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Business fluctuations in Italy, 1861–1913: The new evidence ☆

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Abstract

Band-pass filters and structural time-series models are applied to the new estimates of Italy's domestic product from 1861 to 1913. These indicate a strong four-year cycle, derived from the agricultural sector, which curiously (and perhaps spuriously) vanishes after 30 years. Over the longer term GDP and the services reflect the long swing in industrial production, tied to the investment cycle. Agriculture seems marked instead by a further cycle of some 12–15 years, and also by a long wave related to the sector's terms of trade.
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1. Introduction

Italy's national historical accounts were reconstructed just over a half-century ago by Istat (the Istituto Centrale di Statistica) and Ornello Vitali (the statistician of the "Ancona Group" organized by Giorgio Fuà). The Istat–Vitali estimates for the decades between Unification (1861) and World War I have long been considered seriously distorted; preliminary alternative estimates that combine Giovanni Federico's constant-price value added

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series for agriculture and the corresponding Fenoaltea series for industry and the services point to higher and above all much steadier long-term growth.[1] This paper examines business fluctuations in post-Unification Italy in the light of these new estimates. Section 2 considers the short-term business cycle, and Section 3 the longer-term fluctuations in GDP; a brief conclusion summarizes the main empirical results, and the research agenda to which they point.

The business cycle in the new GDP series is identified through alternative standard decompositions; these yield very similar results, which are correspondingly robust. Post-Unification Italy was largely agricultural, and the short-term cycle in GDP derived overwhelmingly from the movements of agricultural production. The estimated cyclical deviations were unusually moderate over the quarter-century before the war; but this comparative stability is not clearly confirmed by the available historical data, and it may be a statistical artifact.

Over the longer term trend growth appears to have been above average in the 1880s, and even more so after the turn of the century; alternative decompositions again yield very similar results, and these fluctuations too appear to be robustly identified. The agricultural series displays a further cycle of some 12–15 years, and an even longer fluctuation apparently related to the sector's terms of trade; but these movements are relatively mild. The estimated fluctuations of the services sector are even milder, and the major longer-term movements in GDP paralleled those in industrial output. The statistically significant turn-of-the-century acceleration of GDP growth is tied to the rising industrial production of durables; it appears to reflect a sustained upswing in the investment cycle induced by the varying supply of foreign capital, rather than a break in the deep structure of the economy.

2. The business cycle

2.1. The business cycle over time

The new GDP series is illustrated in Fig. 1a.[2] Fig. 1b presents the business cycle identified through two alternative decompositions of log GDP. One uses a Baxter–King (1999) band-pass filter that admits periodic components between 2 and 8 years, and a symmetric moving average of order 3, as is standard when dealing with annual macroeconomic data. The other relies on the general structural time-series model with uncorrelated components described in Harvey and Jaeger (1993) and extensively applied to historical time series by Crafts and Mills (1996, and references therein).[3]

These alternative approaches to the identification of the business cycle reflect very different statistical methodologies; but in the present case they yield results that are very

[1] The original estimates appeared in Istat (1957) and Fuà (1969); Fenoaltea (2005) presents the new estimates, and compares them to their predecessors.

[2] GDP at market prices includes net indirect business taxes; GDP at factor cost does not. The conventional measure "of GDP" is the former, and that is the series analyzed here; but the two series are very close. Population growth was very steady, at least between census benchmarks; as it remains unknown at higher frequencies, the extant per-capita series are in essence rescaled and retrended versions of the corresponding aggregates, with no independent variation (Fenoaltea, 1988, 2005).

[3] Neither decomposition requires a prior verification of the unit-root properties of the series under investigation (Baxter–King, 1999, Appendix A; Harvey, 1997).

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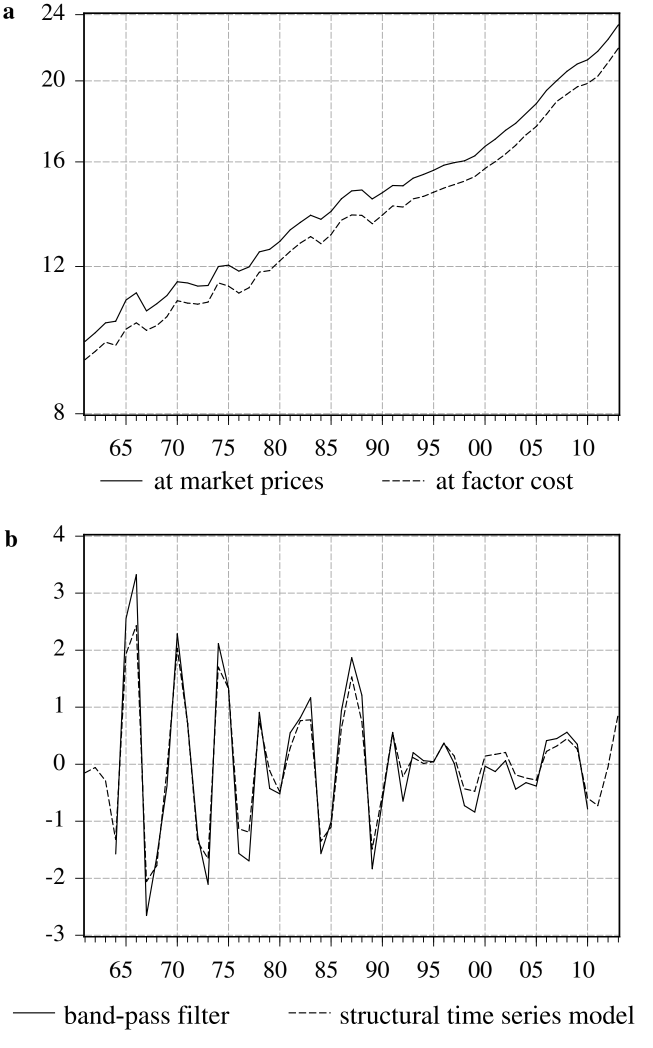

Fig. 1. GDP and the business cycle. (a) Gross domestic product (billion lire at 1911 prices). (b) Cyclical fluctuations (percentage deviations from trend). Source: see text.

similar (and similar to those obtained through alternative filters).[4] The cycle which they identify is essentially one and the same, and appears to be robustly based in the GDP series itself.

[4] These alternative filters are the fixed-length symmetric Christiano–Fitzgerald (1999) filter, very similar in spirit and structure to that of Baxter and King, and the full-sample asymmetric Christiano–Fitzgerald (2003) filter with time-varying data-sensitive weights; these aspects of the latter weighting structure are captured by the structural time-series model. A very similar cycle (apart from the end-points) is also obtained through a Nadaraya–Watson non-parametric regression with Gaussian kernel and the corresponding Silverman optimal band-width.

