What Do We Learn From Credit Market Frictions?

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Asset Prices and Economic Activity

- Financial markets are forward looking:
  - Asset prices should impound information about investors' expectations of future economic outcomes.
  - Extracting that information may be complicated by the presence of time-varying risk premia.
- Research on the role of asset prices in economic fluctuations emphasizes the predictive content of default-risk indicators. (Friedman & Kuttner [1992, 1998]; Gertler & Lown [1999]; Mody & Taylor [2004]; Mueller [2009])

Credit Spreads and Economic Activity

- Predictive content of credit spreads could reflect disruption in the supply:
  - Worsening of the quality of borrowers' balance sheets.
    (Bernanke & Gertler [1989]; Kiyotaki & Moore [1997]; Bernanke, Gertler & Gilchrist [1999]; Hall [2011])
  - Deterioration in the health of financial intermediaries.
    (Gertler & Kiyotaki [2010]; Gertler & Karadi [2011])
- Predictive content could reflect the ability of the corporate bond market to signal more accurately than the stock market a decline in economic fundamentals.
  (Philippon [2009])

Gilchrist and Zakrajšek [2012]

- Examine the evidence on the relationship between credit spreads and economic activity over the 1973–2010 period.
- Use prices of individual securities to construct a new credit spread with a high information content for future economic activity.
- Decompose the predictive content of credit spreads:
  - Component capturing countercyclical movements in expected defaults.
  - Component representing cyclical changes in the relationship between expected default risk and credit spreads—the excess bond premium (EBP).
- Decomposition motivated in part by the "credit spread puzzle." (Elton et al. [2009]; Collin-Dufresne et al. [2001]; Driessen [2005])

Data Sources & Methods

- CRSP/COMPUSTAT panel of U.S. nonfinancial firms matched with prices of outstanding corporate bonds traded in the secondary market.
- Lehman/Warga & Merrill Lynch issue-level data:
  - **Sample period**: Jan1973–Sep2010 (month-end)
  - 1,112 U.S. nonfinancial issuers
  - 5,982 senior unsecured (fixed-coupon) bond issues
  - 346,126 observations
  - **Information**: price, amount, issue date, maturity, coupon, etc.

Measuring Credit Spreads

- Construct a risk-free security that replicates the cash-flows of the corporate debt instrument.
- Price of a bond with cash-flows: $\{c(s)\colon s = 1, 2, \ldots, S\}$

$$P_t = \sum_{s=1}^{S} c(s) D(t_s), \quad D(t) = e^{-r_t t}$$

- P_t^f = price of a corresponding risk-free security
  - Cash-flows discounted using continuously-compounded zero-coupon Treasury yields in period t.
- **Credit spread**: $S_{it}[k] = y_{it}[k] - y_t^f[k]$
  - $y_{it}[k]$ = YTM of corporate bond k (issued by firm i)
  - $y_t^f[k]$ = YTM of the corresponding risk-free bond

Summary Statistics of Bond Characteristics

(Jan1973–Sep2010)

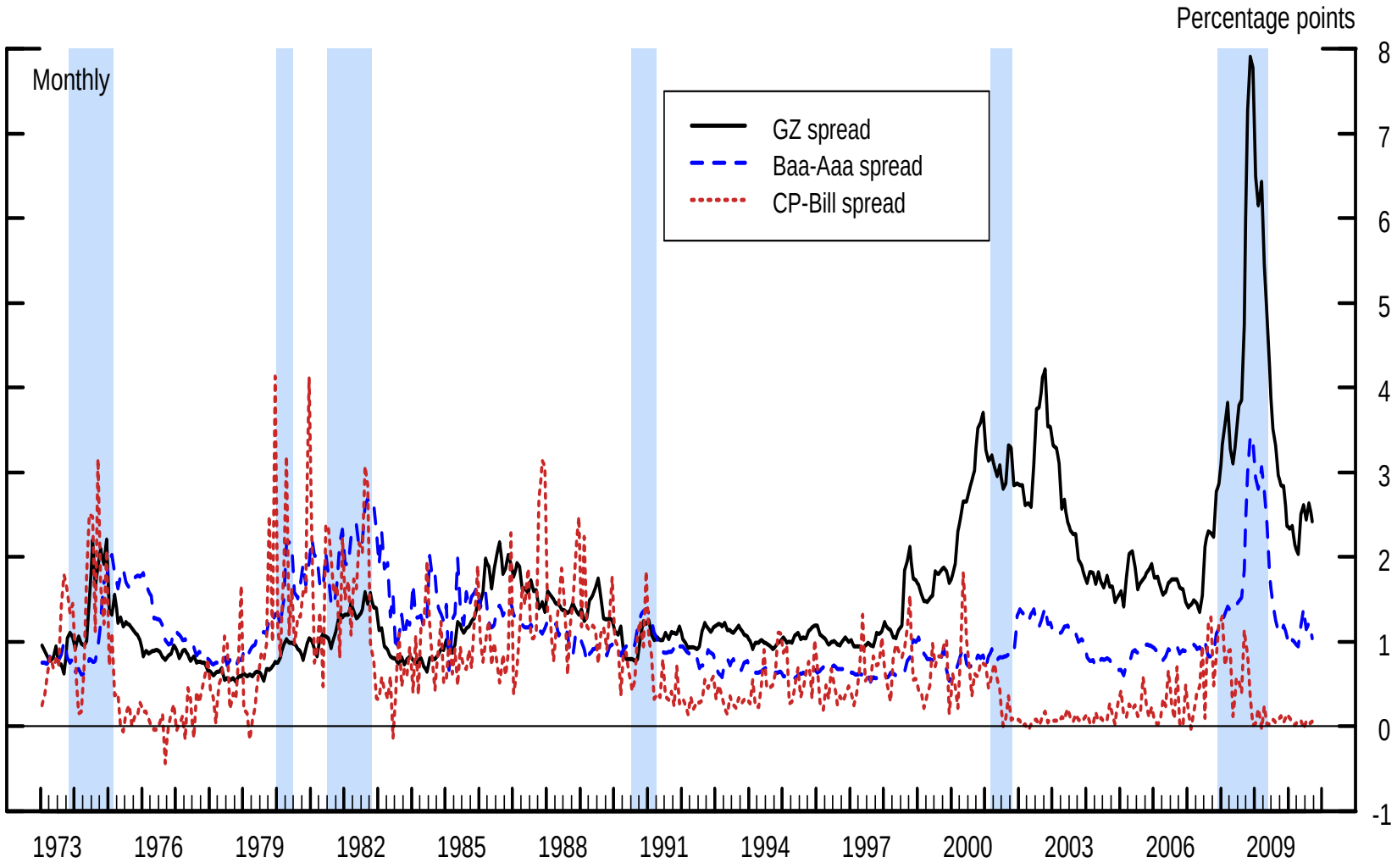
Variable	Mean	SD	Min	P50	Max
No. of bonds per firm/month	2.91	3.64	1.00	2.00	74.0
Mkt. value of issue ($mil.)	322.9	326.6	1.22	238.6	5,628
Maturity at issue (yrs.)	13.0	9.3	1.0	10.0	50.0
Term to maturity (yrs.)	11.3	8.5	1.0	8.1	30.0
Duration (years)	6.47	3.20	0.91	6.06	16.0
Callable (pct.)	67.2	47.0	-	-	-
Credit rating (S&P)	-	-	D	BBB1	AAA
Coupon rate (pct.)	7.34	1.99	1.80	7.00	17.5
Nominal effective yield (pct.)	7.68	3.24	0.54	7.16	44.3
Credit spread (bps.)	204	281	5	118	3,499

- GZ spread: cross-sectional average of credit spreads in period t

$$S_t^{GZ} = \frac{1}{N_t} \sum_i \sum_k S_{it}[k]$$

Selected Corporate Credit Spreads

(Jan1973–Sep2010)



Predictive Content of Credit Spreads

- Forecasting specification (h-periods ahead):

$$\nabla^h Y_{t+h} = \alpha + \sum_{i=0}^{p} \beta_i \nabla Y_{t-1-i} + \gamma_1 TS_t + \gamma_2 RFF_t + \gamma_3 CS_t + \epsilon_{t+h}$$

  - $\nabla^h Y_{t+h} \equiv \frac{c}{h+1} \ln\left(\frac{Y_{t+h}}{Y_{t-1}}\right)$, where $(c = 400/1,200)$
  - $Y_t =$ measure of economic activity
  - $TS_t =$ term spread (Treas3mo $-$ Treas10yr)
  - $RFF_t =$ real federal funds rate (nominal FFR $-$ core PCE infl.)
  - $CS_t =$ credit spread (paper-bill, Baa-Aaa, GZ)
- Allows for the possibility of "nowcasting" (i.e., $h = 0$).
- Estimated by OLS w/ Hodrick (1992) standard errors.

