Modeling & Forecasting the International Dimensions: Business cycles, exchange rates, and cross-border flows capital and trade flows

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ISF at Darden School

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Outline

Day 1

- Introduction
- Business Cycles – domestic, int'l predictors
- Trade Flows
- Current Accounts

Day 2

- Exchange Rates
- Interest rate linkages
- Inflation

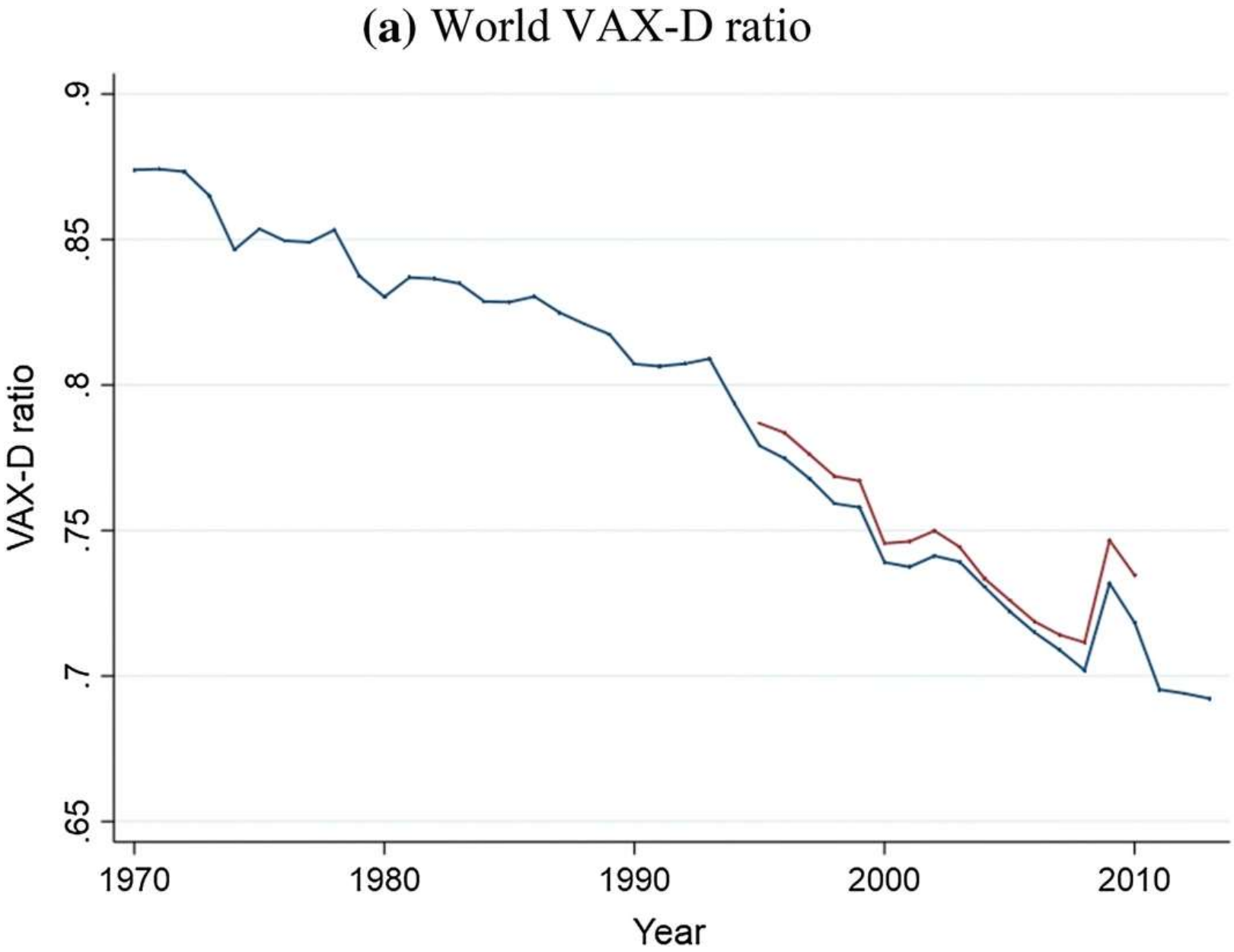
Introduction

The Rising Importance of Global Forces

- Increasing penetration of imports, exports
- Increasing intermediate inputs
- Increasing size of financial capital flows
- Increasing cross-border holdings of assets/liabilities

Trade Openness (I)

Trade Openness (II)



Share of value added in manufacturing as share of exports.
Source: Pahl, Timmer, (RIE, 2019).

Financial Openness (I)

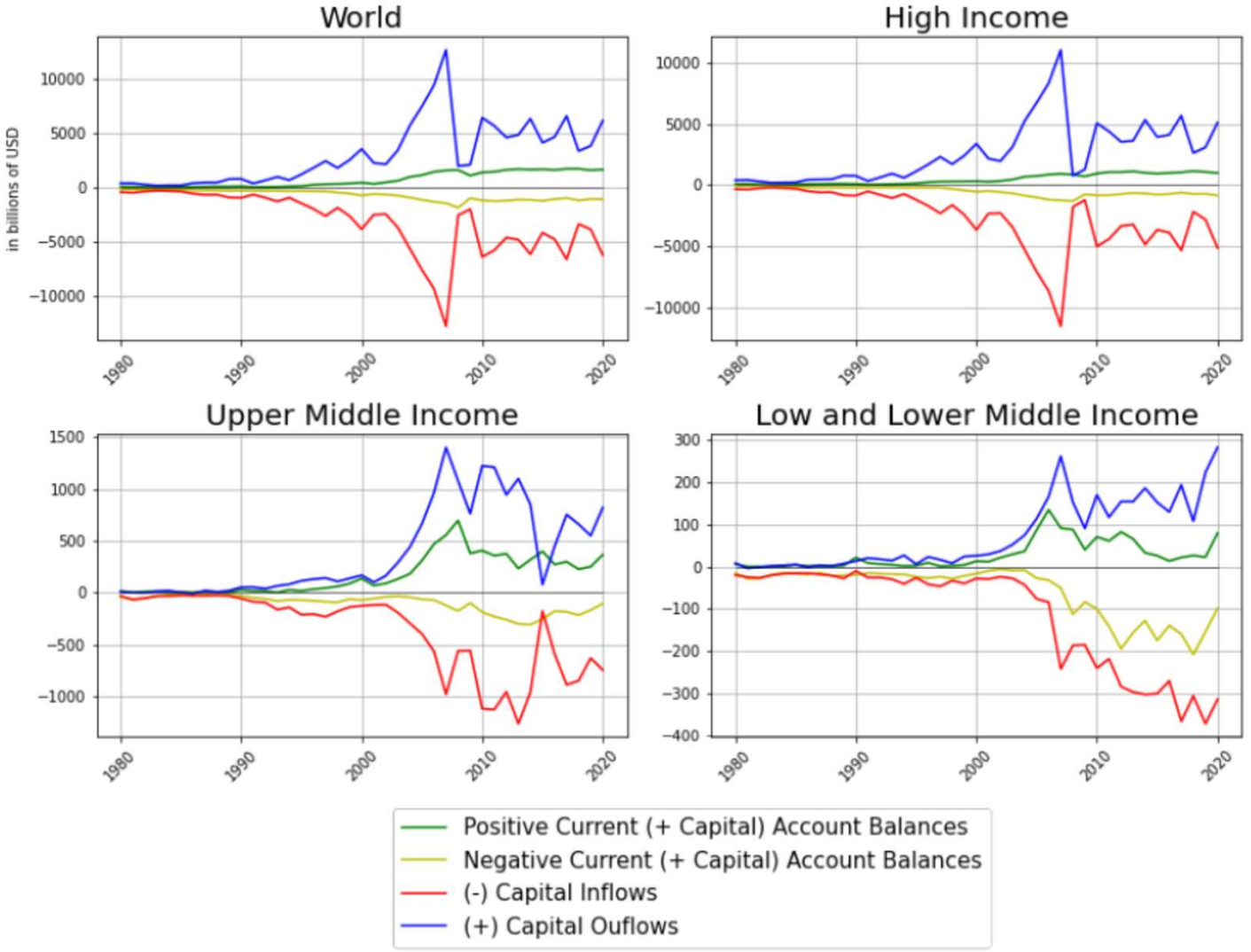


Figure 2: Global current account imbalances and financial flows across country groups, 1980-2020 (billions USD)

Obstfeld, Zhou (BPEA conf, 2022)

Financial Openness (II)

