

*Online Supplement* for  
“Delayed Overshooting: Is It an 80s Puzzle?”

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## Contents

This supplement consists of 6 sections and presents the conditional behavior of relevant variables in the benchmark model (Section 1), the conditional behavior of nominal exchange rates in the benchmark model (Section 2), the conditional and unconditional behavior of the US-AGG98 exchange rate (Section 3), the robustness analysis described in the text (Section 4), the results for each of 14 individual country pairs (Section 5), and the results from structural break tests (Section 6). *The list of full contents is tabulated in page 2.*

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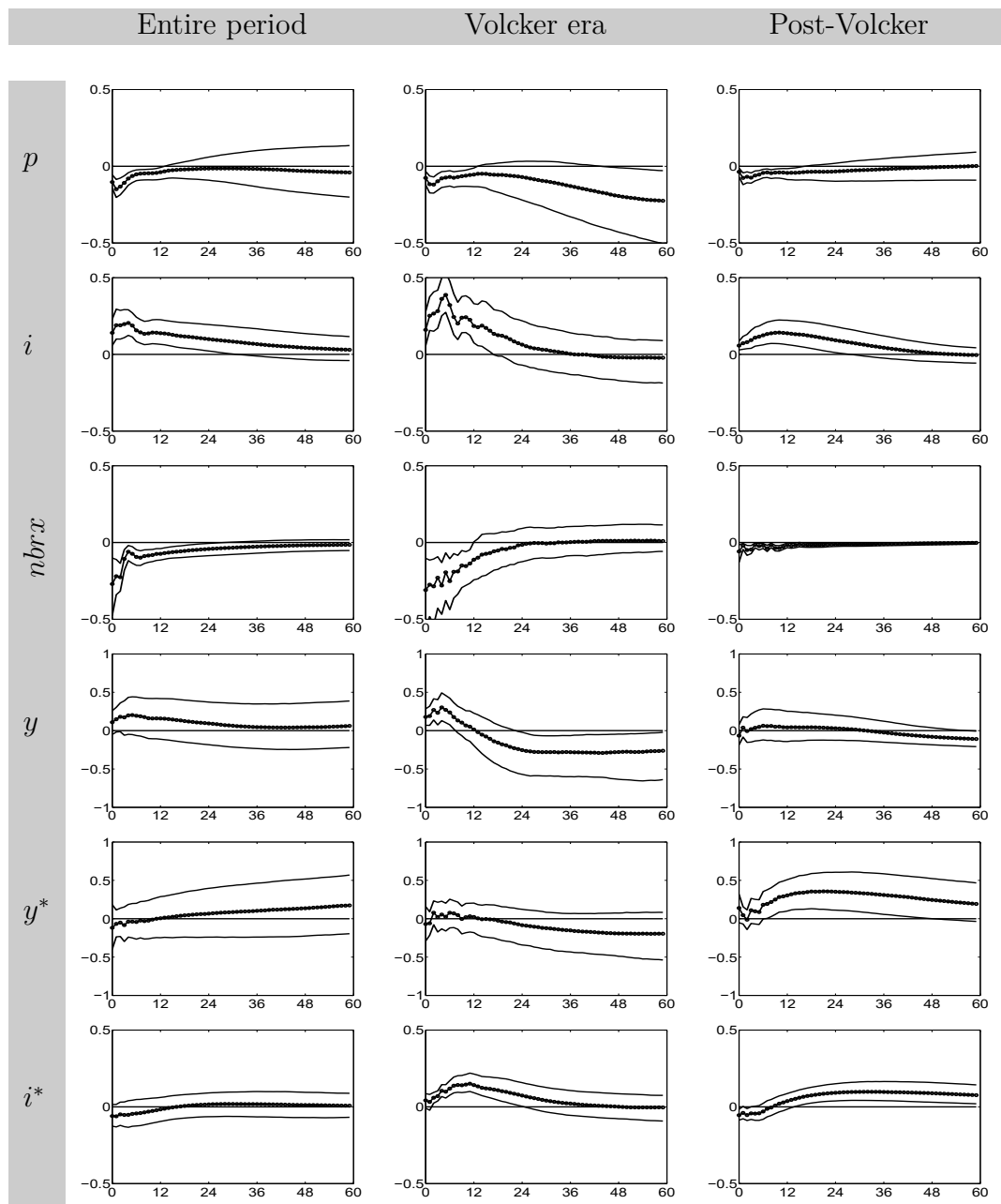
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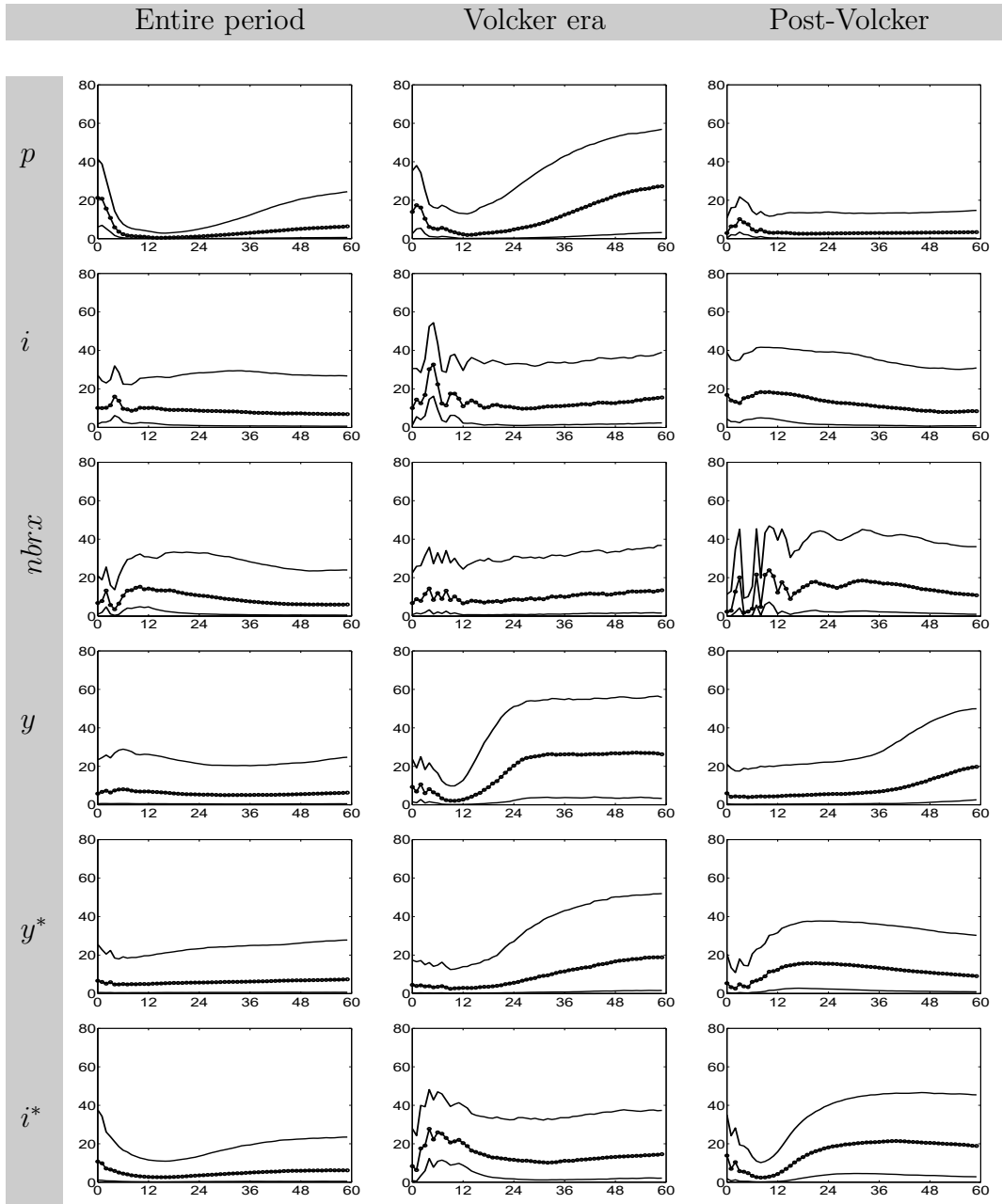
Label	Description
<b>Section 1: Relevant Variables</b>	
S1	the impulse responses of relevant variables
S2	the forecast error variance decomposition for each of the relevant variables
<b>Section 2: Nominal Exchange Rates</b>	
S3	the impulse responses of the two aggregate nominal exchange rates
S4	the posterior distribution of the timing at which the maximal response of the aggregate nominal exchange rates occurs
<b>Section 3: The US-AGG98</b>	
S5	the conditional and unconditional behavior of the US-AGG98 real exchange rate and excess returns
<b>Section 4: Robustness</b>	
S6	the impulse responses of the US-AGG real exchange rate, US CPI, the federal funds rate and 3-month US treasury bill rate based on recursive identification methods
S7	the impulse responses of the US-AGG real exchange rate in two variants of the benchmark model
S8	the impulse responses of the US-AGG real exchange rate when varying lag lengths
S9	the impulse responses of the US-AGG real exchange rate when varying horizons of sign restrictions
S10	the impulse responses of the US-AGG real exchange rate in two variants of the benchmark model
S11	the monetary policy stance using the shocks identified by the benchmark model
<b>Section 5: Individual Country Pairs</b>	
S12	the impulse responses of each of the 14 bilateral real exchange rates
S13	the posterior distribution of the timing at which the maximal response of each of the 14 bilateral real exchange rates occurs
S14	the forecast error variance decomposition for each of the 14 bilateral real exchange rates
S15	the serial dependence of each of the 14 bilateral real exchange rates
S16	the cumulated impulse responses of 3-month excess returns for each of the 14 US trading partners
S17	the serial dependence of 3-month excess returns for each of the 14 US trading partners
<b>Section 6: Tables</b>	
TS1	the results from test for equality of peak timing between the Volcker era and the post-Volcker era
TS2	the results from Bai and Perron's (2003) structural break tests for the mean of excess returns

# 1 Relevant Variables in the Benchmark VAR



$p$  is the US CPI;  $i$  is the 3-month US Treasury bill rate;  $nbrx$  is the ratio nonborrowed reserves to total reserves;  $y$  is the US industrial production index;  $y^*$  is the AGG aggregate industrial production index;  $i^*$  is the AGG aggregate interest rate. The horizontal axis is in months. The median (line with circles) and the 16% and 84% quantiles of the distribution are shown.

