Forecasting in the presence of recent structural breaks

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It's just one damn thing after another: or, structural breaks keep on coming

- Structural change is a major source of forecast error
- Breaks are characterized by abrupt parameter shifts
- Two issues:
  1. How to detect a break? - Chow (1960), Andrews (1993), Bai and Perron (1998)
  2. How to modify forecasting strategy? - Pesaran-Timmermann (2007)

Recognising and dealing with **recent** breaks when they arrive in **real time**

Few observations available for either estimation or forecast evaluation
How to address those two issues?

1. *Monitoring* for a break, i.e. real-time break detection
   - Chu, Stinchcombe and White (1996) - asymptotic proper size under successive and repeative testing, although have low power
2. How to modify forecasting strategy? - not discussed in the literature
   - Are breaks rare OR recurring?
   - Detect a break and react, OR use robust methods?

The class of model we're interested in

$$y_t = x_t' \beta_t + u_t, \qquad t = 1, \ldots, T_1, \ldots, T, \ldots$$

- x_t $k \times 1$ vector of predetermined stochastic variables
- β_t $k \times 1$ vectors of parameters
- u_t martingale difference sequence independent of x_t with finite variance possibly changing at T_1
- Critical: possibility that T_1 is close to T
- Focus: on forecasting at T

Forecasting strategies for distant past breaks

Pesaran and Timmermann (2007)

1. Using basic model estimated over post-break data
2. Trading off the variance against the bias of the forecast by estimating the optimal size of the estimation window
3. Estimating optimal estimation window size by cross-validation
4. Combining forecasts from different estimation windows by using weights obtained through cross-validation as in 3
5. Simple average forecast combination with equal weights

Can we use these after we have monitored and identified a break?

- No; due to lack of data

We propose to use a modified version of no. 5: Monitoring + forecast combination

1. Monitor for a break
2. After a break is detected, wait for $\underline{\omega}$ periods to estimate post-break model
3. Start forecast as soon as feasible post break, averaging forecasts from no-break model using full sample and post-break model, with increasing weight on post-break model
4. 100% weight at $\underline{\omega} + \overline{f}$

$\overline{f}$ is window size after which the post-break model is the sole forecasting model

Strategies robust to a recent break

- Time varying coefficient models specified in variety of ways - controversial specification issues
- Alternative: to consider β_t time dependent but deterministic - estimated nonparametrically (kernel based)
- Rolling regressions a pragmatic response
- Exponentially weighted moving averages is a generalisation with declining weights for older observations
- Pesaran and Timmermann forecast combination aggregates different estimation windows

Theoretical results

Hoping to establish theoretical MSFE rankings for two cases:

- Stochastic breaks
- Deterministic breaks

- Interested in MSFE of a one step ahead forecast based on a model estimated over the **whole period** versus one that is estimated from a method that discounts early data
- We consider
  1. Full sample forecasts (=benchmark)
  2. Rolling estimation
  3. Forecast averaging over estimation periods
  4. EWMA forecast

Stochastic breaks

$$
\begin{aligned}
y_t &= \beta_t + \epsilon_t, \qquad t = 1, \ldots, T \\
\beta_t &= \sum_{i=1}^{t} \mathcal{I}\left(\nu_i = 1\right) u_i
\end{aligned}
$$

- Simplest model that can accommodate multiple breaks - **location** (intercept) shift
- ν_i i.i.d. sequence of Bernouli random variables, value 1 with probability p and 0 otherwise
- ϵ_t and u_i iid series independent of each other and ν_i with finite variance σ_ϵ^2 and σ_u^2

MSFE rankings in the stochastic case

- Full sample forecast diverges as T increases $\rightarrow$ use less data than T
- For window size m, if $m/T \rightarrow 0$ can rank methods:

  RMSFE rolling $<$ averaging $<$ full sample.

