11. LABOUR INPUT PRODUCTIVITY
Comparative Measures and Quality Issues

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Introduction

In the second half of the 1990s, Italy has had a relevant increase of the labour utilisation but the intensity of the growth rates differ in relation to the labour input measure chosen. In particular, the growth rates of the persons employed go faster that those ones of the full-time equivalent units, that represent a proxy of the amount of hours worked. At the same time, data shows that production trend follows the employment time profile only in some years.

Since 2005, the National Statistical Office of Italy (Istat) has began to produce information on hours actually worked that represent a more appropriate measure to quantify the labour participation to the productive process and to analyse labour productivity growth. The time series of hours actually worked seems to approach well the fluctuations of the production values.

The paper presents all the different measures of labour currently produced by Istat. A detailed description of the method for estimating hours actually worked is presented, as a description of the results obtained for the period from 1993 to 2005. The results enable, in particular, to understand the impact of the labour input trend on the productivity, which is firstly calculated without considering differentiated types of hours actually worked.

A new method that takes into account variables that correct the traditional method of estimating labour productivity is presented too; the new approach introduces factors of differentiation of workforce that measure changes in quality over time.

The next section describes all the different measures of labour input produced by Istat. The third section describes the methodology used for estimating hours actually worked. The fourth section presents the new approach to taking into account the adjustment for labour quality and the results obtained. Finally, the last section reports some conclusions and possible future developments of the method proposed.

Labour input measures

Labour input can be measured in terms of total hours worked, number of persons employed and/or number of full-time equivalent unit, a unit of analysis obtained transforming part-time jobs in terms of full-time job. For productivity and GDP growth analysis, it is preferable to measure labour input in terms of hours actually worked.

The views expressed are those of the authors and do not necessarily reflect those of the National Statistical Office of Italy (Istat).
Total hours actually worked produced by the National Statistical Office of Italy are consistent with national accounts. Some uncertainty remains regarding the comparability of data with the others European Union countries because the approaches used for annual estimates differ across them.

Total hours worked can be derived by combining estimates of annual hours worked per person employed with the average level of employment or per capita hours worked by each job multiplied for the corresponding number of jobs; according to the Istat approach, jobs represent the basic measure of labour input that is multiplied for per-capita hours data in order to obtain the total amount of hours worked or that is transformed in full-time equivalent unit.

The Italian measures of labour produced by national accountants are currently checked by the European Statistical Office (EUROSTAT) with the aim to ensure consistency within the framework of the System of national accounts (ESA95) and comparability among countries.

Estimates on hours worked

According to the System of national account, the hours actually worked represent the most adapted measure for quantifying the real use of labour in the income production process. In particular, the availability of the information would enable to fully consider brief-period fluctuations of the labour factor due to both economic factors and extra-economic factors. The problems associated to this estimate, nevertheless, are different and relate to the difficulties of integrating in a satisfying way the sources from the enterprises side and those from the household’s side. Another difficulty lies in measuring the hours worked by self-employed workers and their relative remuneration.

In accordance with ESA95, the total amount of hours actually worked includes the hours worked, both remunerated and non-remunerated by employees and self-employed, as long as they are oriented to the production of income.

The estimates of the hours worked refer to the jobs according to a domestic concept: in other words, they include all the hours worked in productive units distributed nationally, apart from the residence and nationality of the person carrying out these hours. Moreover, the estimates meet an exhaustive concept of employment that takes into account both the hours worked in a first and multiple job regularly registered as well as those unregistered, that is not declared to the tax office or social security institutions and insurance companies.

The estimates are drawn by Istat for the period 1993–2005 and divided in 30 industries of the NACE-Rev 1.2 classification and by occupation (employee and self-employed); the estimates are regularly produced, together with the other employment measures estimated from the national accounts, that is the number of jobs, persons employed according to the domestic concept and the full-time equivalent units.

Total hours represents the whole amount of the hours worked, remunerated and/or partially remunerated; it includes the working hours performed in addition to the normal working hours and excludes the hours remunerated but not actually worked (such as holidays, sickness, reduction of working hours due to absenteeism, leaves and other), as well as all the hours worked in activities that, according to the national accounts, are not to be considered for the purposes of calculating the GDP (mainly homely work, productive...
service volunteering, do-it-yourself type of activities other than extraordinary house maintenance work).

For estimating the hours worked, the approach adopted consists in multiplying the number of jobs of specific typologies of employment by an annual per capita number of hours worked, the latter being directly taken from the statistical surveys that measure this phenomenon.

Jobs are differentiated per type of work in order to apply homogeneous working hours per capita in relation to the statistical unit of reference (enterprise, institution or household), the industry and the type of employment (registered, unregistered, main and multiple job).

Up until today, the full-time equivalent units have been considered as a proxy of the total of hours worked. They are computed by applying to the part-time jobs transformation coefficients obtained from the relation between the hours worked in part-time activities and those worked full-time in the same industry.