Figure S1: Impulse responses of relevant variables (the benchmark model).

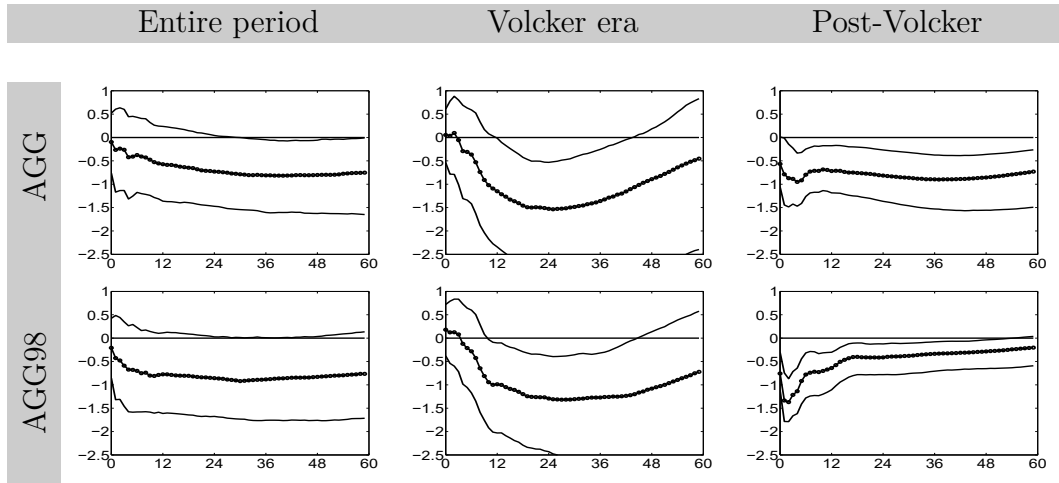


$p$  is the US CPI;  $i$  is the 3-month US Treasury bill rate;  $nbrx$  is the ratio nonborrowed reserves to total reserves;  $y$  is the US industrial production index;  $y^*$  is the AGG aggregate industrial production index;  $i^*$  is the AGG aggregate interest rate. The horizontal axis is in months. The median (line with circles) and the 16% and 84% quantiles of the distribution are shown.

Figure S2: Forecast error variance decomposition of relevant variables (the

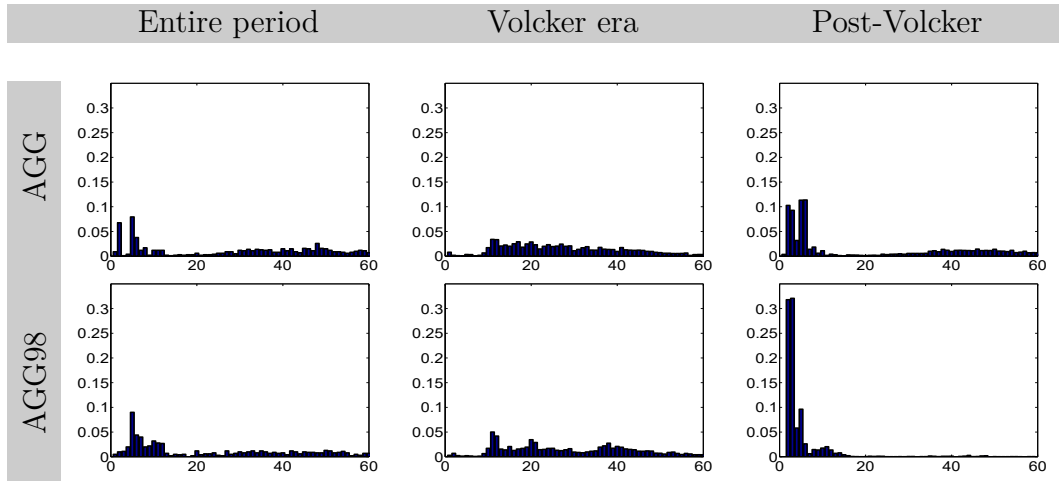
benchmark model).

## 2 Nominal Exchange Rates



AGG: 7 non-EMU countries plus GE as an EMU representative prior to 2008 and AGG98: 14 country pairs prior to 1999. The horizontal axis is in months. The median impulse response (line with circles) and the 16% and 84% quantiles of the posterior distribution are shown.

Figure S3: Impulse response of nominal exchange rates (the benchmark model)



AGG: 7 non-EMU countries plus GE as an EMU representative prior to 2008, and AGG98: 14 country pairs prior to 1999. The horizontal axis is in months and the vertical axis represents the frequency of month with the lowest value of each impulse response.

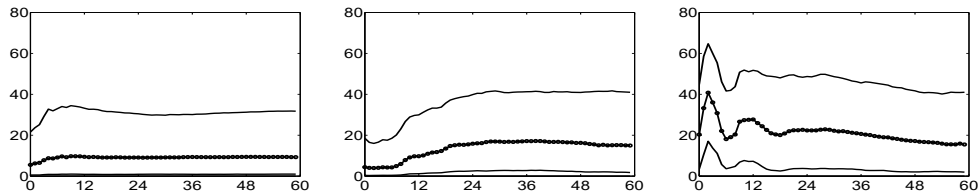
Figure S4: Posterior distribution of the timing of maximal response of nominal

exchange rates (the benchmark model)

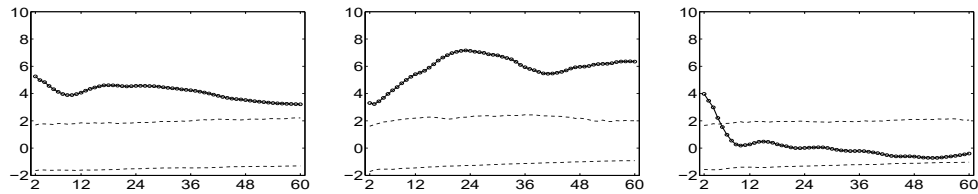
### 3 The US-AGG98 Real Exchange Rate

Entire period                      Volcker era                      Post-Volcker

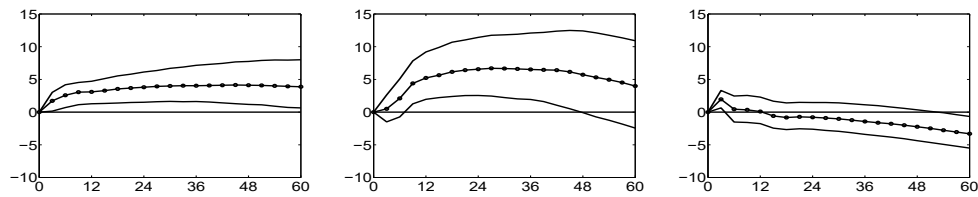
Forecast error variance decomposition of the US-AGG98 real exchange rate



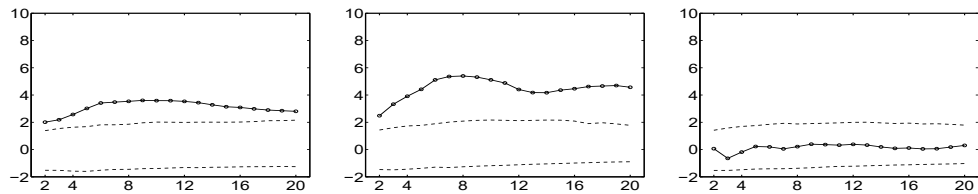
Serial dependence of changes in the US-AGG98 real exchange rate



