Towards better macroeconomic measurement

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How do we measure the business cycles?

1. Employment
2. Personal income
3. Production
4. Sales

What we have achieved?

1. Employment
2. Personal income
3. Production
4. Sales

Two steps towards better measurement

For production: GDP excluding agriculture and excluding government: Output of individuals and firms in industry and services

- Fluctuations in agriculture do not reflect business cycle conditions.
- Spending by Government does not reflect business cycle conditions.

Using firm data:

- We look at the sales of non-finance, non-oil companies
- For each pair of quarters, we work out the percentage change in sum of sales across all the firms
- Construct a net sales index

Part I

Seasonal adjustment

Why seasonal adjustment?

- Large seasonal movements can obscure important features of a time series:
  1. Direction
  2. Turning points
  3. Consistency between indicators
- Bell and Hillmer (1984) “Seasonal adjustment is done to simplify the data so that they may be more easily interpreted....without a significant loss of information”
- Seasonal adjustment is the first step towards a meaningful business cycle measurement.

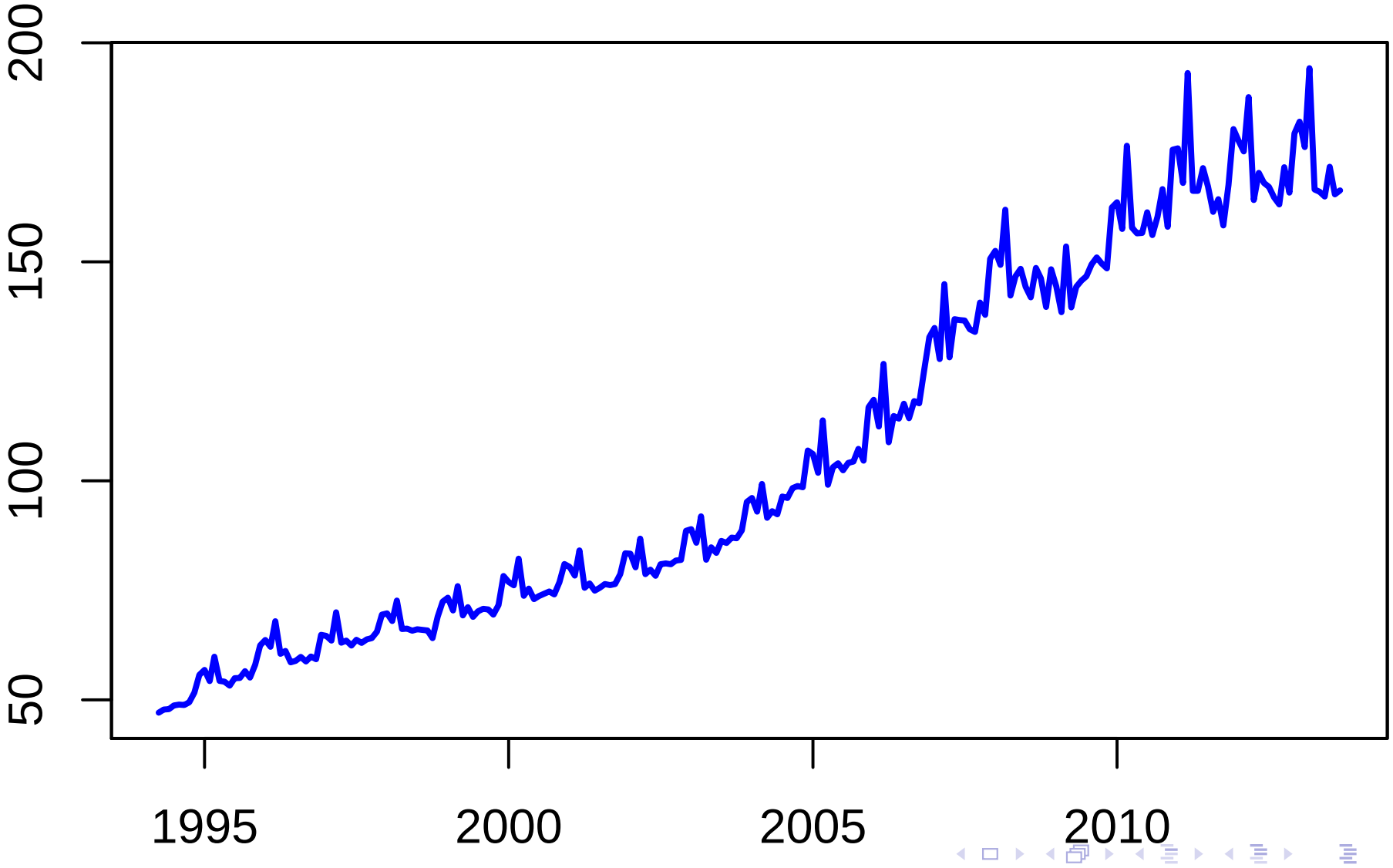
Seasonal adjustment in India

- No statistical agency in India releases seasonally adjusted data
- This acts as roadblock
- We have set up a framework to carefully monitor key macroeconomic series and adjust for seasonality through X-12-ARIMA program.

