Predicting Long-Term Financial Returns: VAR vs. DSGE Model – A Horse-Race
Online Appendix

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A DSGE Model

A.1 Analysis of the Bond and Stock Premia

In this section, we discuss the dynamics of the bond and stock risk premia and their drivers. Then, we investigate the role played by the risk premia in the model.

A.1.1 Evolution of the Bond and Stock Premia

The evolution of the bond and stock premia implied by the full and restricted DGSE models is displayed in Figure A1. These premia have a mean equal to 0 by construction. We find several interesting results. As the figure shows, the stock premium is more persistent than the bond premium ($\rho_s = 0.58$ vs. $\rho_b = 0.34$). However, they exhibit similar annualized volatility: 33% for the bond premium and 37% for the stock premium. The shaded bars represent NBER-dated recessions. Before economic downturns, we observe a decrease in the term spread, which corresponds to monetary policy tightening. In the recession, the short-term rate goes down and the bond premium decreases. The large value of the premium in the period 1981–1985 follows the Federal Reserve's adoption of a nonborrowed reserve operating procedure. This dynamics of the bond premium is similar to the evolution reported by Sangvinatsos and Wachter (2005) for their model-implied long-term bond risk premia. We note that the bond premium decreased dramatically during and after the subprime crisis. This fall in the bond premium is necessary to explain the relatively large term spread observed after the monetary easing in 2008.

As Panel B reveals, the stock risk premium increases significantly prior to and during cyclical downturns. The evolution of the stock risk premium is in fact characterized by two main phases: it experiences a large decrease from a maximum value of 15% in 1976 to a minimum of -30% in 2000. This evolution reflects the very low valuation ratio during the development of the dot-com bubble. Campbell and Thompson (2008) report a similar decrease in the stock market excess return. Thereafter, the premium increases substantially during the recession periods and decreases during recovery periods. At the end of the period, the stock premium nearly returns to its sample average, reflecting a fair valuation.

In Panels C and D, we display the dynamics of the risk premia obtained with the restricted DGSE model, which correspond to pure ARMA(1,1) processes. As the lower part of the figure shows, in this model the evolution of the implied stock risk premium is similar to the evolution obtained with the full model. This result suggests that the dynamics of the stock premium is largely driven by its autoregressive term. However, the restricted model fails to capture the properties of the bond risk premium. As the scale of the top figure shows, the premium is approximately 10 times smaller than the premium obtained with the full model. Several papers have reported the difficulty of standard DSGE models in fitting the term structure because of their inability to capture the dynamics of the term premium (e.g., Hördahl et al., 2006). This result is confirmed by our restricted model, which is unable to reproduce long-term rate movements. In contrast, the full DSGE model performs well because it allows the bond premium to depend on its actual drivers.

[Insert Figure A1 here]

A.1.2 Contribution of the Bond and Stock Risk Shocks

Figures A2 to A4 display the impulse responses of the key variables of the model to one-standard deviation in the monetary policy shock, the bond risk shock, and the stock risk shock. The 95% confidence interval is also represented.

As expected, a contractionary monetary policy shock induces a decrease in consumption and investment (Figure A2). Model-consistent dividends increase due to the fall in investment. However, the market value of the firm decreases because of the rise in the discount rate, which reduces the present value of future cash flows. The fall in the market value of the firm is amplified by the negative impact of the monetary policy shock on the stock premium. This effect, although limited, results in a decrease in market value of 1.5% at impact. In the restricted DSGE model, the decline in the market value is only 0.2%.

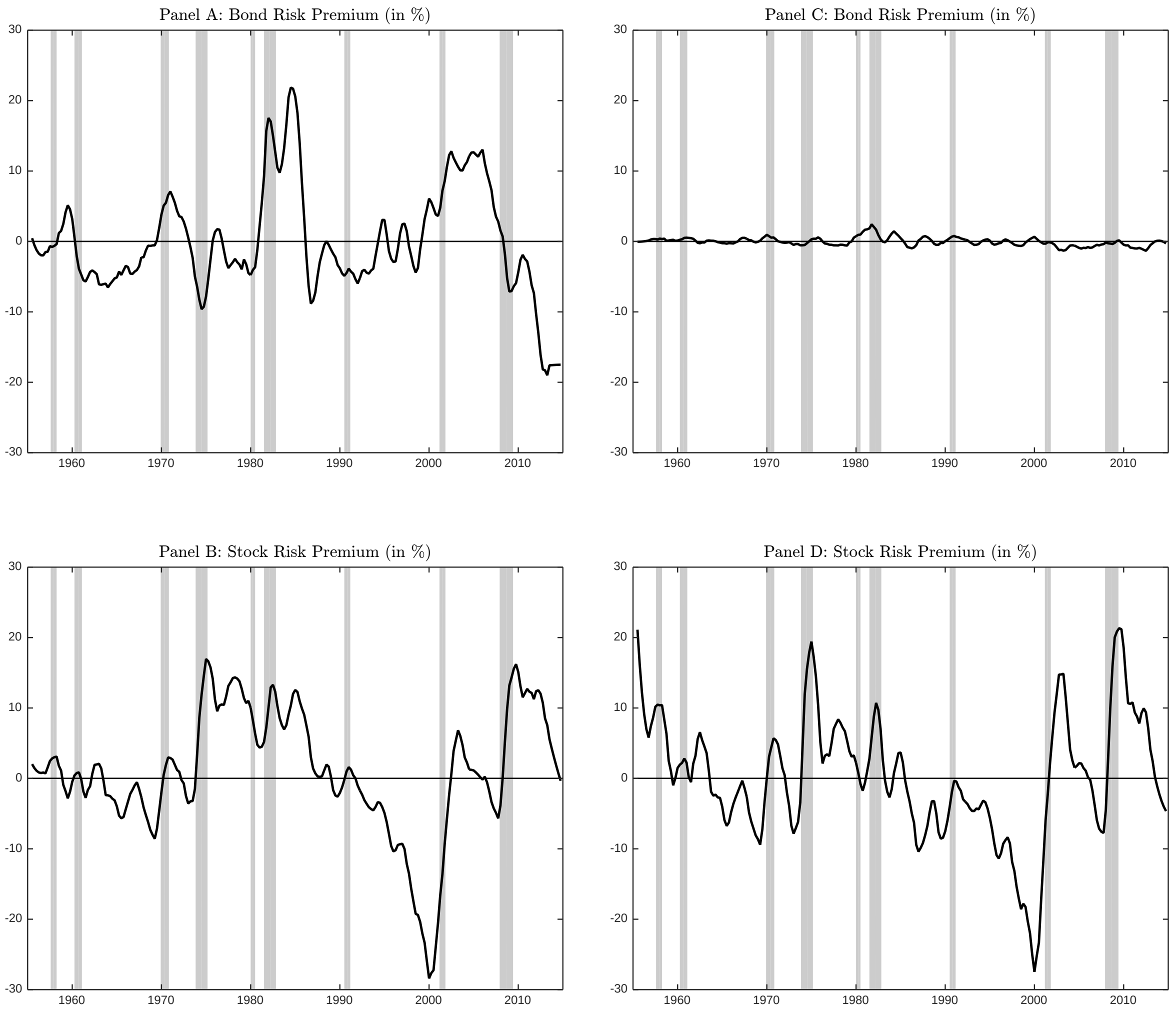
Contrary to the monetary policy shock, a shock on the bond risk (Figure A3) results in a decrease in the real short-term interest rate at impact, resulting in a rise in consumption. In parallel, the bond risk negatively affects the stock premium ($\vartheta_{s,b} = -0.182$). The decrease in the stock premium causes a rise in the market value of the firm and in the firm's investment through the valuation effect.

The shock on the stock risk also implies an increase in the bond premium because of the large and positive coefficient $\vartheta_{b,s} = 0.654$ (Figure A4). In parallel, the 3.4% initial increase in the stock premium shock strongly depresses the market value of the firm, by approximately 4.5% at impact, and increases the real short-term and long-term rates at impact. These effects combine to depress economic activity and the inflation rate. The decline in output is approximately 0.8% after one year. The magnitude is similar to that from the evaluation reported by Alpanda (2013).

[Insert Figures A2 to A4 here]

