Results of a pilot study towards an early labour cost index: successes and failures in the multi-source Italian production system

Eleonora Cimino, Maria Cirelli, Francesca R. Pogelli, Donatella Tuzi[1]

[1]*Italian National Institute of Statistics. Social Statistics and Welfare Directorate*

Abstract

In 2019, in the context of the Labour Market Indicators (LMI) Review, Eurostat launched a pilot exercise to study the feasibility of a flash estimate (*time* release at *t*+45 days from the end of the quarter) of the hourly labour cost index (LCI), anticipating the current official timeliness (*t*+70). Italy was included in the set of testing countries. The LCI is one of the Principal European Economic Indicators and measures the cost pressure arising from the production factor "labour". In Italy, the LCI is compiled into an integrated multi-source statistical system that, exploiting Admin, Survey and Quarterly National Accounts (QNA) data, produces a number of timely and broad coverage labour market indicators. Nevertheless, the sources contributing to this system are only partially available for this new early deadline and the extension of the current methodology for an anticipated estimate, as suggested by Eurostat, is not achievable. This paper describes strengths and weaknesses of a number of experiments aimed at an early estimate of the LCI exploiting the available information at the new time constraint. At a first stage, a time series approach was pursued, based on the full information available until previous time (*t*-1), supported by auxiliary early signals on *t*. A macro deterministic extrapolation was initially tested, followed by forecasting solutions, improved progressively introducing exogenous predictors on *t*. As an experimental evolution, a more elaborated micro approach was subsequently used, based on the exploitation of the partial Admin, Survey and QNA sources available at the early timeliness. Tests were carried out on a number of quarters, in a period characterized by a frequently chancing economic situation and a very significant outbreak (the pandemic emergency) and results were evaluated looking at revision errors. The micro approach turned out to be the most promising in terms of quality, but greatly dispendious as far as time/resources involved, burdens that strongly limit its implementation. In both cases, the partial availability of data implied appreciable results in condition of steady state. Weak outcomes emerged in situations of breaks, changing legislation etc., not predictable events that affect differently the variables involved in the LCI compilation. The main conclusion of the tests was that the quality of flash estimates could not be assured in a context of partial information and changing economic/legislation situation, implying a high risk of providing misleading early signals.

Keywords: Timeliness, Early estimate, Multi-source data, Partial information, Labour Cost Index**.**

1. Introduction

The Labour Cost Index (LCI) is one of the 22 short-term statistics defining the Principal European Economic Indicators (PEEI)[1], a comprehensive set of macroeconomic statistics at European Union and its Member States (MS) level, essential for the co-ordination of economic policies, the assessment of convergence and the conduct of monetary policy. Showing the developments of the total labour costs incurred by employers, the LCI is a key statistic for the assessment of the inflationary pressure caused by wage developments, i.e. from the

[1]See for details: https://ec.europa.eu/eurostat/web/euro-indicators.

production factor “labour”. Its early availability is relevant for the ECB, the European Commission and the Social partners involved in wage negotiations.

In 2019, in the context of the Labour Market Indicators (LMI) Review Task Force[2], Eurostat launched a pilot study on *flash estimate* of the LCI anticipating of about 25 days the current official release (*t*+50 instead of *t*+75). The aim of this proposal was to publish a “whole economy” European aggregate for the Euro Area and the European Union, based on a subset of countries and Italy was included among these. Since 2003, the Italian National Statistical Institute compiles the LCI into an integrated multi-source statistical system exploiting all already existing sources (Admin, Survey and Quarterly National Accounts – QNA - data). Yet, the sources contributing to this system are only partially available for this new early deadline and the extension of the current methodology for an anticipated estimate is not fully achievable.

This paper is organised as it follows: paragraph 2 presents requirements and data availability for the pilot study. Paragraph 3 reports the main methodological alternatives undertaken, while in paragraph 4 the focus is on results. Paragraph 5 concludes.

