CONSTRUCTING REAL-TIME BUSINESS CYCLE INDICATORS FOR TURKEY

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ECONOMIC RESEARCH FORUM CONFERENCE

Outline

- Motivation
- Model and Methodology
- Data
- Results
  - Historical Perspective
  - Real-Time Implementation
- Concluding Remarks

Motivation

- Measuring the state of the economy
  - Observed indicators: GDP, employment, sales, etc. → arrive at different frequencies
- Lucas, 1977: Latency of business conditions
  - Rather than being shaped by a single variable, business cycles reflect the dynamic interactions (comovements) of many variables
- No commonly-agreed, objective historical account of business cycles in Turkey
- Flexible methodology that allows for mixed frequencies
- Real-time application

✓ Tested and proven to be useful in the US (Aruoba *et al.*, 2009)

Data

- Analysis covers 1987-2010 period in Turkey.
- Five indicators are selected wrt the following criteria:
  - Representative power
    - ✓ Covering the economy as a whole on sectoral basis (industrial production, GDP, employment)
    - ✓ Considering the production dynamics peculiar to Turkey (intermediate imports)
  - Timeliness (electricity production)
  - Length of time series

Selected Indicators for Turkey

Variable	Source	Frequency	Period	Definition
Electricity Production	TEIAS	Monthly	1985M1-2010M12	Single series from beginning
Industrial Production	TUIK	Monthly	1986M1-2010M12	3 different series (1992, 1997, 2005)
Intermediate Goods Imports	TUIK	Monthly	1994M1-2010M12	2 different series (1994, 2003)
Employment	TUIK	Monthly	2005M1-2010M12	Single series from beginning
		Quarterly	2000Q1-2004Q4	Single series from beginning
GDP	TUIK	Quarterly	1987Q1-2010Q4	2 different series (1987, 1998)

- Time series with different base years are combined.
- All source series are adjusted for seasonality by using Tramo-Seats.
- We work with annualized monthly/quarterly growth rates.
- Employment: announcement frequency is monthly but original data are MA(3) → converted to monthly.

Model and Methodology

- A dynamic factor model with a monthly base frequency.
- The unobserved factor evolves according to the following transition equation:

$$x_t = \rho_1 x_{t-1} + \rho_2 x_{t-2} + \rho_3 x_{t-3} + e_t$$

$$e_t \sim N(0, \sigma_e^2)$$

$$var(x_t) = 1$$

- Measurement equations:

$$y_t = \alpha + \beta\, x_t + u_t$$ u_t: AR(3) process (for monthly variables)

$$y_t = \alpha + \beta\,(x_t + x_{t-1} + x_{t-2}) + (u_t + u_{t-1} + u_{t-2})$$ (for quarterly GDP)

$$y_t = \alpha + \left(\frac{\beta}{3}\right)(x_t + x_{t-1} + x_{t-2}) + \left(\frac{1}{3}\right)(u_t + u_{t-1} + u_{t-2})$$ (for quarterly employment)

Model and Methodology

- Once the model is written in state-space form, factor extraction method is straightforward:
  - Kalman filter with the forecast error decomposition,
  - Maximum likelihood to estimate the model,
  - Kalman smoother to obtain an estimate of the factor.
- Typical applications of unobserved component models: Output gap, NAIRU, etc.
  - How does your unobserved component evolve?
  - How do you relate it to observed variables?

Results: Historical Perspective

Information Content of Selected Indicators

Estimation Results

Variable	Frequency	c	beta
IP	M	3.92	17.72
ELEC	M	6.91	5.91
INTER	M	9.55	34.27
GDP	Q	4.04	3.91
EMP	M and Q	1.60	2.55

Correlation of Factor with Indicators

IP	ELEC	INTER	GDP	EMP (monthly)	EMP (quarterly)
0.624	0.324	0.592	0.578	0.431	0.070

- All indicators proved to be useful in generating economically and statistically significant value-added.