In reality, the full-time equivalent units slightly diverge from the total of hours worked not only as level but also as regards the trend, since they are mainly determined by the distribution of the jobs among full-time, part-time and multiple job-holders employment. On the other hand, the total of hours actually worked is identified not only from the composition of the above indicated jobs but also from other important components, such as overtime and absenteeism from work. If, for example, leaves due to illnesses or for some other motives grow over time, while the level and composition between part-time and multiple job-holder employment do not change, the total of hours actually worked will be reduced while the full-time equivalent units will remain unchanged.

In order to interpret correctly the diversity that characterises the full-time equivalent units and the total of hours worked, it is thus necessary to take into account the calculation differences associated to the different aggregates.

**Sources of information used for the estimates**

Information regarding the length of time of weekly and/or annual employment is obtained from the workers themselves through statistical surveys addressed to households or from employers, through surveys addressed to enterprises.

The main sources of information on the hours actually worked available are the following:

- The Labour Force Survey\(^{180}\)
- The annual surveys on the private enterprises economic accounts
- The monthly survey on enterprises with over 500 employees
- The quadrennial survey on the labour cost conducted on a sample of enterprises with 10 employees and over

\(^{180}\) The Labour Force Survey has been completely reviewed since 2004. The new survey is a continuous-type survey and the reference weeks are uniformly distributed over the whole year. The data on the hours worked used for estimating the total of hours actually worked are those from the continuous survey estimated backward till the IV quarter of 1992.
It is important to highlight that one of the reasons of differentiation between the enterprise surveys and the households surveys is that the first ones analyse the value per capita of the hours actually worked per job and the second ones study per capita of the hours worked by an employed person in the main job activity and distinctly in the second one.

Another difference is that the enterprise surveys gather information directly from the employers who, theoretically, provide more precise data than those declared by the households. Generally, though, the enterprise surveys do not register the hours worked by the self-employed workers, they do not cover all economic activity sectors (such as, for example, the agricultural sector, the general government sector and all non-market productive activities) and do not survey the employment of who is unrecorded for the tax-contribution institutions.

Another element to be taken into account when analysing the total of hours worked is that the respondent enterprises could show a certain tendency at declaring more frequently the per capita of hours remunerated rather than that of hours actually worked, even if adequately defined.

The household surveys provide complete information on the hours actually worked, both remunerated and non-remunerated, and on the working hours used unregistered in tax-contribution institutions; moreover, these surveys enable to obtain more detailed information divided per important demographic variables such as gender, age and study degree, all relevant for the purposes of the socio-economic analyses and international comparisons. The coverage of the survey interests the entire economy but, as regards the persons employed deriving from the enterprise surveys, it does not cover the workers present in the country but without residence who work in resident productive units, as they are not part of the survey sample selected from the population registers.

The data on the hours provided by respondents often result affected by non-systematic response errors. Moreover, the statistical practice pointed out that the information on the hours actually worked tends at approaching that on the usual hours; this is the case of the responses given by persons who are not remunerated per hour worked and who can take into consideration in the response given to the interviewer the overtime worked.

When estimating the total of hours produced by the national accounts, enterprises surveys provided information on the per capita of hours actually worked by employees for different market industries (divisions C-K and M,N,O of the Nace Rev.1.2 classification) and by size of enterprises; the labour force survey provided data for a detailed level of industries (4 digit of the Nace Rev. 1.1 classification) for employees and self-employed.

The total of hours worked has been obtained by applying the per capita of hours actually worked surveyed to the universe of jobs, distinguished into the different types of employment, and estimated coherently with the national accounts.

The estimate of the hours actually worked in the service sectors used also the information available on the per capita of hours actually worked deriving from the following informative sources:

• The General Accounts Department, which enabled to survey the direct and indirect data on the hours worked in the General Government sector (as defined in the national accounts framework);
The ABI (Italian Bank Association), which provided specific data on the workable hours in the finance industry.

The estimation procedure of the total of hours worked

The estimation on the total of hours worked was carried out using the so-called account approach: data on the per capita of hours worked deriving from the surveys and adequately detailed have been applied to the different types of jobs estimated from the national accounts.

Working on a long time period has entailed the need of harmonising the data of a same survey over time, taking into account the changes that have regarded the statistical units of reference, the survey techniques and the industry coverage.

For the purposes of estimating the annual hours worked by employees, it was possible to use all information on the per capita of hours worked deriving from the above-indicated enterprise surveys and available from 1992. In particular, the annual surveys on the enterprise’ economic accounts include, since 1998, all companies with 100 employees and over as well as a sample of companies with a lower number of employees. For the year 2000, it has been possible to make use of the detailed data on the number of hours worked obtained from the quadrennial survey on the labour cost structure addressed to companies with 10 employees and over.