2. Feasibility of a flash estimate of the Italian LCI

2.1 Framework of the pilot study

The LCI is calculated dividing labour costs by the number of hours worked. Labour costs (TLC) include wages and salaries (WAG) and non-wage costs (OTH) such as employer's social contributions. In the current official delivery (*t*+70), data are made available at NACE section level and main aggregates. The flash estimate of TOT, WAG and OTH is only required for the “whole economy” (B to S aggregate, no NACE breakdown)[3].

The pilot project, started in the second half of 2019, is still in progress. Currently, a subset of 10 countries contribute to the flash LCI[4]. Their selection was based on their share in the Euro Area total (EA) in terms of annual number of employees[5]: Italy (10%) was included. To assess the feasibility of a LCI Flash estimate, the Task Force fixed some key quality aspects: *accuracy* of the European aggregates obtained from the subset of Member States (the so called 'flash countries'), based on the comparison of the flash and the current estimates with full coverage; *completeness* of the early estimates availability from the flash countries; *accuracy* of the

[2]The LMI Review initiative is part of an overall modernisation programme for Social Statistics at Europen level. It targets the development and adoption of a European Parliament and Council Regulation providing a comprehensive and modernised legal basis in the areas labour costs, earnings and job vacancies.

[3]Data must be provided non seasonally adjusted (NSA) and calendar adjusted. In this work we deal only with NSA results.

[4] Germany, France, Italy, Spain, the Netherlands, Belgium, Portugal, Austria, Poland and Romania.

[5] The theshold of this share, based on the number of employees aged 15 years and more, was fixed to 3% to be assessed over a consecutive three-years period.

country level flash estimates compared with the final. A precision target of 0.6 p.p. on the wage component was fixed as maximum revision to consider figures releasable at EA20 level.

2.2 Data availability in Italy

The Italian LCI is calculated using all already existing sources. Figures on the business economy (sections from B to N of NACE) are compiled combining three harmonized sources: a census monthly survey on large enterprises (LES) (+500 employees, named LEs), a quarterly sample survey on job vacancies and hours worked (JVHW) and a survey on employment, wages and labour cost (OROS)[6], based on Social Security data (used for enterprises with less 500 employees, named SMEs). Activities of the mainly non-business economy (O to S NACE) are covered with an ad-hoc QNA estimate. These different sources are not fully usable for a timely LCI flash estimate, as illustrated in Figure 1. Indeed at about *t*+40 days (the shortest deadline to process flash LCI) not all the processing phases have been run, highlighting problems of data availability and data quality (micro data on the third month have been partially submitted to E&I and the quarterly data on per-capita hours worked even not calibrated. QNA, estimates are mainly forecasting[7]).

Figure 1: Information context for LCI flash and regular estimates.

Source	LCI component	Data availability	Coverage rate for t+70 (Regular estimate)	Coverage rate for t+45 (Flash estimate)	Data processing degree for t+45 (Flash estimate)
LES-OROS-JVHW (B to N, Nace breakdown)	Employment Total labour cost Wages Other labour costs	Monthly Social Security admin data: m1, m2 available at t+38 days m3 available at t+45 days	**98%** for months m1, m2, m3	**98%** for months m1, m2 **0%** for month m3	**Partial** for months m1, m2 **Not available** for month m3
		Monthly Large Enterprises Survey on labour input and labour costs (LES): m1, m2 available at t+34 days m3 available at t+40 days	**100%** for months m1, m2, m3	**100%** for months m1, m2 **74%** for month m3	**Completed** for months m1, m2 **Partial** for month m3
	Per capita hours worked	Quarterly Job Vacancies and Hour Worked Survey (JVHW): q available at t+40 days	**65%** for quarter	**30%** for quarter	**no E&I, no calibration**
		Monthly Large Enterprises Survey on labour input and labour costs (LES): m1, m2 available at t+34 days m3 available at t+40 days	**100%** for months m1, m2, m3	**100%** for months m1, m2, m3 **74%** for month m3	**Completed** for months m1, m2 **Partial** for month m3
Quarterly National Accounts (O to S, Nace breakdown)	Total labour cost Wages Total hours worked	Quarterly National Accounts: q available at t+56 days	**100%** for quarter	**n.a.** for quarter	Ad hoc methology, mainly forecasting based on very few indicators

The following expression shows how each component contributes to the quarterly per hour labour cost ($_{\mathrm{hw}}^{BS}\mathrm{TLC}^{\mathrm{q}}$) of total aggregate (B to S sections), clearly showing the high integration level between sources and processes at the basis of the OROS-LES-JVHW-QNA system:

[6] See for details: https://www.istat.it/it/archivio/229033.