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Table 1
Band-pass filter cycles

(a): Turning points

Year	(1) GDP	(2) agr.	(3) ind.	(4) ser.	Year	(1) GDP	(2) agr.	(3) ind.	(4) ser.
1864	[**T**]	[**T**]	**[t]**	[**T**]					
1865	(P)		**P**		1890			**p**	(p)
1866	**P**	**P**		**P**	1891	**p**	**p+**		**p**
1867	**T**	**T**		**T**	1892	t	**t**	**T**	**T**
1868		(T)	**T**	(T)	1893	p	p		**p**
1869					1894	(t)	t	**p**	
1870	**P**	**P**	**p**	**P**	1895	t			**t**
1871			**t**		1896	p	**p**	**T**	(t)
1872				**t**	1897				p
1873	**T**	**T**	(P)		1898				
1874	**P**	**P**	**P**	**P**	1899	**t**	**t**	**p+**	t
1875			**t+**		1900	p	p		p
1876	(T)	**T**		**T**	1901	t		**t**	**t**
1877	**T**	(T)		(T)	1902	p		p	
1878	**p**	**p+**	**p**	**p**	1903	t	t		
1879	(t)	**t**	**T**	**T**	1904	p	p	**T**	**p**
1880	**t**	(t)			1905	t			**T**
1881					1906		t		**p**
1882			**p**		1907	**p**	**p+**		t
1883	**p**	**P**		**P**	1908				
1884	**T**	**T**	**t**	(T)	1909				**p**
1885				**T**	1910	**[t]**	[**T**]	**[P]**	[**T**]
1886		(P)		**P**					
1887	**P**	**P**	**P**	t					
1888			(P)	**P**					
1889	**T**	**T**	**t**	**t**					.

(b) Simple correlations

	1864–1891			1892–1910			Full sample		
	Agr.	Ind	Ser.	Agr.	Ind	Ser.	Agr.	Ind	Ser.
Ind.	.28			−.26			.18		
Ser.	.81	.57		.27	.08		.72	.47	
GDP	.92	.41	.86	.77	.15	.40	.91	.36	.79

Key: **P**, **T**: major turning point, at least one standard deviation from trend. **p**, **t**: significant turning point, following or preceding a one-standard-deviation or larger improvement or deterioration. **p+**, **t+**: significant, near-major turning point. p, t: other turning point. (P), (T), (p), (t): deviation close to that of neighboring major or significant turning point. Source: see text.

The business-cycle chronology that emerges from these series is presented in Table 1a, col. 1.[5] All turning points are identified by a *p* (peak) or a *t* (trough). A bold-face *P* or *T*

[5] Table 1a is based on the Baxter–King filter alone: since it has recently been applied to the Istat–Vitali estimates of Italian GDP (as amended, from 1890, by Rossi et al., 1993) by Delli Gatti et al. (2005), the chronology presented here directly illustrates the differences in the time series that are being analyzed, without clouding the comparison with a change in the technique used to decompose the series.

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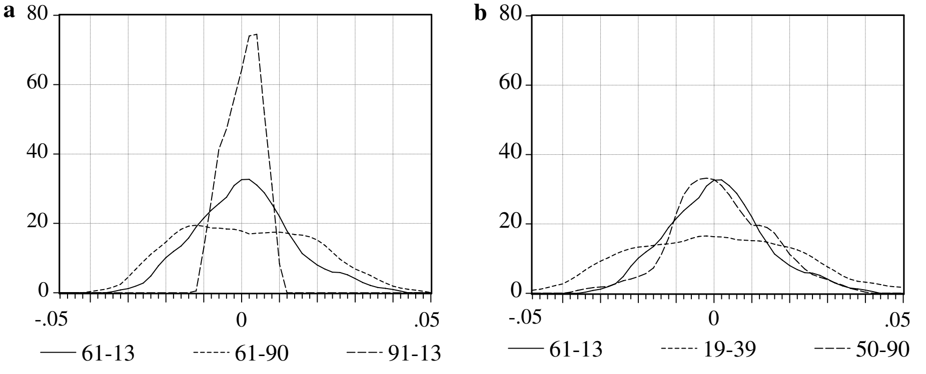

Fig. 2. Band-pass filter cycles: kernel density estimates. (a) 1861–1913. (b) 1861–1990. Source: see text.

identifies a major peak or trough, defined as a turning point that deviates from the series' own trend by no less than *s*, the standard deviation of the cyclical deviations themselves. A bold-face *p* or *t* identifies a minor but still significant turning point, with a cyclical deviation under *s*, but with a deviation from either the previous or the succeeding turning point no smaller than *s*; a "plus" highlights those that are borderline major. Parentheses indicate a cyclical deviation close to that of the neighboring peak or trough; square brackets appear in the initial and final years, to signal local extreme values that are not of course turning points.

The new GDP series is characterized by a sharp, roughly quadriennial cycle until about 1890; subsequently, its cyclical variations are much reduced, and on the present definitions major peaks and troughs do not recur.[6] The contrast is evident in Fig. 2a, which presents the kernel density estimates of the (band-pass) cyclical deviations of GDP over the full span from 1861 to 1913, and the sub-periods 1861–1890 and 1891–1913.[7]

Fig. 2b is analogous to Fig. 2a; it compares the post-Unification (1861–1913) experience represented by the new series at 1911 prices with the inter-war (1919–1939) and post-war (1950–1990) experience represented by the Rossi–Sorgato–Toniolo series at 1938 and at 1985 prices, respectively (Rossi et al., 1993). Over its full span the post-Unification economy appears more stable than the inter-war economy, and no more unstable than the post-war economy; but the measured amplitude of the business cycle is extremely sensitive to the precise methods used to generate the time-series estimates (Romer, 1986), and over these three periods the GDP series are not homogeneous.

Only the post-World War II series are derived from current, broadly based national accounts; the pre-World War I and inter-war series are estimates derived from limited historical data, and reflect very different approaches. The inter-war series is a very partial revision of the original Istat–Vitali estimates (Bardini et al., 1995), obtained with the traditional methodology of the pioneers: a small number of series is taken to represent a much larger whole, in effect overstating cyclical variations by assuming perfect

[6] Over the full half-century the cycle period estimated by the structural model is 4.56 years (Appendix A).

[7] These estimates were generated with an Epanechnikov kernel and a band-width proportional to the sample size raised to the power −.2.

positive correlations even where these were more plausibly limited or even negative (Fenoaltea, 2003).

The new series for the decades to World War I avoid Scylla, but in the present, preliminary version sail close to Charybdis. Their immediate aim was to remove the gross errors displayed over the medium and long term by the extant Istat–Vitali series and their subsequent derivatives; and this much they appear to have achieved. But the aggregate series for industry and for the services both include provisional elements that simply interpolate a small handful of census benchmarks, and do not yet incorporate any short-term movements at all (Fenoaltea, 2003, 2005). The agricultural aggregate too is excessively stable. Federico's component series are normally simple averages of separate production-side and consumption-side estimates calculated for 10 major products. The consumption-side estimates model consumption as a function of wages and deflated current prices, and deduct net imports to estimate production; depending on the openness of the market, therefore, supply shocks show up either in prices and consumption, or in net imports. The production-side estimates assume supply curves that shift steadily with technical progress, and movements along these curves that are a function of lagged relative prices, with elasticities that reflect the competing uses of the available land; but in these preliminary estimates the deviations between planned and actual output are simply neglected (Federico, 2003).

Fig. 2b cannot therefore be taken at face value, for the series for the three sub-periods are not directly comparable. Allowing for the differences in the series' cyclical sensitivity, all Fig. 2b actually suggests is that the pre-World War I economy was less stable than the post-World War II economy. The relative volatility of the inter-war economy cannot be ascertained at all: as measured it was the highest, but its measure alone is biased upwards.

