Is Business confidence still a good indicator for industrial production? Evidence from the EC survey

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Abstract

Business surveys are not revised, not in need to be filtered and released well in advance with respect to quantitative data. However, in order to be considered as reliable indicators in business cycle analysis, they should be significantly related to the underlying quantitative variable they are meant to approximate. The aim of this paper is to analyze the evolution of this relationship over time, using confidence indicators calculated by the European Commission. We consider a large number of EC countries and include the most recent period following the sovereign debt crisis, for which emerging evidence suggests a possible de-coupling among the cyclical behavior of quantitative and qualitative data. After a description of the effects of the great recession on industrial activity in Europe, we first check for the coherence of the two series at turning points; secondly, we analyze possible changes in cross-correlation coefficients over time; finally, we look at the ability of survey data to cause industrial production in the sense of Granger and check whether the causal link has changed over time. We find that the relationship remains strong, even if weaker during recessions. This may be linked to statistical problems in sampling selection, or to changes in the way agents form expectations: during recessions, perceptions on "normal" levels of output are lower and hence opinion variables may show a favorable trend even if the reference variable does not show remarkable changes.

Keywords: Business cycles; Business surveys; structural breaks; causality.
JEL classification: C12; E23; E32.

[1] The views expressed in the paper are those of the author and do not involve the responsibility of ANVUR.

1. Introduction

Business surveys data are well-established tools for the analysis of the business cycle. Their success depends upon some desirable properties they usually show: timeliness, no revision and good correlation with underlying, quantitative variables. Another important characteristic is that survey data provide unique information about agents' opinions and expectations on relevant economic outcomes and about economic phenomena for which there is no or insufficient quantitative data, such as constraints in production, the level of capacity utilization and inventories behavior. For those reasons, business survey data are often used, alone or in combination with "hard" indicators, to anticipate and forecasts important macroeconomic variables such as industrial production (IP) and GDP[2], and to study possible determinants of business cycle performance (Cesaroni et al, 2011). However, in recent years evidence has emerged of a possible decoupling among "soft" and "hard" data, both at the aggregate European and country level (see Biau and D'Elia, 2011; Aprigliano, 2011, Conti and Rondinelli, 2015). A simple graphical inspection of the relationship between the two series (see Figure 1[3]) confirms an emerging divergence, particularly evident in the most recent years after the sovereign debt crisis. Following this strand of literature, the aim of our paper is to analyze in detail the relationship among business confidence and industrial production; with respect to previous contributions, we broaden the analysis considering a large dataset comprising 16 EU countries and concentrate our attention on the most recent period.

In the following, the analysis will proceed in three steps: after having introduced the dataset and provided a brief description of the effects of the crisis on industrial production in section 2, section 3 will look at coherence of the two series at turning points; hence, in section 4 we will check if and how the correlation among soft and hard data has changed over the years; finally, in section 5 we will control for the capability of business surveys to cause IP in the sense of Granger, evaluating the evolution of this relationship over time.

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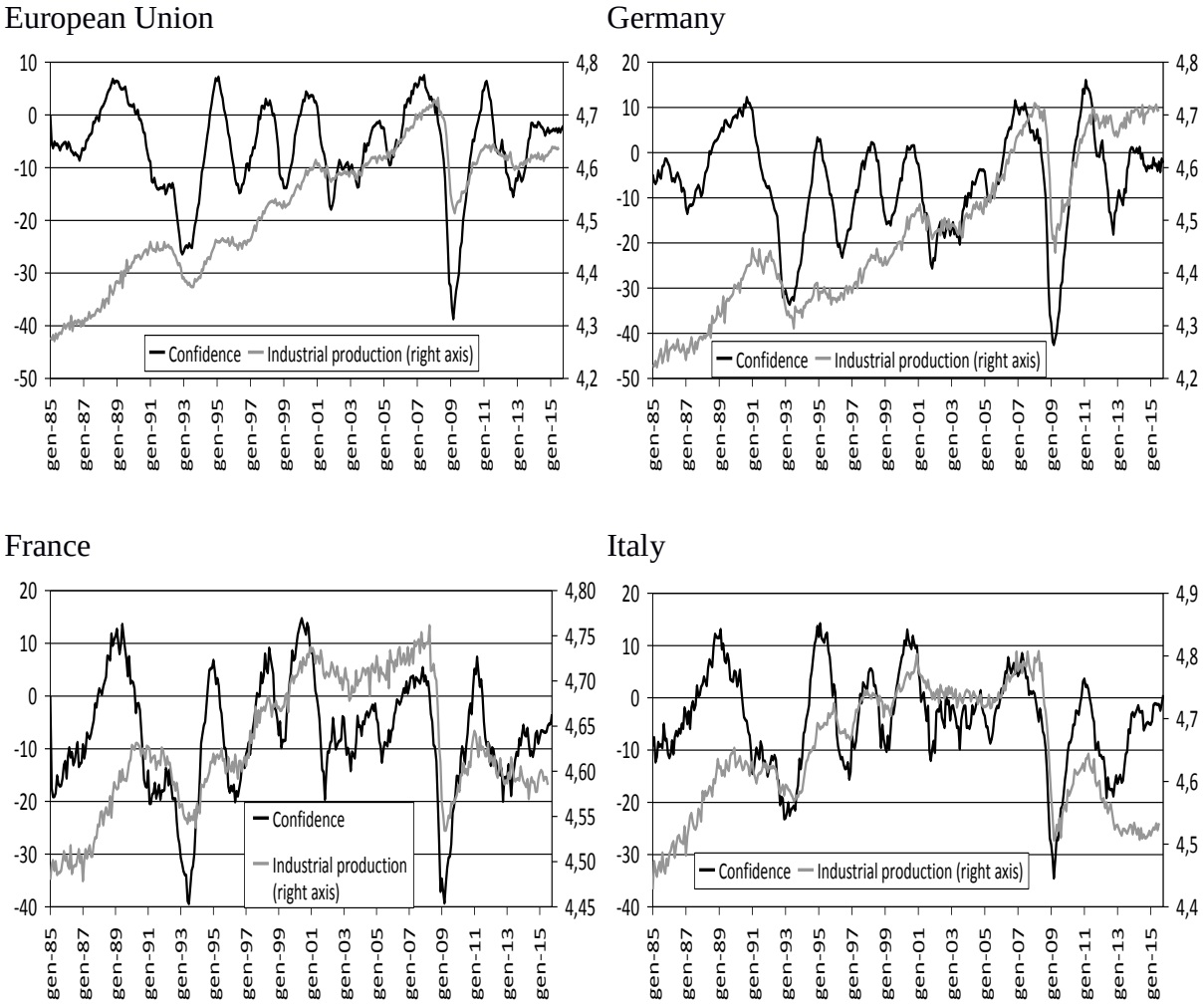
[2] Bruno and Lupi, 2004 and Leduc and Sill, 2013, among other, use (mostly) only business survey data in order to predict the evolution of industrial production; Cesaroni, 2010 shows that the short-run GDP forecasts improve with respect to the benchmark model when the business climate index is included; on the other hand, in Altissimo et al. (2010) survey data are used in combination with other more traditional information based on quantitative data in order to derive a leading indicator of industrial activity in the Euro Area.

[3] The graphical analysis concerning the remaining European countries is available with the authors upon request.

