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Abstract

Traditional measures of the output gap rely on statistical filtering of trended series, results being highly sensitive to the method chosen, especially at endpoints (Oprhanides and van Norden, 2002). Following Koberl and Lein (2011) and Fessler et al. (2014), the aim of our paper is to derive ameasure of capacity utilisation gap for Italy, usually referred to in the literature asthe Non-Inflationary Rate of Capacity Utilisation (NIRCU).The NIRCU is defined as the capacity utilisation rate at which firms do not feel any pressure to adjust prices; the main advantages of the methodare (1) that it is micro-founded, being based on firm level information about capacity and prices, (2) that it is available almost in real time and (3) that it does not need any prior statistical filtering. Our NIRCU performs well as an indicator of inflationary pressures in a standard Phillips-curve framework.Results also show that the capacity gap after the crisis is in Italy at its highest in the last 25 years, remaining more than 5 percentage points above the current level of capacity utilisation, a finding with relevant implication for both monetary and fiscal policies.

JEL: E31, E32, E52

Keywords: inflation; capacity utilisation; NIRCU; Phillips Curve

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1. Introduction

The financial crisis has determined a sharp contraction of Italian industrial output, which at the time of writing (November 2014), according to official statistics, is still over 25 percentage points below the peak of the pre-crisis levels (January 2008). However, how much of this contraction is attributable to cyclical factors or to a structural reduction of potential productive capacity is still a disputed issue. Recent estimates of the Italian output gap include for instance those of the IMF and the OECD, according to which in 2014 the gap was equal respectively to -4,3% and -5,9%, among the highest figures for industrialised countries[1]; different conclusions are reached instead by the European Commission, which in its Autumn 2014 forecasts projects a considerable reduction of the Italian output gap for the years 2015-2016,mostly because of an expected rise in the Non Accelerating Wage Rate of Unemployment (NAWRU), which would remain close to the actual rate (European Commission, 2014). As a consequence, the EC deems that Italian structural fiscal imbalances will be stable or even growing as a percentage of GDP (from 0.8 to 1% of GDP) between 2013 and 2016,despite a significant reduction of the nominal general government balance (from 2.8 to 2.2% in the same years), hence paving the way to further requests of contraction policies according to the Fiscal Compact[2].

However, potential capacity and potential output are inherently unobservable variables, and estimating them is not an easy task: various methods, relying both on univariate and multivariate techniques, have been used in the literature, but results are often un-satisfactory, especially because they are found to depend heavily on the method chosen to filter original variables (GDP, Industrial production, capacity utilization, the unemployment rate) and to be prone to large revisions over time, especially at endpoints (see on this, among others, Orphanides and van Norden, 2002). The aim of this paper is to try to derive a capacity gap measure that will not depend on filtering or econometric techniques, relying uniquely on firm-level information: in doing so we will make use of data stemming from the ISTAT manufacturing survey regarding the level of capacity utilisation. From those data, we will derive a Non Inflationary Rate of Capacity Utilisation (NIRCU), which can be considered as the equivalent of the well-known Non inflationary rate of unemployment (NIRU) firstly introduced in the literature by Modigliani and Papademos (1975).According to the definition, the NIRCU is the capacity rate at which firms do not feel any pressures to adjust their selling prices; thus the NIRCU is defined as the level of capacity associated with zero investment gap and no change in prices. This definition has been first used by Koberl and Lein (2011) for the Swiss economy; different measures for the Austrian and Brazilian economy have recently been derived by Fesserl et al (2014) and Bezerra and Malgarini (2014), respectively. The main innovation of the Koberl-Lein paper is that their measure of the NIRCU is not derived from appropriately filtering current capacity utilisation, but rather from micro-level information based on survey data; in this way, they are able to circumvent some of the typical problems associated with data filtering, especially that of being particularly affected by data revision towards the end of the sample, exactly when the information is particularly relevant for policy makers. Moreover, filtering methods (e.g., Kalman Filter) often rely on strong statistical assumptions (e.g. trend and cycle components being uncorrelated), lacking solid theoretical support. On the other hand, the Koberl and Lein approach uses firm level information concerning the level of capacity utilisation and price expectations; on the basis of those information, according to this methodology it is possible to link the utilisation rate to the knowledge of whether, and at what given utilisation rate, a firm expects to adjust

[1]http://www.econstats.com/weo/V009.htm

[2]See on this also Fantacone et al. (2014)

prices. More specifically, if a given firm in the data set indicates that it does not expect to adjust prices in the next period, the utilisation rate the firm currently reports can be considered to reflect the firm-specific NIRCU, defined as the rate of utilisation that is consistent with no change in prices; an appropriate aggregation of all the firms being at their NIRCU allows to derive an aggregate estimate for the manufacturing sector.

