Does it matter where transaction takes place ?

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Although the day of the week anomaly has been internationally documented in the literature, the anomalous patterns are various across countries and assets. Unlike previous studies that investigated anomalies of different assets in different places, this paper focuses on the yen-dollar exchange rates, which is traded internationally. We find that where transaction took place was important in early period when the capital markets were segmented, but the place did not matter in the late 1980's. Furthermore, we confirm that the day-of-the-week anomaly is not found in the 1990's.

1. Introduction

Anomalous movements in financial asset returns have been well documented in the literature, since French (1980) found the famous Monday effect in the U.S. stock returns. The search for the anomaly has been extended from the U.S. stock index returns to the returns of other assets, such as individual stocks, bonds, preferable stocks, and foreign currencies. Also, the search has been extended to cover the international asset markets, such as Tokyo and London.

For example, Agrawal and Tandon (1994) investigated stock index returns of eighteen countries and found that the anomalous patterns were various across countries. They found that the lowest and negative returns occurred on Mondays in nine countries including United Kingdom and Germany and on Tuesdays in eight countries including Japan and France. However, the reason why the anomalous patterns of counties were different from each other is not clear because previous studies compared different assets' returns in different places. The problem whether the anomaly is due to some market characters such as clearing procedures or due to the asset's fundamentals remains unsolved.

To consider this place-or-asset problem directly, it is ideal to investigate the anomaly regarding the same asset's returns in different places. As all stocks that constitute each country's stock index are not traded internationally, it is impossible to deal with the place-or-asset problem by using stock index returns.

Fortunately, foreign currencies are traded in many countries. Although the anomalies have received relatively little

attention in studies of exchange rate behavior, there are a few studies. McFarland, Pettit and Sung (1982) found that returns on foreign currencies to an American investor in New York market were generally high on Monday and Wednesday and low on Tuesday and Friday[1]. As this anomaly was common to major currencies, their results suggest that the place where transaction took place (i.e., New York) did matter. Regarding non-U.S. markets, Joseph and Hewins (1992) studied foreign exchange returns in the U.K. market. As their results on day of the week returns were generally different to those of U.S. studies, they concluded that the U.K. stock market settlement procedures affected foreign currency returns by day of the week. That is, they suggested that where transaction took place did matter. Moreover, as the anomalous patterns of various currencies in the U.K. market were different, the assets that were traded also did matter.

Thus, previous studies investigated the anomaly of different assets in the same place (i.e., U.S. or U.K. market). In marked contrast to previous studies, this paper investigates the anomaly of the same asset in different places. Concretely, we examine the yen-dollar foreign currency returns in seven countries. If we find that the anomalous patterns of daily returns are different across the countries, the anomaly is due to the character of markets where transaction takes place. If the anomalous patterns are similar to each other, then the anomaly is due to the characters of the asset.

The paper is organized as follows. Section 2 provides a brief explanation on the data used in this paper. Section 3 reports the results. Finally, Section 4 concludes this paper.

2. Data and Methodology

(1) Data

We focus on the yen-dollar exchange rates. The specification of the model begins with daily returns, R_t, which are calculated as $\log(P_t/P_{t-1})$[2]. As the price is expressed as Japanese yen per unit of U.S. dollar, negative value of the daily returns means that the Japanese yen appreciates against U.S. dollar. Therefore, R_t are regarded as returns on U.S. dollar to Japanese investors.

Using several sources, we compile seven data sets regarding the yen-dollar exchange rates in seven countries, including Tokyo, New York, London, Paris, Frankfurt, Switzerland, and Canada.

The data regarding Tokyo come from two sources. For the period from March 19 1973 to December 30, 1997[3], the data come from the CD-ROM version of *Foreign Exchange and Interest Annual* published by Toyo Keizai Shinposha (a big Japanese publisher), which provides daily closing spot exchange rates of Japanese yen against the U.S. dollar in the Tokyo market. And the data for the period from

January 5, 1998, to December 30, 1999, are retrieved from the DATASTREAM[4]. The entire sample consists of 6652 observations.