Fig. 2a is of course derived from the new series alone, and free of such problems; the sharp difference in volatility across the sub-periods 1861–1890 and 1891–1913 cannot simply be dismissed, and warrants further investigation.

2.2. The sectoral origins of the business cycle

The immediate sources of the business cycle are here explored by applying the Baxter–King filter to the new series for agriculture, industry, and the services, here illustrated in Fig. 3.[8] In this context, the computational simplicity of this decomposition facilitates the interpretation of the results: their statistical roots are perfectly transparent, and the trend and cycle of GDP are simple sums of those obtained for its component series.[9]

The resulting chronology is transcribed in Table 1a, cols. 2–4; all three sectors display major peaks and troughs, as here defined with reference to each series' own variability,

[8] The fourth component of GDP at market prices, indirect business taxes, is very minor, and the only element of the new estimates borrowed from the Istat–Vitali corpus (Fenoaltea, 2005); it is not separately investigated here.

[9] With the standard parameters used here, the weights that generate the cyclical variable c_t have a very simple structure: approximately .77 to the current observation x_t, and −.20, −.14, and −.05, respectively, to those 1, 2, and 3 years removed. This is equivalent to calculating c_t as the deviation of x_t from a trend y_t calculated as a straightforward seven-year moving average of x_t with weights equal to .23 on the current observation and .20, .14, and .05, respectively, on its neighbors. The corresponding algorithm of the structural time-series model is much more complex (Proietti, 2002), and does not lend itself to straightforward disaggregation; as noted below, the results obtained with the latter model agree with those presented here.

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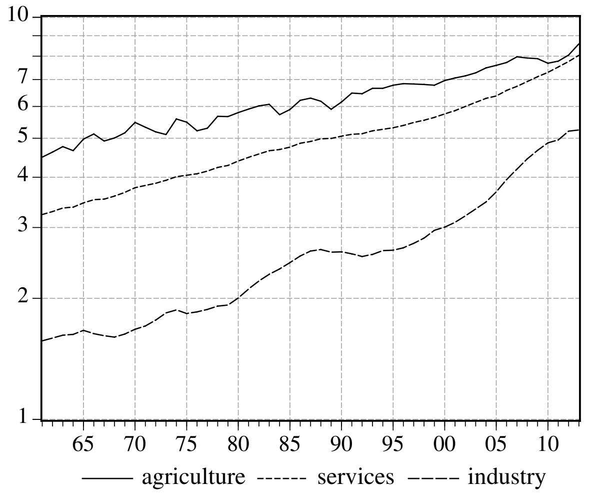

Fig. 3. Value added, by major sector (billion lire ar 1911 prices). Source: Fenoaltea (2005).

especially over the first three decades of the period at hand. But the different sectors were not equally variable, nor equally large; as is apparent from Figs. 4 and 5, which compare the cycles in GDP and in the three major sectors, there are sharp differences in their relative contribution to the cycle in GDP.

Fig. 4 presents the cycle series separately, but they are all expressed as percentages of trend GDP; the vertical scale differs by an order of magnitude between the upper graphs, for GDP and agriculture, and the lower graphs, for industry and services. The sector graphs include reference lines that indicate a constant range of variation with respect to the sector's own calculated trend; that range is set at (plus or minus) 2% in the case of agriculture, and just 1% in that of industry and the services. These lines converge as the sector's share of GDP declines and a given percentage of GDP equals an ever larger percentage of the sector itself, and obviously diverge in the opposite case.

The three sectors differed significantly in their relative variability. The percentage deviations from the sector's own trend (measured in Fig. 4 with respect to the dotted reference lines) were clearly greatest in agriculture, much reduced in industry, and least in the services: agriculture deviated from its trend by more than 2%, industry by less than 2% but more than 1%, the services by well under 1%. Agriculture was at once the largest sector, and the most variable: in their impact on GDP, its fluctuations were an order of magnitude greater than those of industry or of the services. The services in particular had a minimal impact, especially in a causal sense: within that sector, by construction, large components are virtually devoid of cyclical movements, and the parts that do vary respond to the changes in commodity production (Fenoaltea, 2005).

Fig. 5 superimposes the different series illustrated separately in Fig. 4: it is immediately apparent that the business cycle of the new GDP series is essentially that of its agricultural component. The post-1890 reduction in the amplitude of the GDP cycle coincides with a reduction of the co-variation of the sector cycles (Table 1b), but that co-variation seems to have exacerbated the GDP cycle only in the 1860s, and again at the late-1880s peak; the

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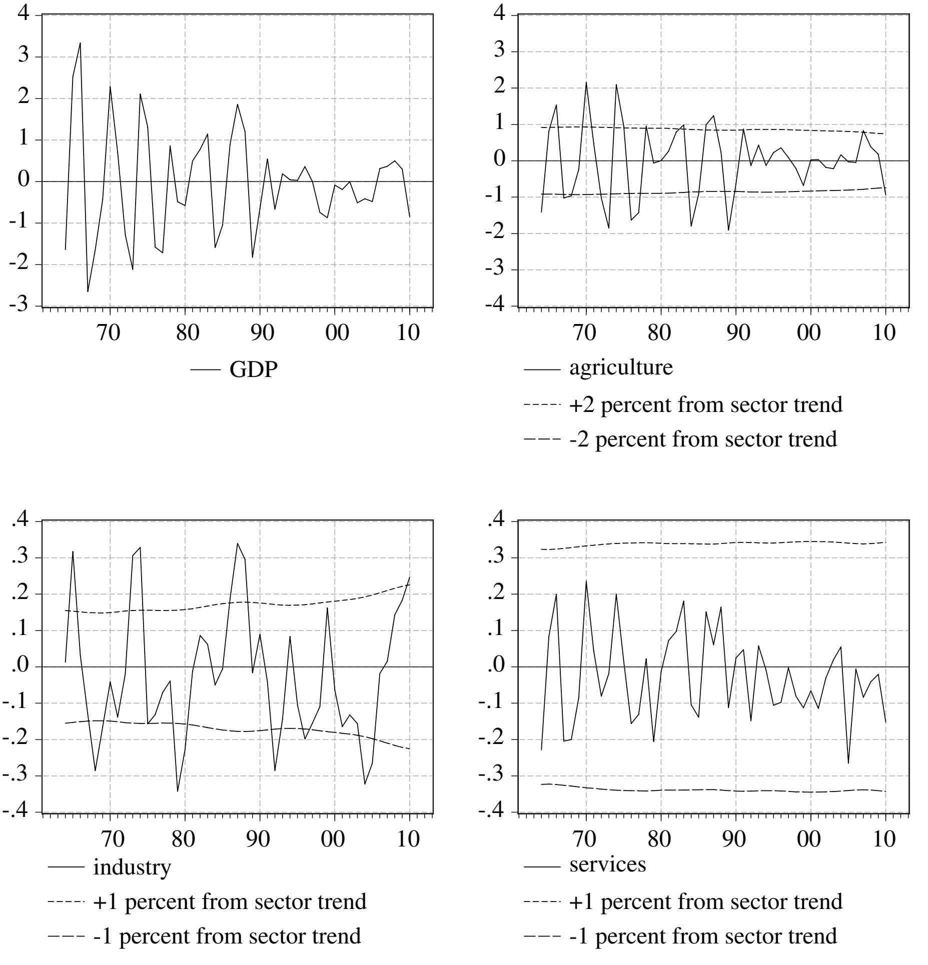

Fig. 4. Band-pass filter cycles in the major sectors (deviations from trend as percentages of trend GDP). Source: see text.

other swings in GDP up to 1890 were virtually the agricultural cycle alone, with a negligible net contribution from the other sectors.[10]

The post-1890 reduction in the variability of GDP seems correspondingly to have derived primarily from the reduction in the variability of agricultural production, which similarly varies much less than before: the 2%-of-sector-trend dotted line was regularly crossed between 1861 and 1891, but from then on it would be reached again only at the very end of the period at hand, in 1907 and again in 1910 (Fig. 4).

