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Detecting unemployment hysteresis

A simultaneous unobserved components model with Markov switching

Sabine Klinger
Enzo Weber

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Sabine Klinger (Institute for Employment Research Nuremberg and University of Regensburg)

Enzo Weber (Institute for Employment Research Nuremberg, University of Regensburg and IOS Regensburg)

Mit der Reihe „IAB-Discussion Paper“ will das Forschungsinstitut der Bundesagentur für Arbeit den Dialog mit der externen Wissenschaft intensivieren. Durch die rasche Verbreitung von Forschungsergebnissen über das Internet soll noch vor Drucklegung Kritik angeregt und Qualität gesichert werden.

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Zusammenfassung

Wir konstruieren ein neues Modell unbeobachteter Komponenten mit Markov-Switching zur Analyse von Hysterese-Effekten, also der Verfestigung ursprünglich zyklischer Fluktuationen. Das Modell kombiniert die Bestandteile einer Trend-Zyklus Zerlegung, der Identifikation von gegenseitigen Kausaleffekten zwischen den Komponenten und der Asymmetrie über den Konjunkturzyklus. Es zeigt sich, dass der jahrzehntelange Aufwärtstrend der Arbeitslosigkeit in Deutschland vollständig durch Hysterese erklärt werden kann. Dagegen folgte die Arbeitslosigkeit in den USA keinem Hysterese-Muster, auch nicht während der großen Rezession. Deutschland überstand diese Rezession so gut, weil sowohl Hysterese als auch strukturelle Arbeitslosigkeit durch institutionelle Reformen deutlich reduziert wurden.

Abstract

We construct a new Markov-switching unobserved components framework for the analysis of hysteresis effects. Our model unifies the ingredients of trend-cycle decomposition, identification of spillovers between the components and asymmetry over the business cycle. Employing the model for Germany and the U.S. over 55 years, we find that the decades-long upward trend in German unemployment is fully explained by hysteresis. The Great Recession was well absorbed because both hysteresis effects and structural unemployment were substantially reduced after institutional reforms. In contrast, U.S. unemployment did not evolve according to hysteresis, not even during the Great Recession.

JEL Klassifikation: E24, E32, J64, C32

Keywords: hysteresis, structural unemployment, business cycle, unobserved components, Markov switching

1 Introduction

Hysteresis is the evolution of long-lasting effects out of just transitory impulses. Then, unemployment hysteresis is the effect of cyclical on structural unemployment. The theories of negative duration dependence and insider outsider models provide reasons for unemployment hysteresis (Blanchard/Summers 1986, Blanchard/Diamond 1994, Falk/Huffman/Sunde 2006). Even though unemployment may have been caused by a recessionary shock, workers lose their skills, get stigmatized or neglect search because of a lack in self-esteem the longer they are unemployed. Insiders negotiate wages too high to account for re-entry barriers of outsiders. As a consequence, unemployment becomes persistent.

However, the relevance of hysteresis for the long-run development of unemployment has been discussed controversially over decades. Among others, Blanchard/Wolfers (2000) state that hysteresis proved to be of minor importance whereas the NAIRU typically depends on the supply side of the labour market as described by minimum wages, unionization, search intensity and so forth. This view has been challenged several times (Reinhart/Rogoff 2009 with respect to financial crises, Ball 2009). Recently, the Great Recession revived interest in hysteresis as output potential was destroyed and dismissed workers were detached from the labour market (Reinhart/Rogoff 2014, Ball 2014).

An empirical analysis of hysteresis requires three important ingredients: first, the breakdown of unemployment into a long-run and a transitory component (the trend and the cycle). Second, spillover effects between trend and cycle in order to disentangle causality in both directions. And third, asymmetric responses of unemployment, as hysteresis is typically meant as a trend increase following a recessionary cycle.