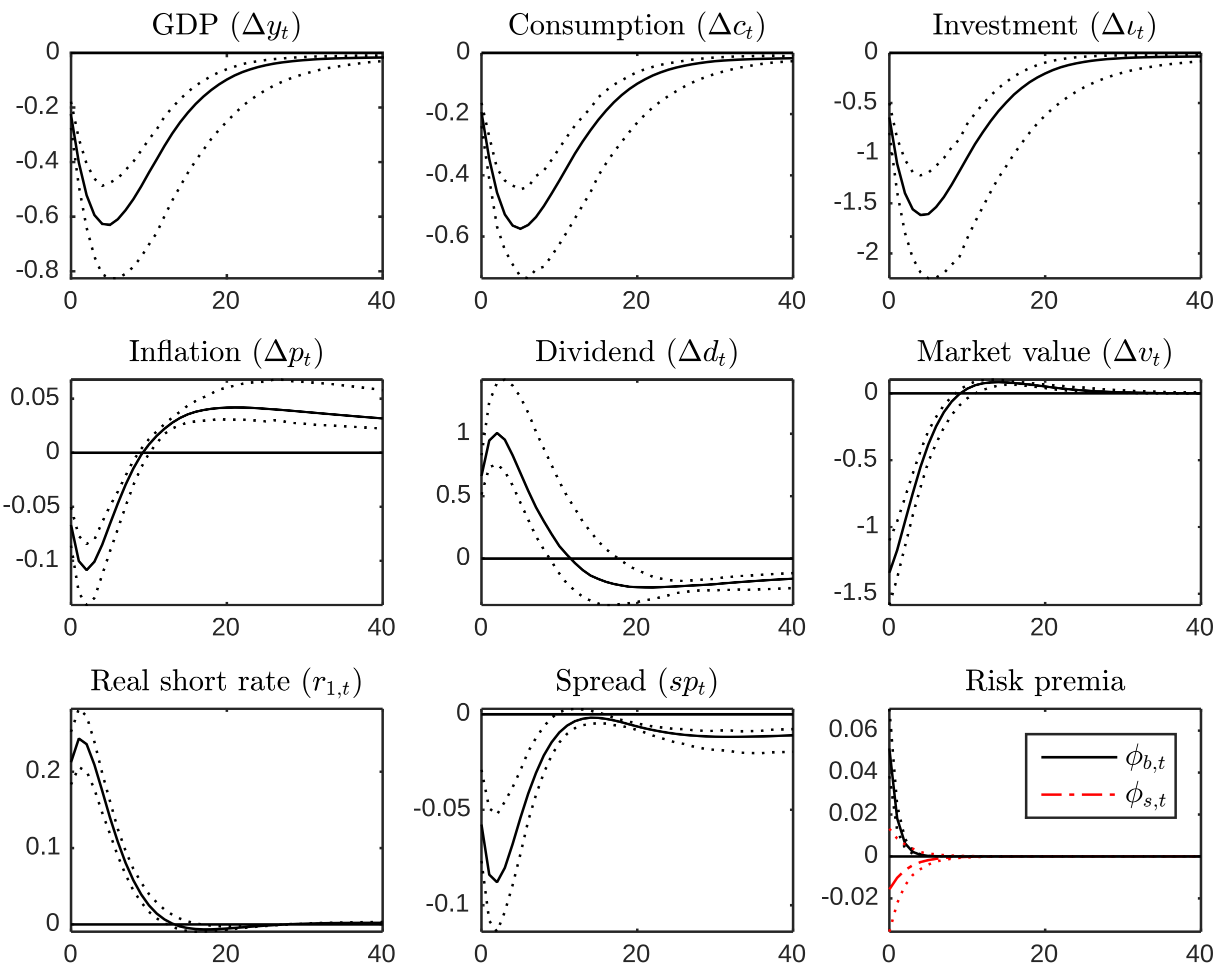
Figure A1: Bond and stock premia – Full DSGE model

Unrestricted DSGE model | Restricted DSGE model



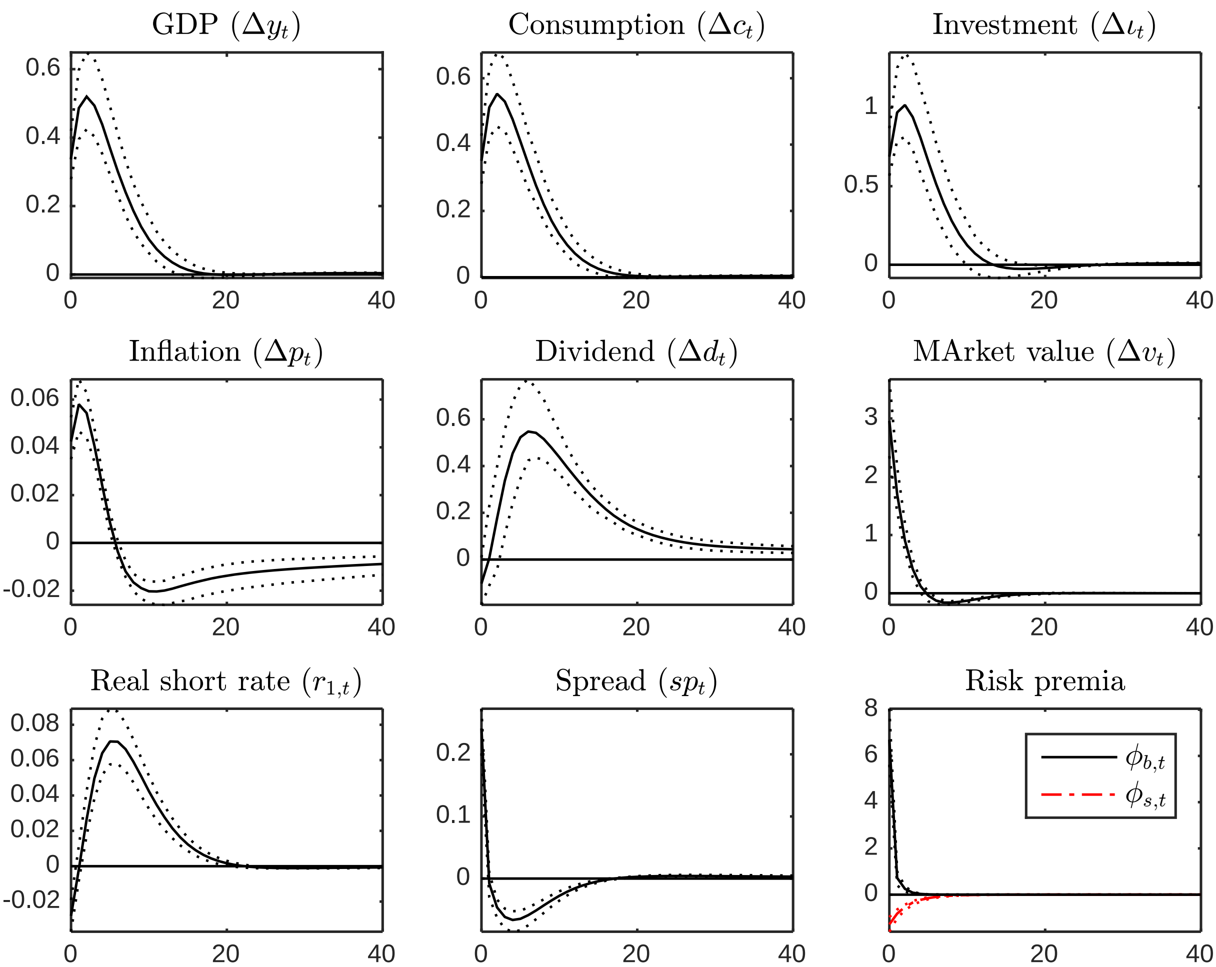
Note: The figure displays the evolution of the bond and stock risk premia estimated with the full DSGE model. The shaded bars represent the NBER-dated recessions.

Figure A2: Impulse response to 1 standard deviation monetary shock



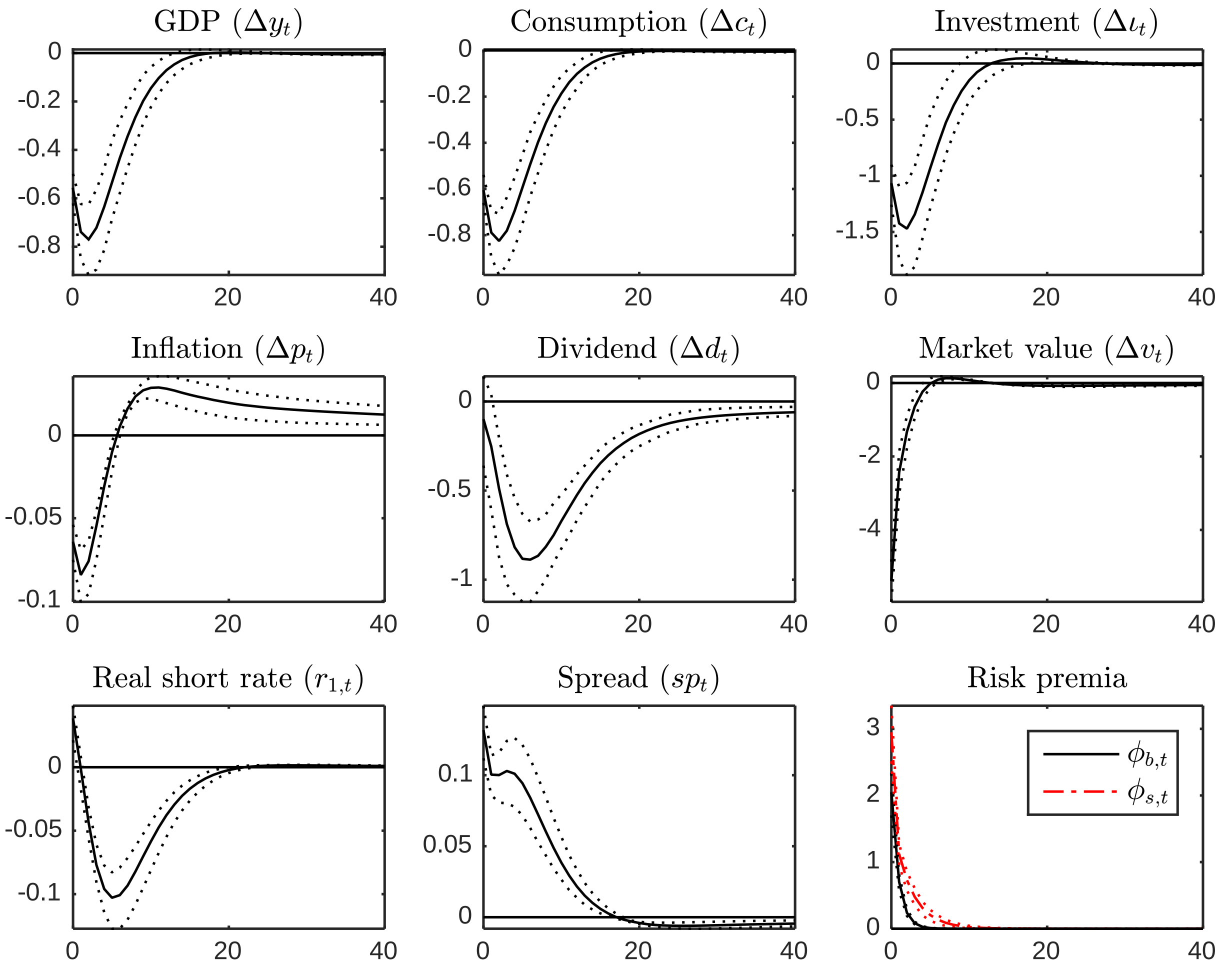
Note: The figure displays the impulse response to a one standard deviation monetary shock (% deviation from the linear trend).

