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EXCHANGE RATES AND FOREIGN DIRECT INVESTMENT: A NOTE

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ABSTRACT

In "Exchange Rates and Direct Investment: An Imperfect Capital Markets Approach," Kenneth Froot and Jeremy Stein [1991] develop a new finance-based theory to answer an old question -- the relationship, if any, between the flow of foreign direct investment and the exchange rate. Their theory, based on the possibility that a foreign firm's borrowing opportunities for financing a U.S. acquisition may be a function of its net worth in dollars, implies a negative relationship between a dollar appreciation and direct investment inflows into the United States. Empirically, the authors find statistically significant evidence of the implied negative relationship for quarterly and annual time series regressions, over the period 1973-88.

The major purpose of this note is to show that this empirical support for the theory is weak. The authors' regressions show evidence of serious instability, and the significant negative relationship between direct investment inflows and the value of the dollar disappears for important subperiods of the 1973-88 period and for the sample period extended through 1991.

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I. INTRODUCTION

In "Exchange Rates and Direct Investment: An Imperfect Capital Markets Approach," Kenneth Froot and Jeremy Stein [1991] develop a new finance-based theory to answer an old question -- the relationship, if any, between the flow of foreign direct investment and the exchange rate. Their theory, based on the possibility that a foreign firm's borrowing opportunities for financing a U.S. acquisition may be a function of its net worth in dollars, implies a negative relationship between a dollar appreciation and direct investment inflows into the United States. Empirically, the authors find statistically significant evidence of the implied negative relationship for quarterly and annual time series regressions, over the period 1973-1988.

The major purpose of this note is to show that, irrespective of whether this evidence serves to distinguish their theory from its competitors, the empirical support for the theory is weak. The quarterly aggregate regressions show evidence of serious instability inside and outside the 1973-88 sample period, and the significant negative relationship between direct investment inflows and the value of the dollar holds for only part of it. Moreover, when the sample period for the quarterly regression is extended through 1991, the estimated coefficient on the exchange rate again becomes insignificant. A similar

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picture appears for the annual aggregate regressions.

II. SOME CONTRARY RESULTS

Table I tells the story. The results presented here accept the Froot-Stein functional form, but test for the equation's parameter stability for subsets of the original sample period, and for a longer sample period extending through part or all of 1991.[1,2] In all cases the dependent variable is the ratio of nominal direct investment inflows divided by nominal U.S. GNP (seasonally adjusted), and the exchange rate variable is the natural log of the IMF's MERM exchange rate index; a linear time trend and an intercept are the other independent variables.

The first equation in the table, for the time period 1973:1 - 1988:1, is essentially the same as the key quarterly regression reported in Table I of the original paper.[3] As reported by Froot and Stein, for this sample period, the dependent variable is significantly related to two variables: positively to the time trend and, most important, negatively to the value of the dollar (the MERM index). The authors also

1. This note does not examine the authors' results for annual data broken down by industry, country, or type of transaction reported in their Tables III, IV, and V -- primarily because these results were mixed and, thus, much less strikingly in support of their maintained hypothesis.

2. Since Froot and Stein followed the practice of *leading* the dependent variable in the quarterly regressions, rather than lagging the regressors, the sample period for the dependent variable is actually one quarter beyond those listed in the table. For the quarterly regressions 4, 5 and 6, data beyond 1991:3 were not used for two reasons: (1) in June 1992 the definition of the inflow of direct investment, the numerator of the dependent variable, was revised, causing a break in the series starting in 1992:1 (see Murad [1992]); (2) although a preliminary figure for the fourth quarter of 1991 became available in March 1992, no revised figure for this quarter was produced before the revisions in June. However, for the *annual* regressions that include 1991, the preliminary figure for 1991:4 was used in the construction of the annual total.

3. The end of the sample period at 1988:1 (1988:2 for the dependent variable) is not clear from a reading of the Froot-Stein article; this point was clarified in discussions with the authors.

show that a regression using *annual* aggregate data leads to the same conclusion (equation 7).

However, equations 2, 3 and 8 in the table illustrate that their key finding is not robust for subsamples within their chosen sample period. For more than half of the initial quarterly sample period, 1973:1 through 1981:4, the value of the dollar is insignificantly related to the direct investment ratio (equation 2); this is also the case for many subsamples ending before 1980, for example 1973:1 to 1977:4 (equation 3). Equation 8 shows a similar picture for the annual data.

The Froot-Stein result is absent, not only for large parts of their original quarterly and annual sample periods, but also for recent history -- 1988:2 through 1991:2 for the quarterly data, and 1988-1991 for the annual. The regression for the quarterly subsample (equation 4) shows a positive, although statistically insignificant, coefficient for the MERM index.[4] When the original sample is extended to 1991, the coefficient for the value of the dollar is insignificant for both quarterly and annual regressions (equations 5 and 9). It might be added that this failure of the exchange-rate variable is not the result of seasonal factors or the autocorrelation of the residuals (ρ) that seems present in equation 5. In fact, standard attempts to correct for these factors in equation 6 further reduce the explanatory power of the exchange rate (insignificant seasonals not reported).