[7] QNA at their turn use OROS-LES-JVHW data as main indicators to compile *t*+60 final estimates on labour input and labour cost and the lack of these sources at the time of *t*+30 estimates (flash GDP) implies their substitution with feebly adequate auxiliary information implying in some cases high revisions.

$$\underset{hw}{BS}TLC^{q} = \frac{{}^{BS}TLC^{q}}{{}^{BS}THW^{q}} = \frac{({}^{BN}tlc^{q}_{LES+OROS})*({}^{BN}J^{q}_{LES+OROS})+({}^{OS}TLC^{q}_{QNA})}{({}^{BN}thw^{q}_{LES+VELA})*({}^{BN}J^{q}_{LES+OROS})+({}^{OS}THW^{q}_{QNA})} \quad (1)$$

Where ${}^{BN}tlc^{q}_{LES+OROS}$ is the *per-capita* indicator of total labour cost (LES-OROS source) and ${}^{BN}thw^{q}_{LES+VELA}$ is the *per-capita* indicator of hours worked (LES-JVHW source). Reconciliation is guaranteed by the number of jobs ${}^{BN}J^{q}_{LES+OROS}$ (LES-OROS source), allowing the calculation of TLC and total hours worked (THW) for the B to N aggregate. The O to S sectors are included through the QNA's gross values TLC (${}^{OS}TLC^{q}_{QNA}$) and THW (${}^{OS}THW^{q}_{QNA}$).

3. Methods for the Italian LCI flash estimate

According to Eurostat recommendations[8], *Statistical methods used in compiling flash estimates should also be in line with the regular production process*, *and the information available when computing flash estimates should allow the possibility to replicate, even if in simplified way, the same compilation process used in the regular statistical process*. The main reason of this approach, suggested by the LMI Task Force for the flash LCI compilation, is to limit revisions' sources and size. Given data availability, in Italy different approaches were followed for the sectors B to N and O to S.

For sectors from B to N, given the information set at the time of flash estimate, several experiments were carried out. At a first stage, a ***macro time series approach*** at sections level was followed, based on ARIMAX models with full information available until *t*-1 and auxiliary early signals on *t*. The flash estimates of the hourly wages and other costs were obtained using past data on the corresponding variable (ARIMA) with the addition of regressors (X) containing news on *t*[9], applying the seasonal models of the *t*+70 LCI estimate. This approach turned out to be feebly performant, particularly in situation of changing business cycle. At a second stage, a ***micro approach*** was detected, based on early partial admin and survey available data, more similar to that used for the *t*+70 estimates. It was very time consuming, implying the building of a parallel LCI process but aimed at estimating coherent *year-on-year changes* of each single component of the hourly labour cost, calculated on the first two months available. In the formula below (2), $\tilde{v}(c)_i^{t,t-4}$ is the *year-on-year changes* of each single component *c* (i.e. wages, other costs and as sum total labour cost) at NACE section level (*i*), to be applied to the respective regular *t*-4 indices $I(c)_i^{t-4}$, to get the flash values of the hourly indices for quarter *t*:

[8]Eurostat Handbook on Rapid Estimates. Version 2017. Available at the link: https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/ks-gq-17-008.

