International Evidence on Credit and Economic Activity

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July 10, 2019

Credit growth and income growth are positively correlated

- The ratio of credit to GDP is often used as an indication of "financial depth", and thought to be positively related to future growth.
- Credit is likely to expand when investors see profitable opportunities, which should usually (but not necessarily always) be followed by output growth.
- Cross country or time series scatter plots largely bear out the postive relationship.

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- The 2008-9 great recession is an obvious example.
- Formal or informal empirical analyses trying to uncover a negative predictive relation between credit growth and future output growth are abundant, especially since 2009.

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- Formal or informal empirical analyses trying to uncover a negative predictive relation between credit growth and future output growth are abundant, especially since 2009.
- So if there is any negative effect of credit growth on future GDP growth, there must be at least two causal channels connecting the two, which implies a need for multiple equation modeling.

Other multi-equation models of credit and growth

- Mian, Sufi, and Verner (2017) look at a system with GDP and two measures of credit, household and business. They use an international panel. They do not include an interest rate, so they cannot examine the role of endogenous responses of monetary policy.

- Brunnermeier, Palia, Sastry, and Sims (2018) use monthly US data, with a 10-variable SVAR, including spreads, two credit aggregates, and interest rates.

- Both these papers find that there is a shock that produces an initial joint rise in GDP and credit aggregates, followed by a decline in GDP not clearly larger than the initial rise. Little of the variance of GDP is explained by this shock in most time periods.

This paper's contribution

- It's a relatively large SVAR, including interest rates (like BPSS).
- It adds real estate prices (but omits, for now, spreads).
- It uses quarterly data on an international panel, like MSV.

Preview of results

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- There is a shock that produces an immediate jump in real estate prices and a brief but sharp rise in GDP growth, followed after about two years by a decline in GDP growth.
- This shock accounts for a small part of overall gdp growth variance in most countries.
- The net long term effect of the initial rise and later fall in gdp growth is positive.
- All the other shocks produce either positive comovement or no comovement between the credit aggregate and GDP.

The model

$$y'_{it}A(L) = \tilde{y}'_t F(L) + u'_{it}$$

where the $p \times 1$ vector y_{it} represents a specific country, and the $q \times 1$ vector $\tilde{y}_t$ represents the US variables we are conditioning on.

We separately estimate a dynamic model for $\tilde{y}$ from US data. Treating $\tilde{y}$ as exogenous, we can form a block-triangular model by appending the US model to the model for the other countries.

The shocks u_{it} are treated as $N(0, \Omega_i)$, where Ω_i is diagonal and varies across countries. The variation across countries in structural shock variances allows us to separate structural shocks without appeal to zero restrictions on A_0.

The countries

- We use quarterly data for 20 countries, over time spans that all end in 2013:2 and have initial dates ranging from 1978 to 2010:2. eight of the time series are quite short — two years or less — but they have little overall weight in the results. They imply no problems for the estimation.

- We include the Euro area as one country from 1999 onwards. We would include, and may yet include, individual Euro area countries before 1997:3 as separate countries, but because of limited availability of historical data on real estate prices, only Italy is included separately for now.

Country names

aus	can	dan	it	jpn	no
Australia	canada	Denmark	Italy	Japan	Norway
uk	ind	che	cze	hung	idn
UK	India	Switzerland	Czech republic	Hungary	Indonesia
mex	pl	th	tr	eu	za
Mexico	Poland	Thailand	Turkey	Euro area	South Africa

The variables

rp:	real estate price
rgdp:	real gdp
r:	short interest rate
pc:	commodity price index
defl:	gdp deflator
credit:	BIS aggregate household credit index (aha)
usr:	US federal funds rate

Estimation

- We model the conditional distribution of the country constant vectors c_i given the country initial conditions y_{i0} as normal with mean an affine function of y_{i0}.

- We impose priors on all the unknown parameters, though the prior for the coefficients in $c_i \mid y_{i0}$ is flat, and sample from the posterior density to obtain point estimates and error bands for impulse responses.

- By modeling the dependence of c_i on y_{i0} we are using a method that delivers consistent estimates of $A(L)$ as the number of countries $N \to \infty$, though with $N = 20$ and T small for some countries, we rely mainly on the small sample Bayesian interpretation of our results.

Further comments on methods

- It's well known that in large-N, small-T panel data models naive "fixed effects" estimation is inconsistent as $N \to \infty$.
- A great deal of applied work therefore uses instrumental variables approaches in such models, originated by Arellano and Bond.
- Arellano-Bond estimation can be extremely inefficient.
- It is possibly not so widely recognized that by modeling the distribution of $c_i \mid y_{i0}$ and taking a likelihood-based (usually Bayesian) approach, the inconsistency goes away. (Liu, 2017; Sims, 2000)

Further comments on methods

- Unlike reduced form, unrestricted VAR's with constant covariance matrices, structural VAR's with time varying shock variances can't be estimated by stacking the entire system.

- They can be estimated with a Kalman filter, and that may seem to be the obvious approach.

- However, it is much more efficient to treat each equation separately, in which case weighting observations and stacking does work.

- The priors we have used, including the prior on $c_i \mid y_{i0}$, can be implementd with dummy observations. We have an appendix that explains how we did it.

Impulse responses

- Identification is nearly trivial — all the strong first-period responses are on the diagonal, reflecting near-diagonality of the covariance matrix of reduced form disturbances.

- The first shock, which moves rp first, produces a significant rise, then fall, in rgdp and an expansion in credit. This fits the story of a housing-based credit boom followed by contraction.

- However, the shock also increases inflation and a raises interest rates, which, consistent with results in Brunnermeier, Palia, Sastry, and Sims (2018), suggests that the slowing of growth can be explained by the endogenous monetary policy reaction to inflation, or to the credit growth itself.

Impulse Responses

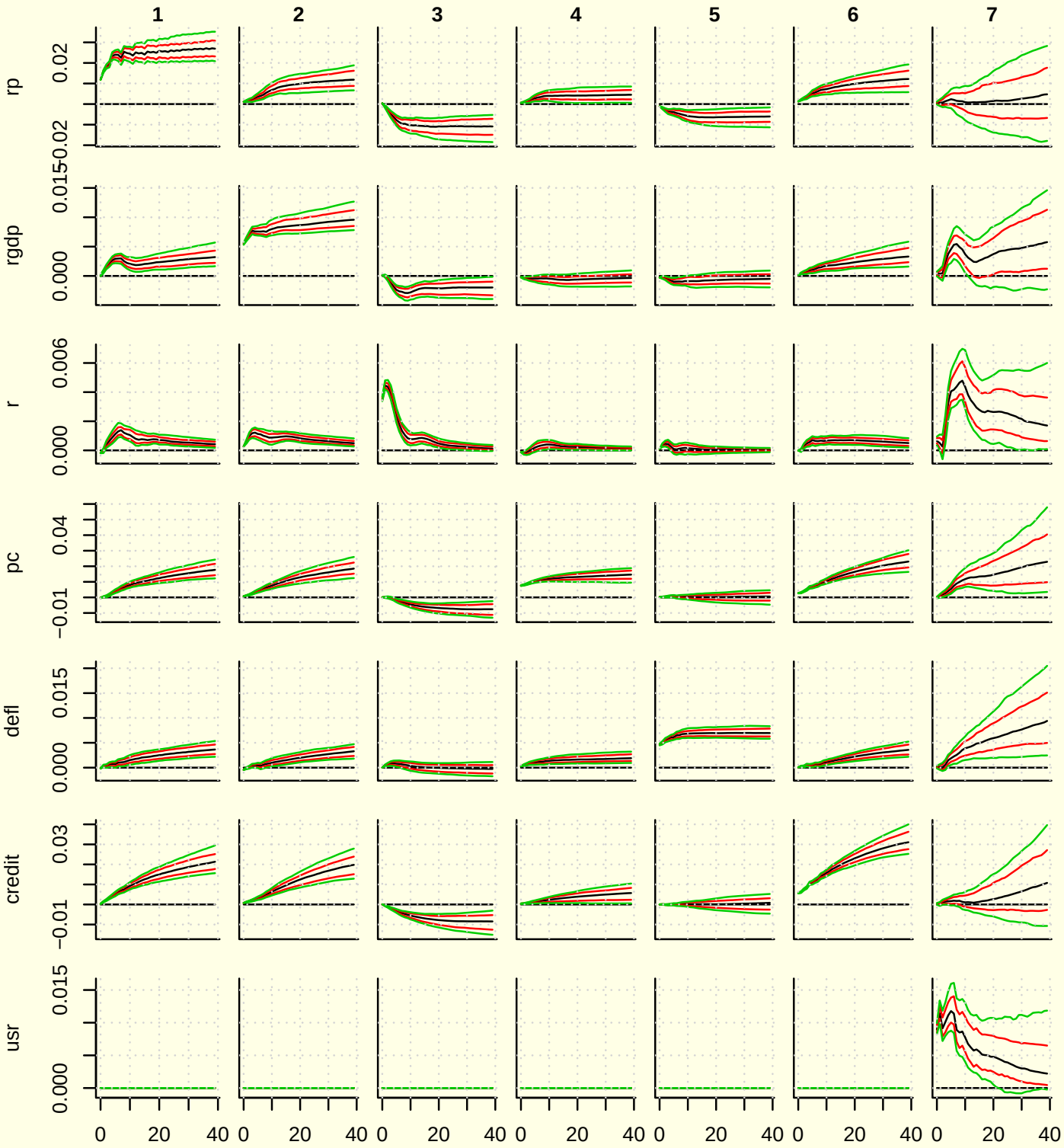
- The third shock fits the usual sign restrictions used to identify a monetary policy shock, though the response of defl is weak.

- The usr shock effects have wider error bands, as only one country has been used to estimate that model.

- The usr effects are not what would be expected if they respresented contractionary US policy forcing contraction in other countries. The effects appear expansionary.

- Two possible explanations: The domestic r response is less than half the usr response itself, so the exchange rate may be devaluing, producing an expansionary effect. Or, the current model's use of a 1-variable AR in usr alone may make the usr shocks fail to separate monetary contraction from other influences on r.

IRF conditional on usr



Residual diagnostics

- The residuals do not show clear patterns of serial dependence.
- The dummy observation residuals are small, indicating that our prior is loose. For the c_i prior, this might be important.
- Cross-country correlations for countries with big overlapping samples are not large, for the most part, but they are probably statistically significant in some cases — eu vs UK most notably.

Next steps

- The current error bands are unrealistically tight. This is a common issue when we approach large data sets with our traditional modeling tools: We have too few free parameters, because we have not let model complexity expand with the data set.

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- The current error bands are unrealistically tight. This is a common issue when we approach large data sets with our traditional modeling tools: We have too few free parameters, because we have not let model complexity expand with the data set.

- Use a US model with more variables. Particularly spread variables, which were important in BPSS and might absorb cross-country shock correlation.

- Allow for variation across countries in $A^{+}(L)$.

- Add time variation on top of country variation in shock variances.