Conditional UIP: cumulated 3-month US-AGG98 excess return



Unconditional UIP: serial dependence of 3-month US-AGG98 excess return

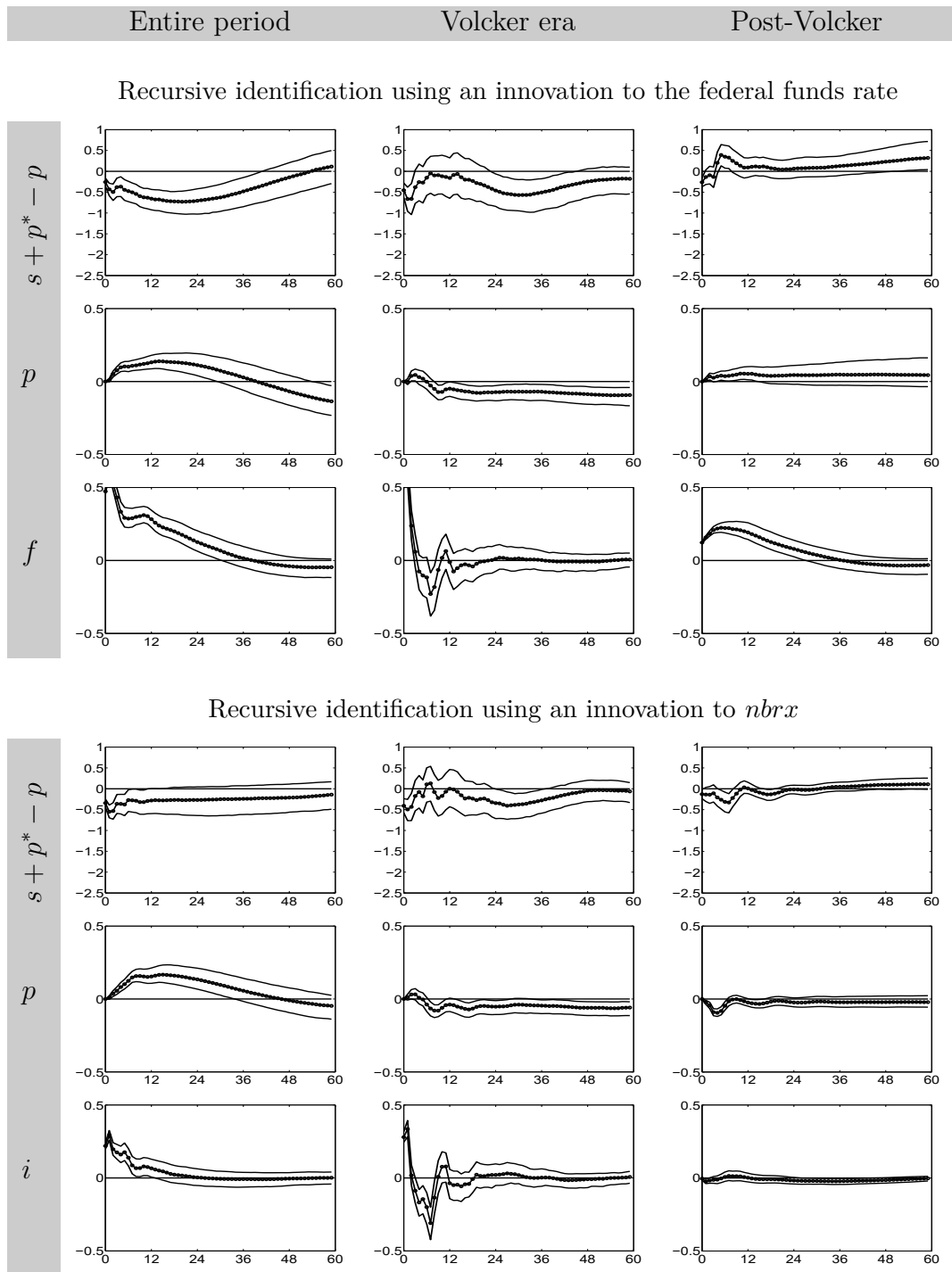


AGG98: 14 country pairs prior to 1999. For the first to third panels, the horizontal axis is in months; the median impulse response (line with circles) and the 16% and 84% quantiles of the posterior distribution are shown. For the fourth panel, the horizontal axis is in quarters. For the second and fourth panels, the vertical axis represents  $t$ -values; the line with circles represents the  $t$ -values of estimated variance ratios, and the two dashed lines are the 5% and 95% quantiles of the empirical distribution based on 5,000 draws.

Figure S5: Conditional and unconditional behavior of the US-AGG98 real

exchange rate

## 4 Robustness

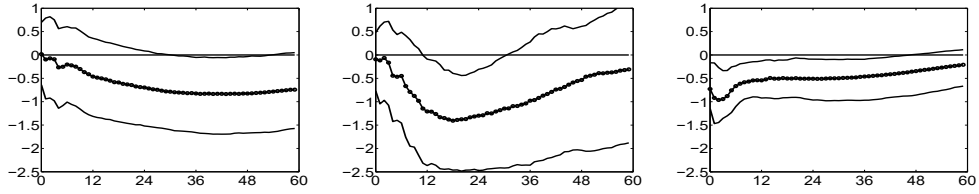


AGG: 7 non-EMU countries plus GE as an EMU representative prior to 2008;  $s + p^* - p$  is the real exchange rate;  $p$  is the US CPI;  $f$  is the federal funds rate;  $i$  is the 3-month US Treasury bill rate.

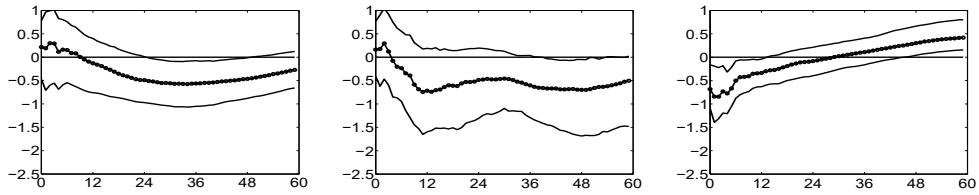
Figure S6: Impulse responses of AGG aggregate variables (a 7-variable VAR)

Entire period                      Volcker era                      Post-Volcker

Model FF



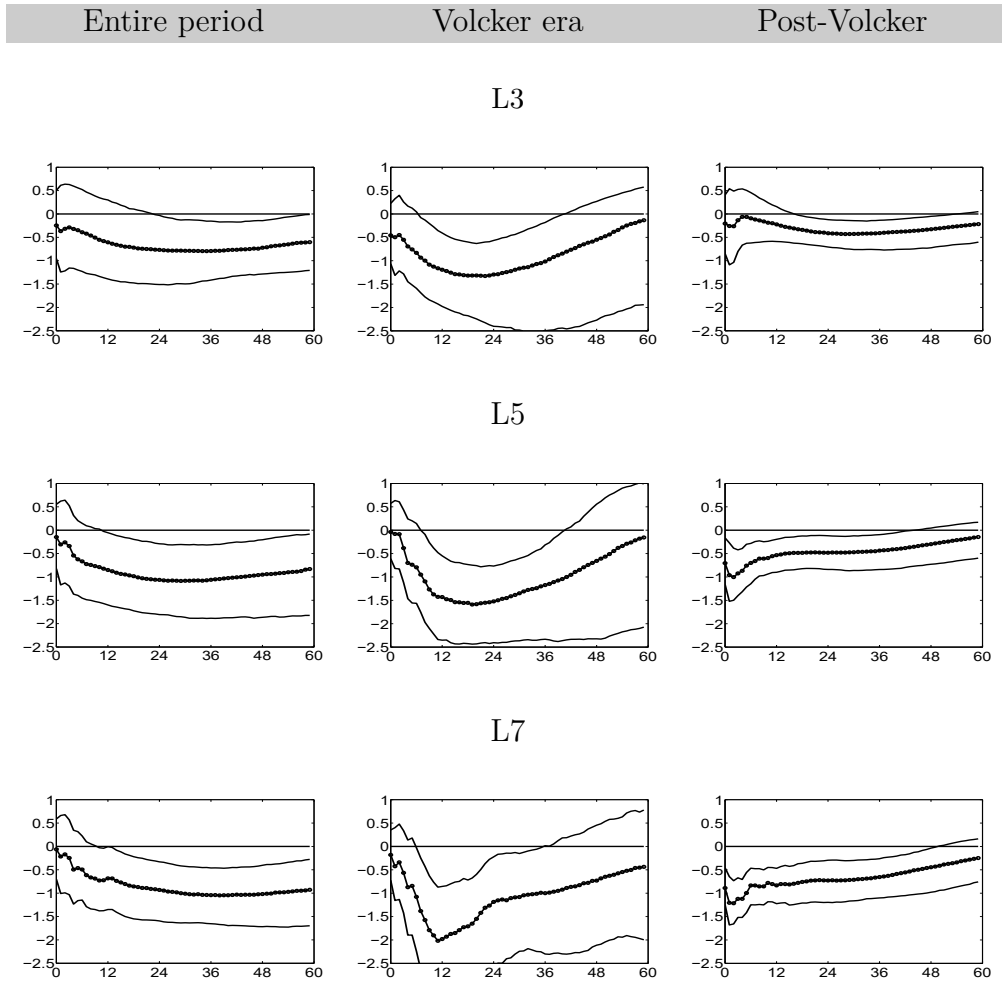
Model C



AGG: 7 non-EMU countries plus GE as an EMU representative prior to 2008. “Model FF” represents the benchmark model modified with replacing the interest rate with the federal funds rate; “Model C” represents the benchmark model modified with adding a constant term. The horizontal axis is in months. The median impulse response (line with circles) and the 16% and 84% quantiles of the posterior distribution are shown.

Figure S7: Impulse responses of the US-AGG real exchange rate (Sensitivity Analysis I)

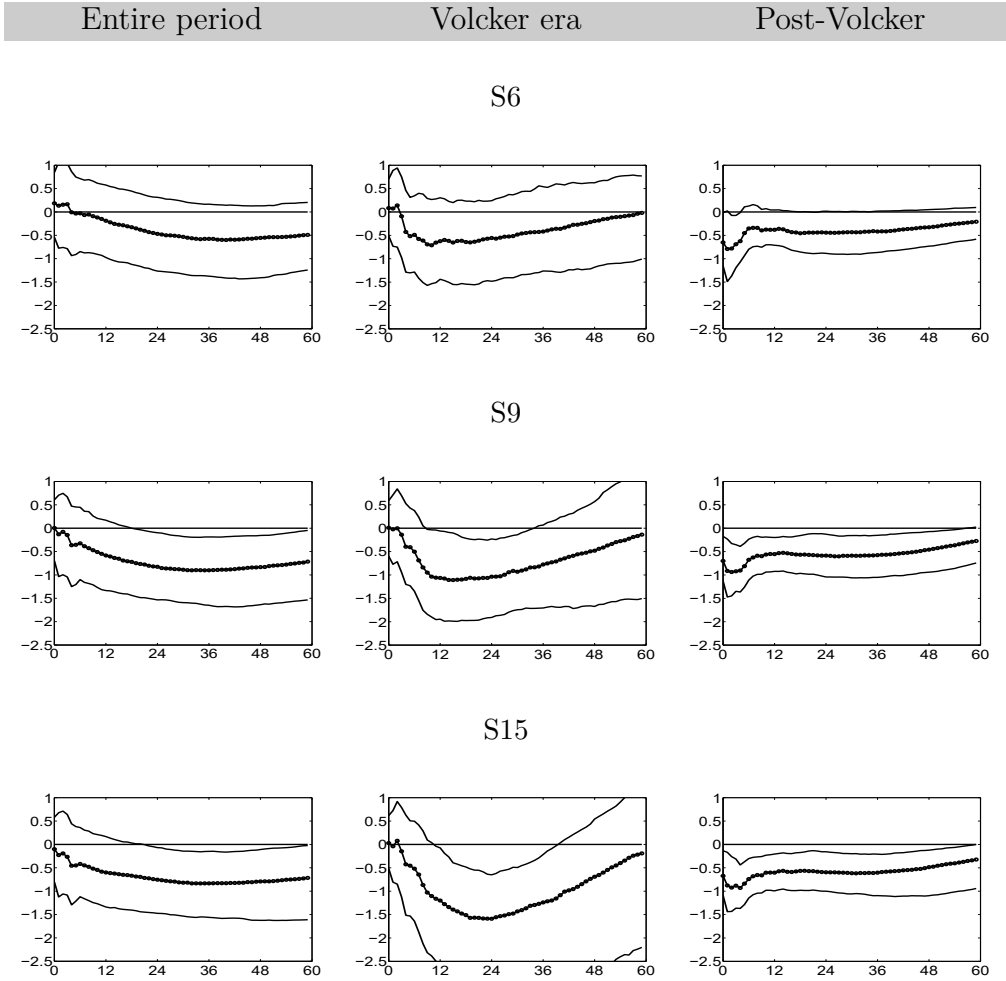




AGG: 7 non-EMU countries plus GE as an EMU representative prior to 2008. “L3” (L5, L7) represents the benchmark model modified with lag length of 3 (5,7). The horizontal axis is in months. The median impulse response (line with circles) and the 16% and 84% quantiles of the posterior distribution are shown.