[10] The analogous figure obtained from the structural time-series model returns this result in even stronger terms. The agricultural trend and cycle are virtually identical to their Baxter–King equivalents, and the GDP cycle is all but exhausted by the agricultural cycle, with a negligible contribution from industry and the services. In both decompositions the only exception is in the early years, where a significant residual is due to a sharp fluctuation in indirect business taxes (Fig. 1a).

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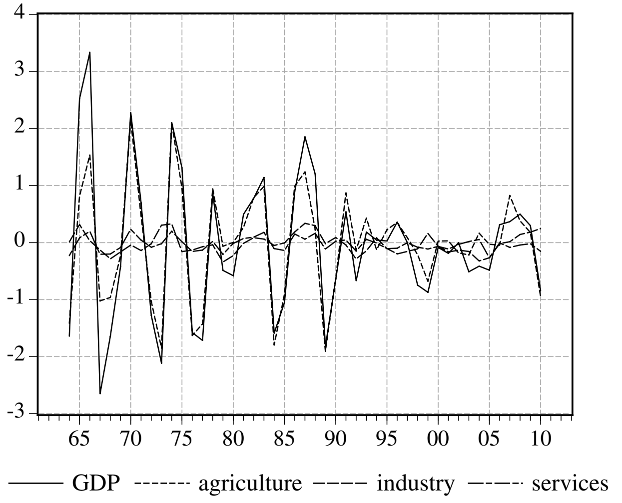

Fig. 5. Band-pass filter cycles (deviations from trend as percentages of trend GDP). Source: see text.

2.3. *Is the relative stability of the pre-war years a figment of the data?*

It is of course hardly surprising that in a largely agricultural economy the cycle in GDP should have been, to a first approximation, the cycle of the agricultural sector. A progressive reduction in the volatility of GDP as the more stable sectors became relatively larger, and perhaps as the diffusion of new techniques made agriculture itself less sensitive to natural shocks, would be similarly plausible; but the observed reduction in volatility is within agriculture itself, very sudden, and apparently unparalleled.

Table 2 presents summary measures of the variability of agricultural output in a broad spectrum of European countries.[11] These measures are of course unusually sensitive to the idiosyncracies of the series' underlying sources and methods, and cannot be presumed comparable either across space or over time.[12] Such as they are, they produce a variety of patterns, with a number of outliers of exceptional stability (France in 1881–1890) or instability (Switzerland in 1891–1900, due largely to an apparent miracle in 1900); but the clear step function described by the Italian figures is theirs alone.

Its statistical roots cannot be investigated directly, for the component elements of the Federico series have not been published, and the available description of his sources and methods is very terse (Federico, 2003). Over the short term, as noted, the movements of the new series reflect the consumption-side evidence from changes in prices and trade flows, but not (yet) any direct production-side testimony on the relative abundance of each harvest. From this perspective the new series is a mirror-image of the agricultural statistics

[11] These measures are the standard deviations of the cyclical deviations from trend, by decade, calculated by applying the Baxter–King filter to the log of the agricultural GSP series used in Federico (2004) and available on his website.

[12] As recalled above, the country- and period-specific gaps in the underlying data are typically bridged either by inserting simple trends, and thus understating the actual variation, or by letting the available series represent the missing ones, and thus overstating it. Federico's series for Italy is as noted homogeneous over time; the other national series may or may not be, but cannot here be investigated further.

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Table 2
Band-pass filter agricultural cycles: standard deviations, by decades

Country	1871–1880	1881–1890	1891–1900	1901–1910
Austria	4.97[a]	2.26	3.65	2.86
Belgium	5.69	2.70	2.71	1.52
Denmark	2.84	4.35	8.85	3.48
Finland	2.45[a]	4.53	5.21	2.98
France	7.90	1.70	4.74	5.04
Germany	3.59	1.59	2.91	2.26
Greece	4.76	6.09	8.98	6.96
Hungary	3.95[a]	4.76	5.88	8.69
Italy	2.78	2.97	1.12	1.19
Netherlands	3.54	3.24	4.60	2.43
Portugal	2.48	3.44	3.91	5.21
Spain	8.41	3.29	7.46	5.67
Sweden	5.79	4.31	3.23	4.96
Switzerland	5.11[a]	5.67	11.30	6.44
UK	6.36	2.46	1.99	3.13

[a] Standard deviation computed over the period 1873–1880. Source: see text.

generated at the time: these apparently got the longer-term movements wildly wrong—and transmitted their errors even to their distant progeny (Fenoaltea, 2005)—but they clearly incorporated the perceived short-term variations in the harvest.

Annual series for wheat, corn, and wine, beginning in 1884, were published by the Direzione generale della statistica (1915). In 1911, according to Federico (2000), these three products accounted for some two fifths of agriculture's GSP (8.06 billion lire): wine alone represented about one fifth (1.71 billion) and wheat almost another sixth (1.23 billion), with corn far behind (.25 billion). Fig. 6 presents the (Baxter–King) cycles in these historical series, and compares them to the corresponding cycle in the Federico series. The wheat series points to relatively constant variability (the 1897 catastrophe apart), and the (minor) corn series tends if anything to vary more where the Federico series varies less. The wine series alone displays less cyclical variation over its central span than at the beginning and the end, as the new aggregate does; and while wine was the most important of the measured crops it is relatively *sui generis*, and less likely than the others to be correlated with omitted items.

Little further evidence speaks to the point.[13] Before the public sector took on the burden of monitoring the economy, the study of its fluctuations relied on whatever statistics had been generated for other purposes; and one of the more useful real indicators was provided by the data on railroad traffic. The time series for freight-car vehicle-kilometers incorporated in the new service-sector estimates is illustrated in Fig. 7a: over the early years it seems to reflect little more than the initial construction of the national network, but from about 1875 it too displays apparently meaningful cyclical variations. The cycle

[13] The mean temperature and total precipitation series in Istat (1958) shed little light on current conditions. Over most of the 1890s the temperature data are altogether lacking. The available local series are not highly intercorrelated—Italy is notoriously a land of multiple local climates—and there is no visible correlation with the calculated agricultural cycle. This too is unsurprising, as the seasonal distribution of precipitation matters as much as its annual total, and a given amount of precipitation has very different effects if it takes the form of large hailstones rather than of a gentle rain.