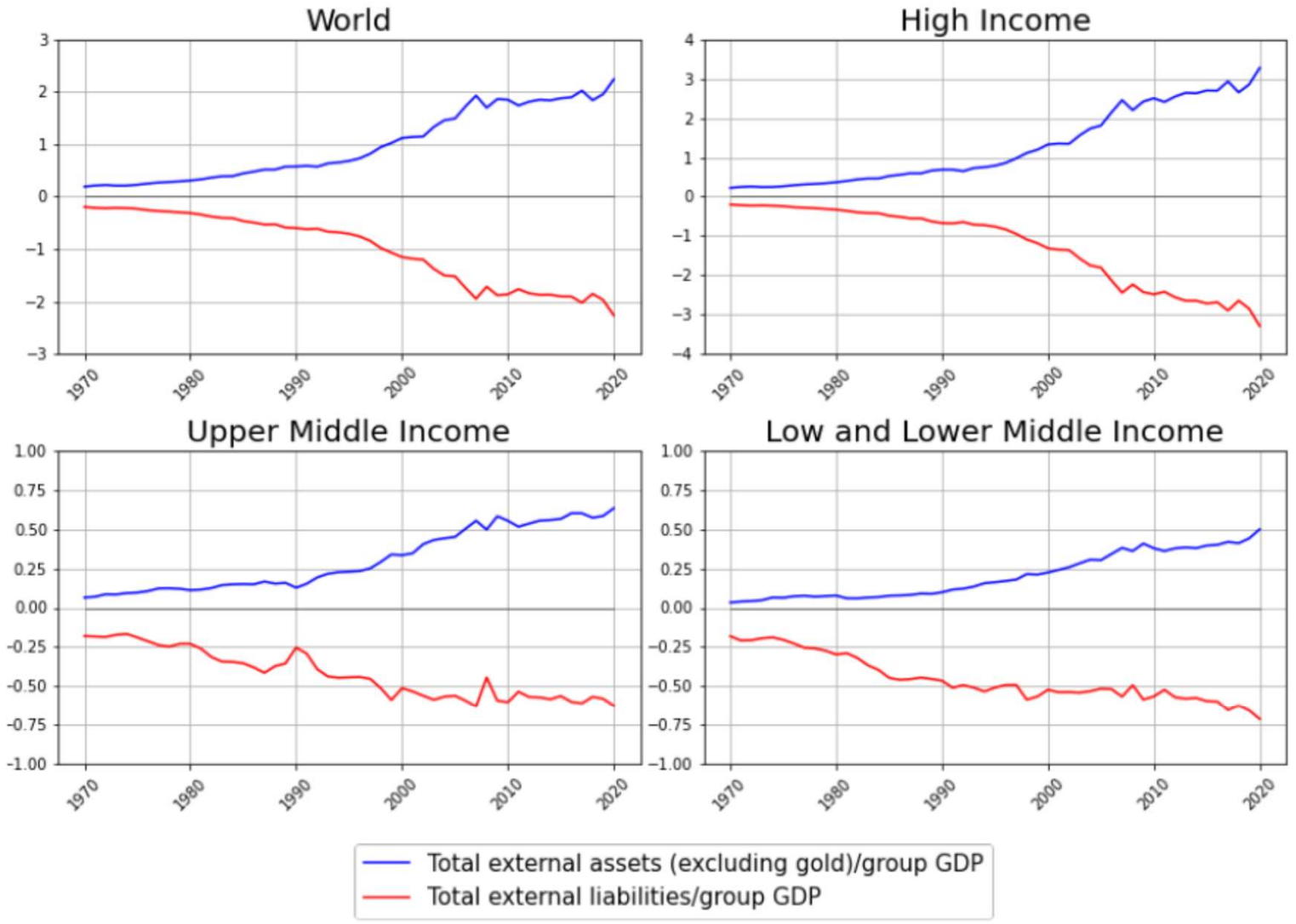
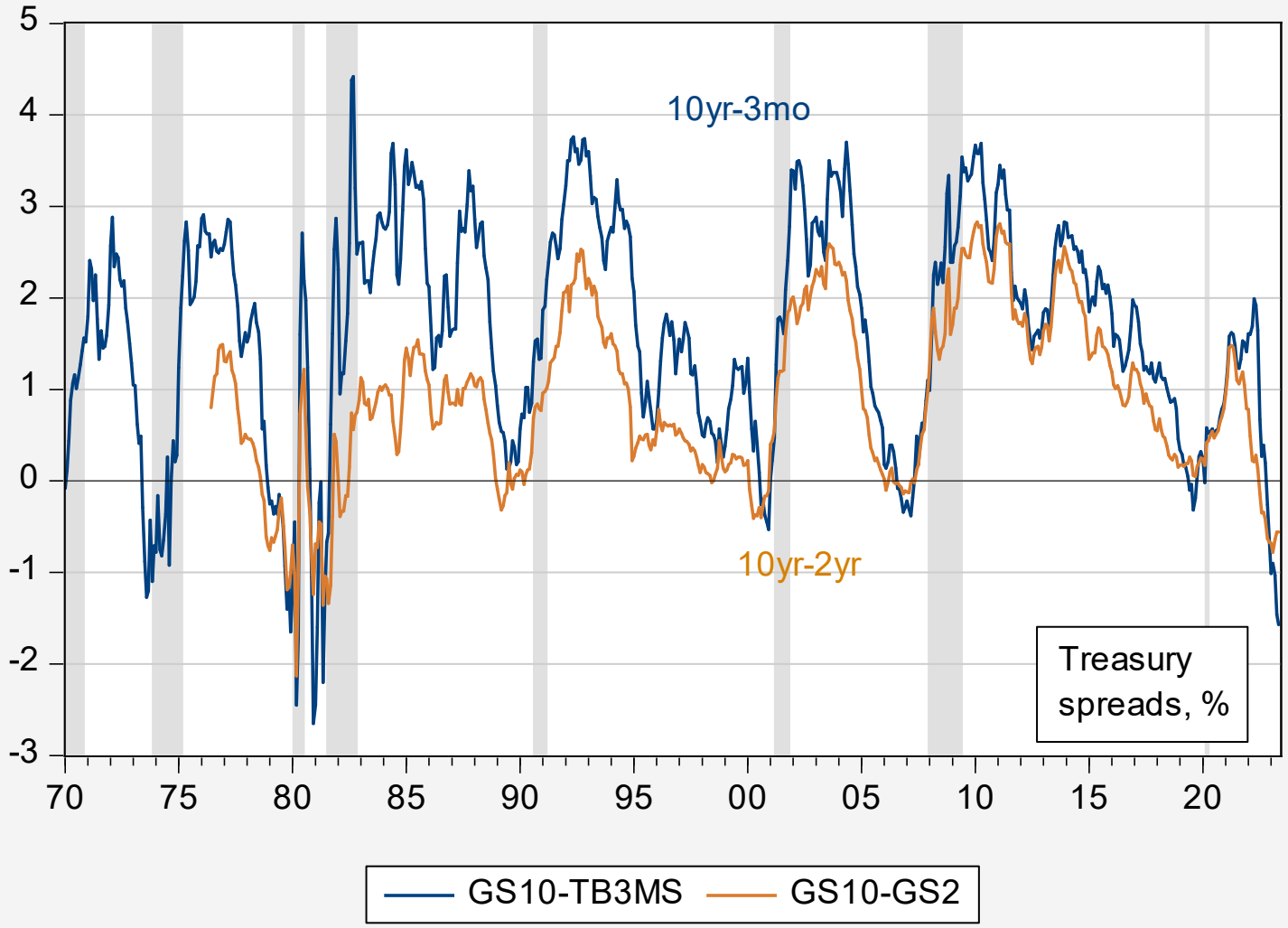


Figure 1: External asset and liability ratios to GDP across country groups, 1970-2020

Obstfeld, Zhou (BPEA conf, 2022)