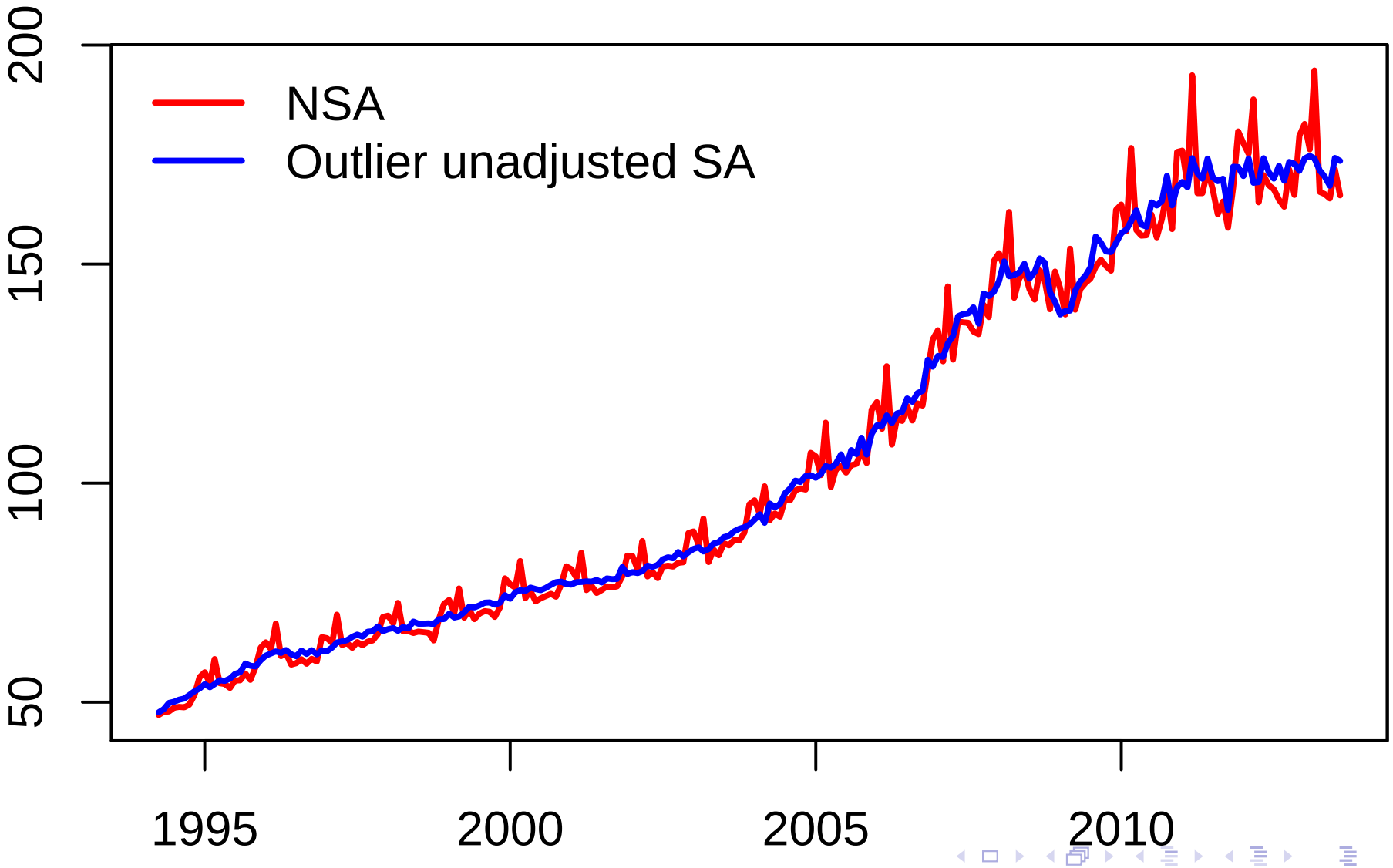
Steps in seasonal adjustment

- Pre-adjustment analysis
  - Visual inspection
  - Additive vs multiplicative seasonality
  - User defined regressors–Diwali effect
- X-12-ARIMA run
  - X-12-ARIMA diagnostics
  - Outlier detection and adjustment
  - Freezing model for subsequent adjustment