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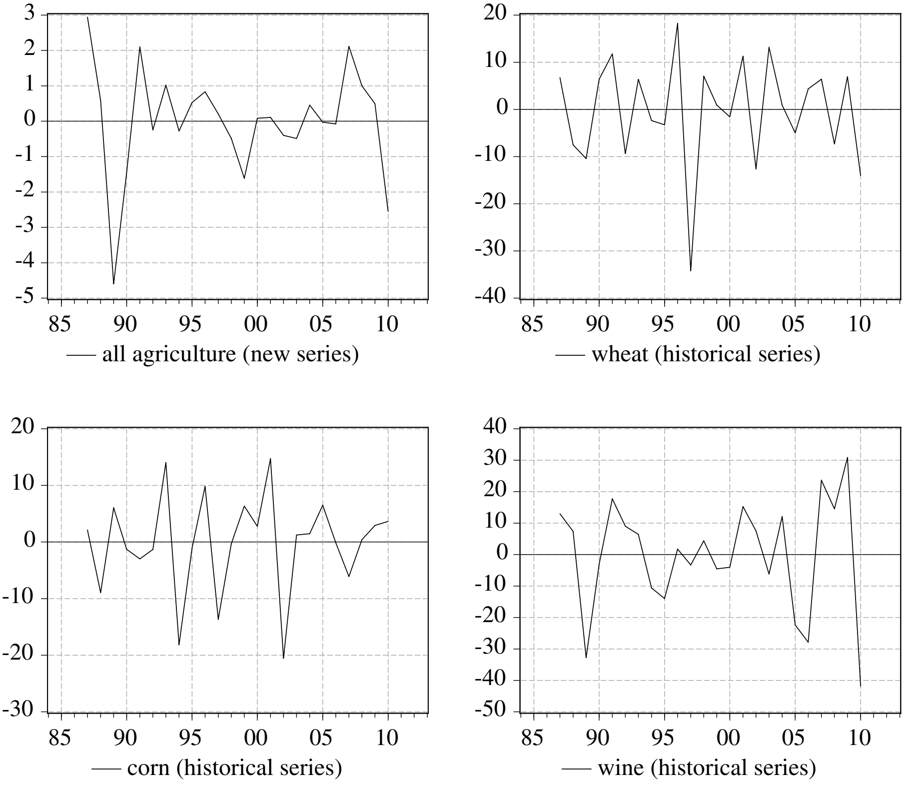

Fig. 6. Band-pass filter cycles in the agricultural series (percentage deviations from trend). Source: see text.

identified by the Baxter–King filter appears in Fig. 7b: it is quite regular and roughly quadriennial from the mid-1870s to about 1890, and somewhat less regular—and partly abated—from then on. This indicator too must be interpreted with caution, however, for the traffic data available for the end of the period at hand suggest that some three-quarters of railway shipments consisted, in roughly equal parts, of coal alone, agricultural products (largely grain, and not much wine), and construction materials. With the exception of these last, the railways seemed engaged very largely in the distribution of bulk imports; most domestic agricultural goods seem to have been consumed locally, and moved by traditional means (Fenoaltea, 1983).[14]

The very limited evidence that can now be examined thus suggests a cautious evaluation. There are scattered indications that the cyclical variations of the post-Unification economy may indeed have been somewhat milder after 1890 than before, but the sharp stabilization that the present estimates derive from the preliminary agricultural series must be verified by further research.

[14] The cyclical movements of railway freight traffic seem to corroborate this evidence: from 1875 on the railway freight cycle shows a negative correlation with the GDP cycle (−.46), but a weak positive partial correlation with the industrial cycle (.25), presumably from coal traffic, and a stronger negative partial correlation with the agricultural cycle (−.62), presumably from the opposite cycle in compensating imports.

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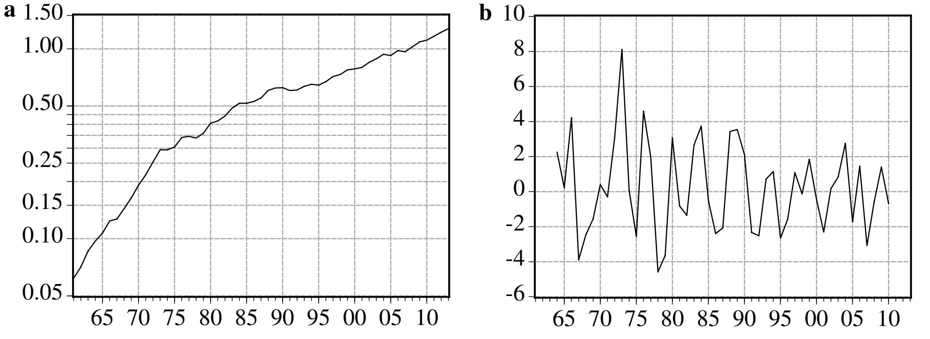

Fig. 7. Railway traffic. (a) Freight-car vehicle-kilometers (billions). (b) Freight-car vehicle-kilometers: band-pass filter cycles (percentage deviations from trend). Source: see text.

3. Longer-term movements

3.1. The trends over time

In much of the current literature "the business cycle" is in a predetermined, relatively high-frequency range, and the "local," "flexible" trend absorbs a good deal of the original series' low-frequency variation (e.g., Zarnowitz and Ozyildirim, 2002). The older literature defined the "trend" as a very low-order polynomial, that could not snake around; and it spoke not of "the" business cycle but of Juglars and Kitchins, Kuznets and Kondratieffs, Dungeons and Dragons. Its richness was there, not in the eventless "trend."

To historians, the fluctuations of the local, flexible "trend" are no less interesting than "the cycle." Moreover, with annual macroeconomic data the "trend" generated by the standard fixed-length symmetric filters is a very familiar construct: it is a seven-year moving average, of the sort traditionally used to smooth series and bring out their longer-term variations—improved by a triangular weight structure that has individual observations enter and leave the moving average with a whisper instead of a bang.[15] The equivalent construct in the general structural model is more complex, and noisier: in logs, the trend level equals its own past value plus a slope coefficient plus a random disturbance, with the slope coefficient itself equal to its own past value plus a random disturbance.[16]

Fig. 8 presents the trend in GDP and in the three major sectors identified by the same alternative decompositions used above to identify the business cycle. The band-pass trends are somewhat smoother than the structural model trends, but in every case the two are so close as to be almost indistinguishable (from each other, and also from those obtained by

[15] Above, note 9. This simple weighting scheme is specific to the chosen band (with the minimal lower bound of 2 years), and the low order of the moving average. If one keeps the latter at three but raises the lower bound, the reference "trend" is obtained with negative weights on the immediate neighbors of the current observation; these de-stabilize a positively autocorrelated time-series, and render the trend "noisier." If one increases the order of the moving average, in calculating the "trend" negative weights appear at the tails; with a positively autocorrelated time-series these tend to offset the neighboring positive weights, so that the moving average is effectively shortened and the resulting "trend" is again more flexible. See Harvey and Trimbur (2003).

[16] See Appendix A. The trend can be smoothed by setting the variance of the trend-level disturbance equal to zero, but this restriction has not here been imposed.

