The Italian Business Cycle from the Unification until Today: A Disaggregate Approach

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Table of Contents

1 Motivation
2 Contribution
3 Methodology
4 Data
5 Results
# Table of Contents

1. **Motivation**
2. **Contribution**
3. **Methodology**
4. **Data**
5. **Results**
Recovering business cycle facts
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- Recent data work has highlighted long standing inconsistencies in Historical National Accounts (HNA)
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Recovering business cycle facts

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- The 1950s
Factor models as a complement to HNA
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We show that this methodology can be used to recover business cycles facts in the presence of scattered data and deep structural changes.
Factor models as a complement to HNA

- We show that this methodology can be used to recover business cycles facts in the presence of scattered data and deep structural changes
- Ritschl, Sarferaz and Übele (2008), Sarferaz and Übele (2009)
Motivation

Structural change: sectoral value added shares

Source: Broadberry, Giordano and Zollino (2011)
Structural change: sectoral employment shares

Source: Broadberry, Giordano and Zollino (2011)
The importance of historical data

“Structural” differences between today’s economy and the economies of the past, which are sometimes viewed as a reason to avoid historical data, are in fact what make historical data uniquely useful to macroeconomics. The feature that make up the modern economy - everything from the body of knowledge that constitutes “technology” to the rules and behavior that define “institutions” - developed over time. (Calomiris & Hanes 1994, p. 3)
Why is Italy interesting

- Unification process and EU/EEC/Euro membership
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- Unification process and EU/EEC/Euro membership
- Various monetary arrangements throughout history
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Why is Italy interesting

- Unification process and EU/EEC/Euro membership
- Various monetary arrangements throughout history
- It is not the USA → Italy as a case study for the more complex non-US Great Moderation
Table of Contents

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2. Contribution
3. Methodology
4. Data
5. Results
What we do

Replace Historical National Accounts (HNA) with activity index in the spirit of Stock and Watson... and Burns and Mitchell (1946), before them

Large (\(n > 100\)) panels of disaggregated time series

Dynamic (one-) Factor Model

Extract common cyclical component

Allow for time varying factor loadings (index weights)

Bayesian estimation

Papadia, Ritschl, Sarferaz (LSE, ETH)

The Italian Business Cycle
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- Estimate single-factor models for subsets of series
  - Agriculture and non agricultural
  - Real and nominal
Settling debates in Italian Economic History
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- We are on a fact-finding mission

Scattered time series evidence
Scarcity of business census data
Uneven development across principal sectors and regions of the Italian economy
A lot of work concentrated on the post Unification era (1861-1913) and the more recent past (1970s- today), but few long term studies (Delli Gatti, Gallegati and Gallegati, 2005; Baffigi, Bontempi and Golinelli, 2011)

Results should make us worried

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- We revisit some large controversies as well as some established facts
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Table of Contents

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3. Methodology
4. Data
5. Results
Dynamic Factor Analysis

Extract common component (factor) from a large number of time series.
Replace aggregation through index weights with aggregation through cross-sectional correlation.

Classical: Principal Components (static or dynamic)
Dynamic Factor Analysis

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Dynamic Factor Analysis

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  - Classical: Principal Components (static or dynamic)
**Factor Model**

Each series $y_{i,t}, i = 1, ... N; t = 1, ..., T$ is related to factor $f_t$ by factor loadings $\lambda_i$ according to observation equation

$$y_{i,t} = \lambda_{i,t} f_t + u_{i,t} \tag{1}$$

Both $f_t$ and $\lambda_i$ need to be estimated, while $u_{i,t}$ is the idiosyncratic part of series $i$

The factor and disturbances follow AR processes of order $q$ and $p$ respectively

$$f_t = \phi_1 f_{t-1} + ... + \phi_q f_{t-q} + \nu_t \tag{2}$$

with $\phi$ diagonal and $\nu_t$ i.i.d.

$$u_{i,t} = \theta^i_1 u_{i,t-1} + ... + \theta^i_p u_{i,t-p} + \chi_{i,t} \tag{3}$$

with $\chi_t$ i.i.d.
Factor Loadings

Time varying factor loadings follow a driftless random walk

\[ \lambda_{i,t} = \lambda_{i,t-1} + \epsilon_{i,t} \]  

(4)

with \( \epsilon_{i,t} \) i.d.d.
Factor identification

- Sign indeterminacy:

\[ Y_t = \Lambda f_t = (-\Lambda)(-f_t) \quad (5) \]

- Impose sign restriction on upper \((K \times K)\) of \(\Lambda\) (Geweke and Zhou, 1996)
Methodology

Factor identification

- Sign indeterminacy:

\[ Y_t = \Lambda f_t = (-\Lambda)(-f_t) \] (5)

- Impose sign restriction on upper \((K \times K)\) of \(\Lambda\) (Geweke and Zhou, 1996)

- Scale indeterminacy:

\[ Y_t = \Lambda f_t = \frac{\Lambda}{\alpha} f_t \] (6)

- Set the variance of the factors to a constant (Sargent and Sims, 1977, Stock and Watson, 1989,...)