Figure A3: Impulse response to 1 standard deviation bond risk premium shock



Note: The figure displays the impulse response to a one standard deviation bond risk premium shock (% deviation from the linear trend).

Figure A4: Impulse response to 1 standard deviation stock risk premium shock



Note: The figure displays the impulse response to a one standard deviation stock risk premium shock (% deviation from the linear trend).

A.2 Parameter Estimates of the Restricted DSGE Model

Table A1: Parameter estimates of the restricted DSGE model

		Prior			Posterior distribution		
		Dist.	Par.1	Par.2	Mode	5%	95%
ζ	Habit	beta	0.7	0.1	0.908	0.901	0.915
σ_C	Consumption elasticity	norm	1.5	0.37	1.514	1.491	1.546
σ_L	Labor supply elasticity	norm	2	0.75	2.977	2.847	3.152
ψ	Wage markup	norm	1.5	0.12	1.524	1.512	1.537
θ	Price markup	norm	1.5	0.12	1.789	1.773	1.806
χ^e	Utilization elasticity	beta	0.5	0.15	0.815	0.795	0.836
κ_w^e	Adjustment cost - Wage	beta	0.5	0.1	0.604	0.592	0.617
κ_p^e	Adjustment cost - Price	beta	0.6	0.1	0.790	0.778	0.804
κ_ι	Adjustment cost - Invest.	norm	4	1.5	4.185	3.876	4.429
η_w	Wage indexation	beta	0.5	0.15	0.839	0.817	0.861
η_p	Price indexation	beta	0.5	0.15	0.509	0.477	0.545
ρ_r	Taylor - Smoothing	beta	0.75	0.1	0.922	0.911	0.930
a_π	Taylor - Inflation	norm	1.5	0.25	1.440	1.408	1.468
a_y	Taylor - Output gap	norm	0.12	0.05	0.331	0.324	0.338
a_g	Taylor - Output growth	norm	0.12	0.05	-0.070	-0.079	-0.063
ρ_v	AR term. Preference	beta	0.5	0.2	0.990	0.987	0.993
ρ_ψ	AR term. Wage markup	beta	0.6	0.2	0.852	0.836	0.870
ρ_θ	AR term. Price markup	beta	0.5	0.2	0.932	0.920	0.943
ρ_z	AR term. Technology	beta	0.5	0.2	0.972	0.965	0.980
ρ_ι	AR term. Investment	beta	0.6	0.2	0.852	0.832	0.869
ρ_g	AR term. Government	beta	0.5	0.2	0.634	0.601	0.672
ρ_r	AR term. Monetary	beta	0.5	0.2	0.543	0.524	0.561
ρ_d	AR term. Dividend	beta	0.5	0.2	0.950	0.940	0.960
ρ_b	AR term. Bond risk premium	beta	0.5	0.2	0.992	0.986	0.999
ρ_s	AR term. Stock risk premium	beta	0.5	0.2	0.407	0.369	0.446
$\rho_{\bar{\pi}}$	AR term. Target inflation	beta	0.5	0.2	0.468	0.434	0.497
$\rho_{g,z}$	Cross-corr. Gvt-Prod.	beta	0.5	0.2	0.644	0.626	0.662
ς_v	MA term. Preference	beta	0.5	0.2	0.581	0.567	0.598
ς_ψ	MA term. Wage markup	beta	0.5	0.2	0.209	0.180	0.244
ς_θ	MA term. Price markup	beta	0.5	0.2	0.898	0.882	0.915
ς_z	MA term. Technology	beta	0.5	0.2	0.307	0.290	0.332
ς_ι	MA term. Investment	beta	0.5	0.2	0.713	0.691	0.734
ς_g	MA term. Government	beta	0.5	0.2	0.007	0.001	0.012
ς_r	MA term. Monetary	beta	0.5	0.2	0.834	0.794	0.880
ς_d	MA term. Dividend	beta	0.5	0.2	0.017	0.002	0.030
ς_b	MA term. Bond risk premium	beta	0.5	0.2	0.896	0.878	0.908
ς_s	MA term. Stock risk premium	beta	0.5	0.2	0.164	0.139	0.188
$\varsigma_{\bar{\pi}}$	MA term. Target inflation	beta	0.5	0.2	0.013	0.003	0.024

Table A2: Parameter estimates of the restricted DSGE model (continued)

		Priors			Posterior distribution		
		Dist.	Par.1	Par.2	Mode	5%	95%
Standard deviation of shocks ($\times$100)							
σ_v	Preference	invg	0.005	Inf	16.67	15.10	18.13
σ_ψ	Wage markup	invg	0.005	Inf	0.56	0.50	0.62
σ_θ	Price markup	invg	0.005	Inf	0.22	0.20	0.24
σ_z	Technology	invg	0.005	Inf	0.62	0.57	0.67
σ_ι	Investment	invg	0.005	Inf	2.39	2.15	2.61
σ_g	Government	invg	0.005	Inf	8.52	7.43	9.50
σ_r	Monetary	invg	0.005	Inf	0.14	0.12	0.16
σ_d	Dividend	invg	0.005	Inf	0.90	0.83	0.97
σ_b	Bond risk premium	invg	0.005	Inf	1.09	0.88	1.30
σ_s	Stock risk premium	invg	0.005	Inf	7.23	6.36	7.98
$\sigma_{\bar{\pi}}$	Target inflation	invg	0.005	Inf	1.36	1.14	1.64

Note: The table reports the information about the prior and posterior distributions of the parameters. For the prior distribution, the table indicates the class of distribution and its mean and standard deviation. For the posterior distribution, the table reports the mean and the 5%–95% confidence interval. The acronyms "beta", "norm.", and "invg" stand for the Beta, the normal, and the inverse Gamma distributions. Parameters χ^e, κ_w^e, and κ_p^e are rescaled versions of parameters χ, κ_w, and κ_p, as explained in Appendix C.