The derived NIRCU will have the desirable properties of being time-variant and available in advance with respect to official GDP and unemployment figures, since survey data are usually released before the end of the month to which they refer to. According to the literature, the goodness of the NIRCU estimates may be tested looking at their role as a measure of inflationary pressures in a new-Keynesian Phillips curve framework. As far as we know, this is the first time the new method is applied for the Italian economy, for which a reliable estimation of the output gap is a much needed information from a policy perspective for the reasons outlined above. The rest of the paper is organized as follows: section 2 briefly introduces the ISTAT manufacturing survey and discuss the NIRCU measure at the firm level, while section 3 derives the aggregate measure for the Italian economy which will be used in the section 4 in a Phillips curve framework in order to test its usefulness as a measure of inflationary pressures. Section 5 concludes the paper commenting upon the results obtained.

2. The ISTAT manufacturing survey

2.1 Survey methodology

Manufacturing surveys are part of the Joint EU Program of Business and Consumer Surveys, launched by the Commission decision of November 15, 1961[3]. In Italy, the survey was originally started by the Institute on Economic Cycle (ISCO) in 1962, on a monthly basis; from 1999 to 2010 it was carried out by the Institute for Studies and Economic Analysis (ISAE) and since January 2011 it is compiled by the National Institute of Statistics (ISTAT). The basic purpose of the survey is to gather assessments and expectations of entrepreneurs on a range of variables regarding both their own business and general situation of the economy. In respect of the European Commission' principles of harmonization, most methodological and statistical survey features have remained substantially unchanged over time. Some changes have however gradually be introduced in the survey mode (the survey being conducted with CATI methods since 2002) and in sampling selection methods.

Survey participation is compulsory by law; nevertheless, while small/medium size firms who declare that they do not want to cooperate are not fined, those that are bigger, which absolutely refuse to collaborate, are[4]. Following the most recent revision occurred in June 2013, the reporting unit coincides with the sampling unit and is currently represented by the enterprise. Therefore, the target population is the set of all Italian firms operating in the manufacturing sector, according to section "C" of NACE Revision 2 classification. The survey theoretical sample is a fixed panel of 4000 enterprises. Nevertheless, because of

[3] At present, the harmonized EU program is governed by Commission decision C(97)2241, of 15 July 1997 and Commission Communication COM(2006) 379, of 12 July 2006.

[4] ISTAT manufacturing survey is included in the list of national interest surveys and is part of the National System of Statistics (SISTAN). The obligation to respond to surveys enclosed in the system is governed by articles 7 and 11 of Legislative Decree n. 322/1989 and Presidential Decree of September 26, 2012. As such, the survey is also on the list of surveys for which the failure to provide required data involves the application of administrative sanctions. The validity of the above list has been extended until the expiring of the National Statistics Program currently in force. Sanctions are applied only to firms with at least 500 employees.

non-response, it actually is on average 5%lower. Being a longitudinal sample, the units contacted do not change from one month to another, if they are still part of the target population. The firms that are no longer willing to participate or that are ceased (bankruptcies, merges, liquidations and those that have changed activity) are replaced with homogeneous ones according to type of activity, size and geographic area. Italian population size and the structural heterogeneity of the country's economy have always justified the width of the theoretical panel. The frame list from which units of the target population are selected is the official ISTAT ASIA archives of active firms updated to 2010. Due to the skewed distribution of manufacturing industries in the country (many small and very few large units), a cut-off strategy has been introduced, taking into account a size threshold. In particular, the frame has been limited to firms with at least 5 employees (representing 33%of the total number of enterprises in the sector). The coverage rate of the survey sample with respect to the frame is equal to approximately 3%. The survey is managed on a stratified random sampling, strata being defined according to three variables: firm size (5-9, 10-49, 50-249, 250-999, 1000 employees and more), geographical area (North-west; North-east; Centre; South and Islands) and economic sector (the two-digit sectors of NACE rev.2, from 10th to 33rd, and the three-digit sectors of divisions 10, 13, 20, 25, 26, 27, 30, 32). The whole sample includes 368 grid cells. The sampling method is based upon a random sampling scheme for firms with less than 1000 employees and a census sample for the ones with 1000 or more. Units with less than 1000 employees are allocated on the basis of the ROAUST (Robust Optimal Allocation with Uniform Stratum Threshold) criterion, applying the uniform allocation system to allocate a share of sampling units (approximately 50% of the total) and the Neyman allocation method for the remaining ones[5]. Percentages of answers to each reply option (in general three, for example: "high", "Normal", "low") are calculated for each stratum; frequencies are estimated using a double weighting system. To reflect the relative significance of the firm in the strata, a first "internal" weight is used, represented by the number of employees declared by each company in the questionnaire. Overall results are obtained as weighted averages of the strata; at this stage, official data on Value Added at factor costs for each stratum is used as "external" weight. Synthetic information on the observed phenomena is expressed by the balance statistic, which is calculated as the difference between positive and negative replies. Moreover, the manufacturing confidence indicator is produced monthly as the arithmetic average of the seasonally adjusted data related to the assessments on level of total orders and stocks (with inverted sign) and the short-term (three months) expectations on production[6].