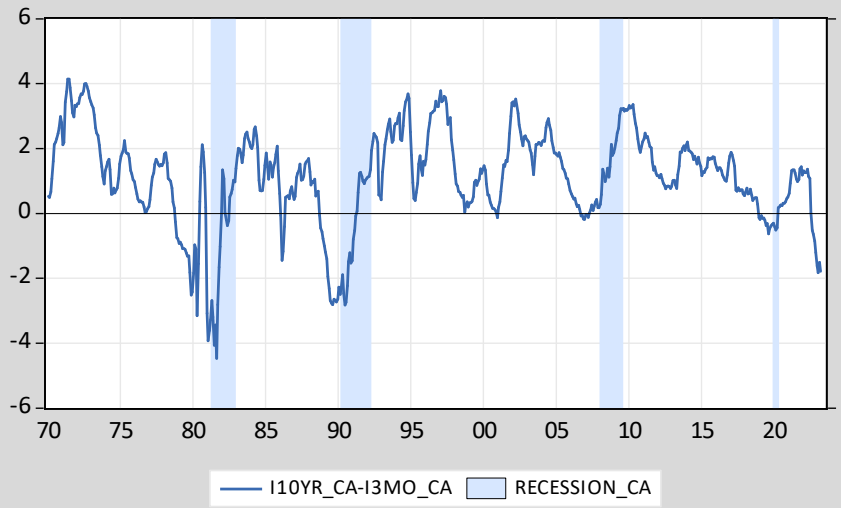
Business Cycle Prediction

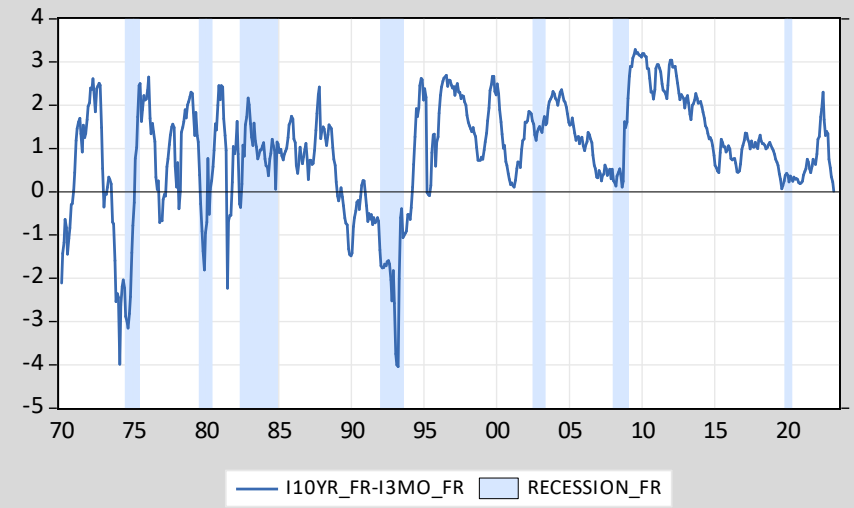
Domestic Financial Factors

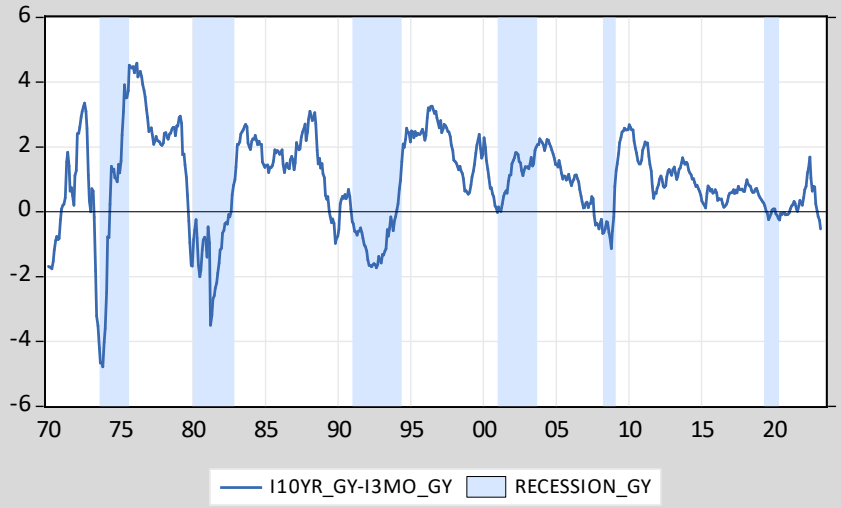


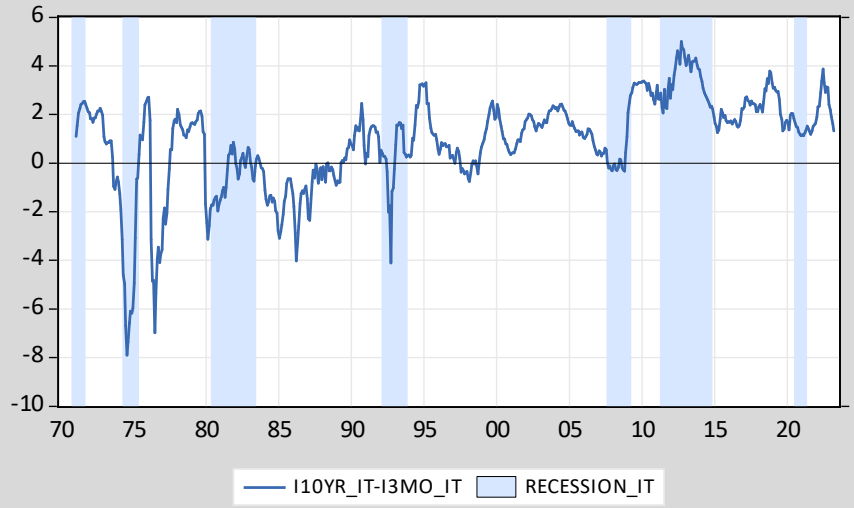
Data through 6/16/2023, NBER peak-to-trough, assumes no recessions through June 2023

Comparative



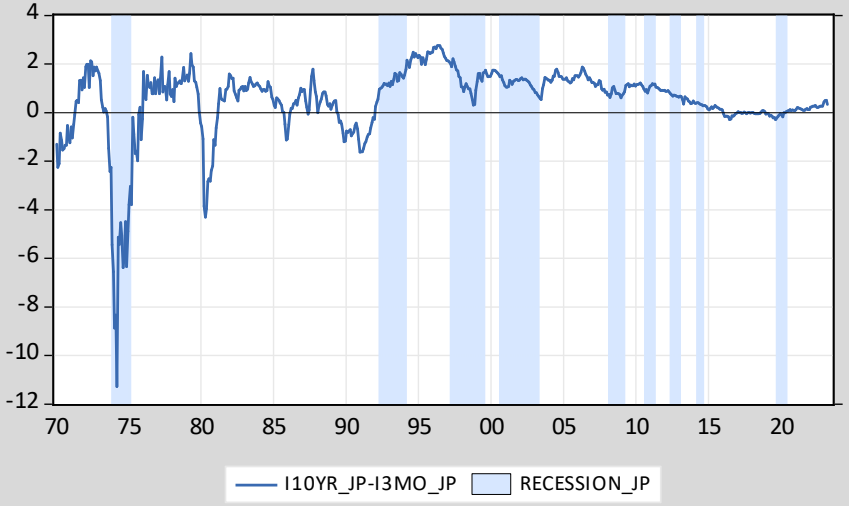


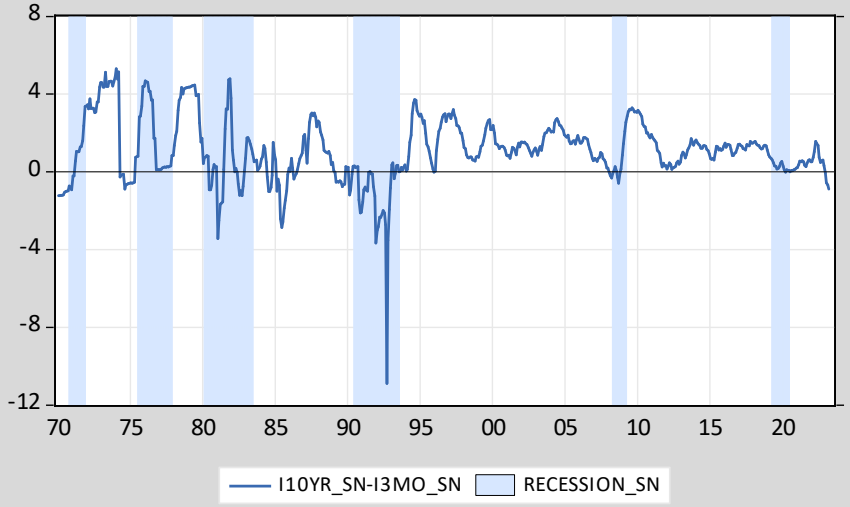


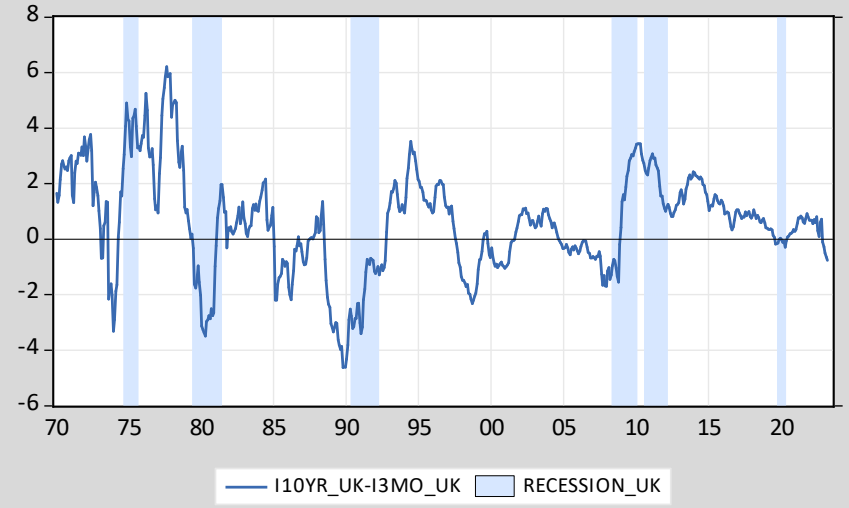


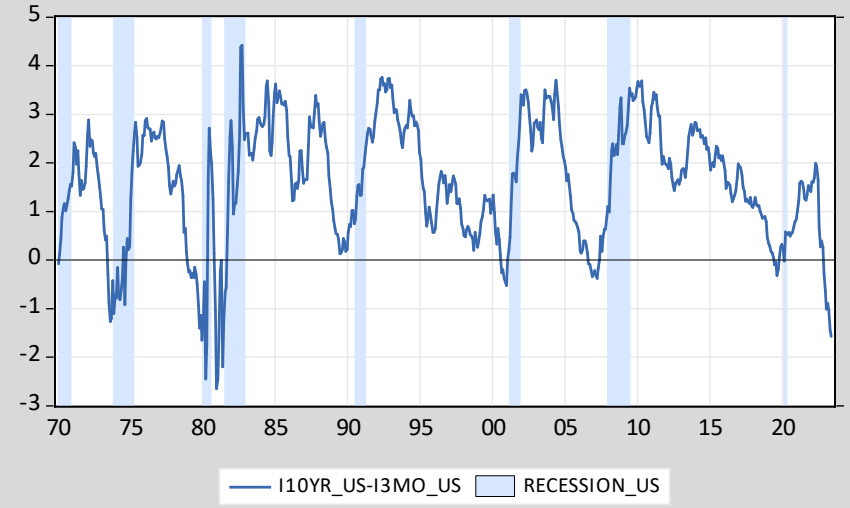
Assumes no recessions through June 2023. ECRI peak-to-trough recession dates

Theory









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Theory

Linkages between long and short-term rates:

- Expectations Hypothesis of the Term Structure

  Long term bond yield is the average of the one period interest rates expected over the lifetime of the long term bond

- Liquidity Premium Theory

  Allows that there will be supply and demand conditions that pertain specifically to bonds of that maturity

Theory

- Long term rates can be decomposed as:

$$i_t^n = \frac{i_t + i_{t+1}^e + \ldots + i_{t+n-1}^e}{n} + \ell_t^n$$

- Given $\ell^n > 0$ when do we observe an inverted yield spread?
- Short-term rates lower during slow economic growth
  - Monetary Policy
  - Decreased credit demand
- Hamilton & Kim (2002) note term premium also predicts slower growth

Literature

- U.S. yield curve signaling recession

  Harvey (1988,1989), Stock and Watson (1989), Estrella and Hardouvelis (1991), Hamilton and Kim (2002)
- Concurrent research expands data outside the U.S.

  Harvey (1991), Davis and Henry (1994), Estrella and Mishkin (1997), Bonser-Neal and Morley (1997)
- Measures of Economic Growth
  - GDP
  - IP
  - Unemployment

Literature

- Varying model specifications
  - Bi-variate
  - Probit: Estrella and Hardouvelis (1991), Wright (2006)
- Spread contains significant in-sample explanatory power
- Out-of-sample forecasting power is less convincing
- The relationship begins to deteriorate after 1985

Motivation

Questions:

- Has the deterioration since 1985 continued?
- What impact has the Euro had on financial linkages since late 1990s?
- Did the link between interest rates and output change during the “Great Moderation”
- Global savings glut hypothesis
- Zero lower bound in policy rates
- Impact of Quantitative Easing/Tightening
- International factors

Data for Chinn-Kucko

Country Selection Criteria

- Adequately represent the Euro Area
- Provide a basis of comparison
- Liquid financial markets
- Large sample size (covering the “Great Moderation” and maximizing number of observations)

Data

- Data set includes
  - Canada
  - France
  - Germany
  - Italy
  - Japan
  - The Netherlands
  - Sweden
  - The United Kingdom
  - The United States
  - Aggregate Euro Area (1990 - 2008)
- 10 year – 3 month
- IP vs GDP
- Recession Dates (NBER, ECRI)
- Data from 1970-2013, split sample at 1997/1998

OLS Model

- We begin with a simple bi-variate specification

$$IPGrowth_{t,t+k} = \beta_0 + \beta_1 Spread_t + \varepsilon_{t+k}$$

$$Spread_t \equiv i_t^{10yr} - i_t^{3mo}$$

- Growth over period *t+k* (monthly frequency)
- *k = 12, k= 24*
- Full sample, 1970-1997 sample, 1998-2013 sample