Regarding New York, the data source is the Federal Reserve Board's FAME database. We use the noon buying rates in New York City for cable transfer, reported by the Federal Reserve Bank of New York. The entire sample consists of 7265 observations, from January 4, 1971, to December 31, 1999.

Regarding London, Paris, Frankfurt, Switzerland, and Canada, the direct data source is Standard & Poor's DRI database. London's closing spot rates are reported by Reuters America and, previously, by County NatWest Bank, London. We simply average the bid and ask prices to obtain the exchange rates that we use in this paper. The London's rates are available from October 9, 1986, to December 31, 1999. Regarding Paris, we use 4:00 P.M. bid rates, reported by Reuters America and, previously, by Credit Lyonnais. The yen-dollar exchange rates are calculated by using yen-French francs rates and dollar-French francs rates. These data series are available from January 4, 1982, to December 31, 1998. Regarding Frankfurt, the original source is Commerzbank, Frankfurt. The Frankfurt closing spot quote rates are used. The yen-dollar exchange rates are calculated by using yen-Deutsche mark rates and dollar-Deutsche mark rates. The entire sample consists of 3745 observations, covering

from January 2, 1984, to December 29, 1998. Regarding Switzerland, the spot bid rates reported by Reuters America are used. The yen-dollar exchange rates are calculated by using yen-Swiss franc rates and dollar-Swiss franc rates. The entire sample consists of 1533 observations, covering from September 13, 1993, to December 31, 1999, with a break from October 1, 1998 to December 31, 1998. Finally, regarding Canada, the noon buying rates are reported by the Bank of Canada. The yen-dollar exchange rates are calculated by using yen-Canadian dollar rates and U.S. dollar-Canadian dollar rates. These data series are available only from July 15, 1996, to December 31, 1999.

(2) How to identify the day-of-the-week anomaly

Following Kohers and Patel (1999) among others, this paper employs standard parametric approach (i.e., ANOVA), which are also supplemented by non-parametric procedure (i.e., Kruskal–Wallis). The null hypothesis is that the return for each day of the week is equal to each other. If the null hypothesis is rejected at the conventional level (i.e., the 5% level is used in this paper), then the day-of-the-week effect is identified. If the anomaly is identified, then we investigate what day of the week records anomalous returns.

3．Results

(1) Basic Results

Table 1 displays the ANOVA F-statistics and Kruskal–Wallis statistics for the five-year sub-periods. Several statistics in Table 1 are calculated by using only a part of the sub-period, when the data are not available for the whole sub-period. For example, as Tokyo's data series start from March 20, 1973, the statistic in the cell for the 1970–74 sub-period regarding Tokyo is based on the data over the March 20, 1973, to December 31, 1974.

The ANOVA test reveals that the day-of-the-week anomaly existed in New York for the 1970–74 sub-period[5], in Tokyo and New York for the 1975–79 sub-period, and in New York and London for the 1985–89 sub-period. No day-of-the-week anomaly is identified in Paris, Frankfurt, Switzerland, and Canada.

The Kruskal–Wallis test confirms the rejection of the null hypothesis regarding Tokyo and New York for the 1975–79 sub-period, but fails to confirm it regarding New York for the 1970–74 sub-period. Furthermore, the Kruskal–Wallis test detects the anomaly in Tokyo, New York and London for the 1980–84 sub-period.

In sum, considering both results, we conclude that the day-of-the-week effect existed in the 1970's and the 1980's, and the anomaly disappears in the 1990's.

(2) Returns on Each Day of the Week

The important question is whether the anomalous patterns are different across the markets. Table 2 reports the returns across the markets by day of the week. Naturally, our discussion is focused on the sub-periods when the anomaly is found.