Economic Indicator: Payroll Employment

(Sample period: Jan1973–Sep2010)

Financial Indicator	Forecast Horizon: 3 months				Forecast Horizon: 12 months			
Term spread	-0.096	-0.102	-0.110	-0.110	-0.252	-0.255	-0.241	-0.277
	[2.12]	[2.27]	[2.44]	[2.42]	[4.94]	[5.05]	[4.93]	[5.53]
Real FFR	-0.058	0.050	-0.038	-0.113	-0.116	-0.064	-0.129	-0.204
	[1.18]	[0.78]	[0.75]	[2.23]	[2.10]	[0.96]	[2.45]	[3.84]
CP-bill spread	-	-0.165	-	-	-	-0.080	-	-
		[3.80]				[2.29]		
Baa–Aaa spread	-	-	-0.075	-	-	-	0.054	-
			[2.05]				[1.15]	
GZ spread	-	-	-	-0.322	-	-	-	-0.497
				[8.50]				[13.4]
Adj. R^2	0.622	0.639	0.625	0.685	0.422	0.424	0.422	0.579

NOTE: Parameter estimates are standardized; absolute t-statistics in brackets.

Economic Indicator: Real GDP

(Sample period: 1973:Q1–2010:Q3)

Financial Indicator	Forecast Horizon: 1 quarter				Forecast Horizon: 4 quarters			
Term spread	-0.198	-0.217	-0.250	-0.247	-0.398	-0.406	-0.413	-0.460
	[1.77]	[1.92]	[2.07]	[2.26]	[2.79]	[2.81]	[2.70]	[3.22]
Real FFR	-0.016	0.175	0.020	-0.123	-0.036	0.042	-0.026	-0.131
	[0.12]	[1.12]	[0.15]	[0.95]	[0.24]	[0.22]	[0.17]	[0.87]
CP-bill spread	-	-0.254	-	-	-	-0.105	-	-
		[2.16]				[0.82]		
Baa–Aaa spread	-	-	-0.229	-	-	-	-0.066	-
			[1.95]				[0.52]	
GZ spread	-	-	-	-0.437	-	-	-	-0.482
				[4.96]				[5.74]
Adj. R^2	0.170	0.197	0.209	0.313	0.215	0.215	0.213	0.369

NOTE: Parameter estimates are standardized; absolute t-statistics in brackets.

FRAMEWORK

- Empirical credit-spread model:

$$\ln S_{it}[k] = \beta DFT_{it} + \gamma' Z_{it}[k] + \epsilon_{it}[k]$$

  - $S_{it}[k]$ = credit spread on bond k (issued by firm i)
  - DFT_{it} = measure of expected default risk for firm i
  - $Z_{it}[k]$ = bond-specific control variables
  - $\epsilon_{it}[k]$ = "pricing error"
- Estimated by OLS w/ two-way clustered standard errors.

Credit Spread Decomposition

- Predicted level of the spread for bond k:

$$\widehat{S}_{it}[k] = \exp\left[\hat{\beta} DFT_{it} + \hat{\gamma}' Z_{it}[k] + \frac{\hat{\sigma}^2}{2}\right]$$

- Predicted GZ spread:

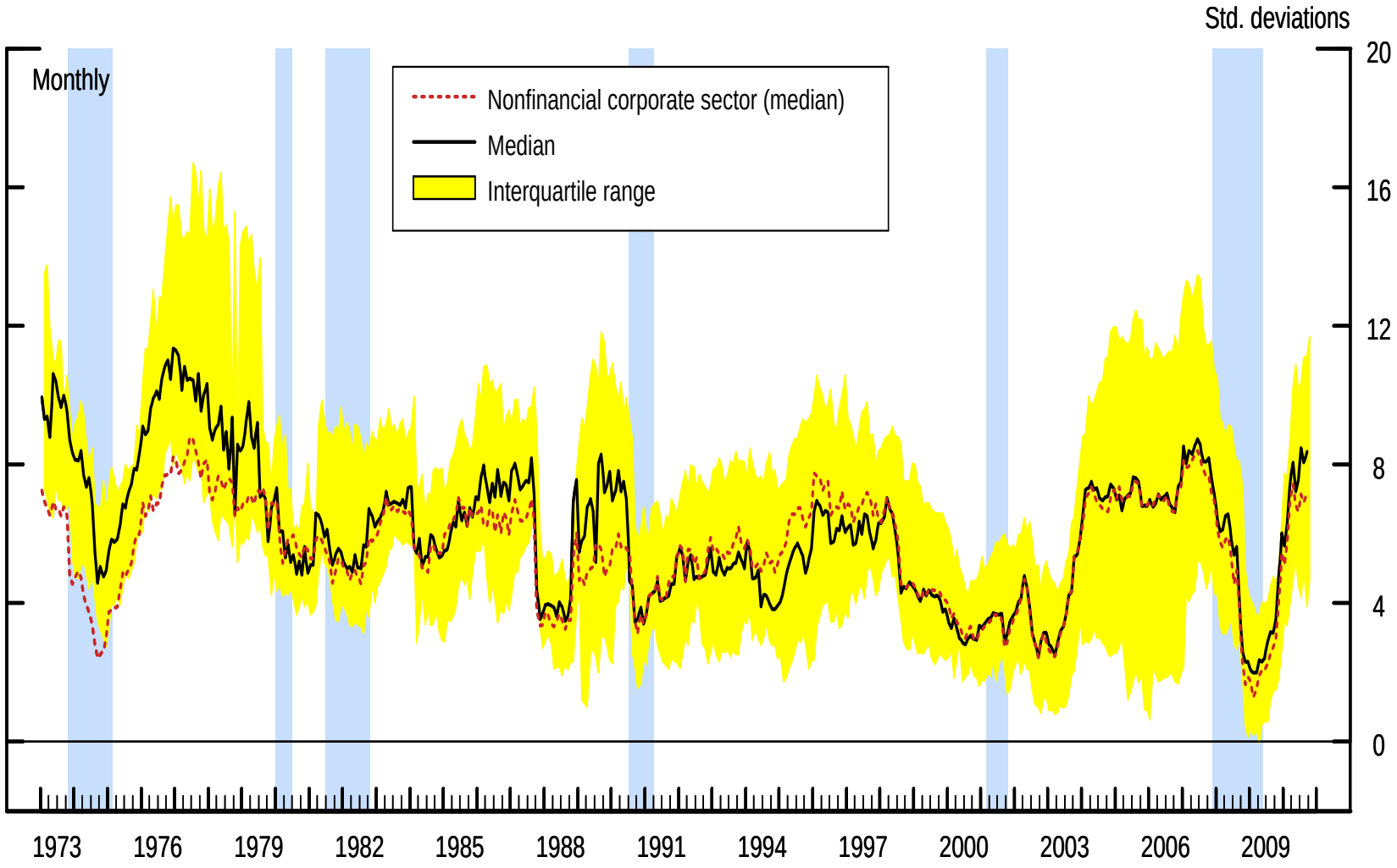
$$\widehat{S}_t^{GZ} = \frac{1}{N_t} \sum_i \sum_k \widehat{S}_{it}[k]$$

- Excess Bond Premium:

$$EBP_t = S_t^{GZ} - \widehat{S}_t^{GZ}$$

Distance to Default

(Jan1973–Sep2010)

