Is it necessary to seasonally adjust business and consumer surveys

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Outline

1. BTS features
2. Simulation exercise
3. Seasonal ARIMA modelling
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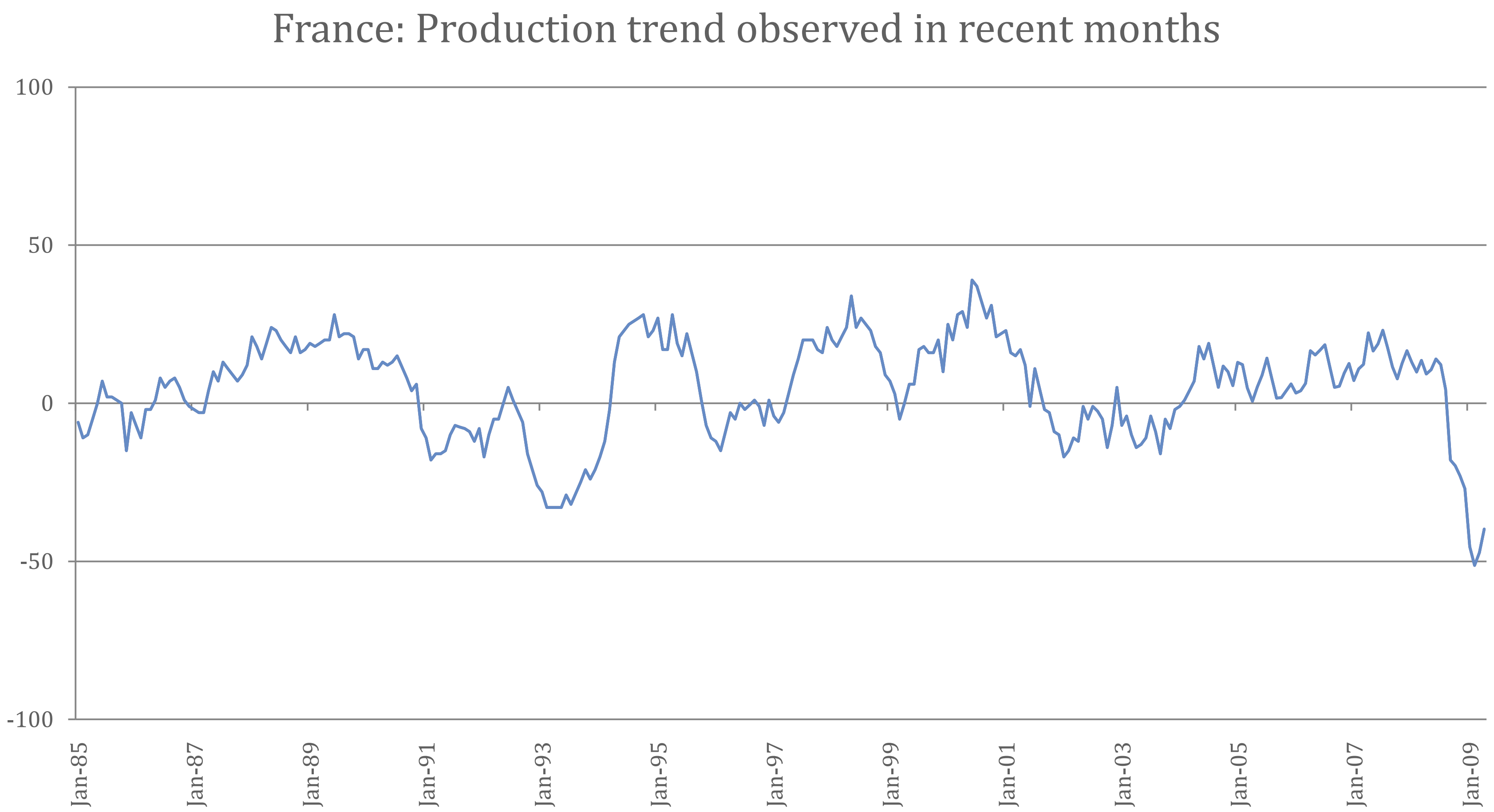
Characteristics of BTS