Results: Historical Perspective

Information Content of Selected Indicators

Implicit Weights*

Dependent Variable: Factor				
# of obs.	200	87	67	22
IPM_STD	**0.44**	**0.50**	**0.32**	**0.31**
	12.25	*9.54*	*7.60*	*3.60*
ELECM_STD	**0.13**	**0.07**	**0.12**	**0.03**
	4.11	*1.90*	*3.57*	*0.46*
INTERM_STD	**0.35**	**0.41**	**0.26**	**0.40**
	11.31	*8.92*	*7.31*	*3.71*
EMPMM_STD	-	**0.19**	-	**0.04**
	-	*5.43*	-	*0.62*
GDPQ_STD	-	-	**0.36**	**0.37**
	-	-	*9.92*	*5.23*

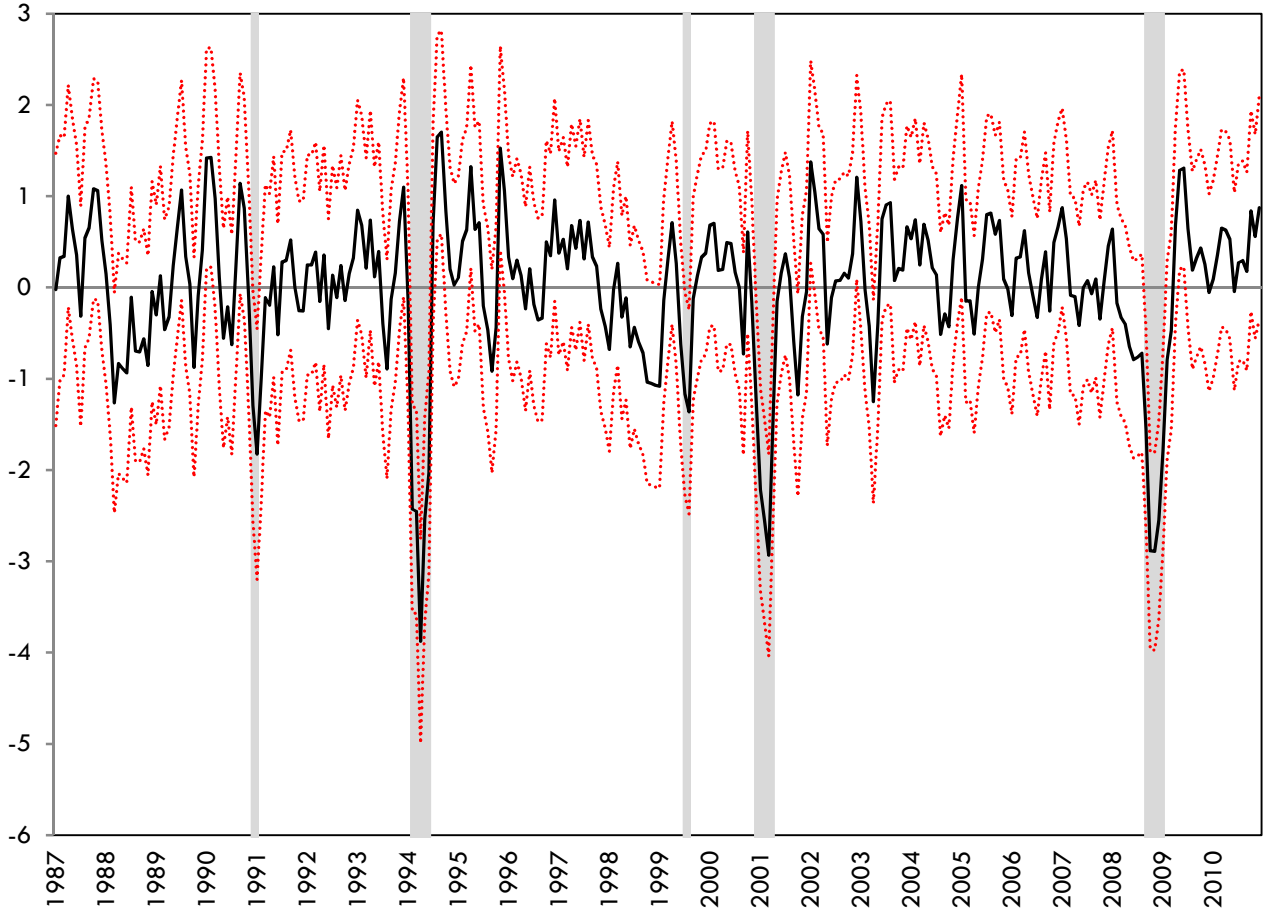
* t-statistics in italic form.