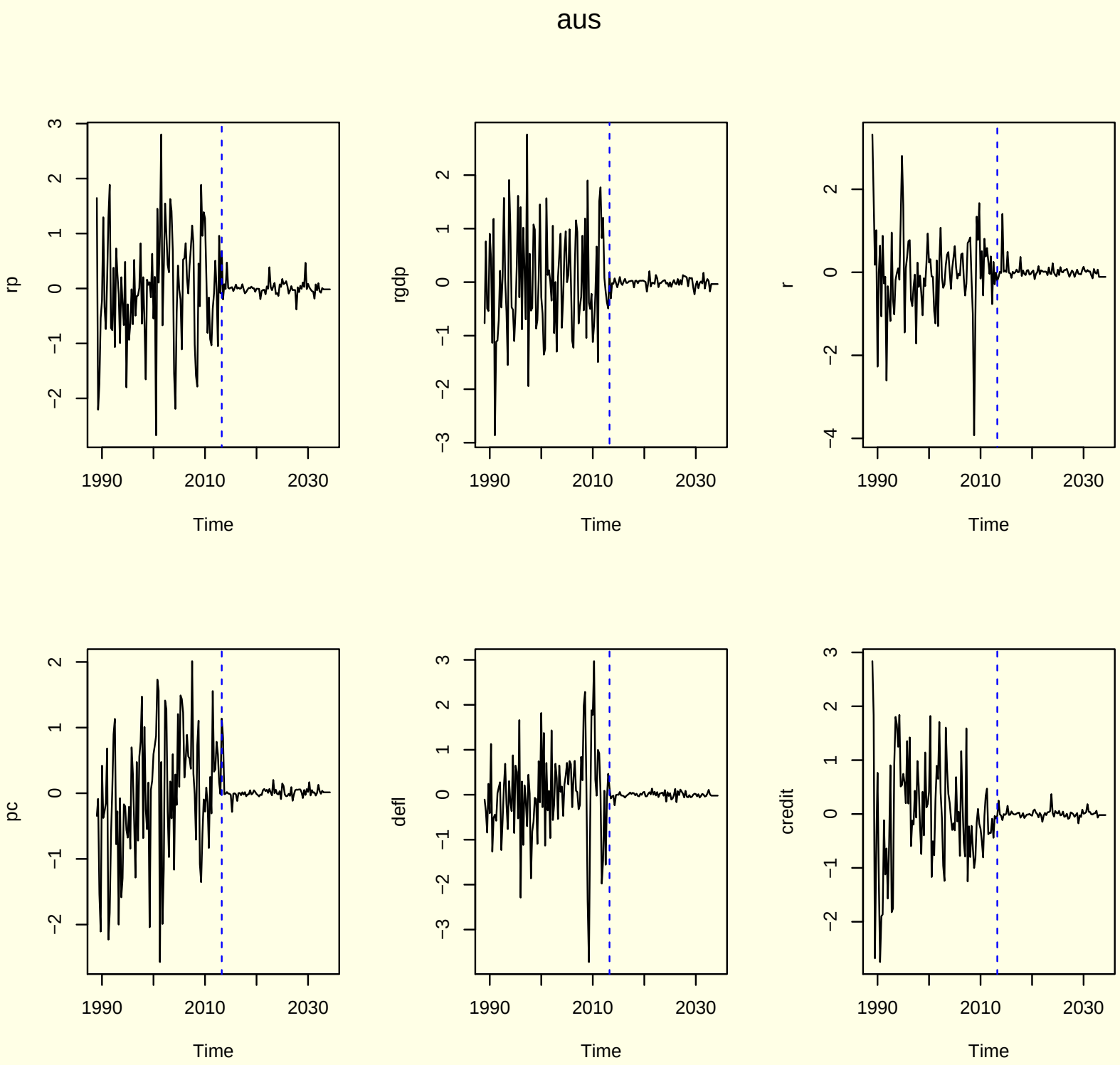
- Estimate the regime switches, using the Hidden Markov Chain modeling approach as in Sims and Zha (2006).

- Any of these complications are in principle feasible using MCMC posterior inference, but the latter three might start to be computationally challenging.

Summary of substantive conclusions

- Credit expansions accompannied by real estate price inflation do predict future low GDP growth, but the also predict immediate high GDP growth, and the low growth seems to be a response to ordinary anti-inflationary monetary policy.