A.3 Dynamics of Parameter Estimates

Figure A5: Parameter dynamics: Structural parameters

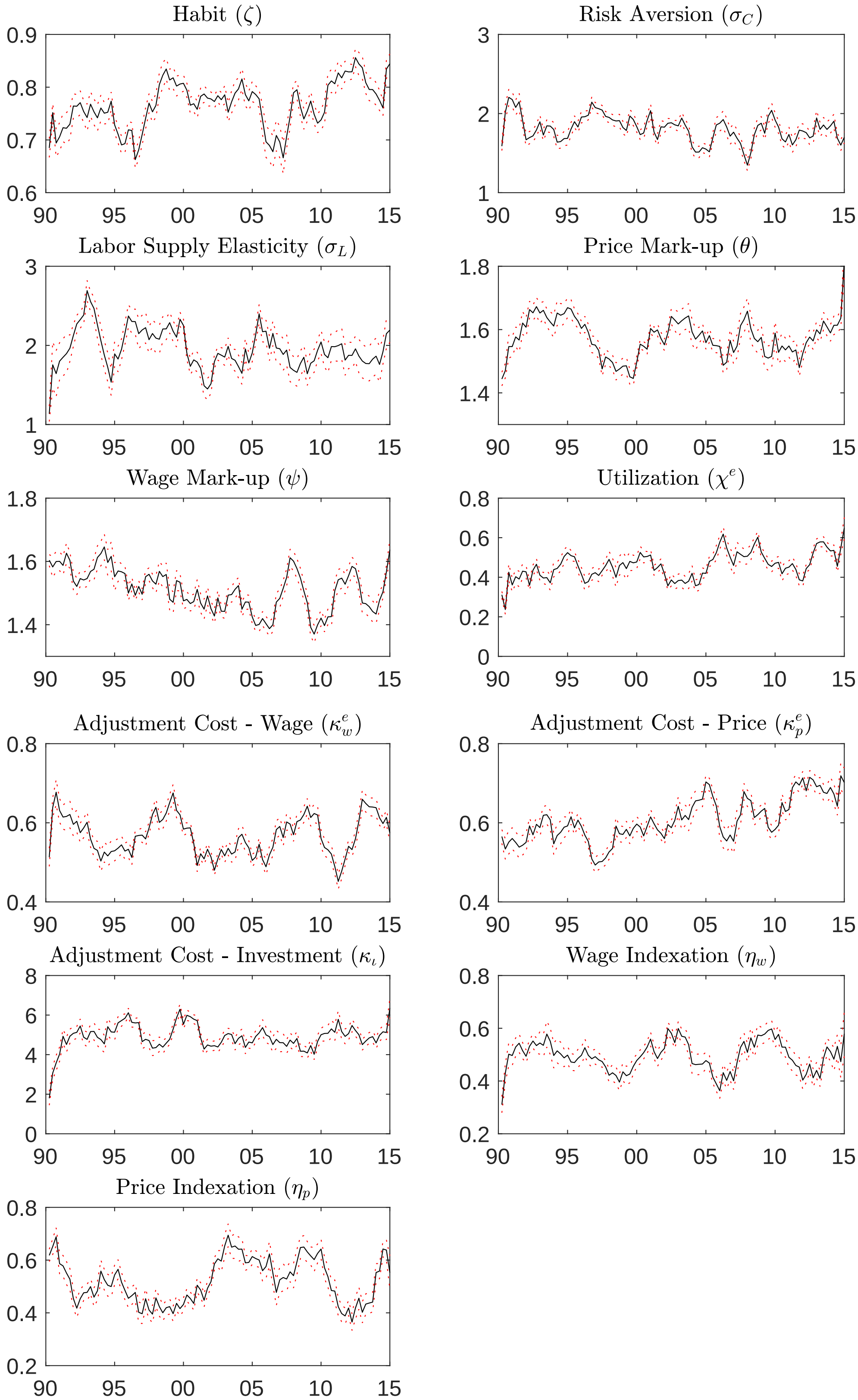


Figure A6: Parameter dynamics: Monetary policy

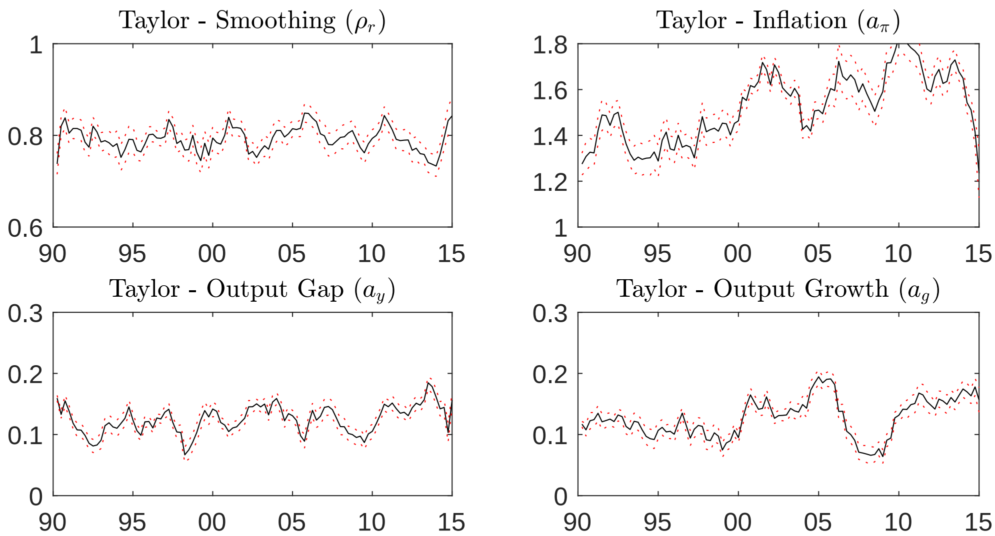


Figure A7: Parameter dynamics: Autoregressive terms

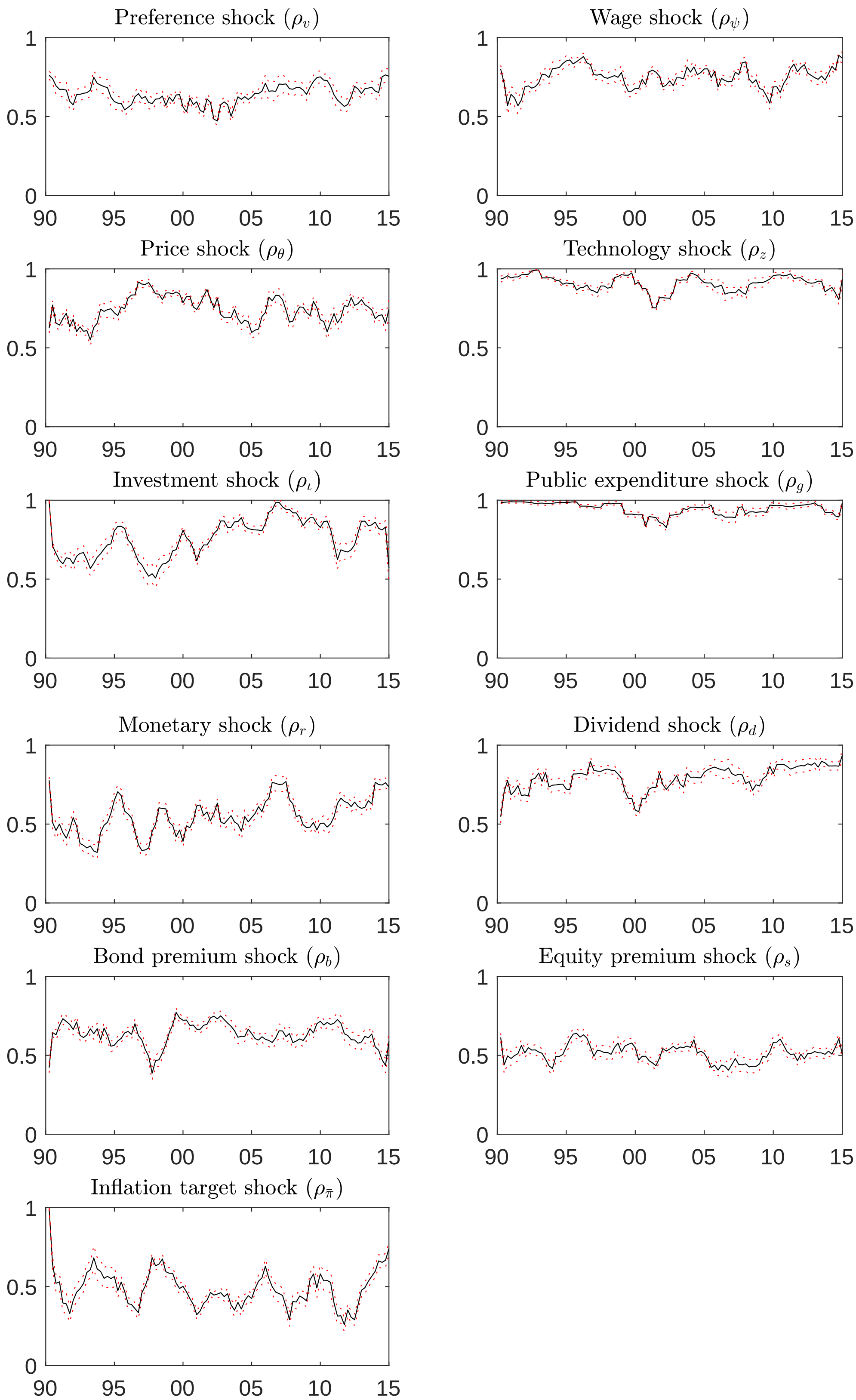