Figure S8: Impulse responses of the US-AGG real exchange rate (Sensitivity

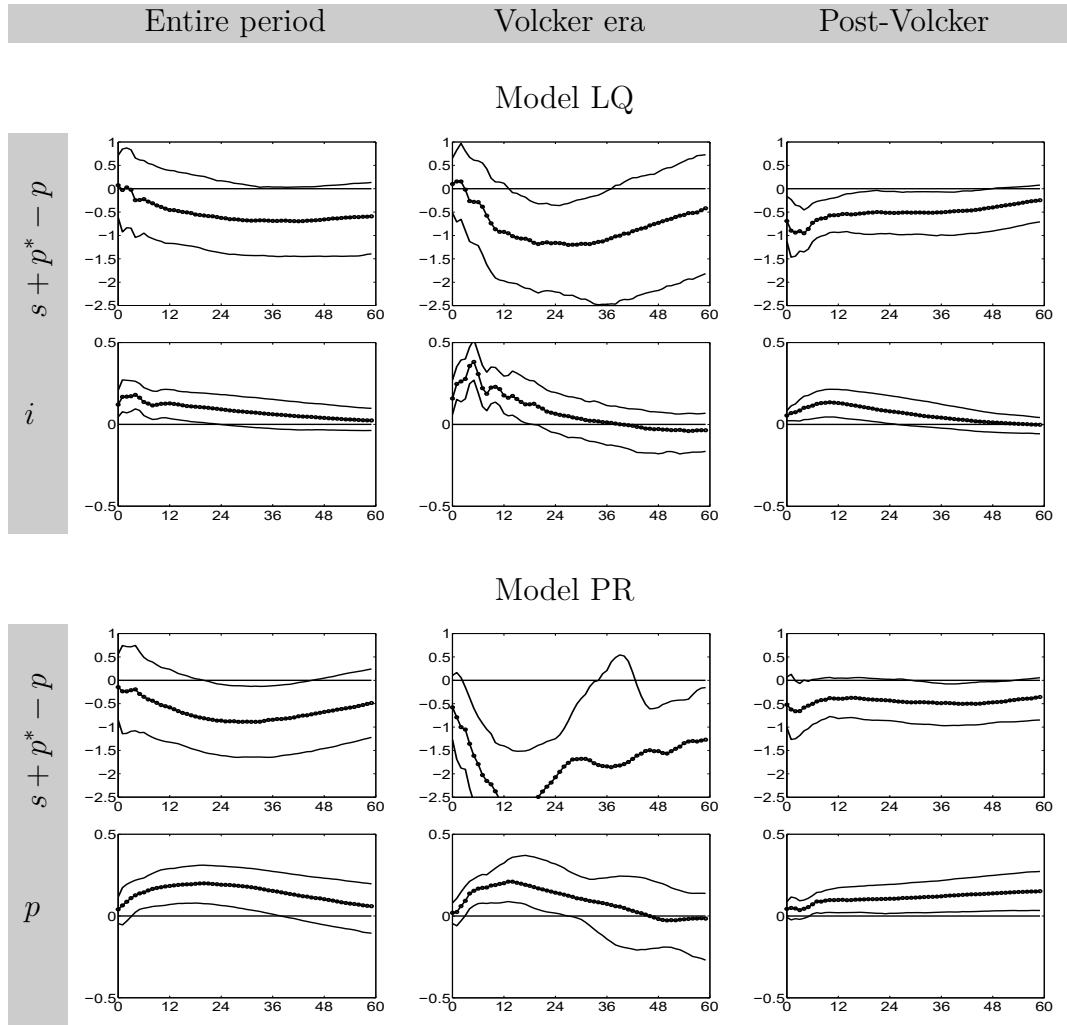
Analysis II)



“S6” (S9, S15) represents the benchmark model modified with the duration of sign restrictions of 6 (9,15) months. The horizontal axis is in months. The median impulse response (line with circles) and the 16% and 84% quantiles of the posterior distribution are shown.

Figure S9: Impulse responses of the US-AGG real exchange rate (Sensitivity

Analysis III)

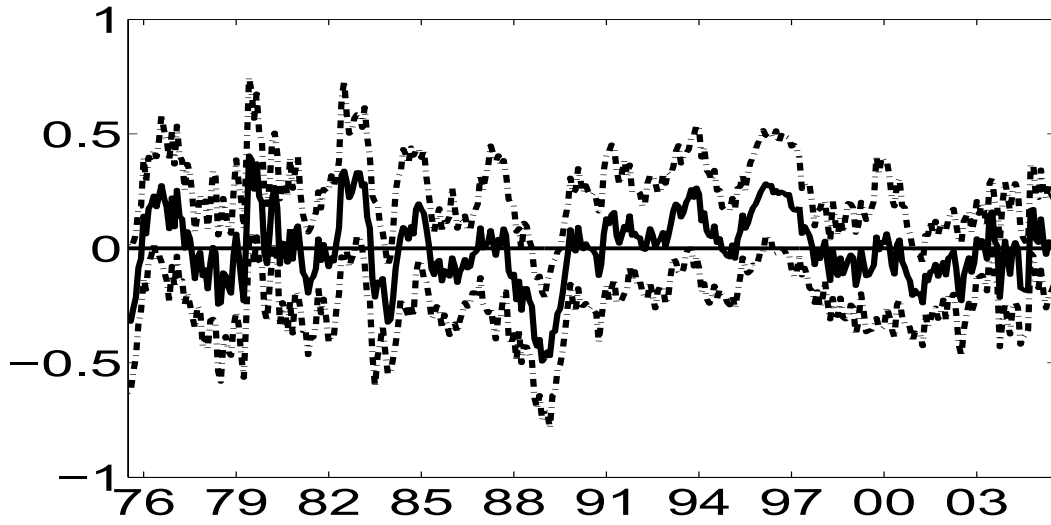


AGG: 7 non-EMU countries plus GE as an EMU representative prior to 2008;  $s + p^* - p$  is the real exchange rate;  $i$  is the 3-month US treasury bill rate. “Model LQ” imposes the positive sign restriction on the interest rate only on impact but keeps the restrictions of  $p$  and  $nbrx$  in the benchmark model. “Model PR” only imposes restrictions on  $i$  and  $nbrx$  for one year. The horizontal axis is in months. The median impulse response (line with circles) and the 16% and 84% quantiles of the posterior distribution are shown.

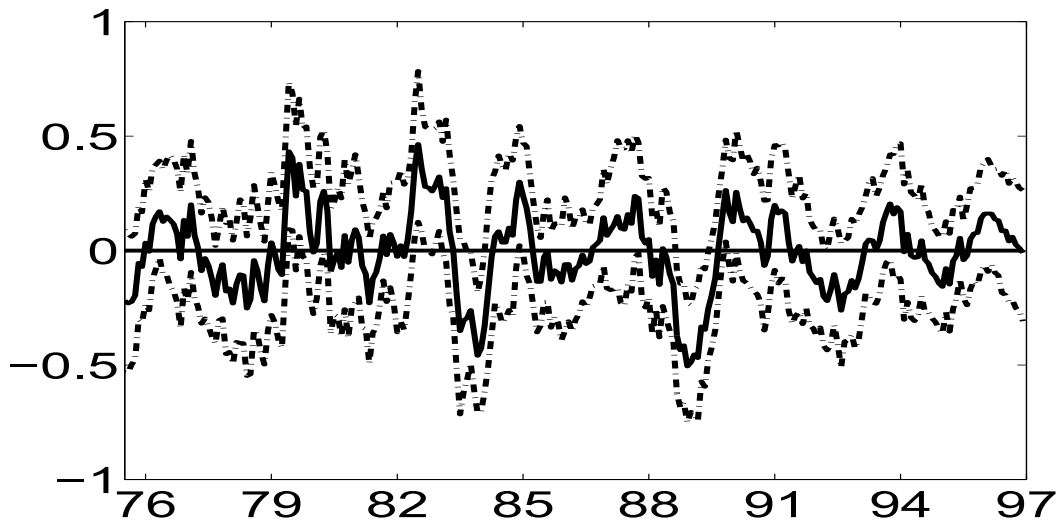
Figure S10: Impulse responses of AGG aggregate variables (Sensitivity Analysis

IV)

Identified when having US-AGG in the benchmark model



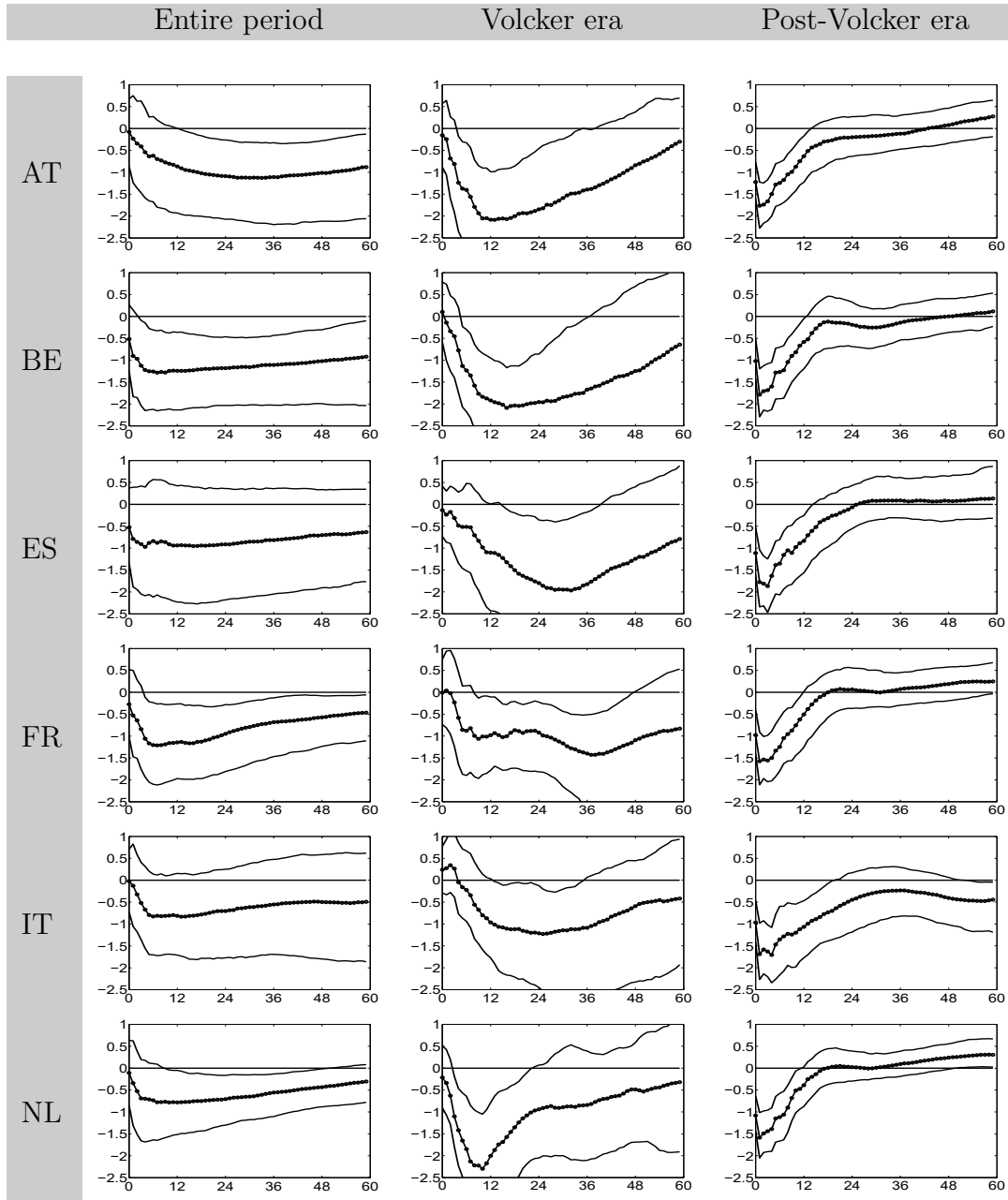
Identified when having US-AGG98 in the benchmark model



