

Towards a Labour Price Index

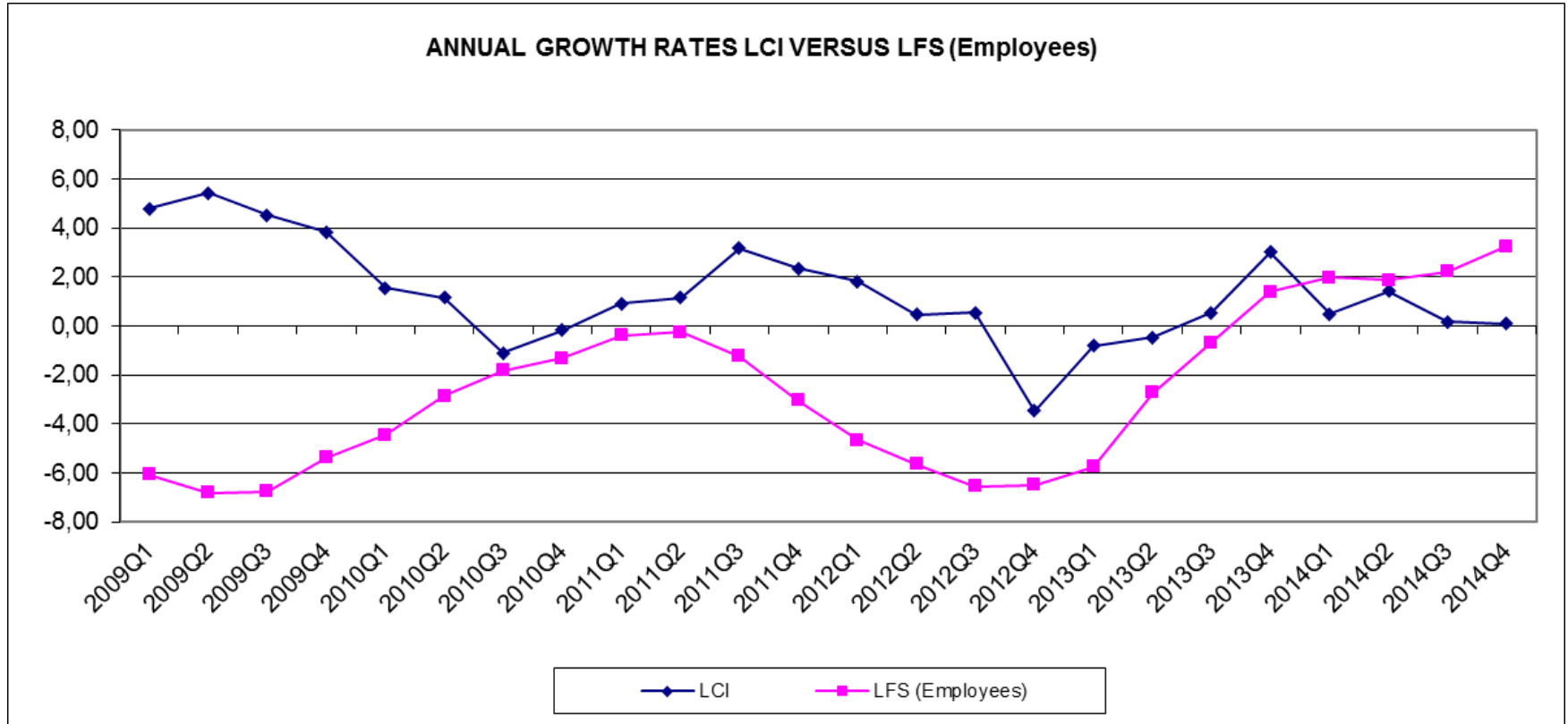
Workshop on Labour Costs

Rome, 5 - 6 May 2015

Labour Market Statistics Directorate
National Statistical Institute of Spain



Why a Labour Price Index ?