- Correlations between indicators blurs the individual contributions.
- Add more lags to reveal a more realistic picture about implicit weights.

Results: Historical Perspective

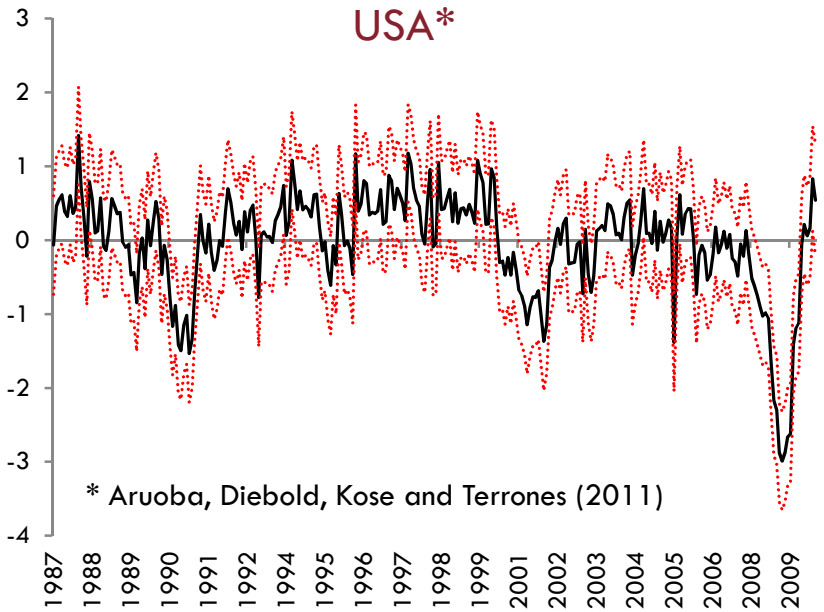
A Real Economic Activity Indicator for Turkey

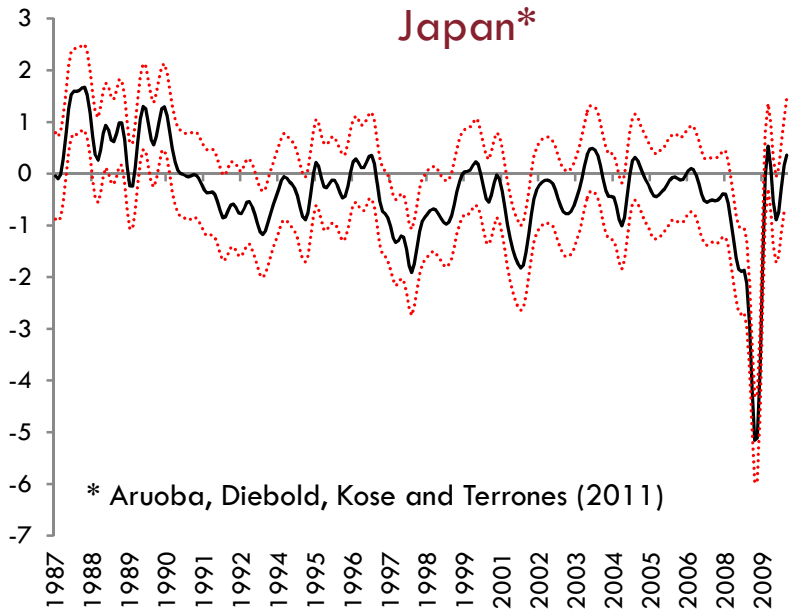
Business Conditions Index (BCI)