Deterministic breaks

$$y_t = \begin{cases} \beta_1 + \epsilon_t & \text{if } \ t \leq t_1 \\ \beta_2 + \epsilon_t & \text{if } \ t_1 < t \leq t_2 \\ \vdots & \quad \vdots \\ \beta_n + \epsilon_t & \text{if } \ t_{n-1} < t \leq t_n \equiv T + 1 \end{cases}$$

- Often assumed time dependent breaks are deterministic
- In the full sample and rolling cases natural decomposition of MSFE into squared bias (increases with T or window m) and variance. Either can dominate
- In general, rankings depend on parametrisations

Monte Carlo results

Examine richer cases than a simple location model - breaks in AR models

1. Single deterministic break in an AR model
2. Multiple stochastic breaks in a location model
3. Multiple stochastic breaks in an AR model

Single break (deterministic)

$$y_t = \alpha + \rho y_{t-1} + \epsilon_t, \qquad t = 1, \ldots, T_0, \ldots, T_1, \ldots, T.$$

$$y_t = \begin{cases} \alpha_1 + \rho_1 y_{t-1} + \epsilon_t, & t = 1, \ldots, T_1 - 1 \\ \alpha_2 + \rho_2 y_{t-1} + \epsilon_t, & t = T_1, \ldots, T \end{cases}$$

- Monitoring and forecasting start T_0
- Break occurs at T_1 in AR parameter, takes the value ρ_1 to T_1, ρ_2 thereafter
- We assume $\alpha_1 = \alpha_2 = 0$ when ρ breaks, or $\rho = 0$ if α breaks

Single break

Design

- ρ_1, ρ_2 pairs drawn from $\{-0.6, -0.4, -0.2, 0, 0.2, 0.4, 0.6, 0.8\}$
- α_1, α_2 pairs drawn from $\{-1.2, -0.8, -0.4, 0, 0.4, 0.8, 1.2, 1.6\}$
- Monitoring ceases when a break is detected
- Forecasting and our evaluation stops at $T = 150$
- Forecast evaluation therefore over T_0 to T
- Model averaging period $\hat{T}_1 + 5$ to $\hat{T}_1 + \overline{f}$ where $\hat{T}_1$ is the date at which the break is detected

Multiple break (stochastic)

Design

$$y_t = \alpha + \rho y_{t-1} + \epsilon_t, \qquad t = 1, \ldots, T_0, \ldots, T_1, \ldots, T.$$

$$\rho_t = \begin{cases} \rho_{t-1}, & \text{with probability} \quad 1-p \\ \eta_{1,t}, & \text{with probability} \quad p \end{cases}$$

$$\alpha_t = \begin{cases} \alpha_{t-1}, & \text{with probability} \quad 1-p \\ \eta_{2,t}, & \text{with probability} \quad p \end{cases}$$

- $p = 0.1, 0.05, 0.02, 0.01$ (breaks every 10 to 100 periods).
- $\eta_{i,t} \sim i.i.d.U\left(\eta_{il}, \eta_{iu}\right)$

$\{\eta_{\rho,l}, \eta_{\rho,u}\} = \{-0.8, 0.8\}, \{-0.6, 0.6\}, \{-0.4, 0.4\}, \{-0.2, 0.2\}$
$\{\eta_{\alpha,l}, \eta_{\alpha,u}\} = \{-2, 2\}, \{-1.6, 1.6\}, \{-1.2, 1.2\}, \{-0.8, 0.8\}, \{-0.4, 0.4\}$

Forecasting strategy

Design

1. Rolling estimation window size M
2. Forecast averaging of forecasts obtained using parameters estimated over all possible estimation windows
3. EWMA based least squares estimator of the regression $y_t = \beta' x_t + u_t$, $t = 1, \ldots, T$ is
   $\hat{\beta} = \left(\lambda \sum_{t=1}^{T} (1-\lambda)^{T-t} x_t x_t' \right)^{-1} \lambda \sum_{t=1}^{T} (1-\lambda)^{T-t} x_t y_t$
   λ a decay parameter
   Following Harvey - we average over $\lambda = 0.1, 0.2, 0.3$

Location model

Multiple stochastic breaks

- Begin with location model - have the analytical results
- Rolling regressions (short windows) $\supset$ rolling regressions (longer window) $\supset$ averaging
- This is roughly the ranking found
- Although there are configurations where any one of the methods outperforms the others

Location model

Multiple stochastic breaks

- Begin with location model - have the analytical results
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- This is roughly the ranking found
- Although there are configurations where any one of the methods outperforms the others