The analysis of the enterprises data pointed out to a tendency (which is even more accentuated as regards smaller enterprises) at providing data on the hours remunerated rather than that relatively to the hours actually worked. Thus, a statistical method has been applied which, based on the number of hours worked and on the remunerated hours, both surveyed by means of the quadrennial labour cost survey, has enabled to reduce the distortion due to this over-estimation.

The data on the per capita of hours actually worked in the industries that are not covered by the enterprise surveys, those relative to the multiple jobs and the per capita of self-employed workers are directly surveyed by means of the labour force survey on a continuous base. Starting from the first quarter of 2004, the above survey is conducted each week of the year even if the results are reliable at a quarter level.\textsuperscript{181}

The approach per component method has been only used to calculate the annual per capita of hours worked in the General Government and in the finance industries, and consists in estimating the components that imply a variation of the working time compared to a norm considered equal to the working hours established by national agreements. In this case too, the total of hours worked has been obtained multiplying the per capita estimated for the whole of the registered jobs of employees estimated from the national accounts in the competent industries.

\textsuperscript{181} Before of the above date, the survey was done every three month four weeks a year during which there were no holidays, in the months of January, April, July and October. It caused two main problems in terms of hours worked analysis: 1) the possible distortion of the seasonal profile considering the fact that the reference week of the interview was distant from the usual holiday periods; 2) the consequent possible annual over-estimation of the hours actually worked.
International comparability of the estimates

The use of statistics on labour input is being promoted on an international level in order to improve the comparability of the estimates as regards labour productivity. The definition of labour productivity that is generally accepted is that of Gross Domestic Product per hour worked, even though it is being acknowledged that this measure might not be able to gather the differences of productivity among the various countries because influenced by different factors, such as the composition of labour force (high or low specialisation).

Numerous problems need yet to be overcome in order to reach the above objective. A factor that affects the quality of international comparisons relatively to the hours worked is represented, as mentioned in previous paragraphs, by the reference measure of the hour per capita indicator that, in some countries, is the person employed and in other countries, such as in Italy, the job.

Another important aspect is linked to the different concepts and definitions used in the statistical surveys, as well as to the sources of information available and to the different coverage degree of the surveys.

International comparisons make necessary to identify an indicator that takes into account some other factors, such as the different weight of the active population and the participation degree of the labour force in order to provide a more accurate framework of the working hours and their effects on the entire economy.

Even in front of evident problems of comparability, the OECD (Organisation for Economic Co-operation and Development) publishes some annual estimates on the hours actually worked on a per capita level for 29 countries. The national institutes of statistics provide these estimates; nevertheless, only for some of them, the results are coherent with the concepts and the coverage degree of the national accounts. To produce these estimates, some countries use the hours actually worked drawn from the enterprises surveys, which generally regard only employees, while other countries use the data from the labour force survey that enables to measure the working hours of self-employed workers.

The series that the OECD has made available up until now represent only the first step towards the harmonization and a greater international comparability of the estimates. The problems linked to the study and the adjusting of the international definitions on the hours worked, as well as the improvement of the quality of information have been object of discussion since a few years within the Paris Group, a workgroup that brings together the different national institutes of statistics as well as some important international institutions such as OECD and ILO (International Organisation of Labour). The objectives the Paris Group has set, include to promote the development of statistical information regarding the hours worked, recognizing their importance for estimating the total of hours to be put in relation to the national accounts economical aggregates, for estimating correctly the productivity of the labour factor and for measuring the impact of the social policies, such as that of reducing the working hours.

Istat has already started since a few years an intense work of developing information on the hours worked and is, on an international level, involved in the activities promoted by the Paris Group and by some other important institutions (EUROSTAT and OECD); nationally, it aims at promoting mainly the development of concepts, definitions, verification and correction procedures of the information gathered during the various statistical surveys.
The estimates produced by the national accounts will thus evolve in relation to the development of the study and promotion activities of statistical information on the hours worked started by the Institute and which involve various statistical contexts (surveys on enterprises, agricultural farms, households and administrative sources).

**The analysis of the results obtained**

In this paragraph, we present data on hours worked in the period 1993–2005 that are analysed taking into consideration three different periods (Graph 11–1). The first period (from 1993 to 1995) is characterised by a decrease of the hours worked; in this period, the employment registered an unprecedented drop compared to the trend of the previous decade. The second period (the two-year period from 1996 to 1997) saw the expansion and subsequent reduction of the hours worked, together with a slow recovery of the employment. Finally, in the third period (from 1998 to 2005) the hours worked grew at a more sustained rhythm, encouraged by the important increase of employment, just interrupted at the end of the period (in 2005).