Characteristics of BTS

BTS are bounded by construction

- possible non linear behaviour, i.e. SETAR-type behaviour:

$$y_t = \rho_w y_{t-1} + \varepsilon_t \qquad if \left| y_t \right| \le d$$
$$y_t = \rho_s y_{t-1} + \varepsilon_t \qquad if \left| y_t \right| > d$$

with $o << \rho_s < \rho_w << 1$

- variance may vary, but should not increase over time
- long term trend is not likely to occur, BTS are likely to be stationary, so models should not treat these series as integrated

Characteristics of BTS

BTS are likely to be non-seasonal

- Questions formulated to ignore seasonal effects
- But despite this precaution, some “balance” series may display some seasonality, which should be treated before the series are analyzed
- How many series are affected?

Simulation exercise

What is the simulation exercise for?

- We would like to see how series that correspond to our priors: - boundedness
  - no-integration
  - no-seasonality
  - overlapping evaluation horizons) show up in TRAMO-SEATS and X12-ARIMA.

- the simulation generates BTS series and their underlying equivalents

Simulation exercise

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ \vdots \\ \vdots \\ y_{360} \end{bmatrix} \quad \begin{bmatrix} \\ \\ x_3 \\ x_4 \\ \vdots \\ \vdots \\ x_{360} \end{bmatrix}$$

$$\begin{bmatrix} y_1+u_{1,1} & y_1+u_{1,2} & \cdots & y_1+u_{1,100} \\ y_2+u_{2,1} & y_2+u_{2,2} & \cdots & y_2+u_{2,100} \\ y_3+u_{3,1} & y_3+u_{3,2} & \cdots & y_3+u_{3,100} \\ \vdots & \vdots & & \vdots \\ \vdots & \vdots & & \vdots \\ y_{360}+u_{360,1} & y_{360}+u_{360,2} & \cdots & y_{360}+u_{360,100} \end{bmatrix} \quad \begin{bmatrix} \\ x_{3,1} & x_{3,2} & \cdots & x_{3,100} \\ \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots \\ x_{360,1} & x_{360,2} & \cdots & x_{360,100} \end{bmatrix}$$

$$\begin{bmatrix} \\ r_{3,1} & r_{3,2} & \cdots & r_{3,100} \\ \vdots & \vdots & & \vdots \\ \vdots & \vdots & & \vdots \\ r_{360,1} & r_{360,2} & \cdots & r_{360,100} \end{bmatrix} \quad \begin{bmatrix} \\ R_3 \\ \vdots \\ \vdots \\ R_{360} \end{bmatrix}$$

$y_t = \mu + \rho \cdot y_{t-1} + \varepsilon_t$ **Monthly growth rate** of the economic underlying variable, for the *whole* economy (e.g. monthly growth rate of the i.i.p.) $y_t \sim AR(1)$

$x_t = y_t + y_{t-1} + y_{t-2}$ $\quad x_t = 3\mu + \rho \cdot x_{t-1} + \varepsilon_t + \varepsilon_{t-1} + \varepsilon_{t-2}$ **Three- month growth rate** of the economic underlying variable, for the *whole* economy. $x_t \sim ARMA(1,2)$

$y_{t,i} = y_t + u_{t,i}$ $\quad y_{t,i} = \mu + \rho \cdot y_{t-1} + \varepsilon_t + u_{t,i}$ Firm *individual* monthly estimation of the underlying variable, with $u_{t,i} \sim N(0, \sigma_u^2)$

$x_{t,i} = y_{t,i} + y_{t-1,i} + y_{t-2,i}$ Firm *individual* three-month perception of the underlying variable

$$r_{t,i} = \begin{cases} 1 & \text{if } x_{t,i} \geq d \\ 0 & \text{if } |x_{t,i}| < d \\ -1 & \text{if } x_{t,i} \leq d \end{cases}$$