Figure 1 – Business confidence and Industrial production in Europe



Source: OECD and European Commission.

According to our analysis, differences in cyclical behavior among soft and hard indicators usually emerge in times of economic crisis: possible explanations include statistical problems in sampling selection during the crisis, or changes in the way agents form their expectations about the future (Malgarini, 2011). Indeed, according to the latter hypothesis, recessions may contribute to temporary alter agents' perception of the "normal" levels on which they base their answers to business surveys. If long term perceptions of "normal" levels are lower than in the past, it is well possible for opinion variables to show a favorable trend even if the underlying quantitative variable does not show remarkable changes, which is exactly what happened in Europe in the aftermath of the Great Recession.

2. The dataset

2.1 Industrial production

The activity variable considered in the analysis is the level of industrial production. The data are referred to 16 EU member states, 12 of which are also part of the Euro Area, and to the EU and EA aggregates[4]. They are monthly and are extracted from the OECD online database (http://stats.oecd.org/), being generally referred to the period January 1985-July 2015[5]. In order to study the main business cycle characteristics of the series, we calculate their cyclical chronology on the basis of the original Bry-Boschan procedure. We consider the "classical" definition of the cycle, i.e. without pre-filtering the series in order to extract their cyclical components (Harding and Pagan, 2002). Table 1 presents various statistics, including the average duration of complete cycles, the periods of expansions and contractions, their amplitude and steepness (i.e. the amplitude divided by the duration). For EA and EU aggregates, it is possible to identify four complete cycles of the industrial production index, with an average duration of 58 months; expansions are on average much longer (47 and 45 months respectively in EA and EU) than recessions (13/14 months EA/EU). The average production loss in an average recession is higher in the Euro area (-9,2%) than in the EU as a whole (-8,2%); however, also expansionary phases are stronger in the EA (+14,6%) than in the EU (+13,7). Recessions are usually steeper than expansions; steepness of both is similar in EU and EA. Remarkable differences emerge at the country level: number of cycles is often larger than for the aggregates (only exceptions being Estonia, Slovak Republic and Hungary) and hence duration is shorter. Also at the country level expansions are usually larger than recessions: Italy and Greece are the only exceptions, while in Portugal downturns and upturns of industrial activity show the same amplitude.

[4] EA countries considered in the analysis are: Austria; Belgium; Estonia; France; Germany; Greece; Italy; Netherlands; Portugal; Slovak Republic; Spain. The other EU countries are Czech Republic, Hungary, Poland and the UK.

[5] Exceptions are Czech Republic, Estonia and Slovak Republic for which data are available, respectively, only from January 1990, January 1998 and January 1989.

Table 1 – Business cycle characteristics in the European Union, 1985-2015

	#cycles	Average duration	Average duration recessions	Average duration expansions	Average amplitude of recessions	Average amplitude expansions	Steepness (recession)	Steepness (expansion)	Triangle aproximation (recession)	Triangle aproximation (expantion)	Excess (recession)	Excess (expantion)
Austria	4	83,5	11,6	70,8	-7,8	31	-0,7	0,4	-45,1	1097	-0,6	0,4
Belgium	7	48,1	15,3	32,7	-7,4	16,9	-0,5	0,5	-56,8	275,8	-0,5	0,5
Czech Republic	5	50,4	12,3	38	-21,1	25,4	-1,7	0,7	-129,8	482,3	-1,6	0,7
Denmark	5	59,4	16,8	43	-14,6	20,8	-0,9	0,5	-123,2	447,3	-0,8	0,5
Estonia	1	85	22	81	-39,4	69,3	-1,8	0,9	-433,1	2805,3	-1,7	0,8
France	5	49,6	22,8	30,2	-8,3	8,7	-0,4	0,3	-94,9	132,1	-0,3	0,3
Germany	5	46,6	13,7	33,8	-10,4	16,8	-0,8	0,5	-70,8	283,7	-0,7	0,5
Greece	5	69,2	34,4	34,8	-14,9	13,3	-0,4	0,4	-256,7	231,4	-0,4	0,4
Hungary	3	96,3	23	69,7	-25,6	52,9	-1,1	0,8	-293,9	1841,9	-1,1	0,7
Italy	6	42,7	23	22	-10,4	9,8	-0,5	0,4	-120,2	107,4	-0,4	0,4
Netherlands	6	42,5	12,5	35,7	-8,3	13,8	-0,7	0,4	-51,9	246,6	-0,6	0,4
Poland	4	68,8	16,6	51	-20,7	43,3	-1,2	0,8	-172,2	1104,1	-1,2	0,8
Portugal	4	62	24,8	36	-12,7	12,8	-0,5	0,4	-156,9	231,2	-0,5	0,3
Slovak Republic	3	74,3	17,5	54,3	-30,7	36,9	-1,8	0,7	-268,3	1003,3	-1,7	0,7
Spain	5	51,2	16,5	36,2	-11,9	12,9	-0,7	0,4	-98,5	234	-0,7	0,3
United Kingdom	5	49,4	19	30,8	-6,5	6,4	-0,3	0,2	-62	98,3	-0,3	0,2
Euro area	4	58,3	12,6	46,5	-9,2	14,6	-0,7	0,3	-58,2	338,8	-0,7	0,3
European Union	4	57,8	14,2	45,3	-8,2	13,7	-0,6	0,3	-58,2	309,7	-0,5	0,3

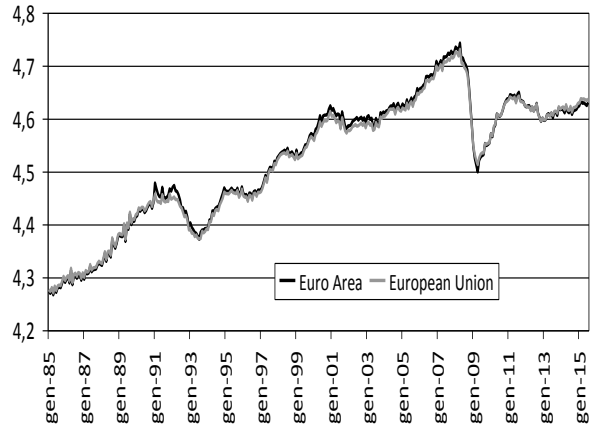
Source: authors' elaboration on OECD data.