Results: Historical Perspective

Turkey vs. Developed Economies

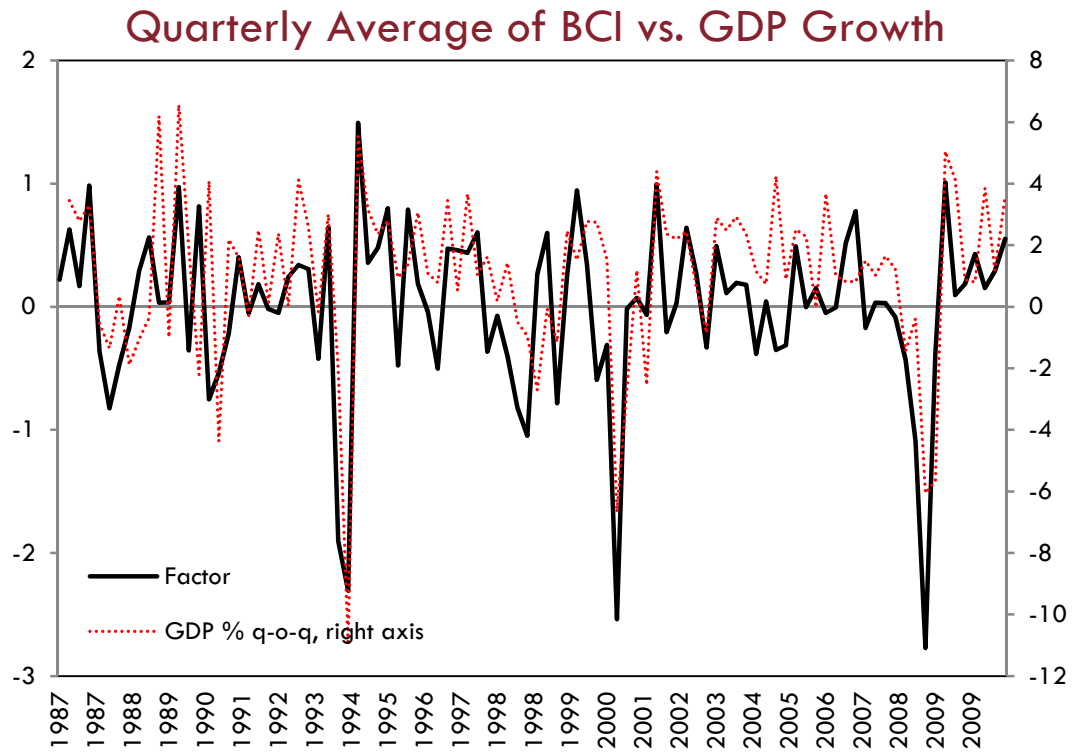




- Higher volatility, sharp reversals around zero
  - Coefficient of variation → US: 20.7, Japan: 2.7, Turkey: 43.1
  - Turkey could not settle on a sustained growth path (boom-bust cycles)
- Larger standard error band
  - Data uncertainty
  - Harder to assess economic stance