Industrial Production Growth

Table 1: Current Yield Spread as Predictor of Future IP Growth: Full Sample (1970–2013)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Neth.	(7) Sweden	(8) UK	(9) US
12-month growth									
Spread	1.81	1.22	1.52	0.85	1.23	1.03	0.99	0.69	1.14
	[0.23]***	[0.38]***	[0.30]***	[0.31]***	[0.47]***	[0.27]***	[0.41]**	[0.22]***	[0.22]***
Constant	0.079	−0.022	−0.059	0.84	1.26	0.26	−1.54	0.38	1.71
	[0.65]	[0.72]	[0.71]	[0.80]	[0.95]	[0.58]	[1.02]	[0.49]	[0.61]***
R^2	0.27	0.13	0.23	0.064	0.068	0.11	0.068	0.11	0.20
Observations	501	507	507	495	507	474	495	507	508
Durbin–Watson	0.142	0.245	0.314	0.272	0.133	0.848	0.351	0.286	0.069
White	0.004	0.031	0.001	0.776	0.813	0.050	0.209	0.738	0.002
24-month growth									
Spread	1.22	0.55	1.11	0.056	0.28	0.53	0.74	0.52	0.88
	[0.22]***	[0.24]**	[0.18]***	[0.21]	[0.33]	[0.13]***	[0.36]**	[0.14]***	[0.15]***
Constant	0.71	0.55	0.34	1.13	1.69	0.72	−2.28	0.49	1.85
	[0.58]	[0.55]	[0.48]	[0.58]	[0.74]**	[0.32]**	[1.07]**	[0.39]	[0.50]***
R^2	0.22	0.053	0.27	0.00065	0.0084	0.10	0.046	0.14	0.22
Observations	489	495	495	483	495	462	483	495	496
Durbin–Watson	0.070	0.134	0.202	0.149	0.080	0.743	0.133	0.155	0.048
White	0.001	0.000	0.000	0.323	0.406	0.731	0.002	0.025	0.000

IP Growth: Early

Table 2: Current Yield Spread as Predictor of Future IP Growth: Early Sample (1970–1997)

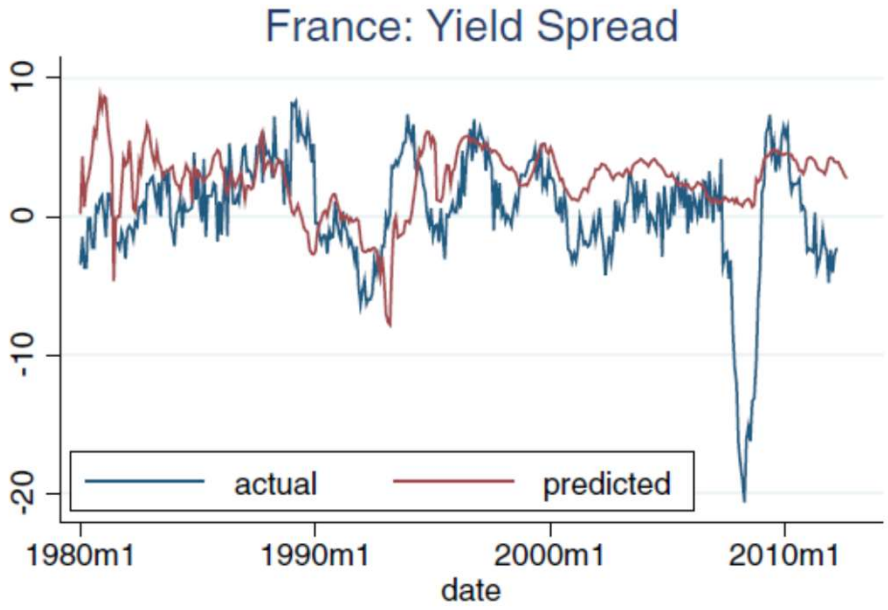
	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Neth.	(7) Sweden	(8) UK	(9) US
12-month growth									
Spread	2.00	1.63	1.15	1.28	1.47	0.91	0.55	0.68	1.37
	[0.21]***	[0.42]***	[0.22]***	[0.31]***	[0.47]***	[0.25]***	[0.35]	[0.24]***	[0.27]***
Constant	0.93	1.03	0.37	2.59	2.46	0.43	−1.14	1.12	2.68
	[0.60]	[0.63]	[0.61]	[0.80]***	[0.92]***	[0.58]	[1.00]	[0.58]	[0.61]***
R^2	0.41	0.29	0.25	0.18	0.21	0.12	0.035	0.12	0.34
Observations	336	336	336	324	336	303	324	336	336
Durbin–Watson	0.217	0.400	0.503	0.465	0.147	0.993	0.435	0.344	0.103
White	0.055	0.000	0.032	0.084	0.422	0.534	0.751	0.512	0.007
24-month growth									
Spread	1.29	0.71	0.89	0.26	0.52	0.48	0.41	0.50	0.98
	[0.21]***	[0.26]***	[0.16]***	[0.24]	[0.32]	[0.13]***	[0.38]	[0.13]***	[0.16]***
Constant	1.60	1.42	0.58	2.28	2.60	0.77	−2.30	1.22	2.79
	[0.52]***	[0.49]***	[0.46]	[0.58]***	[0.78]***	[0.35]**	[1.29]	[0.45]***	[0.49]***
R^2	0.33	0.12	0.33	0.021	0.049	0.11	0.019	0.16	0.33
Observations	336	336	336	324	336	303	324	336	336
Durbin–Watson	0.102	0.201	0.327	0.265	0.071	0.785	0.137	0.209	0.076
White	0.024	0.046	0.000	0.127	0.123	0.409	0.006	0.031	0.000

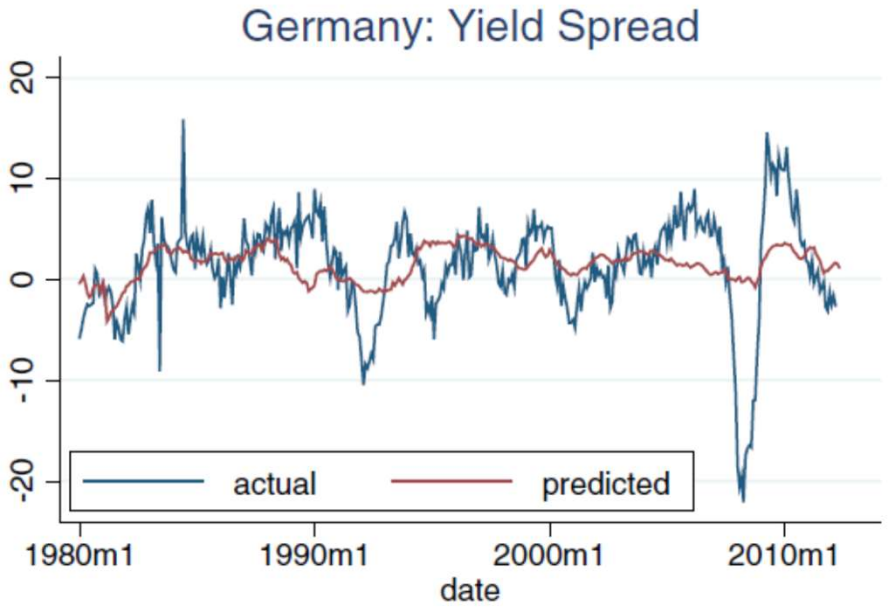
IP Growth: Later

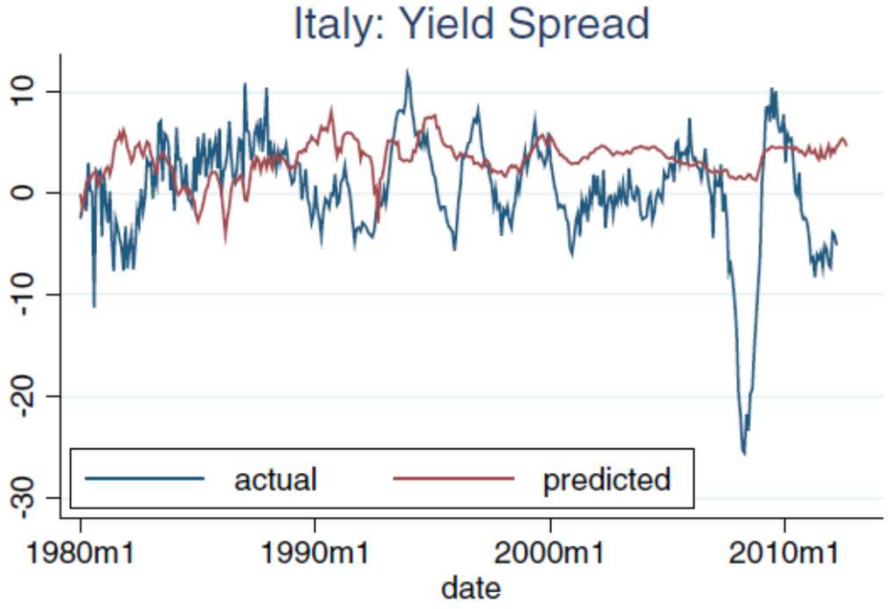
Table 3: Current Yield Spread as Predictor of Future IP Growth: Late Sample (1998–2013)