However, in all the countries considered recessions are at least as steep as expansions, and usually steeper. The table also reports the excess of cumulate movement (E) indicator, assessing the deviation of the economy from a constant expansion/contraction: a value of E close to zero indicates linearity of the fluctuation; during an expansion, a negative sign implies a progressive intensification of gains (concave expansions) and a positive sign instead a slowing down of output gains. On the other hand, during a recession a positive sign indicates that output losses are particularly intense at the beginning of the fluctuation; conversely, if the indicator has a negative sign losses are particularly intense towards the end of the fluctuation. At the European aggregate level, the indicator shows that both expansions and recessions gain momentum over time: in other words, both expansions and recessions are stronger towards the end of the phase, non-linearity being stronger for eastern European countries and during recessions. Overall, looking at the most recent period, in the European Union and the Euro Area industrial production fell sharply since the first month of 2008, reaching a throw in April

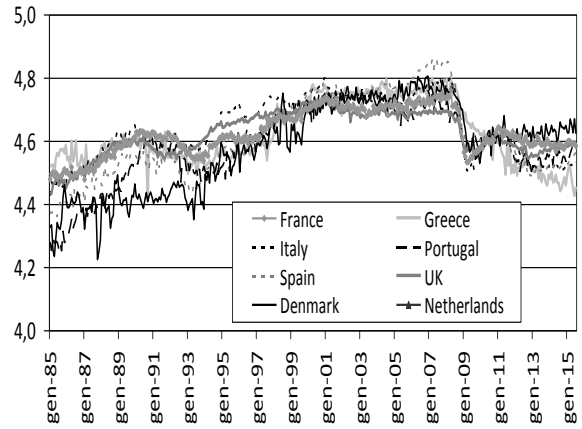
2009; the following recovery was not enough to re-gain the pre-crisis production levels, being interrupted by a new contraction occurring since the beginning of 2011, as a consequence of the Sovereign debt crisis. After that, production roughly stabilized on levels that are now still 9,4% below those reached at the time of the last peak, in April 2008 (-11,3 for the Euro Area, see Figure 2, Panel A). Similar cycles emerge also at the national level, where, however, it is possible to distinguish among three groups of countries: the first group (Figure 2, panel B) includes a vast majority of European countries and is characterized by industrial levels that are now still well below the 2008 peak: particularly remarkable production loss occur not only in the peripheral Mediterranean countries primarily hit by the 2011 sovereign debt crisis (Greece, -34,3%; Spain, -28,8%; Portugal, -16%; Italy, -27,4%), but also in France (-17,6%), Denmark (-18,2%), the Netherlands (-18,6%) and the UK (-10,7%).

Figure 2 – Industrial production in the European Union, 1985-2015

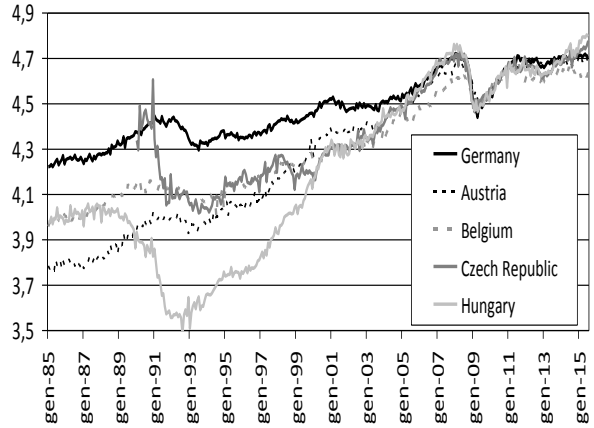
Euro Area and European Union



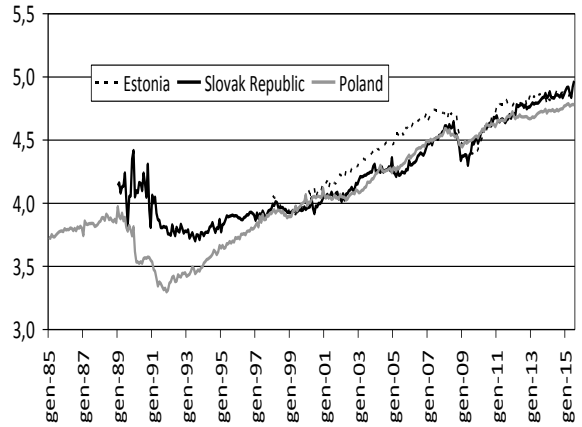
Countries with lower post-crisis IP levels



Countries with similar post-crisis IP levels



Countries with higher post-crisis IP levels



Source: authors' elaborations on OECD data.

In a second group, comprising Germany and four other EA (Austria and Belgium) and non EA countries (Czech Republic and Hungary), industrial production has recently returned to levels similar, slightly higher or slightly lower, to those of the previous phase. Finally, a small group of Eastern European countries stands out (Estonia, Slovak Republic and Poland) as being characterized by level of industrial production much higher now than it was before the crisis.

2.2 Business confidence

Thanks to its high frequency and generally recognized reliability, industrial production is one of the main business cycle indicators available in Europe. In fact, even if the industrial sector is a shrinking part of overall activity, agriculture and services are often found not to show a well-defined cyclical pattern, and hence GDP and industrial production growth rates are usually highly correlated (A'Hearn and Woitek, 2001). However, in Europe information about industrial production is currently available only with approximately a 40-days delay with respect to the end of the reference month; therefore, having complementary reliable information capable of correctly tracking business cycle evolution in real time is considered of the utmost importance by economic analysts and policy makers. A possibility to derive this kind of information is to use monthly Business survey data published, within the end of the reference month, by the European Commission within the Harmonized framework of business and consumers' surveys (EU, 2014). In the following we will use data referred to the same 16 EU member states analyzed in section 2.1, referred to the period January 1985-July 2015[6].

Respondents to these kind of surveys are not asked for precise (quantitative) information on (for example) levels of output, sales, investment, employment; rather, they are asked to provide information of a qualitative type, i.e. about whether a variable (say, industrial production or sales), is growing/stable/decreasing with respect to the recent past, or in a short term perspective (see UN, 2014). For instance, a question on the current level of production does not ask to provide the quantitative amount of production in a given month, but rather to report whether production has "gone up", "stayed the same", or "gone down" in a given month with respect to the previous one, or with respect to a "normal" or "desired" level, or if it is expected to go up/down/stay the same in the foreseeable future (usually, the expectations' horizon is three months); hence, by construction, this kind of indicator does not contain any trend component (i.e. it is purely related to the cyclical component of output). Of course, this

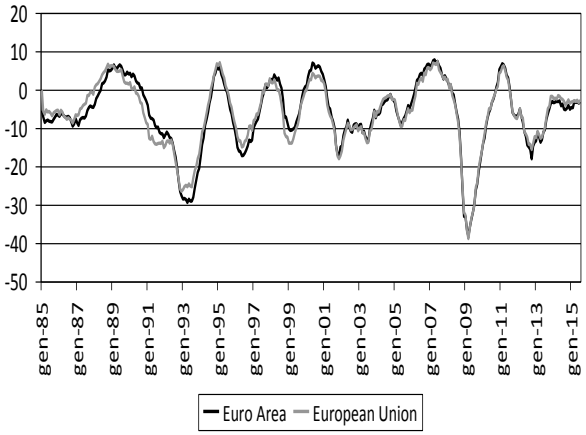
[6] Exceptions are Czech Republic, Estonia and Slovak Republic for which data are available, respectively, only from January 1990, January 1998 and January 1989.

kind of information is less precise with respect to the standard quantitative one, but has the distinct advantage of being more timely and able to provide data about variables which are not directly observed in standard quantitative statistics, including agents' expectations. Firm-level information is usually aggregated to provide data at the industry level, using weighted averages of individual replies, i.e. by calculating the percentage of replies for each possible option. As a standard quantification method, for each question the balance is calculated as the difference between positive and negative shares of replies. Questions included in the harmonized European questionnaire include those on the current and expected level of orders and production and the level of finished goods inventories. Every month, the European Commission also publishes a Business Confidence Indicator, which is obtained as the simple average of the three balances concerning the current level of orders and inventories and production expectations.