Model details

Priors
Estimation via Gibbs Sampling

- Divide joint distribution into several known conditional distributions
Methodology

Estimation via Gibbs Sampling

- Divide joint distribution into several known conditional distributions
- Draw iteratively from conditional distributions
**Methodology**

**Estimation via Gibbs Sampling**

- Divide joint distribution into several known conditional distributions
- Draw iteratively from conditional distributions
- Sampler converges when number of iterations is large
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1 Estimate model parameters conditional on prior factor loadings and factors: \( p(\Theta^1 | \Lambda^0, f^0) \)
Estimation via Gibbs Sampling

- Divide joint distribution into several known conditional distributions
- Draw iteratively from conditional distributions
- Sampler converges when number of iterations is large

1. Estimate model parameters conditional on prior factor loadings and factors: \( p(\Theta^1 | \Lambda^0 f^0) \)

2. Calculate new value of factors conditional on estimates in Step 1: \( p(f^1 | \Theta^1 \Lambda^0) \)
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1. Estimate model parameters conditional on prior factor loadings and factors: \( p(\Theta^1|\Lambda^0 f^0) \)
2. Calculate new value of factors conditional on estimates in Step 1: \( p(f^1|\Theta^1 \Lambda^0) \)
3. Calculate new value of factor loadings, conditional on Step 2: \( p(\Lambda^1|f^1 \Theta^1) \)
Estimation via Gibbs Sampling

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1. Estimate model parameters conditional on prior factor loadings and factors: \( p(\Theta^1|\Lambda^0 f^0) \)
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3. Calculate new value of factor loadings, conditional on Step 2: \( p(\Lambda^1|f^1 \Theta^1) \)
4. Iterate (Kim and Nelson, 1999)
n’th Iteration

1. \( p(\Theta^n | \Lambda^{n-1} f^{n-1}) \)
2. \( p(f^n | \Theta^n \Lambda^n - 1) \)
3. \( p(\Lambda^n | f^n \Theta^n) \)

- Geman and Geman (1984) show convergence
Table of Contents

1 Motivation

2 Contribution

3 Methodology

4 Data

5 Results
1863-1913

- 167 time series
- 124 real, 43 nominal
- 91 non agricultural, 33 agricultural
1914-1942

- 178 time series
- 130 real, 48 nominal
- 70 non agricultural, 60 agricultural
- Sources: ISTAT, De Bonis, Farabullini, Rocchelli and Salvio (2012), Felice and Carreras (2012)
1956-2005

- 145 time series
- 104 real, 41 nominal
- 54 non agricultural, 60 agricultural
- Sources: ISTAT, De Bonis, Farabullini, Rocchelli and Salvio (2012)

Further sub-sample 1947-2008
Table of Contents

1 Motivation

2 Contribution

3 Methodology

4 Data

5 Results
The Debates: pre-WWI

Sharp decrease in volatility post unification: reality (Ciccarelli and Fenoaltea 2007) or an artifact of the data (Marchionatti and Sella 2012)?

Post-unification moderation has been ascribed to the use of agricultural series reconstructed by Federico (2003) which correct the bias in levels and long-run growth of the ISTAT series, but are widely believed to be too smooth.

We use the ISTAT series since they capture the cyclical component of agricultural production (Ciccarelli and Fenoaltea 2007).
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The Debates: interwar period

Results

The Debates: interwar period

Economic boom during World War I

Early GDP estimations (e.g. Maddison, 1991, 2003; Rossi, Sorgato, and Toniolo, 1993) showed massive boom during the conflict, recent revisions show slower growth (Baffigi 2011) and a slowdown in industrial activity (Felice and Carreras 2012).

