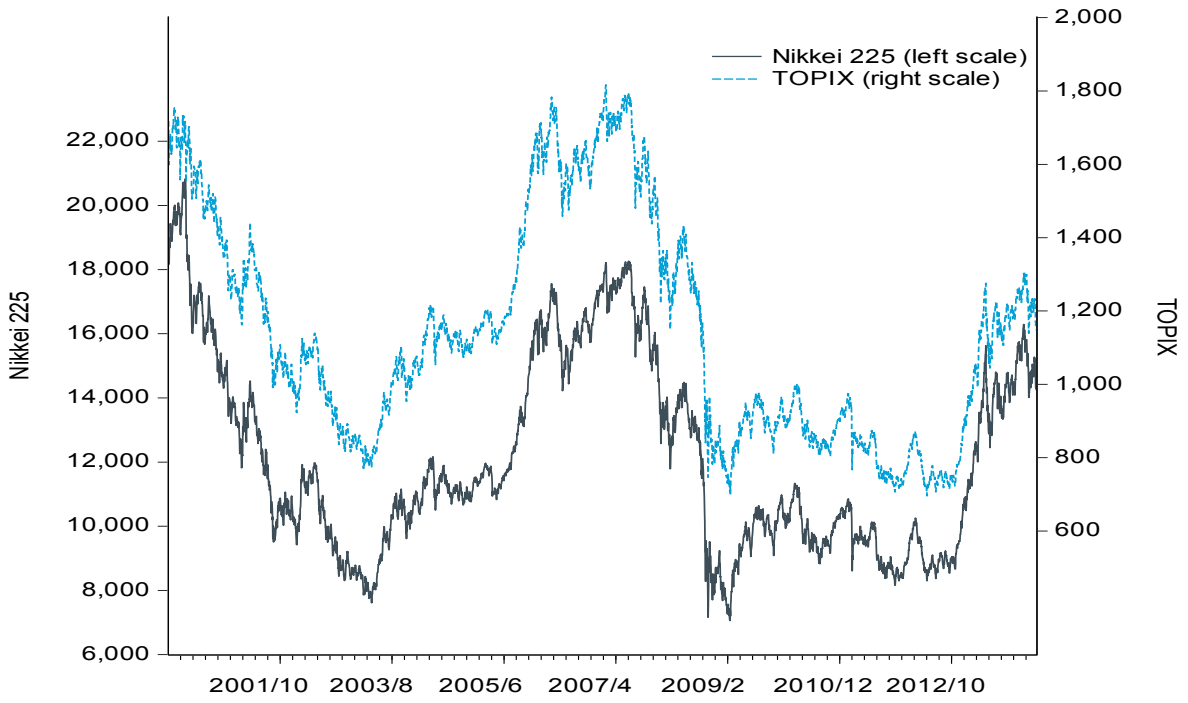

Figure 1. Dynamics of TOPIX and the Nikkei 225: The daily time-series evolution for the period from January 2000 to March 2014