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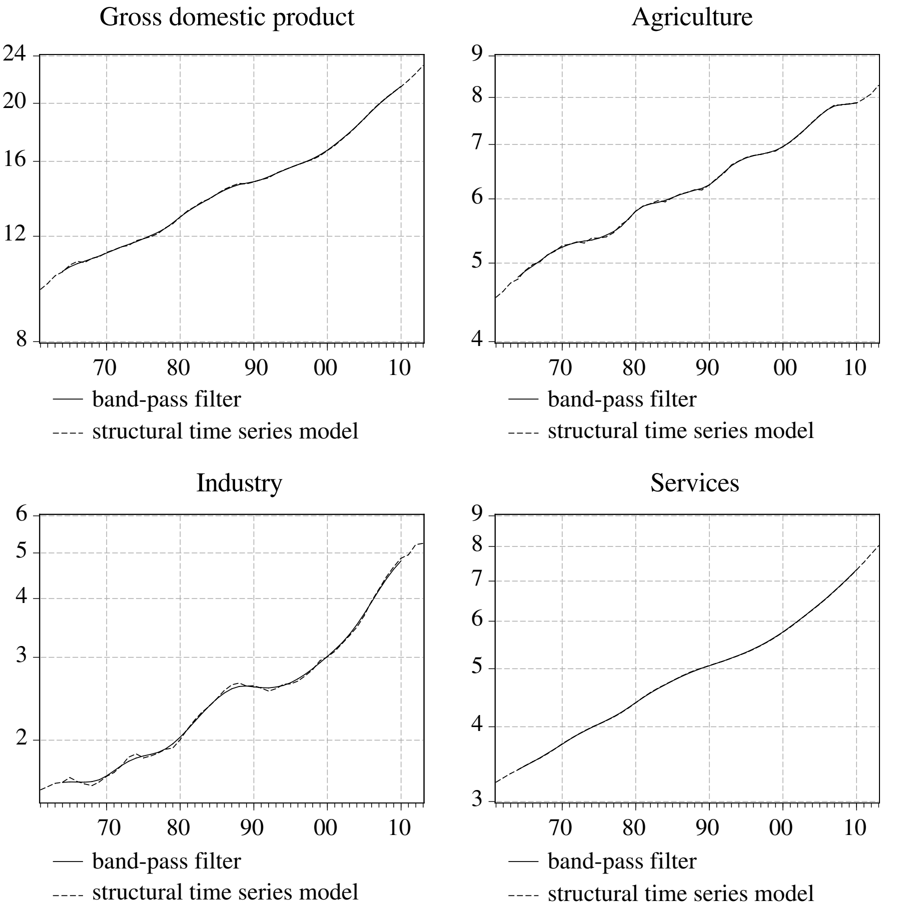

Fig. 8. GDP and sector trends: alternative estimates (billion lire at 1911 prices). Source: see text.

alternative filters): the trends too appear robustly rooted in the series themselves. The annual growth rates of the trend series are illustrated in Fig. 9; the relative "noisiness" of the structural trends is readily apparent.

3.2. The trend of GDP

Trend GDP manifests clear long-term fluctuations, with sustained above-average growth in the 1880s and especially after 1900.

The turn-of-the-century acceleration in the growth of the Italian economy to the First World War has long attracted attention. The early consensus that it represented a rostowian "take-off" was buttressed by the Istat–Vitali series, which showed a very sharp jump in the growth rate, in fact the beginning of growth in per-capita terms (Gerschenkron, 1955, 1968; Istat, 1957; Romeo, 1959). Historians have come to doubt such a sharp break, and most now prefer to describe a drawn-out, difficult take-off in a series of "waves" (Bonelli, 1978; Cafagna, 1983a,b; Toniolo, 2003). The new GDP series lacks the obvious disconti-

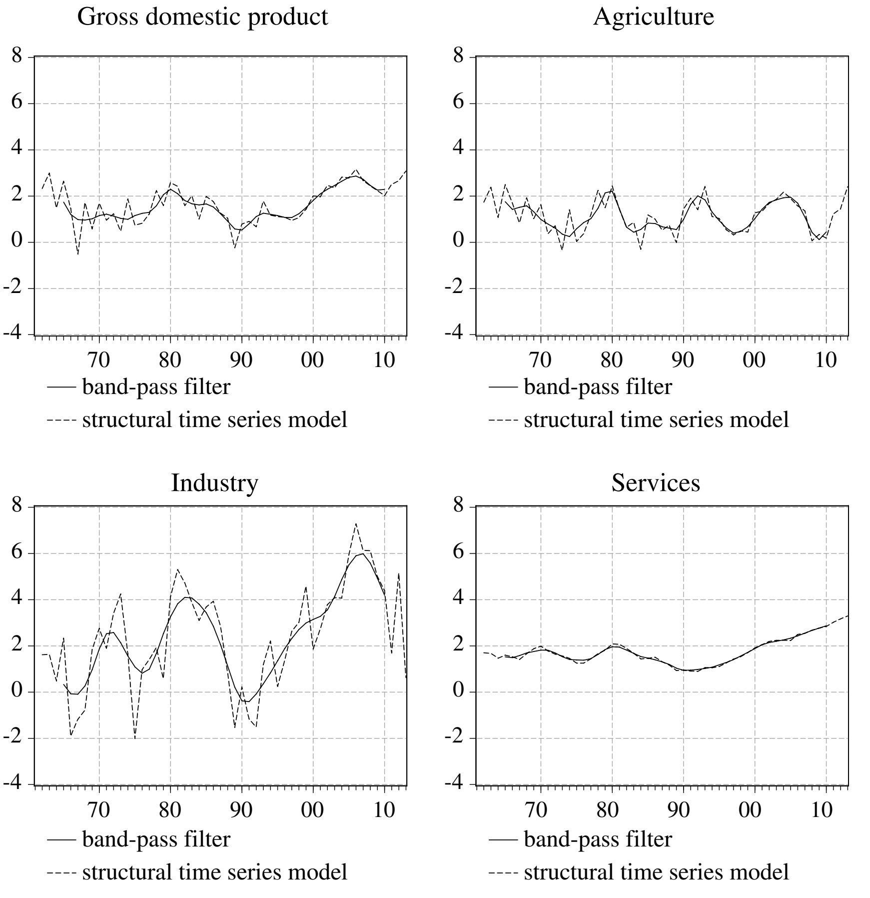

Fig. 9. Year-to-year trend growth rates: alternative estimates (percent). Source: see text.

nuity of its predecessors; but it too grows faster in the 1900s than in the preceding decades, and its acceleration may well be significant.[17]

A simple Chow-style test for a break at an unknown date regresses the annual growth rate of GDP on a constant and a time dummy that passes at some date from zero to one, and tests for the significance of the coefficient on the dummy. Fig. 10 presents the QLR test results obtained by letting the break date run (almost) from end to end; the no-break null is clearly rejected. The test statistic points to a break in 1900, with the mean growth rate nearly doubling from 1.34% per year to 2.57%.[18]

More subtle evidence emerges from within the structural time-series model. Harvey (1997) recommends not imposing an *a priori* break, on the grounds that the general model

[17] The sharp end-of-the-century break that characterized the Istat series and their various modifications was clearly much overstated: it apparently derived from an interpolation between the badly underestimated agricultural output estimates of the late 1890s and the much higher figures obtained for the 1900s by the new statistical service (Fenoaltea, 2005).

[18] The tests are based on the Newey–West standard errors; the (asymptotic) critical values are derived from Andrews (2003), with 15% trimming.