Figure A8: Parameter dynamics: Moving average terms

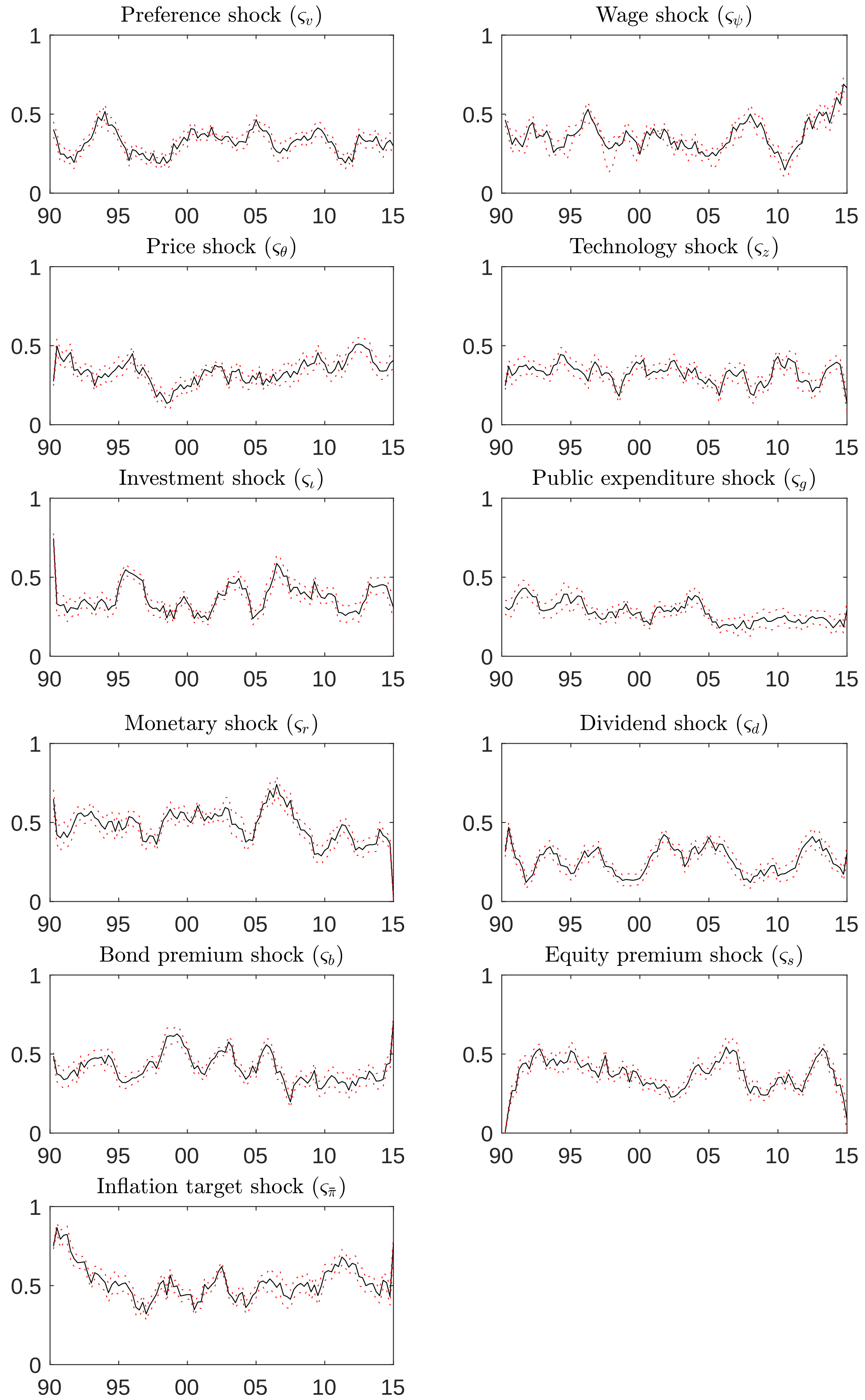


Figure A9: Parameter dynamics: Spillover shock to bond premium

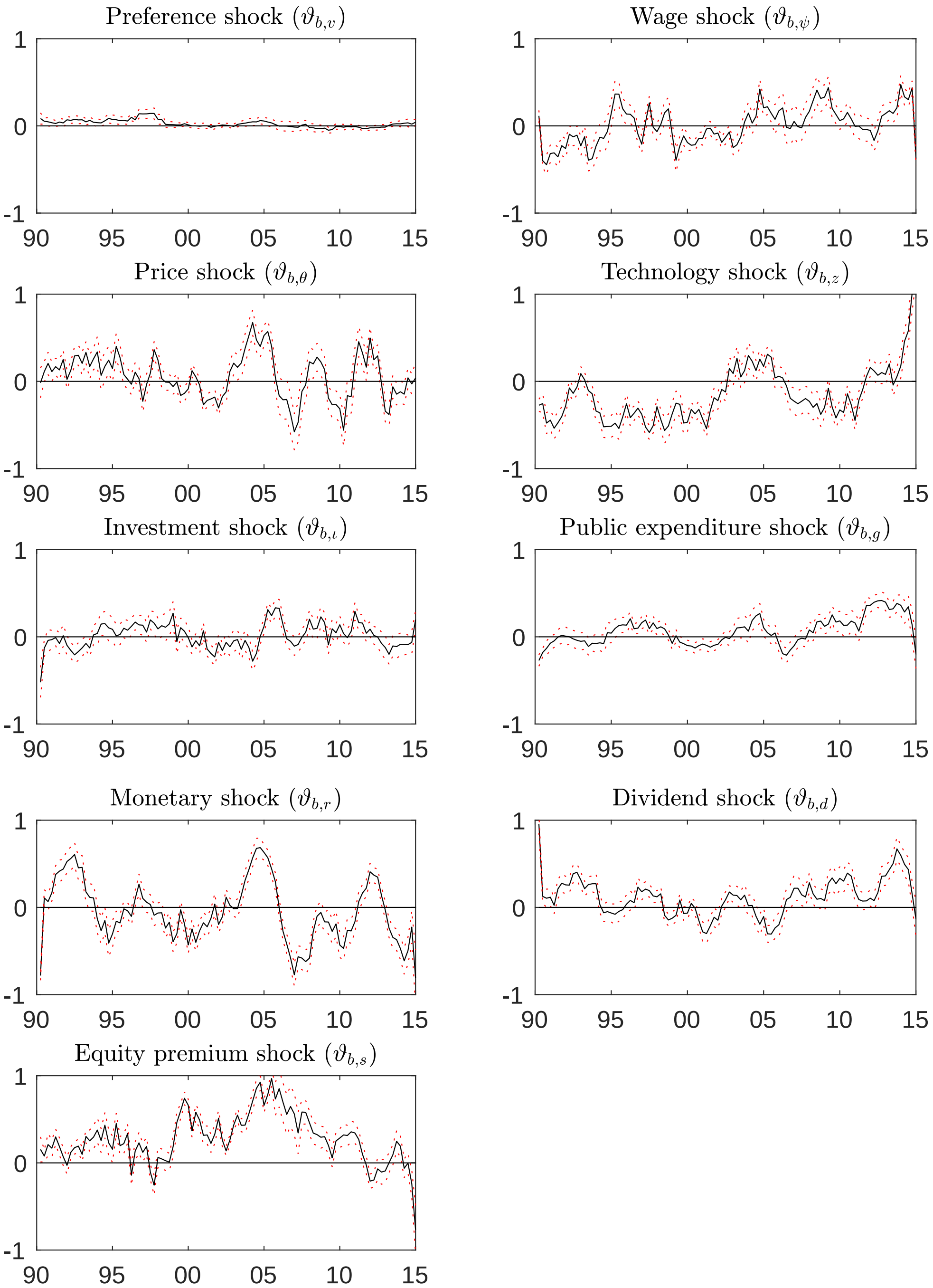


Figure A10: Parameter dynamics: Spillover shock to stock premium

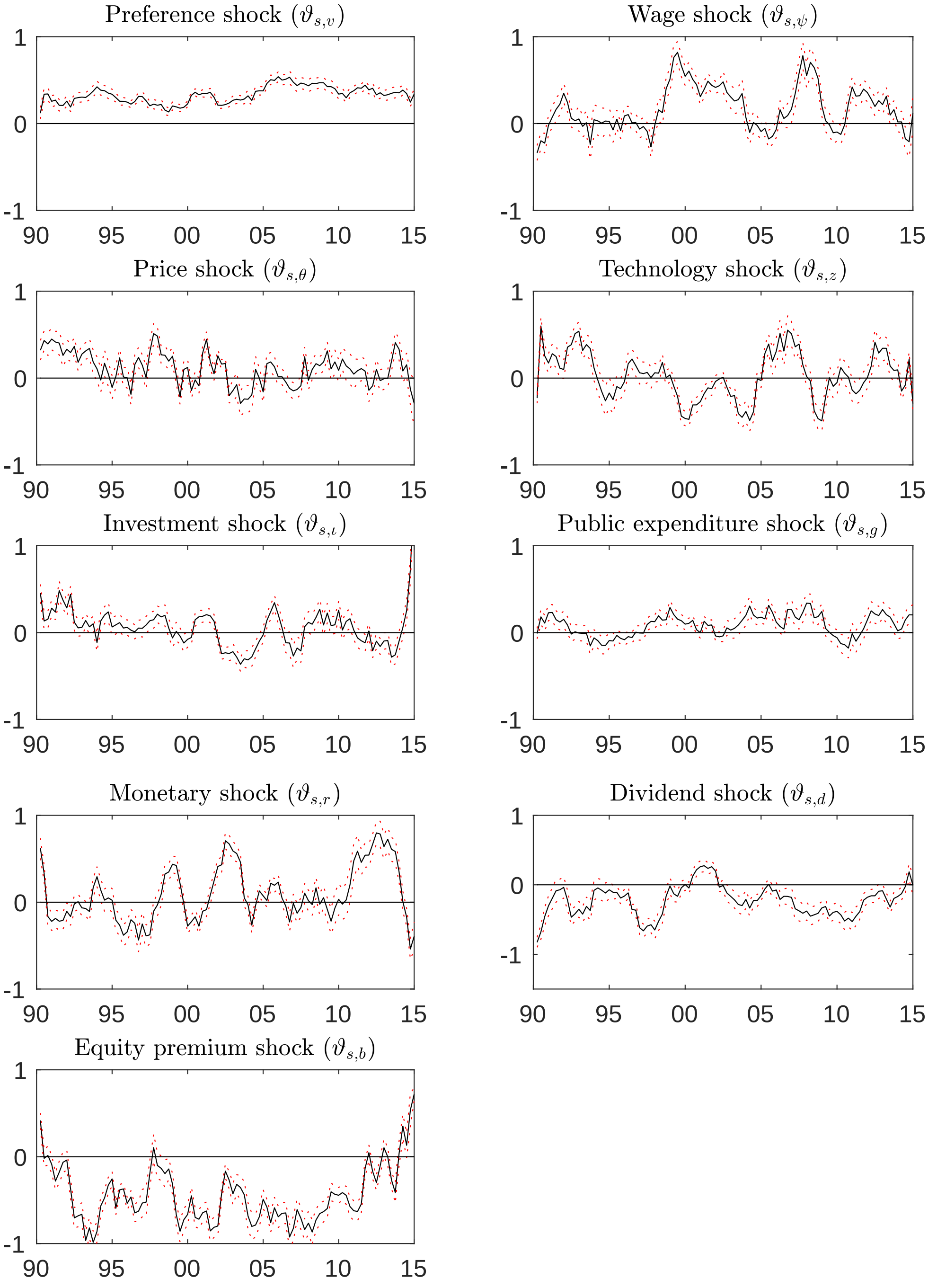
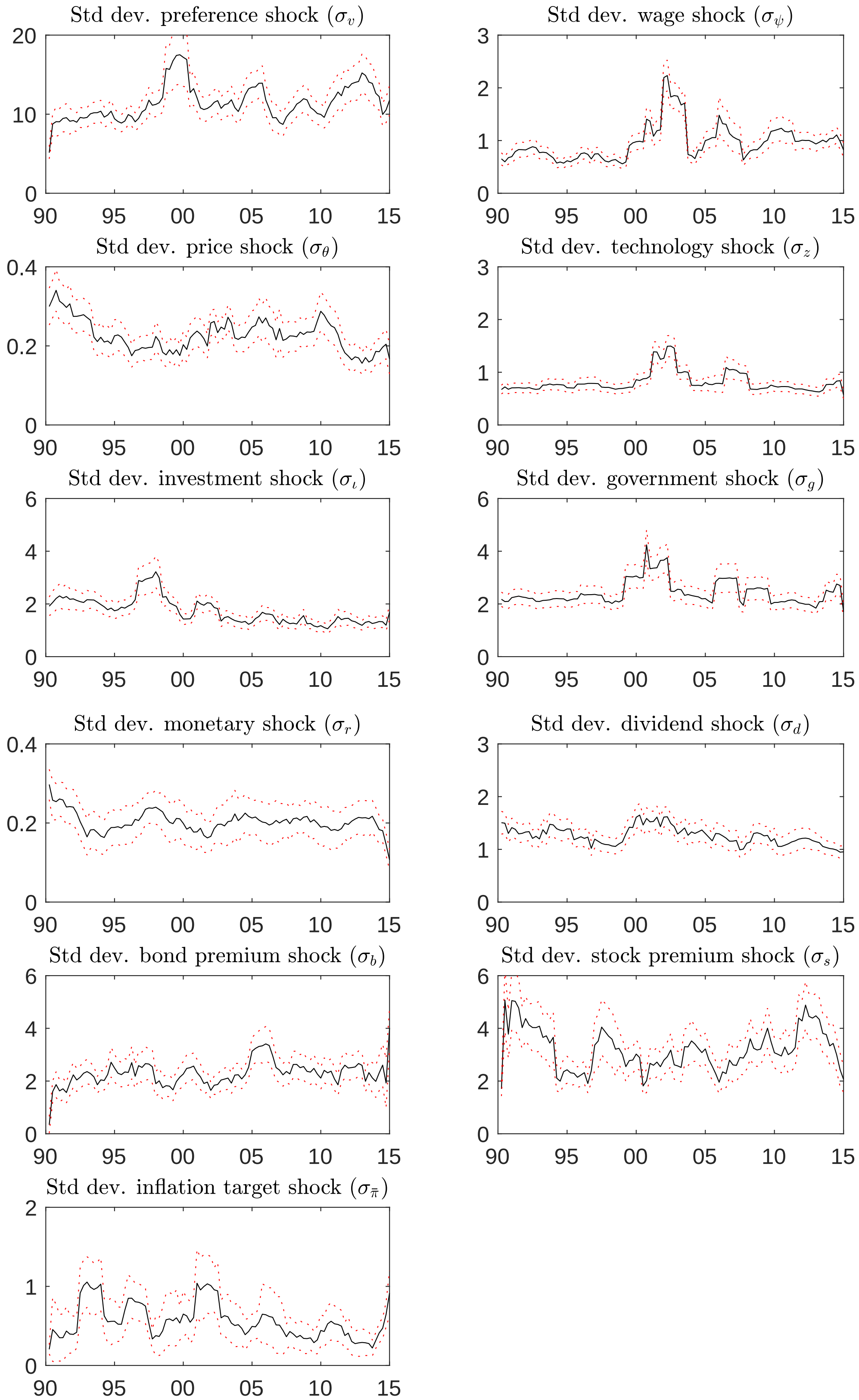