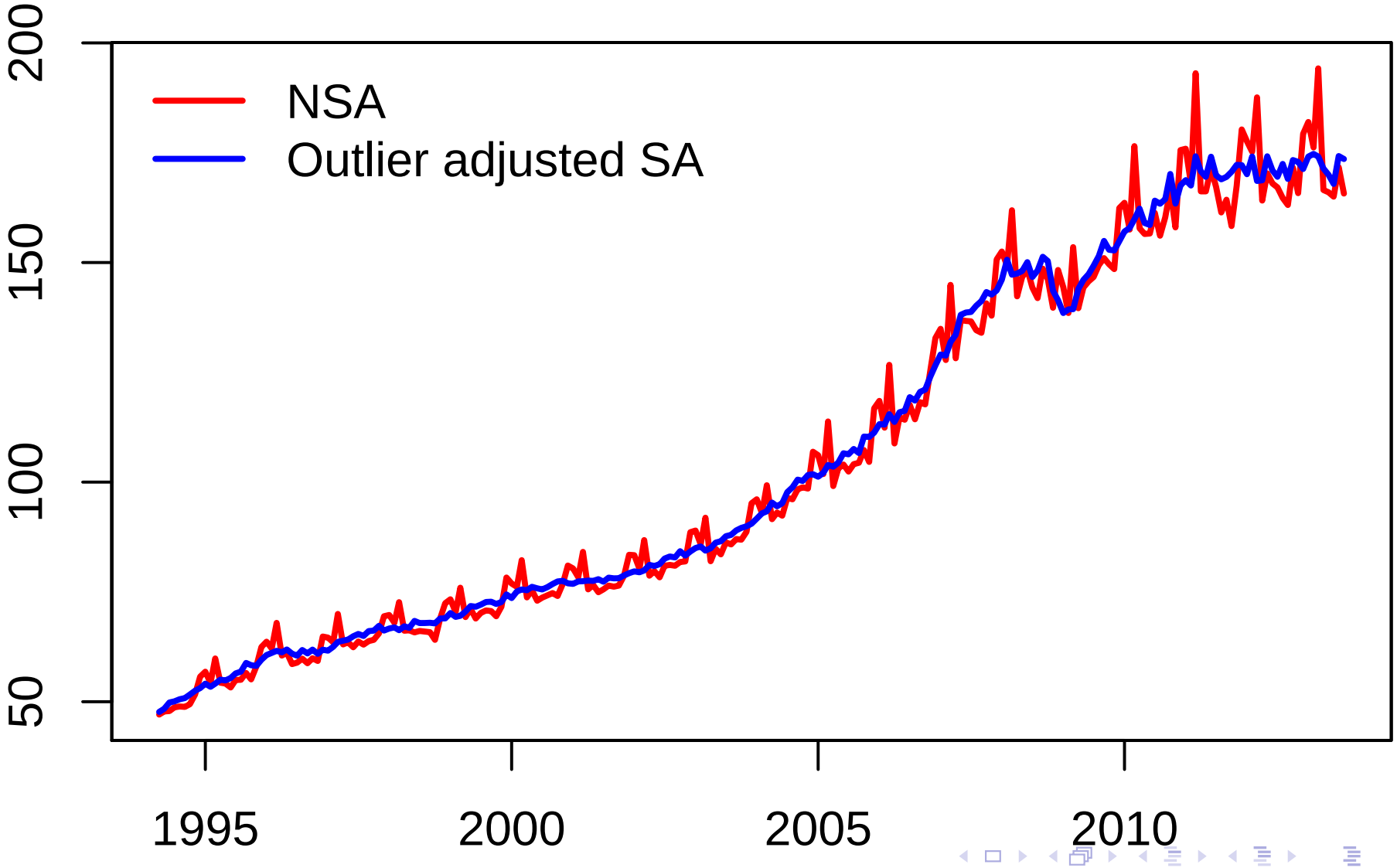
Seasonal fluctuations in IIP



IIP: Adjusting for seasonality



IIP: Adjusting for seasonality and outliers



Our testing framework

List of candidate series for seasonal adjustment		
GDP	Non-agri GDP	Non-agri, non Govt GDP
Net sales	Index of export income	Operating profits
IIP	IIP (Manufacturing)	IIP (Capital goods)
IIP (Consumer goods)	IIP (Mining)	Car production
Car sales	Exports	Non-oil exports
CPI (IW)	WPI (Food articles)	WPI (Fruits and vegetables)
M1	M3	Non-oil imports
WPI (Non-food, non-fuel), Non-oil non gold imports	Profit margin	
Announced projects	Under implementation projects	Total outstanding

Part II

Business cycle turning points

Selection of series

List of candidate series for coincident indicator		
Exports	Cars and vans production	Cars and vans sales
Imports	Non-oil imports	Govt manufacturing announced
Pvt manufacturing announced	Govt infrastructure announced	Pvt infrastructure announced
Govt announced	Pvt announced	Govt manufacturing UI
Govt infrastructure UI	Pvt infrastructure UI	All industries govt
All industries pvt	All industries all ownership	Non-food credit
IIP (Manufacturing)	IIP (Consumer goods)	IIP (Capital goods)
CPI-IW	WPI (Food articles)	WPI (Fruits n vegetables)
REER	Corporation sales	Total expenses
Operating profit	Export income	PAT to Sales
PBDIT to Sales	INR/USD	FDI
M3	Cospi-PE	Cospi closing
Pvt manufacturing UI	Non-oil exports	Non-oil, non gold imports

Reference series and data

- Non-agri Non-govt Gross Domestic Product (Constant prices SA).
- Data is available from 1999 (July-Sep) to 2013 (Apr-Jun).
- Variables are adjusted for seasonality and deflated with CPI-IW.
- Trade variables are deflated using WPI.