For the 1975–79 sub-period, the return for Tuesday in Tokyo is negative and the lowest, while the return for Monday in New York is negative and the lowest. This is interesting because the previous studies investigating stock returns found that Japanese stock returns recorded the lowest return for Tuesday (e.g., Kato, 1990), and that U.S. stock returns recorded the lowest return for Monday (e.g., French, 1980). This is also consistent with Joseph and Hewins (1992), who maintained that the stock market settlement procedure affected the weakly pattern of the FX returns. Also, the pair-wise test for the mean difference reveals that the Thursday mean returns between Tokyo and New York are significantly different from each other at the 1 % critical level[6].

For the 1980–84 sub-period, the return for Friday in Tokyo is the largest across days of the week and significantly different from zero at the 5% critical level. However, comparing the 1975–79 period, return patterns became similar between New York and Tokyo. In fact, the Friday return in Tokyo (i.e., 0.079%) is not significantly different from the Friday return in New York (i.e., 0.042%)[7]. Similarly, there are

Table 1   Basic Results

(1) ANOVA F-statistics

	Entire Sample Period	Total Observations	1970-74 F-statistic	1970-74 Probability	1975-79 F-statistic	1975-79 Probability	1980-84 F-statistic	1980-84 Probability	1985-89 F-statistic	1985-89 Probability	1990-94 F-statistic	1990-94 Probability	1995-99 F-statistic	1995-99 Probability
Tokyo	1973/3/20 -1999/12/30	6652	0.744	0.563	3.298	0.011	1.692	0.150	1.012	0.400	0.548	0.701	0.409	0.803
New York	1971/1/4 -1999/12/31	7265	2.937	0.020	5.461	0.000	1.788	0.129	2.413	0.047	0.604	0.660	1.163	0.326
London	1986/10/9 -1999/12/31	3348							2.867	0.023	0.668	0.614	0.450	0.773
Paris	1982/1/4 -1998/12/31	4214					1.167	0.324	1.209	0.305	0.335	0.854	0.942	0.439
Frankfurt	1984/1/2 -1998/12/29	3745					0.468	0.759	1.005	0.404	0.144	0.966	1.152	0.331
Switzerland	1993/9/13 -1998/9/30, 1999/1/4 -1999/12/31	1533									1.862	0.117	0.268	0.899
Canada	1996/7/15 -1999/12/31	868											1.350	0.250

(2) Kruskal-Wallis statistics

	Entire Sample Period	Total Observations	1970-74 F-statistic	1970-74 Probability	1975-79 F-statistic	1975-79 Probability	1980-84 F-statistic	1980-84 Probability	1985-89 F-statistic	1985-89 Probability	1990-94 F-statistic	1990-94 Probability	1995-99 F-statistic	1995-99 Probability
Tokyo	1973/3/20 -1999/12/30	6652	14.833	0.005	31.659	0.000	9.973	0.041	3.612	0.461	2.276	0.685	2.264	0.684
New York	1971/1/4 -1999/12/31	7265	3.531	0.473	21.917	0.000	10.171	0.038	8.015	0.091	2.562	0.634	8.387	0.078
London	1986/10/9 -1999/12/31	3348							8.807	0.066	4.417	0.353	4.893	0.299
Paris	1982/1/4 -1998/12/31	4214					8.298	0.081	5.502	0.24	1.158	0.885	5.949	0.203
Frankfurt	1984/1/2 -1998/12/29	3745					5.81	0.214	2.877	0.579	0.617	0.961	5.725	0.221
Switzerland	1993/9/13 -1998/9/30, 1999/1/4 -1999/12/31	1533									9.021	0.061	3.268	0.514
Canada	1996/7/15 -1999/12/31	868											8.047	0.090