2.2 Capacity utilization and the NIRCU

The ISTAT Manufacturing survey includes eighteen monthly questions of qualitative nature, seven of which are part of EU Program and eleven (five of which related to access to credit) specific to the Italian questionnaire. The content of the questionnaire also varies according to the reference month, enriched, each quarter, by some qualitative and quantitative information not normally reported in conventional statistics and related to international trade, market position, production capacity and degree of capacity utilization[7]. The survey also includes the three questions of interest for the calculation of the NIRCU, namely those concerning the level of capacity utilization, the current state of technical capacity and prices expectations. The quarterly question concerning the capacity utilization reads:

[5] See Chiodini and alii (2010).

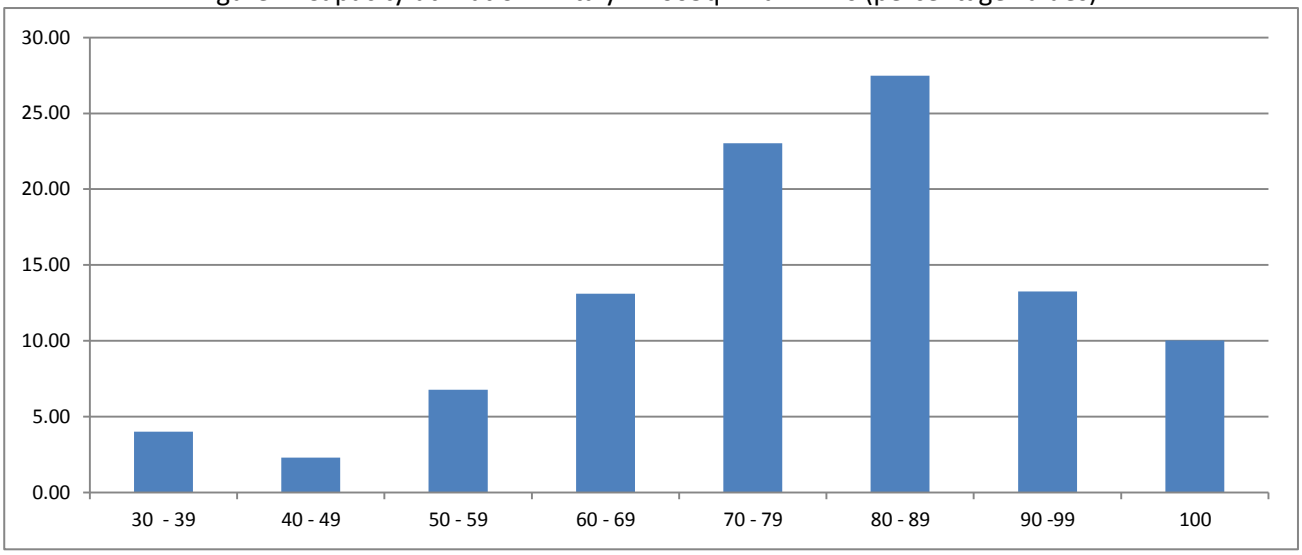
[6] The series of both the confidence indicator and balances are seasonally adjusted with the Tramo Seats. Since every month the addition of a new information permits a better evaluation of the various components of the series, data are monthly subject to a slight revision.

[7] Both questionnaire and the aggregated survey data are available on the ISTAT data warehouse at the following URL: http://dati.istat.it/.

”Compared with the maximum utilization percentage, what was the degree of capacity utilization during the (last) quarter?”.
Firms are asked to provide an answer in percentage values ranging from a minimum of 20% to a maximum of 100%. As for the quarterly question on production capacity, firms are invited to answer the question taking into account both their order-books and the demand for their products in the following twelve months. Entrepreneurs can choose between three possible answers: “More than sufficient”, “Sufficient” and “Not sufficient”. From the responses, at the period t, we can distinguish the firms that need to change their capital stock by those with a zero investment gap. Firms reporting a positive or negative investment gap should not concur in determining the NIRCU, even if they are not expecting to change their prices: in fact, their utilization rate may be upward or downward biased by the investment gap, even if they declare to expect to keep prices stable in the foreseeable future[8]. Finally, the monthly question on prices expectations asks whether selling prices are expected to remain stable, to increase or decrease for the following three months[9]. All the data are available for the period 1991Q1-2014Q1, for a total of about 280.000observations.