Figure A11: Parameter dynamics: Std dev. of shocks



B Alternative VAR specifications

Table A3: Parameter estimates of the Bayesian VAR(1)

	Δy_t	Δc_t	$\Delta \iota_t$	Δh_t	Δw_t	Δp_t	$r_{1,t}$	sp_t	$x_{b,t}$	$x_{s,t}$	dpr_t
Δy_{t+1}	-0.24	0.44	0.03	0.22	0.07	0.03	0.04	0.49	0.00	0.02	0.00
	(0.21)	(0.17)	(0.04)	(0.10)	(0.09)	(0.15)	(0.12)	(0.24)	(0.02)	(0.01)	(0.00)
Δc_{t+1}	-0.04	0.13	0.04	0.03	0.11	0.07	0.11	0.44	0.04	0.02	0.00
	(0.16)	(0.14)	(0.03)	(0.08)	(0.07)	(0.12)	(0.10)	(0.19)	(0.02)	(0.01)	(0.00)
$\Delta \iota_{t+1}$	-2.12	3.08	0.13	1.46	-0.11	0.35	-0.15	2.14	-0.14	0.09	-0.01
	(0.90)	(0.75)	(0.15)	(0.45)	(0.38)	(0.65)	(0.54)	(1.06)	(0.10)	(0.04)	(0.01)
Δh_{t+1}	-0.06	0.48	0.04	0.10	-0.03	0.23	-0.01	0.47	-0.01	0.03	0.00
	(0.21)	(0.18)	(0.04)	(0.11)	(0.09)	(0.15)	(0.13)	(0.25)	(0.02)	(0.01)	(0.00)
Δw_{t+1}	0.12	0.11	-0.01	-0.06	-0.13	-0.14	-0.09	-0.29	0.03	0.02	0.00
	(0.21)	(0.18)	(0.04)	(0.10)	(0.09)	(0.15)	(0.13)	(0.25)	(0.02)	(0.01)	(0.00)
Δp_{t+1}	0.06	-0.01	-0.02	0.04	0.02	0.83	0.05	-0.11	0.00	0.00	0.00
	(0.07)	(0.06)	(0.01)	(0.04)	(0.03)	(0.06)	(0.05)	(0.09)	(0.01)	(0.00)	(0.00)
$r_{1,t+1}$	-0.01	0.05	0.01	-0.01	-0.02	0.21	0.87	0.14	-0.01	0.00	0.00
	(0.09)	(0.07)	(0.02)	(0.04)	(0.04)	(0.06)	(0.05)	(0.11)	(0.01)	(0.00)	(0.00)
sp_{t+1}	-0.02	-0.03	0.00	-0.03	0.00	-0.02	0.02	0.90	0.01	0.00	0.00
	(0.04)	(0.04)	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)	(0.06)	(0.01)	(0.00)	(0.00)
$x_{b,t+1}$	-0.85	-0.36	0.15	-0.03	0.06	-0.45	1.24	2.72	0.20	-0.07	0.00
	(0.78)	(0.66)	(0.13)	(0.40)	(0.33)	(0.59)	(0.47)	(0.93)	(0.09)	(0.04)	(0.01)
$x_{s,t+1}$	0.73	-0.81	-0.12	-0.31	0.11	-0.97	-0.66	1.38	0.33	0.04	0.06
	(1.92)	(1.65)	(0.34)	(0.98)	(0.83)	(1.46)	(1.18)	(2.35)	(0.22)	(0.09)	(0.02)
dpr_{t+1}	-0.21	0.25	-0.08	1.03	-0.53	3.30	-0.64	6.33	-0.43	0.08	0.92
	(2.68)	(2.21)	(0.47)	(1.31)	(1.13)	(1.94)	(1.59)	(3.13)	(0.29)	(0.12)	(0.03)

Note: The table reports the parameter estimates for the unrestricted VAR(1) estimated with Bayesian technique. Numbers in parentheses represent the interquartile range of the parameter estimates. We use the notations $dpr_t = d_t - v_t$, $sp_t = y_{b,t} - r_{1,t}$, $x_{b,t} = r_{b,t} - r_{1,t}$, and $x_{s,t} = r_{s,t} - r_{1,t}$.

Table A4: Parameter estimates of the VAR with hours in level

	Δy_t	Δc_t	$\Delta \iota_t$	h_t	Δw_t	Δp_t	$r_{1,t}$	sp_t	$x_{b,t}$	$x_{s,t}$	dpr_t	R^2
Panel A: Parameter estimates												
Δy_{t+1}	-0.32	0.57	0.07	-3.60	0.04	0.02	0.04	0.59	-0.01	0.02	0.00	0.29
	(2.04)	(4.47)	(2.55)	(1.64)	(0.59)	(0.13)	(0.43)	(3.14)	(0.80)	(2.80)	(0.44)	
Δc_{t+1}	-0.02	0.11	0.04	-4.37	0.09	-0.05	0.12	0.54	0.04	0.02	0.00	0.30
	(0.19)	(1.16)	(2.22)	(2.55)	(1.69)	(0.50)	(1.66)	(3.71)	(2.90)	(3.09)	(0.80)	
$\Delta \iota_{t+1}$	-2.24	3.78	0.32	-9.22	-0.21	0.72	-0.20	2.43	-0.20	0.09	-0.01	0.35
	(3.15)	(6.64)	(2.80)	(0.93)	(0.71)	(1.22)	(0.49)	(2.89)	(2.67)	(3.05)	(1.27)	
h_{t+1}	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99
	(0.52)	(4.18)	(2.33)	(446.0)	(0.65)	(2.05)	(0.32)	(2.76)	(0.87)	(3.94)	(0.50)	
Δw_{t+1}	0.13	0.05	-0.02	-6.90	-0.17	-0.09	-0.06	-0.12	0.03	0.01	0.00	0.13
	(0.82)	(0.42)	(0.70)	(3.13)	(2.64)	(0.69)	(0.62)	(0.66)	(2.01)	(2.08)	(0.78)	
Δp_{t+1}	0.06	0.00	-0.01	-0.20	0.02	0.78	0.06	-0.10	-0.01	0.00	0.00	0.77
	(0.95)	(0.11)	(1.27)	(0.24)	(0.62)	(16.0)	(1.69)	(1.37)	(0.88)	(0.92)	(0.25)	
$r_{1,t+1}$	0.05	0.06	0.00	0.35	0.00	0.12	0.92	0.03	-0.02	0.00	0.00	0.95
	(1.13)	(1.78)	(0.50)	(0.60)	(0.06)	(3.53)	(38.4)	(0.64)	(3.84)	(1.32)	(0.33)	
sp_{t+1}	-0.01	-0.05	0.00	-0.34	0.00	-0.06	0.03	0.90	0.01	0.00	0.00	0.81
	(0.39)	(1.74)	(0.37)	(0.68)	(0.17)	(1.89)	(1.27)	(20.9)	(2.65)	(0.04)	(0.75)	
$x_{b,t+1}$	-0.92	-0.36	0.16	0.42	0.03	-1.80	1.31	2.74	0.20	-0.07	0.00	0.23
	(1.50)	(0.72)	(1.60)	(0.05)	(0.12)	(3.52)	(3.71)	(3.77)	(3.12)	(2.72)	(0.39)	
$x_{s,t+1}$	0.74	-0.77	-0.14	16.45	0.22	-0.91	-0.02	0.93	0.32	0.04	0.07	0.10
	(0.49)	(0.64)	(0.59)	(0.78)	(0.35)	(0.72)	(0.02)	(0.52)	(2.06)	(0.55)	(3.50)	
dpr_{t+1}	-0.24	0.41	0.06	-70.06	-0.96	3.72	-0.14	8.16	-0.45	0.07	0.88	0.90
	(0.12)	(0.26)	(0.18)	(2.52)	(1.15)	(2.25)	(0.12)	(3.46)	(2.18)	(0.78)	(33.1)	
Panel B: Correlation matrix of residuals												
Δy_t	1	0.63	0.75	0.52	-0.01	-0.16	0.21	-0.09	-0.25	0.10	0.25	
Δc_t	–	1	0.17	0.33	0.15	-0.18	0.16	-0.09	-0.16	0.14	0.04	
$\Delta \iota_t$	–	–	1	0.53	-0.08	0.04	0.19	-0.07	-0.23	0.00	0.31	
h_t	–	–	–	1	-0.06	0.11	0.27	-0.12	-0.31	0.04	0.15	
Δw_t	–	–	–	–	1	-0.14	-0.06	0.04	0.03	0.04	-0.11	
Δp_t	–	–	–	–	–	1	0.13	-0.09	-0.11	-0.14	0.09	
$r_{1,t}$	–	–	–	–	–	–	1	-0.84	-0.51	-0.11	0.05	
sp_t	–	–	–	–	–	–	–	1	-0.02	0.12	0.00	
$x_{b,t}$	–	–	–	–	–	–	–	–	1	-0.01	-0.06	
$x_{s,t}$	–	–	–	–	–	–	–	–	–	1	-0.65	
dpr_t	–	–	–	–	–	–	–	–	–	–	1	