Table 2 Returns on Each Day of the Week

City	Day of the Week	1975–1979					1980–1984					1985–1989					1990–94					1995–99				
		Mean	t-value	Median	Std. Dev.	Obs.	Mean	t-value	Median	Std. Dev.	Obs.	Mean	t-value	Median	Std. Dev.	Obs.	Mean	t-value	Median	Std. Dev.	Obs.	Mean	t-value	Median	Std. Dev.	Obs.
Tokyo	Monday	-0.00051	-1.247	0.00000	0.00639	245	0.00040	0.801	0.00105	0.00782	244	0.00007	0.148	0.00024	0.00786	244	-0.00031	-0.671	-0.00005	0.00723	240	0.00042	0.752	0.00056	0.00855	239
	Tuesday	-0.00068	-2.122	-0.00039	0.00508	252	-0.00036	-0.886	-0.00030	0.00635	250	-0.00089	-1.941	-0.00037	0.00720	249	-0.00069	-1.876	-0.00040	0.00579	251	0.00021	0.455	0.00000	0.00744	246
	Wednesday	0.00017	0.602	0.00023	0.00438	249	-0.00040	-0.951	-0.00021	0.00666	252	-0.00025	-0.647	0.00000	0.00601	252	-0.00044	-1.161	-0.00040	0.00599	246	-0.00047	-0.895	0.00028	0.00834	249
	Thursday	-0.00055	-1.807	-0.00040	0.00478	251	-0.00024	-0.663	-0.00023	0.00572	250	-0.00095	-2.311	0.00000	0.00648	249	0.00004	0.119	0.00023	0.00648	249	0.00011	0.174	-0.00000	0.00995	249
	Friday	0.00066	2.592	0.00040	0.00401	250	0.00079	2.309	0.00142	0.00543	253	-0.00025	-0.543	-0.00022	0.00722	248	-0.00007	-0.172	0.00047	0.00629	249	-0.00014	-0.294	0.00043	0.00777	251
	All	-0.00018	-1.284	0.00000	0.00501	1247	0.00004	0.209	0.00030	0.00645	1249	-0.00045	-2.289	0.00000	0.00698	1242	-0.00029	-1.654	0.00000	0.00623	1235	0.00002	0.081	0.00031	0.00840	1234
New York	Monday	-0.00136	-3.159	-0.00042	0.00657	234	-0.00051	0.847	0.00091	0.00752	235	-0.00087	-1.746	-0.00014	0.00754	230	-0.00056	-0.853	-0.00008	0.00652	230	-0.00008	-0.155	-0.00015	0.00805	231
	Tuesday	0.00005	0.175	0.00000	0.00443	251	-0.00051	-1.178	0.00091	0.00627	252	-0.00038	-0.959	-0.00047	0.00627	257	-0.00068	-1.714	-0.00027	0.00635	259	0.00022	0.427	0.00035	0.00833	259
	Wednesday	-0.00057	-1.846	-0.00027	0.00498	257	-0.00059	-1.440	0.00015	0.00597	258	-0.00038	-1.033	-0.00025	0.00597	258	0.00005	0.147	0.00045	0.00573	257	0.00018	0.321	0.00056	0.00996	258
	Thursday	0.00054	1.845	0.00028	0.00465	251	0.00049	1.484	0.00068	0.00646	253	-0.00119	-2.924	-0.00036	0.00646	253	-0.00003	-0.065	-0.00014	0.00636	254	-0.00089	-1.666	-0.00038	0.00848	252
	Friday	0.00035	1.135	0.00030	0.00499	259	0.00042	1.115	0.00079	0.00701	256	0.00053	1.213	0.00076	0.00701	257	-0.00060	-1.121	-0.00049	0.00636	258	0.00064	1.275	0.00101	0.00907	258
	All	-0.00018	-1.226	0.00000	0.00519	1252	0.00004	0.200	0.00042	0.00667	1254	-0.00045	-2.370	-0.00015	0.00667	1255	-0.00029	-1.660	-0.00018	0.00624	1258	0.00002	0.085	0.00028	0.00839	1258
London	Monday						0.00091	1.345	0.00124	0.00793	139	-0.00050	-0.774	0.00000	0.00656	104	-0.00032	-0.693	-0.00015	0.00700	237	-0.00002	-0.029	0.00000	0.00821	241
	Tuesday						0.00022	0.439	0.00036	0.00612	149	-0.00034	-0.572	-0.00053	0.00543	115	-0.00074	-1.960	-0.00029	0.00606	258	0.00044	0.828	0.00048	0.00849	260
	Wednesday						-0.00059	-1.120	-0.00015	0.00640	149	0.00043	0.712	0.00000	0.00650	116	0.00015	0.410	0.00000	0.00591	257	-0.00006	-0.114	0.00015	0.00853	259