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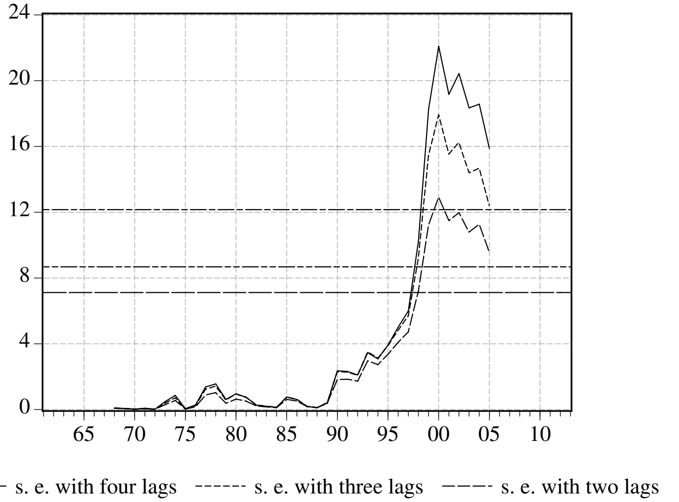

The horizontal lines indicate the 1%, 5%, and 10% critical values.

Fig. 10. GDP series: QLR test statistics for structural break (with alternative Newey–West standard errors). Source: see text.

is sufficiently flexible to capture a trend acceleration if one is indeed present in the data. In the present case the trend acceleration is brought out by the year-to-year growth rates of trend GDP in Fig. 9, and even more directly by the plot of the trend's slope coefficient alone in Fig. 11: in both graphs the relevant growth rate breaks out of its previous range of variation around the turn of the century, and is perceptibly higher in the 1900s than before.

If the model is reestimated allowing a discontinuous change in the trend's slope coefficient in 1900, a significant discontinuity emerges; interestingly, the estimated variance of the slope coefficient falls to zero, and the coefficient itself is constant before and after

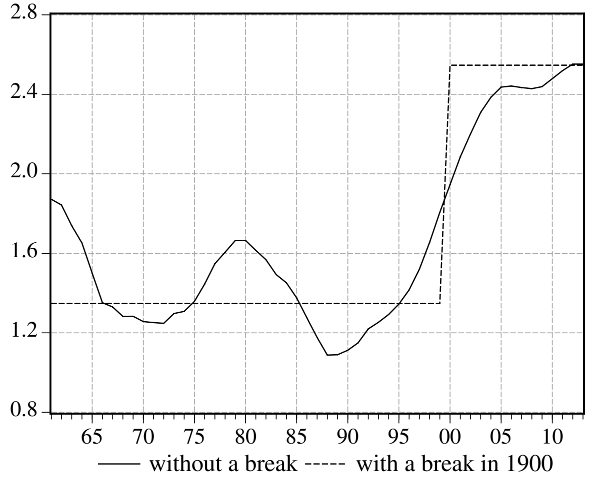

Fig. 11. Structural time-series model: estimated trend slope coefficient (annual percentage growth). Source: see text.

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the break (Fig. 11 and Appendix A). Statistically, the model with the break performs marginally better, but the trend and cycle which it yields are all but indistinguishable from those obtained above: with or without a break in the trend slope coefficient the decomposition of the GDP series is essentially one and the same.[19]

The new GDP series thus sharply reduce the turn-of-the century increase in the economy's growth rate, especially in per-capita terms (Fenoaltea, 2005), but they do not negate it. In the long decade to the war, the economy grew significantly faster than before.

This statistical evidence is not of course sufficient reason to revive the older view that Italy's economy "took off" in the early 20th century, for a "take-off" is a stages-of-growth concept that involves much more than that. It refers specifically to the acceleration that occurs when the economy acquires the "prerequisite" (and previously missing) capacity to take advantage of (already present) opportunities: in Gerschenkron's famous analysis, for example, the creation of the mixed banks provided the entrepreneurial–managerial talent that Italy had lacked. For this reason, and in this specific sense, the take-off (or "big push," as Gerschenkron preferred to call it) is "a period of 'long-term' growth," and not a mere cyclical upswing (Gerschenkron, 1955). The statistical break is a fact (within the limits of our perception); the "take-off" of the historical literature is an interpretation of its nature and causes.

3.3. *The trends of the major sectors*

The immediate sources of the fluctuations of trend GDP are of course the fluctuations of the major-sector trends documented in Figs. 8 and 9.[20]

The sustained growth of trend GDP in the 1880s and especially the early 1900s appears to reflect the movements of the industrial trend: similar fluctuations appear in the services' trend, but these are muted and, as noted above, largely derived from the commodity-producing sectors. Within industry, in turn, the trend fluctuations are located in the production of durable goods (and related materials: Fenoaltea, 2003); the trend of non-durables' production is altogether smoother (Fig. 12). The long cycle of the GDP series appears to have been the investment cycle.

Investment displayed above-average growth rates from the late 1870s to the later 1880s and again after the mid-1890s, and also, by pre-1900 standards, in the early 1870s; it followed the Kuznets cycle common to the capital-importing periphery, and apparently traceable to the parallel cycle in British capital exports (Fenoaltea, 1988, 2003). In the early 1900s these surged to new highs, and Italy found itself, by its own standards, awash with capital: borrowing rates fell to historic lows, and finance-sensitive investment rose to historic highs. The preceding surge of the 1880s, and even the brief upswing of the early 1870s, were similarly associated with a temporary increase in the supply of foreign capital; the upswing of the 1900s is not as transparently cyclical only because the War interrupted the Kuznets-cycle sequence near a cyclical peak, but its analogy to earlier episodes is readily apparent if one investigates its sources. In the early 1900s GDP grew faster than before, but the underlying improvement was in the agents' opportunities, and not, as the stages-of-growth interpretations would have it, in their ability to react to them.

[19] The estimated trends are always within a fraction of a percentage point of each other, and the calculated cycles differ only in 1861–1862 and in the immediate neighborhood of the break itself.

[20] Above, note 9.

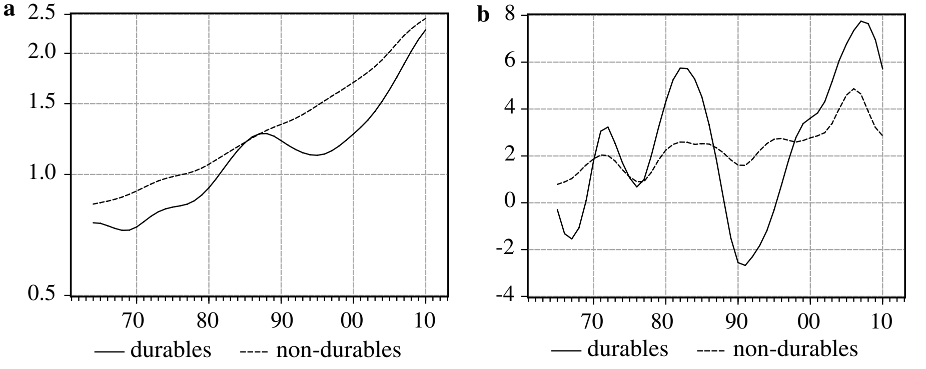

Fig. 12. Industrial sub-sectors: durables and non-durables (a) Band-pass filter trends (billion lire at 1911 prices) (b) Year-to-year trend growth rates (percent). Source: see text.