This paper provides an innovative specification to account for all of these requirements: a simultaneous Markov-switching unobserved components model. By means of that model, we can review the development of unemployment over the past decades and specifically in the Great Recession and study whether and why it became persistent: Did unemployment come up cyclically because of a drop in demand (hysteresis) or structurally from the very beginning?

Our comparison of Germany and the U.S. reveals that hysteresis effects are significant for the former only. This is in line with findings on the functionality of the labour markets in the two countries regarding labour market regulation, flows, and unemployment duration (e.g. Jung/Kuhn 2014). However, during and after the Great Recession, German unemployment did hardly rise and quickly recovered while U.S. unemployment increased drastically, took a while to recover and has not yet reached its pre-crisis level. We show that hysteresis had lost importance in Germany after severe labour market reforms had come into force and unemployment had turned onto a declining trend. By contrast, U.S. unemployment increased for cyclical as well as structural reasons at the same time, which do not imply hysteresis but mirror the nature of the crisis.

We build our contribution on several discrete pieces of work: First, studies that view the NAIRU as the permanent component in unemployment which econometrically involves a unit root in the unemployment series (see Canarella et al. 2013 for a discussion and Leon-Ledesma/McAdam 2004 for an application). Permanent and cyclical components can be detected by correlated UC models without leaving either one to being a residual (Morley et al. 2003). A procedure to disentangle the causality structure between the trend and cycle shocks was developed by Weber (2011). Asymmetry with respect to unemployment was analysed with respect to Okun´s law by, e.g., Lucchetta/Paradiso (2014), Owyang/Sekhposyan (2012) and Pereira (2013). Regime switching UC models have been proposed by Morley/Piger (2008, 2012) or Sinclair (2010).

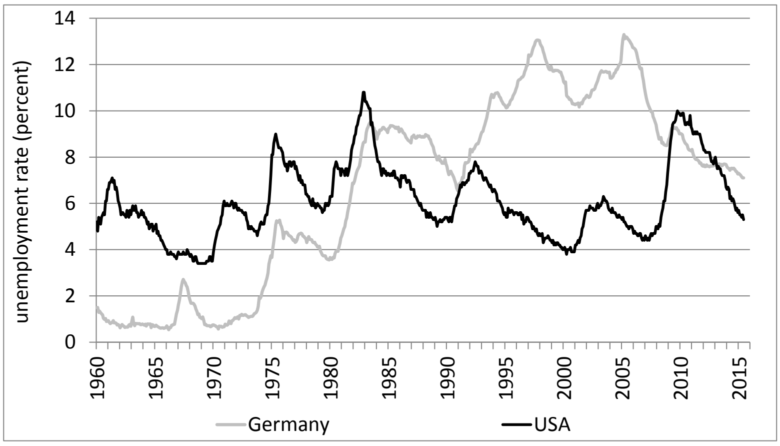
In what follows, we describe the data and the model, explain the results and conclude.

2 Data

We use seasonally adjusted unemployment rates ranging from January 1960 to June 2015. For Germany, this is register data by the Federal Employment Agency. A worker counts as unemployed if he or she is temporarily not employed, searches for a new job subject to social security, is available for job placement efforts of the employment agency (thus not yet in measures) and registered as unemployed. U.S. unemployment provided by the Bureau of Labor Statistics is based on the self-assessment of participants in the Current Population Survey regarding their labour market related activities in the reference week. Due to these different concepts, the absolute levels of the two series should not be compared.

Even though the developments diverge in the years 1967, 1970 and 1997, the main recessions in the mid-70ies and at the beginning of the 1980ies, 90ies, and 2000s led to an increase in unemployment in both countries (Figure 1). While the U.S. unemployment rate recovered more quickly and (until 1985: almost) fully, the German rate increased in stairs. Inflexible institutions and generous unemployment insurance have been named as major reasons (Blanchard/Wolfers 2000, Nickell et al. 2005). However, from the pure look at the data one crucial distinction cannot be made: Did German unemployment rise because of hysteresis or did it simply follow an upward trend with cyclical deviations?