Results: Historical Perspective

A Real Economic Activity Indicator for Turkey

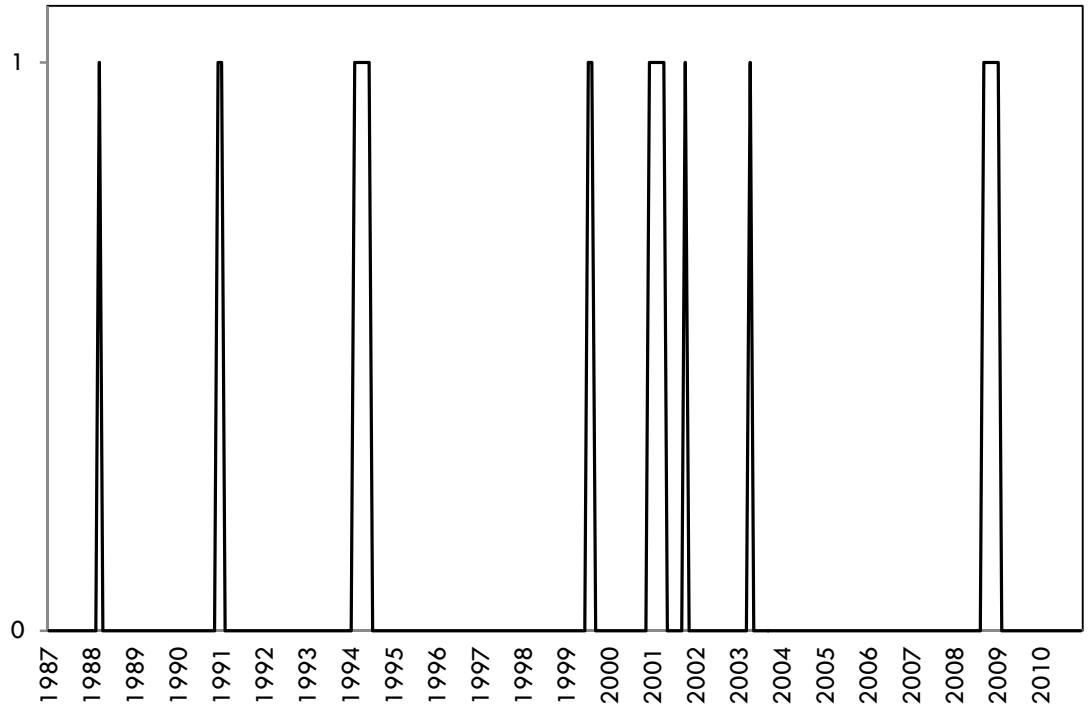


- Index picks up movements in GDP, even without having GDP as an observable.
- However, forecasting (here 'nowcasting') growth is not a direct purpose. We focus on depicting latent 'business conditions', determined by a set of macro variables.

Results: Historical Perspective

How to Detect Recessions

Recession Indicator Based on Upper Band

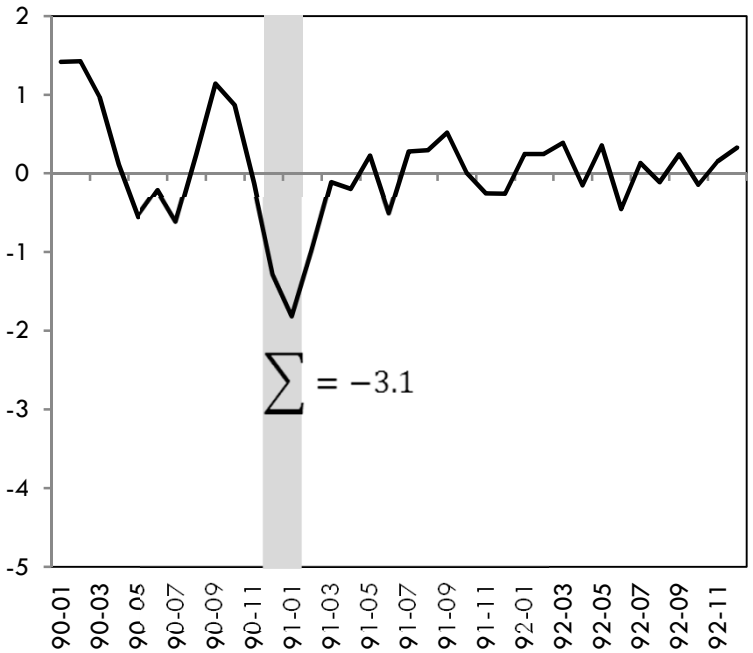


- Data uncertainty → use of upper band instead of the factor itself (95 % probability that the factor < 0.)
- Temporary shocks → eliminate one-time sharp spikes
- How severe is the contraction to call it a 'recession' → at least two (or more) months

