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Inverted Yield Curves and Expected Stock Returns

Eugene F. Fama and Kenneth R. French[1]

Yield curves typically slope up, with long maturity government bonds promising higher returns than short maturity bonds. Much empirical evidence says the slope of the yield curve predicts economic activity (e.g., Harvey 1988, Estrella and Hardouvelis 1989, Fama and French 1989, Estrella and Mishkin 1996). Inverted yield curves, with higher yields on short-term government bonds, tend to forecast future recessions. Perhaps because of this relation, some investors, fearing that an inverted yield curve predicts low stock returns, reduce their equity exposure when the term spread is negative. We test whether the fear is justified. The answer is no. We find no evidence that inverted yield curves predict stocks will underperform Treasury bills for forecast periods of one, two, three, and five years.

I. Estimation Procedure

The tests use monthly stock and government bond data for the United States and 11 other major markets. We start in January 1975 with six countries, including the U.S. The sample grows to ten countries by 1990 and the last two, Belgium and Italy, are added in 1991. The tests end in December 2018. Depending on the data available, we consider up to six term spreads in a country, comparing one-month, one-year, and two-year short-term yields with five- and ten-year long-term yields. (See the appendix for details on the data.)

We take the perspective of a U.S. investor. The default or passive strategy delivers the U.S. dollar return on one of three stock portfolios: the U.S. stock market; the portfolio of available markets outside the U.S., which we call World ex U.S.; or the World portfolio of all available markets. The active strategy for the U.S. replaces the stock market with one-month Treasury bills when the U.S. term spread is negative. The active strategies for World and World ex U.S. combine the dollar-denominated returns from

[1] Booth School of Business University of Chicago (Fama) and Tuck School of Business, Dartmouth College (French). Fama and French are consultants to, board members of, and shareholders in Dimensional Fund Advisors. Thanks to Dimensional's research group for providing the data.

country-specific strategies that follow the same rules as the U.S. strategy, replacing a country's stock market with U.S. T-bills when its local yield curve is inverted. Our goal is to assess whether the expected equity premium—the expected return on stock in excess of the bill return—is negative after an inversion.

The hypothesis that an inverted yield spread predicts low stock returns does not specify, however, when low returns occur after an inversion. We examine forecast periods of one, two, three, and five years.

A one-year forecast period implies that we want the shape of the yield curve (inverted or not) to predict returns up to a year ahead. To this end, we construct a portfolio every month that makes 12 investments in bills or stocks depending on the yield curve at the end of each of the 12 months of the preceding year. If the yield curve is inverted at the end on month t-1, 1/12th of the portfolio for month t is invested in bills. If the yield curve is inverted at the end on month t-2, another 1/12th of the portfolio for month t is invested in bills. Etc. The portfolio's total allocations in month t depend on the number of inversions in the prior 12 months. If seven of the term spreads from t-12 to t-1 are negative, 7/12ths of the portfolio is in bills and 5/12ths is in stock in month t. More generally, if H is the forecast horizon and N_t is the number of inversions from t-H to t-1, then $n_t = N_t/H$ is the weight of bills in the month t portfolio and $1 - n_t$ is the weight of the market portfolio. The return of the active strategy, R_{At}, is

$$R_{At} = n_t R_{Ct} + (1 - n_t) R_{Mt}, \tag{1}$$

where R_{Ct}, and R_{Mt} are the month t returns on bills (cash) and the stock market portfolio.

Since the passive strategy holds the market, the difference between the realized active and passive returns for month t, which we call the active premium, is

$$\begin{aligned} R_{At} - R_{Mt} &= [n_t R_{Ct} + (1 - n_t) R_{Mt}] - R_{Mt} \\ &= n_t (R_{Ct} - R_{Mt}). \end{aligned} \tag{2}$$

The realized active premium in equation (2) is the heart of our tests. If the term structure is inverted in at least one of the H months before t, the active strategy moves some of the portfolio from stock to cash in t, so n_t is positive. The expected payoff from the reallocation to cash depends on what an inverted term structure says about future stock returns. If an inversion forecasts a negative equity premium—so the expected excess stock return is negative—the expected value of the active premium,

$n_t E(R_{Ct} - R_{Mt})$, is positive. If inversions say nothing about the equity premium, the allocation to bills reduces the portfolio's expected return and the expected active premium is negative. Thus, to judge whether an inverted yield curve predicts a negative equity premium, we test whether the expected value of the active premium in (2) is positive.