Figure 1
Unemployment rates in Germany and the U.S.



Source: German Federal Employment Agency, BLS.

Starting in 2005, after severe labour market reforms had come into force in Germany (for a summary see Klinger/Rothe 2012), the picture changes drastically. German unemployment moved along a negative trend that was just mildly interrupted by the Great Recession. In contrast, it was U.S. unemployment that rose much more strongly during the Great Recession. By mid-2015, the pre-crisis level had hardly been reached again.

3 The simultaneous correlated unobserved components model with regime switching

The structural form of our model reads as:

(1) $u_t = \tau_t + c_t$

(2) $\tau_t = \tau_{t-1} + \mu^\tau + (k + \Delta k\, S_{t-1}) c_{t-1} + \eta_t$

(3) $c_t = \sum_{i=1}^{p} \phi_i c_{t-i} + \mu_1^c S_t + \mu_0^c (1 - S_t) + \varepsilon_t$

Unemployment u_t is disentangled into a permanent component τ_t and a transitory component c_t (equation 1). The permanent component or trend is a random walk with drift μ^τ (equation 2) while the transitory component or cycle is a stationary autoregression (equation 3).[1] All roots of the lag polynomial $\Phi(L) = 1 - \phi_1 L - ... - \phi_p L^p$ in modulus lie outside the unit circle. Given this mean-reverting property, the cycle can be interpreted as deviation from the trend.

[1] Note that none of these components is imposed on the data since the shock variances can become zero in the estimation. In particular, the model does not impose non-stationarity on the data.

To analyse hysteresis, spillovers between trend and cycle have to be implemented and must be assignable to the direction of hysteresis, i.e. from cycle onto trend. Following Weber (2011), the UC innovations are considered as composites of uncorrelated core trend and cycle shocks $\tilde{\eta}$ and $\tilde{\varepsilon}$ (with normalised variances). In the linear combinations (4), κ_{ij} (*i, j* = 1, 2) denote the mutual contemporaneous spillover effects. With impact κ_{12}, permanent effects may be induced by transitory reasons.

(4) $$\begin{aligned} \eta_t &= \kappa_{11}\,\tilde{\eta}_t + \left(\kappa_{12} + \Delta\kappa_{12} S_t\right)\tilde{\varepsilon}_t \\ \varepsilon_t &= \kappa_{21}\,\tilde{\eta}_t + \kappa_{22}\,\tilde{\varepsilon}_t \end{aligned} \qquad \text{with } \kappa_{ii} > 0 \;\; (i = 1, 2)$$

In addition, hysteresis effects are implemented directly in the measurement equation of the trend (2). This adds a lagged cycle impact, denoted by *k*.

The model contains regime switches to account for the fact that hysteresis is merely seen as the long-lasting effect of a recessionary rather than an expansionary shock. We implement endogenous regime switching by a two-state first-order Markov process. The state variable S_t in equations (2)-(4) takes the value of 0 if unemployment is in regime 0 and the value of 1 if it is in regime 1. S_t depends on S_{t-1} according to the transition probabilities in Table 1.

Table 1
Probabilities to stay in or switch the regime

		S_{t-1}	
		0	1
S_t	0	λ_0	$1-\lambda_1$
	1	$1-\lambda_0$	λ_1

The regimes are distinguished by a switch in cyclical unemployment as well as switches in the spillovers of cycle onto trend. Formally, this is captured by temporary cycle means μ_0^c and μ_1^c in (3) – with $\mu_0^c = -\mu_1^c \frac{1-\lambda_0}{1-\lambda_1}$ (guaranteeing an unconditional cycle mean of 0) and $\mu_1^c > 0$ – as well as breaks in the lagged and contemporaneous spillover coefficients, Δk and $\Delta\kappa_{12}$, in (2) and (4).[2] Then, the state $S_t = 1$ refers to recessions when cyclical unemployment rises. $k + \Delta k$ as well as $\kappa_{12} + \Delta\kappa_{12}$ mirror the hysteresis effects of cyclical increases in unemployment.