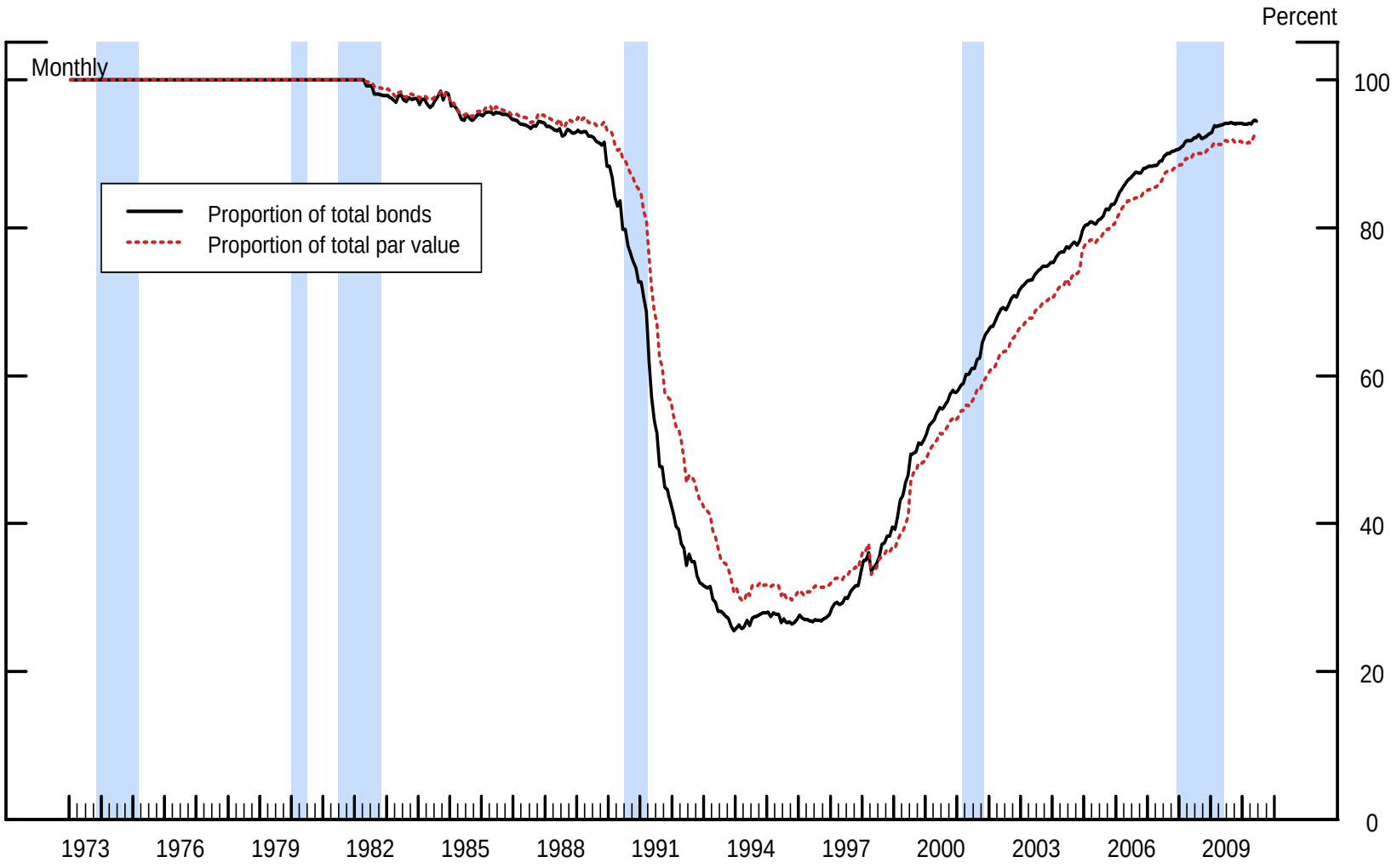


Adjusting for Call Optionality

- Movements in risk-free rates—by changing the value of embedded call options—have an independent effect on prices of callable bonds.
  (Duffee [1998])
- Prices of callable bonds are more sensitive to uncertainty regarding the future course of interest rates.

Callable Corporate Debt

(Jan1973–Sep2010)



Credit-Spread Model with Option Adjustment

- Credit-spread model:

$$\ln S_{it}[k] = \beta_1 DFT_{it} + \gamma_1' Z_{it}[k] + C_i[k] \times \left(\beta_2 DFT_{it} + \gamma_2' Z_{it}[k]\right) + C_i[k] \times (\theta_1 LEV_t + \theta_2 SLP_t + \theta_3 CRV_t + \theta_4 VOL_t) + \epsilon_{it}[k]$$

  - $C_i[k] =$ callable (0/1) indicator
- Credit spreads of callable bonds depend on:
  - Level, slope, and curvature factors of the Treasury yield curve.
  - Realized volatility of long-term interest rates.

SELECTED MARGINAL EFFECTS BY TYPE OF BOND

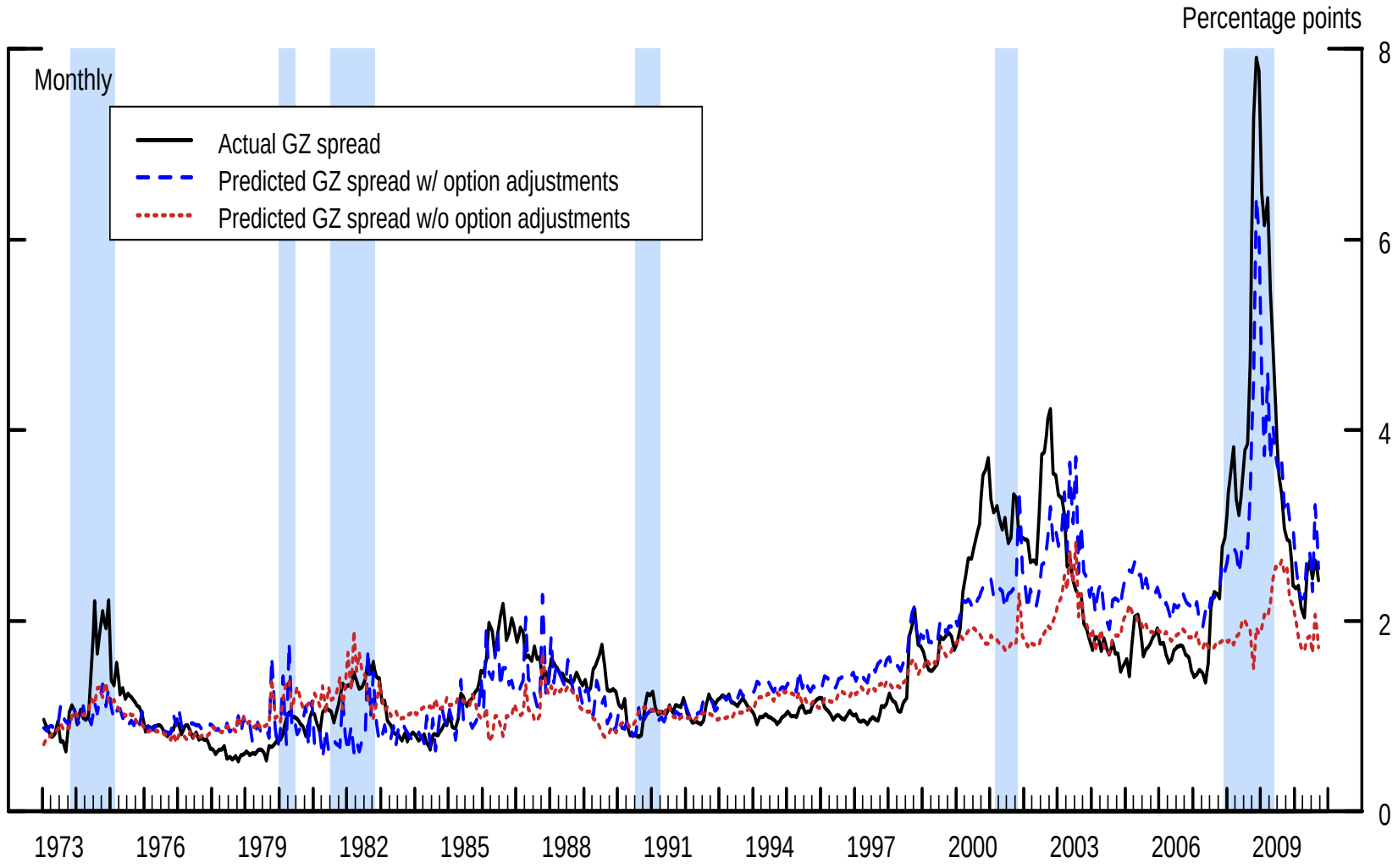
(Sample period: Jan1973–Sep2010)