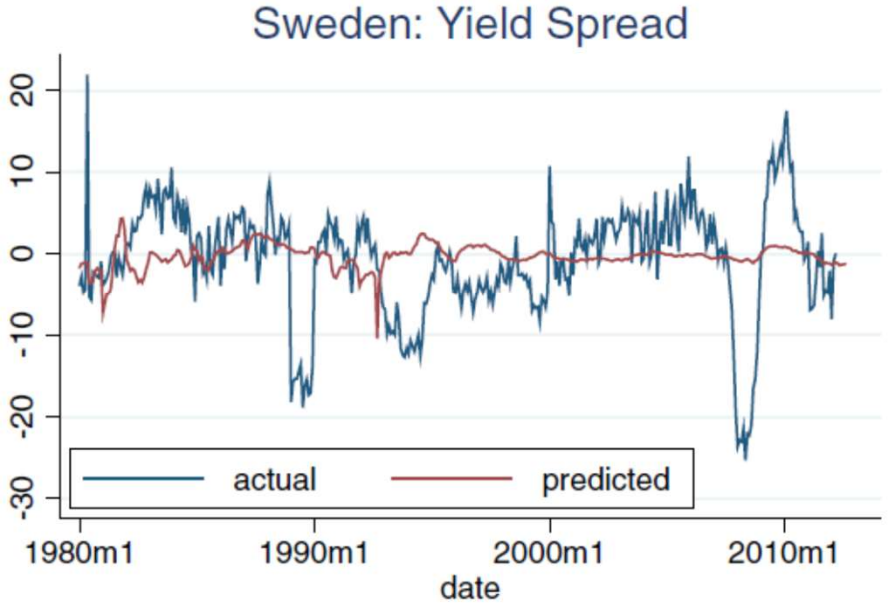
	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Neth.	(7) Sweden	(8) UK	(9) US
12-month growth									
Spread	1.60	2.45	5.04	2.57	5.86	1.95	6.04	0.44	1.19
	[0.89]	[1.26]	[1.40]***	[1.49]	[5.92]	[1.19]	[1.67]***	[0.53]	[0.50]**
Constant	−1.75	−4.49	−4.25	−5.01	−6.74	−0.99	−8.51	−0.99	−0.38
	[2.27]	[2.72]	[2.22]	[3.00]	[8.53]	[2.01]	[3.00]***	[0.78]	[1.48]
R^2	0.10	0.21	0.46	0.19	0.035	0.13	0.45	0.041	0.14
Observations	165	171	171	171	171	171	171	171	172
Durbin–Watson	0.082	0.202	0.233	0.142	0.152	0.611	0.386	0.178	0.059
White	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
24-month growth									
Spread	1.54	2.24	3.21	1.77	0.30	0.93	4.59	0.24	1.32
	[0.81]	[0.81]***	[0.72]***	[1.03]	[2.90]	[0.47]	[0.89]***	[0.38]	[0.43]***
Constant	−1.90	−4.04	−2.16	−3.60	−0.40	0.20	−7.16	−0.97	−0.73
	[1.97]	[1.70]**	[1.32]	[2.11]	[4.20]	[0.85]	[1.98]***	[0.55]	[1.14]
R^2	0.18	0.34	0.42	0.19	0.00030	0.11	0.43	0.026	0.34
Observations	153	159	159	159	159	159	159	159	160
Durbin–Watson	0.054	0.166	0.146	0.074	0.117	0.665	0.200	0.104	0.056
White	0.000	0.000	0.007	0.000	0.016	0.037	0.026	0.000	0.000

Out-of-Sample Forecasts









Rolling regressions, 1970-79, out-of-sample 1980-2013

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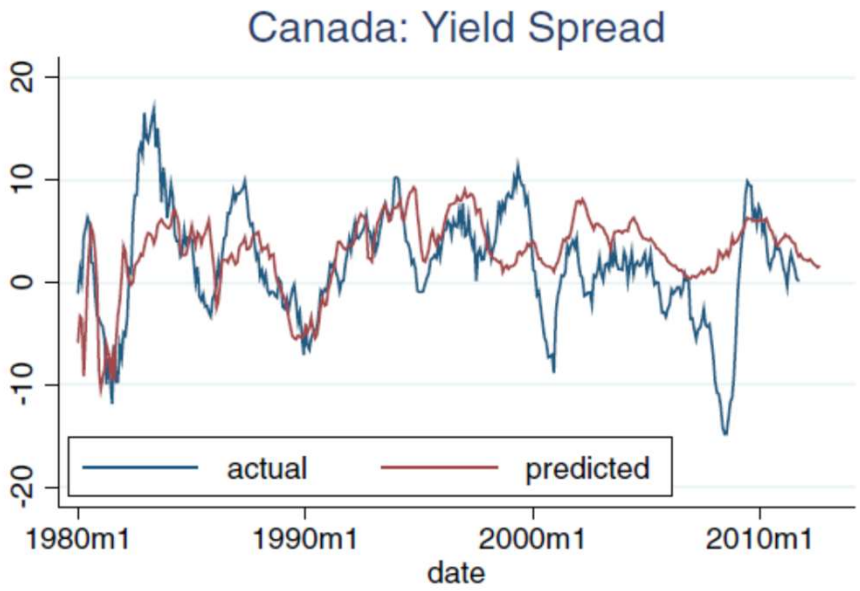

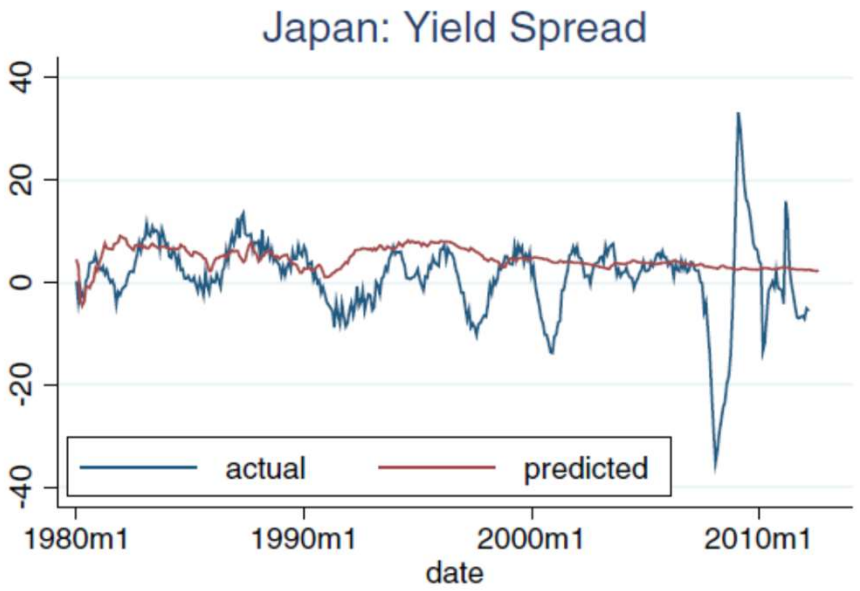

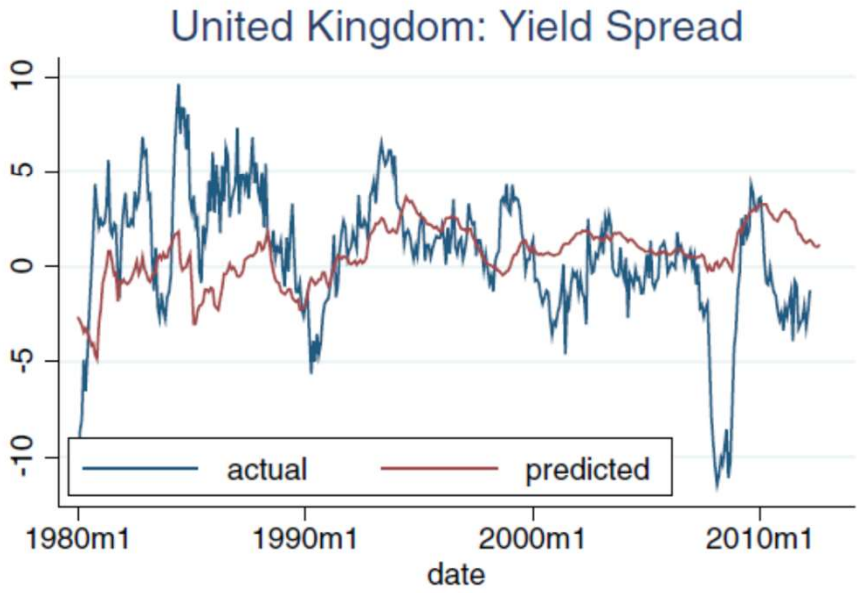

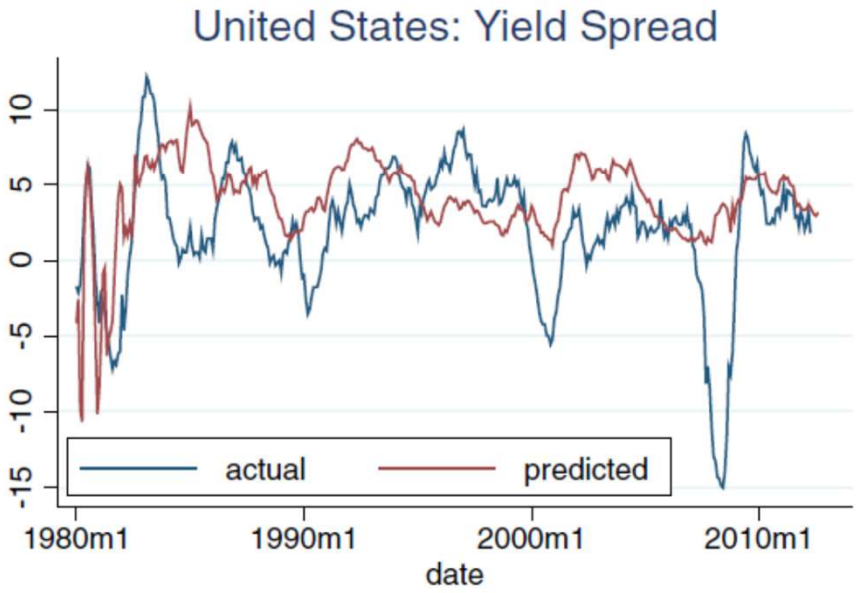

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Table 4: Historical Ex Post-Simulation: MSE

	AR1	Spread	Spread and AR1	Spread and 3-Mo	Spread, 3-Mo and AR1
Canada	33.10	25.25	22.83	20.74	20.64
D-M Stat*	.	0.0601	0.0106	0.0189	0.0179
France	20.43	22.33	16.57	16.27	16.30
	.	0.445	0.242	0.213	0.253
Germany	27.37	21.49	19.46	20.22	19.49
	.	0.0404	0.0755	0.0408	0.0656
Italy	37.03	39.54	30.69	30.26	30.22
	.	0.544	0.250	0.259	0.225
Japan	58.85	66.56	52.81	54.20	48.80
	.	0.0260	0.279	0.369	0.323
Netherlands	20.32	20.24	16.86	19.65	16.80
	.	0.974	0.0959	0.789	0.114
Sweden	52.54	50.68	46.94	46.88	46.81
	.	0.558	0.281	0.256	0.263
UK	16.33	13.60	12.21	11.57	11.66
	.	0.413	0.211	0.123	0.134
US	20.76	20.86	15.92	15.81	15.71
	.	0.976	0.0374	0.0607	0.0574

Notes: Each column displays RMSE from a separate forecasting model of IP growth using the column headers as explanatory variables. Diebold–Mariano statistic is the *P*-value for equal forecasting power.