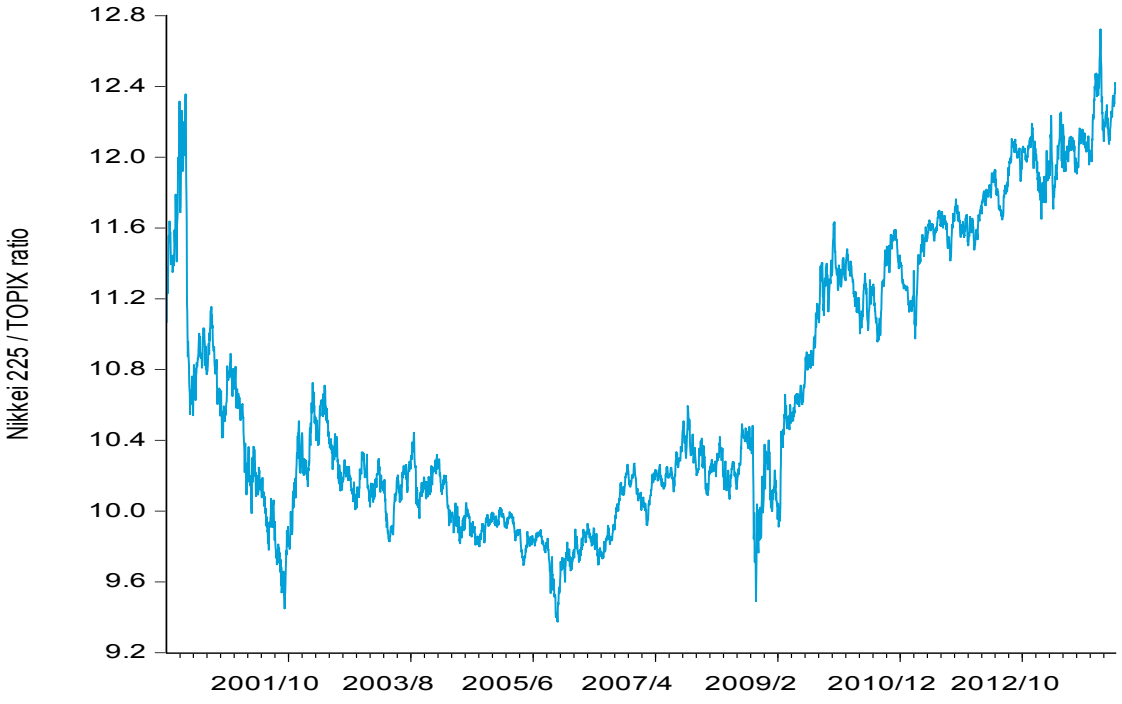

Figure 2. Dynamics of the Nikkei 225-TOPIX ratio: The daily time-series evolution for the period from January 2000 to March 2014

Table 1. Descriptive statistics

	DLTOPIX	DLNIKKEI	DLNT	DLFISH	DLMIN	DLCONS	DLFOOD
Mean	−0.0116	−0.0083	0.0033	0.0111	0.0110	0.0170	0.0060
Std. Dev.	1.4320	1.5777	0.4476	1.6553	2.3302	1.6136	1.1176
Skewness	−0.3548	−0.4181	−0.4048	0.1219	0.1236	−0.1316	−0.4655
Kurtosis	5.8597	6.1365	4.8748	5.4058	3.7586	5.0229	9.9727
	DLTA	DLPP	DLCHEM	DLPHAR	DLPETRO	DLRUB	DLGC
Mean	−0.0020	−0.0116	0.0023	0.0103	0.0136	0.0192	0.0098
Std. Dev.	1.5733	1.7804	1.4865	1.2746	1.7939	2.0233	1.9239
Skewness	−0.3604	−0.1428	−0.3067	−0.3735	−0.1886	−0.0929	−0.3076
Kurtosis	6.5907	4.1088	6.9638	7.6565	4.4451	3.3744	4.7290
	DLSTL	DLNM	DLMACH	DLEMACH	DLSHIP	DLAUTO	DLTRANS
Mean	0.0101	−0.0046	0.0041	−0.0164	0.0243	0.0154	0.0276
Std. Dev.	2.0117	1.8306	1.7686	1.8303	2.6023	1.8295	2.1032
Skewness	−0.2591	−0.2328	−0.2628	−0.1428	−0.0765	−0.1190	−0.2973
Kurtosis	6.1780	5.8796	4.4108	3.6471	5.2629	5.8491	4.9386
	DLPI	DLOM	DLTRAD	DLRETAIL	DLBANK	DLOFS	
Mean	−0.0116	−0.0237	−0.0229	−0.0031	−0.0115	−0.0169	
Std. Dev.	1.9315	1.5755	1.7967	1.4932	1.6906	2.2771	
Skewness	−0.2363	−0.4236	−0.3972	−0.2928	−0.1095	−0.0528	
Kurtosis	4.6650	6.3489	7.7231	4.7279	5.0060	3.0708	
	DLSEC	DLINS	DLREST	DLRB	DLLTRANS	DLMTRANS	
Mean	−0.0098	0.0053	0.0295	0.0111	−0.0112	0.0042	
Std. Dev.	2.4647	2.0864	2.3194	1.2331	1.5746	2.4217	
Skewness	−0.0799	−0.1966	0.0233	−0.1354	0.0546	−0.0835	
Kurtosis	2.4298	5.5542	2.8159	5.9637	4.8209	3.9026	
	DLATRANS	DLCOM	DLWARE	DLEP	DLGAS	DLSERV	
Mean	−0.0326	0.0196	−0.0411	−0.0103	0.0230	−0.0382	
Std. Dev.	1.8038	1.8322	1.8312	1.3788	1.3212	1.6477	
Skewness	0.2951	−0.0063	−0.4548	−0.1194	−0.1761	−0.2251	
Kurtosis	7.0520	4.4517	4.0180	8.2556	5.5302	5.4395	