We estimate the expected active premium by averaging monthly realized premiums for 1975-2018., The familiar *t*-statistic for the average premium provides the appropriate test of whether the expected premium is positive. Since this is a simple test of means, heteroscedasticity that arises because the variance of the active premium depends on the fraction of the portfolio in bills is not a problem for inferences.

If there are no inversions in the H months before t, the active portfolio is fully invested in stock and both n_t and the active premium, $n_t(R_{Ct} - R_{Mt})$, are zero. The active strategy cannot beat the passive when both hold the value weight (VW) market portfolio, so the tests use only months with positive n_t.

II. Combining Countries

We compare active and passive strategies for three portfolios, the U.S. market portfolio, the World ex U.S. portfolio of 11 countries outside the U.S., and the World portfolio of all 12 countries. We value weight securities in each country and value weight countries in the global portfolios. In other words, each security's weight in a country is proportional to its market cap and each country's weight in the World or World ex U.S. portfolio is proportional to the aggregate market cap of the country's stocks.

We assume each country's yield curve forecasts only the local stock market. Inversion in a country is measured by yields on its government bonds in the local currency. Because we want to combine monthly country returns into global portfolio returns, we convert local monthly stock market returns to U.S. dollar-denominated returns. Each country's contribution to a global portfolio's active return is its weight in the global portfolio, w_{it}, times n_{it}, the fraction of the H months before t in which the country's local term structure is inverted, times the difference between its dollar-denominated stock market return and the return on one-month U.S. Treasury bills. This contribution is zero when the country

has no local inversions in the prior H months. Extending equation (2), the active premium for the World or World ex U.S. portfolio in month t is

$$R_{At} - R_{Pt} = \Sigma_i w_{it}[n_{it}R_{Ct} + (1 - n_{it})R_{Mit}] - \Sigma_i w_{it}R_{Mit}$$

$$= \Sigma_i w_{it} n_{it}(R_{Ct} - R_{Mit}), \quad (3)$$

where n_{it} is the fraction of the H months before t in which the country's local term structure is inverted, R_{Mit} is the country's dollar-denominated market return for month t, R_{Ct} is the month t return on U.S. T-bills, and w_{it}, the weight of country i in the active and passive portfolios, is proportional to the market cap of the country's stocks at the beginning of t. In short, the active premium in a global portfolio is the value weight average of the active premiums for the countries in the portfolio.

III. The Evidence

Panel A of Table 1 summarizes the Treasury bill and bond yields we use to measure U.S. term spreads. Consistent with a typically upward sloping yield curve, the average yields for the 588 months of 1975-2018 increase monotonically from 4.38% per year at one month to maturity and 5.04% at one year to 5.81% and 6.19% at five and ten years.

Investors seeking to increase their expected portfolio return by selling stock and buying Treasury bills when the term structure inverts are betting that the equity premium will be negative while they are in bills. Summary statistics for the returns and equity premiums on the three passive market portfolios we consider are in Panel B of Table 1. The 1975-2018 average annualized difference between the monthly returns on the VW portfolio of U.S. stocks and one-month bills is 8.32%, with a t-statistic of 3.61. The average equity premiums for World ex U.S. and World are 6.75% (t = 2.66) and 7.31% (t = 3.29). The large t-statistics for the three equity premiums say their unconditional expected values are reliably positive. Large and reliably positive unconditional equity premiums are a challenge to investors who try to increase their expected return by using the term spread to time the premium.

Table 2 describes the incidence of yield curve inversions. Inversions tend to be persistent. To reduce the likelihood that some signals triggering the active strategy are data errors or other noise, we

ignore a negative term spread unless the spreads for the prior two months are also negative. (Increasing the requirement from three consecutive negative spreads to six has no meaningful effect on the results.) In 1975-2018, the six U.S. spreads we study have between six and nine runs with at least three consecutive inverted months. The average length of a run in the U.S. is between 6.3 and 9.2 months. Excluding the first two months of each run because we do not treat their inversions as sell signals, the total number of inverted months varies from 26, for the U.S. spread between one- and 60-month yields, and 58, between 12- and 60-month yields.