**Hours actually worked between 1993 and 2005**

(absolute data in millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Hours (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>39,000</td>
</tr>
<tr>
<td>1994</td>
<td>38,000</td>
</tr>
<tr>
<td>1995</td>
<td>39,000</td>
</tr>
<tr>
<td>1996</td>
<td>40,000</td>
</tr>
<tr>
<td>1997</td>
<td>41,000</td>
</tr>
<tr>
<td>1998</td>
<td>42,000</td>
</tr>
<tr>
<td>1999</td>
<td>43,000</td>
</tr>
<tr>
<td>2000</td>
<td>44,000</td>
</tr>
<tr>
<td>2001</td>
<td>45,000</td>
</tr>
<tr>
<td>2002</td>
<td>46,000</td>
</tr>
<tr>
<td>2003</td>
<td>47,000</td>
</tr>
<tr>
<td>2004</td>
<td>48,000</td>
</tr>
<tr>
<td>2005</td>
<td>49,000</td>
</tr>
</tbody>
</table>

The availability of the data on the hours worked, together with the GDP estimations (seasonally and calendar adjusted, chain-linked volumes 2000=100), enables to analyse better the contribution of the labour factor in the growth of the output (Graph 11–2). In this case, two distinct phases can be distinguished: one that goes from 1993 to 2001 and the other that goes from 2002 to 2005. The first phase registered a growth of the product almost always superior to that of the hours worked necessary for realising it (except for years 1996 and 1998); the second phase, though, saw a change in the relation between hours worked and product with the approaching of the two series at the end of the period (years 2004 and 2005) to such an extent that the trend of the total of hours worked appeared to reflect the trend of the GDP due to its intensity and signal with the exception of the 2003 result.
In 1993, the total of hours worked amounted to about 41,446 millions of hours, while the subsequent years registered a drop following the reduction of jobs; a recovery of the work intensity was registered as from 1998, when the hours worked exceeded, even though to a modest extent, the levels registered at the beginning of the period. In 1998, the hours worked amounted to about 41,828 millions. Since that year, they have registered a quite regular positive trend, even reaching 44,172 millions of hours in 2005.

The whole period, object of observation, enables to study the different growth rhythm of the full-time equivalent units (obtained by transforming the jobs at reduced time and multiple jobs in full-time jobs) compared to the trend of the total of hours worked (Table 11–1). The comparison between the two employment measures points out to the differences in the intensity of growth rather than to a contraposition in the increase rates; nevertheless, the two measures differ as the full-time equivalent units do not take into account the overtime and absenteeism and do not reflect, as closely as does the total of hours worked, the trend of the jobs and that of the per capita of hours used for the purpose of the estimation.

### Table 11–1 Growth rates of persons employed, full-time equivalent units, jobs and hours worked (% values)

<table>
<thead>
<tr>
<th>Years</th>
<th>Persons employed</th>
<th>Full-time equivalent units</th>
<th>Jobs</th>
<th>Hours worked</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>-2.7</td>
<td>-3.2</td>
<td>-2.7</td>
<td>-3.0</td>
</tr>
<tr>
<td>1994</td>
<td>-1.6</td>
<td>-1.1</td>
<td>-0.8</td>
<td>-2.0</td>
</tr>
<tr>
<td>1995</td>
<td>-0.2</td>
<td>-0.0</td>
<td>-0.2</td>
<td>-0.1</td>
</tr>
<tr>
<td>1996</td>
<td>0.6</td>
<td>0.3</td>
<td>1.1</td>
<td>1.3</td>
</tr>
<tr>
<td>1997</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>-0.2</td>
</tr>
<tr>
<td>1998</td>
<td>1.0</td>
<td>0.9</td>
<td>1.6</td>
<td>1.9</td>
</tr>
<tr>
<td>1999</td>
<td>1.1</td>
<td>0.5</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>2000</td>
<td>1.9</td>
<td>1.8</td>
<td>2.1</td>
<td>1.2</td>
</tr>
<tr>
<td>2001</td>
<td>2.0</td>
<td>1.8</td>
<td>2.1</td>
<td>1.0</td>
</tr>
<tr>
<td>2002</td>
<td>1.7</td>
<td>1.3</td>
<td>1.4</td>
<td>1.0</td>
</tr>
<tr>
<td>2003</td>
<td>1.5</td>
<td>0.6</td>
<td>1.8</td>
<td>1.2</td>
</tr>
<tr>
<td>2004</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>2005</td>
<td>0.3</td>
<td>-0.2</td>
<td>-0.0</td>
<td>-0.3</td>
</tr>
</tbody>
</table>
All through the reference period, the trend of the hours worked was influenced by both the trend of the jobs and by the changes in the average annual working hours; the years following 1993, the base year=100, registered a drop of the hours worked and jobs up until 1996, a subsequent increase of both employment measures (characterised by a higher dynamism of the hours worked between 1997 and 2003) and, finally, an interruption of this tendency only in 2005 when the stability of the jobs corresponded to a modest decrease of the hours (Graph 11–3).

In the period 1993–2005, different trends of the hours worked have been registered at an industry level. Data shows a reduction of the hours worked in agriculture and industry sectors, accompanied by a strong increase of the hours worked in the service sector.

In 2005, the service industry accounts for 67,2% of the total of hours worked, the industry sector 27,2% and agriculture 5,6%; in terms of jobs, these sectors employed around 69%, 24,7% and 6,4% respectively.