Notes: The full sample period spans from 5 January 2000 to 20 March 2014, and this period includes 3491 observations. Std. Dev. denotes the standard deviation value.

Moreover, DLSEC denotes the percentage log return of securities industry; DLINS is that of insurance industry; DLREST means that of real estate industry; DLRB shows that of railway and bus industry; DLLTRANS is that of land transport industry; DLMTRANS denotes that of marine transport industry; DLATRANS is that of air transport industry; DLCOM shows that of communications industry; DLWARE is that of warehousing industry; DLEP means that of electric power industry; DLGAS is that of gas industry; DLSERV denotes that of services industry in Japan. All industry classifications above are according to the Nikkei Inc. and our full sample period is from 5 January 2000 to 20 March 2014.

Figure 1 shows the daily dynamics of TOPIX and the Nikkei 225 for the period from 5 January 2000 to 20 March 2014 and Figure 2 exhibits the daily dynamics of the NT ratio for the same period. Figure 2 demonstrates that the NT ratio sharply increased after around the year of 2009. In addition, Table 1 displays the descriptive statistics for our variables. This table shows that DLTOPIX and DLNIKKEI have negative average returns for our full sample period and all variables except for DLSEC and DLREST show the greater values of kurtosis than three; hence all daily variables except for securities industry and real estate industry have fat-tailed distributions in our full sample period.

Next, describing the testing methodology, after examining the statistical characteristics of all above variables, we scrutinize the correlation coefficients between the DLNT (the percentage log difference of the NT ratio) and each industry return in order to clarify which industries are strongly connected with the NT ratio in Japan. For this test, we use the *t*-test for the average correlation coefficients to judge the relations statistically by using the full sample period and two sub-sample periods.

EMPIRICAL RESULTS

This section documents our empirical results. Our test results are shown in Tables 2 to 4. First, (1) Table 2 exhibits the *t*-test results of the correlations between the changes of the NT ratio and the daily returns of various industries in Japan for the full sample period from 5 January 2000 to 20 March 2014. Second, (2) Table 3 displays the *t*-test results of the correlations between them for the first half sub-sample period from 5 January 2000 to 28 December 2007. Third, (3) Table 4 shows the *t*-test results of the correlations for the latter half sub-sample period from 4 January 2008 to 20 March 2014. We note that our latter half sub-sample period includes the Lehman shock in the US.

More concretely, the statistically significant positive correlations between the changes of the NT ratio and the daily returns of various industries in Japan are seen in Tables 2 to 4 in general. Listing up the industry returns that show the greater correlation coefficients than 0.3, in Table 2, they are DLPHAR, DLEMACH, and DLCOM for our full sample period; in Table 3, it is only DLTRANS for our first half sub-sample period; in Table 4, they are DLFOOD, DLTA, DLCHEM, DLPHAR, DLGC, DLEMACH, DLPI, DLOM, DLRETAIL, DLCOM, and DLWARE for our latter sub-sample period. Therefore, we understand that the industries which are relatively strongly connected with the recent higher NT ratio observed in our sample period are foods, textiles and apparel, chemicals, pharmaceuticals, glass and ceramics, electric machinery, precision instruments, other manufacturing, retail, communications, and warehousing industries.