	Thursday						-0.00009	-0.211	-0.00014	0.00543	149	-0.00208	-3.338	-0.00186	0.00662	113	-0.00018	-0.483	0.00000	0.00613	259	-0.00050	-0.972	-0.00047	0.00825	258
	Friday						0.00054	1.104	0.00045	0.00601	149	0.00058	0.864	0.00028	0.00714	113	-0.00036	-0.885	0.00000	0.00645	253	0.00024	0.433	0.00063	0.00878	253
	All						0.00019	0.795	0.00032	0.00641	735	-0.00038	-1.330	-0.00031	0.00670	561	-0.00029	-1.629	0.00000	0.00631	1264	0.00002	0.086	0.00016	0.00845	1271
Paris	Monday						0.00066	0.605	0.00164	0.00766	49	0.00002	0.028	-0.00027	0.01091	236	-0.00016	-0.323	0.00027	0.00788	241	0.00115	1.843	0.00096	0.00863	192
	Tuesday						0.00065	1.185	0.00068	0.00388	50	-0.00065	-1.156	-0.00056	0.00894	250	-0.00054	-1.417	0.00056	0.00603	254	0.00003	0.060	0.00001	0.00757	206
	Wednesday						-0.00042	-0.764	0.00015	0.00390	50	-0.00026	-0.612	0.00004	0.00674	248	0.00013	-0.281	0.00004	0.00713	253	0.00025	0.355	0.00010	0.00100	203
	Thursday						0.00015	0.287	0.00026	0.00379	50	-0.00137	-3.257	-0.00067	0.00661	248	-0.00004	-0.110	-0.00002	0.00635	252	-0.00049	-0.752	-0.00012	0.00930	201
	Friday						0.00064	1.078	0.00084	0.00421	51	-0.00005	0.091	0.00017	0.00810	244	-0.00060	-1.313	0.00000	0.00717	250	0.00015	0.028	0.00050	0.00994	201
	All						0.00034	1.088	0.00078	0.00488	250	-0.00045	-1.874	0.00000	0.00839	1226	-0.00029	-1.501	0.00000	0.00692	1250	0.00013	0.463	0.00044	0.00994	1003
Frankfurt	Monday											-0.00053	-0.979	-0.00045	0.00852	246	-0.00050	-1.011	-0.00028	0.00777	246	0.00134	2.257	0.00123	0.00842	200
	Tuesday											-0.00025	-0.641	-0.00031	0.00615	257	-0.00039	-1.025	-0.00039	0.00596	252	-0.00010	-0.196	-0.00014	0.00753	205
	Wednesday											-0.00026	-0.574	-0.00022	0.00708	251	0.00011	0.060	0.00011	0.00711	251	0.00025	0.060	0.00015	0.00965	199
	Thursday											-0.00120	-2.825	-0.00018	0.00669	247	0.00005	-0.123	0.00010	0.00651	248	-0.00059	-0.740	-0.00006	0.01116	196
	Friday											-0.00001	-0.012	0.00035	0.00758	249	-0.00026	-0.563	0.00038	0.00722	248	0.00002	0.028	0.00081	0.01002	199
	All											-0.00045	-2.179	0.00000	0.00724	1251	-0.00002	-1.497	0.00002	0.00693	1245	0.00015	0.485	0.00050	0.00945	999
Switzerland	Monday																-0.00015	-0.145	-0.00011	0.00797	63	0.00025	0.453	0.00002	0.00828	234
	Tuesday																-0.00133	-1.883	-0.00163	0.00582	68	0.00026	0.518	0.00039	0.00791	246
	Wednesday																-0.00053	-0.818	-0.00075	0.00531	68	0.00032	0.614	0.00028	0.00811	244
	Thursday																0.00147	2.151	0.00111	0.00560	67	-0.00020	-0.610	-0.00023	0.00747	237
	Friday																-0.00041	-0.559	0.00015	0.00656	67	0.00037	0.674	0.00078	0.00858	239
	All																-0.00019	-0.564	-0.00029	0.00621	333	0.00018	0.782	0.00026	0.00807	1200
Canada	Monday																					0.00081	1.177	0.00066	0.00870	162
	Tuesday																					-0.00011	-0.935	-0.00039	0.00791	178
	Wednesday																					-0.00053	-0.739	0.00048	0.00849	177
	Thursday																					-0.00078	-1.205	-0.00025	0.00859	176
	Friday																					0.00074	1.169	0.00112	0.00836	175
	All																					-0.00009	-0.303	0.00034	0.00877	868