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UK	16.33	13.60	12.21	11.57	11.66
	.	0.413	0.211	0.123	0.134
US	20.76	20.86	15.92	15.81	15.71
	.	0.976	0.0374	0.0607	0.0574

Notes: Each column displays RMSE from a separate forecasting model of IP growth using the column headers as explanatory variables. Diebold–Mariano statistic is the *P*-value for equal forecasting power.

Rolling regressions, 1970-79, out-of-sample 1980-2013

Yield Curve and Recessions

- Use yield curve data to predict a future recession
- Wright (2006) argued that when predicting recessions the short term rate adds predictive power
- Our Probit Models:

$$\Pr(R_{t+1,t+k}) = \phi(\beta_o + \beta_1 Spread_t)$$

$$\Pr(R_{t+1,t+k}) = \phi(\beta_o + \beta_1 Spread_t + \beta_2 3mo_t)$$

  - Where the recession indicator equals one if there is a recession in any month between *t+1* and *t+k* , inclusive.
  - Recessions defined by NBER for the United States and by the ECRI for non-US countries.

Recession

Table 5: Current Yield Spread as Predictor of Future Recession: Full Sample (1970–2013)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
Next 6 months								
Spread	−0.39	−0.37	−0.68	−0.094	−0.059	−0.29	−0.067	−0.46
	[0.11]***	[0.091]***	[0.17]***	[0.093]	[0.095]	[0.12]**	[0.10]	[0.085]**
Constant	−0.73	−0.43	0.11	−0.51	−0.42	−0.21	−0.68	−0.64
	[0.23]***	[0.19]**	[0.23]	[0.19]***	[0.18]**	[0.19]	[0.19]***	[0.19]***
R^2	0.18	0.12	0.34	0.016	0.0045	0.10	0.0094	0.27
Observations	519	519	509	505	519	519	519	519
Next 12 months								
Spread	−0.49	−0.44	−0.63	−0.053	−0.020	−0.29	−0.11	−0.69
	[0.12]***	[0.10]***	[0.15]***	[0.089]	[0.099]	[0.13]**	[0.099]	[0.12]***
Constant	−0.50	−0.14	0.31	−0.36	−0.23	−0.047	−0.51	−0.29
	[0.22]**	[0.20]	[0.24]	[0.19]	[0.18]	[0.19]	[0.19]***	[0.20]
R^2	0.24	0.15	0.29	0.0050	0.00051	0.11	0.025	0.38
Observations	519	519	509	505	519	519	519	519

Recession

Table 5: Current Yield Spread as Predictor of Future Recession: Full Sample (1970–2013)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
Next 6 months								
Spread	−0.39	−0.37	−0.68	−0.094	−0.059	−0.29	−0.067	−0.46
	[0.11]***	[0.091]***	[0.17]***	[0.093]	[0.095]	[0.12]**	[0.10]	[0.085]**
Constant	−0.73	−0.43	0.11	−0.51	−0.42	−0.21	−0.68	−0.64
	[0.23]***	[0.19]**	[0.23]	[0.19]***	[0.18]**	[0.19]	[0.19]***	[0.19]***
R^2	0.18	0.12	0.34	0.016	0.0045	0.10	0.0094	0.27
Observations	519	519	509	505	519	519	519	519
Next 12 months								
Spread	−0.49	−0.44	−0.63	−0.053	−0.020	−0.29	−0.11	−0.69
	[0.12]***	[0.10]***	[0.15]***	[0.089]	[0.099]	[0.13]**	[0.099]	[0.12]***
Constant	−0.50	−0.14	0.31	−0.36	−0.23	−0.047	−0.51	−0.29
	[0.22]**	[0.20]	[0.24]	[0.19]	[0.18]	[0.19]	[0.19]***	[0.20]
R^2	0.24	0.15	0.29	0.0050	0.00051	0.11	0.025	0.38
Observations	519	519	509	505	519	519	519	519

Recession

Table 5: Current Yield Spread as Predictor of Future Recession: Full Sample (1970–2013)

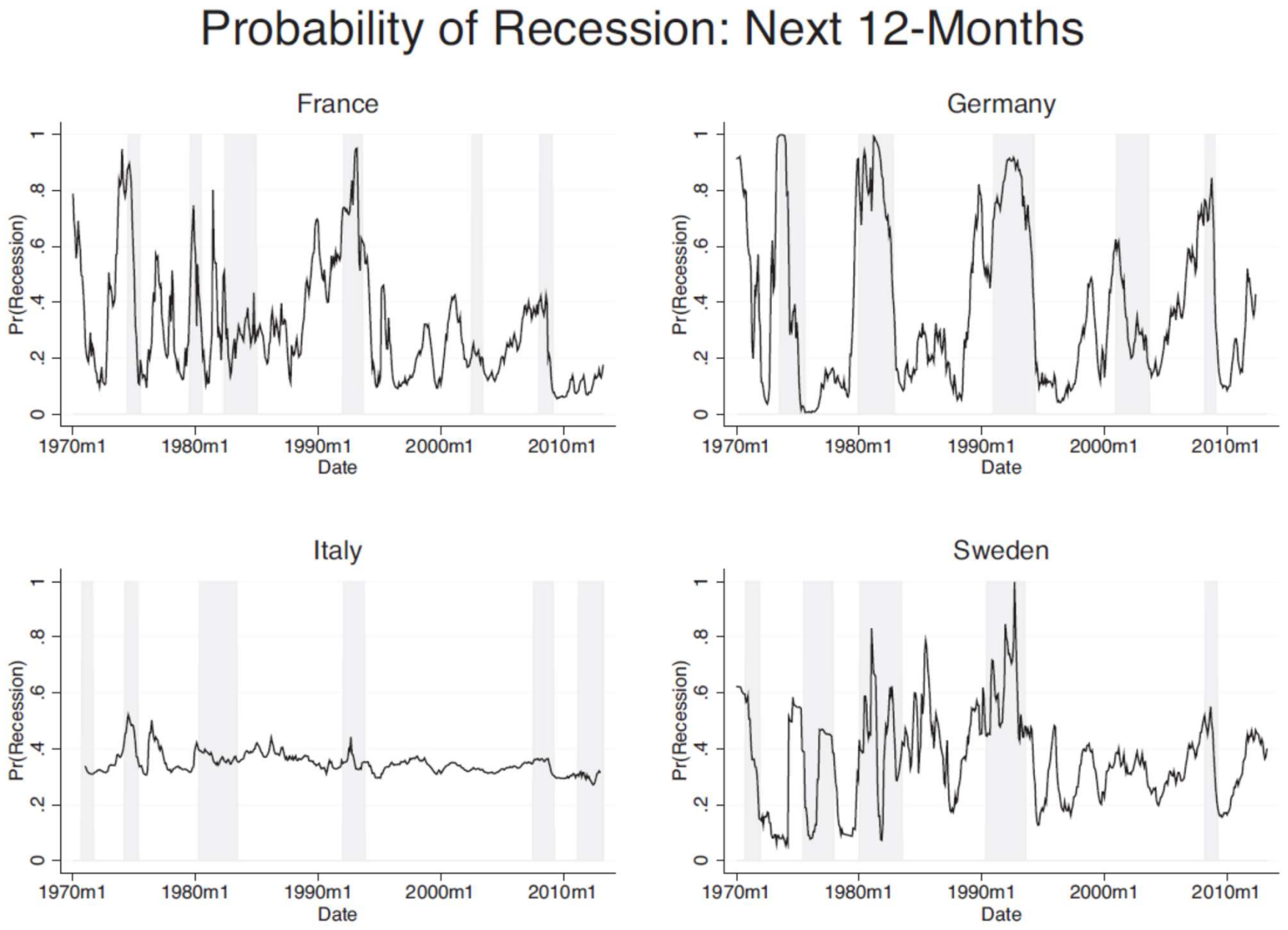
	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
Next 6 months								
Spread	−0.39	−0.37	−0.68	−0.094	−0.059	−0.29	−0.067	−0.46
	[0.11]***	[0.091]***	[0.17]***	[0.093]	[0.095]	[0.12]**	[0.10]	[0.085]**
Constant	−0.73	−0.43	0.11	−0.51	−0.42	−0.21	−0.68	−0.64
	[0.23]***	[0.19]**	[0.23]	[0.19]***	[0.18]**	[0.19]	[0.19]***	[0.19]***
R^2	0.18	0.12	0.34	0.016	0.0045	0.10	0.0094	0.27
Observations	519	519	509	505	519	519	519	519
Next 12 months								
Spread	−0.49	−0.44	−0.63	−0.053	−0.020	−0.29	−0.11	−0.69
	[0.12]***	[0.10]***	[0.15]***	[0.089]	[0.099]	[0.13]**	[0.099]	[0.12]***
Constant	−0.50	−0.14	0.31	−0.36	−0.23	−0.047	−0.51	−0.29
	[0.22]**	[0.20]	[0.24]	[0.19]	[0.18]	[0.19]	[0.19]***	[0.20]
R^2	0.24	0.15	0.29	0.0050	0.00051	0.11	0.025	0.38
Observations	519	519	509	505	519	519	519	519

Recession

Table 6: Current Yield Spread as Predictor of Future Recession: Full Sample (1970-2013)