Table 1. RRMSFE: Location Model

$p \backslash$ u_l / u_u	-1 / 1	-0.9 / 0.9	-0.8 / 0.8	-0.7 / 0.7	-0.6 / 0.6
Rolling Window ($M = 20$)					
0.2	**0.77**	**0.77**	**0.79**	**0.80**	**0.83**
0.1	**0.81**	**0.83**	**0.84**	**0.87**	0.91
Forecast Averaging					
0.2	0.84	0.84	0.85	0.85	0.87
0.1	0.85	0.87	0.87	0.88	**0.90**
Rolling Window ($M = 60$)					
0.2	0.84	0.84	0.84	0.85	0.86
0.1	0.84	0.84	0.85	0.88	**0.90**
EWMA					
0.2	0.81	0.83	0.86	0.88	0.92
0.1	0.88	0.92	0.94	0.98	1.02

Location model

Summary

- Short rolling windows do best
- Long rolling windows and averaging next best
- EWMA worst
- But not a particularly rich model

Location model

Summary

- Short rolling windows do best
- Long rolling windows and averaging next best
- EWMA worst
- But not a particularly rich model

Table 2. RRMSFE: recurring breaks in ρ: $\alpha = 0$.

$p\backslash$ $\eta_{\rho,l}$ / $\eta_{\rho,u}$	-0.8 / 0.8	-0.6 / 0.6	-0.4 / 0.4	-0.2 / 0.2	-0.8 / 0.8	-0.6 / 0.6	-0.4 / 0.4	-0.2 / 0.2
	Rolling Window ($M = 20$)				Rolling Window ($M = 60$)			
0.1	0.97	1.04	1.07	1.09	1.00	1.01	1.02	1.02
0.05	**0.93**	1.01	1.06	1.09	0.96	1.00	1.01	1.02
0.02	**0.90**	1.00	1.05	1.09	0.93	0.97	1.00	1.02
0.01	**0.91**	1.02	1.06	1.09	0.91	0.97	1.00	1.02
	Forecast Averaging				EWMA			
0.1	**0.95**	**0.98**	**1.00**	**1.01**	1.02	1.14	1.21	1.25
0.05	**0.93**	**0.97**	**0.99**	**1.01**	1.00	1.12	1.20	1.25
0.02	0.91	**0.96**	**0.99**	**1.00**	0.99	1.12	1.20	1.25
0.01	**0.91**	**0.97**	**0.99**	**1.00**	1.02	1.16	1.22	1.25

- Infrequent large breaks: low rolling window and averaging good
- As break size declines rolling deteriorates
- Larger window rolling more robust (less small-change penalty)
- EWMA always worst - often very bad
- Averaging good performance similar to small windows: but best performer when small changes: **Overall best**

Table 2. RRMSFE: recurring breaks in ρ: $\alpha = 0$.

$p\backslash$ $\eta_{\rho,l}$ / $\eta_{\rho,u}$	-0.8 / 0.8	-0.6 / 0.6	-0.4 / 0.4	-0.2 / 0.2	-0.8 / 0.8	-0.6 / 0.6	-0.4 / 0.4	-0.2 / 0.2
	Rolling Window ($M = 20$)				Rolling Window ($M = 60$)			
0.1	0.97	1.04	1.07	1.09	1.00	1.01	1.02	1.02
0.05	**0.93**	1.01	1.06	1.09	0.96	1.00	1.01	1.02
0.02	**0.90**	1.00	1.05	1.09	0.93	0.97	1.00	1.02
0.01	**0.91**	1.02	1.06	1.09	0.91	0.97	1.00	1.02
	Forecast Averaging				EWMA			
0.1	**0.95**	**0.98**	**1.00**	**1.01**	1.02	1.14	1.21	1.25
0.05	**0.93**	**0.97**	**0.99**	**1.01**	1.00	1.12	1.20	1.25
0.02	0.91	**0.96**	**0.99**	**1.00**	0.99	1.12	1.20	1.25
0.01	**0.91**	**0.97**	**0.99**	**1.00**	1.02	1.16	1.22	1.25

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- As break size declines rolling deteriorates
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- EWMA always worst - often very bad
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Table 3. RRMSFE: recurring breaks in α: $\rho = 0$.