The global passive and active strategies combine U.S. dollar-denominated returns from country-specific passive and active strategies that are identical to the strategies we follow in the U.S. Since the World and World ex U.S. strategies invest part of the active portfolio in U.S. Treasury bills following a negative term spread in any country, in Table 2 we say a global portfolio's term structure is inverted in month *t* if the term structure for any of its countries is inverted in *t* and the prior two months. There are 11 countries in World ex U.S. and 12—including the U.S.—in World, so it is no surprise that the global portfolios have more runs of three or more inverted months, more months in the runs, and more inverted months than the U.S. Focusing on just the averages across the six spreads, World ex U.S. and World have about five times as many inverted months (216 and 225 versus 44 for U.S.), almost twice as many runs (13.0 and 13.3 versus 7.3), and substantially longer runs (19.3 and 19.6 months versus 7.9 month). Similarly, the estimates for World, with 12 possibly-inverted countries, are always at least as large as the estimates for World ex U.S., with only 11.

These differences are apparent in Panel A of Table 3, which describes the percent of months in which a strategy allocates part of its portfolio to bills. Two predictable and clear patterns in Panel A help explain the return results below. The first is foreshadowed by the counts in Table 2. Judged on the frequency of their bets against the equity premium, the global strategies are more active than the U.S. strategies, and the World strategies are more active than the World ex U.S. strategies. For all 24 combinations of spread and forecast period, for example, the fraction of months in which either global strategy allocates some of its portfolio to bills exceeds the fraction for the matching U.S. strategy. Second,

for each portfolio and spread, the frequency of active bets always increases with the forecast period. The reason is apparent if we consider an inversion in the United States that lasts for only one month. Ignoring our three-month rule for inversions, the isolated inversion triggers 12 monthly bets with a one-year forecast period and 60 with a five-year forecast period.

More frequent allocations to bills does not imply a larger average allocation to bills. For example, each of the 12 monthly bets triggered by an isolated U.S. inversion shifts 1/12th of the portfolio from stocks to bills, while each of the five-year forecast period's 60 monthly bets shifts only 1/60th of the portfolio. The net effect is an average allocation to bills over the 60 months after the inversion of 1/60th of the portfolio for both the one-year and five-year strategies. Several issues make the actual allocations more complicated, but the average allocations to bills in Panel B of Table 3 are not dramatically different across the three portfolios or the four forecast periods.

Table 4, the centerpiece of the paper, summarizes the monthly active premiums of Equation (2). The results should disappoint investors hoping to use inverted yield curves to improve their expected portfolio return. If negative term spreads forecast negative excess stock returns, shifting from stock to bills after inversions increases expected return. The striking result in Table 4 is the large fraction of term spread strategies—67 of 72—that reduce the investment payoff for 1975-2018 by following this general rule. With the diversification of 11 or 12 countries and 60 monthly premiums after each inversion, the average active premiums are more than two standard errors below zero for all six World strategies with five-year forecast periods and for four of six World ex U.S. strategies. The *t*-statistics for shorter forecast periods and for five-year U.S strategies are weaker, but the almost uniformly negative average premiums in Table 4 suggest active strategies that shift away from stock after the term structure is inverted reduce investors' expected return.

The simplest explanation for the results in Table 4 is that inverted yield curves provide no information about future excess stock returns. If so, the negative realized premiums in Table 4 are the cost of uninformed bets against the equity premium.

IV. Summary

We test the hypothesis that inverted yield curves predict negative equity premiums. The tests use monthly observations for 1975-2018, with six countries, including the U.S., in the sample throughout the period and 12 for the last 28 years. We consider three broad market portfolios: the U.S., the World, which combines all available countries, and the World ex U.S. The tests examine 24 investment strategies for each market, using six yield spreads and four forecast periods. Each is designed to increase expected portfolio returns by exploiting the term spread's hypothesized information about future equity premiums.

We find no evidence that yield curve inversions can help investors avoid poor stock returns. Relative to the returns on the three passive stock market portfolios, all 24 active U.S. and World strategies and 19 of 24 World ex U.S. strategies reduce the average realized return for 1975-2018. The longest forecast period is five years. With the diversification of 11 or 12 countries and 60 months after each inversion, almost all the expected five-year premiums for the active World and World ex U.S. strategies are reliably negative.

The simplest interpretation of the negative active premiums we observe is that yield curves do not forecast the equity premium. This interpretation implies that investors who try to increase their expected return by shifting from stock to bills after inversions just sacrifice the reliably positive unconditional expected equity premium.