- Use of identification through heteroskedasticity to identify monetary policy responses yields results similar to other approaches, and other data sets, in the literature.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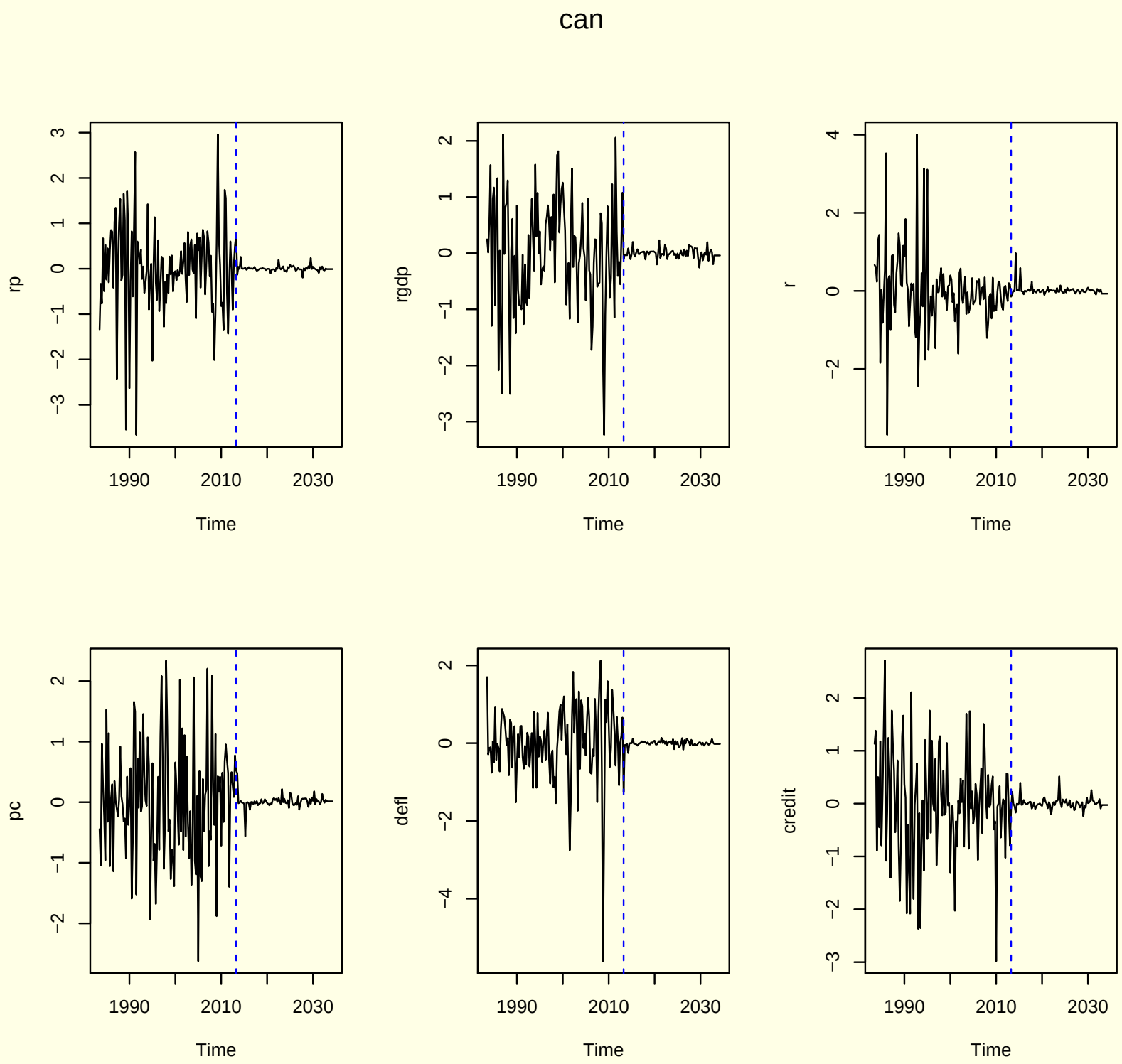
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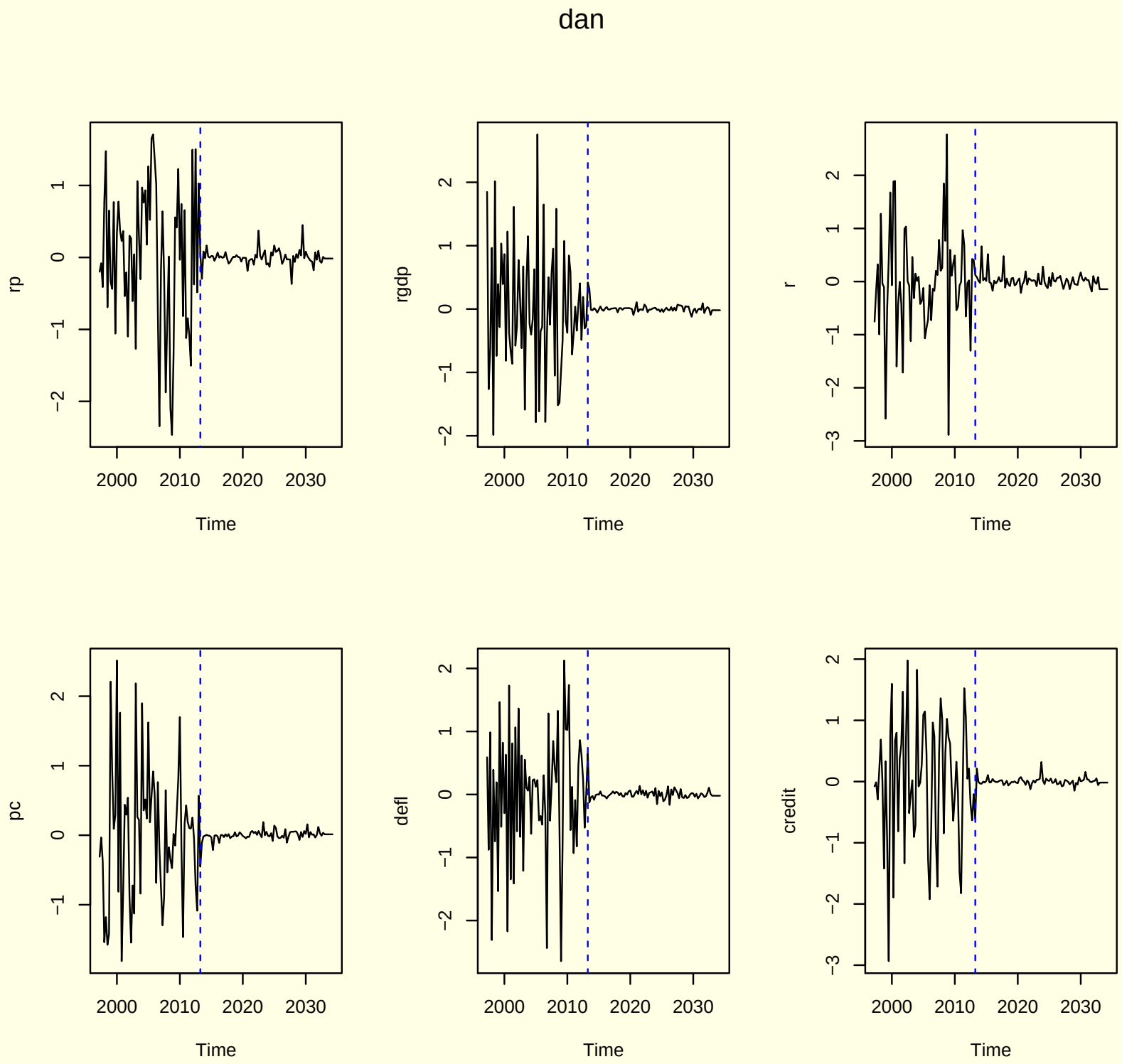