Table 2. Test results of the correlations between the changes of the NT ratio and the daily returns of various industries in Japan for the full sample period from 5 January 2000 to 20 March 2014

	DLFISH	DLMIN	DLCONS	DLFOOD	DLTA	DLPP
Correl.	0.121***	0.176***	0.162***	0.254***	0.263***	0.224***
t-value	7.179	10.542	9.693	15.495	16.133	13.560
p-value	0.000	0.000	0.000	0.000	0.000	0.000
	DLCHEM	DLPHAR	DLPETRO	DLRUB	DLGC	
Correl.	0.294***	0.304***	0.168***	0.198***	0.263***	
t-value	18.179	18.852	10.093	11.924	16.131	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLSTL	DLNM	DLMACH	DLEMACH	DLSHIP	
Correl.	0.101***	0.267***	0.207***	0.327***	0.129***	
t-value	5.987	16.333	12.479	20.429	7.665	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLAUTO	DLTRANS	DLPI	DLOM	DLTRAD	
Correl.	0.204***	0.278***	0.280***	0.218***	0.134***	
t-value	12.322	17.121	17.233	13.186	7.991	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLRETAIL	DLBANK	DLOFS	DLSEC	DLINS	
Correl.	0.175***	0.039**	0.038**	0.121***	0.099***	
t-value	10.511	2.316	2.249	7.188	5.891	
p-value	0.000	0.021	0.025	0.000	0.000	
	DLREST	DLRB	DLLTRANS	DLMTRANS	DLATRANS	
Correl.	0.135***	0.147***	0.171***	0.175***	0.142***	
t-value	8.028	8.791	10.274	10.491	8.496	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLCOM	DLWARE	DLEP	DLGAS	DLSERV	
Correl.	0.303***	0.227***	−0.046***	0.025	0.139***	
t-value	18.774	13.797	2.748	1.453	8.313	
p-value	0.000	0.000	0.006	0.146	0.000	

*Notes: The sample period includes 3491 observations. ***, **, and * denote the statistical significance at the 1%, 5%, and 10% levels, respectively. Correl. denotes the correlation coefficient value.*

Table 3. Test results of the correlations between the changes of the NT ratio and the daily returns of various industries in Japan for the sub-sample period from 5 January 2000 to 28 December 2007

	DLFISH	DLMIN	DLCONS	DLFOOD	DLTA	DLPP
Correl.	0.127***	0.158***	0.072***	0.208***	0.235***	0.205***
t-value	5.682	7.075	3.202	9.406	10.710	9.305
p-value	0.000	0.000	0.001	0.000	0.000	0.000
	DLCHEM	DLPHAR	DLPETRO	DLRUB	DLGC	
Correl.	0.266***	0.267***	0.118***	0.164***	0.236***	
t-value	12.227	12.291	5.263	7.382	10.763	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLSTL	DLNM	DLMACH	DLEMACH	DLSHIP	
Correl.	0.004	0.250***	0.133***	0.280***	0.091***	
t-value	0.199	11.446	5.961	12.911	4.068	
p-value	0.842	0.000	0.000	0.000	0.000	
	DLAUTO	DLTRANS	DLPI	DLOM	DLTRAD	
Correl.	0.169***	0.374***	0.197***	0.115***	0.088***	
t-value	7.606	17.887	8.899	5.122	3.901	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLRETAIL	DLBANK	DLOFS	DLSEC	DLINS	
Correl.	0.045**	−0.028	−0.047**	0.088***	0.038*	
t-value	1.982	1.241	2.102	3.922	1.704	
p-value	0.048	0.215	0.036	0.000	0.089	
	DLREST	DLRB	DLLTRANS	DLMTRANS	DLATRANS	
Correl.	0.106***	0.121***	0.076***	0.160***	0.175***	
t-value	4.732	5.384	3.368	7.189	7.880	
p-value	0.000	0.000	0.001	0.000	0.000	
	DLCOM	DLWARE	DLEP	DLGAS	DLSERV	
Correl.	0.261***	0.132***	−0.048**	0.015	0.053**	
t-value	11.966	5.919	2.133	0.675	2.354	
p-value	0.000	0.000	0.033	0.500	0.019	