As an example, figure 1 presents the distribution of replies to the capacity utilization question for a particular quarter, the fourth quarter of 2005; figure 2, on the other hand, includes the distribution of the replies of the firms that declared their production capacity sufficient (that is, the ones that reported no investment gap) and stated that they would not have changed their selling prices in the following quarter. According to our definition, those firms are operating at their NIRCU. First, we can see that in Italy the distribution of capacity utilization seems quite heterogeneous for all the firms, including those at their NIRCU. Moreover, looking at both figures, the levels of capacity utilization would seem similar between the set of all the companies that belong to the sample and those who operate at their NIRCU. However, a careful examination shows that, in the quarter under consideration, 4% of all firms in the sample currently use less than 40% of their capacity. The percentage of capacity utilization varies between 80 and 89% for most of the companies (roughly 27%) and, finally, 10% produce at their full capacity (100%). It is interesting to note that considering only firms that expect no modification in their selling prices and who had an investment-gap equal to zero, we actually observe slightly higher percentages (in particular, 31% of these firms operate using a capacity utilization that varies between 80% and 89%; 11% operate at 100%).

Figure 1 Capacity utilization in Italy – 2005q4 – all firms (percentage values)

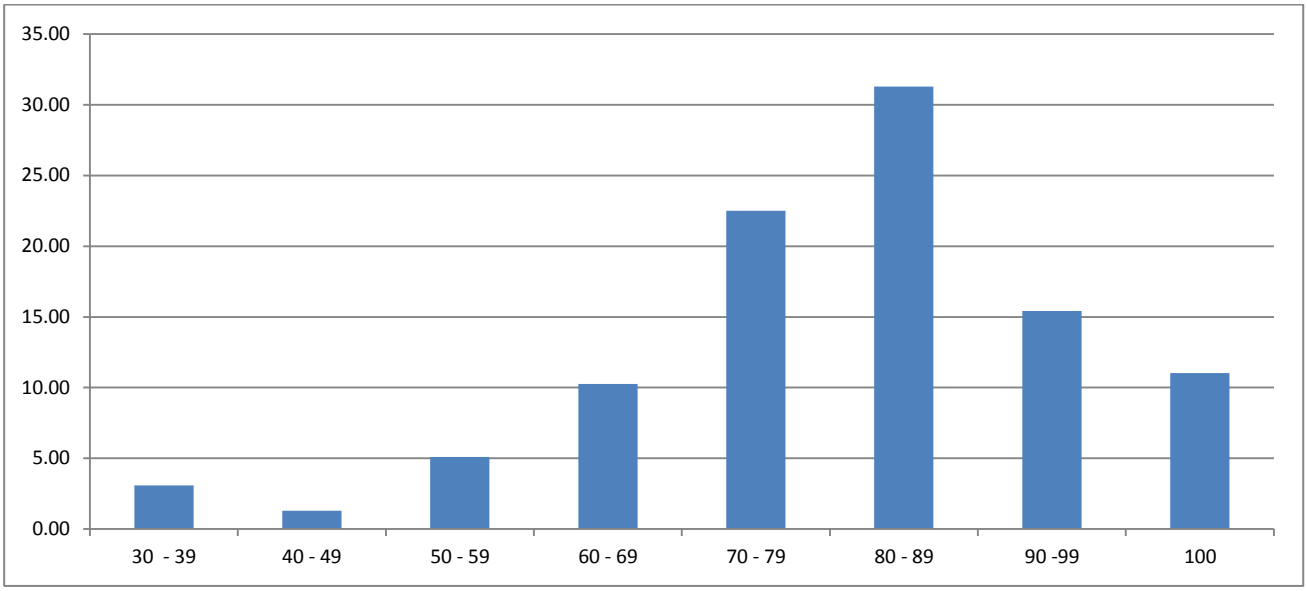


Source: our elaboration on ISTAT data

[8] See on this Caballero et al. (1995), Doms and Dunne (1998), Koberl and Lein (2011) and Fessler et al. (2014).

[9] In both Koberl and Leinand Fessler et al. papers, assessments on current prices are also included in the NIRCU calculation. However, Koberl and Lein (2011) show that results obtained are similar if current prices are excluded from the calculation; since this variable is no longer available in the Italian survey starting from April 2006, we will derive the NIRCU excluding it from the calculation.