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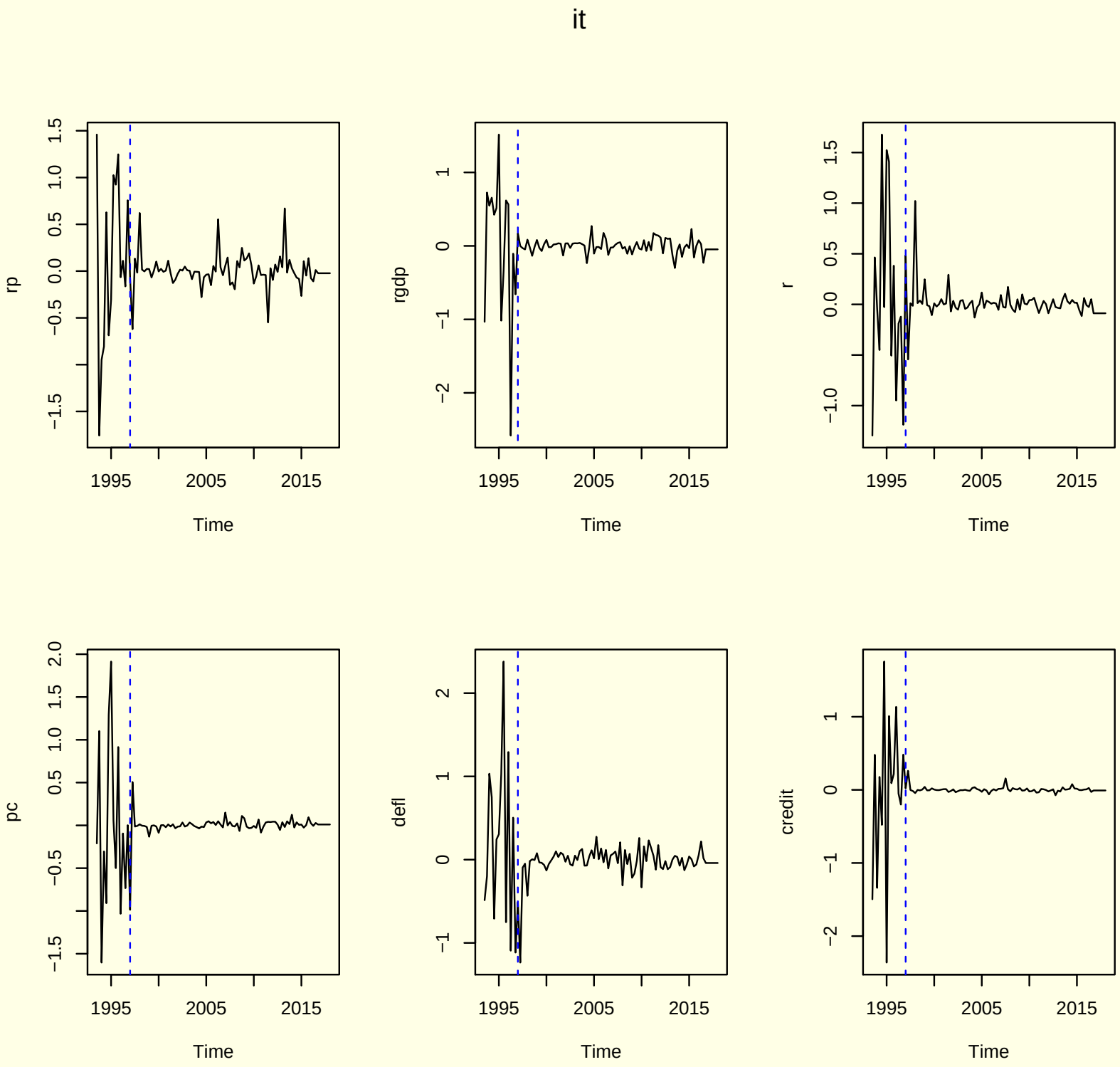
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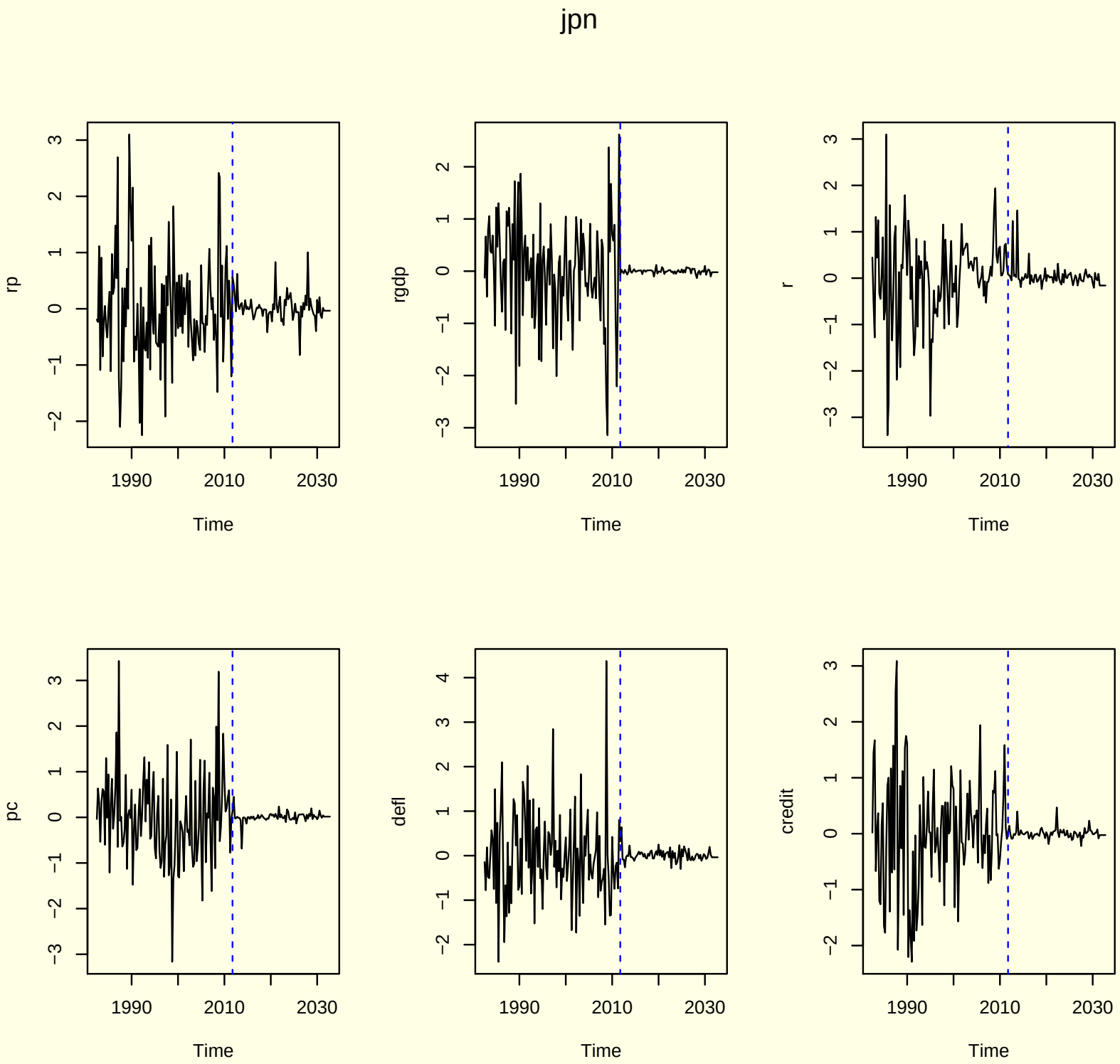
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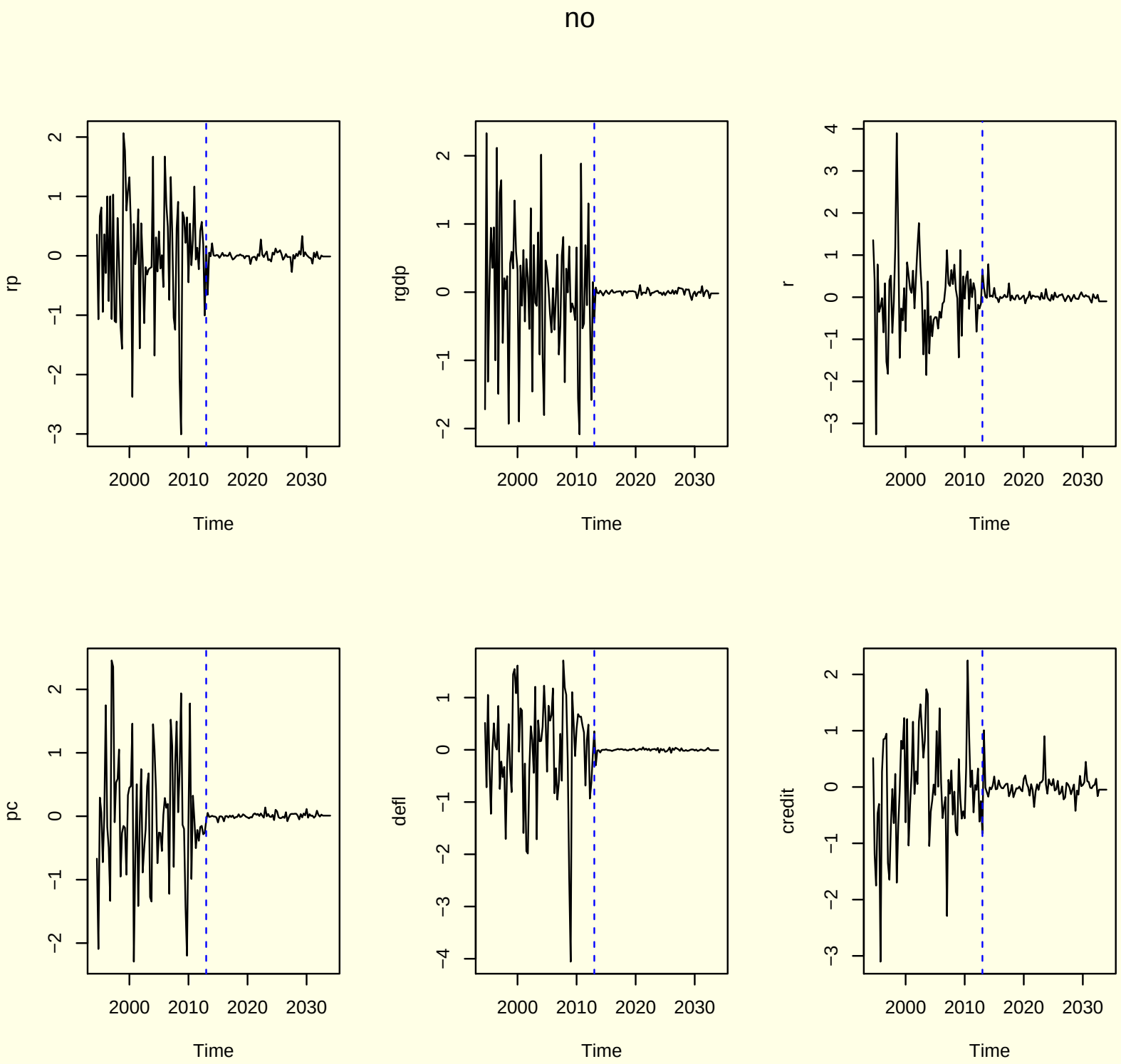