These results enable us to see how the productive system (especially in the sector of services) has been using more flexible work contracts and diversified working hours regimes, even as regards full-time workers. Ever since the nineties, companies and public institutions seem not to search anymore, as in the past, regularisation forms of working hours but, on the contrary, tend to accept the changes in the weekly working hours regimes that are reflected in the total estimation of the total of hours worked.

As told before, the total of hours worked is obtained by multiplying the average annual number of hours worked in a job (per capita) per the total of corresponding jobs. This means that the average annual working hours used for the purposes of the estimation do not refer to the number of physical persons employed but to the total of the jobs that each employed person can carry out, even in different industries and different status in employment (for example, a first job as employee and a second job as self-employed).
From the national accounting point of view, to calculate the average per capita number of hours worked per job is considered as more correct than to measure the working hours of each person employed. The latter indicator, unlike the previous one, is significant only if measured for the entire economy; it provides no information at an industry level as there is no certainty as to whether the employed persons surveyed in the same sector are the only ones who have contributed in the total of hours worked, estimated in a given industry or in a specific job position.

As highlighted in Graph 11–4, the average annual per capita of hours worked calculated per employed person appears definitively superior to that estimated per job. In 2005, each employed person worked on average 1,815 hours while the hours corresponding to each job was of 1,495 hours. In 1993, the per capita numbers were of 1,863 hours and 1,554 hours respectively. The results obtained are influenced by the effect of multiple jobs that in 2005 weight for 7.4% on the total amount of hours actually worked (the 5.7% in 1993).

The integrated approach used for the purposes of estimating the labour input of the national accounts enables to measure the volume of labour in terms of jobs and, consequently, to use better the sources available on the hours worked, in some case, in terms of hours worked per employed person distinguished between first and second job (the surveys addressed to households) and, in other cases, in terms of hours worked per job (surveys addressed to enterprises).

Labour quality

The methodology here applied to measure quality-adjusted labour input is the one proposed by the OECD productivity manual.\textsuperscript{182} Data are referred to hours worked by individuals and their hourly income. Hours worked have been disaggregated according to their different

\textsuperscript{182} OECD (2001).
characteristics in order to account for quality; in this way, indeed, is possible to consider substitution between the different inputs for identifying properly productivity growth.

The data analysed permits to cross-classify individuals by gender, age and types of educational attainment.

Several are the approaches proposed by the literature and the practical experience to explicit differentiation of labour input. Differences are related to the measurement used for taking into account individuals skills.

Starting from the application of existing methodologies,\textsuperscript{183} we have measured labour services in terms of the growth rate of hours worked by each individual labour category weighted with its compensation share in total labour compensation.

We have considered three characteristics (gender, age, education) to cross-classify labour input for the whole economy. Because the different characteristics are correlated, the corresponding labour compensation measure reflects both the direct contributions of these characteristics to output growth as interaction effects between them. In our approach the interaction effects are reduced because no differentiation by industry is considered and this because of the lack of data.

According to the method applied and the neo-classic theory, each labour category is weighted by its compensation share: labour is compensated at marginal productivity. The above considerations produce that women and young workers would be less compensated than men or older workers on productivity account.

The approach permits to produce and analyse three different results: 1) the time profile of the simple sum of hours worked, that is the quantity of labour input; 2) the time profile of the quality-adjusted measure of hours worked, that is the quality of labour input; 3) the time profile of the differential effect between the total and the quality of labour input.\textsuperscript{184}

In conclusion, an increase in the average quality of labour implies that the quality-adjusted measure of hours worked rises faster than the unadjusted measure of labour input.

\textit{Sources of data and methodological approach}

The National Statistical Office of Italy doesn’t currently produce detailed data on employment (hours worked and labour compensation per different types of employment) by the same sources of data. In order to reach the goal of measuring labour quality, we have used more that one sources of data.

Data on total hours worked detailed by gender, age and education have been provided by the Labour Force Survey, a quarterly survey on a continue base; then, shares of each types of labour on the total amount of hours worked surveyed have been estimates. The above shares have been applied to the national accounts figures on the total hours worked in order to detail the exhaustive level of hours worked (coherent with the GDP level) for a quite good level of employment characteristics.

\textsuperscript{183} Jorgenson (1987).

\textsuperscript{184} Fosgerau and others (2000).
Istat compiles a wide range of annual and infra-annual statistics using different sources in the area of wages, earnings, compensation and labour cost. Each of the above statistics represents a part of the phenomenon because based on different definitions and different aims of representing it. In particular, hourly labour compensation by type is available from the Istat survey on Structure of Earning that provides information every four years but, at the moment, it is possible to use only 2002 data.

Data on hourly wage compensation by types of labour have been produced using micro data of the Bank of Italy’s Survey of Households’ income and wealth in the period 1992–2004. The survey is compiled every two years; values for missing years have been here obtained by interpolation.