Firm qualitative response reflecting its *individual* perception of the underlying variable

$$R_t = \sum_{i=1}^{100} r_{t,i}$$

BTS series expressing the 100 firms perceptions of the underlying variable

Simulation exercise

Results

	AR() param = **0.8**						AR() param = **0.7**						AR() param = **0.6**					
	BTS			Underlying ARMA(1,2)			BTS			Underlying ARMA(1,2)			BTS			Underlying ARMA(1,2)		
	I	SA	Rej	I	SA	Rej	I	SA	Rej	I	SA	Rej	I	SA	Rej	I	SA	Rej
Mean=0.25	77	16	8	44	43	7	20	7	5	15	41	6	2	12	1	2	42	4
Mean=0	81	14	5	42	35	11	24	8	3	15	37	9	3	10	4	1	36	4

I=integrated, SA = seasonal model, Rej = no acceptable model found

- TRAMO-SEATS strongly tuned towards differentiation
- TRAMO-SEATS strongly detected seasonality, but less apparent in the BTS series than in the underlying
- X12-ARIMA rejected all the models but detected seasonality on 5% of them.

Seasonal ARIMA modelling

- Analysis with TRAMO-SEATS and X12-ARIMA
- Brute force analysis
- Box & Jenkins analysis

Seasonal ARIMA modelling

Analysis with TRAMO-SEATS and X12-ARIMA

- large share of BTS have a seasonal component (75% with TRAMO-SEATS and 60% with X12-ARIMA)
- tendency to over differentiation with TRAMO-SEATS
- but high number of rejected models

Seasonal ARIMA modelling

Brute force analysis

Series	Selection method	Model specification	Series	Selection method	Model specification
BEASOB	AIC	(1 0 6) (1 0 1)	PLPREX	AIC	(3 0 4) (1 0 1)
	BIC	(2 0 2) (1 0 0)		BIC	(1 0 1) (2 0 0)
	Tramo-Seats	(3 1 0) (0 0 1)		Tramo-Seats	(0 1 1) (0 1 1)
DKPREX	AIC	(2 0 0) (0 0 0)	FRPROP	AIC	(2 0 2) (1 0 1)
	BIC	(1 0 0) (0 0 0)		BIC	(2 0 2) (1 0 1)
	Tramo-Seats	(0 1 1) (0 1 1)		Tramo-Seats	(3 1 1) (0 1 1)
PTPROP	AIC	(3 0 6) (1 0 1)	BEPROT	AIC	(3 0 1) (1 0 1)
	BIC	(1 0 1) (1 0 1)		BIC	(1 0 0) (1 0 1)
	Tramo-Seats	(0 1 1) (0 1 1)		Tramo-Seats	(0 1 1)(0 1 1)

- BIC based models are more parsimonious, but parsimony is not achieved via fewer seasonal components
- TRAMO-SEATS results contradicted in one series

Seasonal ARIMA modelling

Box and Jenkins analysis

- Correlogram indicates that the optimal model should have one AR lag maximum and the number of MA lags may range from 3 to 9 potentially.
- The partial autocorrelation function suggests a weak presence of a AR-type seasonality.

Model description	ARIMA SARIMA	BIC
The best BIC based seasonal	(2 0 2) (1 0 1)	1850.32
The best BIC based non-seasonal	(3 0 2) (0 0 0)	1869.78
AC and PAC based non-parsimonious, non-seasonal	(1 0 7) (0 0 0)	1889.64
AC and PAC based parsimonious non-seasonal	(1 0 3) (0 0 0)	1873.15
seasonal extension AR	(1 0 3) (1 0 0)	1868.93
seasonal extension MA	(1 0 3) (0 0 1)	1870.29

Conclusion

- Seasonal adjustment leads to estimate the raw series
- Seasonal adjustment is best not done routinely and a careful analysis should be carried out with either the detailed analysis module of TRAMO-SEATS or with a standalone econometrics SW capable of SARIMA modelling
- Research could be undertaken to analyze whether or not doing a seasonal adjustment has practical relevance
- Further work could be focused on the way we model BTS series in which non-linearities - stemming from the business cycle or from the bounded nature of the series - and seasonality are mixed. Would a SEA-SETAR model give more accurate results than a SARIMA model?

END