Part III

Methodology

Growth Cycle Approach

- Growth cycle approach to identify the turning points in Indian business cycle.
- The series is adjusted for seasonal fluctuations.
- Following Mintz, (1969,72,74) the identification of turning points is based on cyclical component.

Growth Cycle Approach

- The approach involves the choice of a filter to isolate the trend and the cyclical component.
- We use the HP filter to extract the cyclical component
- The standardised cyclical component forms the reference series to apply the business cycle dating algorithm.

Part IV

Turning points

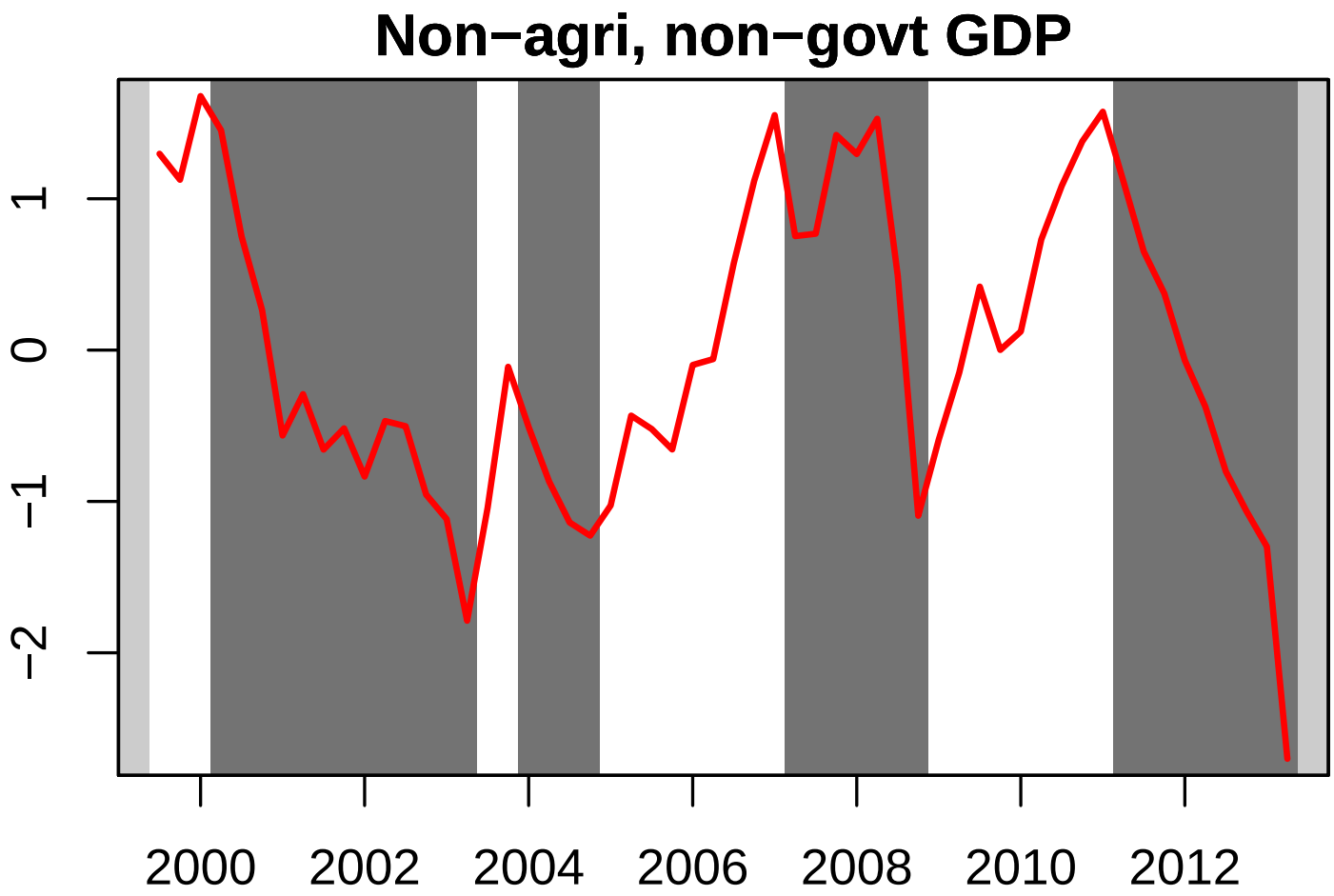
Identification of Business Cycle Turning Points

- The identification of turning points dates back to the dating algorithm used by Bry and Boschan (1971).
- The algorithm was improved and extended to quarterly series by Harding and Pagan, (2002) and (2006).

