Online Appendix

Financial-Cycle Ratios and Medium-Term Predictions of GDP: Evidence from the United States

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Appendix Tables and Figures

In this Appendix, we provide several tables and figures which contain results discussed in Section 4 ("Extensions and robustness checks") of the paper.

Table A1: High-dimensional models and forecast combinations: MSFEs for year-on-year GDP growth

forecasting model/method	$h = 4$	$h = 12$	$h = 20$
LBVAR	0.82	0.88	0.81
LASSO VAR	0.87	0.94	0.99
Factor model	0.91	0.97	1.00
Forecast combination (equal weights)	0.93	1.00	1.00
Forecast combination (BMA weights)	0.96	1.00	1.00
IMF	0.76	1.08	1.13

Notes: The table shows the mean squared forecast errors (MSFEs) for the h-quarter-ahead year-on-year GDP growth rate, relative to the benchmark AR, over the period 1990Q1-2017Q4. The forecasting models/methods considered are the same as in Table 6 of the paper.

Table A2: Forecasts based on rolling-window estimates: MSFEs

	$h = 4$		$h = 12$		$h = 20$	
	ARDL					
1	**NNBTILQ027SBDIx**	0.61	**NNBTILQ027SBDIx**	0.31	pr	0.40
2	cli	0.87	IPCONGD	0.83	**NNBTILQ027SBDIx**	0.49
3	AMDMUOx	0.96	cli	0.86	AMDMUOx	0.74
4	TNWMVBSNNCBBDIx	0.98	TNWMVBSNNCBBDIx	0.91	CONSPIx	0.81
5	TLBSNNCBBDIx	1.00	DHLCRG3Q086SBEA	0.93	**capr**	0.82
6	prfi_gdp	1.03	IPNCONGD	0.96	TNWMVBSNNCBBDIx	0.97
7	hpi	1.03	CPIMEDSL	1.00	cli	0.98
8	PRFIx	1.08	IPDCONGD	1.01	CPIMEDSL	0.99
9	MORTG10YRx	1.08	EXUSUKx	1.02	DHLCRG3Q086SBEA	1.00
10	USMINE	1.08	DREQRG3Q086SBEA	1.02	PRFIx	1.02
	VAR					
1	**NNBTILQ027SBDIx**	**0.72**	**NNBTILQ027SBDIx**	**0.40**	**NNBTILQ027SBDIx**	**0.72**
2	**capr**	**0.96**	TNWMVBSNNCBBDIx	0.80	AMDMUOx	0.74
3	cli	0.97	AMDMUOx	0.84	**capr**	**0.95**
4	CPIAUCSL	1.01	cli	0.84	cli	0.95
5	AMDMUOx	1.06	**capr**	**1.02**	TNWMVBSNNCBBDIx	1.00
6	PRFIx	1.09	USMINE	1.10	BUSLOANSx	1.10
7	TNWMVBSNNCBBDIx	1.10	CPIAUCSL	1.12	USTPU	1.18
8	WPU0561	1.10	B021RE1Q156NBEA	1.18	HOUST5F	1.21
9	B021RE1Q156NBEA	1.12	PRFIx	1.20	IPMAT	1.25
10	hpi	1.12	HOUST5F	1.23	S&P: PE ratio	1.25

Notes: MSFEs for the h-quarter-ahead (cumulative) GDP growth rate, relative to the benchmark AR, calculated over the period 1990Q1-2017Q4. All models are estimated on rolling windows of size 60 quarters. See Table 1 of the paper and McCracken and Ng (2021) for a description of the variables.