$p \backslash$ $\eta_{\alpha,l}$ / $\eta_{\alpha,u}$	-2 / 2	-1.6 / 1.6	-1.2 / 1.2	-0.8 / 0.8	-0.4 / 0.4	-2 / 2	-1.6 / 1.6	-1.2 / 1.2	-0.8 / 0.8	-0.4 / 0.4
	Rolling Window ($M = 20$)					Rolling Window ($M = 60$)				
0.1	1.04	1.04	1.04	1.05	1.08	1.02	1.01	1.02	1.01	1.02
0.05	0.94	0.95	0.98	1.02	1.07	0.99	0.99	0.99	1.00	1.02
0.02	**0.84**	**0.88**	**0.92**	0.99	1.06	0.91	0.93	0.94	0.97	1.01
0.01	**0.84**	**0.87**	0.93	0.99	1.07	0.88	0.89	0.93	0.97	1.01
	Forecast Averaging					EWMA				
0.1	**0.97**	**0.97**	**0.98**	**0.99**	**1.00**	1.06	1.06	1.10	1.16	1.23
0.05	**0.93**	**0.94**	**0.95**	**0.97**	**1.00**	0.97	0.99	1.05	1.13	1.22
0.02	0.88	0.90	**0.92**	**0.96**	**0.99**	0.91	0.96	1.02	1.12	1.22
0.01	0.87	0.89	**0.92**	**0.96**	**1.00**	0.93	0.97	1.05	1.13	1.23

- EWMA poor performer
- Averaging overall best
- Overall, similar to results for ρ breaks

Table 4: Single break in ρ: Monitoring

$\rho_1 \backslash \rho_2$	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8
				Monitoring ($\overline{f} = 60$)				
-0.6	**1.00**	**1.00**	1.00	1.00	1.00	0.99	0.99	0.95
-0.4	**1.00**	**1.00**	**1.00**	1.00	1.00	1.00	0.99	0.97
-0.2	1.00	**1.00**	**1.00**	**1.00**	1.00	1.00	0.99	0.97
0	1.00	1.00	**1.00**	**1.00**	**1.00**	1.00	0.99	0.99
0.2	0.00	1.00	1.00	**1.00**	**1.00**	**1.00**	1.00	0.99
0.4	0.99	1.00	1.00	1.00	**1.00**	**1.00**	**1.00**	1.00
0.6	0.00	1.00	1.00	1.00	1.00	**1.00**	**1.00**	**1.00**
0.8	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**	**1.00**

- Monitoring works, but few dramatic improvements, and mainly for large breaks
- Conservative, in sense never does much worse than the benchmark

Table 4: Single break in ρ: Rolling

$\rho_1 \backslash \rho_2$	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8
				Rolling Window ($M = 20$)				
-0.6	1.09	1.06	1.00	**0.94**	**0.84**	**0.74**	**0.61**	**0.48**
-0.4	1.06	1.09	1.06	1.01	**0.94**	**0.82**	**0.70**	**0.54**
-0.2	0.99	1.07	1.09	1.06	1.01	**0.93**	**0.81**	**0.64**
0	**0.90**	1.01	1.07	1.09	1.08	1.02	**0.90**	**0.74**
0.2	**0.80**	**0.91**	1.01	1.07	1.09	1.08	1.00	**0.87**
0.4	**0.70**	**0.84**	0.94	1.02	1.08	1.09	1.08	0.97
0.6	**0.61**	**0.74**	**0.84**	0.94	1.02	1.08	1.11	1.07
0.8	0.53	**0.66**	**0.76**	0.86	0.95	1.01	1.08	1.12

- Rolling more effective
- Performs best for large breaks

Table 4: Single break in ρ: Rolling

$\rho_1 \backslash \rho_2$	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8
	Rolling Window ($M = 60$)							
-0.6	1.01	1.01	0.99	0.96	0.93	0.88	0.82	0.74
-0.4	1.01	1.02	1.01	0.98	0.96	0.91	0.84	0.76
-0.2	0.98	1.01	1.02	1.01	0.99	0.95	0.89	0.79
0	0.93	0.98	1.01	1.02	1.01	0.98	0.94	0.84
0.2	0.88	0.94	0.99	1.01	1.02	1.01	0.98	0.90
0.4	0.85	0.91	0.95	0.99	1.01	1.02	1.01	0.95
0.6	0.81	0.88	0.92	0.96	0.99	1.01	1.02	1.00
0.8	0.81	0.86	0.91	0.94	0.96	0.99	1.01	1.02