GDP Non-agri Non-gov: Cyclical characteristics

CF-Filter		HP-Filter	
Peak	Trough	Peak	Trough
2000 Q4	2001 Q3	2000 Q1	2003 Q2
2002 Q2	2005 Q2	2003 Q4	2004 Q4
2007 Q2	2009 Q2	2007 Q1	2008 Q4
2011 Q1	2011 Q4	2011 Q1	

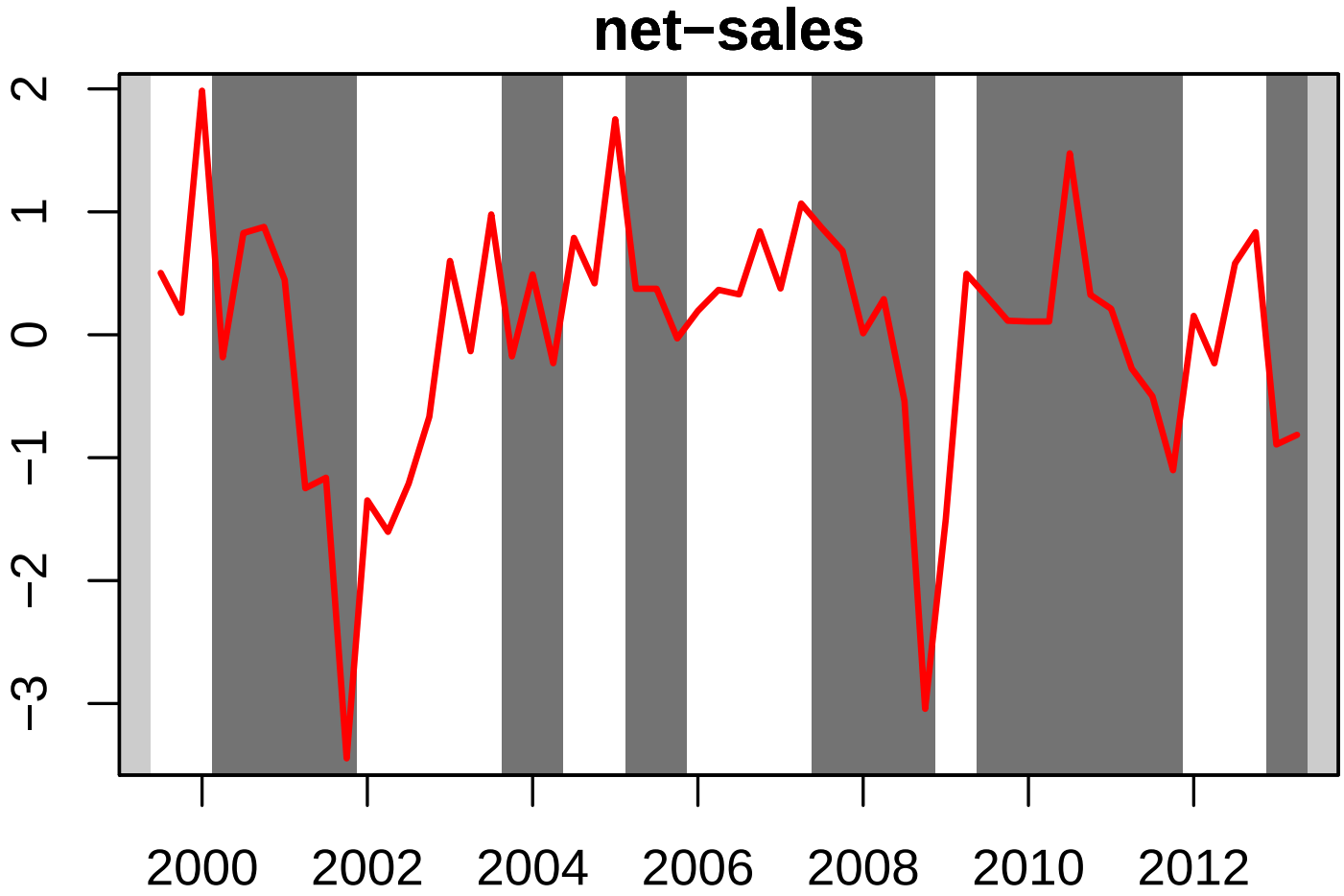
GDP Non-agri Non-gov: Cyclical characteristics with HP filter