2 Additionally, the variance of the uncorrelated cycle shock $\sigma_{\tilde{\varepsilon}}^2$ is allowed to switch, see the appendix.

Specifically for Germany, additional breaks in April 2005 were considered in the drift μ^{τ} and recession parameters Δk and $\Delta\kappa_{12}$ in order to capture potential effects of the labour market reforms.

Identification of the causal structure requires two distinct volatility regimes (see Weber 2011 and appendix), which are given here by Markov switching. For estimation, the structural model is cast in state-space representation (see appendix). Maximum likelihood is applied to estimate the parameters. Thereby, the likelihood function is constructed using the prediction error decomposition from the Kalman filter. Auxiliary regressions of the reduced form ARIMA models deliver optimal information criteria and residuals free of autocorrelation for lag lengths $p = 8$ in Germany and $p = 12$ in the U.S.

4 Results

4.1 Germany

Until the labour market reforms in Germany, the continuous rise in unemployment rested on an increase of the permanent component (Figure 2). Nevertheless, the drift parameter is negligible. Instead, hysteresis effects play the dominant role (Table 2): During recessions, a) the cycle mean rises above zero. b) Cyclical unemployment shocks positively[3] affect the trend with spillover strength of almost 70 percent. c) The lagged cycle raises trend unemployment: each period, almost one tenth of the lagged cyclical unemployment is taken over by the trend.

By contrast, trend unemployment has been declining after the reforms. The structural break coefficients indicate a new explanation for unemployment development as well: First, the total hysteresis effect has become much smaller as the lagged effect is reversed completely. Second, the drift turns significantly negative. These outcomes also underlay the modest reaction of German unemployment to the Great Recession: Cyclical unemployment did not become persistent, and it was partly offset by a structurally improved labour market trend due to a new institutional setting.

[3] This effect is negative in normal times, as is typical for UC models.