	Noncallable		**Callable**			
Explanatory Variable	*Est.*	*S.E.*	*Est.*	*S.E.*	*Mean*	*STD*
Distance-to-default: $-DD_{it}$	0.190	0.010	0.129	0.008	6.610	3.946
Term structure: LEV_t	-	-	-0.783	0.055	0.000	1.000
Term structure: SLP_t	-	-	-0.179	0.034	0.000	1.000
Term structure: CRV_t	-	-	-0.082	0.038	0.000	1.000
Term structure: VOL_t (%)	-	-	0.273	0.043	1.862	1.239

NOTE: Evaluated at the sample mean.

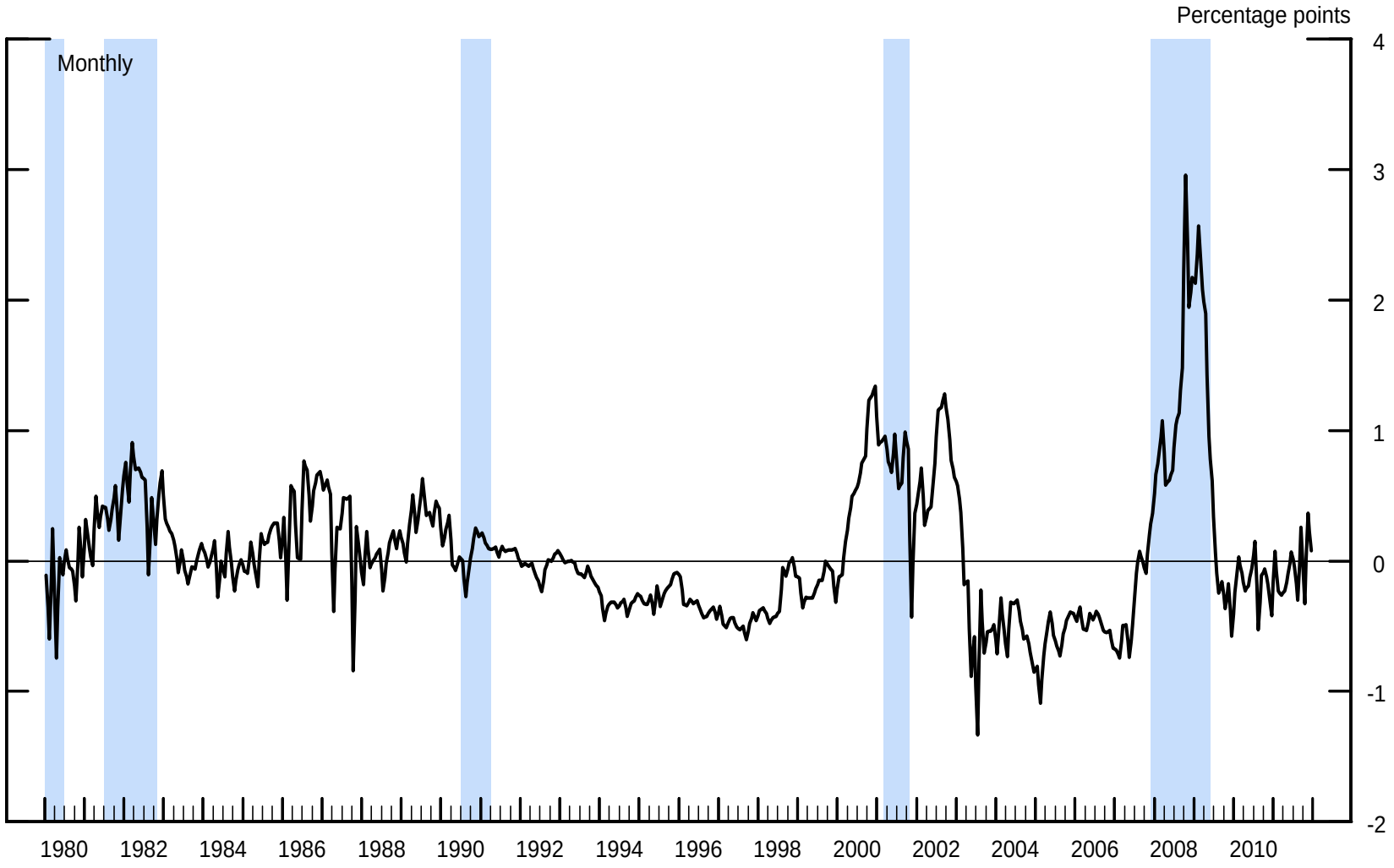
Actual and Predicted Credit Spreads

(Jan1973–Sep2010)



Excess Bond Premium

(Jan1973–Dec2011)



Excess Bond Premium and Economic Activity

(Sample period: Jan1973–Sep2010)

	Forecast Horizon: 3 months			Forecast Horizon: 12 months		
Financial Indicator	EMP	UER	IPM	EMP	UER	IPM
Term spread	-0.122	0.221	-0.256	-0.291	0.440	-0.435
	[2.67]	[10.3]	[3.60]	[5.78]	[55.4]	[4.99]
Real FFR	-0.044	0.007	-0.018	-0.112	0.022	-0.079
	[0.87]	[0.30]	[0.23]	[2.06]	[2.70]	[0.81]
Predicted OA-GZ spread	-0.202	0.134	-0.186	-0.355	0.213	-0.283
	[5.65]	[8.41]	[3.62]	[9.63]	[38.5]	[4.18]
Excess bond premium	-0.259	0.331	-0.386	-0.369	0.414	-0.388
	[8.52]	[20.9]	[5.87]	[14.5]	[91.6]	[5.42]
Adj. R^2	0.687	0.430	0.381	0.588	0.433	0.384

NOTE: Parameter estimates are standardized; absolute t-statistics in brackets.

Excess Bond Premium and Real GDP

(Sample period: 1973:Q1–2010:Q3)

Financial Indicator	Forecast Horizon: 1 quarter	Forecast Horizon: 4 quarters
Term spread	-0.281	-0.478
	[2.58]	[3.33]
Real FFR	-0.005	-0.036
	[0.04]	[0.24]
Predicted OA-GZ spread	-0.194	-0.258
	[2.25]	[2.56]
Excess bond premium	-0.411	-0.364
	[5.53]	[5.36]
Adj. R^2	0.331	0.365

NOTE: Parameter estimates are standardized; absolute t-statistics in brackets.