Table A3: R^2 of ARDL models estimated on sub-samples

		$h = 4$		$h = 12$		$h = 20$	
	**(a) sample: excluding 2007Q3-2009Q2 (GFC)**					
1	cli	0.36	**capr**	0.61	**capr**	0.68	
2	DOTSRG3Q086SBEA	0.34	pr	0.56	pr	0.65	
3	fedfunds	0.34	**NNBTILQ027SBDIx**	0.55	**NNBTILQ027SBDIx**	0.59	
4	CP3M	0.33	AMDMUOx	0.52	LIABPIx	0.58	
5	IPCONGD	0.33	cli	0.51	mortg_inc	0.58	
6	CP3M	0.31	mortg_inc	0.42	ISRATIOx	0.52	
7	TB3MS	0.31	ISRATIOx	0.41	cred_gdp	0.52	
8	MORTGAGE30US	0.31	LIABPIx	0.41	cli	0.50	
9	**capr**	0.31	cred_gdp	0.39	NWPIx	0.47	
10	TB6MS	0.30	AAA	0.38	AMDMUOx	0.47	
	**(b) sample: up to 2007Q2**					
1	fedfunds	0.38	UEMPMEAN	0.59	UEMPMEAN	0.78	
2	IMPGSC1	0.38	hpi	0.57	pr	0.68	
3	MORTGAGE30US	0.37	prfi_gdp	0.57	UNRATELTx	0.63	
4	CP3M	0.36	CPIAUCSL	0.56	**capr**	0.59	
5	TB3MS	0.36	PCECTPI	0.55	hpi	0.58	
6	DOTSRG3Q086SBEA	0.36	UNRATELTx	0.54	USGOVT	0.57	
7	prfi_gdp	0.35	CUSR0000SA0L5	0.54	CONSPIx	0.57	
8	BAA	0.35	IMPGSC1	0.54	mortg	0.57	
9	TB6M3Mx	0.35	**capr**	0.53	AWHNONAG	0.56	
10	TB6M3Mx	0.35	DHLCRG3Q086SBEA	0.53	CES9093000001	0.53	
	**(c) sample: "Great Moderation", 1983Q1-2007Q2**					
1	TLBSNNCBBDIx	0.53	**NNBTILQ027SBDIx**	0.62	UEMPMEAN	0.81	
2	**NNBTILQ027SBDIx**	0.53	**capr**	0.61	**capr**	0.74	
3	CUSR0000SAS	0.52	DHLCRG3Q086SBEA	0.59	UNRATELTx	0.73	
4	USGOVT	0.46	OUTMS	0.59	OUTMS	0.69	
5	cred_gdp	0.46	UEMPMEAN	0.57	REALLNx	0.69	
6	LNS14000012	0.46	GDPCTPI	0.57	USGOVT	0.69	
7	CPILFESL	0.46	PCEPILFE	0.55	pr	0.67	
8	DHUTRG3Q086SBEA	0.44	USGOVT	0.54	CES9093000001	0.64	
9	UNRATELTx	0.43	IMPGSC1	0.53	mortg	0.64	
10	USFIRE	0.43	IPDBS	0.52	IMPGSC1	0.62	

Notes: For each h, the dependent variable is GDP growth over h quarters. Please refer to Section 4.5 of the paper for details.