Figure 2
Trend and cyclical unemployment in Germany

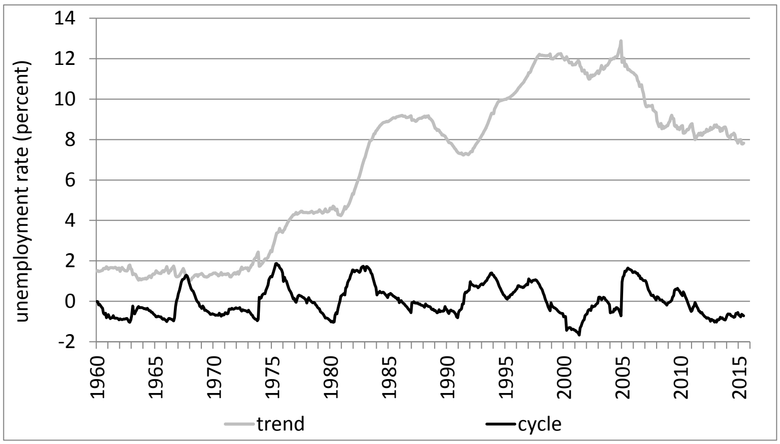


Table 2
Estimation results

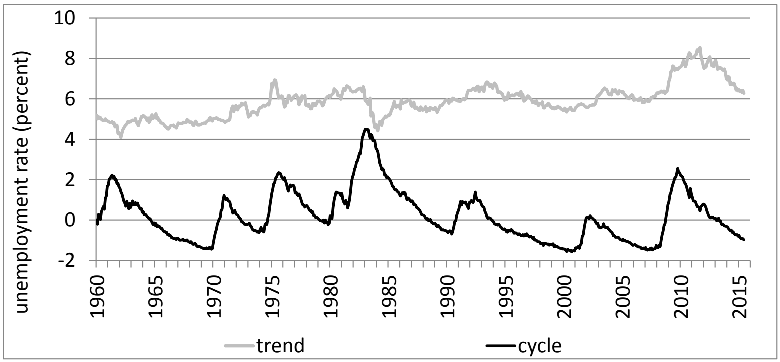
		Germany			U.S.		
		coefficient	standard error	sign.	coefficient	standard error	sign.
deterministics	drift	0.004	0.006		0.003	0.006	
	drift after reforms	-0.037	0.014	***			
	cycle mean#	0.029	0.007	***	0.221	0.047	***
direct spillover	k	-0.016	0.009	*	-0.001	0.006	
	$\Delta k^{\#}$	0.107	0.020	***	0.003	0.016	
	$\Delta k^{\#}$ after reforms	-0.107	0.020	***			
causal structure of trend and cycle shocks	κ_{11}	0.845	0.030	***	0.673	0.110	***
	κ_{12}	-0.663	0.233	**	-0.075	0.352	
	$\Delta\kappa_{12}^{\#}$	1.346	0.591	**	-0.140	0.374	
	$\Delta\kappa_{12}^{\#}$ after reforms	-0.099	0.069				
	κ_{21}	-0.606	0.190	***	0.556	0.105	***
	κ_{22}	0.507	0.223	**	0.140	0.180	

Remarks: # added during recession regime. Post-reform coefficients add to the pre-reform coefficients.

4.2 USA

Between the 1970ies and the Great Recession, U.S. unemployment consisted of a relatively stable permanent component of about 6 percent (Figure 3). This can be interpreted as the level of frictional unemployment given the setting of institutions. Unemployment movements are dominated by the cycle. On average, the cycle mean rises by 0.2 percentage points per month in the recessionary regime (Table 2). However, as none of the hysteresis parameters is significant, cyclical unemployment is reversed automatically as soon as the recession is over. This result is in line with the notion that the flexibility (including worker mobility) on the U.S. labour market is substantially higher than on the German labour market.

Figure 3
Trend and cyclical unemployment in the U.S.

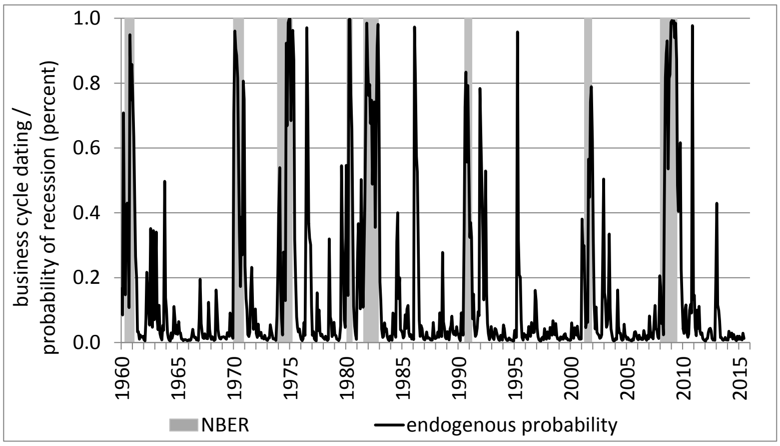


The Great Recession deviates from this pattern to some extent. Cyclical unemployment that arose by that time declined almost as quickly as it used to. However, the trend increased far more than was ever known in the past 55 years. While one might suspect hysteresis behind this phenomenon, allowing for structural breaks in 2007 was far from turning the hysteresis parameters into a significant range. In the absence of hysteresis, the results mean that unemployment occurred for both cyclical and structural reasons. The structural part led to higher persistence and a slow recovery.