Excess Bond Premium and Real GDP

(Sample period: 1985:Q1–2010:Q3)

Financial Indicator	Forecast Horizon: 1 quarter	Forecast Horizon: 4 quarters
Term spread	-0.520	-0.509
	[4.23]	[4.09]
Real FFR	0.603	0.424
	[3.62]	[2.67]
Predicted OA-GZ spread	0.131	-0.023
	[1.07]	[0.20]
Excess bond premium	-0.557	-0.501
	[6.17]	[6.80]
Adj. R^2	0.532	0.357

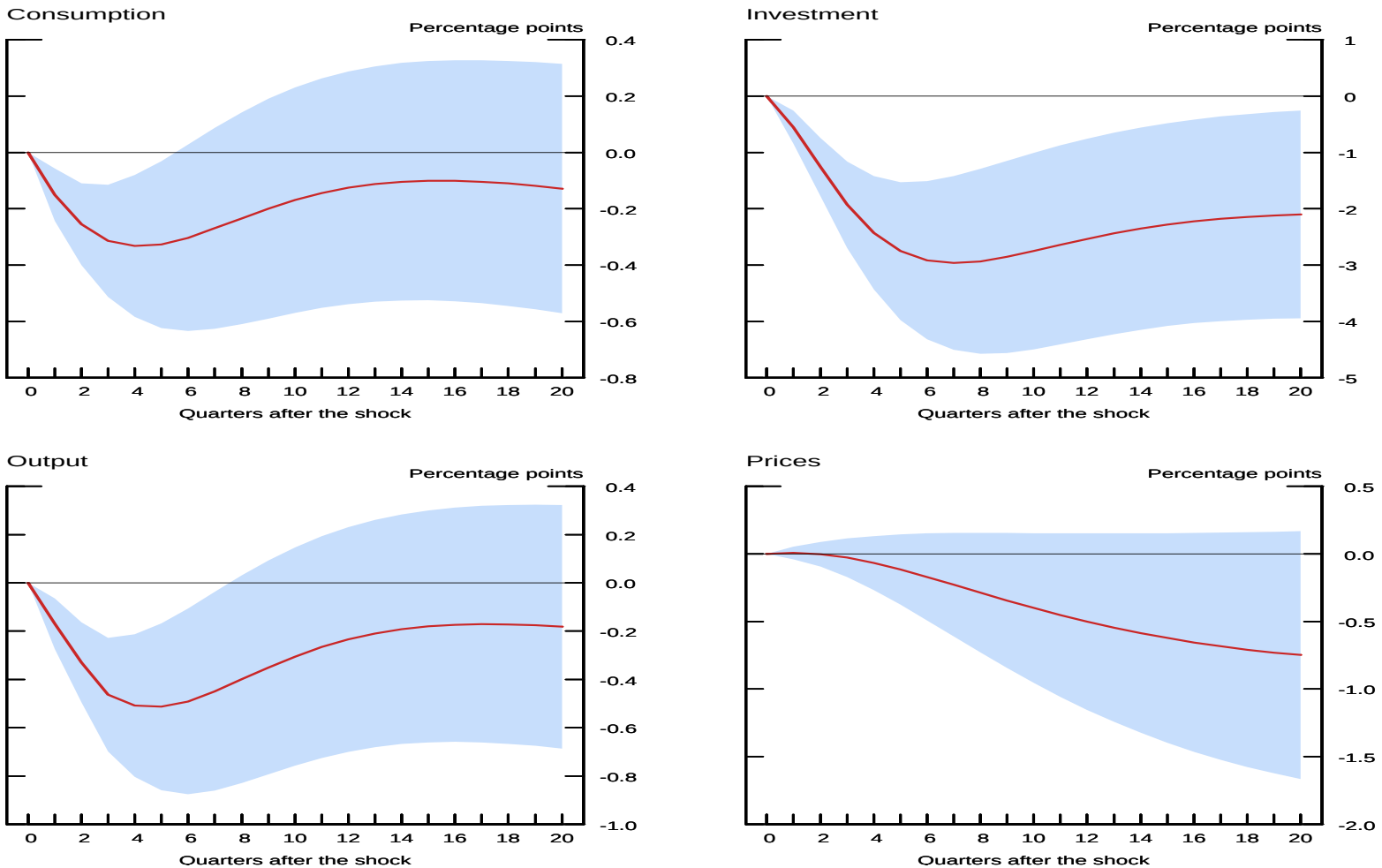
NOTE: Parameter estimates are standardized; absolute t-statistics in brackets.

Macroeconomic Implications

- 8-variable VAR(2) specification:
  - log-difference of real PCE
  - log-difference of real BFI
  - log-difference of real GDP
  - GDP price inflation
  - excess bond premium
  - excess (value-weighted) market return
  - 10-year (nominal) Treasury yield
  - effective federal funds rate
- Estimation period: 1973:Q1–2010:Q3
- EBP shocks identified using the Cholesky decomposition.

ADVERSE EBP SHOCK

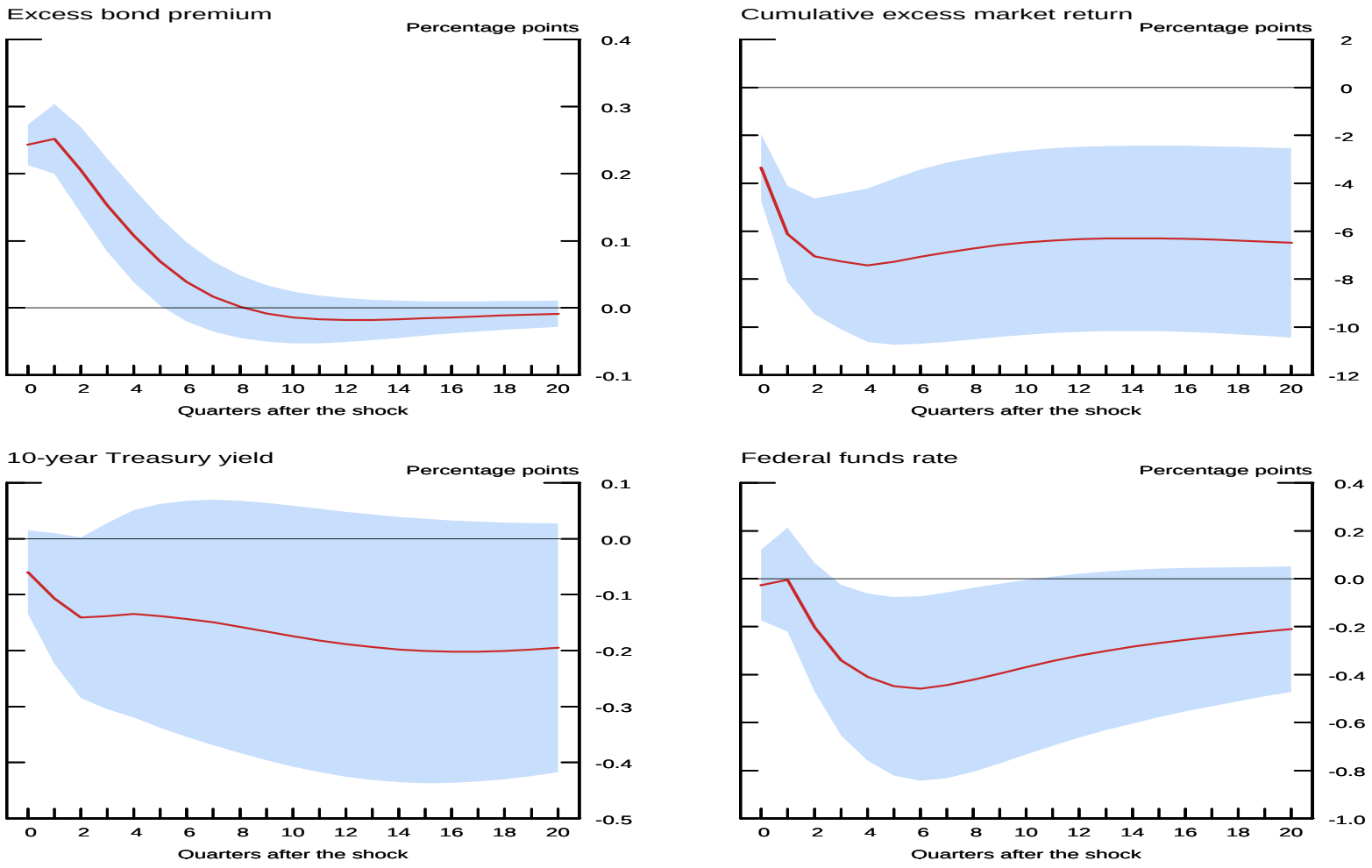
Macroeconomic Variables



NOTE: Shaded bands denote 95-percent confidence intervals.