- Rolling more effective
- For this window, also a safe strategy

Table 4: Single break in ρ: Averaging

$\rho_1 \backslash \rho_2$	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8
				Forecast Averaging				
-0.6	1.01	**1.00**	**0.97**	**0.94**	0.89	0.83	0.75	0.67
-0.4	**1.00**	1.01	**1.00**	**0.97**	**0.94**	0.87	0.80	0.70
-0.2	**0.96**	**1.00**	1.01	**1.00**	**0.97**	**0.93**	0.85	0.75
0	0.91	**0.97**	1.01	1.01	**1.00**	**0.97**	0.91	0.81
0.2	0.86	0.92	**0.97**	**1.00**	1.01	**1.00**	**0.96**	0.88
0.4	0.80	0.88	**0.93**	**0.98**	1.01	1.01	**1.00**	**0.94**
0.6	0.75	0.83	0.88	**0.93**	**0.97**	**1.00**	1.02	**0.99**
0.8	0.72	0.79	0.85	**0.89**	**0.93**	**0.97**	**1.00**	1.01

- Averaging also performs well, in this case better than rolling $M = 60$
- Also safe

Table 4: Single break in ρ: EWMA

$\rho_1 \backslash \rho_2$	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8
				EWMA				
-0.6	1.26	1.23	1.14	1.06	0.90	0.75	0.59	0.41
-0.4	1.22	1.26	1.23	1.14	1.05	0.87	0.71	0.51
-0.2	1.13	1.24	1.27	1.22	1.15	1.03	0.84	0.62
0	1.03	1.16	1.24	1.26	1.22	1.14	0.96	0.74
.2	0.89	1.04	1.16	1.23	1.25	1.22	1.08	0.90
0.4	0.75	0.92	1.06	1.16	1.23	1.23	1.18	1.02
0.6	0.63	0.79	0.92	1.05	1.15	1.22	1.22	1.14
0.8	**0.52**	0.68	0.81	0.93	1.04	1.12	1.19	1.19

- EWMA works very well for some large breaks, eg -0.6 to 0.8 ...
- ... but very badly otherwise

Table 4: Single break in ρ: EWMA

$\rho_1 \backslash \rho_2$	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8
				EWMA				
-0.6	1.26	1.23	1.14	1.06	0.90	0.75	0.59	0.41
-0.4	1.22	1.26	1.23	1.14	1.05	0.87	0.71	0.51
-0.2	1.13	1.24	1.27	1.22	1.15	1.03	0.84	0.62
0	1.03	1.16	1.24	1.26	1.22	1.14	0.96	0.74
.2	0.89	1.04	1.16	1.23	1.25	1.22	1.08	0.90
0.4	0.75	0.92	1.06	1.16	1.23	1.23	1.18	1.02
0.6	0.63	0.79	0.92	1.05	1.15	1.22	1.22	1.14
0.8	**0.52**	0.68	0.81	0.93	1.04	1.12	1.19	1.19

- EWMA works very well for some large breaks, eg -0.6 to 0.8 ...
- ... but very badly otherwise

Single break results: summary

$\rho_1 \backslash \rho_2$	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8
-0.6	MON	MON	AVG	AVG	ROL	ROL	ROL	ROL
-0.4	MON	MON	MON	AVG	AVG	ROL	ROL	ROL
-0.2	AVG	MON	MON	MON	AVG	AVG	ROL	ROL
0	ROL	AVG	MON	MON	MON	AVG	ROL	ROL
0.2	ROL	ROL	AVG	MON	MON	MON	AVG	ROL
0.4	ROL	ROL	AVG	AVG	MON	MON	MON	AVG
0.6	ROL	ROL	ROL	AVG	AVG	MON	MON	MON
0.8	EWMA	ROL	ROL	AVG	AVG	AVG	MON	MON

Summary

- **Monitoring** works, is safe and in general has a small pay off
- **Rolling** windows improve performance after a shock but have a cost where there are small shocks
- **Forecast averaging** works well and is a safe strategy

Monte Carlo results

Summary

- Monitoring works but generally has a small pay off. But it is safe
- Short rolling windows improve performance after a shock but have a cost where there are small shocks
- Forecast averaging works well and is a safe strategy