LPI Definition

The LPI should provide a measure of changes over time in the price paid for labour but it should not be affected by changes in the quality or quantity or work performed. i.e. by changes in the composition of the labour force, hours worked, or changes in characteristics of employees

LPI Requirements

- ✓ A sample of units (local units or establishments)
- ✓ A sample of jobs in each unit
- ✓ A sample of employees in each job

Information on each local unit:

- ✓ Economic activity (NACE rev.2)
- ✓ Region
- ✓ Size

Information on each individual employee:

- ✓ Personal characteristics
- ✓ Job characteristics
- ✓ Labour cost components
- ✓ Hours worked

Major formulas

Let c a basic cell composed of data from a defined set of employees, sorted by the main characteristics of the jobs in which they work. Then:

ω_c^k : is the hourly labour costs for the employees working in c in year k .

h_c^k : is the hours worked by the employees working in c in year k .

$W_c^k = \omega_c^k \times h_c^k$: is the labour costs of employees working in c in year k .

The basic Laspeyres formula to calculate the LPI for year j with base year k is:

$$\text{LPI}_{j(k)} = \frac{\sum_c \omega_c^j h_c^k}{\sum_c \omega_c^k h_c^k} = \frac{\sum_c \omega_c^j \frac{\omega_c^k}{\omega_c^k} h_c^k}{\sum_c W_c^k} = \frac{\sum_c \frac{\omega_c^j}{\omega_c^k} \omega_c^k h_c^k}{\sum_c W_c^k} = \frac{\sum_c \frac{\omega_c^j}{\omega_c^k} W_c^k}{\sum_c W_c^k}$$

Weights

Major formulas

INSTITUTO NACIONAL DE ESTADÍSTICA The annual link for year j to j+1 is:

$$L_{j, j+1} = \frac{\sum_c \omega_c^{j+1} h_c^j}{\sum_c \omega_c^j h_c^j} \longrightarrow \text{LPI}_{j+1}(j)$$

The Laspeyres chain index formula for year j for a set of Q cells c with reference year k is defined:

$$IPT_{j(k), Q} = 100 * IPT_{k+1(k), Q} * IPT_{k+2(k+1), Q} * \dots * IPT_{j-1(j-2), Q} * IPT_{j(j-1), Q}$$

Information Used

The Structure of Earnings Surveys (fouryearly and annual) is the source chosen to obtain the LPI.

The random unit selection procedure corresponds to two-stage stratified sampling where the first stage units are local units, while the second stage units are the employees.

Sample size 28,000 units and 215,000 employees

Information on each local unit:

- ✓ Economic activity (B-S NACE rev.2)
- ✓ Region (17 regions)
- ✓ Size (all sizes included)

Information on each individual employee:

- ✓ Personal characteristics (Gender, age, citizenship)
- ✓ Job characteristics (Occupation by ISCO-08, type of contract, contractual working time, seniority in the unit)
- ✓ Wages and salaries
- ✓ Hours paid

Level of disaggregation of the variables

Information on each local unit:

- ✓ Economic activity → 18 sections (B-S NACE rev.2)
- ✓ Regions → 17 regions
- ✓ Size → 8 size classes (1-4, 5-9, 10-19, 29-49, 50-99, 100-199, 200-499, ≥500)

Information on each individual employee:

- ✓ Gender → 2 categories (male and female)
- ✓ Age → 5 intervals (<25, 25-34, 35-44, 45-54, >55)
- ✓ Citizenship → 2 categories (resident with citizenship and resident with foreign citizenship)
- ✓ Occupation → 9 categories (main groups of ISCO-08, 6-7 joined)
- ✓ Type of contract → 2 categories (indefinite duration and temporary/fixed duration)
- ✓ Contractual working time → 2 categories (full-time and part-time)
- ✓ Seniority in the unit → 6 intervals (<1, 1-3, 4-10, 11-20, 21-29, ≥30)

More than 100,000 combinations are obtained !!