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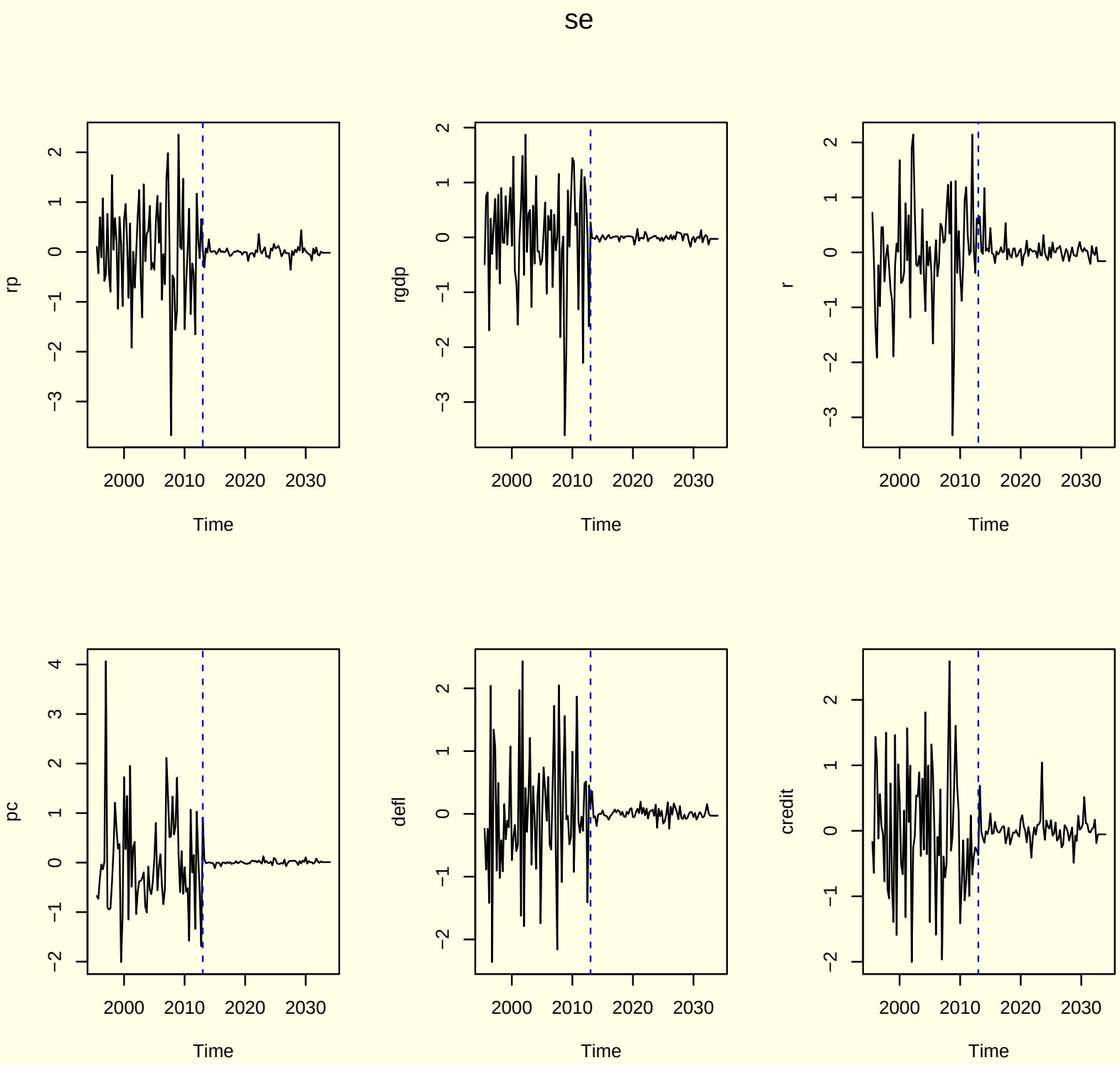
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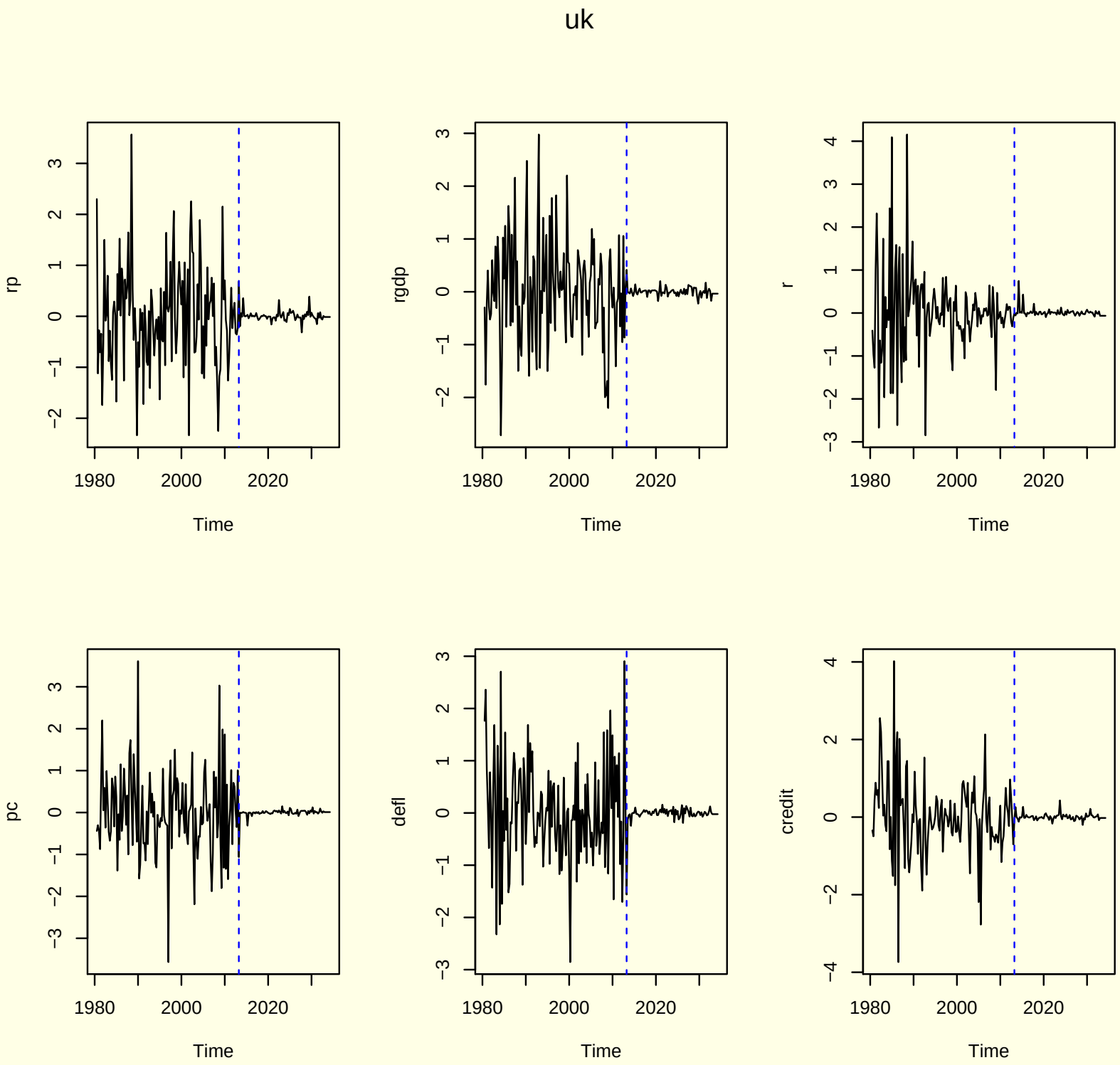
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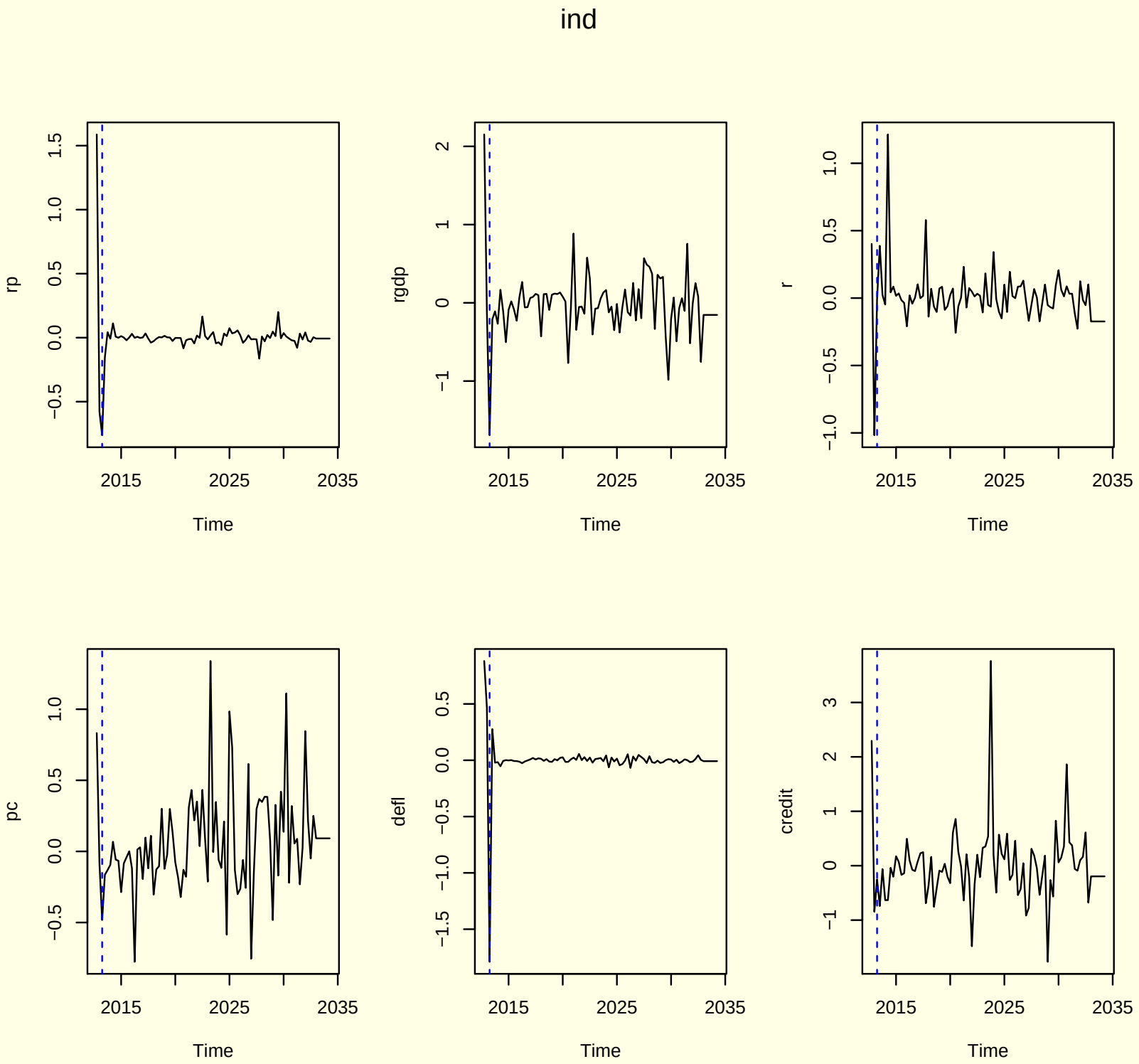
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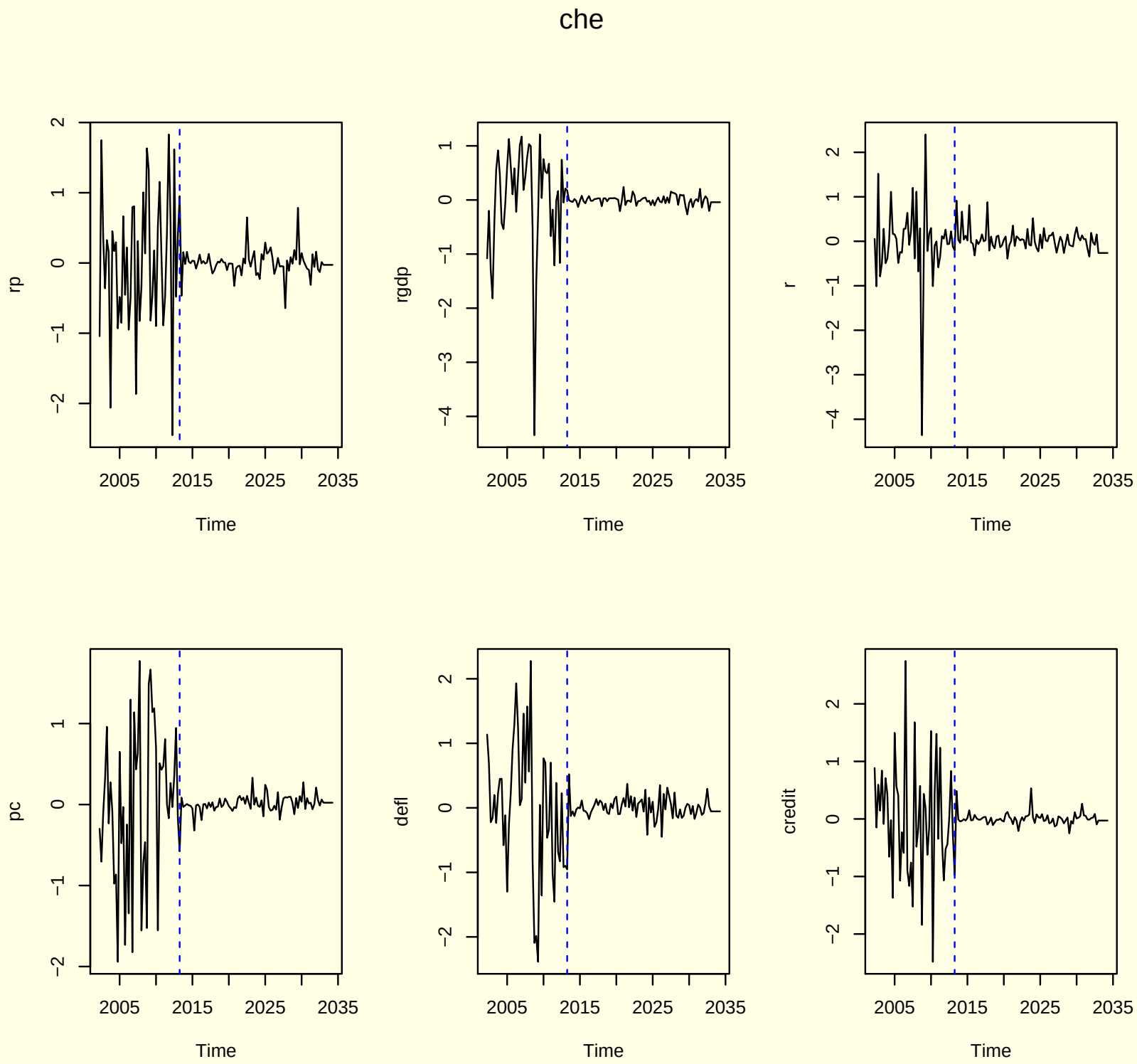