AGG: 7 non-EMU countries plus GE as an EMU representative prior to 2008, and AGG98: 14 country pairs prior to 1999. The horizontal axis is in months. The median impulse response (line with circles) and the 16% and 84% quantiles of the distribution are shown. We identify monetary policy shocks associated with the identification in the benchmark model and construct a stance of US monetary policy as a 12-month moving average window of the monetary policy shocks.

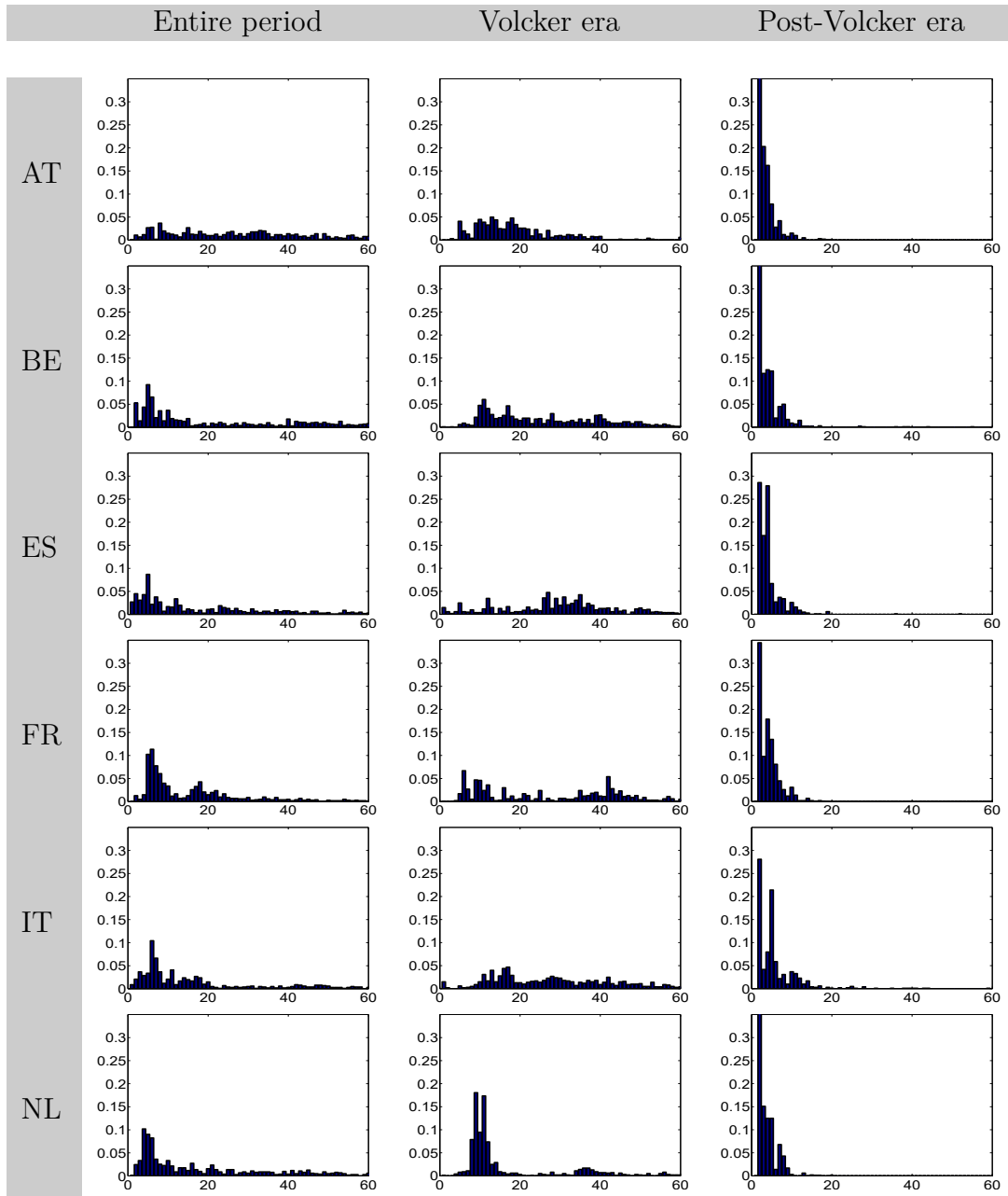
Figure S11: US monetary policy stance

## 5 Individual Country Pairs



The horizontal axis is in months. The median impulse response (line with circles) and the 16% and 84% quantiles of the distribution are shown.

Figure S12: Impulse responses of real exchange rates (individual country pairs)



The horizontal axis is in months. The median impulse response (line with circles) and the vertical axis represents the frequency of month with the lowest value of each impulse response.

Figure S13: Posterior distribution of the timing of maximal response of real exchange rates (individual country pairs)