[9]For the flash estimate of the hourly wages and hourly other costs the regressors used were, respectively, the time series of hourly contractual wages and of LEs hourly wages (for the first) and hourly other costs (for the second). Forecasting are calculated using Jdemetra+ tool.

$$I(\widetilde{c})_i^t = I(c)_i^{t-4}\tilde{v}(c)_i^{t,t-4}. \quad (2)$$

Furthermore, the absence of data for the third month implies a lack of relevant information that are difficult to predict, i.e. high volatility of the wage component or active polices on the labour market that acts trough social contributions. Employment is much more inertial, but the recent pandemic events have provoked strong and varying shocks. The most severe problem is the unfeasibility of using micro data on the hours worked for SMEs for *t*. Several solutions have been explored to fill this information gap: a test with the partial microdata on earlier respondents[10], then another one with per-capita hours worked from the labour force survey, early respondents, were also tested as possible proxy. None of them provided suitably stable results. The best solution in terms of accuracy turned to be time series forecasting, based on an ARIMAX model[11] on past time series (available until *t*-1), with the addition of regressors (X) available at *t*+45 days and containing news on *t*. After several tests based on various short-term regressors, the most performant turned out to be the LES per-capita hours worked calculated on the first two months of quarter *q*, the QNA flash estimate of GDP (already available at *t*+30), the hours "paid" by employers, available from admin, but only for the first two months of *q*. Forecasted per-capita hours worked are reported to totals multiplying by the number of employees, whose flash estimate is drawn, as wages and other costs components by first two months' admin and survey data. **For sectors from O to S**, the flash LCI is based on QNA estimates available at *t*+30. In particular, the general Government component estimate on information available from the State General Accounting Department, is partially subject to revisions as of *t*+60 estimates, while for the private component, the flash estimate of labour cost (wages and salaries and non-wage component) is based on a prediction from an ARIMA model, while the hours worked estimate is partially based on preliminary LFS (Labour Force Survey) data. Finally, the **total flash LCI Laspeyres chain index B to S** is obtained summing up and chaining the indices at section level, with the structure of weights used for the compilation of the previous release for the *t*+70 estimate[12].

4. Accuracy of the Italian flash estimates based on revision analysis

The main results presented in this section refer to the micro approach and are in terms of year-on-year growth rates' revision[13] between the final release (*t*+70) and the early estimate (*t*+45),

[10] Two approaches were detected: a first estimate based on all the early respondents at *t* as representative of the target total population and a second based only on panel early respondents between *t* and *t*-4. In both cases data were not yet submitted to any E&I procedures to correct outliers.

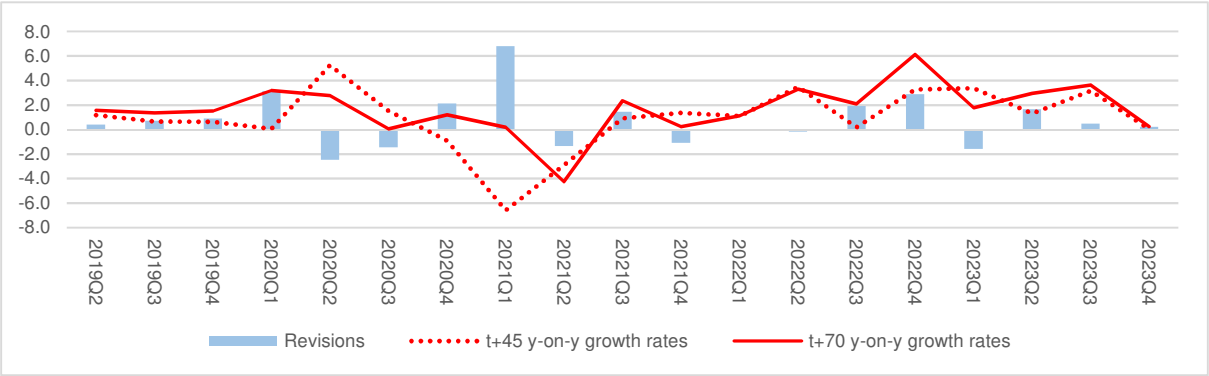
[11] Forecasting are calculated using Jdemetra+.

[12] Weights are an additional cause of revision of the flash estimates with respect to the regular ones.