In this approach, we take into account only labour compensation of employees. The treatment of income generated by self-employed persons has been not faced. We have assumed that the average compensation per hour of a self-employed person of each type equals that of an employee of the same type.

In the final database of hours actually worked and hourly compensation the information are separated by two gender groups (men, women), four age classes (<25 years old, 25–34, 35–54, >54) and four level of education (elementary school or none, low secondary school, high secondary school and university degree). We have obtained 32 characteristics (2*4*4 cells). No breakdown by industry has been considered because the number of cases in each cell weren’t significant.

The value attributed to hours worked is represented by the average compensation per hour; this corresponds to the wage rate from a producer’s point of view and it includes all supplements to wages and salaries. We take into account only labour compensation of employees assuming that the average compensation per hour of a self-employed person of each type equals that of an employee of the same type.

The labour index proposed in the paper is a weighted average of the growth rate of hours worked according to the above labour characteristics. In particular, three first-order indexes have been computed for each characteristic of the workforce (gender, age and education) combining hours worked with the corresponding compensation; then other three second-order indexes have been obtained through the interaction of each characteristic with the others. The last order represents the total labour services adding the weighted growth rates of each characteristic.

The ratio of labour services obtained using different orders can measure the labour input quality. The labour index in this way is represented by a quantity factor, the volume of hours worked, and a quality factor with the aim of measuring the substitution between the above two factors. The quality index increases when components generating the most labour services grow faster than the other characteristics, or decreases if the least efficient hours worked grow faster than the others.

In order to reach the goal, the growth rate of labour input (indicated in Equation 1) is measured on the base of the following formulation (Tornqvist index).\textsuperscript{185}

\textsuperscript{185} The Tornqvist index is based on the logarithmic differences of the growth rates weighted with the influence of each input cost on the total cost.
where $H_i$ represents hours worked by each type of employment considered ($i = 1, \ldots, n$) and where $\nu_i$ is the rate of remuneration associated to it compared to the whole labour cost formulated as:

$$\nu_i = \frac{w_i H_i}{\sum_i w_i H_i} \quad (2)$$

where $w^i$ is the price of labour input of type $i$. The above equation expresses the *volume of labour input* as a translog index of the individual components.

To quantify the impact of labour services among different types of labour input, we have adopted the methodology proposed by Jorgenson to assume that labour input for each category $L_i$ is proportional to hours worked $H_i$. In particular, a measure of the contribution of substitution between components of the labour input respect to the volume of hours worked can be expressed as follows:

$$L_i = Q_i H_i$$

where $L_i$ represent labour services in cell $i$, $Q_i$ represent constants of proportionality of labour input and $H_i$ the non-weighted hours worked. The contribution of substitution among the components of labour input to the volume obtained from a given number of hours is expressed by the following equation:

$$Q_i = \frac{L_i}{H_i}$$

where the unweighted sum of hours actually worked is the following:

$$H = \sum_i H_i$$

The quality of labour can be also expressed as follows:

$$\Delta \ln Q = \sum \nu_i \Delta \ln H - \Delta \ln H \quad (3)$$

In this way, the ratio of labour services measured on the different orders respect to the growth rate of unweighted hours worked measures the *labour quality index* and it represents the labour-augmentation factor calculated as residual between a constant quality labour input index and an index of the quality of hours worked as a measure of changes in the components of labour input.
Final results will be shown on labour productivity adjusted and non-adjusted for quality for the period 1992–2005. In the two cases, the measure of labour input is represented by hours actually worked.

**Quality adjusted labour input results**

The approach here proposed is based on the methodology described by Ho and Jorgenson (1999) and applied by Melka and Nyman for France.\(^\text{186}\) It outlines the compositional change in the use of labour and the contributions of various factors (gender, age and education) to labour quality over the period 1992–2005. Hours worked have been disaggregated according to these three different characteristics in order to account the labour quality and to provide a measure of labour services. Labour services are obtained by aggregation of the growth rate of hours worked, classified by gender, education and age, with weights determined by the compensation share of each type of labour; labour quality is indicated by the difference between labour services and the growth rate of hours worked. Moreover, the decomposition of overall quality index to the contributions of its determinants provides some insight on the factors explaining changes in labour quality growth.

The overall contribution of the three factors to labour quality growth has been calculated and the results are shown in Graph 11–5.

![Graph 11–5](image)

According to the exercise proposed, hours worked register a positive trend in all the period and labour services follows the positive time profile of hours worked; labour quality shows a quite steady time profile.

The above results can be well understood analysing the decomposition of the quality index to the contributions of its determinants. The first order indexes indicate the contributions of each factor to labour quality growth and Table 11–2 presents the results obtained.