Empirical exercise for the UK and US

- UK: **94** series, 1992Q1 to 2008Q2: *sub-periods* 1992Q1-1999Q4, 2000Q1-2008Q2
- US: **98** series, 1975Q1 to 2008Q3: *sub-periods* 1975Q1-1986Q2, 1986Q3-1997Q4, 1998Q1-2008Q3
- Compare RMSFEs to an AR(1) benchmark
- Monitoring using 40 and 60-period windows ($M40$ and $M60$)
- Rolling-window using 40 and 60-period windows ($R40$ and $R60$)
- Averaging across estimation periods (AV)
- EWMA.

UK performance: first period

Relative RMSFE

	M40	M60	R40	R60	AV	EWMA
			First Period (1992Q1 - 1999Q4)			
Mean	0.972	0.980	0.925	0.959	0.903	1.029
Median	1.000	1.000	0.959	0.987	0.949	1.096
Minimum	0.619	0.737	0.006	0.005	0.047	0.005
Maximum	1.040	1.025	1.511	1.514	1.301	1.622
Std. Dev.	0.065	0.044	0.238	0.218	0.189	0.317
Skewness	-2.806	-2.819	-0.676	-0.636	-1.182	-0.525
DM(R)	12	12	16	16	22	8
DM(FS)	1	2	2	8	1	9

UK performance: second period

Relative RMSFE

	M40	M60	R40	R60	AV	EWMA
	Second Period (2000Q1 - 2008Q2)					
Mean	0.978	0.984	0.957	0.975	0.918	1.054
Median	1.000	1.000	0.974	0.984	0.951	1.056
Minimum	0.607	0.692	0.118	0.792	0.155	0.010
Maximum	1.050	1.031	1.525	1.235	1.265	2.228
Std. Dev.	0.058	0.043	0.170	0.085	0.157	0.301
Skewness	-3.783	-4.239	-0.725	0.383	-1.429	0.155
DM(R)	14	14	18	16	17	6
DM(FS)	2	2	4	4	1	8

UK summary

- 33 series exhibited breaks (based on Bai-Perron mean shift in an AR)
- On mean and median RMSFE criteria *averaging* best
- *EWMA* worst performer. On average fails to beat the the full sample AR - although in some cases it does extremely well
- The *monitoring* method on average beats the benchmark, with a 40 period window outperforming 60 periods
- *Rolling* window does better, especially with a shorter window. Risk averse forecasters might still choose monitoring: maximum RRMSFE are close to unity and variation in RRMSFE smallest
- Conclude: averaging would have been a good strategy

US performance

	M40	M60	R40	R60	AV	EWMA
	First Period (1975Q1 - 1986Q2)					
Mean	1.011	1.005	1.033	1.012	1.032	1.221
Median	1.000	1.000	1.033	1.007	1.034	1.212
Minimum	0.872	0.905	0.906	0.937	0.889	0.792
Maximum	1.171	1.106	1.135	1.355	1.291	2.594
	Second Period (1986Q3 - 1997Q4)					
Mean	0.990	0.991	0.999	1.040	0.987	1.145
Median	1.000	1.000	0.999	1.029	1.008	1.161
Minimum	0.815	0.870	0.641	0.798	0.711	0.583
Maximum	1.092	1.054	1.284	1.414	1.113	1.732
	Third Period (1998Q1 - 2008Q3)					
Mean	0.998	0.991	1.002	0.977	0.952	1.307
Median	1.000	1.000	1.025	0.997	0.969	1.104
Minimum	0.842	0.877	0.311	0.324	0.513	0.333
Maximum	1.623	1.052	2.557	1.626	1.113	15.818

US summary

- Very few breaks identified: 6
- So gains smaller, best in final period
- EWMA remains worst and most volatile

Conclusions

- Systematic theoretical, experimental and empirical examination of strategies appropriate for real-life forecasting activities in the presence of breaks
- First examination of monitoring-combination strategy
- Monitoring and combining works but has few benefits: is safe however
- In Monte Carlo evidence and real data EWMA very variable and often very bad
- Rolling regressions are not bad ....
- ... but forecast averaging à la Pesaran and Timmermann works well

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