*Notes: The sample period includes 1968 observations. ***, **, and * denote the statistical significance at the 1%, 5%, and 10% levels, respectively. Correl. denotes the correlation coefficient value.*

Table 4. Test results of the correlations between the changes of the NT ratio and the daily returns of various industries in Japan for the sub-sample period from 4 January 2008 to 20 March 2014

	DLFISH	DLMIN	DLCONS	DLFOOD	DLTA	DLPP
Correl.	0.112***	0.201***	0.267***	0.309***	0.301***	0.249***
t-value	4.381	7.982	10.796	12.662	12.326	10.018
p-value	0.000	0.000	0.000	0.000	0.000	0.000
	DLCHEM	DLPHAR	DLPETRO	DLRUB	DLGC	
Correl.	0.335***	0.351***	0.231***	0.239***	0.301***	
t-value	13.870	14.630	9.279	9.613	12.314	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLSTL	DLNM	DLMACH	DLEMACH	DLSHIP	
Correl.	0.201***	0.292***	0.291***	0.387***	0.178***	
t-value	8.020	11.889	11.845	16.365	7.054	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLAUTO	DLTRANS	DLPI	DLOM	DLTRAD	
Correl.	0.248***	0.169***	0.389***	0.328***	0.224***	
t-value	9.983	6.699	16.471	13.538	8.965	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLRETAIL	DLBANK	DLOFS	DLSEC	DLINS	
Correl.	0.353***	0.115***	0.129***	0.163***	0.161***	
t-value	14.719	4.498	5.076	6.460	6.381	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLREST	DLRB	DLLTRANS	DLMTRANS	DLATRANS	
Correl.	0.171***	0.181***	0.285***	0.197***	0.104***	
t-value	6.751	7.192	11.590	7.855	4.076	
p-value	0.000	0.000	0.000	0.000	0.000	
	DLCOM	DLWARE	DLEP	DLGAS	DLSERV	
Correl.	0.358***	0.373***	−0.049*	0.036	0.268***	
t-value	14.930	15.665	1.932	1.398	10.836	
p-value	0.000	0.000	0.054	0.162	0.000	

*Notes: The sample period includes 1523 observations. ***, **, and * denote the statistical significance at the 1%, 5%, and 10% levels, respectively. Correl. denotes the correlation coefficient value.*