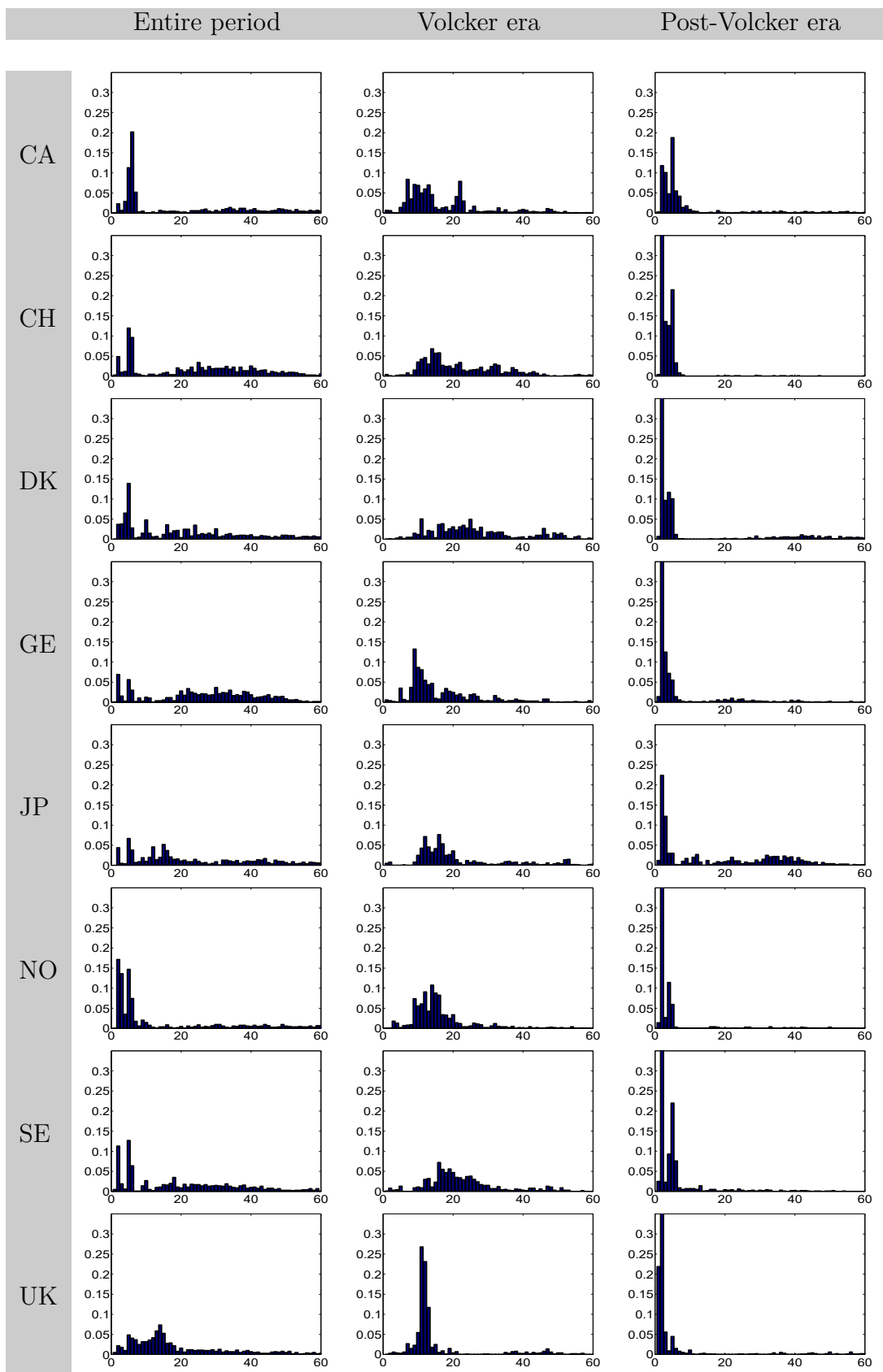
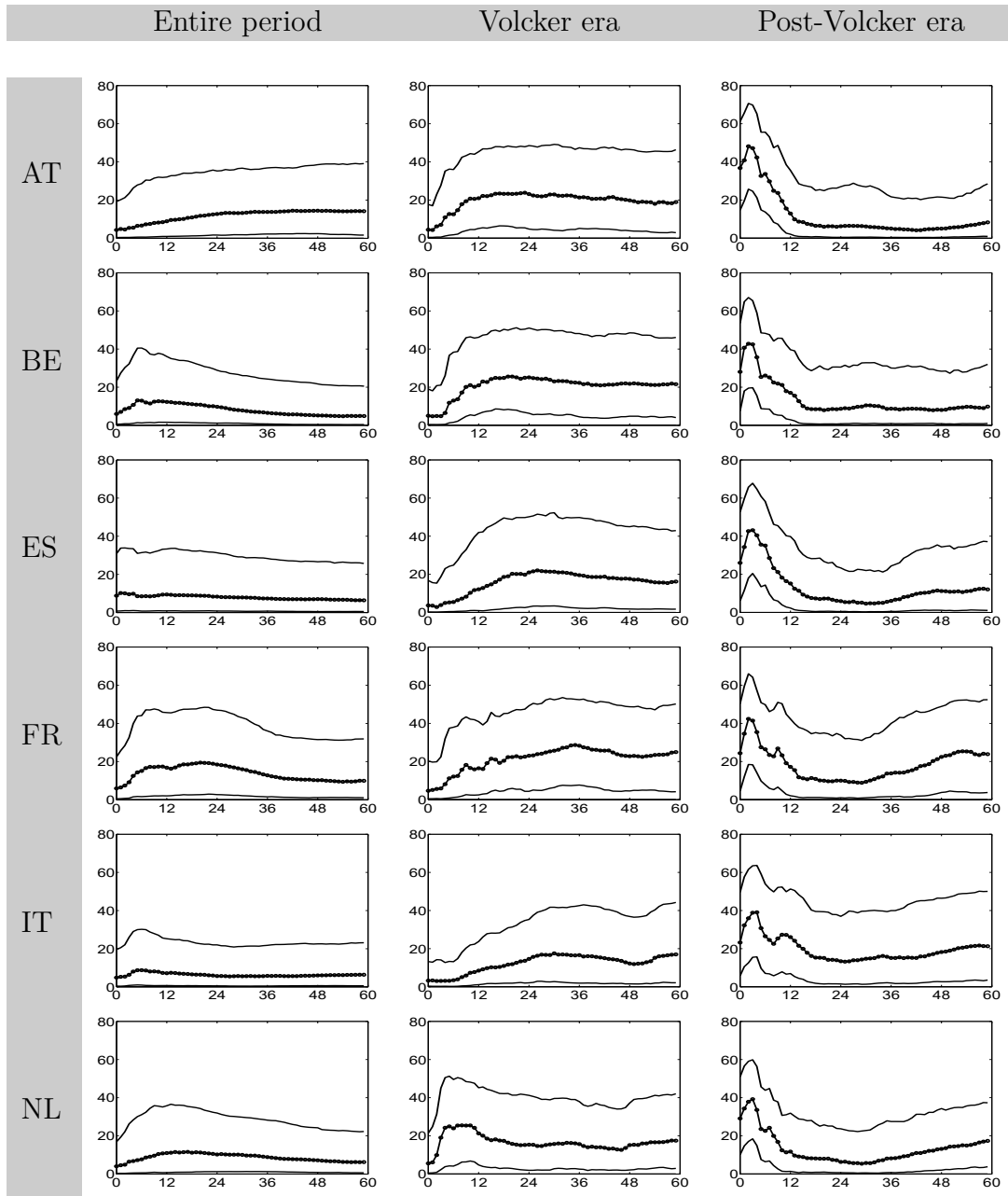


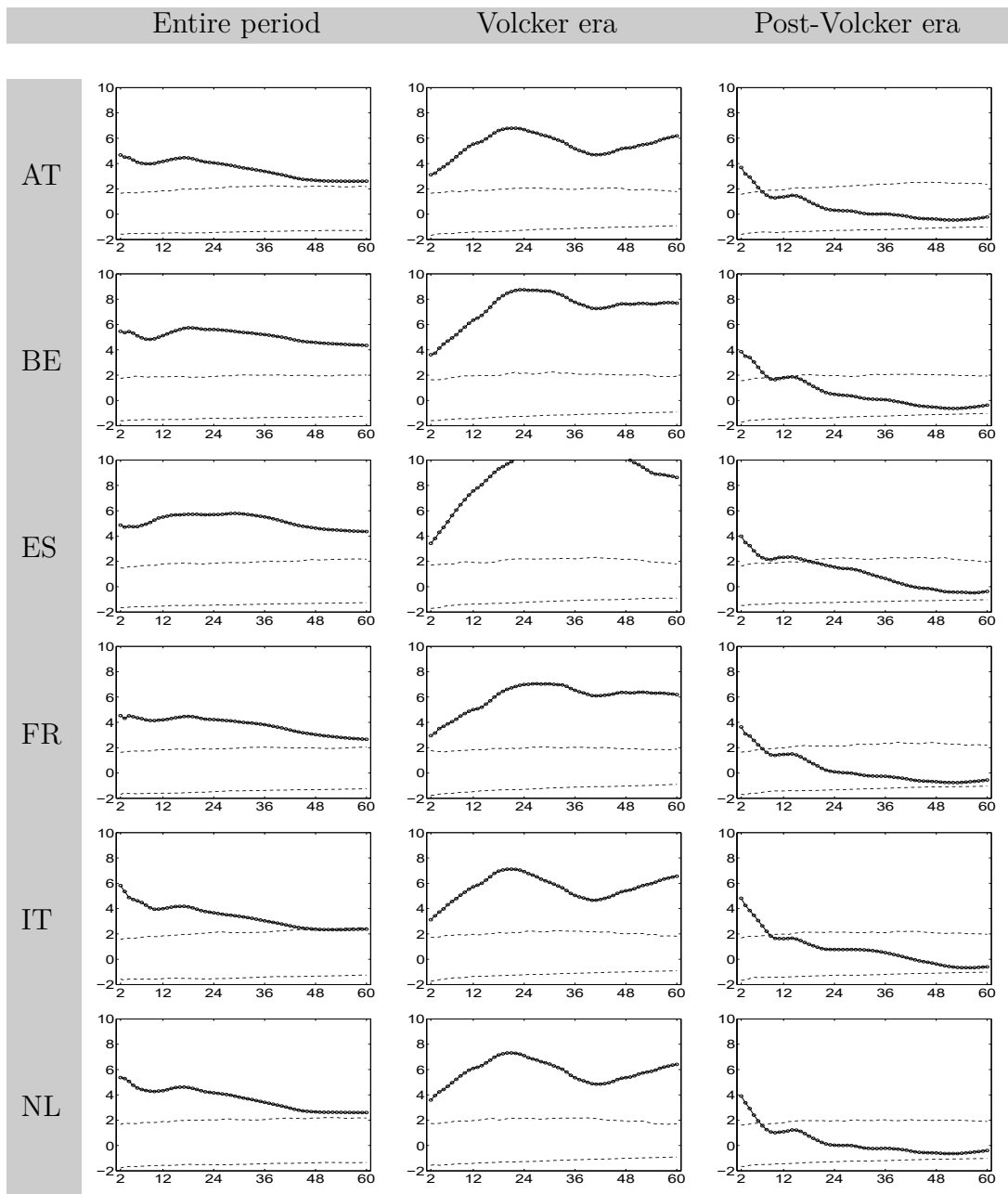
Figure S13: (cont'd)



The horizontal axis is in months. The median impulse response (line with circles) and the 16% and 84% quantiles of the distribution are shown.

Figure S14: Forecast error variance decomposition of real exchange rates  
(individual country pairs)





The horizontal axis is in months, corresponding to  $q$ . The vertical axis represents  $t$ -values. The line with circles represents the  $t$ -values of estimated variance ratios, and the two dashed lines are the 5% and 95% quantiles of the bootstrap null empirical distribution based on 5,000 draws.

Figure S15: Serial dependence of changes in real exchange rates (individual

country pairs)