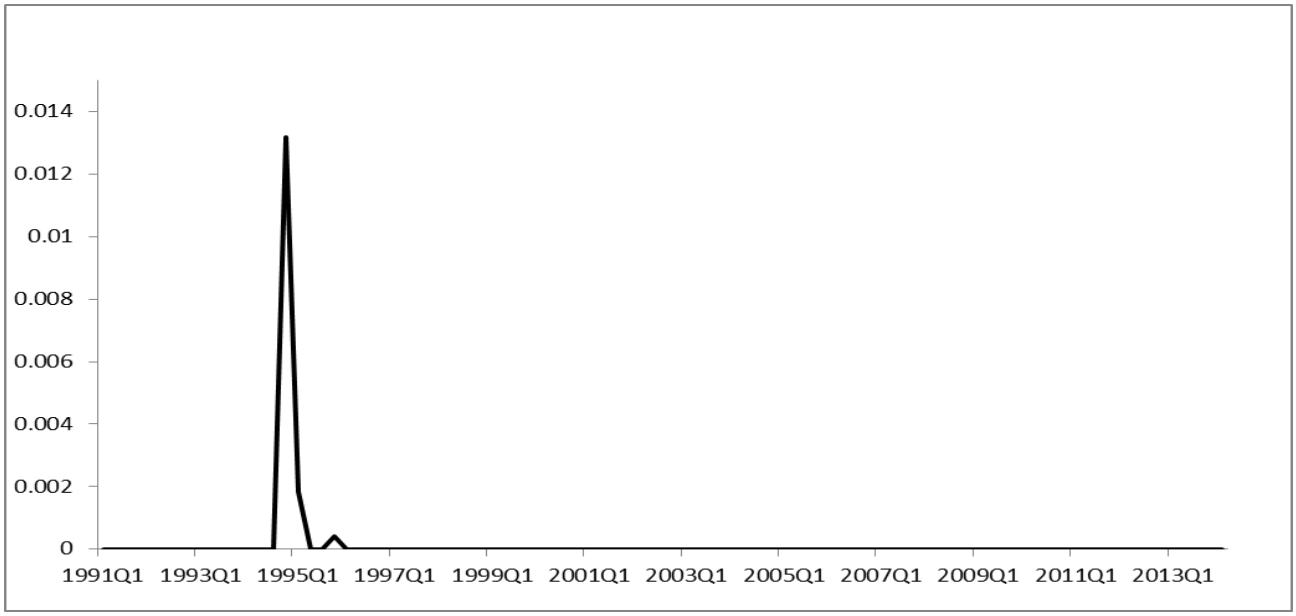
Figure 2: Capacity utilization in Italy – 2005q4 – Firms at NIRCU (percentage values)



Source: our elaboration on ISTAT data

In order to test if the distribution of the capacity utilization rates of firms that are operating at their NIRCU is significantly different from the distribution of the other firms, we use the two-sample Wilcoxon- Mann-Whitney test. The test verifies the null hypothesis that two samples of observations come from the same distribution (Mann and Whitney, 1947; Wilcoxon, 1945). In particular, we test whether the utilization rates for firms operating at the NIRCU are different from those of the other firms. Running the test for each quarter between 1991Q1 –2014 Q1, we can reject the null hypothesis that the two samples are extracted from the same distribution; the associated p-values, in fact, are significant in most quarters at the 1% level (Figure 3).

Figure 3: P-values of the Wilcoxon-Mann-Whitney test



Source: our elaboration on ISTAT data

3. The non-inflationary rate of capacity utilisation (NIRCU) for the Italian manufacturing sector

Following Koberl and Lein (2011), the firm-level NIRCU is defined as the capacity level consistent with one quarter ahead stable prices expectations and no investment gap:

$$NIRCU_{i,t} = \left(CU_{it} \middle| Price^{e}_{i,t} = \mathbf{0} \bigcap Investment\ gap_{i,t} = \mathbf{0} \right) \quad (1)$$

We then proceed to aggregate the firm-level NIRCU at the industry level using the firm number of employees as weights[10]. Let's define $NR_{it} = \mathbf{1}$ if $CU_{it} = NIRCU_{it}$, 0 otherwise; the total number of employees for firms operating at the NIRCU is hence equal to:

$$MaxweightNIRCU_t = \sum_i employee_{it} * NR_{it} \quad (2)$$

It follows that the aggregated NIRCU is given by:

$$NIRCU_t = \sum_i \frac{employee_{it} * NIRCU_{it}}{MaxweightNIRCU_t} \quad (3)$$

Similarly, to derive the current capacity utilisation rate at the macro level, we use capacity utilisation rates for all firms, weighted by firm size, the aggregate measure being:

$$CU_t = \sum_i \frac{employee_{it} * Utilisation_{it}}{MaxweightCU_t} \quad (4)$$

Where $MaxweightCU_t$ is defined as:

$$MaxweightCU_t = \sum_i employee_{it} \quad (5)$$

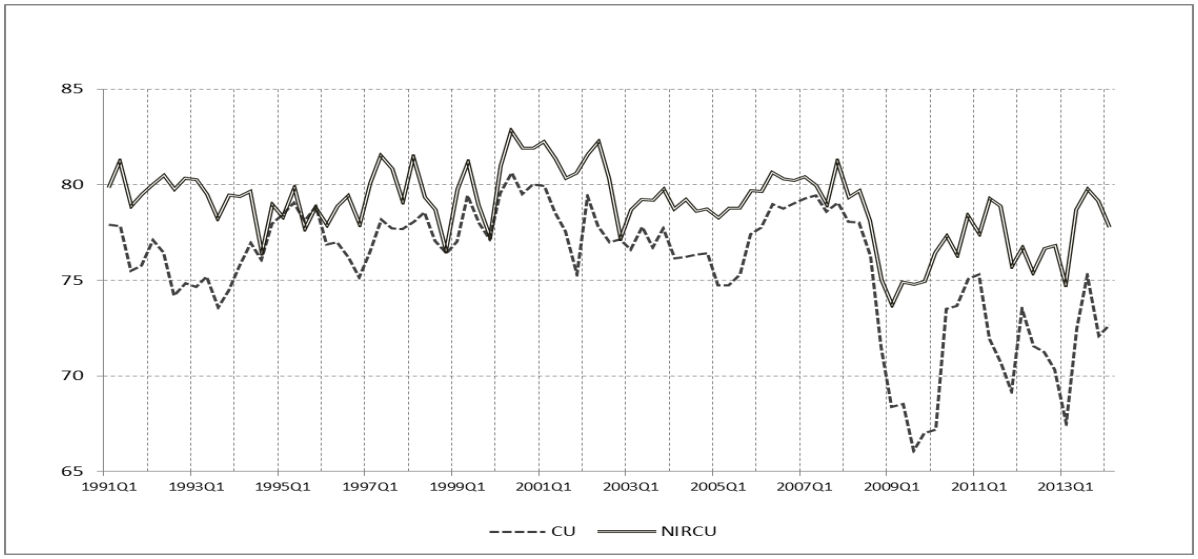
Finally, to obtain a measure of the capacity utilisation gap we simply calculate the difference among the capacity utilisation rate and that of the firms being at the NIRCU:

$$Gap\_CU_t = CU_t - NIRCU_t \quad (6)$$

[10] Ideally, it would be preferable to weight individual firms on the basis of measure of their activity (turnover, value added, market share); however, in the ISTAT questionnaire, the number of employees is the only available variable in order to weight individual firms. This information is also commonly used to derive aggregate published survey results.

Figure 4 plots the capacity rate and the NIRCU calculated on the basis of the methodology described above. Current capacity utilisation in the Italian manufacturing sector (fourth quarter 2014) is around 72.5%, more than 6 percentage points above the trough reached in the first quarter of 2009, but still well below the pre-crisis peak levels (at 78% in the second quarter of 2007). The NIRCU results to be rather stable over time, oscillating around 80% from 1991 until the beginning of the crisis; in 2008-2009 it falls below 76%, stabilizing around 77% during the great recession (2010-2011). Comparing the two series, the NIRCU lies above the CU for the most part of the period considered and it is smoother than the CU (its standard deviation being equal to 1.9, while that of the CU is equal to 3.3.). The volatility of the Italian indicator is slightly lower than that found in the recent empirical literature for Austria (Fessler, Rumler and Schwarz, 2014), Switzerland (Koberl, Lein 2011) and Brazil (Bezzerra, Malgarini, 2014).

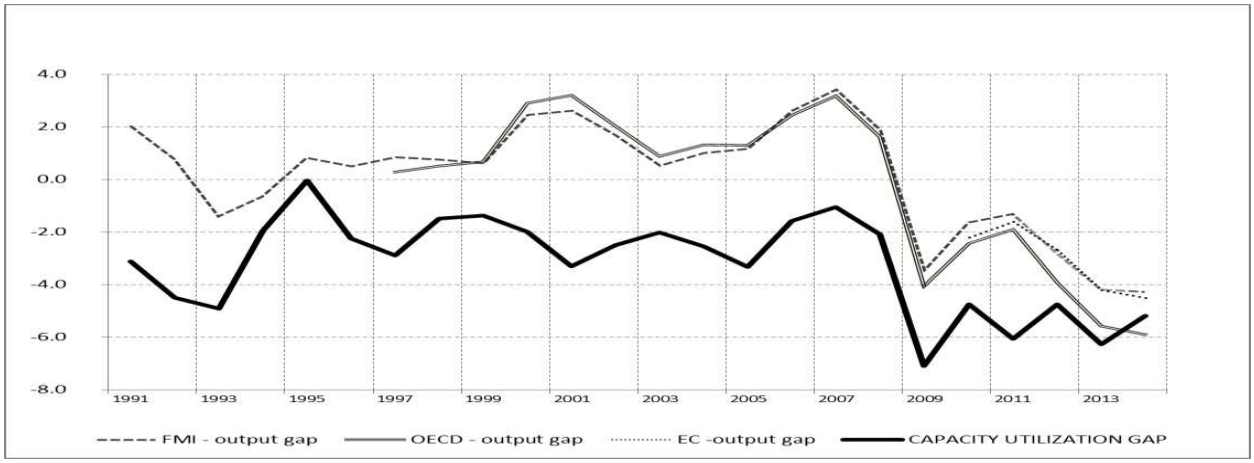
Figure 4: Capacity utilisation and the aggregate NIRCU