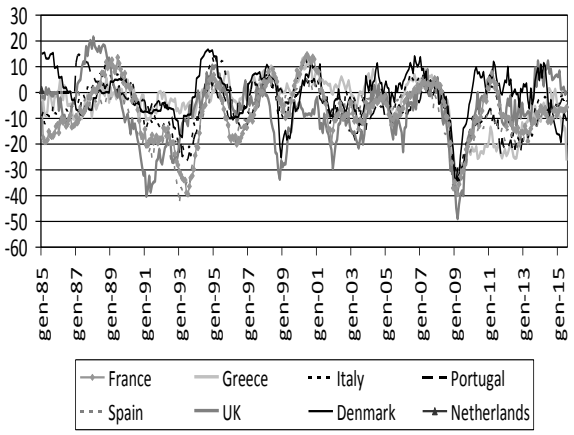
Figure 3 reports seasonally adjusted Business Confidence indicators for the same countries and aggregates analyzed in the previous section; on average, in the European Union and the Euro Area, after a peak in mid-2007 (leading with respect to hard data), Confidence fell sharply until reaching a throw in the first quarter of 2009; after that, European firms appeared to be rather confident in a recovery of industrial activity, with the indicator touching back on the pre-crisis levels in mid-2011, when industrial production was still well below the previous peak. The indicator then roughly stabilized, similarly to what has been observed for industrial production. Remarkable differences emerge looking at individual countries, again divided in 3 groups distinguishing, as in Figure 2, among those with much lower, similar and higher level of production now with respect to those of the last peak before the Great crisis. Most interestingly, the graphical analysis shows that for some of the countries that have lost as much as, or even over, ¼ of their production, during the 2009-2011 period Confidence was indeed back on levels similar to those observed before the crisis, and also in the most recent period it stabilized well above the 2009 trough. Similar results are observed also for countries having recently returned close to pre-2008 levels (Panel C), while in Eastern European countries where production is now higher than in 2008, Confidence has not recovered its pre-crisis levels (Panel D).

Figure 3 – Business Confidence Indicators

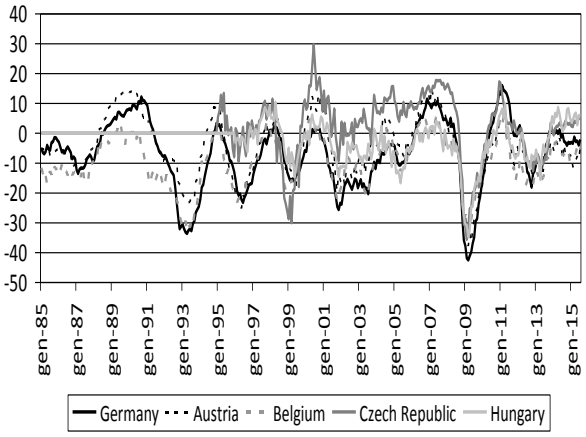
Euro Area and European Union



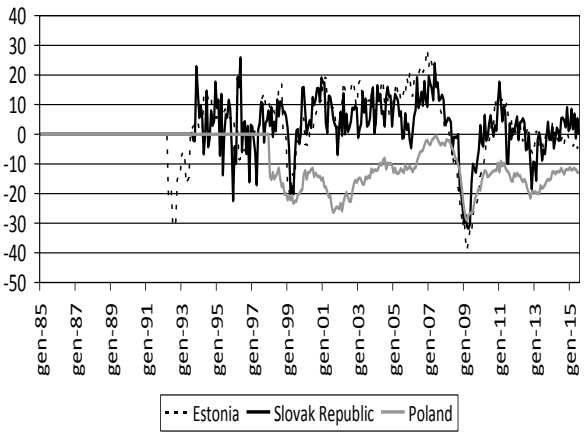
Countries with lower post-crisis IP levels



Countries with same post-crisis IP levels



Countries with higher post-crisis IP levels



Source: authors' elaborations on OECD data.

To sum up, the graphical evidence concerning the cyclical evolution of industrial production and business Confidence shows that the latter has recovered much faster than the former during the 2009-11 recovery and is generally now closer to its pre-crisis levels than the series it is supposed to serve as an indicator, i.e., industrial production. In other words, there is first evidence that the relationship among Confidence and Industrial production is not close now as it was in the past. In the next section, we look further into this issue, studying the coherence of the series at turning points, their cross-correlation functions and checking whether Confidence can be intended to cause, in the sense of Granger, industrial production, and if this relationship has changed over time.

3. Industrial production and the Business climate indicator: turning points analysis

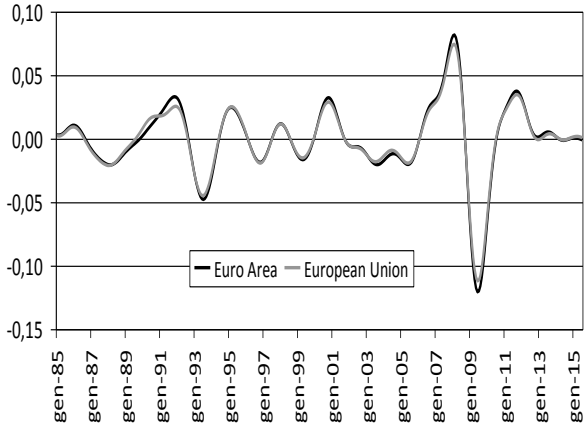
3.1 Extracting the cyclical component of industrial production

As stated in session 2.2, business survey data show the desirable properties of being released almost in real time and with a monthly frequency. However, in order to be of use for economic analysis, they should be reliable, in the sense of providing significant information about the behavior of the industrial business cycle, as measured by the industrial production index analyzed in section 2.1. In order to properly study the relationship among survey data and industrial production, one has first to extract the cyclical component of the latter. In fact, as described in section 2, while the Business Confidence indicator exhibits, by construction, a cyclical profile so no trend component is contained, industrial production is usually considered as a non-stationary variable, and hence a cyclical component should be extracted in order to study its relationship with Confidence. In the following, we choose to obtain the cyclical component of the industrial production index using the Christiano-Fitzgerald Band-Pass filter (CF). Band-pass filters are designed to extract the cyclical component from a series by specifying a range of cycle duration; with respect to other Band pass filters, CF is asymmetric, showing the distinct advantage of including also the final period of the sample, which is obviously the more interesting one from a user' point of view. Furthermore, the CF filter in our case maximizes its correlation with the production series with respect to other filters[7]. More specifically, we use the full-length asymmetric filter under the assumption that industrial production is non–stationary; the cycle period is defined in the range between 18 and 36 months. Figure 4 shows the results obtained for the same groups of countries reported in fig. 2 and 3.

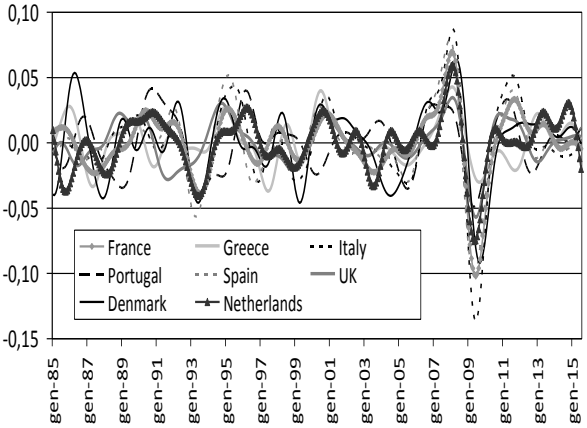
[7] Results obtained by using Hodrick-Prescott and Baxter – King filters are available with the authors upon request.