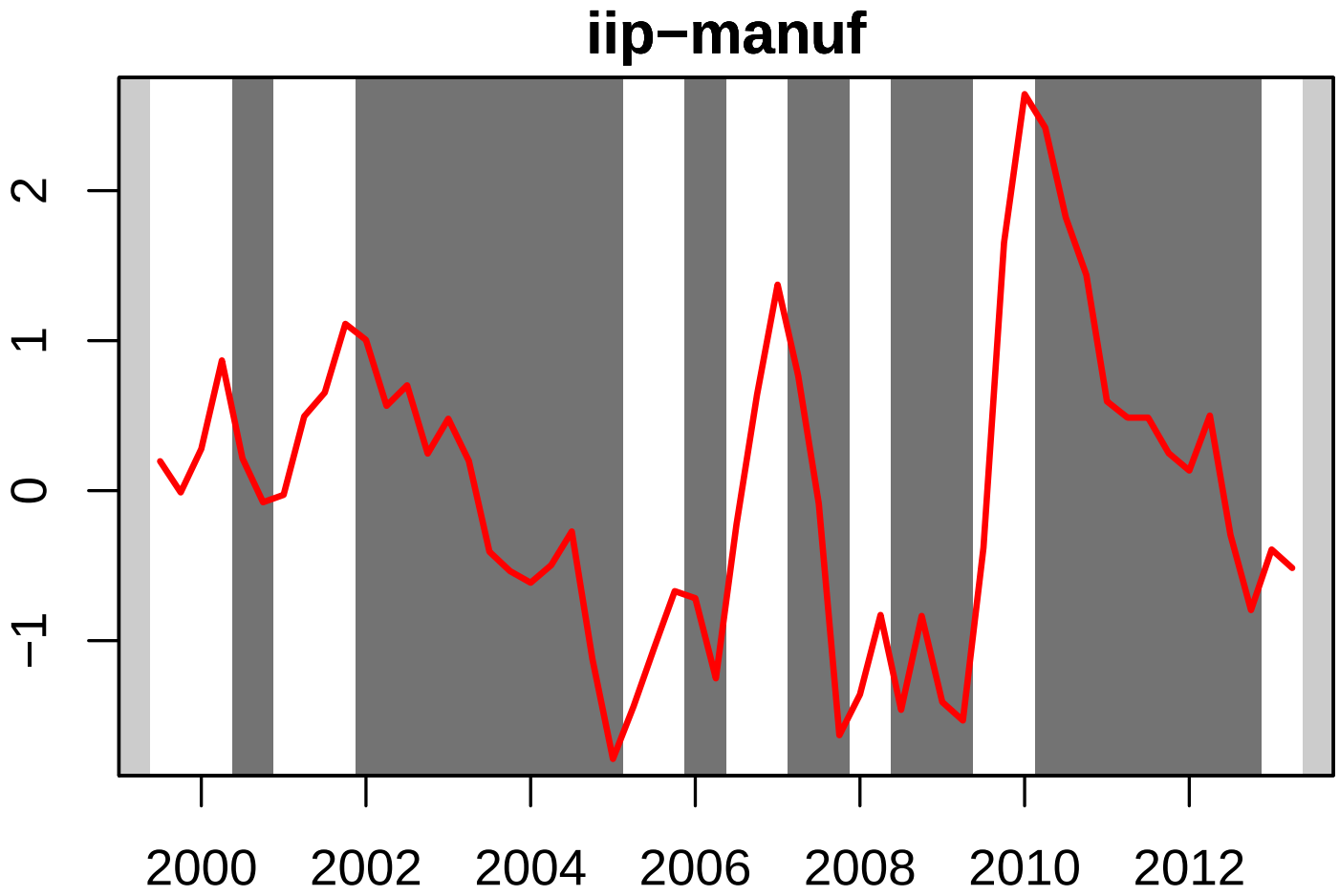
Cyclical characteristics of some key variables using HP filter

Net Sales		IIP Manufacturing		Exports	
Peak	Trough	Peak	Trough	Peak	Trough
2000 Q3	2002 Q4	2000 Q4	2003 Q4	2000 Q2	2002 Q1
2004 Q3	2005 Q3	2005 Q1	2006 Q1	2002 Q3	2003 Q2
2007 Q4	2009 Q4	2007 Q4	2009 Q2	2005 Q1	2005 Q3
2011 Q3		2011 Q1	2011 Q4	2008 Q2	2009 Q2
		2012 Q3		2010 Q1	2010 Q3
				2011 Q1	

Net sales: Turning points



IIP (Manufacturing): Turning points



Exports: Turning points

Part V

Coincident indicators

Cross-correlation analysis

- It is a complement to the peaks and trough analysis.
- Gives an idea of the extent to which the cyclical component of reference series and candidate series are related.
- We find the lag at which the correlation is maximum and greater than 0.45.
- For coincident indicators, the correlation should be maximum and greater than 0.5 at lag=0 (current quarter)
- On the basis of this principle the chosen variables are:
  1. non-oil exports
  2. non-oil non-gold imports
  3. car sales
  4. private manufacturing under-implementation
  5. non-food credit
  6. IIP (Manufacturing)
  7. net sales
  8. operating profit