**T 11–2 Contribution to Italian labour quality (% values)**

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>1.37</td>
<td>1.41</td>
<td>1.27</td>
<td>1.18</td>
<td>0.90</td>
<td>0.81</td>
<td>0.97</td>
<td>0.59</td>
<td>0.67</td>
<td>0.57</td>
<td>0.90</td>
<td>0.83</td>
<td>1.09</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.04</td>
<td>-0.01</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.05</td>
<td>-0.05</td>
<td>-0.01</td>
<td>-0.03</td>
<td>-0.03</td>
<td>-0.00</td>
</tr>
<tr>
<td>Education</td>
<td>0.87</td>
<td>0.87</td>
<td>0.86</td>
<td>0.77</td>
<td>0.72</td>
<td>0.77</td>
<td>0.80</td>
<td>0.55</td>
<td>0.50</td>
<td>0.38</td>
<td>0.76</td>
<td>0.70</td>
<td>0.57</td>
</tr>
<tr>
<td>Age</td>
<td>0.28</td>
<td>0.29</td>
<td>0.23</td>
<td>0.25</td>
<td>0.22</td>
<td>0.12</td>
<td>0.27</td>
<td>0.24</td>
<td>0.29</td>
<td>0.18</td>
<td>0.17</td>
<td>0.16</td>
<td>0.40</td>
</tr>
<tr>
<td>Sum of interactions</td>
<td>0.24</td>
<td>0.26</td>
<td>0.21</td>
<td>0.20</td>
<td>-0.03</td>
<td>-0.05</td>
<td>-0.07</td>
<td>-0.15</td>
<td>-0.07</td>
<td>0.02</td>
<td>0.00</td>
<td>-0.00</td>
<td>0.12</td>
</tr>
<tr>
<td>Non-weighted hours</td>
<td>-2.28</td>
<td>-1.99</td>
<td>-0.08</td>
<td>1.33</td>
<td>-0.22</td>
<td>1.87</td>
<td>0.86</td>
<td>1.16</td>
<td>1.01</td>
<td>1.04</td>
<td>1.19</td>
<td>0.47</td>
<td>-0.27</td>
</tr>
<tr>
<td>Weighted hours (labour services)</td>
<td>-0.90</td>
<td>-0.58</td>
<td>1.20</td>
<td>2.51</td>
<td>0.68</td>
<td>2.68</td>
<td>1.83</td>
<td>1.75</td>
<td>1.69</td>
<td>1.61</td>
<td>2.10</td>
<td>1.30</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Note: quality is the difference between weighted hours and non-weighted hours.

The contribution of education is relevant as that one of age; both plays an important role in labour quality increase.

Contribution of education follows a different trend all over the period: it decreases till 2002, growing up again till 2005. The decrease has been determined by the spreading of atypical works (part-time workers, persons employed by temporary employment agencies and temporary workers) that encourages the participation to labour market of unskilled workers.

The age contribution to labour quality is still significant. The age is a proxy for labour market experience but this factor is strongly related to demographic developments. According to our results, the contribution to quality given by the age is almost steady until 2001 then it decreases in the years 2002–2004 and increases again in 2005.

The above trends can be explained by different factors. Working population over the last 30 years is characterized by the movement of so called baby–boom cohort (those born in the 1950s and 1960s) and this trend is confirmed in the Euro area.\(^\text{187}\) In particular, the upper age (35–54 year) has a relevant role in terms of hours worked (Graph 11–6) and, at the same time, their hourly wages increase. An increase in hours of more experienced workers has contributed to an increase in labour quality that is more relevant in the years 1993–2001 than in following years.

The relevant growth of the age contribution in 2005 is due to upward trend of the 35–54 age bracket’s hours while labour below age 25 goes down. This could reflect the impact on the Labour Force Survey of the foreign resident population afterwards the amnesty on illegal foreigner worker in 2002.

Graph 11–7 shows the growth rates of hours worked by gender. The hours worked by women have increased more than those of men and the higher contribution has been reached by skilled women.
In the same period, the differential between hourly wage of men and women has decreased (see Graph 11–8) but not in a relevant way: men are still better paid than women.

Graph 11–9 shows that differential hourly wage of women relative to men is increased in a negative way, especially for women with the university degree whose hours worked are increased significantly over time. In comparison women with low level of education are better paid; among the four categories, women with high secondary school increased more than the others their hourly wage while hourly wage of graduated women is getting worst in the last ten years.
In conclusion, the compensation weighting scheme has a crucial role in labour quality assessment and our results show that the quality has received impulse by the categories of employment whose compensation share decrease.

The findings of our exercise need to be better analysed also in relation to the quality of data sources. Firstly, hours worked estimated in the national accounts framework have been split by gender and other characteristics using data of the quarterly Labour Force Survey from 1992 till 2003, the new survey on a continue base is available since 2004. The lack of backward calculation series on hours worked by gender, age and education causes a structural break in the figures.

Secondly, the annual Bank of Italy survey on households’ balances presents some discontinuities due to the small sample size for guaranteeing reliable estimates and to the lake of survey in some years.