[13] Revision (R) of year-on-year growth rate of the quarter *q* (Y_q) is defined as: $R_q^t = Y_q^{t+70} - Y_q^{t-45}$
See for details: Eurostat (2014) ESS Guidelines for the implementation of the ESS quality and performance indicators.

calculated over 19 vintages (Q2:2019-Q4:2023). The analysis follows a drill-down approach, from a focus on totals (B to S) to an examination of the contribution of the single LCI components, allowing an insight in the main reasons of revision. As showed in Figure 2, revisions were quite small in the first period, being relative steady state quarters, while they totally overturned by the following Pandemic outbreak: between Q1:2020 and Q4:2021 both the decline of the hours worked and the wage component were seriously affected. In the first half of 2022, results improved significantly, followed by one year of feeble performances, until half 2023, where some not easily controllable events characterized this period (i.e. National contracts' renewals and arrears for wage component and new post-Covid labour market active policies for social contributions). The last two testing quarters newly showed acceptable results, in coherence with a new steady state period. Results are the final effects of the combination of several underlying causes driven by the single LCI components and require further analysis of the different elements that characterize the index.

Figure 2 – Target year-on-year growth rates and revisions (t+70 - t+45 estimates). Hourly TLC. B to S NACE aggregate.



In table 1 revisions of the y-on-y growth rates of the single LCI components are synthetized using some summary measures[14]: For the LCI B to S the mean revision (MR), that gives an indication on the direction of revisions, indicates underestimation by the flash estimates, of about 1 p.p. of the hourly variables, values that are quite uniform among the three, because of their high interrelation: actually, negative revisions are one third of the totals. A significant compensation of opposite sign revisions happens, how the mean of the absolute revisions (MAR) shows, doubling the size of revisions. The latter is influenced by high values of the y-on-y growth rates: normalizing by the average size of the flash estimates (RMAR), revisions halve again. As far as the components, both for the three numerators (still very similar in size

[14] To allow an analysis by components, the index formula has been simplified to "elementary", i.e. neutralizing the effects of the aggregating weights concurring to Laspeyres and chaining (see Ciammola, Tuzi 2010) but introducing effects due to changes in the employment structure, that may be not negligible in periods of business cycle change or shocks.

and direction) and the denominator, the sign of revisions changes to negative, underling a generalized overestimation, more significant for the hours worked.

Table 1: Summary measures of year on year growth' revision error in the period Q2:2019-Q4:2023: analysis by component and Nace macro sectors.