Table A4: ARDL forecasts: MSFEs calculated on sub-periods

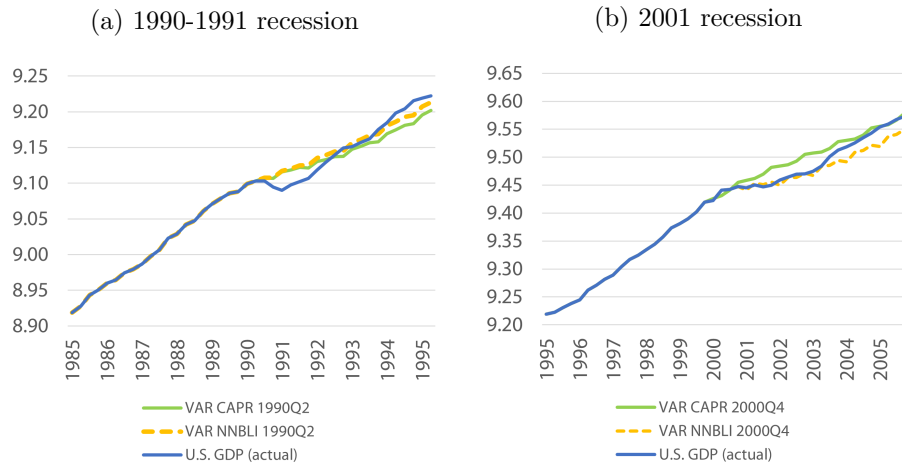|	$h = 4$		$h = 12$		$h = 20$	
	pre-Crisis period: 1990Q1-2007Q2					
1	**NNBTILQ027SBDIx**	0.61	**NNBTILQ027SBDIx**	0.46	**NNBTILQ027SBDIx**	0.46
2	FPIx	0.83	LNS14000012	0.77	**capr**	0.57
3	S&P div. yield	0.89	IMPGSC1	0.81	VXOCLSX	0.60
4	CPILFESL	0.90	UNRATELTx	0.82	LNS14000012	0.62
5	CPIMEDSL	0.90	PERMITNE	0.83	UNRATELTx	0.65
6	CUSR0000SAS	0.90	HOUSTNE	0.87	hpi	0.70
7	OUTNFB	0.90	IPCONGD	0.89	HWIURATIOx	0.78
8	HNOREMQ027Sx	0.90	TLBSNNCBBDIx	0.90	UEMP27OV	0.79
9	LNS14000012	0.90	**capr**	0.91	AWHNONAG	0.80
10	PERMITS	0.91	DREQRG3Q086SBEA	0.91	UNRATE	0.80
	Crisis period: 2007Q3-2009Q2					
1	**NNBTILQ027SBDIx**	0.28	USSTHPI	0.14	**capr**	0.20
2	**capr**	0.29	prfi_gdp	0.18	hpi	0.33
3	PRFIx	0.38	hpi	0.20	USSTHPI	0.34
4	cli	0.42	HNOREMQ027Sx	0.32	HNOREMQ027Sx	0.40
5	hpi	0.43	SPCS10RSA	0.32	TNWBSNNBx	0.42
6	NWPIx	0.44	pr	0.32	prfi_gdp	0.46
7	prfi_gdp	0.47	**capr**	0.33	OUTMS	0.48
8	NNBTASQ027Sx	0.48	TNWBSNNBx	0.39	pr	0.49
9	mortg	0.52	**NNBTILQ027SBDIx**	0.40	TWEXMMTH	0.53
10	B020RE1Q156NBEA	0.53	NNBTASQ027Sx	0.41	mortg	0.56
	post-Crisis period: 2009Q3-2017Q4					
1	IPNCONGD	0.67	**NNBTILQ027SBDIx**	0.35	**capr**	0.31
2	pr	0.68	**capr**	0.59	pr	0.48
3	PCECC96	0.71	cli	0.63	**NNBTILQ027SBDIx**	0.49
4	cred_gdp	0.73	ISRATIOx	0.79	cred_gdp	0.70
5	LIABPIx	0.76	TWEXMMTH	0.85	LIABPIx	0.82
6	bci	0.76	LIABPIx	0.89	ISRATIOx	0.85
7	B021RE1Q156NBEA	0.76	cred_gdp	0.91	B021RE1Q156NBEA	0.86
8	IPCONGD	0.77	mortg_inc	0.91	cli	0.89
9	TWEXMMTH	0.80	NWPIx	0.98	MORTGAGE30US	0.99
10	ISRATIOx	0.80	AMDMUOx	1.00	TWEXMMTH	1.02

Notes: MSFEs for the h-quarter (cumulative) GDP growth rate, relative to the benchmark AR model. Please refer to Section 4.5 of the paper for details.