Figure 4 - Cyclical component of industrial production extracted with the CF filter

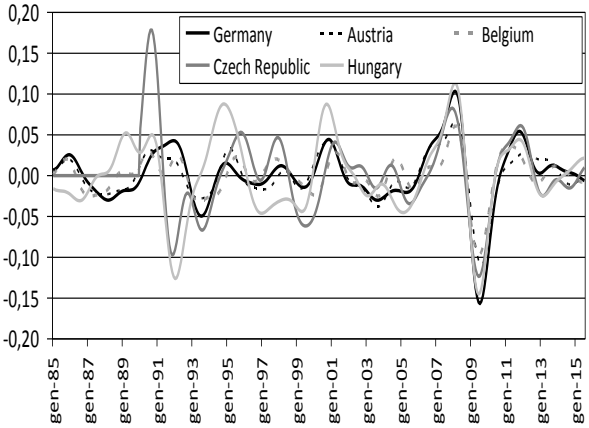
Euro Area and European Union



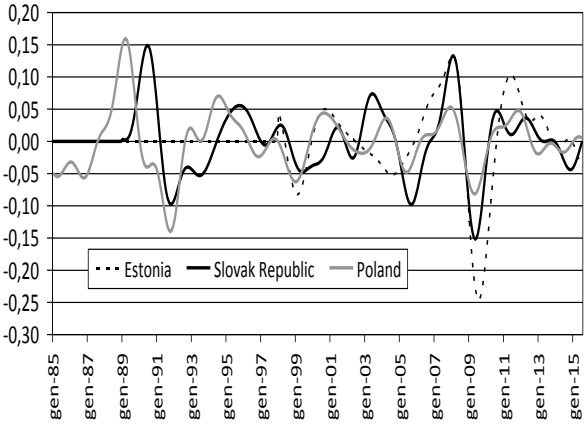
Countries with lower post crisis IP levels



Countries with same post-crisis IP levels



Countries with higher post-crisis IP levels



Source: authors' elaborations on OECD data.

3.2 Turning points analysis

As a next step, we adopt again the Bry-Boschan approach and compare the chronology obtained for the cyclical component of industrial production with the one calculated for the corresponding business confidence indicator (Table 2). Ideally, if confidence is to be considered as a good indicator for industrial production, we should expect to find that the turning points of the two series are roughly coincident, or even that the turning points of business confidence tend to anticipate those of industrial production. Moreover, it would be desirable for business confidence to be able to match all the corresponding turning points of the reference series, without missing relevant turning points in the series or showing extra-cycles.

Table 2 – Turning points analysis

	EU			EA			Austria			Belgio			Czech Rep			Denmark			Estonia			France			Germany		
	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+
P	1985m12			1986m1			1985m11			1985m10	1985m9	-1				1986m4		no data				1985m7			1985m12	1985m10	-2
T	1988m1	1986m10	-15	1988m2	1986m10	-16	1987m12	1987m4	-8	1987m2	1987m4	2				1987m12	1987m6	-6				1987m6			1988m3	1987m2	-13
P																1989m1	1989m7	6				1990m5	1989m2	-15			
T																1989m11		missing				1991m4	1991m3	-1			
P										1990m7	1989m6	-11	1990m9		no data	1990m8		missing									
T										1991m5		missing	1991m11		no data	1991m5	1991m6	1									
P	1991m12	1988m10	-38	1991m11	1989m6	-29	1990m8	1990m3	-5	1992m3		missing	1992m10		no data	1992m3	1992m3	0				1991m12	1992m2	2	1991m12	1990m9	-15
T	1993m7	1992m12	-7	1993m7	1993m4	-3	1993m6	1993m5	-1	1993m5	1993m4	-1	1993m8		no data	1993m6	1993m3	-3				1993m7	1993m7	0	1993m7	1993m4	-3
P	1995m3	1995m2	-1	1995m2	1995m2	0	1995m3	1995m1	-2	1995m7	1995m1	-6	1995m10		no data	1994m12	1994m9	-3		1994m6	no data	1995m2	1995m1	-1	1994m12	1994m12	0
T	1996m11	1996m5	-6	1996m11	1996m5	-6	1997m3	1996m5	-10	1996m8	1996m2	-6	1996m12	1996m3	-9	1997m4	1996m3	-13		1996m4	no data	1996m11	1996m5	-6	1996m10	1996m6	-4
P	1998m1	1997m12	-1	1998m1	1998m3	2	1998m4	1998m4	0	1997m10	1997m11	1	1997m12	1997m9	-3	1998m4	1998m12	8		1998m9	no data	1998m1	1998m6	5	1998m2	1998m3	1
T	1999m4	1999m3	-1	1999m4	1999m2	-2	1999m3	1999m6	3		1998m12	extra	1999m7	1999m3	-4	1999m4	1998m12	-4	1999m2	1999m3	1	1999m3	1999m3	0	1999m6	1999m5	-1
P	2000m10	2000m5	-5	2000m10	2000m5	-5	2000m10	2000m11	1		2000m6	extra	2001m3	2000m6	-9	2000m6	2000m9	3	2000m9	2001m3	6	2000m11	2000m6	-5	2000m11	2000m10	-1
T		2001m11	extra		2001m11	extra	2003m9	2001m10	-23	2000m1	2001m10	9	2003m7	2001m11	-20	2004m7	2003m7	-12		2001m12	extra		2001m11	extra		2001m11	extra
P		2002m5	extra		2002m11	extra	2004m10	2004m5	-5	2001m4	2002m5	13	2004m6		missing		2004m7	extra		2002m9	extra		2002m12	extra		2002m10	extra
T	2003m7	2003m6	-1	2003m8	2003m7	-1	2005m6	2005m8	2	2003m9	2003m6	-3	2005m7		missing		2005m4	extra	2004m7	2004m11	4	2003m7	2003m6	-1	2003m8	2003m7	-1
P	2004m6	2004m10	4	2004m7		missing				2004m9	2004m7	-2				2006m9	2006m9	0				2004m10		missing			
T	2005m6	2005m5	-1	2005m6		missing				2005m9	2005m7	-2				2007m5		missing				2005m6		missing			
P																											
T																											
P	2008m2	2007m6	-8	2008m2	2007m4	-10	2008m2	2007m2	-12	2008m2	2006m7	-19	2007m12	2007m8	-4	2008m5		missing	2008m1	2006m12	-13	2008m2	2007m11	-3	2008m2	2006m11	-3
T	2009m6	2009m3	-3	2009m6	2009m3	-3	2009m8	2009m3	-5	2009m6	2009m3	-3	2009m6	2009m2	-4	2009m9	2009m2	-7	2009m7	2009m3	-4	2009m6	2009m3	-3	2009m7	2009m3	-4
P	2011m9	2011m3	-6	2011m9	2011m2	-7	2012m2	2011m4	-10	2011m3	2011m1	-2	2011m11	2010m12	-11	2012m3	2011m4	-11	2011m6	2010m12	-6	2011m9	2011m3	-6	2011m10	2011m2	-8
T	2012m12	2012m10	-2	2012m12	2012m10	-2				2012m10	2012m6	-4	2013m2	2012m11	-3	2014m3	2013m5	-10	2014m2	2012m12	-14	2012m9	2012m10	1	2012m12	2012m10	-2
P	2013m8	2014m4	6	2013m7		missing				2013m11	2014m2	3	2013m12		missing	2014m12	2014m3	-9	2014m10	2014m1	-9	2013m5	2014m1	8	2013m9	2013m11	2
T	2014m6		missing	2014m6		missing	2014m10	2012m11	-23		2014m12	extra	2014m9		missing		2015m3					2014m5		missing		2014m10	extra
P				2015m2	2014m5	-9		2014m5	extra					2015m6								2015m1		missing			
T								2015m2	extra																		
# cycles p-t-p	8	9		10	8		7	7		9	9		8	6		10	8		3	4		9	8		7	8	
Mean lead/Lag			-5,3			-6,5			-6,5			-1,9			-7,4			-3,8			-4,4			-1,7			-3,6