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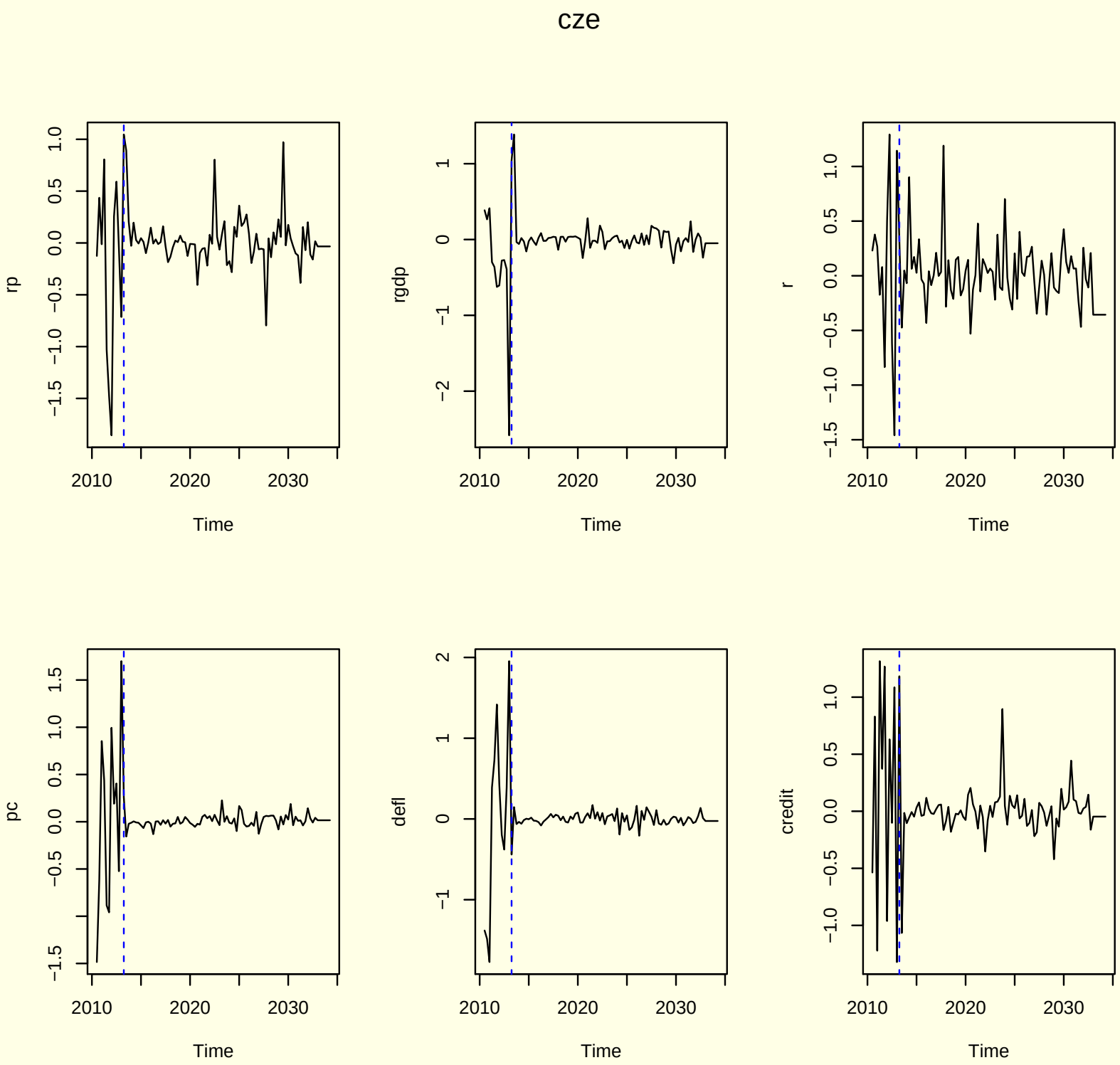
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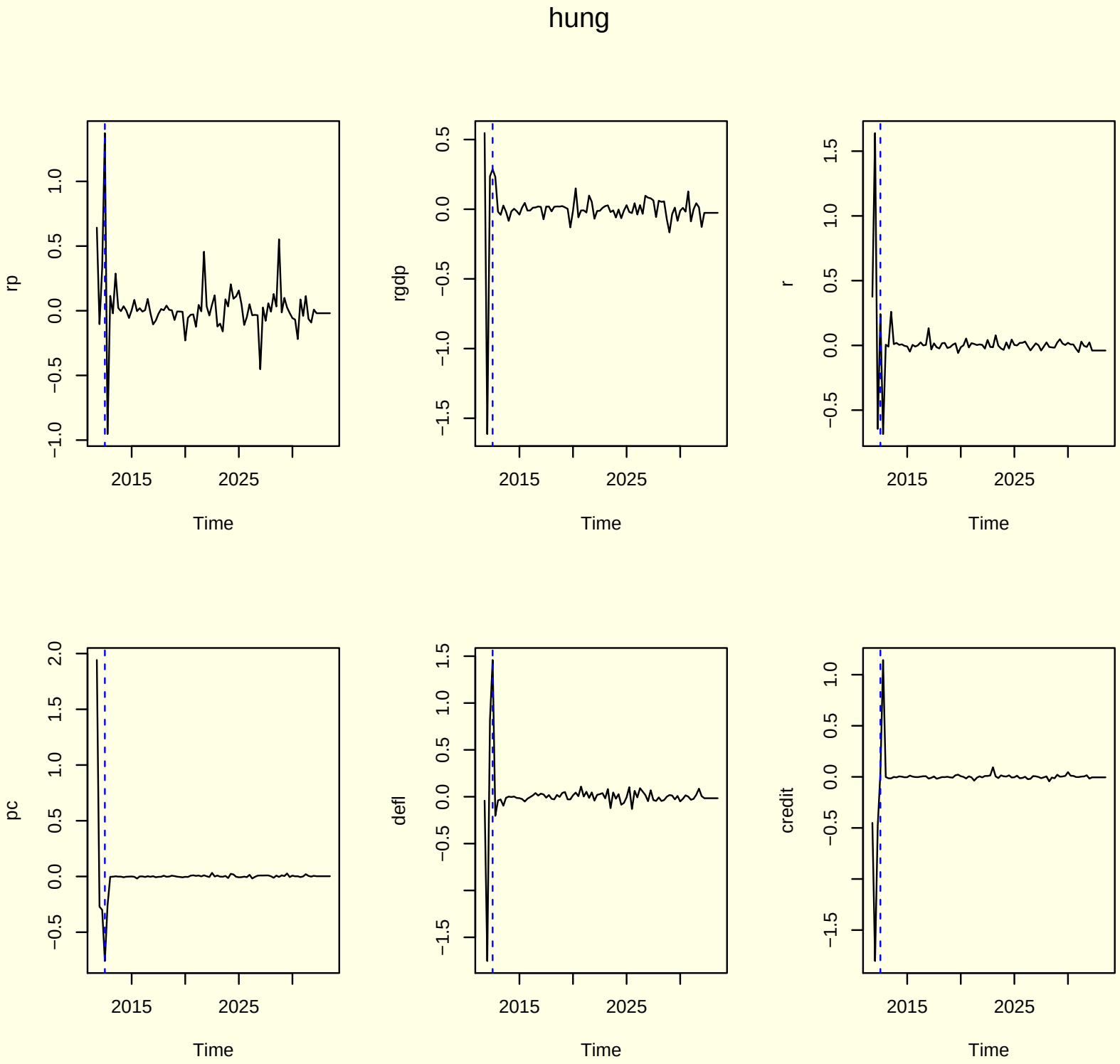
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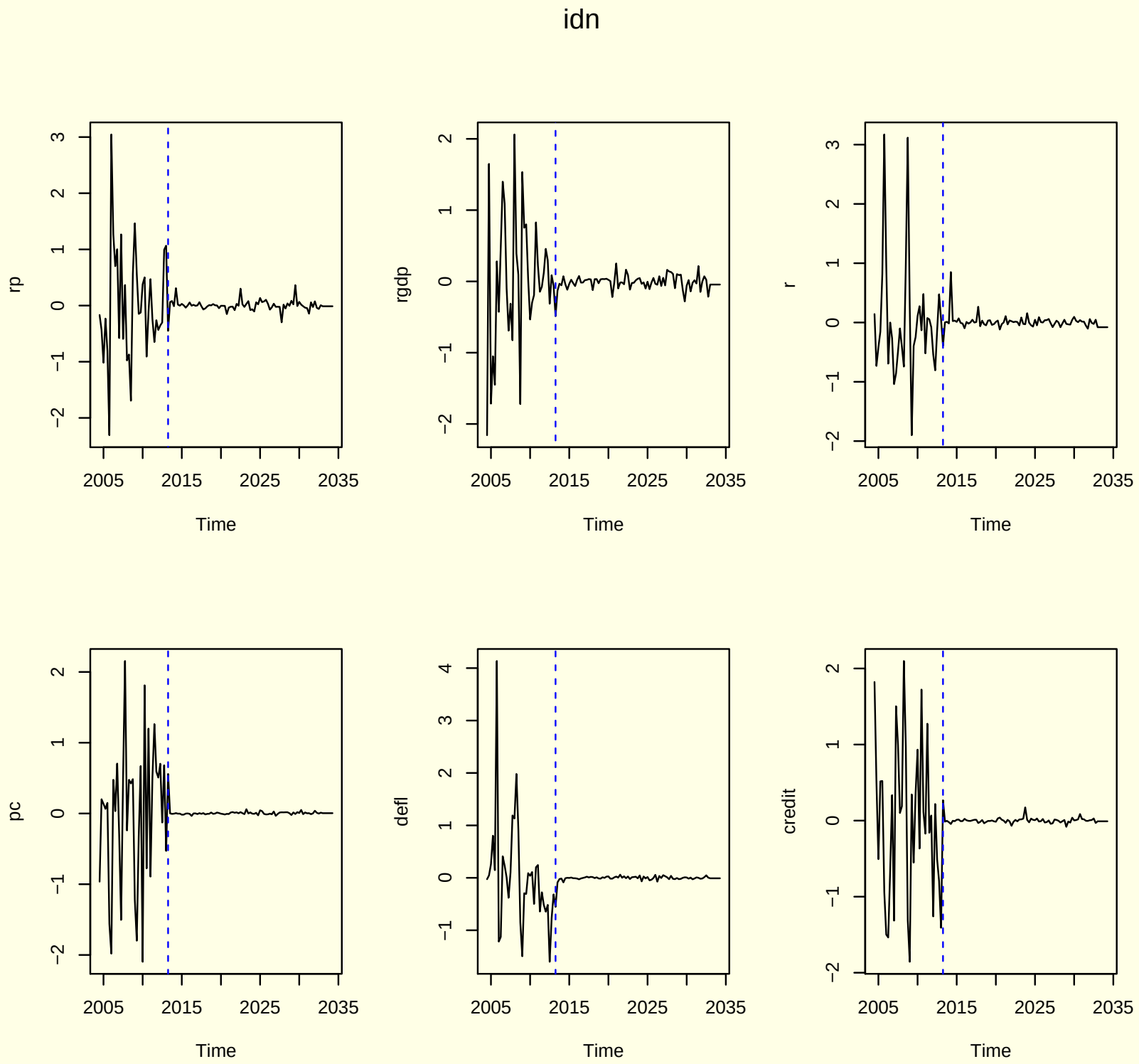