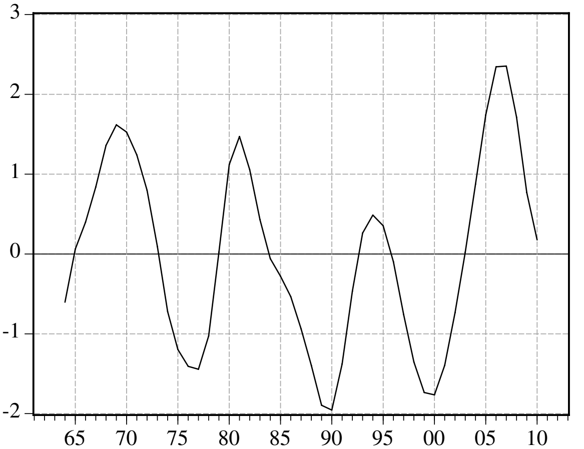

Fig. 13. Band-pass filter agricultural trend: percentage deviations from log-linear interpolator.

Agriculture does not dominate the longer-term fluctuations of GDP as it dominates its short-term fluctuations, but its trend too displays intriguing, unexpected features. Most obviously, the agricultural trend series display a sequence of medium-term oscillations, not unlike those of a number of other countries; in the original series these are altogether masked by the short cycle which has here been removed (Fig. 8).[21]

Fig. 9 suggests that the peaks or troughs of agriculture's trend growth rate cycle were some 12–15 years apart. But there is more: the hills appear at regular intervals, but change shape over time. Over the middle decades the hills are relatively peaky, in the 1860s and 1900s they are altogether fatter: the trend growth rate was above its long-term average in most years before 1870 and again after 1900, but only comparatively rarely between those dates. The relative deviations of the band-pass trend from its log-linear OLS inter-

[21] The band-pass filter trends calculated for the Federico (2004) sample of agricultural GSP series, not illustrated here for reasons of space, show similar oscillations in, for example, Austria, France (after 1880), Germany, and, in the wider world, Argentina.

polator (Fig. 13) tell the same story in another way: the local maxima and minima both decline from the 1860s into the early 1890s, and then both reach new highs. This long cycle was not strong enough to be obvious to the eye in the trend itself (let alone the underlying series), but it is particularly seductive: it closely follows the Kondratieff cycle in commodity prices, which is essentially a cycle in the relative price of agricultural goods (Lewis, 1978). In the early 1900s, agriculture too benefited from improved opportunities.

The first decade of the 20th century was, in Italy, a period of unprecedented prosperity. To revert to the language of a much earlier literature, the analysis of the new time series points to the happy conjunction of the Kuznets-cycle upswing in industry and the Kondratieff-cycle upswing in agriculture.

4. Conclusions

Italy's national historical accounts have recently been revised, and the new series are substantially different from the old.

The decomposition of these series' fluctuations suggests that the (high-frequency) "business cycle" was essentially agricultural. A clear four-to-five-year cycle is evident until about 1890; after that date the short-term variability of agricultural production, and of GDP, is sharply lower than before. This "passing of the business cycle" is only weakly confirmed by the available independent evidence, and, pending further research, must be considered suspect.

Over the longer term GDP and the services appear to reflect the long swing in industry, and specifically in the production of durables, induced by the Kuznets investment cycle. Agriculture displays a further clear cycle with a periodicity of about a dozen years. Moreover, agriculture's trend growth was generally below-average between ca. 1870 and the end of the century, and above-average in the 1860s and again after 1900; this suggests that production responded to the world-wide Kondratieff cycle in the sector's terms of trade.

Appendix A

In the notation of Harvey and Jaeger (1993), the structural model

$$y_t = \mu_t + \psi_t + \epsilon_t \quad (1)$$

linearly decomposes log GDP (y_t) into the sum of a trend (μ_t), a cycle (ψ_t) and an irregular component (ϵ_t); here, $t = 1861, 1862, \ldots, 1913$.

The trend component is defined in Model 1 by the general local linear trend model:

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \quad (2)$$

$$\beta_t = \beta_{t-1} + \zeta_t \quad (3)$$

where the trend-level μ_t equals the sum of its previous value, the rate of growth $\beta_{t\text{-}1}$, and a noise term η_t. The growth coefficient β_t is modeled as a random walk.

In Model 2 Eq. 3 is replaced by Eq. 3.a:

$$\beta_t = \beta_{t-1} + \gamma w_t + \zeta_t \quad (3.a)$$

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This modification adds the pulse variable w_t (with $w_t = 1$ in 1900 and $= 0$ elsewhere), interpreted as a transitory shock to β_t.

The stochastic model for the cycle is formulated as a linear combination of sines and cosines:

$$\begin{bmatrix} \psi_t \\ \psi_t^* \end{bmatrix} = \rho \begin{bmatrix} cos(\lambda_c) & sin(\lambda_c) \\ -sin(\lambda_c) & cos(\lambda_c) \end{bmatrix} \begin{bmatrix} \psi_{t-1} \\ \psi_{t-1}^* \end{bmatrix} + \begin{bmatrix} \kappa_t \\ \kappa_t^* \end{bmatrix} \quad (4)$$

where ρ is a damping factor ($0 \leqslant \rho \leqslant 1$) and λ_c is the frequency of the cycle expressed in radians ($0 \leqslant \lambda_c \leqslant \pi$).

The error terms $\epsilon_t \sim NID(0, \sigma_\epsilon^2)$, $\eta_t \sim NID(0, \sigma_\eta^2)$, $\zeta_t \sim NID(0, \sigma_\zeta^2)$, $\kappa_t \sim NID(0, \sigma_\kappa^2)$, and $\kappa_t^* \sim NID(0, \sigma_\kappa^2)$ are mutually independent.

The ML estimates obtained with STAMP 6.2 (Koopman et al., 2000) are:

	Model 1	Model 2
σ_ϵ	0.00000	0.00000
σ_η	0.00919	0.00936
σ_ζ	0.00240	0.00000
σ_κ	0.00680	0.00717
ρ	0.79504	0.78097
λ_c	1.37843	1.35752
$2\lambda_c/\rho$	4.55822	4.62844
σ_ψ	0.01122	0.01148
σ	0.01668	0.01507
R_D^2	0.16880	0.32116
lnL	206.719	204.053
$Q(11)$	4.22310	6.97700
(p-value)	(0.6465)	(0.3230)

where $2\lambda_c/\rho$ is the period evaluated in years; $\sigma_\psi^2 = \sigma_\kappa^2/(1 - \rho^2)$ is the variance of the cycle; σ is the standard deviation of the one-step-ahead prediction errors (Kalman filter innovations); R_D^2 is the coefficient of determination with respect to the first differences of log GDP; and lnL is the log likelihood function evaluated at the parameter estimates. $Q(11)$ is the Box-Ljung statistic, based on the first 11 residual autocorrelations; the corresponding p-values are from a χ^2 with 6 degrees of freedom.

In Model 2 the estimated value of γ is 0.012. The corresponding test statistic, normally distributed in large samples, equals 3.83; its associated p-value (0.0001) rejects the null hypothesis $\gamma = 0$.

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