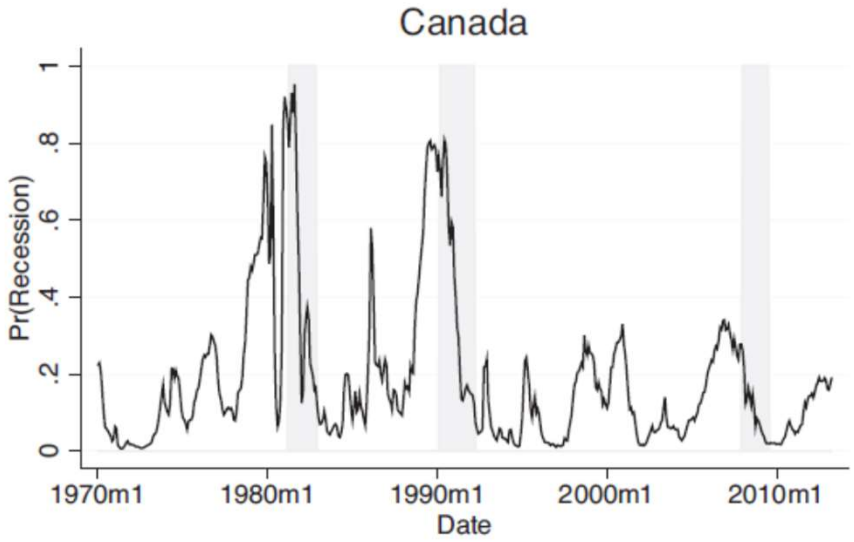
	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
Next 6 months								
Spread	−0.33	−0.22	−0.51	−0.025	−0.74	−0.11	−0.036	−0.46
	[0.15]**	[0.13]	[0.21]**	[0.12]	[0.16]***	[0.14]	[0.095]	[0.12]***
Three-month	0.031	0.096	0.12	0.036	−0.37	0.14	0.029	−0.0036
	[0.090]	[0.066]	[0.098]	[0.044]	[0.072]***	[0.057]**	[0.063]	[0.083]
Constant	−1.00	−1.26	−0.68	−0.88	1.25	−1.42	−0.93	−0.62
	[0.85]	[0.62]**	[0.70]	[0.49]	[0.35]***	[0.52]***	[0.60]	[0.66]
R^2	0.18	0.16	0.35	0.028	0.26	0.19	0.015	0.27
Observations	519	519	509	505	519	519	519	519
Next 12 months								
Spread	−0.44	−0.28	−0.44	0.0044	−0.70	−0.12	−0.070	−0.68
	[0.16]***	[0.14]**	[0.18]**	[0.12]	[0.15]***	[0.14]	[0.094]	[0.13]***
Three-month	0.022	0.100	0.15	0.030	−0.37	0.13	0.041	0.00082
	[0.086]	[0.059]	[0.088]	[0.043]	[0.073]***	[0.057]**	[0.062]	[0.079]
Constant	−0.69	−1.00	−0.66	−0.67	1.53	−1.18	−0.86	−0.29
	[0.80]	[0.58]	[0.61]	[0.48]	[0.38]***	[0.50]**	[0.60]	[0.65]
R^2	0.24	0.19	0.32	0.013	0.27	0.18	0.036	0.38
Observations	519	519	509	505	519	519	519	519

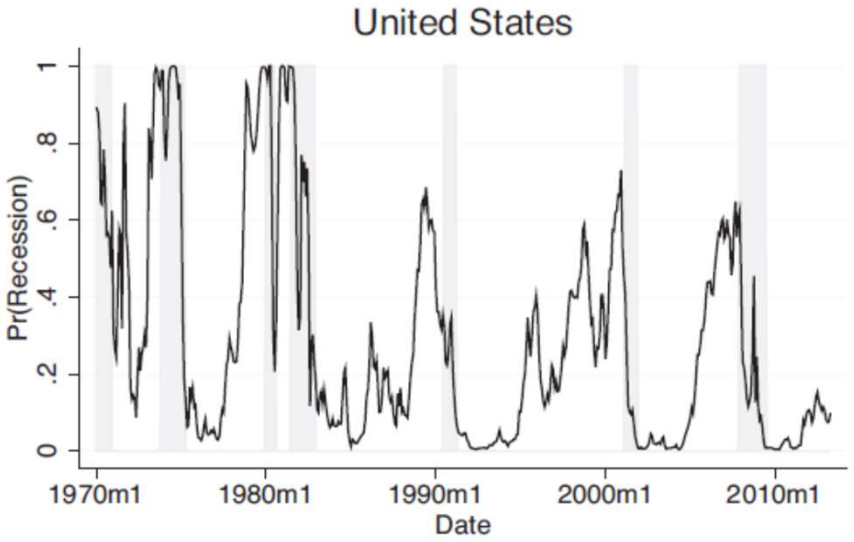
Probit Results

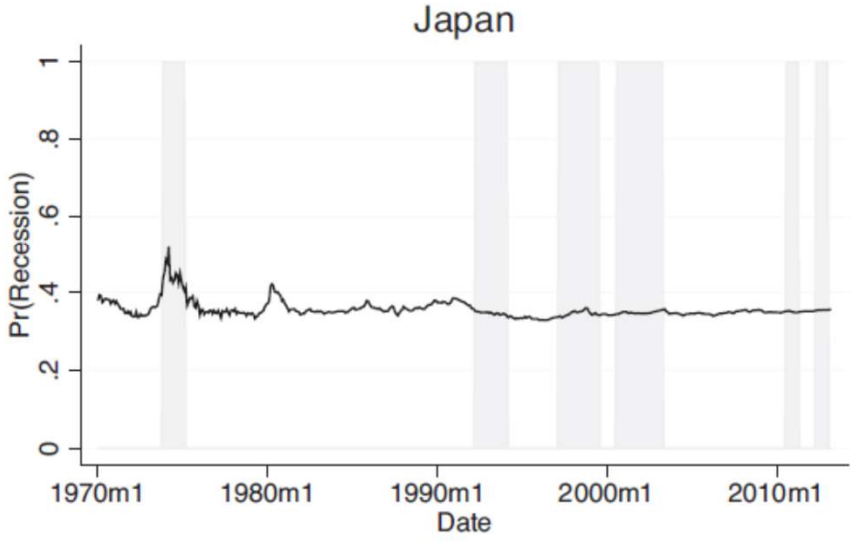


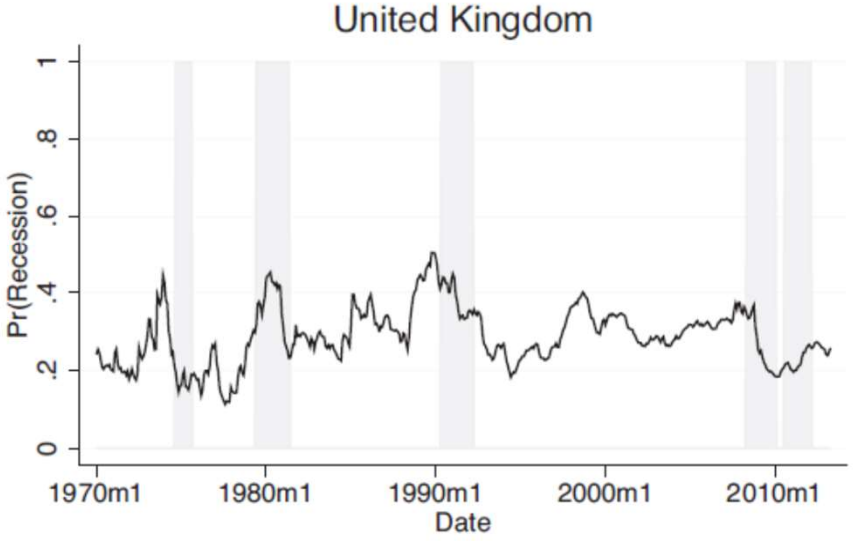
Probit Results

Probability of Recession: Next 12-Months









Conclusion

- In-sample IP growth results: yield spread has significant predictive power when forecasting IP growth over a one-year time horizon.
- Predictive power for one-year growth is much weaker in the more recent period examined
- 4 out of 6 European models exhibited relatively high R-squared statistics when using data from 1998-2008

Conclusion

- Out of sample forecasting: less convincing
  - Beat AR1: Germany, Sweden and France
- Stability of parameters in doubt?
  - Japan: ZIRP
  - US: Global Savings Glut
  - EU: monetary union effect not evident
- Forecasting performance unchanged relative to real time data
- U.S. v Non-U.S. Probit Results for Recessions
- No simple story
  - Clearly possesses some forecasting power
  - Perhaps most evident in the U.S.
  - Declining over time?

Other Factors

- Credit risk

  Gilchrist and Zakrajsek (AER, 2012)

- Financial Conditions Indexes

  Hatzius, Hooper, Mishkin, Schoenholtz, Watson (2010, NBER WP 16150)

- "Financial Cycle"

  - Borio, Drehmann, Xia (J. Macro, 2020)

Other Factors - US

Dependent Variable: RECESSIONLEAD12_US
Method: ML - Binary Probit (Newton-Raphson / Marquardt steps)
Date: 06/23/23 Time: 21:06
Sample: 1973M01 2022M02
Included observations: 590
Convergence achieved after 7 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.842925	0.193965	-4.345765	0.0000
SPREAD_US	-60.33713	7.768568	-7.766828	0.0000
I3MO_US/100	7.565210	2.445654	3.093328	0.0020

McFadden R-squared	0.317936	Mean dependent var	0.133898
S.D. dependent var	0.340832	S.E. of regression	0.286521
Akaike info criterion	0.547268	Sum squared resid	48.18922
Schwarz criterion	0.569540	Log likelihood	-158.4442
Hannan-Quinn criter.	0.555945	Deviance	316.8883
Restr. deviance	464.6021	Restr. log likelihood	-232.3011
LR statistic	147.7138	Avg. log likelihood	-0.268549
Prob(LR statistic)	0.000000		

Obs with Dep=0	511	Total obs	590
Obs with Dep=1	79		

Dependent Variable: RECESSIONLEAD12_US
Method: ML - Binary Probit (Newton-Raphson / Marquardt steps)
Date: 06/23/23 Time: 21:07
Sample: 1973M01 2022M02
Included observations: 590
Convergence achieved after 7 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.842383	0.198831	-4.236687	0.0000
SPREAD_US	-63.92884	8.145374	-7.848485	0.0000
I3MO_US/100	7.002641	2.490293	2.811975	0.0049
EBP/100	47.03399	13.62145	3.452937	0.0006

McFadden R-squared	0.341017	Mean dependent var	0.133898
S.D. dependent var	0.340832	S.E. of regression	0.285756
Akaike info criterion	0.532483	Sum squared resid	47.85084
Schwarz criterion	0.562179	Log likelihood	-153.0824
Hannan-Quinn criter.	0.544052	Deviance	306.1649
Restr. deviance	464.6021	Restr. log likelihood	-232.3011
LR statistic	158.4372	Avg. log likelihood	-0.259462
Prob(LR statistic)	0.000000		