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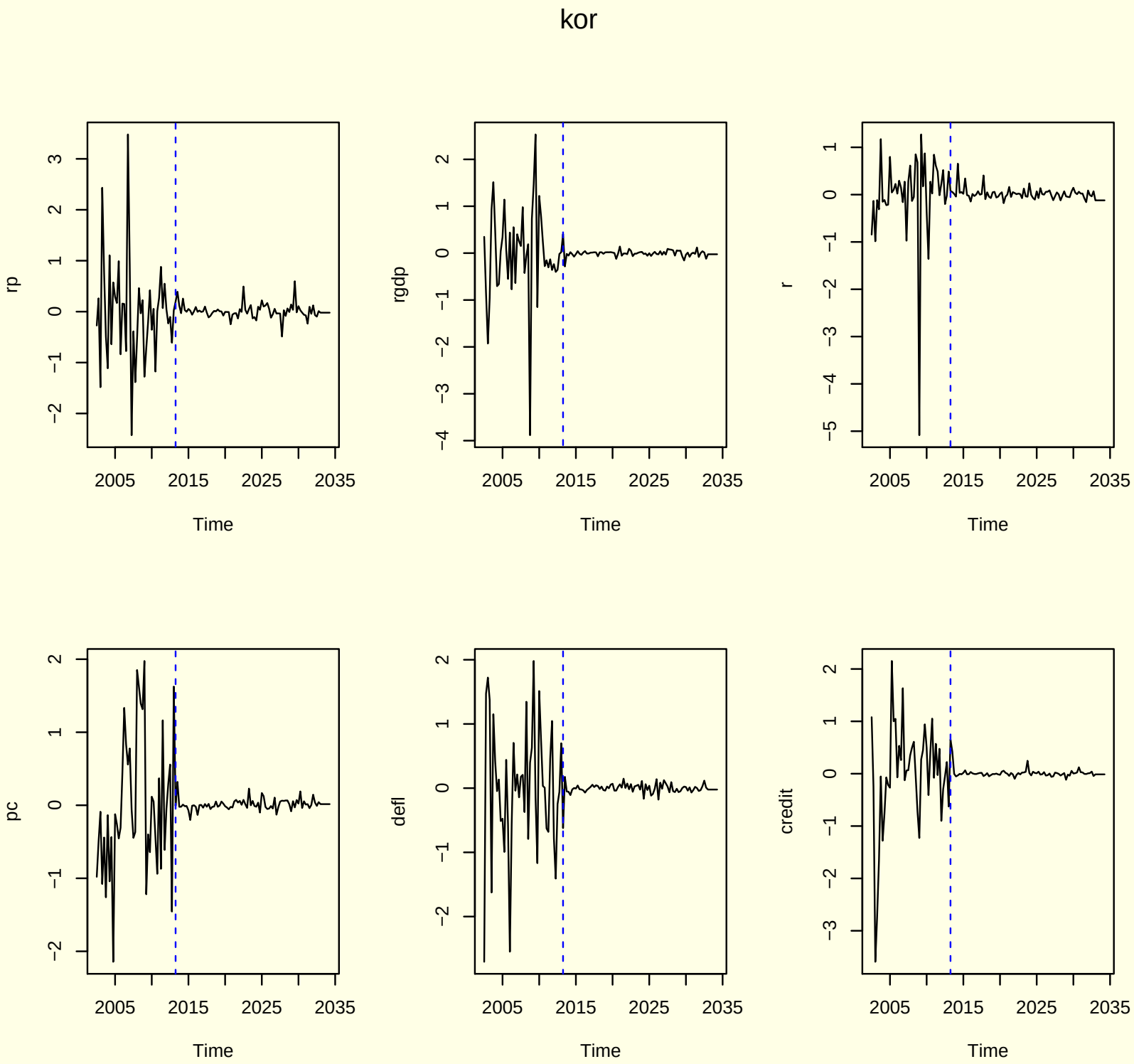
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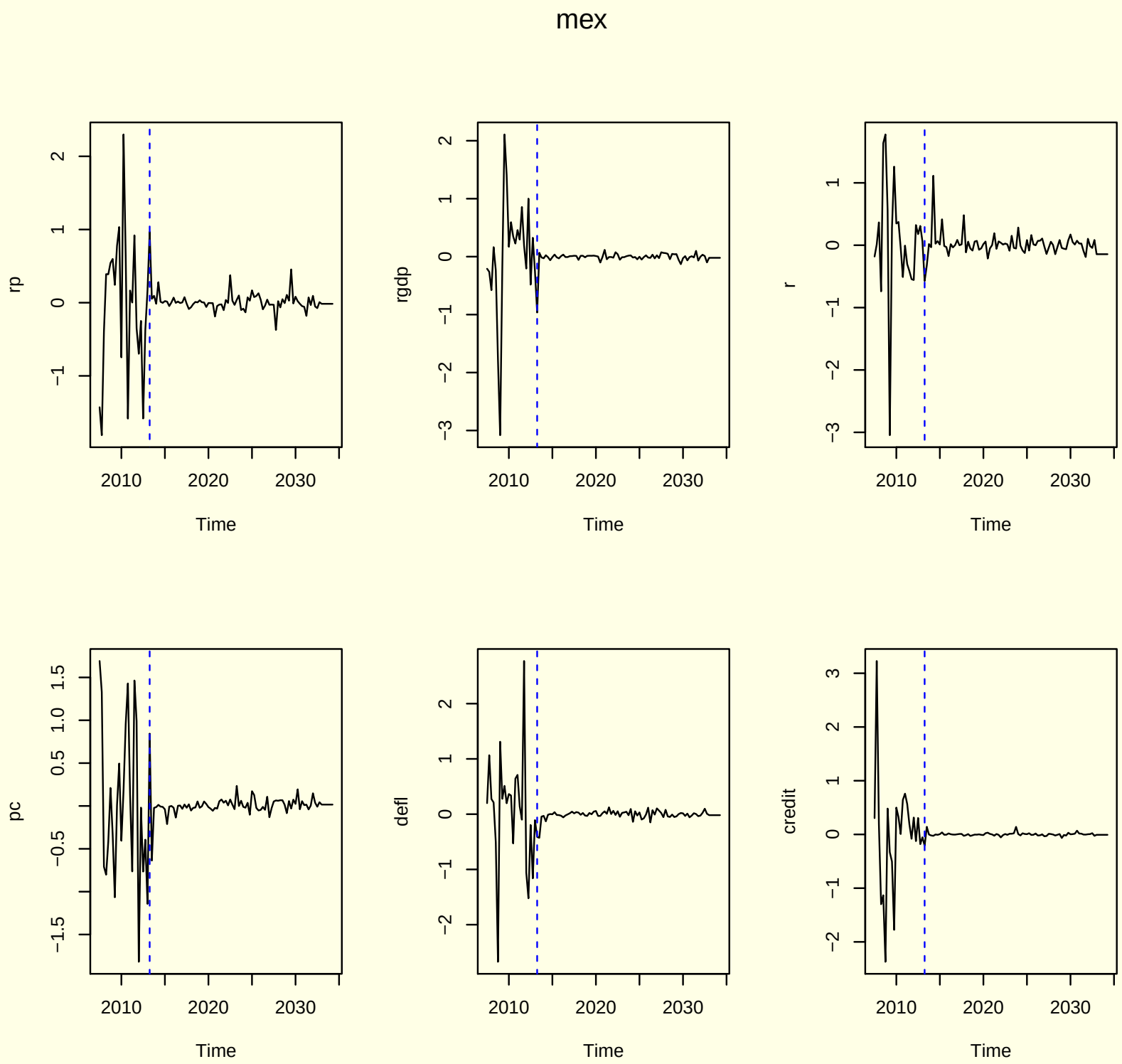
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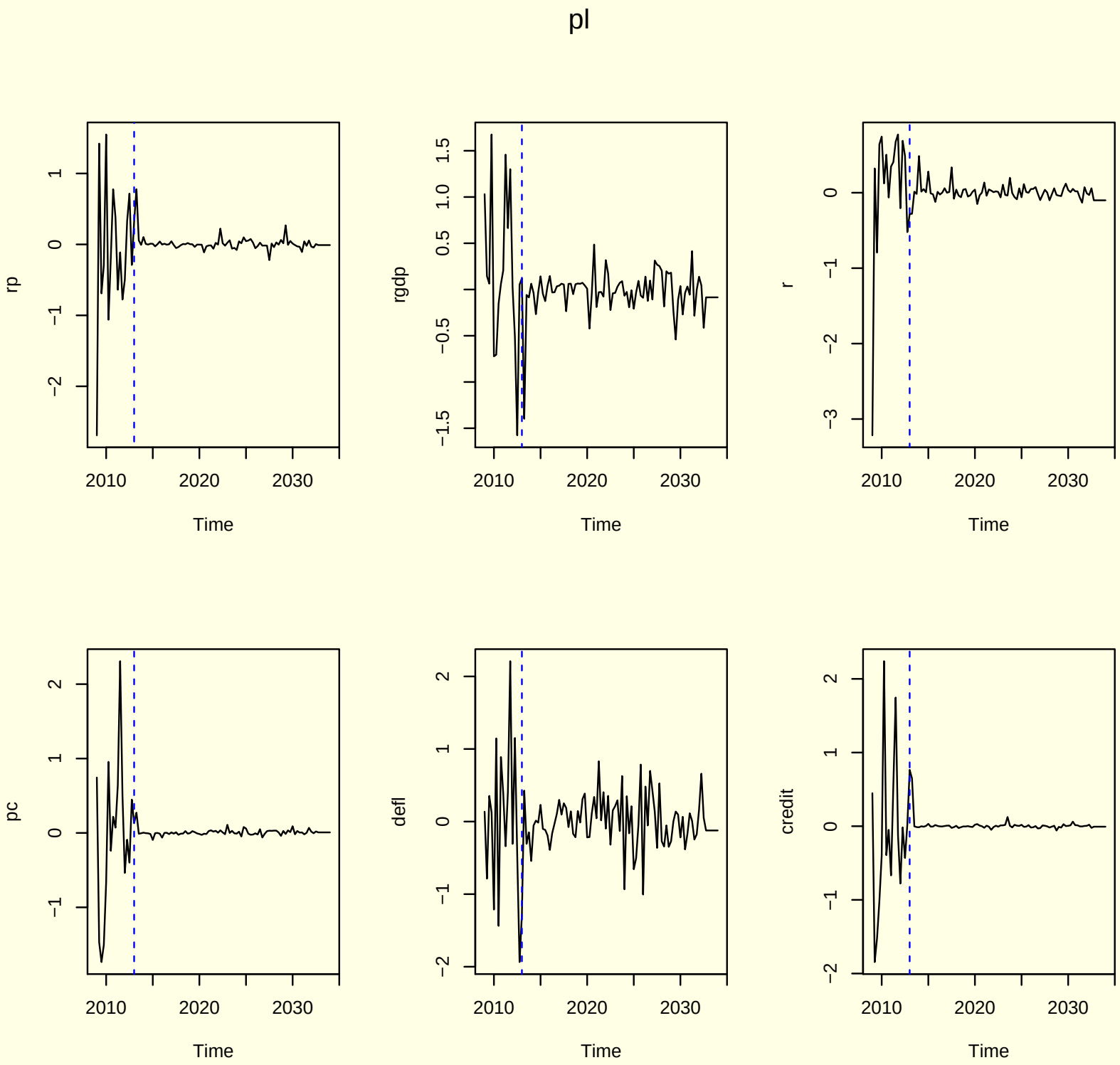
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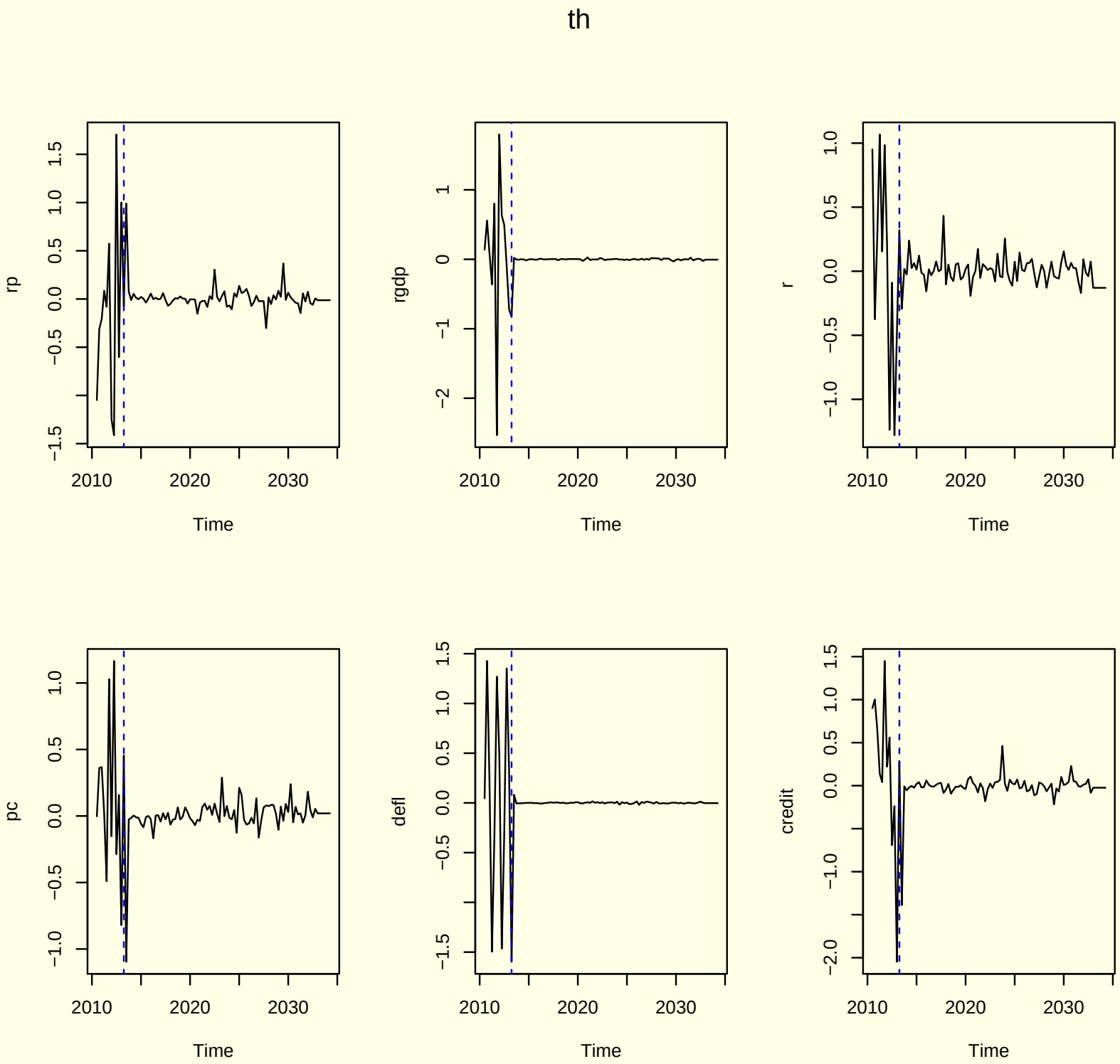