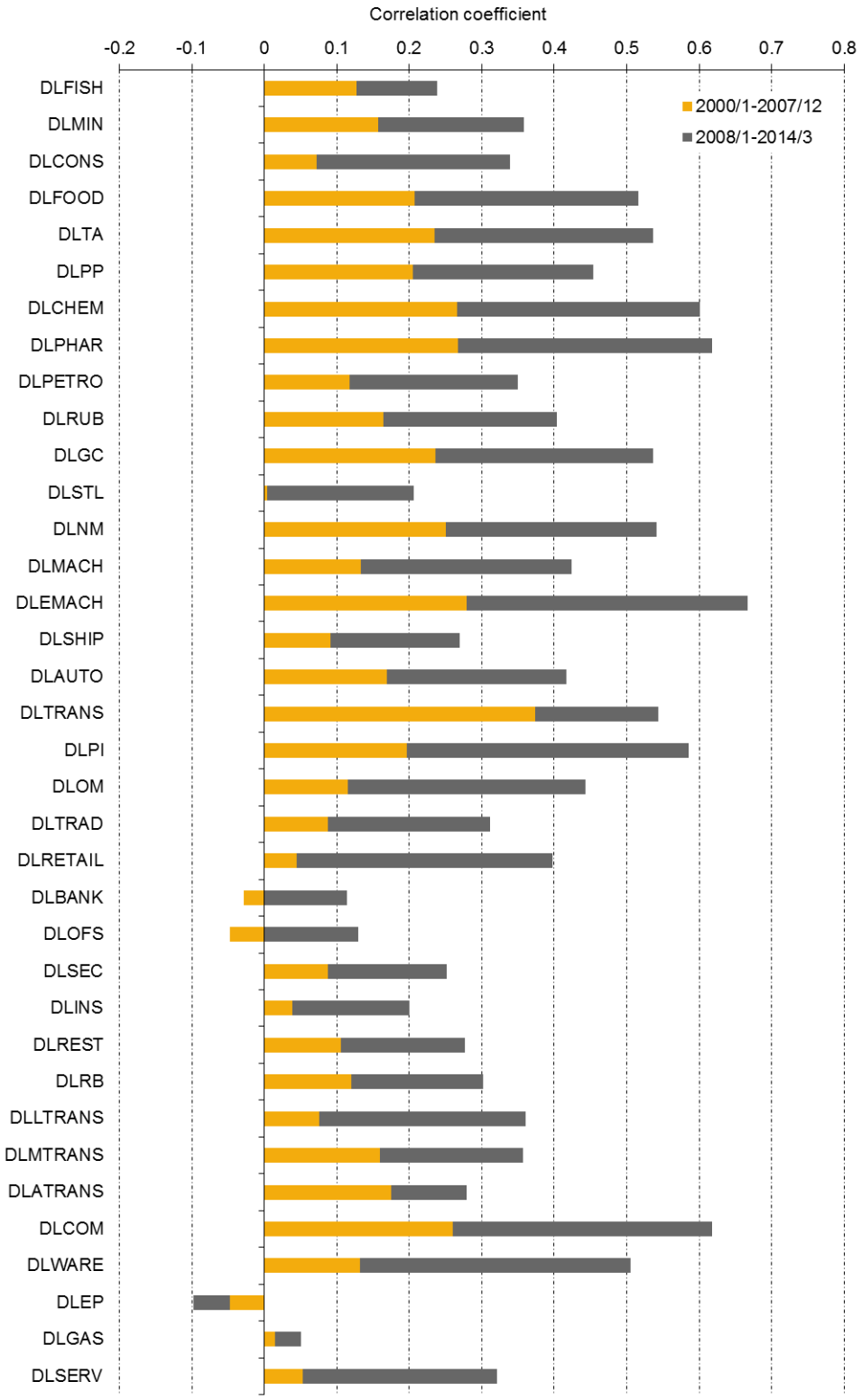

Figure 3. Correlation coefficients between the NT ratio changes and the various industry returns in Japan: The results for the period from 5 January 2000 to 28 December 2007 and from 4 January 2008 to 20 March 2014

On the other hand, rather interestingly, some industries that show the statistically significantly negative correlations between the changes of the NT ratio and the daily returns of various industries in Japan are seen in Tables 2 to 4. They are DLEP for the full sample period (Table 2); DLOFS and DLEP for the first half sub-sample period (Table 3); DLEP for the latter half sub-

sample period (Table 4). Hence we understand that it is only the electric power industry that is inversely associated with the recent higher NT ratio. In addition, we can view the state of the correlation coefficients for the first and latter half periods as to all 36 industries in a bar graph as in Figure 3.

CONCLUSIONS

This paper investigated which industries drive the recent high NT ratio observed in our analyzing periods in Japan. Our empirical examinations clarified the following evidence. First, (1) for our first half sub-sample period before the US Lehman shock, it was only the return of transportation industry that was relatively strongly connected with the changes of the NT ratio. Second, we also revealed that (2) for our latter half sub-sample period, the industries which were relatively strongly associated with the recent higher NT ratio were foods, textiles and apparel, chemicals, pharmaceuticals, glass and ceramics, electric machinery, precision instruments, other manufacturing, retail, communications, and warehousing industries. This evidence after the US Lehman shock also suggests that the relationship between the NT ratio and the above eleven industry returns in Japan became stronger. On the other hand, we further found that (3) the returns of electric power industry always exhibited the statistically significantly negative correlations with the changes of the NT ratio regardless of the sample periods.

We also point out that the recent increase of the NT ratio in Japan implies that the relations between the Nikkei 225 and TOPIX shall be changing. Thus when we construct portfolios with stocks, it may be useful for us to consider various beta values because as our investigations imply, the values of betas for the Nikkei 225 and TOPIX may change over time for example. Moreover, since developments of industries shall be changing in countries, further researches on the relations among industry returns and the linkage between industry returns and various economic or financial market variables may be important and they shall be also our future tasks.

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