Table A5: VAR forecasts: MSFEs calculated on sub-periods

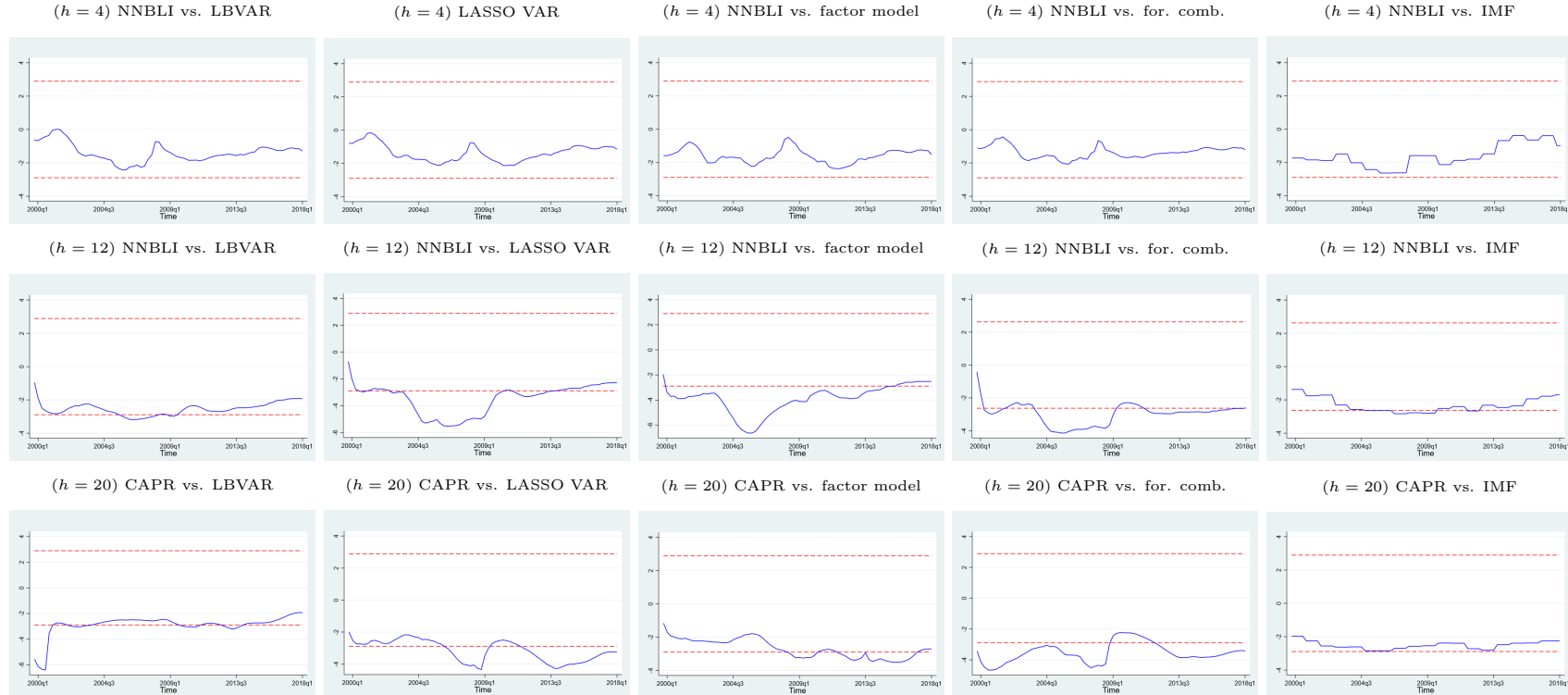|		$h = 4$		$h = 12$		$h = 20$	
	pre-Crisis period: 1990Q1-2007Q2						
1	**NNBTILQ027SBDIx**	0.59	**NNBTILQ027SBDIx**	0.63	UNRATELTx	0.66
2	prfi_gdp	0.81	IMPGSC1	0.72	LNS14000012	0.73
3	OUTNFB	0.84	LNS14000012	0.75	REALLNx	0.73
4	S&P: div. yield	0.84	UNRATELTx	0.80	TB3SMFFM	0.74
5	LNS14000012	0.85	HOUSTNE	0.81	IMPGSC1	0.75
6	PERMITS	0.88	CPIMEDSL	0.83	HNOREMQ027Sx	0.78
7	TLBSNNCBBDIx	0.88	IPNCONGD	0.87	**NNBTILQ027SBDIx**	0.79
8	CPIMEDSL	0.90	PERMITNE	0.88	VXOCLSX	0.79
9	BAA	0.90	OUTNFB	0.89	prfi_gdp	0.80
10	OUTBS	0.90	GPDIC1	0.90	GPDIC1	0.82
	Crisis period: 2007Q3-2009Q2						
1	PRFIx	0.20	pr	0.15	HNOREMQ027Sx	0.48
2	**capr**	0.23	**capr**	0.18	ISRATIOx	0.55
3	**NNBTILQ027SBDIx**	0.31	**NNBTILQ027SBDIx**	0.32	prfi_gdp	0.57