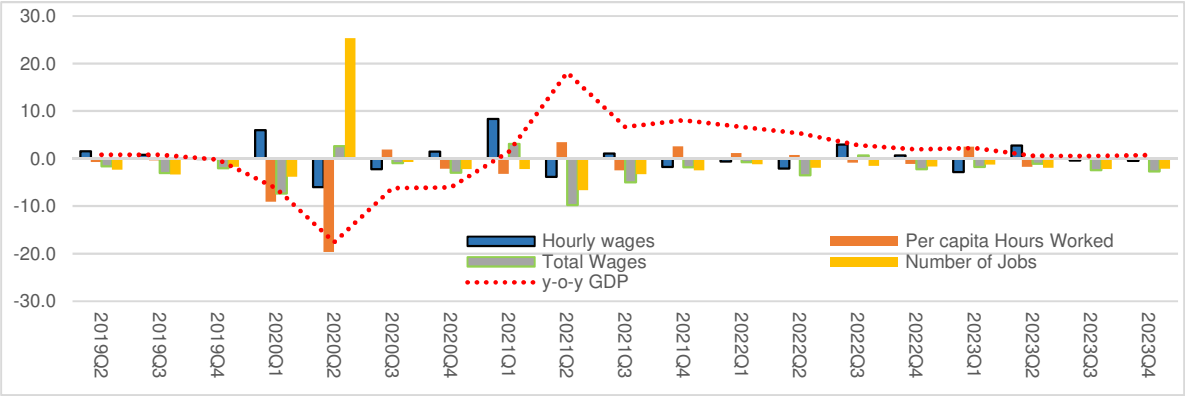
	Hourly wages	Hourly other costs	Hourly Total Labour Cost	Total Wages	Total Other Costs	Total Labour Cost	Per capita Hours Worked	Number of Jobs	Total Hours Worked
B to S sectors									
MR	0.9	0.8	0.9	-0.8	-0.9	-0.8	-	-	-1.8
MAR	2.0	1.9	1.9	1.4	1.6	1.4	-	-	2.5
RMAR	0.9	0.7	0.9	0.2	0.7	0.2	-	-	0.4
MAX (abs value)	6.8	6.6	6.8	4.8	4.8	4.8	-	-	9.4
MIN (abs value)	0.0	0.0	0.0	0.0	0.1	0.0	-	-	0.1
% negative R	31.6	36.8	31.6	68.4	63.2	63.2	-	-	73.7
B to N sectors									
MR	0.3	0.3	0.3	-2.2	-2.2	-2.2	-1.5	-0.9	-2.4
MAR	2.4	2.3	2.4	2.9	2.9	2.9	2.9	3.6	3.3
RMAR	0.8	0.6	0.8	0.3	0.3	0.3	0.8	0.7	0.4
MAX (abs value)	8.3	8.3	8.3	9.7	9.2	9.6	19.7	25.3	12.6
MIN(abs value)	0.0	0.2	0.1	0.7	0.2	0.3	0.0	0.8	0.0
% negative R	47.4	52.6	52.6	84.2	89.5	84.2	57.9	94.7	73.7
O to S sectors									
MR	1.7	1.1	1.5	1.8	1.2	1.7	-	-	0.1
MAR	2.2	2.1	2.0	2.0	2.1	1.9	-	-	1.3
RMAR	1.4	1.3	1.4	1.0	1.0	0.8	-	-	1.6
MAX(abs value)	6.5	6.6	6.5	9.4	9.5	9.4	-	-	2.7
MIN (abs value)	0.2	0.0	0.1	0.1	0.1	0.1	-	-	0.0
% negative R	21.1	31.6	21.1	21.1	15.8	26.3	-	-	52.6

Turning to B to N, the situation is emphasized: the reduced values of the MR of the hourly variables, in sign, are amplified by their MAR, with maximum revisions overcoming 8 points. The job component exerts a higher influence on the size, even if in relative terms jobs and per-capita hours get similar values, being the first characterized by most significant compensations and totally prevalent overestimation. At the end, revisions at the denominator compensate for those at the numerator implying small MRs, but quite similar and non-negligible in size MARs. Looking at the O to S aggregate, MRs in the hourly variables are quite higher that in the market sectors, with wages emerging, but MARs appear similar in size, indicating a lower compensation: for these sectors, it is once again underestimation that prevails, confirmed at the numerators, but not at the denominator. The latter shows a lower MR and MAR, implying a feebler revisions' compensation of the hourly variables with respect to B to N.

A time series analysis on the revisions of the y-on-y growth rates of the hourly wages by components in the B to N sectors (Figure 3), clearly puts in evidence a non-systematic bias in the sign of revisions. That is the result of a systematic bias of its two components: total wages and total hours worked and in particular, the hours worked are characterized by a systematic and higher size bias of the employment component. It is interesting to see how revisions of the

per-capita hours worked increase in occasion of GDP turning points, when it is more difficult to forecast.

Figure 3 – Revisions of the y-on-y growth rates by component. Hourly wages. B to N Nace aggregate.



5. Final remarks

Among several exercises conducted, the approach based on micro data (more similar to official estimate) appeared the most promising in terms of quality of the results, but it was necessary to complement with more flexible solutions, in a parallel production process. These solutions are aimed at coping with a data framework that does not totally represent the quarter and whose representativeness may vary from quarter to quarter, putting at risk also timeliness' compliance. The analysis of revision errors on the single components put in evidence the most critical aspects of this approach, addressing to various area of methodological implementation. Improvements in the early LCI estimates need important efforts in terms of resources and synergy between structures to get an output that is not necessary a priority for the Italian NSI. Furthermore, the recent Covid outbreak and the following period of business cycle instability pointed out the scarce aptitude of partial data to provide early signals on the Italian LCI, in extreme cases putting at risk the quality of the EU totals.

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