	Greece			Hungary			Italy			Netherlands			Poland			Portugal			Slovak rep			Spain			UK		
	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+	IP	ICI	-/+
P	1985m12	1986m2	2				1985m8						1986m1		no data							1985m11		no data			
T	1987m5	1986m11	-6	1986m7		no data	1987m7	1986m1	-18	1985m10	1987m5	19	1986m10		no data	1985m8						1986m10		no data	1986m6	1986m6	0
P	1989m9	1988m10	-11	1989m3		no data	1989m12	1989m2	-10	1986m12		missing	1989m3		no data	1986m10						1987m7		no data	1988m11	1988m1	0
T	1990m11	1991m2	3	1990m1		no data	1991m2		missing	1988m2		missing	1991m10		no data	1989m1	1991m2	25				1988m5		no data	1989m8		missing
P				1990m9		no data																1989m7	1989m5	-2			
T				1992m1		no data																1991m1	1991m6	5			
P	1991m11	1991m12	1				1991m12		missing	1990m10	1989m5	-19	1994m7		no data	1990m10	1991m10	12	1990m6		no data	1992m1	1992m4	3	1990m3		missing
T	1993m10	1993m1	-9				1993m7	1992m12	-7	1993m6	1993m5	-1	1996m11		no data	1993m7	1993m6	-1	1993m6		no data	1993m4	1993m1	-3	1991m9	1991m2	-7
P	1994m12	1995m11	11	1994m11		no data	1995m6	1995m2	-4	1996m3	1995m3	-12				1996m3	1994m10	-17	1995m10	1995m12	2	1995m3	1995m2	-1	1994m10	1994m12	2
T	1997m6	1996m6	-12	1997m1		no data	1996m11	1996m11	0	1997m6	1996m4	-14				1997m4	1996m3	-13	1997m4	1998m6	-10	1996m8	1996m4	-4		1996m5	extra
P	1998m7	1998m5	-2	1998m6	1997m12	-6	1997m11	1998m3	4	1998m1	1997m12	-1	1997m10		no data	1998m2	1998m3	1	1998m2	1999m5	15	1998m3	1997m11	-4		1997m10	extra
T	1999m5	1999m7	2	1999m4	1999m5	1	1999m2	1999m2	0	1998m12	1999m8	-4	1999m1	1999m5	4	2000m4	1999m5	-11	1999m5	2000m12	19	1999m3	1999m7	4	1998m11	1998m11	0
P	2000m7	2000m3	-4	2000m9	2000m5	-4	2000m10	2000m5	-5	2000m8	2000m7	-1	2000m8	2000m6	-2	2001m11	2000m8	-15	2001m6	2001m11	5	2000m6	2000m6	0	2000m9	1999m9	-12
T		2001m12	extra		2001m11	extra		2001m10	extra	2001m10		missing	2002m11	2001m8	-15	2002m10	2003m4	6	2002m4		missing	2002m5	2001m11	-6		2001m12	extra
P		2002m6	extra		2002m5	extra		2002m9	extra	2002m7		missing	2004m3	2004m7	4	2003m11	2004m8	9	2003m6		missing	2003m3	2004m10	19		2002m8	extra
T	2003m3	2003m4	0	2003m2	2003m3	1		2003m7	extra	2003m7	2003m6	-1	2005m6	2005m4	-2	2005m7	2005m7	0	2005m9	2004m9	-12	2005m7	2005m5	-2	2003m3	2003m6	3
P	2004m2	2004m4	2	2003m11	2004m4	5		2004m10	extra	2004m7	2004m7	0													2004m4	2004m8	4
T	2005m6	2005m6	0	2005m2	2005m5	3	2005m7	2005m5	-2	2005m5	2005m6	1													2005m6	2006m1	7
P										2006m3	2006m10	7															
T										2006m12		missing															
P	2008m2	2007m4	-10	2008m2	2007m5	-9	2008m2	2007m4	-10	2008m2		missing	2007m12	2007m6	-6	2007m1	2007m5	4	2008m2	2006m1	-25	2007m12	2007m3	-9	2008m2	2007m6	-8
T	2009m8	2009m3	-5	2009m6	2009m3	-3	2009m6	2009m3	-3	2009m5	2009m2	-3	2009m5	2009m3	-2	2009m5	2009m4	-1	2009m5	2007m5	-24	2009m5	2009m3	-2	2009m6	2009m3	-3
P	2010m10	2011m2	4	2011m10	2011m4	-6	2011m8	2011m1	-7	2010m8	2011m4	8	2011m11	2011m2	-9	2011m4	2011m2	-2	2010m8	2009m4	-8	2011m8	2011m2	-6	2010m11	2011m3	4
T	2011m9	2012m7	10	2013m2	2012m9	-5	2014m7	2012m5	-22	2012m4	2013m1	9	2013m1	2012m10	-3	2012m9	2012m11	2	2011m6	2011m1	-5	2012m11	2012m8	-3	2013m1	2011m12	-13
P	2013m1		missing		2014m4	extra				2013m5		missing	2013m9		missing	2014m1		missing	2012m4	2012m11	7	2013m11				2014m6	extra
T	2014m1		missing							2014m1			2014m6		missing	2014m11		missing	2014m11	2014m11	0	2014m8					
P	2014m12	2014m7	-5							2014m10																	
T																											
# cycles p-t-p	10	10		4	6		7	7		11	6		8	4		8	6		7			10	7		6	8	
Mean lead/Lag			-1.5			-2.3			-6.5			-0.8			-3.4			-0.1			-3.0			-0.7			-1.8