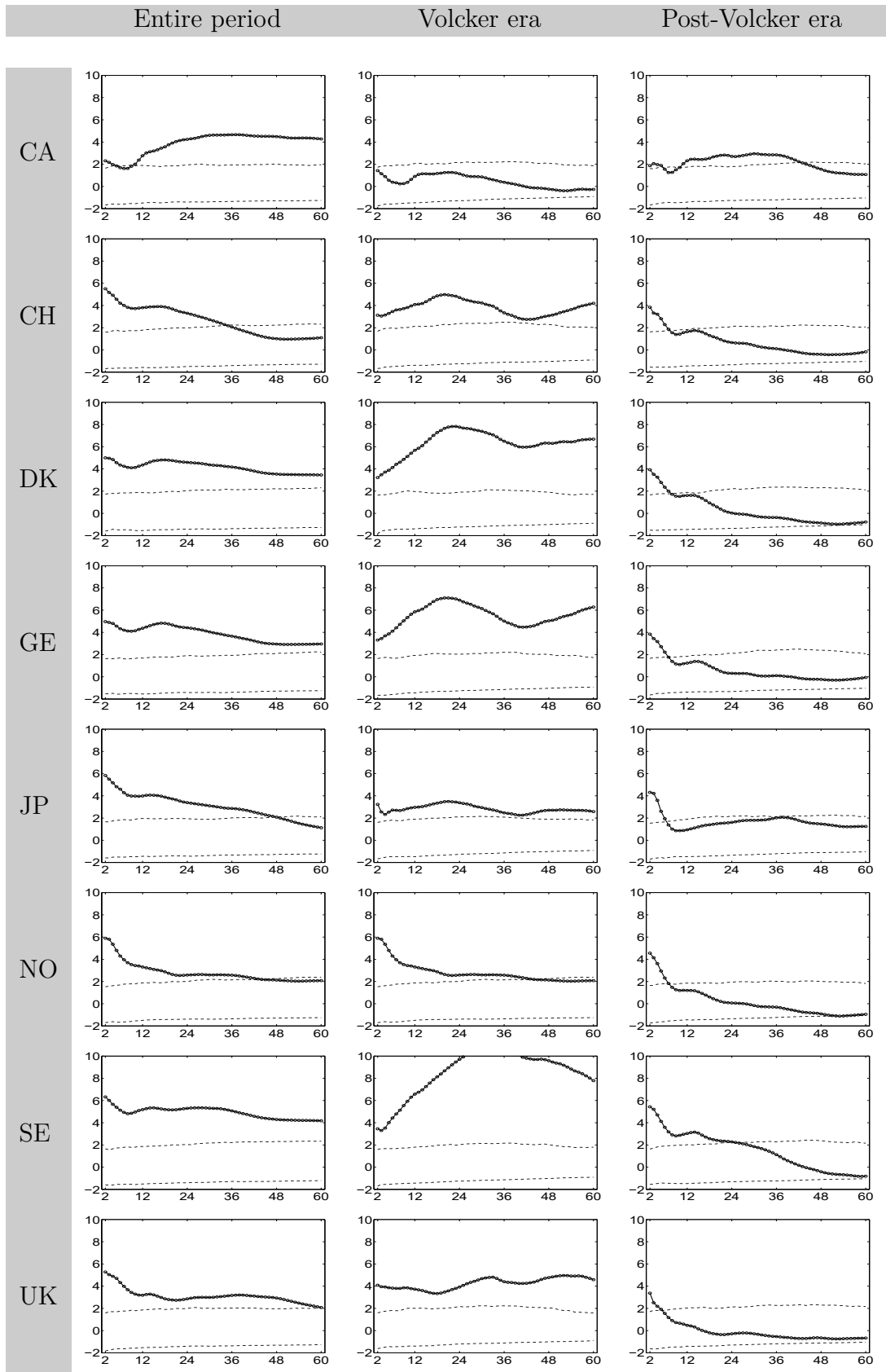
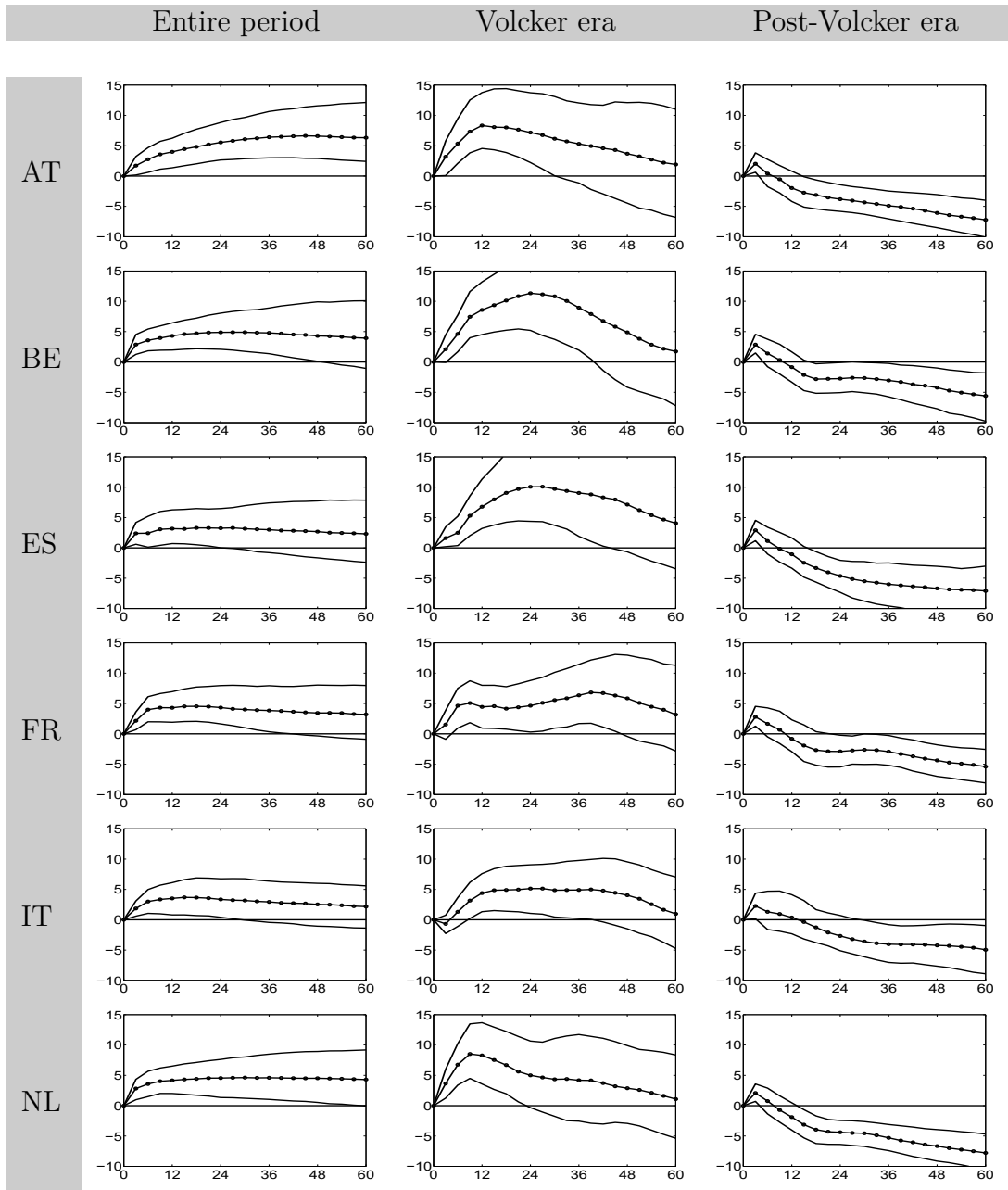


Figure S15: (cont'd)



The horizontal axis is in months. The median impulse response (line with circles) and the 16% and 84% quantiles of the distribution are shown.

Figure S16: Conditional UIP: cumulated responses of 3-month excess returns  
(individual country pairs)

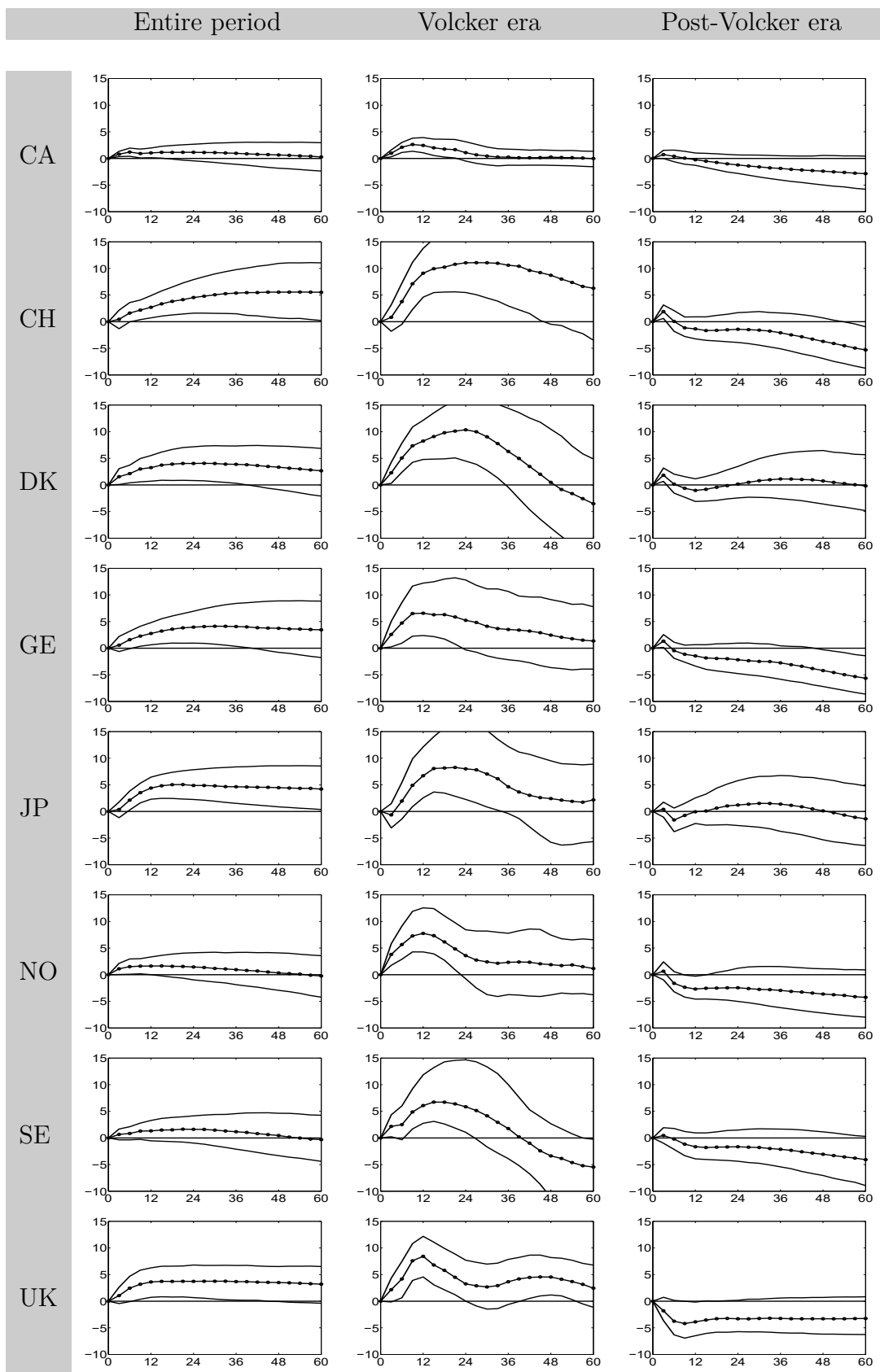
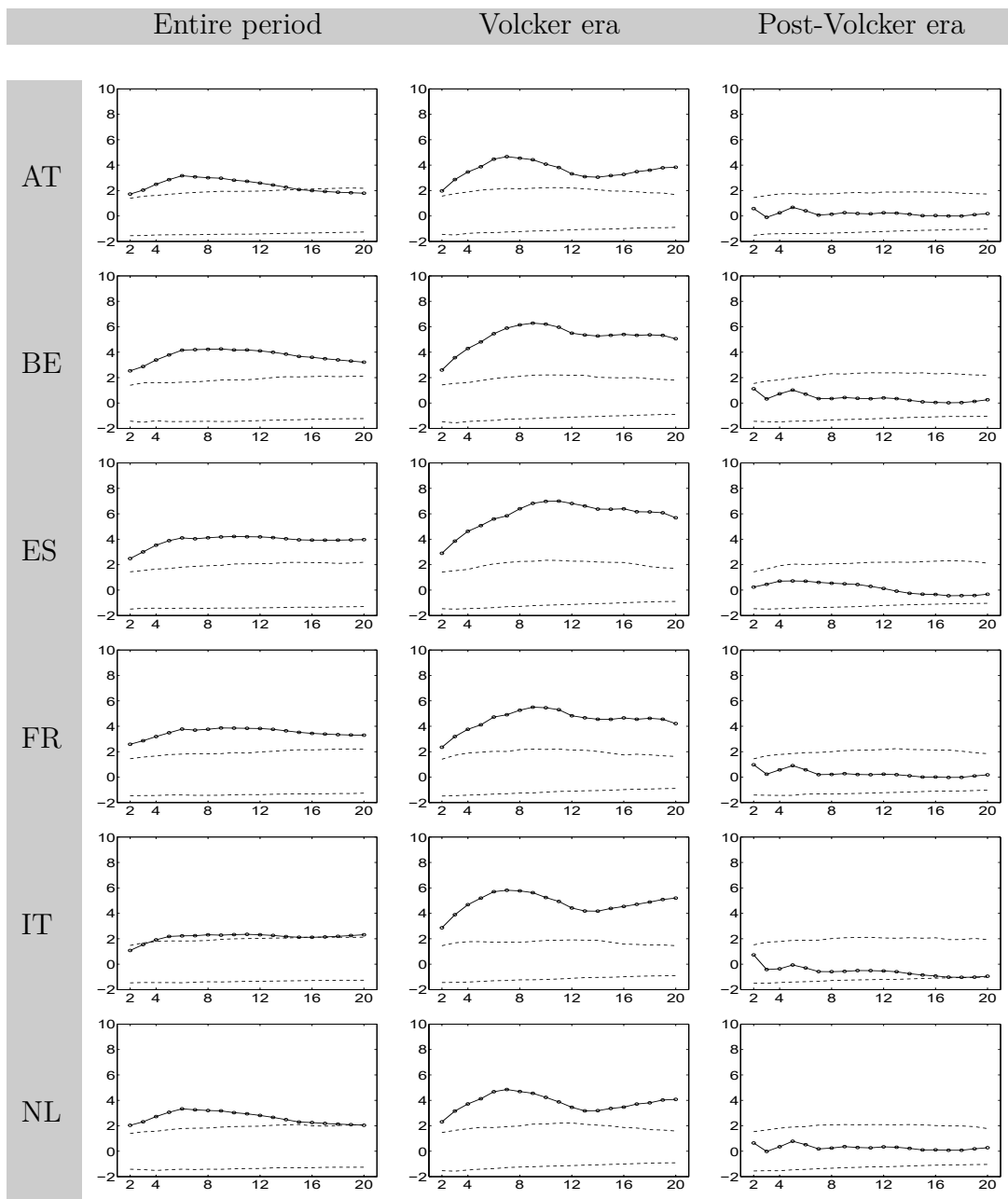