no significant differences in the returns for other days of the week between these two markets.

For the 1985-89 sub-period when the yen sharply appreciated against U.S. dollar, all five markets record large negative returns for Thursday. It is notable that the anomalous patterns are the same across countries. For the 1990-94 and 1995-99 sub-periods, as there is no day-of-the-week anomaly in Tokyo, New York, and London[8], it is natural that we find no significant differences by day of the week among these three markets.

4. Conclusion

This paper investigates whether it does matter where transaction takes place. Using the yen-dollar exchange rates, we find that Tokyo and New York showed different anomalous patterns for the 1975-79 period. The anomalous patterns paralleled what were found in stock market in Japan (i.e., the lowest Tuesday return) and in the United States (i.e., the lowest Monday return). This fact suggests that the anomaly in the foreign currency market in each country was related to country's economic system rather than to the fundamentals of the asset (i.e., yen-dollar). Therefore, the place did matter in the 1975-80 period when international capital markets were highly segmented. This is consistent with Joseph and Hewins (1992).

However, the data show different story

for the 1985-89 period. Namely, all five countries recorded the lowest returns for Thursday for the 1985-89 period. This suggests that the place did not matter during this period, and that this anomalous movement should be due to the asset's characters. This declining importance of the place is consistent with the economic globalization that took place in the 1980's.

Furthermore, the day-of-the-week effect is not found in the 1990's. If the anomaly reflects inefficiency of markets, and certain characters of yen caused the anomaly in the 1980's, then the demise of the day-of-the-week effect is consistent with the general view that the liberalization and globalization of Japanese economy has been progressed since the 1980's. However, further research is needed to confirm the reasons.

Notes

1) Their results have been confirmed by Jaffe and Westerfield (1985), So (1987), and Cornett, Schwarz, and Szakmary (1995).
2) Non-transaction days like holidays, Saturday, and Sunday, are not considered. So, if Tuesday is a holiday, then daily return on next

Wednesday is calculated as Log(Wednesday closing rate)-Log (Monday closing rate).

3) On March 19, 1973, the floating exchange system went into effect.

4) This is quoted by Bank of Tokyo-Mitsubishi as its Telegraph Transfer Rate. (Datastream's Code Number : JSPTUSD).

5) Please note that the starting date is different between Tokyo and New York. If New York data cover the same period as Tokyo, the ANOVA F-statistics is 1.302 (Probability = 0.268).

6) Regarding Tuesday and Wednesday, there are significant differences in returns between New York and Tokyo at the 10% critical level.

7) The z-statistic is 0.729 (Probability = 0.466).

8) Note that the sample intervals for Paris, Frankfurt, Switzerland, and Canada are not the same as Tokyo, New York and London for these periods because of data availability.

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