Note: The table reports the parameter estimates (Panel A) and the correlation matrix of residuals (Panel B) for the unrestricted VAR(1) with hours in level. Numbers in parentheses represent the t-stat of the parameter estimates. We use the notations $dpr_t = d_t - v_t$, $sp_t = y_{b,t} - r_{1,t}$, $x_{b,t} = r_{b,t} - r_{1,t}$, and $x_{s,t} = r_{s,t} - r_{1,t}$.

Table A5: RMSE of Alternative VARs

	RMSE				Diebold-Mariano statistics			
	2 years	5 years	10 years	15 years	2 years	5 years	10 years	15 years
Panel A: Full DSGE model								
Short-term rate	4.12	8.99	14.76	20.29				
Bond return	18.93	20.23	17.80	15.55				
Stock return	26.91	32.81	27.95	24.23				
Panel B: Bayesian VAR model								
Short-term rate	2.88	7.23	13.53	20.68	-2.56	-3.01	-1.32	0.27
Bond return	11.82	22.20	25.97	29.15	-4.87	1.07	5.66	6.34
Stock return	22.64	34.69	40.81	30.89	-1.43	0.55	3.39	2.96
Panel C: Unrestricted VAR (Hours in level)								
Short-term rate	3.12	9.62	22.10	40.34	-1.67	0.80	5.33	5.28
Bond return	11.91	20.84	25.81	26.58	-4.07	0.23	1.86	2.08
Stock return	24.66	46.34	61.24	71.45	-0.68	3.33	2.62	2.16
Nb of obs.	92	80	60	40				

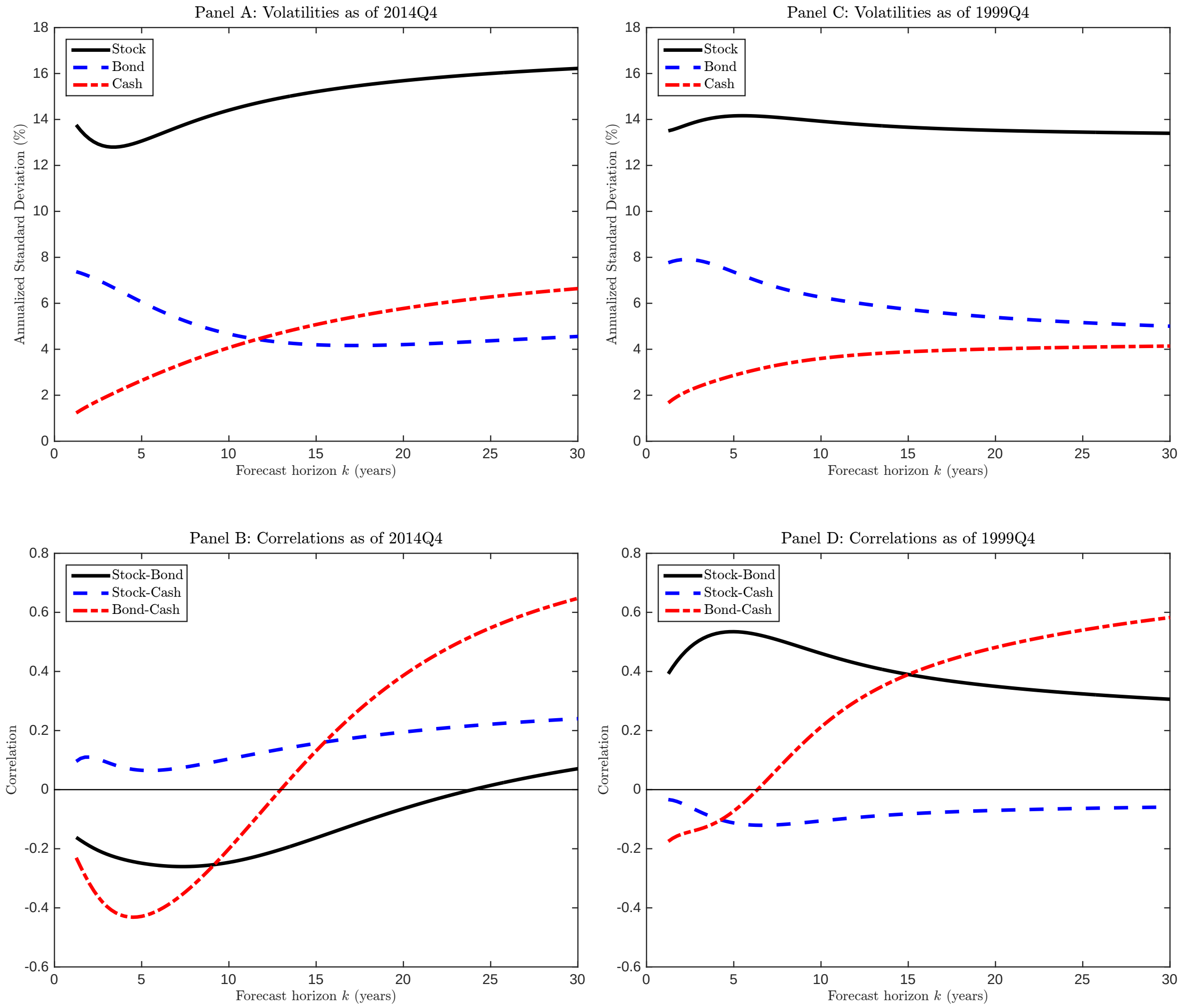
Note: The table reports the percent RMSE (root mean square error) and the Diebold and Mariano (1995) test statistics for the difference between the DSGE and VAR RMSE, over the 2, 5, 10, and 15-year horizons in the DSGE and VAR(1) models. The Diebold and Mariano (1995) test statistics for the difference between two forecasts at horizon k is: $DM_i(k) = \bar{d}_i(k)/\sqrt{\bar{\sigma}_i(k)^2/n}$, where $\bar{d}_i(k)$ is the sample mean and $\bar{\sigma}_i(k)^2$ the sample variance of the loss difference defined as $d_{i,t+k} = (r^{(k)}_{t:t+k} - \mu^{(k)(VAR)}_{r,t:t+k})^2 - (r^{(k)}_{t:t+k} - \mu^{(k)(DSGE)}_{r,t:t+k})^2$, with $i = 1$, b, s. RMSEs are in percentage.

Table A6: Out-of-sample performance of dynamic strategies – Alternative VARs

Risk aversion (γ)	Bayesian VAR Investment horizon				VAR(1) (Hours in level) Investment horizon			
	2 years	5 years	10 years	15 years	2 years	5 years	10 years	15 years
Panel A: Average demand for stocks								
5	0.45	0.55	0.56	0.63	0.55	0.43	0.23	0.14
10	0.26	0.32	0.31	0.36	0.32	0.25	0.14	0.09
20	0.14	0.17	0.18	0.22	0.17	0.14	0.08	0.06
50	0.06	0.09	0.11	0.14	0.09	0.07	0.05	0.04
Panel B: Average demand for bonds								
5	-0.25	-0.49	-0.53	-0.57	-0.49	-0.58	-0.39	-0.44
10	-0.12	-0.24	-0.21	-0.22	-0.24	-0.28	-0.17	-0.26
20	-0.01	-0.05	-0.03	-0.05	-0.05	-0.07	-0.02	-0.09
50	0.06	0.06	0.07	0.06	0.06	0.08	0.10	0.06
Panel C: Average demand for cash								
5	0.79	0.94	0.97	0.93	0.94	1.15	1.15	1.30
10	0.86	0.92	0.90	0.86	0.92	1.04	1.04	1.16
20	0.88	0.88	0.85	0.82	0.88	0.93	0.93	1.02
50	0.89	0.85	0.82	0.80	0.85	0.85	0.85	0.89
Panel D: Annualized real return								
5	4.04	1.69	0.96	1.05	1.69	0.34	-0.64	-1.25
10	2.68	1.50	1.02	1.17	1.50	0.64	-0.01	-0.55
20	1.67	1.18	0.96	1.11	1.18	0.74	0.35	-0.02
50	0.94	0.91	0.87	1.02	0.91	0.79	0.58	0.42
Panel E: Annualized volatility								
5	7.87	5.82	2.34	1.68	5.82	5.65	3.39	3.66
10	5.24	4.01	1.73	1.14	4.01	3.33	1.83	2.36
20	3.07	2.47	1.49	0.94	2.47	1.93	0.92	1.33
50	1.87	1.71	1.38	0.86	1.71	1.34	0.73	0.54
Panel F: Sharpe ratio								
5	0.62	0.40	0.76	1.38	0.40	0.08	-0.25	-0.50
10	0.64	0.55	1.25	2.53	0.55	0.25	-0.01	-0.34
20	0.71	0.74	1.48	3.12	0.74	0.49	0.50	-0.03
50	0.74	0.96	1.54	3.20	0.96	0.86	1.05	1.18