References

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Table 1 – Average yields for U.S. Treasury bonds and summary statistics for annualized U.S. dollar-denominated returns and equity premiums for U.S., World ex U.S., and World market portfolios, 1975-2018, 588 monthly observations

Panel A reports averages of monthly yields on U.S. Treasury bonds. Panel B reports summary statistics for the dollar-denominated monthly return and equity premium—the market return in excess of the one-month Treasury bill rate—on three market portfolios. World is the VW portfolio of country-specific market portfolios available each month. The appendix describes when each of the 12 countries is in the sample. World ex U.S. is World minus the portfolio of U.S. stocks. Ave is the average annualized return or equity premium, SD is the annualized standard deviation of an equity premium, SE is the standard error of Ave, and *t*-stat, the ratio of Ave and SE, tests the hypothesis that the unconditional expected equity premium is zero.

Panel A: Average yields for U.S. Treasury bonds (percent)

Term	1 Month	1 Year	2 Years	5 Years	10 Years
Average yield	4.38	5.04	5.27	5.81	6.19

Panel B: Summary statistics for annualized VW market returns and equity premiums (in percent)

	VW market return	Equity premium			
	Ave	Ave	SD	SE	*t*-stat
U.S.	12.56	8.32	15.27	2.30	3.61
World ex U.S.	10.99	6.75	16.86	2.54	2.66
World	11.55	7.31	14.73	2.22	3.29

Table 2 – Summary statistics for consecutive months with yield curve inversions, 1975-2018, 588 months

Runs is the number of noncontiguous blocks in which the term spread on government bonds is negative for three or more consecutive months. World and World ex U.S. are considered to have a negative yield spread in a month if the local yield spread on government bonds is negative in any of the 11 or 12 countries in the portfolio. The maturities in each spread are measured in months, so the 1-60 spread is the difference between 60-month and one-month yields.

	U.S.			World ex U.S.			World		
Spread	Runs	Length	Months	Runs	Length	Months	Runs	Length	Months
1-60	6	6.3	26	20	16.8	297	20	16.9	298
12-60	8	9.2	58	13	17.2	198	13	18.2	210
24-60	7	8.7	47	13	15.3	173	13	16.3	186
1-120	6	7.0	30	10	33.0	310	10	33.0	310
12-120	9	8.1	55	12	14.8	154	12	16.0	168
24-120	8	8.0	48	10	18.5	165	12	17.2	182
Average	7.3	7.9	44	13.0	19.3	216	13.3	19.6	225

Table 3 – Percent of months with a positive allocation to T-bills and the average percent allocation to T-bills across all 588 months of 1975-2018

Panel A reports the percent of months each strategy has a positive allocation to Treasury bills. Panel B reports each strategy's average allocation to T-bills across all 588 months of 1975-2018. Strategies are defined by the forecast period and the short and long maturities in the term spread. Maturities are measured in months, so a 1-60 strategy uses the spread between the 60-month and one-month yields. Forecast periods are one, two, three, and five years. World strategies combine all countries available each month. World ex U.S. combine all available countries outside the U.S. Average is the average across the six spreads of the percent of months with an allocation to T-bills or the average of the average allocation to T-bills.

	U.S.				World ex U.S.				World			
Spread	1 Yr	2 Yrs	3 Yrs	5 Yrs	1 Yr	2 Yrs	3 Yrs	5 Yrs	1 Yr	2 Yrs	3 Yrs	5 Yrs
Panel A: Percent of months with an allocation to T-bills												
1-60	15.0	24.1	33.1	50.9	84.7	97.0	99.6	100.0	84.7	97.0	99.6	100.0
12-60	25.8	38.6	50.0	70.6	57.2	74.1	87.9	97.0	60.4	77.3	91.1	100.0
24-60	21.8	33.1	44.5	65.3	49.2	59.3	68.4	78.4	52.8	65.2	76.5	87.9
1-120	17.4	28.8	40.2	62.3	74.2	84.3	91.9	97.5	74.2	84.3	91.9	97.5
12-120	25.8	38.6	50.0	70.3	45.6	55.5	63.8	75.4	50.4	62.5	73.1	86.6
24-120	22.3	33.7	45.1	65.3	44.5	53.8	62.9	76.3	50.2	61.7	72.3	87.5
Average	21.3	32.8	43.8	64.1	59.2	70.6	79.1	87.4	62.1	74.7	84.1	93.2
Panel B: Average percent allocation to T-bills												
1-60	5.2	5.9	6.2	6.5	18.6	19.5	20.2	21.1	9.5	10.4	10.8	11.2
12-60	11.7	12.7	13.2	13.6	15.0	15.4	15.6	15.8	13.4	14.5	15.0	15.2
24-60	9.5	10.2	10.6	10.9	12.9	13.2	13.4	13.6	11.5	12.2	12.6	12.8
1-120	6.0	6.8	7.1	7.4	11.8	11.9	12.0	12.1	9.2	9.8	10.1	10.3
12-120	11.4	12.2	12.6	12.9	11.2	11.4	11.5	11.6	12.8	13.5	13.8	14.0
24-120	10.0	10.4	10.6	10.8	9.9	10.1	10.2	10.3	11.9	12.3	12.4	12.4
Average	8.9	9.7	10.1	10.3	13.2	13.6	13.8	14.1	11.4	12.1	12.4	12.6