Adverse EBP Shock

Financial Variables



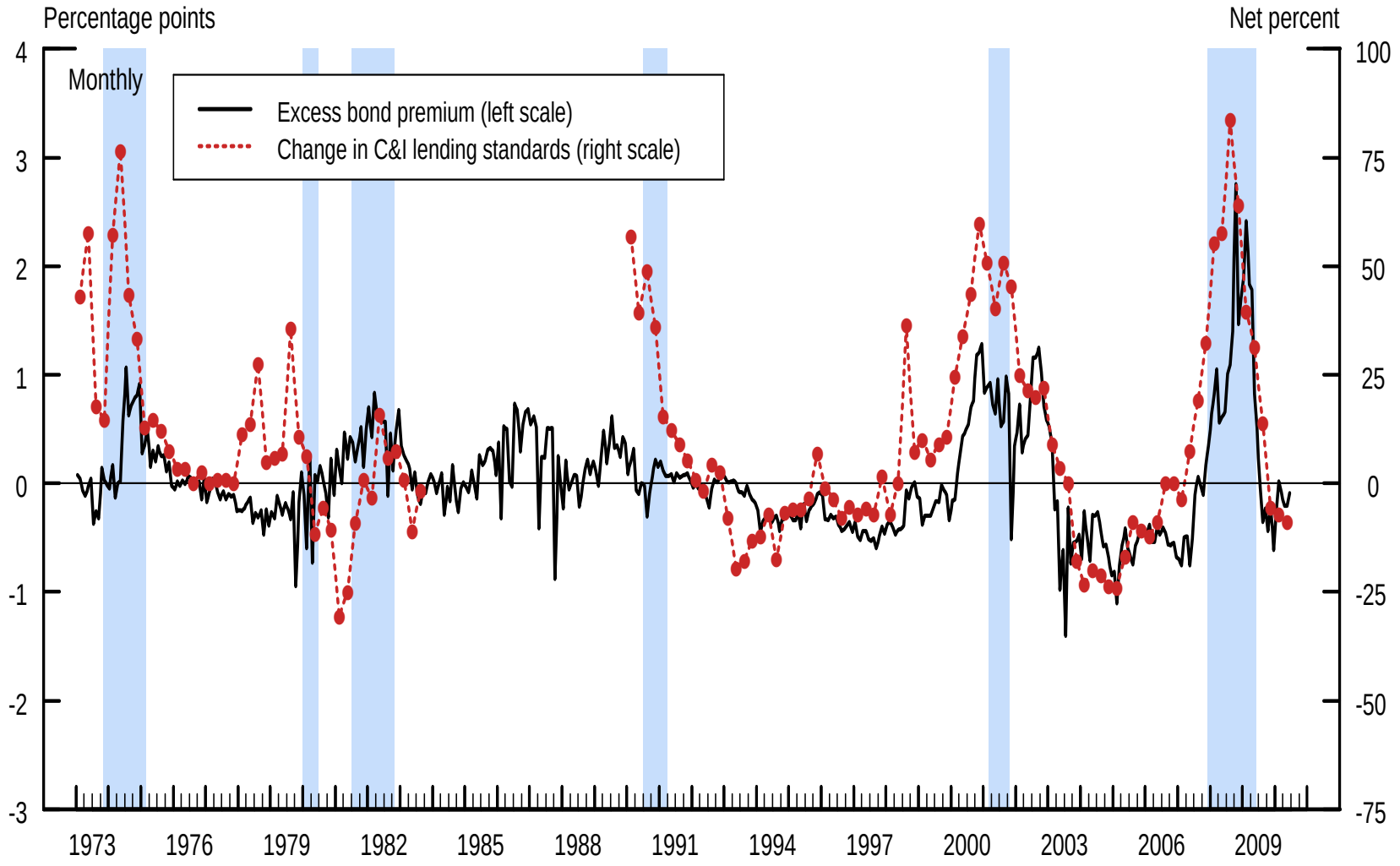
NOTE: Shaded bands denote 95-percent confidence intervals.

INTERPRETATION

- The EBP provides a timely gauge of credit-supply conditions.
- Increase in the EBP leads to an economic downturn vis-à-vis the financial accelerator mechanism.
- Financial shocks may also cause variation in the risk attitudes of the marginal investor pricing corporate bonds:
  - Corporate bond market is dominated by large institutional investors.
  - These financial intermediaries face capital requirements.
  - A shock to their financial capital makes them act in a more risk-averse manner.
  - Shift in their risk attitudes leads to an increase in the EBP. (He & Krishnamurthy [2010]; Adrian, Moench & Shin [2010])

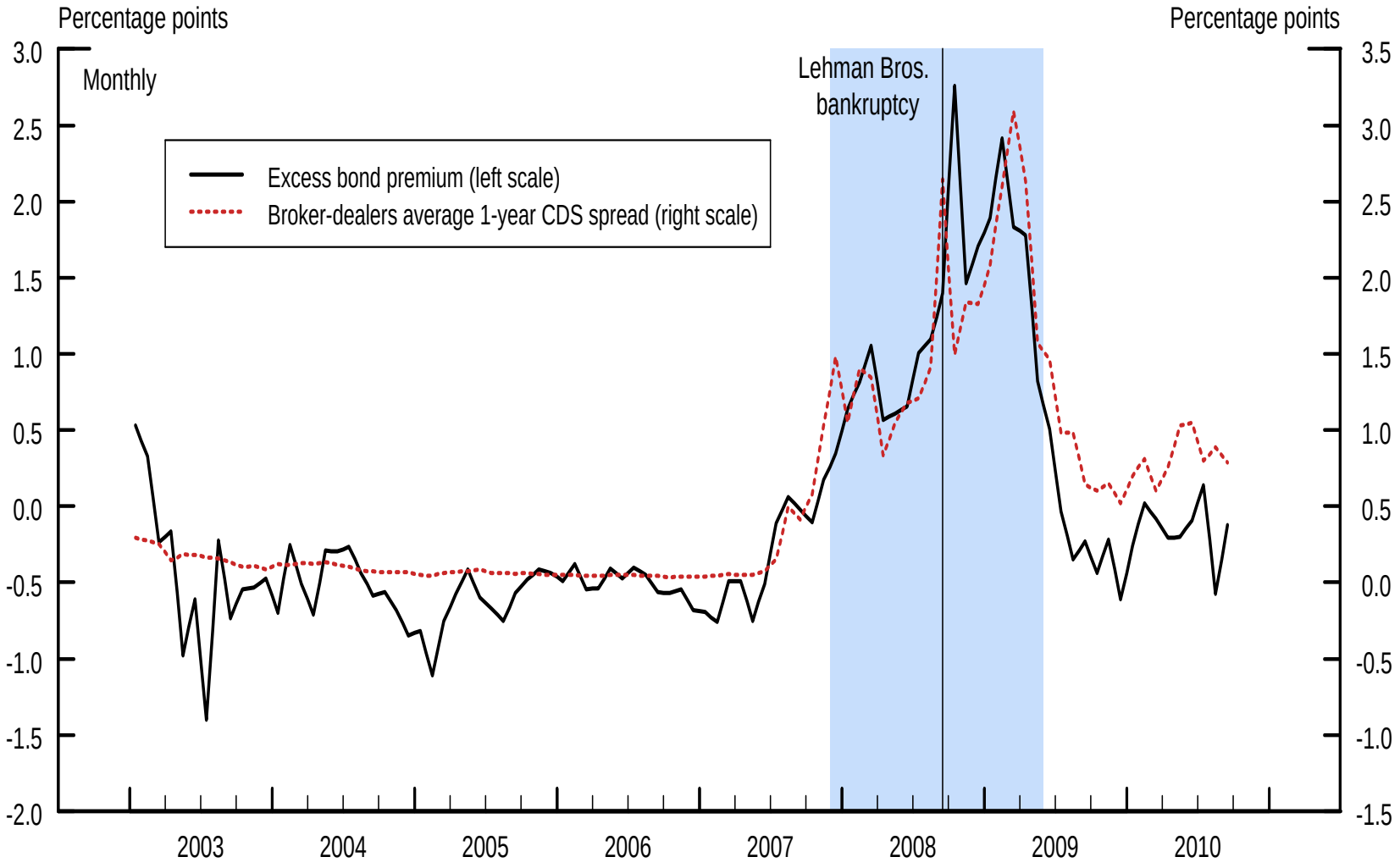
EBP & Changes in Bank Lending Standards

(Jan1973–Sep2010)



EBP & Financial Intermediary CDS Spreads

(Jan2003–Sep2010)



Faust, Gilchrist, Wright & Zakrajšek [2012]

- Provide an evaluation of the marginal information of credit spreads in real-time economic forecasting.
- Utilize portfolio credit spreads based on an extensive micro-level data set of secondary market bond prices.