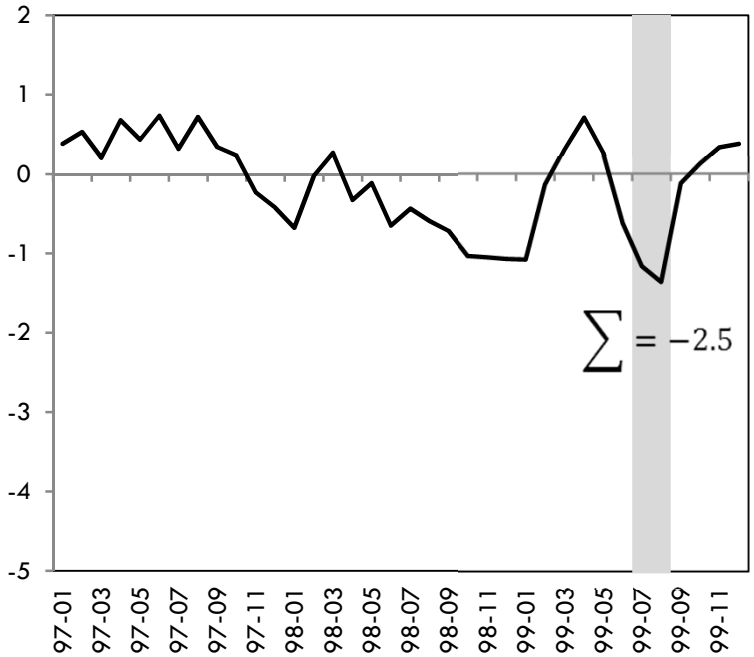
Results: Historical Perspective

How to Detect Recessions

Gulf War: 1991 Turbulence



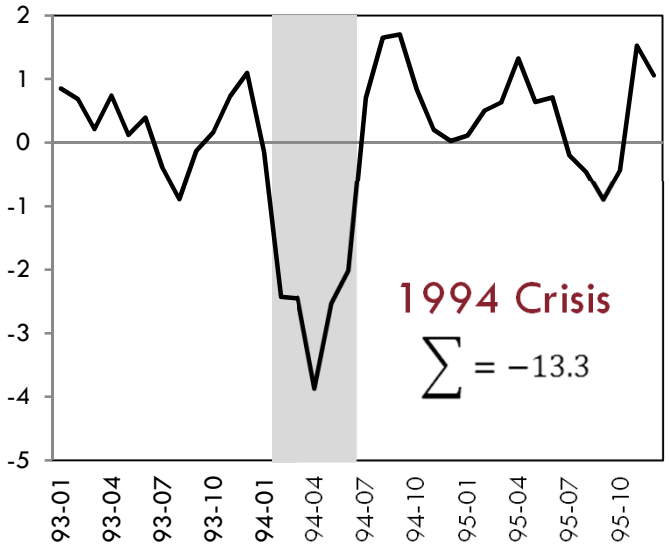
Marmara Earthquake: 1999 Turbulence

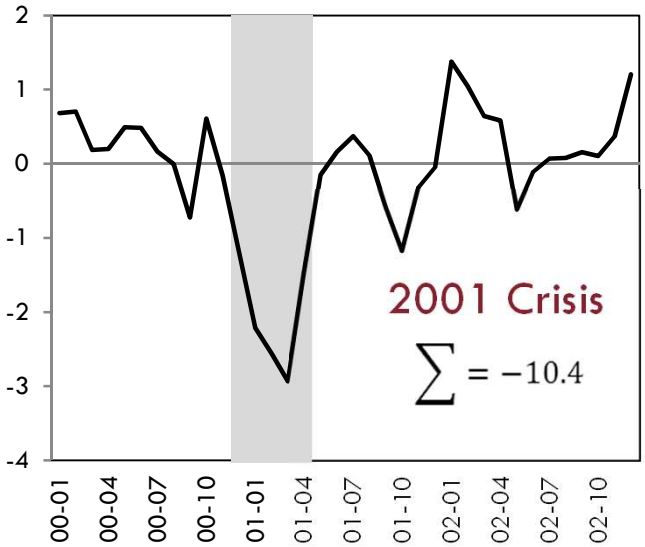


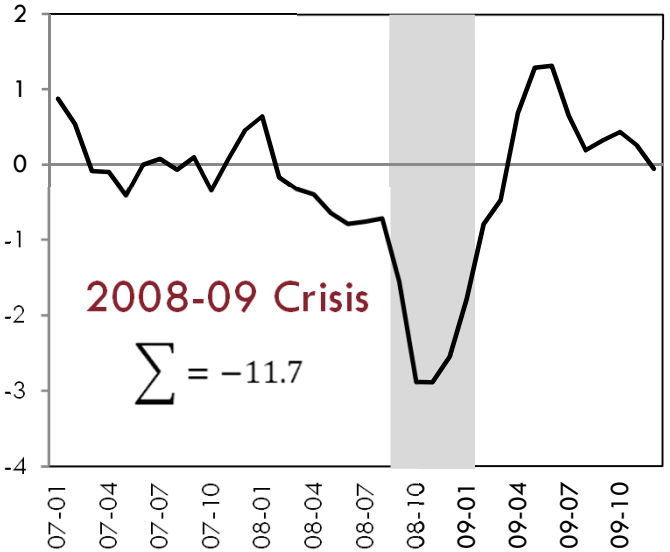
- Shaded regions cover only two months → too short-lived to deem as 'recession'?
- Increasing the criteria to 3 months, 1991 and 1999 drops.

Results: Historical Perspective

How to Detect Recessions







- Severity → both index level and duration

  Upper bound remained at negative levels for five consecutive months.

- Prolonged recession in 2008 → early phases are not reflected under this criteria.

Real-Time Implementation

Historical Perspective vs. Real-Time

- Historical analysis provides useful information about the past experience of the Turkish economy.
  - Three major crises → 1994, 2001, 2008-09
- Future information increases the accuracy of the index