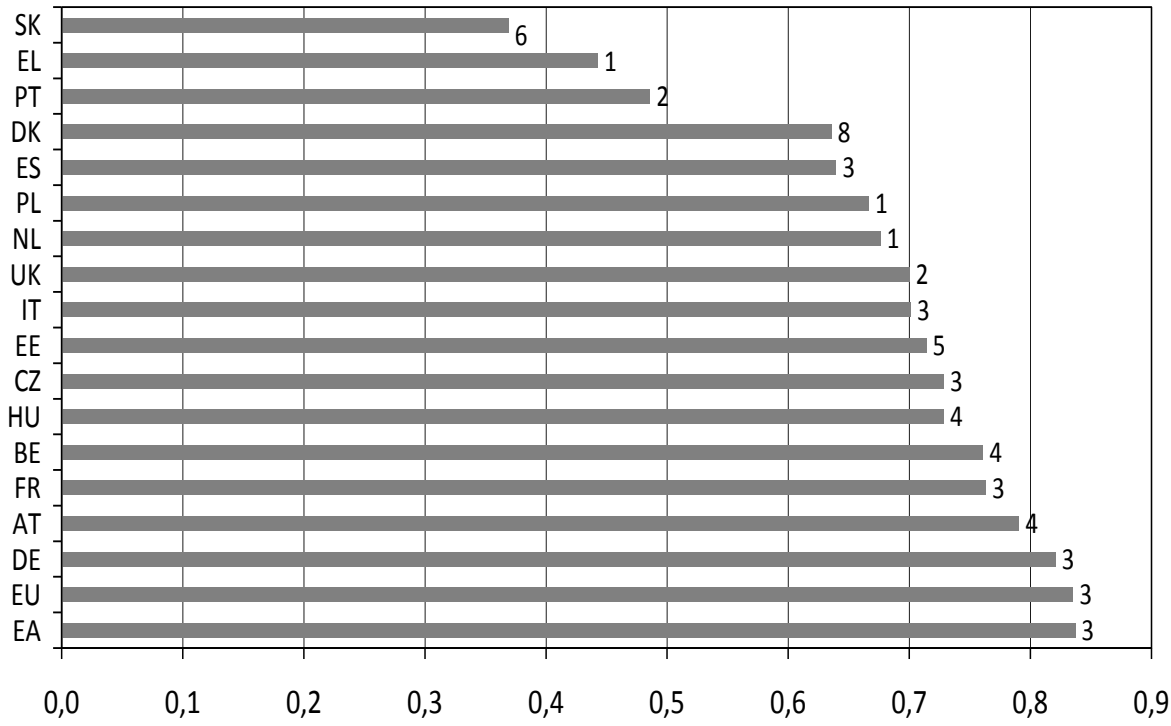
Important results do emerge from the analysis: first of all, at the aggregate level, confidence results to be a leading indicator for industrial production, the lead being equal on average to 5 and 6 months respectively for the Euro Area and the European Union as a whole; similar results emerge at the country level. Confidence is also able to correctly gauge most of the turning points of the corresponding industrial production series: however, in some cases it fails to correctly identify a turning point in industrial production, or it is found to provide a "false signal", in the sense that confidence may show a peak or a trough when there is none in the corresponding production series. Overall, confidence is however a very good cyclical indicator of production turning points and this is generally confirmed also in the last part of the sample.

4. Industrial production and the Business climate indicator: correlation analysis

A further assessment on the relationship among industrial production and business survey data comes from the study of their cross-correlation functions, calculated considering again the cyclical component of the production series introduced in section 3.1. In this respect, Figure 5 presents the maximum correlation coefficient achieved between industrial production and the EC Confidence Indicator, reporting also the number of lags (in months) for which we register a peak in the cross correlation function. Business survey data in most cases are to be considered as good leading indicators of industrial production: cross correlation coefficients range between a maximum of 0,84 for the Euro Area and European Union aggregates to a minimum of 0,37 for the Slovak Republic. At the European level, business survey data lead industrial production by an average of three months; at the country level, the lead ranges between one months (for six of the countries considered) to 8 months (for Denmark). The mode of the distribution of leads is equal to three months.

Correlation coefficients presented in figure 5 are calculated as averages across the period under consideration, and they provide solid evidence about the existence of a strong relationship among industrial production and survey data. However, in this paper we are particularly interested in studying how correlation has evolved over time, especially after the financial crisis of the years 2007-2008 and the subsequent sovereign debt crisis. A first possibility to achieve this goal is to calculate the rolling correlation coefficients among soft and hard data; more specifically, we choose a window of 3 years and calculate the correlation among the two variables in each country, gradually shifting month by month the window across which we proceed to the calculation.

Figure 5 – Cross correlation among soft and hard data (number of months of lead in parenthesis)



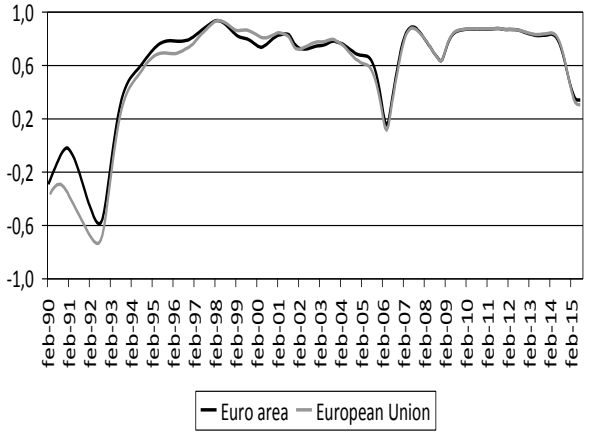
Source: authors' elaboration on EC data.

Figure 6 presents the results obtained; as before, we separately show the results for the Euro Area and European Union aggregates and for groups of countries distinguished on the basis of the effects of the financial and sovereign debt crises on their activity levels. For the European aggregates, correlation coefficients seem to fall during recessions and present a negative outlier corresponding to the last trough in industrial activity. At the end of the period, correlation among soft and hard data is slightly lower than 0,4%, much lower than the figures observed on average during the entire period under scrutiny, but similar to what has already been observed during the 2005 recession. Looking at individual countries, when industrial production is now well below the pre-crisis levels (Panel B), correlation fall steadily as well, the only exception being Portugal, where instead we observe a progressive gain in terms of capacity of survey data of correctly gauging the cyclical behavior of industrial production. Correlation falls around zero in Denmark and around 0,2 in Greece, Italy and Spain; it remains slightly higher in the UK and France (0,4) while becoming negative in the Netherlands. Slightly better results are found in countries where production has almost returned on pre-crisis levels: in Germany and Austria, the correlation coefficient at the end of the sample is around 0,4 and in Hungary it falls below 0,4; the relationship among business survey data and industrial production remains stronger in Belgium and Czech Republic, where the coefficient is

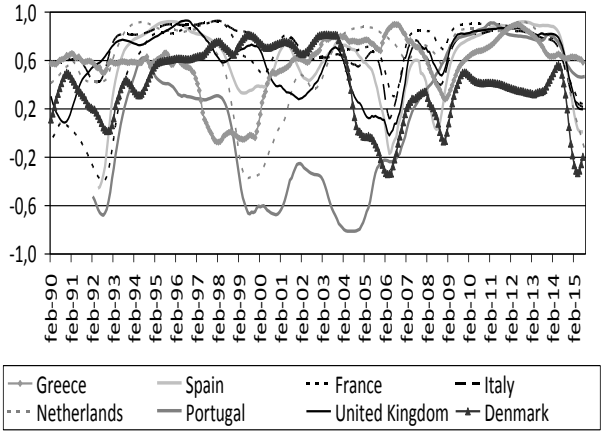
equal to 0,6 and 0,5 respectively. Finally, different behaviors are registered in countries experiencing a gain of production with respect to the period immediately preceding the crisis: in Estonia, correlation remains as high as 0,6 towards the end of the sample, while it falls to 0,4 in Poland and into negative territory in the Slovak Republic. In most of the countries considered, a similar deterioration of correlation among soft and hard data emerged during previous recession periods.