As might be inferred from the above results, formal Chow tests for the most part reject the hypothesis of structural stability for the Froot-Stein equation for subsamples of the original sample period and for the sample period extended through 1991. In the table, all Chow tests are based on Froot and Stein's original sample period, quarterly or

4. The annual regression for 1988-91 also shows a positive coefficient, but is not reported here because it only has one degree of freedom.

annual, as the comparison period.[5] For virtually every alternative sample period, the hypothesis of structural stability is rejected at the 5 percent level or better; the only exception is for equation 8, the annual regression for 1973-81 (despite having an estimated coefficient that is opposite in sign to the Froot-Stein hypothesis).

III. FURTHER OBSERVATIONS

As someone who has labored in this vineyard off and on for over 20 years, I must admit that the above results surprise me only a little. Because of similarly ambiguous results in the late 1970s, I was prompted in Stevens [1977] to develop three alternative models that showed that the effect of a dollar devaluation on direct investment could be of *any sign whatever*. These models were based on an analysis of what it seemed were plausible (but conflicting) ways the exchange rate could be related to the production costs and revenues of the international firm (all unrelated to the Froot-Stein theory).[6] Thus, it did not surprise me when the very simple regressions proposed by Froot and Stein failed to show stability or, even, an unambiguous sign for the exchange rate when the sample period was varied.

Despite the weakness of the results examined above, it is only fair to note that the preponderance of the empirical work done over the last decade favors the negative sign for a home exchange rate appreciation -- although in the context of theoretical models quite different from that of Froot and Stein. Careful empirical work by Bailey and Tavlas [1991], Caves [1990], Cushman [1985], Dewenter [1991], and Ray

5. This particular Chow test tests whether observations through the end of the longer sample period fall within the prediction interval of the equation estimated over the shorter period. (See, e.g., Harvey [1990], p. 183.)

6. See Adler and Prasad [1992] for an exploration of various alternative theories implying an effect of the exchange rate on direct investment.

[1989] supports the hypothesis of a negative sign. However, the instability and ambiguity of the regression results in Table I, along with other contradictory findings,[7] suggest, it seems to me, that the issue is still open.

7. See also the results of Catherine Mann [1993] for Japanese direct investment into the United States; she finds no significant exchange rate effect for the period 1976-87.

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TABLE I

REGRESSIONS FOR RATIO OF U.S. DIRECT INVESTMENT INFLOWS TO GNP

$RATIO = CON + a_1 \ln(MERM) + a_2 T$

#	Sample Period	Coefficients on ln (MERM)	Coefficients on T	Coefficients on CON	R^2	SEE	DW	ρ	DF	RSS	CHOW
				QUARTERLY DATA							
1	73:1 - 88:1	-.28**	.0044**	1.21**	.54	.064	1.85	-	58	.2339	
		(3.8)	(8.2)	(3.8)							
2	73:1 - 81:4	+.059	.0040**	-.23	.39	.054	1.88	-	33	.0951	1.93*
		(.33)	(4.6)	(.31)							F(25,33)
3	73:1 - 77:4	-.007	-.0008	.097	.03	.029	2.44	-	17	.0139	6.57**
		(.03)	(.55)	(.08)							F(41,17)
4	88:2 - 91:2	+.79	-.023**	-1.53	.74	.072	1.99	-	10	.0522	
		(1.5)	(3.7)	(.62)							
5	73:1 - 91:2	-.11	.0031**	.50	.38	.085	1.06	-	71	.5124	5.32**
		(1.4)	(6.6)	(1.5)							F(13,58)
6	73:1 - 91:2	-.065	.0029**	.30	.54	.076	--	.50	66	.3828	
		(.50)	(3.5)	(.53)				(4.5)			
				ANNUAL DATA							
7	73 - 87	-13.0**	.74**	7.6	.79	1.50	1.9	-	12	27.18	
		(3.4)	(6.7)	(.51)							
8	73 - 81	+1.4	.68**	-55.5	.70	1.42	.86	-	6	12.09	1.25
		(.13)	(3.7)	(1.0)							F(6,6)
9	73 - 91	-4.0	.45**	-12.2	.48	2.80	1.05	-	16	125.2	10.8**
		(.77)	(3.8)	(.47)							F(4,12)

Notes: t ratios in parentheses. * and ** indicate, respectively, statistical significance at the 5 and 1 percent levels.