  (Gilchrist, Yankov & Zakrajšek [2009]; Gilchrist & Zakrajšek [2012])
- Employ Bayesian Model Averaging (BMA) to forecast real-time measures of economic activity using portfolio credit spreads and many other asset market indicators:
  - BMA framework addresses model search and selection issues.

Bond, Stock, and DD Portfolios

- Sort bond issuers into categories based on the cross-sectional distribution of DDs in month $t-1$.
- Within each DD-category, sort bonds into maturity categories.
- For each month t calculate:
  - Average credit spread within each DD/maturity category.
  - Average excess stock return within each DD category.
  - Average DD within each DD quartile.
- Use the same procedure to construct stock and DD portfolios for all U.S. nonfinancial and financial corporations.

THE BMA SETUP

- n possible (linear) forecasting models:

$$y_{t+h} = \alpha + \beta_i x_{it} + \sum_{j=1}^{p} \gamma_j y_{t-j} + \epsilon_{t+h}, \quad i = 1, \ldots, n$$

- Priors:
  - All models are equally likely: $P(M_i) = 1/n$.
  - Priors for $\alpha, \gamma_1, \ldots \gamma_p, \sigma^2$: proportional to $1/\sigma$.
  - g-prior for β_i: $N(0, \phi\sigma^2(X_i'X_i)^{-1})$.

THE BMA SETUP (CONT.)

- Bayesian h-period-ahead forecast for model M_i:

$$\tilde{y}^i_{T+h|T} = \hat{\alpha} + \tilde{\beta}_i x_{it} + \sum_{j=1}^{p} \hat{\gamma}_j y_{t-j}$$

  - $\hat{\alpha}, \hat{\beta}, \hat{\gamma}_1, \ldots, \hat{\gamma}_p =$ OLS estimates
  - $\tilde{\beta}_i = \left(\frac{\phi}{\phi+1}\right)\hat{\beta}_i =$ posterior mean of β_i

- Posterior probabilities (given the observed data D):
  - Posterior probability that the M_i model is "true:"

$$P(M_i|D) \propto P(D|M_i)P(M_i)$$

  - Marginal likelihood of the M_i model:

$$P(D|M_i) \propto \left[\frac{1}{1+\phi}\right]^{-\frac{1}{2}} \times \left[\frac{1}{1+\phi}SSR_i + \frac{\phi}{1+\phi}SSE_i\right]^{-\frac{(T-p)}{2}}$$

THE BMA FORECAST

- BMA forecast:

$$\tilde{y}_{T+h|T} = \sum_{i=1}^{n} \tilde{y}^{i}_{T+h|T} \times P(M_i|D)$$

- BMA forecasts depends on the value of ϕ:
  - "Small" $\phi \Rightarrow$ equal-weighted model averaging.
  - "Large" $\phi \Rightarrow$ weighting models by their in-sample R^2.
  - Relationship between ϕ and RMSPE is often U-shaped.
  - Benchmark: $\phi = 4$.

THE FORECASTING SETUP

- Forecast economic activity in quarter $t, t+1, \ldots, t+4$ using macro data available through quarter $t-1$ and asset market indicators at the end of the first month of quarter t:
  - **Economic activity indicators**: GDP, PCE, BFI, IP, nonfarm payrolls, unemployment rate, imports, exports
  - **Sample period:** 1986:Q1–2011:Q3
- Recursive out-of-sample forecasting starts in 1992:Q1.
- All variables are in real time.
  - Including the option adjustment to credit spreads.

Predictors & Forecast Evaluation

- Predictors:
  - Option-adjusted credit spreads in DD-based bond portfolios.
  - Average DDs in DD-based portfolios (bond issuers, financial and nonfinancial firms).
  - Excess stock returns in DD-based portfolios (bond issuers, financial and nonfinancial firms).
  - 15 macroeconomic series.
  - 119 asset market indicators.
- BMA forecasts compared with forecasts based on an AR(p) model.

BMA Out-of-Sample Predictive Accuracy

Predictor Set: All Variables

	Forecast Horizon (h quarters)				
Economic Activity Indicator	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$
GDP	0.96	0.90	0.87	0.88	0.87
	[0.03]	[0.01]	[0.01]	[0.02]	[0.02]
Personal consumption expenditures	0.88	0.90	0.97	1.03	1.06
	[0.01]	[0.02]	[0.12]	[0.28]	[0.35]
Business fixed investment	0.94	0.84	0.90	0.90	0.88
	[0.01]	[0.00]	[0.01]	[0.02]	[0.01]
Industrial production	0.96	0.92	0.93	0.92	0.91
	[0.02]	[0.02]	[0.04]	[0.05]	[0.05]
Private employment	0.92	0.86	0.90	0.90	0.88
	[0.00]	[0.00]	[0.02]	[0.02]	[0.01]
Unemployment rate	0.95	0.87	0.86	0.87	0.88
	[0.01]	[0.00]	[0.00]	[0.01]	[0.02]

NOTE: Relative RMSPEs; bootstrapped p-values in brackets.

BMA Out-of-Sample Predictive Accuracy

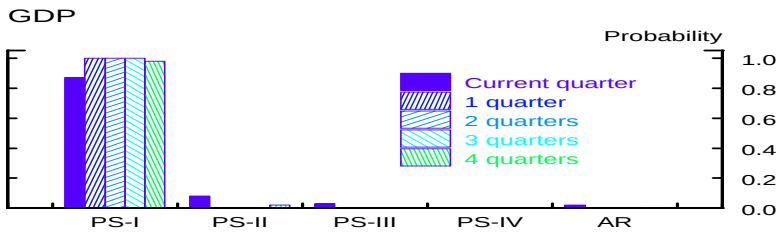
Predictor Set: All Variables Except Credit Spreads in DD-Based Portfolios

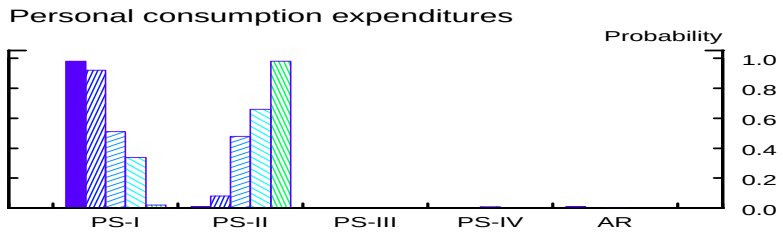
	Forecast Horizon (h quarters)				
Economic Activity Indicator	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$
GDP	0.98	0.98	0.98	0.99	0.99
	[0.11]	[0.13]	[0.14]	[0.15]	[0.14]
Personal consumption expenditures	0.97	0.96	0.99	1.03	1.06
	[0.14]	[0.11]	[0.21]	[0.32]	[0.40]
Business fixed investment	0.95	0.95	0.95	0.97	0.94
	[0.01]	[0.04]	[0.05]	[0.09]	[0.05]
Industrial production	0.99	1.02	1.05	1.05	1.04
	[0.09]	[0.52]	[0.67]	[0.53]	[0.33]
Private employment	0.98	1.00	1.05	1.06	1.03
	[0.07]	[0.26]	[0.58]	[0.51]	[0.24]
Unemployment rate	0.97	0.97	1.02	1.05	1.04
	[0.01]	[0.03]	[0.36]	[0.51]	[0.31]

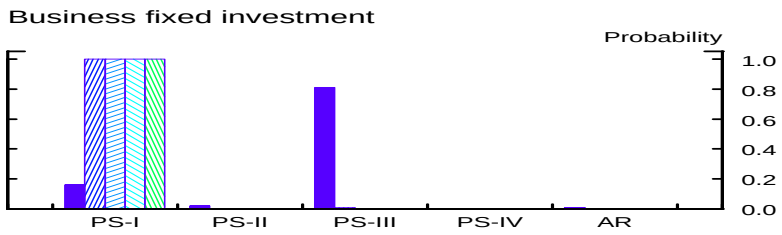
NOTE: Relative RMSPEs; bootstrapped p-values in brackets.