Coincident indicators: Alternative criteria

- We choose those variables whose correlation is greater than 0.45 at t=0 but not at the previous two quarters.
- This is done to exclude the possibility of a leading indicator being chosen as a coincident indicator.
- The variables chosen on the basis of this criteria are:
  1. non-oil exports
  2. non-oil non gold imports
  3. all industries under-implementation
  4. government announced projects
  5. outstanding government projects
  6. non-food credit
- We use these variables to construct a coincident index

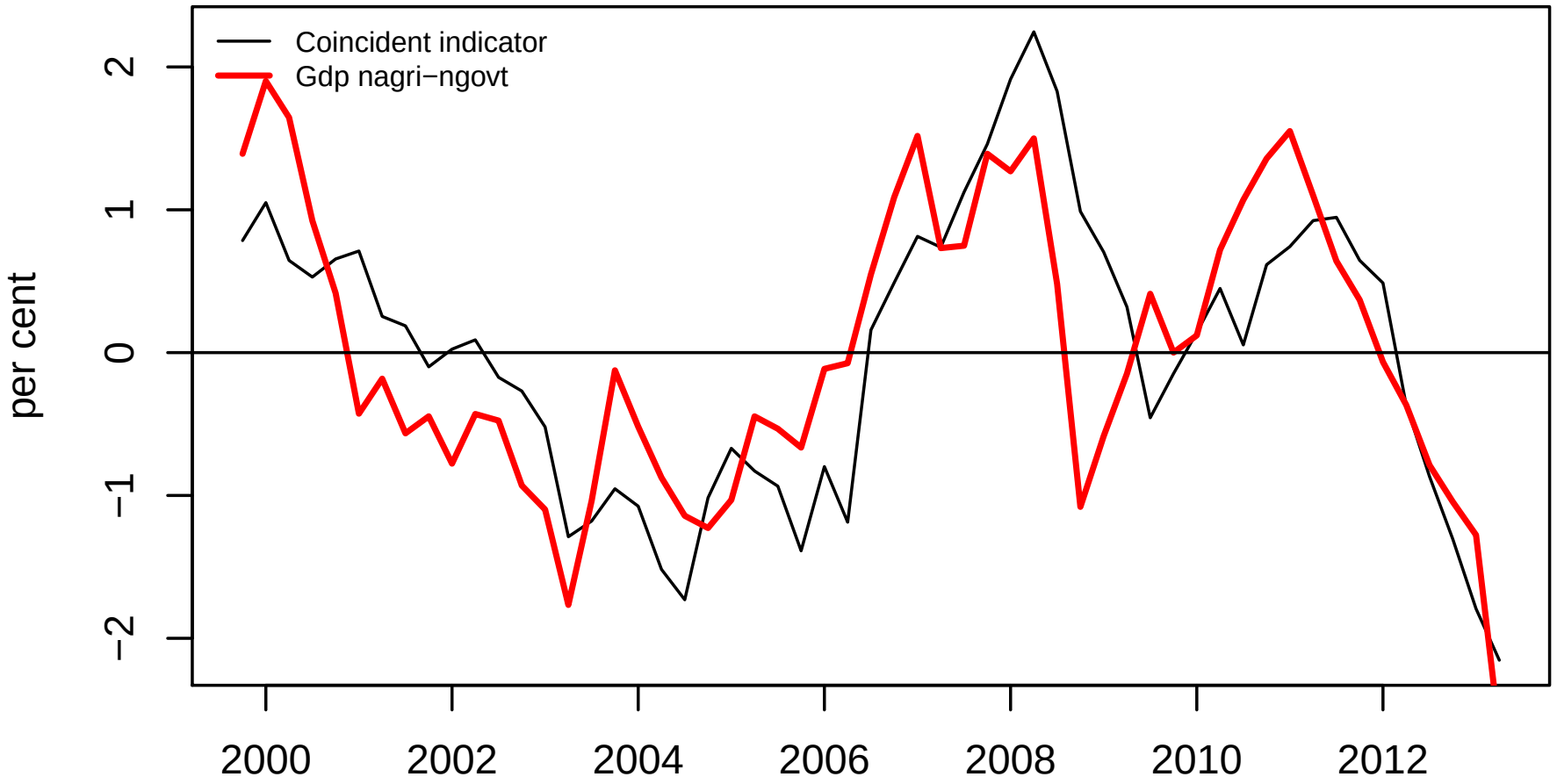
Construction of coincident index

- Conference Board (NBER) inverse standard deviation methodology
- Robust principal component analysis