DATA APPENDIX

	FDI / GNP (t + 1)	FDI	LN (MERM)
1971 Q1	0.0128	0.1960	4.4331
Q2	-0.0263	0.1401	4.4302
Q3	0.0287	-0.2934	4.4167
Q4	-0.0116	0.3247	4.3851
1972 Q1	0.0311	-0.1357	4.3480
Q2	0.0252	0.3731	4.3391
Q3	0.0318	0.3093	4.3389
Q4	0.0480	0.4023	4.3430
1973 Q1	0.0620	0.6313	4.3018
Q2	0.0393	0.8347	4.2538
Q3	0.0562	0.5389	4.2185
Q4	0.1249	0.7951	4.2475
1974 Q1	0.0369	1.7836	4.2950
Q2	0.1081	0.5386	4.2566
Q3	0.0546	1.6097	4.2808
Q4	0.0182	0.8283	4.2796
1975 Q1	0.0557	0.2778	4.2406
Q2	0.0053	0.8700	4.2415
Q3	0.0816	0.0861	4.2880
Q4	0.0849	1.3691	4.3015
1976 Q1	0.0616	1.4717	4.3089
Q2	0.0556	1.0862	4.3233
Q3	0.0428	0.9991	4.3183
Q4	0.0515	0.7895	4.3209
1977 Q1	0.0489	0.9799	4.3248
Q2	0.0503	0.9649	4.3196
Q3	0.0368	1.0232	4.3147
Q4	0.0642	0.7602	4.2936
1978 Q1	0.1036	1.3552	4.2614
Q2	0.1141	2.3129	4.2486
Q3	0.0677	2.6201	4.2004
Q4	0.0640	1.6083	4.1819
1979 Q1	0.1351	1.5532	4.1928
Q2	0.1321	3.3534	4.2123
Q3	0.1372	3.3821	4.1930
Q4	0.1236	3.5880	4.2081
1980 Q1	0.2148	3.3210	4.2111
Q2	0.1720	5.7560	4.2102
Q3	0.1093	4.7130	4.1839
Q4	0.1054	3.1280	4.2111
1981 Q1	0.1751	3.1460	4.2529
Q2	0.1769	5.2940	4.3211
Q3	0.3590	5.5050	4.3735
Q4	0.0666	11.2510	4.3390
1982 Q1	0.1102	2.0800	4.3780
Q2	0.0991	3.5050	4.4138
Q3	0.1564	3.1660	4.4607
Q4	0.0545	5.0410	4.4773
1983 Q1	0.1207	1.7890	4.4495
Q2	0.1242	4.0970	4.4779
Q3	0.0485	4.3250	4.5127
Q4	0.1407	1.7360	4.5160
1984 Q1	0.2384	5.1990	4.5225
Q2	0.1263	9.0090	4.5317
Q3	0.1619	4.8530	4.5897
Q4	0.1345	6.2980	4.6165
1985 Q1	0.1331	5.3210	4.6729
Q2	0.1224	5.3420	4.6458
Q3	0.0807	5.0070	4.5925
Q4	0.0949	3.3520	4.5210
1986 Q1	0.1341	4.0140	4.4600
Q2	0.1881	5.6860	4.4172
Q3	0.3756	8.0870	4.3760
Q4	0.3026	16.3040	4.3683
1987 Q1	0.2076	13.3510	4.3097
Q2	0.4691	9.3360	4.2785
Q3	0.2976	21.4750	4.2925
Q4	0.1784	13.9570	4.2370
1988 Q1	0.3026	8.4990	4.2077
Q2	0.2948	14.7150	4.2002
Q3	0.4276	14.5980	4.2580
Q4	0.3905	21.6120	4.2136
1989 Q1	0.3160	20.1640	4.2344
Q2	0.2162	16.5680	4.2782
Q3	0.4170	11.4460	4.2811
Q4	0.2977	22.3730	4.2552
1990 Q1	0.1688	16.2690	4.2312
Q2	0.1266	9.3460	4.2315
Q3	0.0811	7.0600	4.1808
Q4	0.0772	4.5380	4.1339
1991 Q1	0.1330	4.3360	4.1490
Q2	0.1065	7.5480	4.2191
Q3	0.0731	6.1000	4.2199

	FDI / GNP	FDI	LN (MERM)
1971	0.3326	367.4	4.8175
1972	0.7809	949.0	4.7433
1973	2.0563	2800.0	4.6570
1974	3.2303	4760.2	4.6792
1975	1.6288	2603.0	4.6694
1976	2.4362	4346.5	4.7189
1977	1.8691	3728.2	4.7143
1978	3.5026	7896.5	4.6247
1979	4.7115	11876.7	4.6027
1980	6.1697	16918.0	4.6052
1981	8.2238	25196.0	4.7236
1982	4.3374	13792.0	4.8343
1983	3.4786	11947.0	4.8905
1984	6.6708	25359.0	4.9670
1985	4.6926	19022.0	5.0062
1986	7.9695	34091.0	4.8072
1987	12.7889	58119.0	4.6808
1988	12.1071	59424.0	4.6211
1989	13.4429	70551.0	4.6634
1990	6.7360	37213.0	4.5961
1991	3.8977	22197.0	4.5921

SOURCES: FDI data, quarterly, 1984:1-1990:4, and annual, 1973-1990: Russell B. Scholl, "The International Investment Position of the United States in 1990," *Survey of Current Business* (June 1991), Table 1, line 57, pp. 44-49. For quarterly data before 1984:1, earlier issues of the June *Survey of Current Business;* for quarterly and annual data for 1991 (see also footnote 2, above), Christopher L. Bach, "U.S. International Transactions, Fourth Quarter and Year 1991," *Survey of Current Business* (March, 1992), Table 1, p.75.

MERM exchange rate data: International Monetary Fund, *International Financial Statistics* (February 1992 and earlier issues), line amx for United States (series discontinued after February 1992).

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