Evidently, the structure of the labour market changed with the crisis, but without the link via cyclical unemployment. The recent literature came up with several explanations: Farber (2012) argues that the width and deepness of the crisis made it fairly unattractive for workers (especially compared to previous recessions) to give up their homes and move to places where jobs are still offered. Sahin et al. (2014) find that about one third of the rise in unemployment during the Great Recession is due to newly uncovered mismatch. Elsby et al. (2015) point out that many more people from outside the labour force entered unemployment. Although the reasons are still under debate, one can suspect that these entrants had rather bad risks on the labour market. Consequently, long-term unemployment rose, the Beveridge curve shifted outwards and the recovery in unemployment has taken longer than before. Similarly, the slow decline of the trend since mid-2012 is to be seen against the backdrop of unemployed workers leaving the labour force.

To check robustness, we used exogenous regimes according to the (similarly proceeded) business cycle dating by the Economic Cycle Research Institute (ECRI) for Germany and the NBER for the U.S. We find comparative results to the ones explained above. Figure 4 shows the exogenous as well as endogenous regimes for the U.S. Though referring exclusively to unemployment, our model finds all NBER recessions and clearly distinguishes them from expansionary phases. The few outliers can be explained by strong but short-time increases in unemployment, compared to the average unemployment change in an expansion.

Figure 4
Probability to be in recession and NBER recessions



5 Summary and Conclusions

This paper provides a novel econometric framework to study and compare unemployment hysteresis in Germany and the U.S. Our model combines trend-cycle decomposition, identification of spillovers between the components and asymmetry over the business cycle.

We find significant hysteresis effects in Germany, arising from both the contemporaneous cycle shock as well as the lagged cycle. In contrast, U.S. unemployment did not evolve according to hysteresis, not even during the Great Recession. The different assessment leads to different policy implications. Under hysteresis, countercyclical policies gain importance and measures should be focused on activation, preventing skill deterioration etc.

Either country observed a structural change on its labour market. In Germany, hysteresis effects were reduced after institutional reforms had raised labour market dynamics. Moreover, the decades-long increase in trend unemployment was reversed. Both effects helped mitigate the Great Recession. In the U.S., structural changes due to the nature of the crisis caused unemployment to rise and become more persistent than in the past 55 years. As a general conclusion, the comparison suggests that flexible labour market institutions are the basis to circumvent long-lasting effects of low demand phases.

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Appendix

Identification

For univariate correlated UC models, Morley et al. (2003) describe the general identification strategy. In principle, identification of our more complex model follows the same rules. The reduced form must provide enough information to uncover the structural parameters.

By means of Granger´s Lemma (Granger / Morris 1976), the reduced form of a correlated UC model results as an ARIMA(*p*, 1, max{*p*, 2}) with *p* being the lag length of the cycle autoregression (compare equation 3). The MA-part provides *p*+1 (at least 3) non-zero autocovariances which are typically enough to identify two variances and the covariance of the trend and cycle shocks.

In our model, however, the causal structure of the residual correlation is explicitly specified (compare equation 4) which enlarges the number of unknowns to four: the κ_{ij} (i, j = 1, 2), while the shock variances in regime 0 are normalized to 1. Weber (2011) proposes to use two distinct volatility regimes to identify this structure. With 2(*p*+1) autocovariances, the complex structure can be identified. In our case, the two Markov regimes are used for that purpose (compare also Lanne et al. 2010).

Weber (2011) also points out that lag orders *p* > 2 do not add further information to the Jacobi matrix. In our case, however, the inclusion of the direct spillover *k* circumvents this phenomenon and leads to a full rank of the Jacobi matrix. Thus, with *p* > 3, we cannot only identify the four κ_{ij}, but also *k* as well as the additional parameters from the second regime, $\Delta\kappa_{12}$, Δk and the switching cycle variance.

Identification of the regimes themselves is ensured by the sign restriction $\mu_1^c > 0$. Thus, in recessions, cyclical unemployment rises (corresponding to the negative GDP cycle in Sinclair 2010).