  - What about end-sample? (which in fact contains the most valuable information for policy conduct)
- Decision makers need timely and accurate information.
  - Importance of representative, high-frequency data
  - Real-time performance

Real-Time Implementation

- What will happen when new data arrive?
  - The system is estimated until the end of 2010, the index is computed with fixed parameters throughout 2011. Revisions, i.e. re-estimation, will be made annually.

Release Schedule of Variables in a Typical Month

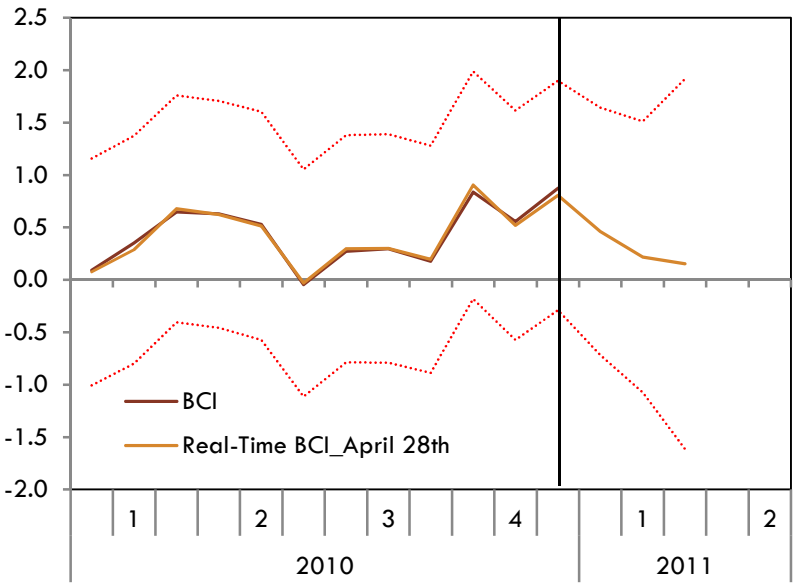
Variable	Source	Frequency	Announcement Dates	Available Until	Lags
Electricity Production	TEIAS	Daily	Everyday	Day Before	1 Day
Industrial Production	TUIK	Monthly	June 8th	April 2011	2 Months
Intermediate Goods Imports	TUIK	Monthly	June 10th	April 2011	2 Months
Employment	TUIK	Monthly	June 15th	April 2011	2 Months
GDP	TUIK	Quarterly	June 30th	2011-Q1	1 Quarter