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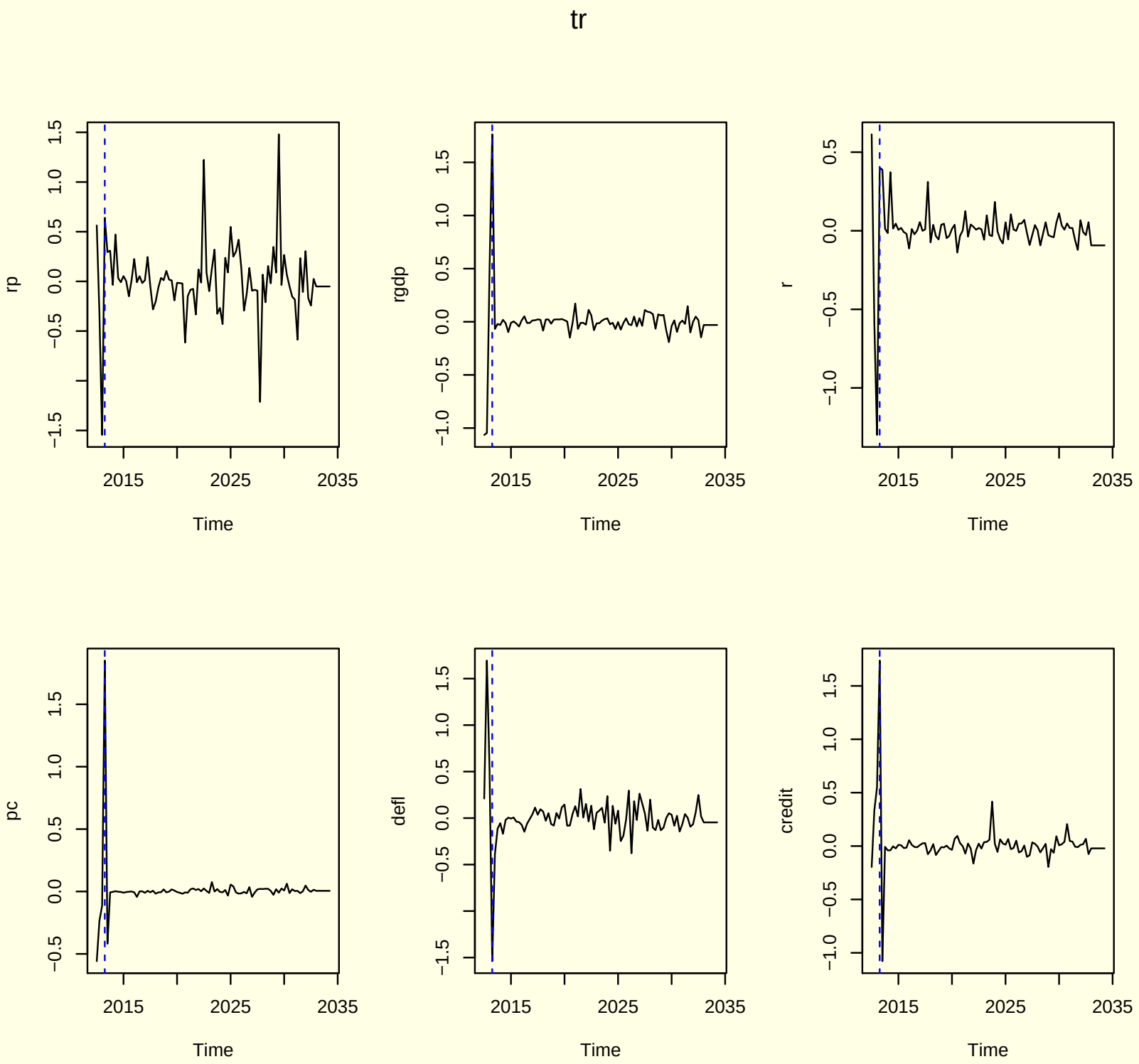
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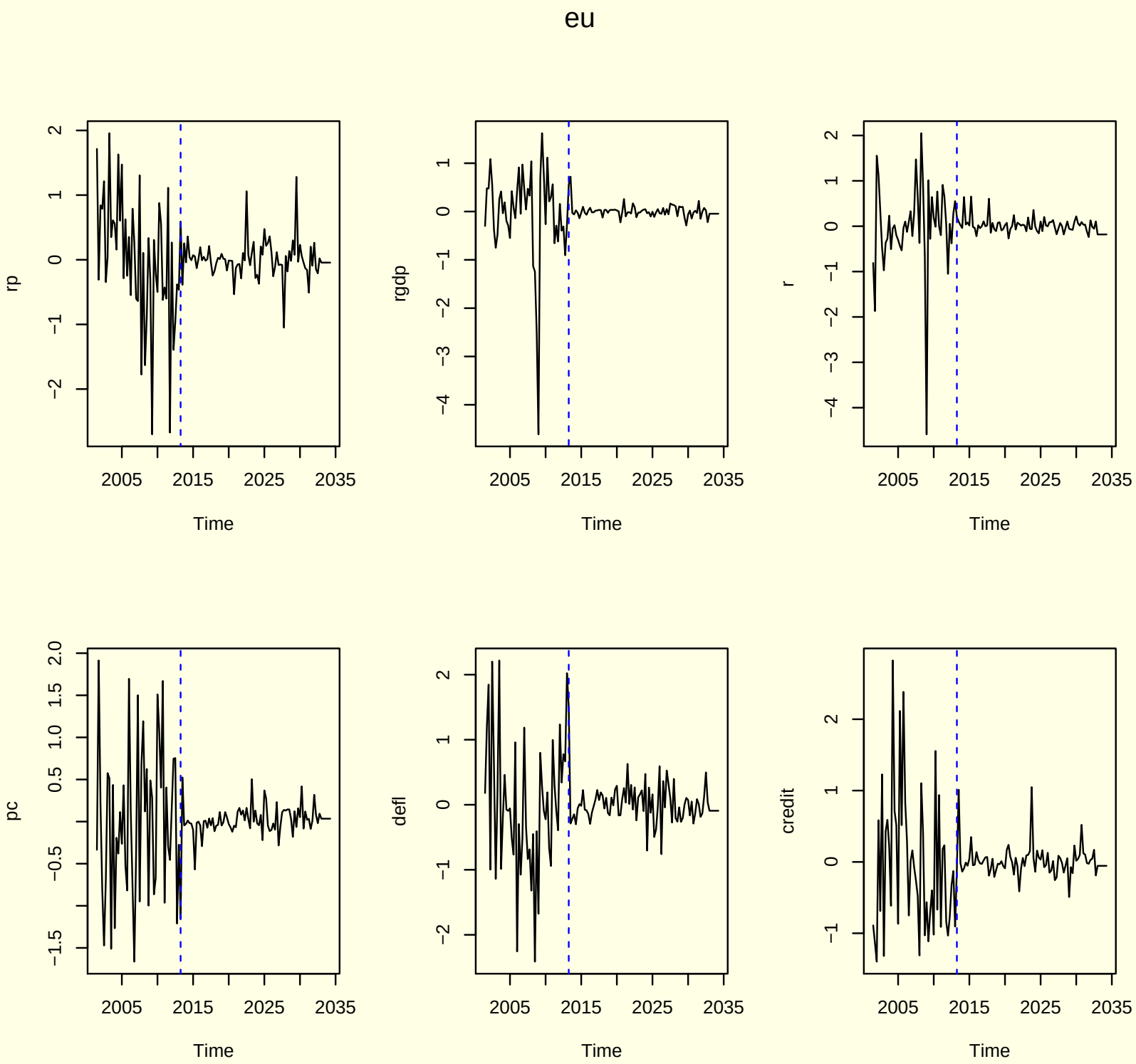
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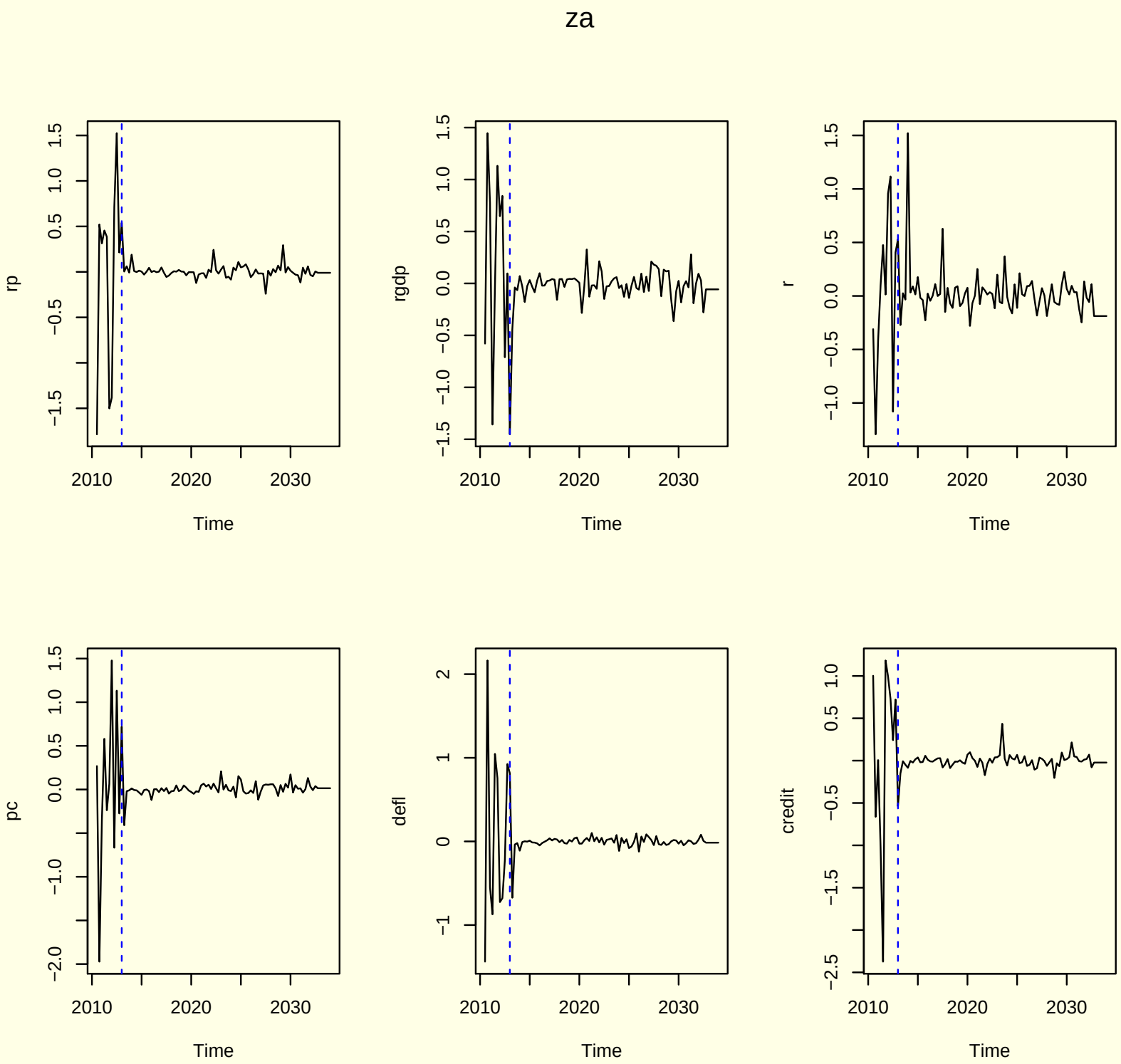
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