Table 4 – Summary statistics for monthly active premiums of Equations (2) and (3), 1975-2018, 588 months

An active strategy's premium over the passive market return for the U.S. in month t is

$$R_{At} - R_{Pt} = n_t(R_{Ct} - R_{Mt}), \quad (2)$$

where R_{At}, R_{Ct}, and R_{Mt} are the returns on the active, T-bill, and passive stock market portfolios in month t and n_t is the fraction of the active portfolio allocated to T-bills in t. If H denotes the number of months in the forecast period and N_t denotes the number of inversions from t-H to t-1, $n_t = N_t/H$. The active premium for World and World ex U.S. strategies in month t is

$$R_{At} - R_{Pt} = \Sigma_i w_{it} n_{it}(R_{Ct} - R_{Mit}), \quad (3)$$

where w_{it}, the weight of country i in the active and passive portfolios, is proportional to the aggregate market cap of stock in i.

	Average				Standard deviation				*t*-statistic			
Spread	1 Yr	2 Yrs	3 Yrs	5 Yrs	1 Yr	2 Yrs	3 Yrs	5 Yrs	1 Yr	2 Yrs	3 Yrs	5 Yrs
U.S.												
1-60	-1.13	-0.40	-0.72	-0.78	7.04	5.13	3.79	2.35	-0.41	-0.25	-0.73	-1.57
12-60	-1.11	-0.69	-0.67	-1.09	9.14	7.21	5.72	3.66	-0.41	-0.39	-0.55	-1.66
24-60	-1.04	-0.35	-0.59	-0.95	8.85	6.61	5.13	3.25	-0.36	-0.20	-0.51	-1.56
1-120	-0.57	-0.66	-0.70	-0.76	7.22	5.19	3.81	2.37	-0.22	-0.45	-0.78	-1.69
12-120	-1.77	-0.95	-0.83	-1.08	9.08	6.90	5.45	3.56	-0.65	-0.57	-0.71	-1.69
24-120	-2.45	-1.08	-0.95	-1.13	9.83	6.74	5.04	3.34	-0.78	-0.62	-0.84	-1.81
World ex U.S.												
1-60	-1.78	-1.41	-1.25	-1.82	6.66	6.15	5.70	5.19	-1.63	-1.50	-1.45	-2.32
12-60	-0.16	-0.04	-0.59	-1.32	7.99	6.19	4.91	4.08	-0.10	-0.04	-0.75	-2.11
24-60	-0.15	0.19	-0.50	-1.47	7.42	6.21	4.94	4.12	-0.10	0.15	-0.56	-2.09
1-120	-0.65	-0.41	-0.39	-0.80	3.79	3.28	2.91	2.47	-0.98	-0.77	-0.86	-2.11
12-120	0.81	0.24	-0.45	-1.28	8.31	6.18	4.87	3.79	0.44	0.20	-0.49	-1.94
24-120	1.41	0.82	-0.02	-0.91	7.59	5.54	4.30	3.16	0.82	0.72	-0.03	-1.67
World												
1-60	-0.58	-0.54	-0.56	-0.80	3.37	2.96	2.65	2.22	-1.05	-1.20	-1.41	-2.38
12-60	-0.40	-0.40	-0.52	-1.01	6.30	5.08	4.07	3.03	-0.32	-0.46	-0.81	-2.21
24-60	-0.27	-0.24	-0.49	-0.95	5.93	4.79	3.84	2.82	-0.22	-0.27	-0.75	-2.09
1-120	-0.43	-0.45	-0.45	-0.70	3.37	2.97	2.54	2.02	-0.72	-0.93	-1.12	-2.28
12-120	-0.33	-0.50	-0.64	-1.09	7.00	5.53	4.35	3.11	-0.22	-0.48	-0.83	-2.17
24-120	-0.46	-0.36	-0.55	-0.99	6.84	5.10	3.94	2.84	-0.32	-0.37	-0.78	-2.17