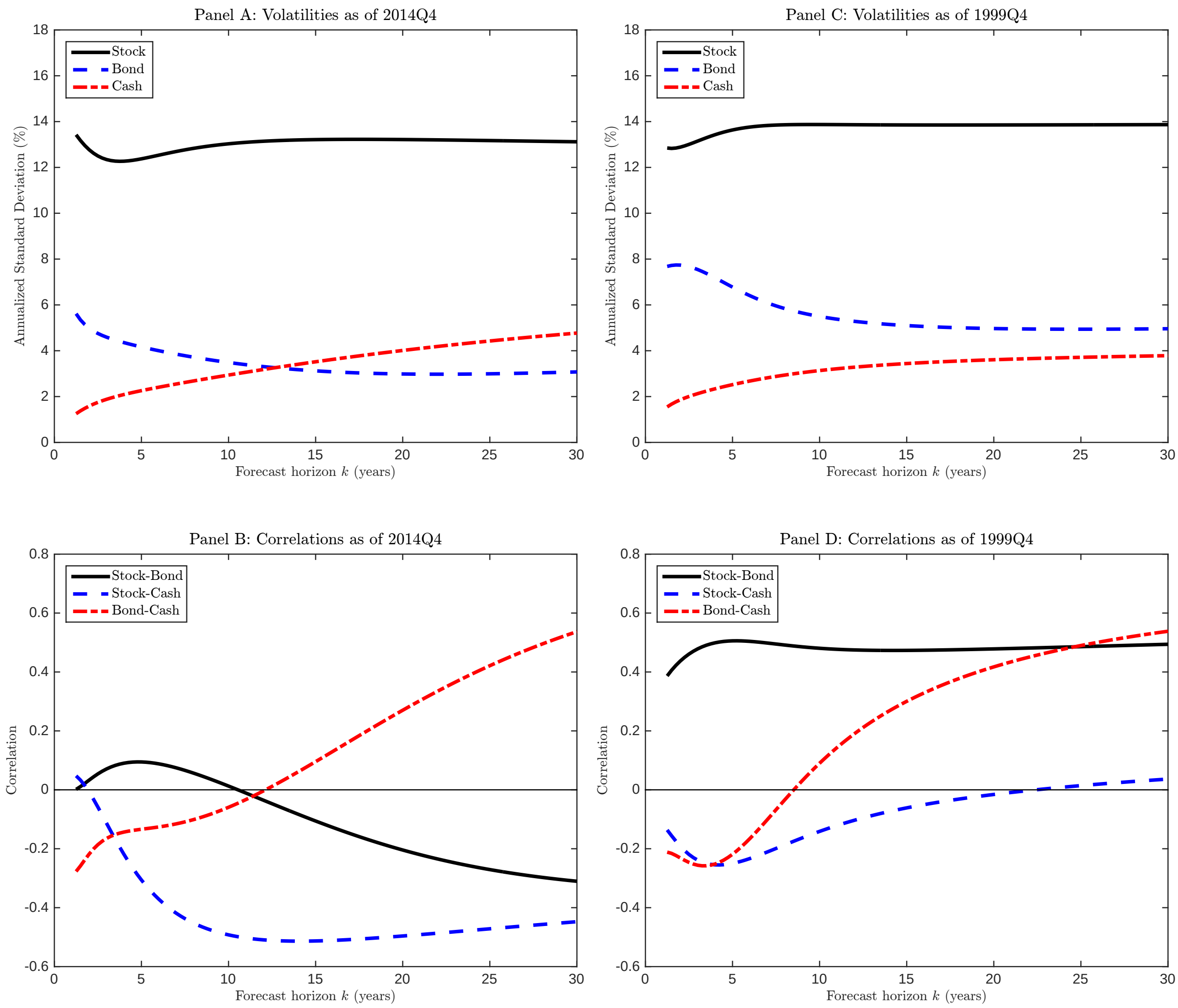
Note: The table reports the average optimal weight for stocks and bonds and statistics on ex-post performances of the dynamic investment strategies based on the Bayesian estimation of the VAR(1) and the unrestricted VAR(1) with hours in level. Return and volatility are in annualized percent.

Figure A12: Term structure of volatilities and correlations – Bayesian VAR



Note: The figure displays the term structure of risks for the Bayesian VAR(1). Panels A and B correspond to the term structure of volatilities and correlations for 2014Q4 and Panels C and D correspond to the term structure of volatilities and correlations for 1999Q4.

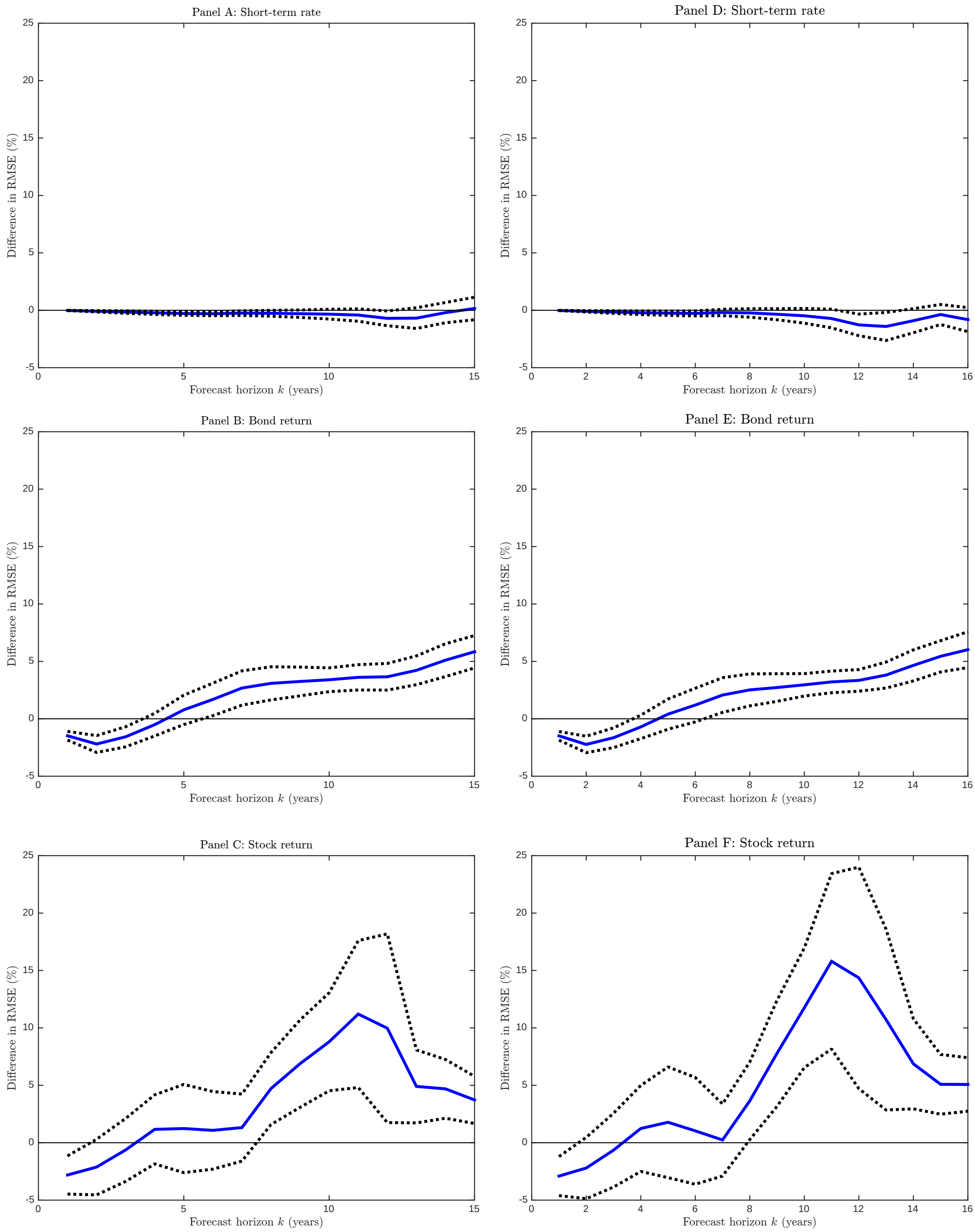
Figure A13: Term structure of volatilities and correlations – Unrestricted VAR (Hours in level)



Note: The figure displays the term structure of risks for the unrestricted VAR(1) with hours in level. Panels A and B correspond to the term structure of volatilities and correlations for 2014Q4 and Panels C and D correspond to the term structure of volatilities and correlations for 1999Q4.

Figure A14: Difference in MSE with full DSGE model

Bayesian VAR　　　　Unrestricted VAR (Hours in level)



Note: The figure displays the difference between the MSE of the VAR and the MSE of the full DSGE model. Panels A, B, and C correspond to the short-term rate, bond return, and stock return, respectively for the Bayesian VAR(1). Panels D, E, and F correspond to the short-term rate, bond return, and stock return, respectively for the unrestricted VAR(1) with hours in level. The figure also represents the 90% confidence interval.

References

Alpanda, S., 2013. Identifying the role of risk shocks in the business cycle using stock price data. Economic Inquiry 51, 304–335.

Campbell, J., Thompson, S., 2008. Predicting the equity premium out of sample: Can anything beat the historical average? Review of Financial Studies 21, 1509–1531.

Diebold, F., Mariano, R., 1995. Comparing predictive accuracy. Journal of Business and Economics Statistics 13, 253–264.

Hördahl, P., Tristani, O., Vestin, D., 2006. A joint econometric model of macroeconomic and term structure dynamics. Journal of Econometrics 131, 405–444.

Sangvinatsos, A., Wachter, J., 2005. Does the failure of the expectations hypothesis matter for long-term investors? Journal of Finance 60, 179–230.