Figure 6 – Rolling correlation coefficients

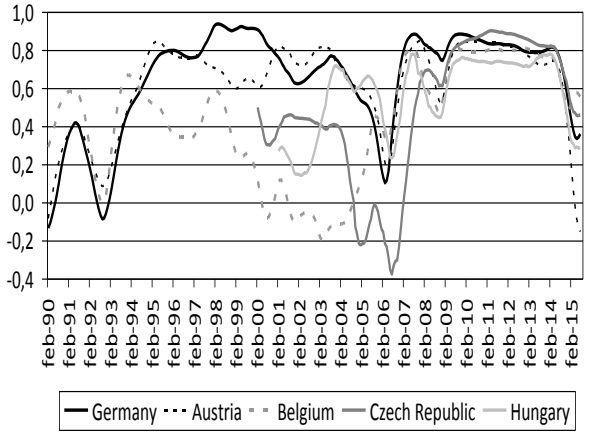
Euro Area and European Union



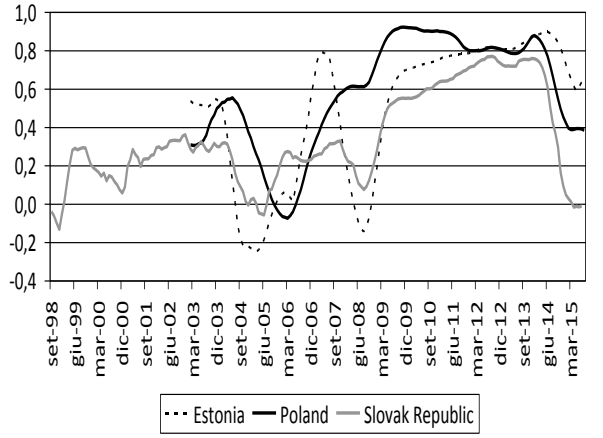
Countries with lower post crisis IP levels



Countries with same post-crisis IP levels



Countries with higher post-crisis IP levels



Source: authors' elaborations on OECD and EU data.

To sum up, correlation analysis provides evidence of diminishing capacity of survey data of correctly gauging the industrial production cycle during recessions. This seem to be particularly true for countries experiencing severe contractions in activity levels, while correlation remains somewhat higher in countries that have now returned to levels of production close to, or even higher than, those prevailing before the crisis.

5. Estimating the relationship among soft and hard data

5.1 Granger causality test

In section 4, we showed some evidence about a change in the relationship in the confidence-industrial production relationship during recessions, based on cross correlation analysis. In this section, we move a step forward, checking whether business confidence is able to cause industrial activity in the sense of Granger. More specifically, for each country we run the following regression:

$$\Delta y_t = c + \alpha_1 \Delta y_{t-1} + \alpha_2 \Delta y_{t-2} + \cdots + \alpha_p \Delta y_{t-p} + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \cdots + \beta_q x_{t-q} + u_t$$

where y_t denotes the log of industrial production index (IP), x_t denotes the level of the confidence indicator (ICI) and *p* and *q* the correspondent number of lags; Δ is the first difference operator. For each country, p and q has been selected by a stepwise backward, general-to-specific, procedure using a p-value of 0.05 as selection criteria: in practice, we started from a model with p=q=12 and then iteratively dropped lags having a p-value higher then the threshold. Residuals are assumed to be homoscedastic and i.i.d. Since we are interested in studying the effects of both the Great recession and the sovereign debt crisis on the production-confidence relationship, we first perform the estimates on the whole sample and then repeat them dividing the sample in three sub-periods, the first starting from 1985 and ending in 2007, the second going from 2008 to 2015 and the third from 2012 onwards. Table 3 reports the results of the Wald test on the null hypothesis that all the β coefficients are jointly equal to zero.

In the whole sample, the hull hypothesis is rejected at a confidence level of 1 per cent for both the European aggregates and individual countries. Hence, we may conclude that in Europe in the period 1985-2015 Confidence Granger-causes production in all countries. However, results change when sub samples are considered; in fact, before the crisis Granger causality is found in most of the countries considered, the only exceptions being Denmark, Portugal, the Netherlands and Estonia. This evidence is reinforced for the period 2008–2015, when Confidence is found to Granger cause industrial production in all countries but Poland, and the value of the Wald tests generally increase with respect to the previous period. However, considering only the period following the sovereign debt crisis, in some countries – including some of the largest European economies (Germany, France and United Kingdom) - no Granger causality is found, even if previous results are still valid at the aggregate European level and for large countries like Italy and Spain.

Table 3 – Granger causality test

Country	1985-2015	1985-2007	2008-2015	2012-2015
Austria	27,6	16,7	9,6	0,3
p-value	0	0	0	0,75
Belgium	22,6	11,6	14,7	4,8
p-value	0	0	0	0,01
Czech Republic	11	5	7,9	2,7
p-value	0	0	0	0,07
Estonia	8,1	0,9	8,6	4,3
p-value	0	0,47	0	0
Italy	30,3	11,6	16,4	8
p-value	0	0	0	0
France	16,2	9,5	5,7	1,8
p-value	0	0	0	0,14
Germany	61,9	28,5	23,5	1,9
p-value	0	0	0	0,16
Spain	11,6	5,9	7,2	2,3
p-value	0	0	0	0,06
UK	5,7	2,3	4,8	1,1
p-value	0	0,06	0,02	0,38
Netherlands	15,3	9,4	5,7	1,6
p-value	0	0	0	0,18
Portugal	9,4	5,3	7,3	4,7
p-value	0	0	0	0
EU	38,5	16,3	15,3	4,3
p-value	0	0	0	0
EA	69,7	27,9	31,5	7,3
p-value	0	0	0	0

6. Possible explanations and concluding remarks

Our analysis has shown that business surveys are usually able to correctly track turning points in industrial activity; moreover, survey data show a remarkable correlation with industrial production, and are found to Granger-cause it in most of the countries considered. However, the relationship tends to be weaker during periods of economic crisis, both looking at coherence at turning points and at cross-correlations coefficients. Looking at the most recent period following the sovereign debt crisis, Confidence fails to Granger-cause industrial production in some of the largest European countries. Two different possible explanations may be advanced for this finding. A first possibility is that, during recessions, weaker firms and firms exiting the market may have difficulties or not even be able to reply to survey questions; therefore, business surveys may be temporarily based only on replies of stronger firms. Hence, if the survey sample is not promptly refreshed, this may result in an upward bias of survey result, similar to the one we have observed after the last recession. Another possible explanation is related to how survey questions are formulated. In fact, in many cases, they make reference to a "normal" level of activity: it is well possible that in the aftermath of a recession, especially a strong one, the concept of "normal" itself for a firm may change, becoming lower. In that case, firms may well report activity levels "higher than the normal" even when only modest (or negligible) growth in activity actually occurs, determining an overestimation of the underlying production trends.

Further research is however needed in order to better investigate those issues, possibly making use of firm-level information derived from the surveys. At this stage, the main suggestions that may be derived from our analysis are, for data producer, to take particular care in updating the sample during periods of economic crisis and, for data analyst, to pay particular attention to "false positive" signals that may stem from survey data in the aftermath of prolonged and strong periods of recession that may have had an impact on firms' perceptions about "normal" levels of activity.

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