4	cli	0.35	prfi_gdp	0.35	TNWBSNNBx	0.59
5	hpi	0.36	ISRATIOx	0.36	REVOLSLx	0.63
6	pr	0.40	HNOREMQ027Sx	0.36	USSTHPI	0.63
7	PERMITW	0.44	USSTHPI	0.40	TWEXMMTH	0.66
8	HOUST	0.45	AMDMUOx	0.45	TLBSHNOx	0.69
9	HOUSTS	0.46	TB3MS	0.53	UNRATESTx	0.70
10	PERMITMW	0.46	NNBTASQ027Sx	0.53	PCESVx	0.70
	post-Crisis period: 2009Q3-2017Q4						
1	A014RE1Q156NBEA	0.70	pr	0.15	pr	0.07
2	PCECC96	0.74	**capr**	0.15	**capr**	0.09
3	S&P: div. yield	0.78	**NNBTILQ027SBDIx**	0.18	**NNBTILQ027SBDIx**	0.35
4	pr	0.80	cli	0.51	ISRATIOx	0.37
5	ISRATIOx	0.80	ISRATIOx	0.53	TWEXMMTH	0.60
6	PERMITW	0.81	TWEXMMTH	0.62	B021RE1Q156NBEA	0.60
7	cape	0.81	B021RE1Q156NBEA	0.65	NWPIx	0.62
8	IPCONGD	0.81	UNRATESTx	0.66	USMINE	0.66
9	UNRATESTx	0.81	NWPIx	0.66	cli	0.70
10	EXCAUSx	0.84	AMDMUOx	0.69	UNRATESTx	0.71