Source: our elaboration on Istat data

As a first conclusion, the graphic analysis hence shows that in Italy the NIRCU has been only marginally influenced by the crisis, with a recent tendency to return to levels only slightly below its long term average; as a consequence, the capacity utilisation gap for the Italian manufacturing sector remains very high, above 5% on average in 2014. If we compare our results with the output gap measures calculated by the OECD, the FMI and the European Commission (figure 5), it emerges that the capacity utilisation gap is usually larger than the output gap, even if it follows a similar cyclical pattern. In the most recent period, the capacity gap is close to the output gap calculated by the OECD, while being larger than that provided by the FMI and the European Commission.

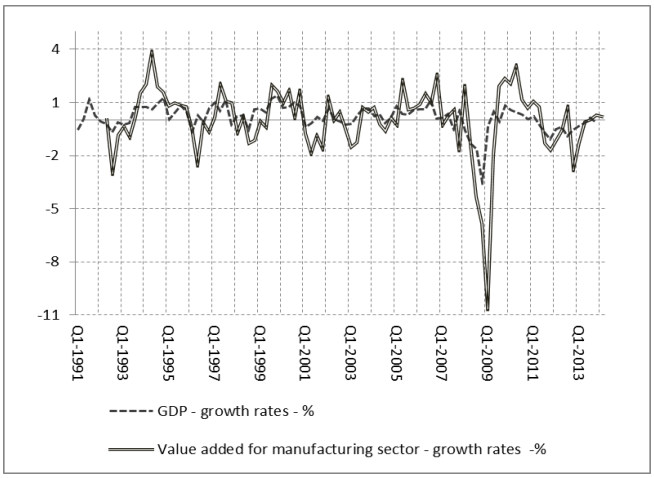
Figure 5: The Italian output gap and capacity utilisation gap

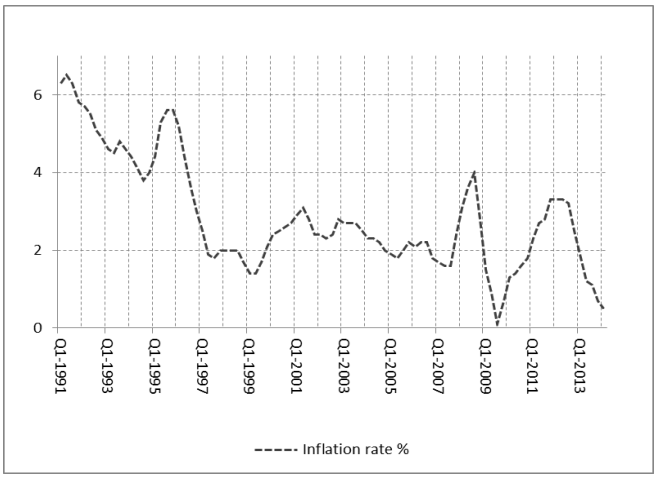


Source: EC, FMI, OECD and our elaboration on ISTAT data

Indeed, it should be reminded that the capacity gap is based on data referred to the manufacturing sector alone, which nowadays represent only a small and decreasing fraction of total output moreover, volatility of growth rates is much higher for manufacturing than for the whole economy (fig. 6), and this may partly explain why the magnitude of the capacity gap is higher than that of the total output gap. On the grounds of these considerations, the usefulness of our indicator as a measure of the capacity gap for the entire economy may be deemed as limited. However, figure 6 also shows that over the observation period the growth rates of GDP and manufacturing value added are well correlated, the contemporaneous coefficient being equal to 0.56, a figure slightly lower than that found for Switzerland (0.64) but still considerably high; in fact, agricultural and service sectors are often found not to display a well-defined cyclical pattern (see on this, for instance, A'hearn and Woitek, 2001), and hence studying only the cyclical behaviour of the manufacturing sector is most of the time considered as a good proxy for the overall business cycle. Another criticism that has been advanced for the indicator refers to the possibility of it not being able to identify the NIRCU for some quarter, for instance because all firms are found to expect to raise prices at the same time; in this respect, it is possible to argue that in the sample used for the construction of the indicator the number of firms that are at the NIRCU is about 47% on average, with no particular changes over time, allowing us to rule out this possibility. Finally, the NIRCU can be considered as a particularly good indicator especially in a low inflation environment (see again Koberl and Lein, 2011); indeed, in Italy inflation was still rather high at the beginning of the 90's dropping however on low levels since 1996 and remaining stable around a2-3% average until the recent crisis; from 2008 the inflation became more volatile with peaks in 2008 and 2012 and a fall in 2009. At the beginning of 2014 the inflation rate is again very low, near to 0.