Coincident index using the Conference Board methodology

- Calculate point-on-point changes
- Adjust point-on-point changes by component's standardisation factor (inverse of standard deviation),
- Add the adjusted point-on-point changes across the components for each month
- Convert the series into index
- Repeat this procedure for reference series
- Plot the cyclical component of the reference index and the coincident index

Coincident index and reference series



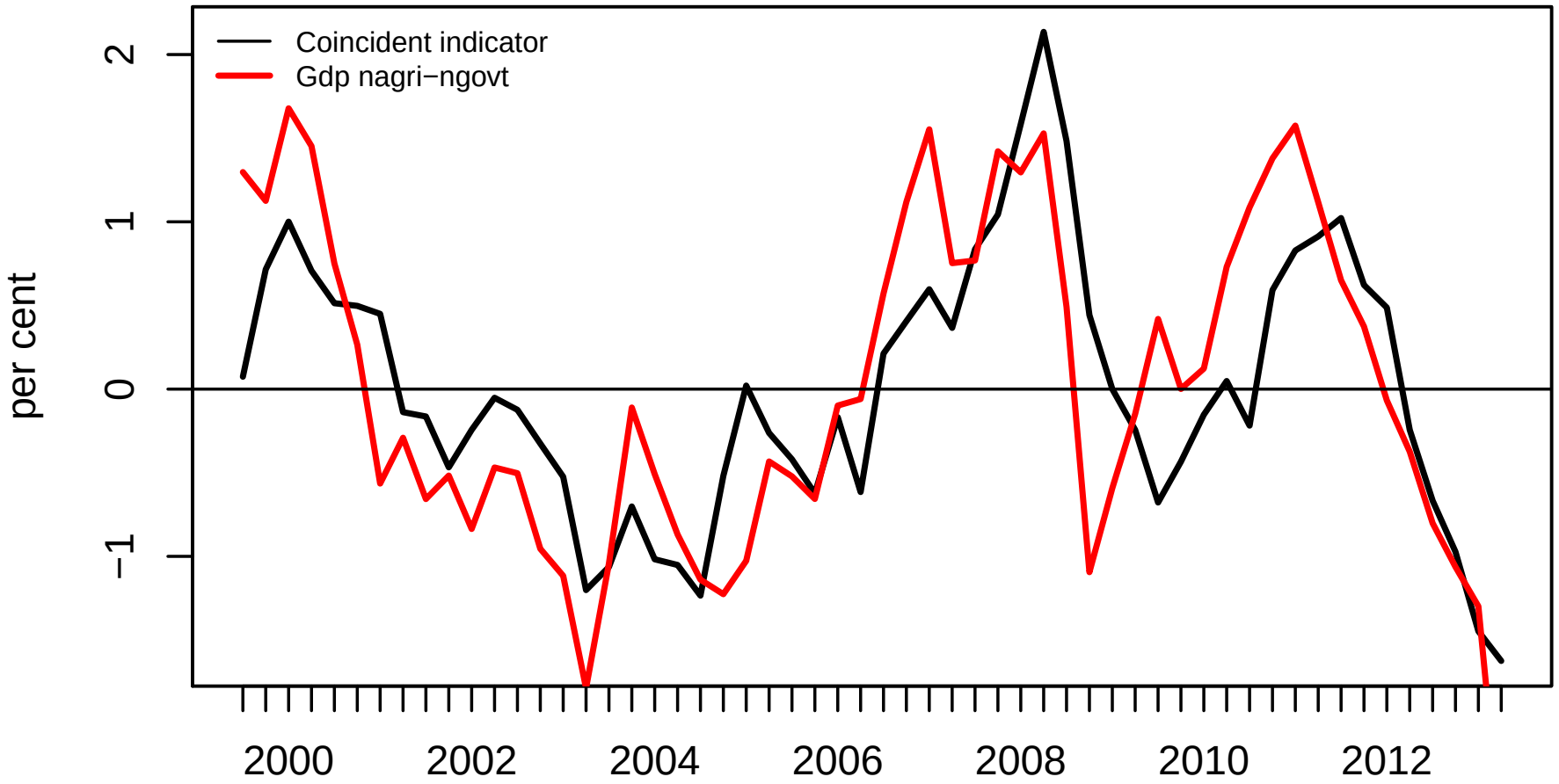
Principal component analysis

- Find the cyclical components of the chosen coincident variables
- The robust principal components of the cyclical variables are regressed on the cyclical component of the reference variable
- The predicted series is the coincident index
- Compare this with the cyclical component of reference series

Proportion of variance explained by the principal components

PC	Proportion of variance (cumulative)
PC1	48.2
PC2	79.8
PC3	90.9
PC4	96.1
PC5	99.3
PC6	100

Coincident index using robust PCA



Next steps

- Sensitivity of results to the choice of filter
- Leading indicator analysis

Thank you