Notes: MSFEs for the h-quarter (cumulative) GDP growth rate, relative to the benchmark AR model. Please refer to Section 4.5 of the paper for details.

Figure A1: Forecasting other recessions: CAPR and NNBLI

(a) 1990-1991 recession

(b) 2001 recession

Notes: This figure shows forecasts of U.S. GDP produced by bivariate VAR models using either CAPR or NNBLI. In panel (a), forecasts are generated in 1990Q2 using models estimated on the sample 1967Q1-1990Q2. In panel (b), they are generated in 2000Q4 using models estimated on the sample 1967Q1-2000Q4.

Figure A2: Comparing forecast accuracy under instability: the Giacomini-Rossi (2010) test

Notes: The figure shows the sequence of loss differences over time (continuous blue line) between forecasts produced by one-predictor models using NNBLI or CAPR and forecasts by competing high-dimensional models, along with the 5% critical values of the Giacomini and Rossi (2010) test (dashed red lines). A loss difference crossing the lower dashed line indicates that forecasts based on NNBLI or CAPR significantly outperform the competing forecasts.

Table A6: Comparing variable selection methods

LASSO ($\lambda = 0.005$)			Shrinkage ("horseshoe") prior			Random Forest			LASSO VAR (GDP equation)
$h = 4$	$h = 12$	$h = 20$	$h = 4$	$h = 12$	$h = 20$	$h = 4$	$h = 12$	$h = 20$	
DOTSRG3Q086SBEA	**capr**	AHETPIx	LNS14000012	AWHMAN	BUSLOANSx	pr	**capr**	**capr**	bci
MORTGAGE30US	AHETPIx	AMDMUOx	**NNBTILQ027SBDIx**	CLI	EXJPUSx	AAAFFM	pr	pr	CLAIMSx
NNBTILQ027SBDIx	AMDMUOx	**capr**	TNWMVBSNNCBBDIx	HWIx	HWIx	**NNBTILQ027SBDIX**	AMDMUOX	cred_gdp	cli
PCESVx	CES9091000001	CES3000000008x	UMCSENTx	**NNBTILQ027SBDIx**	**NNBTILQ027SBDIx**	cred_gdp	**NNBTILQ027SBDIx**	mortg_inc	DODGRG3Q086SBEA
PERMITMW	DOTSRG3Q086SBEA	cli	VXOCLSx	TNWBSNNBBDIx	S&P: div. yield	AMBSLREALX	cred_gdp	hpi	DONGRG3Q086SBEA
T5YFFM	DSERRG3Q086SBEA	cred_gdp		TNWMVBSNNCBBDIx	TLBSNNCBBDIx	T5YFFM	mortg_inc	prfi_gdp	GDPC1
USMINE	HWIX	LNS13023705		UMCSENTx	TNWMVBSNNCBBDIx	mortg_inc	USMINE	NWPIx	mortg
	IPNCONGD	pip_inc				**capr**	GPDICTPI	HNOREMQ027Sx	**NNBTILQ027SBDIx**
	USMINE	USMINE					TCU	TNWBSNNBx	OPHNFB
	B020RE1Q156NBEA	COMPRNFB					prfi_gdp		PCECC96
	FEDFUNDS	EXJPUSx					TB3MS		PCESVx
	NNBTILQ027SBDIx	GFDEBTNx					HWIx		PERMIT
	UMCSENTx	M2REALx							PERMITMW
		NNBTILQ027SBDIx							PRFIx
		REVOLSLx							S&P: indust.
		TWEXMMTH							S&P: div. yield
									UEMPLT5
									UMCSENTx

Notes: The table shows the list of predictors of GDP selected by different variables-selection methods (see Section 4.7 of the paper for details). For each h, the dependent variable is GDP growth over h quarters.

Table A7: Forecasts using real-time data: MSFEs

		$h = 4$			$h = 12$			$h = 20$	
		ARDL							
1	**capr**	0.69	pr		0.54	pr			0.23
2	**NNBTILQ027SBDIx**	0.70	**capr**		0.59	**capr**			0.26
3	pr	0.72	**NNBTILQ027SBDIx**		0.62	**NNBTILQ027SBDIx**			0.76
4	HOUSTW	0.83	AMDMUOx		0.96	ISRATIOx			0.81
5	PERMITW	0.84	AAA		0.99	cli			0.96
6	PERMIT	0.86	gs10		0.99	IPCONGD			1.09
7	DPCERA3M086SBEA	0.88	USTRADE		1.00	EXUSUKx			1.11
8	PERMITMW	0.88	GS5		1.00	UMCSENTx			1.12
9	prfi_gdp	0.91	BAA		1.01	IPDCONGD			1.12
10	PERMITS	0.93	DPCERA3M086SBEA		1.06	IPNMAT			1.13
		VAR							
1	pr	0.66	**NNBTILQ027SBDIx**		0.52	pr			0.48
2	**capr**	0.68	pr		0.58	**capr**			0.51
3	**NNBTILQ027SBDIx**	0.75	**capr**		0.58	**NNBTILQ027SBDIx**			0.56
4	HOUSTW	0.82	AMDMUOx		0.80	ISRATIOx			0.85
5	prfi_gdp	0.85	CES1021000001		0.81	cli			0.85
6	AMDMUOx	0.87	cli		0.87	AMDMUOx			0.87
7	PERMIT	0.87	IPNMAT		0.92	CES1021000001			0.88
8	S_P_div_yield	0.87	HOUST		0.95	IPNMAT			0.89
9	HOUST	0.88	PERMIT		0.96	prfi_gdp			0.91
10	PERMITMW	0.88	HOUSTW		0.97	IPDCONGD			0.96

Notes: Out-of-sample MSFEs for the *h*-quarter (cumulative) GDP growth rate, relative to an AR model. All models are estimated on recursive windows, using historical data vintages (see Section 4.8 of the paper for details). All MSFEs are computed over the period 1990Q1-2017Q4.

References

Giacomini, R. and Rossi, B. (2010), "Forecast Comparisons in Unstable Environments," *Journal of Applied Econometrics*, vol. 25 (4), pp. 595–620.

McCracken, M.W. and Ng, S. (2021), "FRED-QD: A Quarterly Database for Macroeconomic Research," *Federal Reserve Bank of St. Louis Review*, vol. 103 (1), pp. 1–44.