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State space representation

In the state-space model, both trend τ_t and cycle c_t are treated as unobserved states. The measurement equation connects them to the observed series, the unemployment rate u_t. *p* is the lag length of the cycle autoregression.

$$u_t = \underset{(1\times 1+p)}{g} \underset{(1+p\times 1)}{z_t} \qquad \text{with} \qquad g = \begin{pmatrix} 1 & 1 & \underset{(1\times p-1)}{0} \end{pmatrix}$$

$$z_t = \begin{pmatrix} \tau_t \\ c_t \\ \vdots \\ c_{t-(p-1)} \end{pmatrix}$$

The transition equation describes the evolution of the unobserved components.

$$\underset{(1+p\times 1)}{z_t} = \underset{(1+p\times 1)}{d_t} + \underset{(1+p\times 1+p)}{H} \underset{(1+p\times 1)}{z_{t-1}} + \underset{(1+p\times 1)}{e_t}$$

Therein, the vector *d* includes the random walk drift as well as the switching cycle mean. The regime switch implicates time dependence of the intercept.

$$d_t = \begin{pmatrix} \mu^\tau \\ \mu_1^c S_t + \mu_0^c (1 - S_t) \\ \underset{(p-1\times 1)}{0} \end{pmatrix}$$

The transition matrix *H* gives the autoregressive part of trend and cycle as well as a potential direct switching spillover of the lagged cycle on the trend.

$$H_t = \begin{pmatrix} 1 & k + \Delta k S_{t-1} & \underset{(1\times p-1)}{0} & \\ 0 & \phi_1 & \cdots & \phi_p \\ \underset{(p-1\times 1)}{0} & \underset{(p-1\times p-1)}{I} & & \underset{(p-1\times 1)}{0} \end{pmatrix}$$

The covariance matrix of the composite shocks vector $e_t = \begin{pmatrix} \eta_t \\ \varepsilon_t \\ \underset{(p-1\times 1)}{0} \end{pmatrix}$ consists of the variances of the uncorrelated structural shocks as well as the spillovers. Thereby, the shock variances are normalized to 1. The cycle shock variance as well as the spillover effect of cycle shock on trend shock depend on the regime.

$$E_t\left(e_t e_t'\right)=\begin{pmatrix} \sigma^2_{\eta,t} & \sigma_{\eta\varepsilon,t} & \\ \sigma_{\eta\varepsilon,t} & \sigma^2_{\varepsilon,t} & \underset{(1+p\times p-1)}{0} \\ \underset{(p-1\times 2)}{0} & & \end{pmatrix}$$

$$\sigma^2_{\eta,t} = \kappa^2_{11}\,\sigma^2_{\tilde{\eta}} + \left(\kappa_{12} + \Delta\kappa_{12} S_t\right)^2 \left(\sigma^2_{\tilde{\varepsilon},0}(1-S_t) + \sigma^2_{\tilde{\varepsilon},1} S_t\right)$$

with $$\sigma^2_{\varepsilon,t} = \kappa^2_{21}\,\sigma^2_{\tilde{\eta}} + \kappa^2_{22}\left(\sigma^2_{\tilde{\varepsilon},0}(1-S_t) + \sigma^2_{\tilde{\varepsilon},1} S_t\right)$$

$$\sigma_{\eta\varepsilon,t} = \kappa_{11}\,\kappa_{21}\,\sigma^2_{\tilde{\eta}} + \left(\kappa_{12} + \Delta\kappa_{12} S_t\right)\kappa_{22}\left(\sigma^2_{\tilde{\varepsilon},0}(1-S_t) + \sigma^2_{\tilde{\varepsilon},1} S_t\right)$$

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Institute for Employment Research
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Editorial staff
Regina Stoll, Jutta Palm-Nowak

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Gertrud Steele

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For further inquiries contact the authors:

Sabine Klinger
Phone +49.911.179 3255
E-mail sabine.klinger@iab.de

Enzo Weber
Phone +49.911.179 7643
E-mail enzo.weber@iab.de