Conclusions

This paper describes all the developments done in the last years by the National Statistical Office of Italy on labour input and labour productivity measurement.

In particular, a methodology to currently produce annual estimates on persons employed, jobs and hours actually worked has been adopted. The comparability of the results with the GDP growth rates is assured because of the consistency of the all aggregates produced in the context of national accounts.

We have also presented some first evidences of changes in labour quality in Italy by constructing a quality-adjusted index of labour input covering the period 1993–2005. The index is the result of a procedure that combines data on wages from micro data of the Bank of Italy’s Survey of Households’ income and wealth and on hours worked from micro data of Quarterly Labour Force Survey.

The results show that during the overall period the main contribution to the Italian labour quality is driven by the education but this contribution is decreasing over time. Even though the share of hours worked by people with university degree has been increased over time, their hourly wages have been rising but with a negative marginal growth rate and this results reflect two considerations: the first issue is that the share of women with university degree is increased in terms of quantity but not in value due to their low wages; the second consideration is that data reflect a specific problem of the Italian labour market where high level of attainment workers are under-assigning.

The findings of our exercise need to be better analysed also in relation to the quality of data sources. In particular, the quality and the availability of statistical and/or administrative data on hourly wages detailed by quality aspects of labour force remain uncertain. The results obtained in terms of quality adjusted measure of labour input are fragile, in particular considering the difficulties regarding the measurement of hourly labour cost. Nevertheless, Istat is highly interests to promoting convergence on statistical methodologies on hours actually worked and to provide a better statistical base for labour productivity analysis.
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# TABLE OF CONTENTS

**Introduction** 7

1. OECD Workshops on Productivity Analysis and Measurement: Conclusions and Future Directions; *Erwin Dievert* 13

**PART 1: PRODUCTIVITY GROWTH IN SPAIN AND IN SWITZERLAND** 39

2. Productivity Growth and Innovation in OECD; *Dominique Guellec and Dirk Pilat* 41

3. The Role of ICT on the Spanish Productivity Slowdown; *Matilde Mas and Javier Quesada* 61

4. Multi-factor Productivity Measurement: from Data Pitfalls to Problem Solving – the Swiss Way; *Gregory Rais and Pierre Sollberger* 81

5. Innovation and Labour Productivity Growth in Switzerland: An Analysis Based on Firm Level Data; *Spyros Arvanitis and Jan-Egbert Sturm* 101

**PART 2: THE MEASURE OF LABOUR INPUT** 113

6. On the Importance of Using Comparable Labour Input to Make International Comparison of Productivity Levels: Canada-U.S., A Case Study; *Jean-Pierre Maynard* 115

7. Labour Productivity Based on Integrated Labour Accounts – Does It Make any Difference?; *Kamilla Heurlén and Henrik Sejerbo Sørensen* 145


**PART 3: THE MEASURE OF THE COMPOSITION OF LABOUR INPUT** 211

9. Main Sources of Quarterly Labour Productivity Data for the Euro Area; *Wim Haine and Andrew Kanutin* 213


11. Labour Input Productivity: Comparative Measures and Quality Issues; *Antonella Baldassarini and Nadia Di Veroli* 239
### TABLE OF CONTENTS

*Guido Schwerdt and Jarkko Turunen*  
259

#### PART 4: THE MEASURE OF CAPITAL INPUT  
283

13. International Comparisons of Levels of Capital Input and Multi-factor Productivity;  
*Paul Schreyer*  
285

14. Research and Development as a Value Creating Asset;  
*Emma Edworthy and Gavin Wallis*  
303

15. Empirical Analysis of the Effects of R&D on Productivity: Implications for productivity measurement?;  
*Dean Parham*  
337

16. Infrastructures and New Technologies as Sources of Spanish Economic Growth;  
*Matilde Mas*  
357

*Massimiliano Iommi, Cecilia Jona-Lasinio*  
379

#### PART 5: THE MEASURE OF INDUSTRY LEVEL MULTI-FACTOR PRODUCTIVITY  
395

18. Productivity Measurement at Statistics Netherlands;  
*Dirk van den Bergen, Myriam van Rooijen-Horsten, Mark de Haan and Bert M. Balk*  
397

19. Sectoral Productivity in the United States: Recent Developments and the Role of IT;  
*Carol Corrado, Paul Lengermann, Eric J. Bartelsman and J. Joseph Beaulieu*  
435

*Paul Roberts*  
455

21. Shopping with Friends gives more Fun; How Competition, Innovation and Productivity Relate in Dutch Retail Trade;  
*Harold Creusen, Björn Vroomen and Henry van der Wiel*  
479

22. Economic Growth in Sweden, New Measurements;  
*Tomas Skytesvall and Hans-Olof Hagén*  
505

23. Estimates of Labor and Total Factor Productivity by 72 Industries in Korea (1970–2003);  
*Hak K. Pyo, Keun Hee, Rhee and Bongchan Ha*  
527

List of Contributors  
551