If confirmed, Italy's war-time boom would be unique among countries significantly involved in WWI (Broadberry 2005).
The Debates: interwar period

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The Debates: post-WWII

Great Moderation: dampening of volatility observed in most OECD countries starting from the 1980s
Kose, Otrok and Whiteman (2003, 2008)
→ World/G7 and country specific factors dominant in business cycles
→ moderation more complex than single-break US model and associated with decline in size of domestic shocks
Del Negro and Otrok (2008)
→ moderation starts gradually in the mid 1970s, also find that decrease in country specific shocks are crucial
The Debates: post-WWII

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Factor vs. GDP estimate: post-WWII
### Volatility: change in standard deviations

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>GDP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.63</td>
<td>-37%</td>
</tr>
<tr>
<td>FACTOR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.59</td>
<td>-41%</td>
</tr>
</tbody>
</table>
Volatility: change in standard deviations

<table>
<thead>
<tr>
<th>Period</th>
<th>GDP</th>
<th>FACTOR</th>
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<tbody>
<tr>
<td>1956-1965</td>
<td>1.65</td>
<td>0.87</td>
</tr>
<tr>
<td>1966-1975</td>
<td>1.08</td>
<td>0.71</td>
</tr>
<tr>
<td>1976-1985</td>
<td>0.85</td>
<td>0.58</td>
</tr>
<tr>
<td>1985-1995</td>
<td>0.60</td>
<td>0.28</td>
</tr>
<tr>
<td>1996-2006</td>
<td>-29%</td>
<td>-52%</td>
</tr>
</tbody>
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Post-WWII non-agricultural series

1956–2005 real non-agric HP, 1–100, 15K
Post-WWII non-agricultural series

Graph showing a time series of the 1947–2008 real non-agricultural HP, 1–100, 15D.
Post-WWII nominal series extended sample

1947–2008 nominal HP, 1–100, 15K

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The Italian Business Cycle

ASSET Annual Meeting
Factor vs. GDP estimate: pre-WWI
### Volatility: change in standard deviations

<table>
<thead>
<tr>
<th></th>
<th>1862-1870</th>
<th>1870-1880</th>
<th>1880-1890</th>
<th>1890-1900</th>
<th>1900-1913</th>
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<tbody>
<tr>
<td><strong>GDP</strong></td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>0.56</td>
<td>0.43</td>
<td>0.22</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-44%</td>
<td>-22%</td>
<td>-49%</td>
<td>81%</td>
<td></td>
</tr>
<tr>
<td><strong>FACTOR</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>0.63</td>
<td>0.31</td>
<td>0.15</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-37%</td>
<td>-50%</td>
<td>-53%</td>
<td>25%</td>
<td></td>
</tr>
</tbody>
</table>
Pre-WWI agricultural series

1865 1870 1875 1880 1885 1890 1895 1900 1905 1910
-6 -4 -2 0 2 4 6

1863–1913 Real Agr, 1–100, 15K
Pre-WWI non-agricultural series

1863–1913 real non-agric, 1–100, 15K

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Factor vs. GDP estimate: Interwar
Interwar agricultural series

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Interwar non-agricultural series

![Graph showing interwar non-agricultural series with data points from 1915 to 1940. The y-axis ranges from -4 to 1, and the x-axis ranges from 1915 to 1940. The line graph indicates fluctuations over time.]

1914–42 Real Non–Agr, 1–100, 15K

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Summary and conclusions

- We confirm the sharp decrease in volatility in the post-unification era, especially after 1890 → causes?
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  - Cyclical convergence would suggest increase in co-movement, but might be at least partially offset by regional sectoral specialization (Ciccarell, Fenolatea and Proietti, 2010)

- We find no economic boom during WWII, but a sharp recession, in line with other warring countries

- We confirm the Great Moderation and the fact that it was a complex phenomenon → mainly domestic in nature? As opposed to Delli Gatti, Gallegati and Gallegati (2005)

- We highlight the need for further work on cyclical component of economic activity for the pre WWII era

Work focused on getting medium/long term growth right, not cyclical fluctuations

Some extremely under-explored periods, such as the 1950s, and still partial understanding of the interwar era
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  - Work focused on getting medium/long term growth right, not cyclical fluctuations
  - Some extremely under-explored periods, such as the 1950s, and still partial understanding of the interwar era
Thank you!
Priors

• Autoregressive parameters
  • Data is HP filtered so mean of series is 0
  • Variances: $\Sigma = \text{diag}(1, \frac{1}{2}, \ldots, \frac{1}{1-p})$

• For the disturbances of the idiosyncratic parameter
  $\sigma^2_{\chi} \sim IG\left(\frac{\alpha_{\chi}}{2}, \frac{\delta_{\chi}}{2}\right)$ with $\alpha_{\chi} = 6$ and $\delta_{\chi} = 0.001$

• For the time-varying factor loadings $\sigma^2_{\epsilon} \sim IG\left(\frac{\alpha_{\epsilon}}{2}, \frac{\delta_{\epsilon}}{2}\right)$

• $q = 1$, $p = 8$

• 15,000 draws

• Kose, Otrok and Whiteman (2003)
1947-2008

- 139 time series
- 99 real, 40 nominal
- 39 non agricultural, 60 agricultural
- Sources: ISTAT, De Bonis, Farabullini, Rocchelli and Salvio (2012)

Back to Data