Obs with Dep=0	511	Total obs	590
Obs with Dep=1	79		

Other Factors - US

Dependent Variable: RECESSIONLEAD12_US
Method: ML - Binary Probit (Newton-Raphson / Marquardt steps)
Date: 06/23/23 Time: 21:06
Sample: 1973M01 2022M02
Included observations: 590
Convergence achieved after 7 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.842925	0.193965	-4.345765	0.0000
SPREAD_US	-60.33713	7.768568	-7.766828	0.0000
I3MO_US/100	7.565210	2.445654	3.093328	0.0020

McFadden R-squared	0.317936	Mean dependent var	0.133898
S.D. dependent var	0.340832	S.E. of regression	0.286521
Akaike info criterion	0.547268	Sum squared resid	48.18922
Schwarz criterion	0.569540	Log likelihood	-158.4442
Hannan-Quinn criter.	0.555945	Deviance	316.8883
Restr. deviance	464.6021	Restr. log likelihood	-232.3011
LR statistic	147.7138	Avg. log likelihood	-0.268549
Prob(LR statistic)	0.000000		

Obs with Dep=0	511	Total obs	590
Obs with Dep=1	79		

Dependent Variable: RECESSIONLEAD12_US
Method: ML - Binary Probit (Newton-Raphson / Marquardt steps)
Date: 06/23/23 Time: 21:08
Sample: 1973M01 2022M02
Included observations: 590
Convergence achieved after 7 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.812070	0.208213	-3.900195	0.0001
SPREAD_US	-59.83418	7.869095	-7.603692	0.0000
I3MO_US/100	6.772835	3.139821	2.157077	0.0310
NFCI_US	0.036594	0.091291	0.400853	0.6885

McFadden R-squared	0.318279	Mean dependent var	0.133898
S.D. dependent var	0.340832	S.E. of regression	0.287692
Akaike info criterion	0.550388	Sum squared resid	48.50127
Schwarz criterion	0.580084	Log likelihood	-158.3645
Hannan-Quinn criter.	0.561957	Deviance	316.7291
Restr. deviance	464.6021	Restr. log likelihood	-232.3011
LR statistic	147.8731	Avg. log likelihood	-0.268414
Prob(LR statistic)	0.000000		

Obs with Dep=0	511	Total obs	590
Obs with Dep=1	79		

Other Factors - US

Dependent Variable: RECESSIONLEAD12_US
Method: ML - Binary Probit (Newton-Raphson / Marquardt steps)
Date: 06/23/23 Time: 22:19
Sample: 1985M01 2022M02
Included observations: 446
Convergence achieved after 8 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.756662	0.264369	-2.862149	0.0042
SPREAD_US	-78.01093	13.24782	-5.888587	0.0000
I3MO_US/100	9.076506	4.439123	2.044662	0.0409

McFadden R-squared	0.284421	Mean dependent var	0.089686
S.D. dependent var	0.286052	S.E. of regression	0.247122
Akaike info criterion	0.445392	Sum squared resid	27.05379
Schwarz criterion	0.472973	Log likelihood	-96.32250
Hannan-Quinn criter.	0.456267	Deviance	192.6450
Restr. deviance	269.2154	Restr. log likelihood	-134.6077
LR statistic	76.57039	Avg. log likelihood	-0.215970
Prob(LR statistic)	0.000000		

Obs with Dep=0	406	Total obs	446
Obs with Dep=1	40		

Dependent Variable: RECESSIONLEAD12_US
Method: ML - Binary Probit (Newton-Raphson / Marquardt steps)
Date: 06/23/23 Time: 21:09
Sample (adjusted): 1985M01 2022M02
Included observations: 446 after adjustments
Convergence achieved after 8 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-15.85042	2.219607	-7.141094	0.0000
SPREAD_US	-112.1891	19.05168	-5.888673	0.0000
I3MO_US/100	-30.72439	8.174237	-3.758686	0.0002
DSR_US/100	102.1161	14.51468	7.035371	0.0000

McFadden R-squared	0.554054	Mean dependent var	0.089686
S.D. dependent var	0.286052	S.E. of regression	0.201574
Akaike info criterion	0.287120	Sum squared resid	17.95930
Schwarz criterion	0.323894	Log likelihood	-60.02782
Hannan-Quinn criter.	0.301620	Deviance	120.0556
Restr. deviance	269.2154	Restr. log likelihood	-134.6077
LR statistic	149.1597	Avg. log likelihood	-0.134592
Prob(LR statistic)	0.000000		

Obs with Dep=0	406	Total obs	446
Obs with Dep=1	40		

Other Factors - US

Dependent Variable: RECESSIONLEAD12_US
Method: ML - Binary Probit (Newton-Raphson / Marquardt steps)
Date: 06/23/23 Time: 22:19
Sample: 1985M01 2022M02
Included observations: 446
Convergence achieved after 8 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.756662	0.264369	-2.862149	0.0042
SPREAD_US	-78.01093	13.24782	-5.888587	0.0000
I3MO_US/100	9.076506	4.439123	2.044662	0.0409

McFadden R-squared	0.284421	Mean dependent var	0.089686
S.D. dependent var	0.286052	S.E. of regression	0.247122
Akaike info criterion	0.445392	Sum squared resid	27.05379
Schwarz criterion	0.472973	Log likelihood	-96.32250
Hannan-Quinn criter.	0.456267	Deviance	192.6450
Restr. deviance	269.2154	Restr. log likelihood	-134.6077
LR statistic	76.57039	Avg. log likelihood	-0.215970
Prob(LR statistic)	0.000000		

Obs with Dep=0	406	Total obs	446
Obs with Dep=1	40		

Dependent Variable: RECESSIONLEAD12_US
Method: ML - Binary Probit (Newton-Raphson / Marquardt steps)
Date: 06/23/23 Time: 21:11
Sample (adjusted): 1985M01 2022M02
Included observations: 446 after adjustments
Convergence achieved after 9 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-13.64960	2.496076	-5.468422	0.0000
SPREAD_US	-138.7440	27.12480	-5.115024	0.0000
I3MO_US/100	-27.95959	8.366451	-3.341869	0.0008
EBP/100	-8.643642	35.45915	-0.243763	0.8074
NFCI_US	0.723395	0.572723	1.263080	0.2066
DSR_US/100	90.23081	15.81868	5.704068	0.0000

McFadden R-squared	0.569116	Mean dependent var	0.089686
S.D. dependent var	0.286052	S.E. of regression	0.198275
Akaike info criterion	0.286997	Sum squared resid	17.29763
Schwarz criterion	0.342158	Log likelihood	-58.00027
Hannan-Quinn criter.	0.308746	Deviance	116.0005
Restr. deviance	269.2154	Restr. log likelihood	-134.6077
LR statistic	153.2148	Avg. log likelihood	-0.130045
Prob(LR statistic)	0.000000		

Obs with Dep=0	406	Total obs	446
Obs with Dep=1	40		

Updating across Countries

- Probit for recessions
- Industrial production growth

Foreign Term Spread

- Ahmed & Chinn (2022) find foreign term spread is better predictor of US recessions than US term spread
- This counter-intuitive result is fairly robust
- Would be unsurprising that foreign financial variable would be influential (e.g., Agrippina and Rey thesis global financial cycle, and US monetary policy).
- However, surprising that it's true for US recessions
- And for CA, IT, SN, UK

Probit: Recessions 1970-2021M05

coefficient	CA	FR	GY	IT	JP	SN	UK	US
constant	**7.444**	**-13.796**	**-7.778**	**-17.535**	**-1.928**	**20.295**	**-12.010**	**-10.803**
	3.080	4.351	1.951	2.299	0.576	6.747	1.624	2.716
Spread (-)	-32.471	-36.276	**-80.215**	**63.078**	32.262	**-118.508**	**159.954**	-37.789
	52.667	30.876	21.859	16.282	26.256	54.616	44.736	42.433
3 mo (+)	-17.858	**29.934**	-10.610	**-32.563**	36.386	**-89.237**	**49.539**	15.585
	15.201	12.398	10.222	15.356	36.905	28.451	16.417	24.316
FCI (+)	**0.285**	**-0.648**	-0.098	**0.619**	0.033	**1.012**	**1.061**	-0.044
	0.145	0.224	0.210	0.372	0.155	0.324	0.226	0.284
FTS (-)	-**166.974**	4.999	-25.415	-**195.925**	-12.783	**-155.422**	**-176.056**	**-154.258**
	74.674	20.923	17.181	29.114	10.092	46.141	56.268	67.750
DSR (+)	**-32.549**	**70.528**	**64.766**	**160.211**	**7.819**	**-87.973**	**-176.056**	**63.037**
	12.080	22.982	17.472	22.210	4.038	28.979	56.268	20.197
Pseudo R sq.	0.354	0.219	0.252	0.525	0.105	0.386	0.469	0.576
	305	305	305	305	302	305	305	305

OLS: IP growth, 1970-2019

coefficient	CA	FR	GY	IT	JP	SN	UK	US
constant	**-0.223**	0.073	**-0.268**	**0.236**	**-0.143**	0.003	**0.197**	0.042
	0.063	0.098	0.115	0.073	0.084	0.063	0.031	0.063
Spread (+)	-0.287	**1.981**	**3.682**	**1.553**	**4.802**	**3.703**	**-0.957**	**-2.385**
	0.743	1.043	0.960	0.975	2.197	1.125	0.520	0.712
3 mo (-)	-0.305	**-0.788**	**-2.847**	0.448	**-16.169**	**-0.722**	**-0.536**	**-1.044**
	0.303	0.389	0.651	0.394	7.007	0.290	0.205	0.438
FCI (-)	**-0.024**	**-0.015**	-0.004	**-0.018**	**0.045**	**-0.022**	**-0.009**	**-0.010**
	0.006	0.007	0.009	0.009	0.016	0.008	0.004	0.005
FTS (+)	1.749	**-1.376**	**-2.653**	0.838	1.268	-0.688	-0.036	**5.189**
	1.168	0.710	1.037	0.955	1.071	0.832	0.697	0.950
DSR (-)	**1.068**	-0.384	**2.688**	**-2.569**	0.693	-0.085	-0.036	-0.130
	0.264	0.508	0.977	0.841	0.570	0.277	0.697	0.444
Pseudo R sq.	0.434	0.313	0.533	0.307	0.279	0.480	0.394	0.637
N	288	288	288	288	285	288	288	288