Figure S16: (cont'd)



The horizontal axis is in *quarters*. The vertical axis represents *t*-values. The line with circles represents the *t*-values of estimated variance ratios, and the two dashed lines are the 5% and 95% quantiles of the bootstrap null empirical distribution based on 5,000 draws.

Figure S17: Unconditional UIP: serial dependence of 3-month excess returns

(individual country pairs)

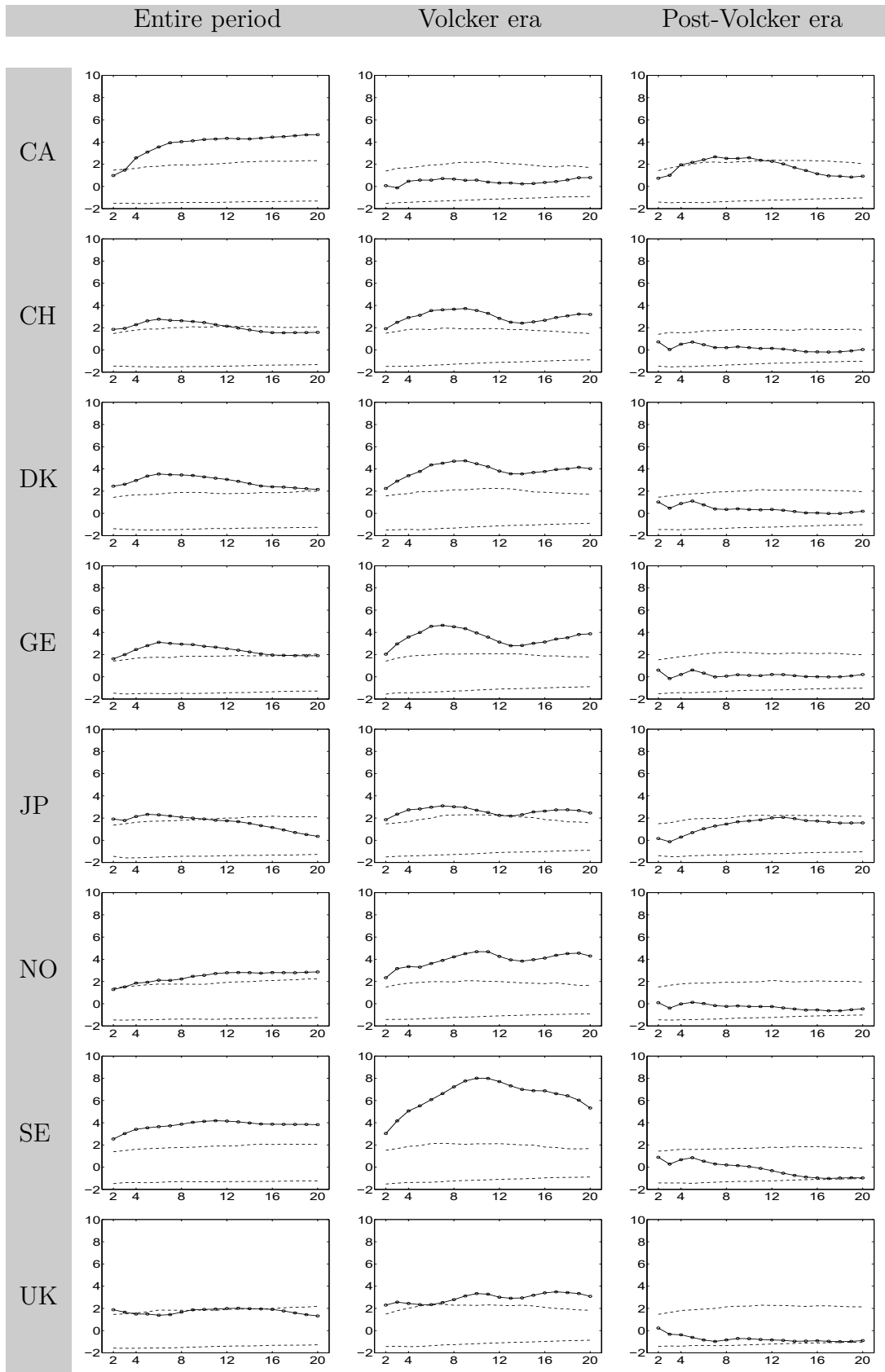


Figure S17: (cont'd)

## 6 Tables

Table TS1: Test for equality of peak timing

	<i>mean</i>		<i>t</i> -value
	Volcker era	Post-Volcker	
AGG	26.777	13.439	-18.588
AGG98	33.508	4.266	-51.191
AGGX	20.556	11.891	-12.141

“*mean*” is the mean location of the maximal response across 10,000 posterior simulations. *t*-value is the *t* statistics for testing the equality of means.

Table TS2: Structural break tests

3-month US-AGG excess return (1976:01-2007:07)						
Specifications <sup>1</sup>						
$z_t=\{1\}$	$q=1$	$p=0$	$h=57$	$M=5$		
Tests <sup>2</sup>						
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$	$Umax$	$Wmax$
5.24	8.88*	8.66*	10.97*	8.80*	10.97*	10.97*
$SupF_T(2 1)$	$SupF_T(3 2)$	$SupF_T(4 3)$	$SupF_T(5 4)$			
9.86*	9.15	16.14*	0.56			
Number of breaks Selected <sup>3</sup>						
Sequential	2 or 4					
BIC	4					
Estimates for break dates selected by the sequential procedure <sup>4</sup>						
$\hat{T}_1$	$\hat{T}_2$	$\hat{T}_3$	$\hat{T}_4$			
80:9	85:6	95:6	01:7			
(78:6-81:12)	(83:5-87:3)	(94:6-98:9)	(99:3-03:5)			

AGG: 7 non-EMU countries plus GE as an EMU representative prior to 2008.

We employ Bai and Perron (2003)’s structural break tests for the changes in the mean of excess returns. For comparison, we use exactly the same notation as Bai and Perron (2003).

<sup>1</sup> See Bai and Perron (2003; p. 18):  $q$  is the number of regressors whose coefficient could break;  $p$  is the number of regressors whose coefficient does not break;  $h$  is the minimal length of a segment;  $M$  is the maximum number of breaks allowed.

<sup>2</sup> The  $SupF_T(k)$  tests the hypothesis of no break versus  $k$  breaks, while  $SupF_T(k+1|k)$  is the sequential test of  $k$  breaks versus  $k+1$  breaks.  $Umax$  and  $Wmax$  are the double maximum tests in Bai and Perron. The heteroscedasticity and autocorrelation consistent covariance matrix is constructed following Andrews (1991) and Andrews and Monahan (1992) using a quadratic kernel with automatic bandwidth selection based on an AR(1) approximation. We select 2 lags for the bandwidth to compute the long-run covariance matrix of the residuals.

<sup>3</sup> We use a 5% size for the sequential test  $SupF_T(k+1|k)$ . BIC represents the Bayesian Information Criterion (BIC).

<sup>4</sup> In parentheses are the 95% confidence intervals for  $\hat{T}_i$ (break date).

\*Significance at the 5% level.