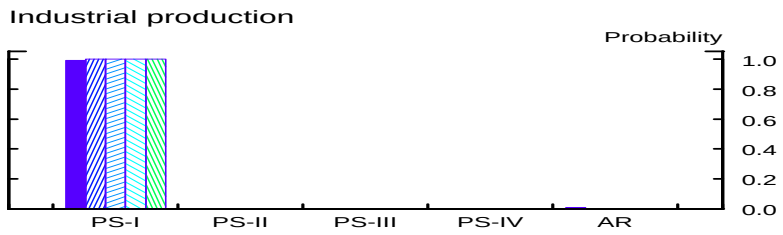
Which Predictors are the Most Informative?

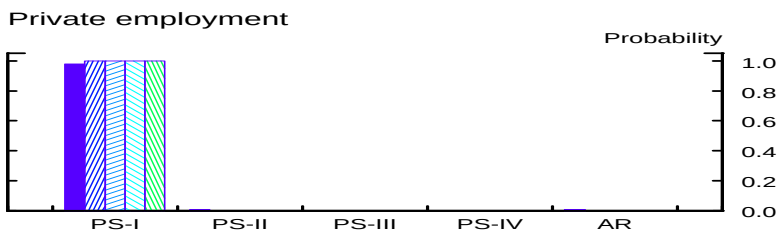
(Final posterior probabilities by predictor type)

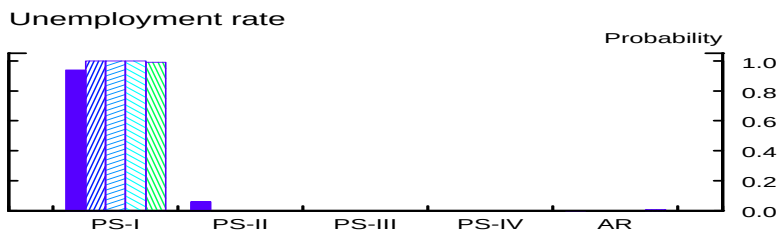


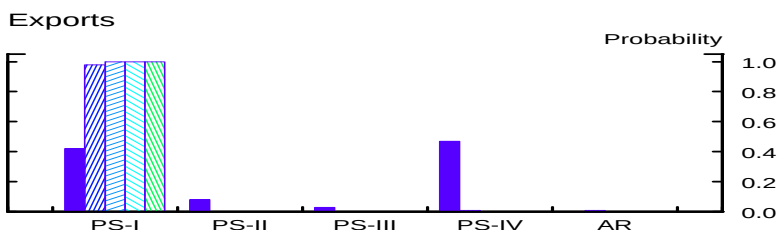


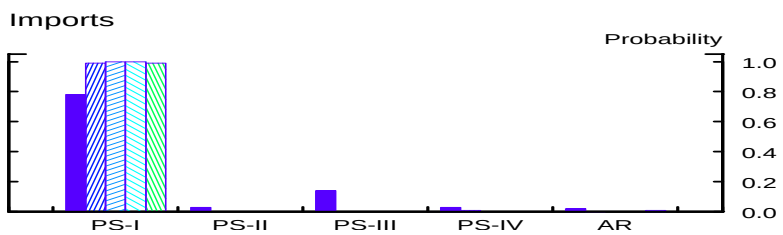






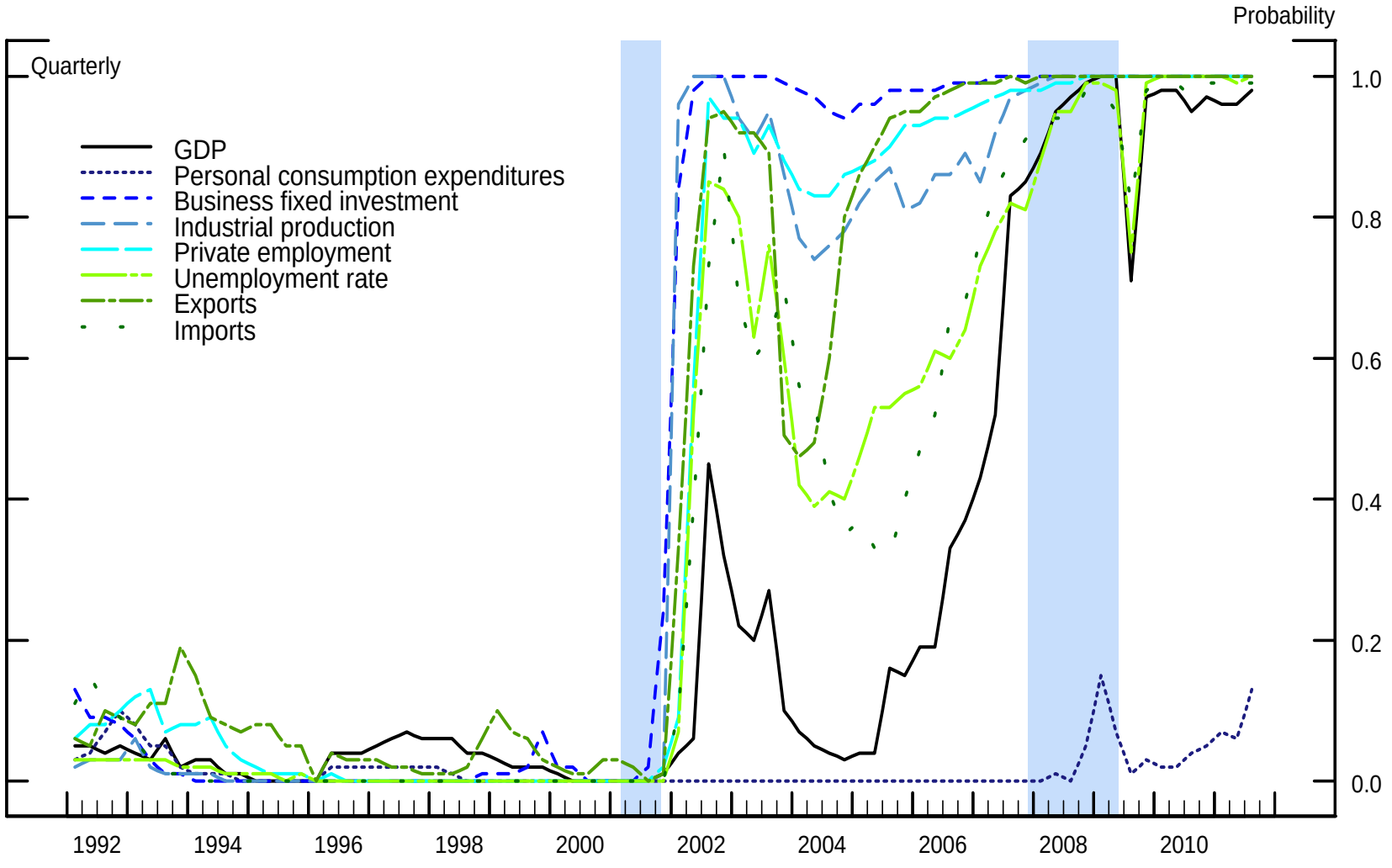






Real-Time Evolution of Posterior Probabilities

(Four-quarter-ahead forecast horizon)



SUMMARY

- Credit spreads have been underutilized in real-time economic forecasting.
- Messy to deal with.
- Contain useful information for medium-term forecasts of economic activity.
- The predictive content appears to reflect almost entirely movements in the non-default component—that is, in the price of default risk rather than in the risk of default:
  (Gilchrist & Zakrajšek [2012])
  - Downside risk not well captured by other asset prices.
    (Gourio [2010])
  - "Risk-bearing capacity" of financial intermediaries.
    (He & Krishnamurthy [2012]; Adrian, Moench & Shin [2010])