- As of end-June, even May outlook is unclear.
  - Electricity production is the most timely variable, while GDP becomes available with one-quarter lag.

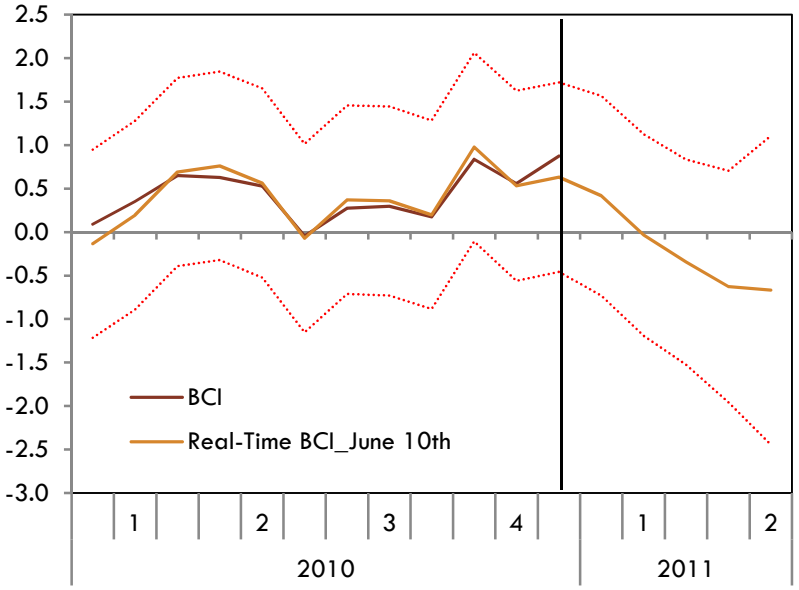
Real-Time Implementation

A Prototype Empirical Application

No clear signals as of end-April…



…Recent figures signal weakening



- What do recent data suggest?
  - Business conditions has weakened compared to 2010 and early-2011.
  - Recession? Upper bound still remains positive.
- How to detect recessions in real-time → More stringent criteria due to increased uncertainty (larger error bands at the end of the sample)

Concluding Remarks

- Historical account of business cycles in Turkey is demonstrated.
  - We incorporated variables at different frequencies to optimally extract latent state of macroeconomic activity.
  - An explicit quantitative criteria is provided to detect recessions.
  - Using the index, one can quantify and thus compare the severity of turbulence/recession periods.
- Dating recessions in real-time is a more demanding task due to higher uncertainty about the future.
  - Coincident indicators are useful as long as information comes timely.
  - Forward-looking policy conduct → Need for 'leading' indicators (with good forecast properties)

Concluding Remarks

- Under the current policy setting the index,
  - Will be updated on a regular basis and released at pre-announced dates.
  - Should not be perceived as an intermediate target.
  - Is an estimate of current stance → subject to change with new data
- Existing literature pave the way for possible extensions:
  - Inclusion of higher frequency data (i.e. financial data, any variable tracking daily transactions)
  - Construction of a composite leading index (CLI)
  - Incorporating non-linearity, exploring threshold levels (regime-switching models)
  - Integrating stochastic process of data revisions → enrich real-time analysis but costly in this model framework

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