Data Appendix

Returns are observed at the end of each month from January 1975 to December 2018. Stock returns are Fama/French research returns, from French's website. The one-month U.S. Treasury bill returns are from the Center for Research in Security Prices (CRSP) at Chicago Booth. Country weights, observed at the beginning of the indicated month, are from Morgan Stanley Capital International (MSCI) for 1975-2006 and Bloomberg for 2007-2018. Exchange rates are from Reuters for 1975-2006 and Bloomberg for 2007-2018.

The sources for each country's government bond yields are in Table A1. The start dates for yield data, which are observed at the end of the indicated months, are in Table A2. If available, we use yield data observed before the first return month, January 1975. If the holding period is five years and the two yields for a spread are available, for example, one 60^{th} of the spread's portfolio for January 1975 is determined by yields observed at the end of each month from January 1970 to December 1974.

Table A1: Sources for Yields on Government Bonds

ST denotes the yield on short-term bonds. They are typically three months to maturity, but short-term bonds for Canada, U.K., and U.S. are one month to maturity. The other yields are for bonds with 1, 2, 5, and 10 years to maturity. OECD is the Organization for Economic Cooperation and Development, IMF is the International Monetary Fund, FTSE is the Financial Times Stock Exchange Group, and CRSP is the Center for Research in Security Prices at Chicago Booth.

	OECD	IMF	Central Bank		Other	
Australia	ST, 10		Royal Bank of Australia	2, 5		
Belgium	ST, 10		National Bank of Belgium	1, 2, 5		
Canada	10		Bank of Canada	1, 2, 5	FTSE Canada	ST
France	10	ST[2]	Bank of France	1, 2, 5		
Germany	10		Deutsche Bundesbank	ST, 1, 2, 5		
Italy		ST, 10	Bank of Italy			
Japan	10[3]	ST[4]	Ministry of Finance	1, 2, 5		
Spain	10		Bank of Spain	ST[5], 1, 5		
Sweden			Sveriges Riksbank	ST[6], 1, 2, 5, 10		
Switzerland	ST, 10		Swiss National Bank	1, 2, 5		
U.K.	10		Bank of England	1, 2, 5	Datastream	ST[7]
U.S.					CRSP	ST, 1, 2, 5, 1

[2] Bank of France after 201705.
[3] IMF before 198901.
[4] Bloomberg three-month Tbill rate after 201706.
[5] OECD before 198803.
[6] IMF before 198612.
[7] One-month U.K. Tbill rate, from Datastream until 200407, the U.K. Debt Management Office for 200408 to 201706, and FTSE Tradeweb after 201706.

Table A2: Start Dates for Yields on Government Bonds

Yields are observed at month end. In most countries, the short-term bonds have three months to maturity. They are one month to maturity for Canada, U.K., and U.S.

	Short-Term	1 Year	2 Years	5 Years	10 Years
Australia	197001	197401	198308	197201	197001
Belgium	197001	199104	199301	199301	197001
Canada	197306	200905	200905	200905	197306
France	197001	200411	200411	200411	197001
Germany	197209	197209	197209	197209	197209
Italy	197703			199103	197703
Japan	197001	198901	198901	198901	197001
Spain[8]	198001	198707		198809	198001
Sweden[9]	197001	198612	198701	198612	197001
Switzerland	197401	198804	198804	198804	197401
U.K.[10]	197001	197001	197001	197001	197001
U.S.	197001	197001	197001	197001	197001

[8] Spain's five-year yield is unavailable for nine months scattered between 198811 and 199101 and its short-term yield is missing for 199209.
[9] Sweden's one-year yield is unavailable after 200906.
[10] U.K.'s one-year yield for 197210 and 197211 is unavailable.