Figure 6: Italian macroeconomic data





Source: our elaboration on Istat and Oecd data

4. The NIRCU as an indicator of inflationary pressures in a Phillips curve framework

After having defined the NIRCU for the Italian economy in section 3, we now proceed to test its reliability as an indicator of the output gap using it as an indicator of inflationary pressures in a Phillips curve framework. More specifically, we define a Phillips curve with backward and forward looking components as follows:

$$\pi_t = \beta_1 \pi_{t-1} + \beta_2 E_t\{\pi_{t+1}\} + \beta_3 gap_t + \alpha \qquad (7)$$

In (7) π_t is the inflation rate, $E_t\{\pi_{t+1}\}$ is expected inflation and gap_t is the output gap, which is represented in different ways. Following Galì and Gertler (1999), and similarly to Koberl and Lein (2011), we estimate (7) with Generalised Method of Moments (GMM), considering that, according to the rational expectations hypothesis, $E_t\{\pi_{t+1}\}$ should be uncorrelated with available information in t. From this assumption, we derive the orthogonality condition that is used in the GMM estimate:

$$E_t\{(\pi_t - \beta_1 \pi_{t-1} - \beta_2 \pi_{t+1} - \beta_3 gap_t - \alpha) Z_t\} = 0 \qquad (6)$$

In (6), Z_t is the vector of instruments, dated at t or earlier, which are assumed to be uncorrelated with inflation expectations for the period t+1. More precisely, in the estimate we use three lags each of the consumers' price inflation rate, unit labour costs inflation rate, the long-short term interest rates spread and one lag of the chosen measure of the gap. As possible measures of the gap, we alternatively use our micro-founded NIRCU, the cyclical component of GDP extracted with the Hodrick-Prescott filter, and a further measure derived from the ISTAT survey on the manufacturing sector, simply calculated as the difference among the current level of capacity and its long time average over the period 1991-2013. Table 1 reports the results obtained from the estimation.

Table 1 – GMM Estimates, 1991Q1-2014Q1

	Model (1) with NIRCU	Model (2) with trend capacity gap	Model (3) with output gap
β_1	0.47 (0.005) ***	0.46 (0.006) ***	0.49 (0.006) ***

β_2		0.58 (0.007) ***	0.58 (0.008) ***	0.55 (0.009) ***
β_3	Gap Nircu	0.030 (0.127) **		
	Gap CU		0.138 (0.071) **	
	Gap GDP			2.947 (0.406) ***
α		-0.10 (0.01) ***		-0.09 (0.011) ***
Observations		85	85	85
Hansen J-test		1.75	1.75	1.721
p-value Hansen		0.972	0.972	0.974

Standard error in parentheses; *** p<0.01; ** p<0.05. Columns 1-3 report GMM estimates using as instruments three lags of the consumers' inflation rate, the unit labour cost growth rate, the spread between the three months BOT rate and ten years BTP yields, and the lagged gap. The gap variable is proxied, respectively, using the NIRCU (column 1), the long-term average of the Capacity utilisation rate (Column 2) and the cyclical component of GDP extracted with the Hodrick Prescott filter.

The value of theβ1 and β2 parameters are close to Galì et al (2001) findings for the European Union. The coefficient for the output gap calculated on the basis of our estimates for the NIRCU is equal to 0.03 and it is significant at the 5% level; also in this case, the estimate is close to the value found by Galì et al for Europe as a whole (0.04). Similar results are found if we use as a proxy of the gap the one based on the long term average of the capacity (column 2) or the cyclical component of GDP (column 3).

5. Conclusions

In the paper we have applied a method firstly developed by Koberl and Lein (2011) for the Swiss economy in order to derive a measure of Non-Inflationary Rate of Capacity Utilisation (NIRCU) for Italy. The main strengths of the method are that it allows to derive a micro-founded measure of the NIRCU, which does not need to resort to disputable statistical filter to be calculated and is time variant; moreover, being derived from business survey data, our NIRCU is also timely released and it is not revised. All the above mentioned characteristics are particularly desirable from a monetary and fiscal policy perspective, providing a useful tool to monitor the evolution of the cyclical situation of the country. We have also tested the usefulness of our measure as an indicator of inflationary pressures: indeed, a productive capacity gap based on the NIRCU is highly significant in a post-Keynesian Philips curve framework, confirming that it may be a useful tool available to scholars and policy makers alike. Looking at the evolution of the capacity gap over and after the recent crisis, we are also able to conclude that Italy is still characterised by a large gap in productive capacity: indeed, it is possible to estimate that on average in 2014 the current level of capacity utilisation was still around 5% points below the level which is compatible with stable prices and zero investment gap. Policy implication of this finding may be relevant: in particular, on the basis of these findings more growth-oriented monetary and fiscal policy may be inferred to result in an increase of production and capacity utilisation without generating any inflationary tension in the short run.

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