Regression Model

For each year a , it is assumed that the hourly earnings, G , of the employees belonging to cell c , is:

$$l_c^a = \ln G_c^a = x_c' \beta^a + \varepsilon_c^a \quad (1)$$

Where,

x_c' is a vector of dimension $(1 \times p)$ of characteristics

β^a is a vector of p unknown parameters, of dimension $(p \times 1)$

ε_c^a is the random component of the model in the year a that verify:

$$\begin{aligned} E[\varepsilon_c^a] &= 0 \\ \text{Cov}[\varepsilon_c^a, \varepsilon_d^a] &= 0, \quad \forall c \neq d \\ \text{Var}[\varepsilon_c^a] &= \sigma_a^2 \end{aligned}$$

Regression Model

As the data used in the regression model are derived from samples drawn from a population with a given sample design, it is used ordinary least squares estimator weighted by the sampling weights (WOLS) from β^a :

$$\hat{\beta}^a = (X^{a'} W^a X^a)^{-1} X^a W^a L^a$$

Where, W^a

is a diagonal matrix of dimension $n^a \times n^a$ of sampling weights, and its variation is:

$$\text{Var}[\hat{\beta}^a] = \sigma_a^2 (X^{a'} W^a X^a)^{-1} X^{a'} W^{a2} X^a (X^{a'} W^a X^a)^{-1} = V^a$$

Where the matrix, V^a has dimension $p \times p$

Regression Model

In the compilation of the LPI, it is necessary to have, for each year, the estimated average hourly earnings corresponding to each cell. This estimated hourly earnings is obtained using the formula (1); thus, the estimated hourly earnings of cell c , in year a , is the following:

$$G_c^a = \exp(x_c' \hat{\beta}^a)$$

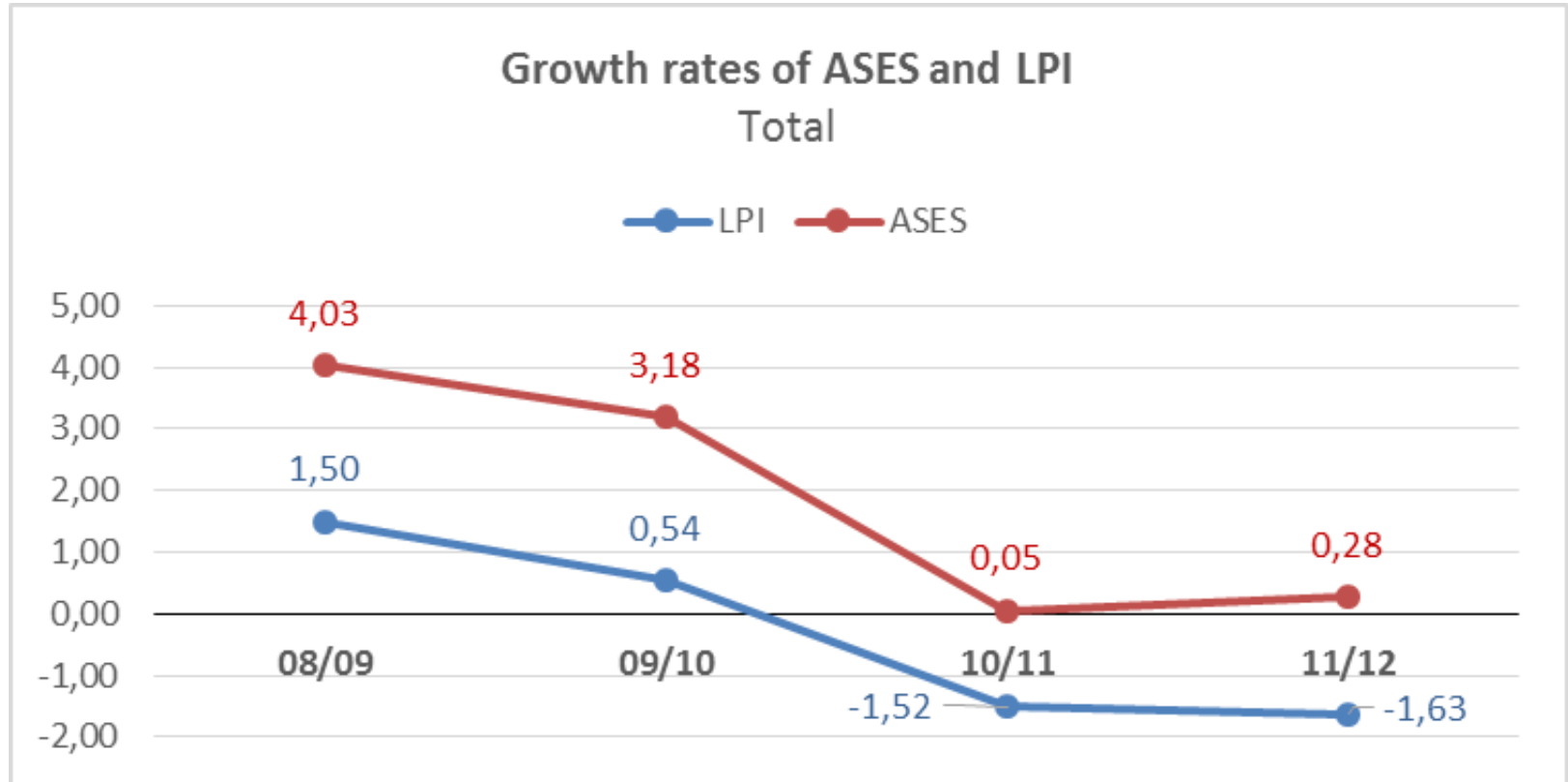
It is a biased estimator. To correct the bias:

$$\hat{G}_c^a = \exp \left\{ x_c' \hat{\beta}^a - \frac{1}{2} x_c' \hat{V}^a x_c + \frac{1}{2} \hat{\sigma}_a^2 \right\}$$

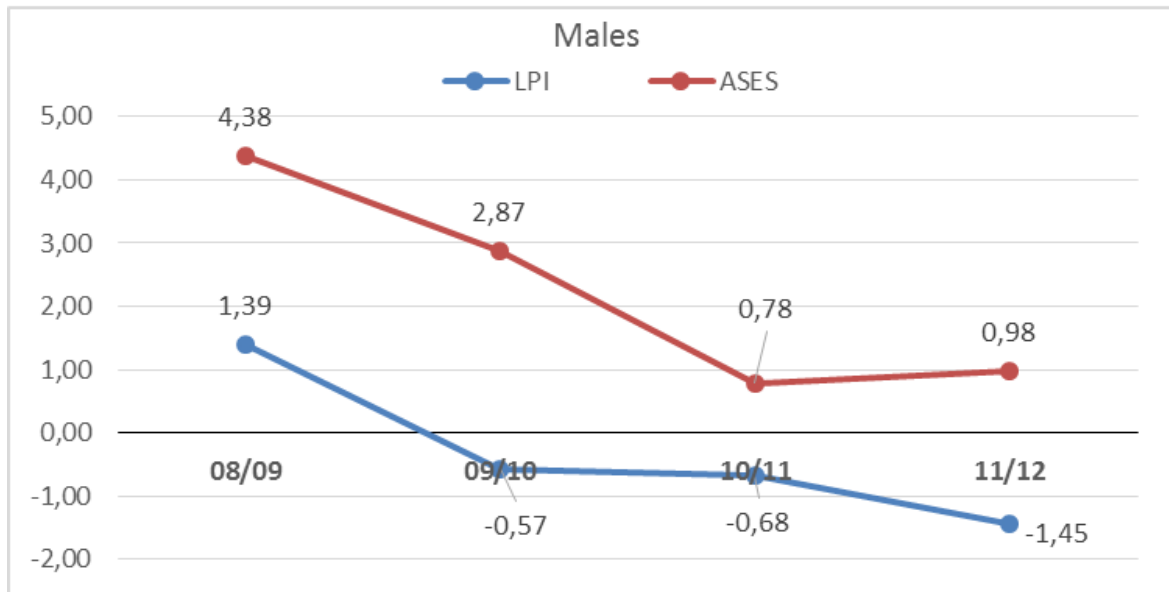
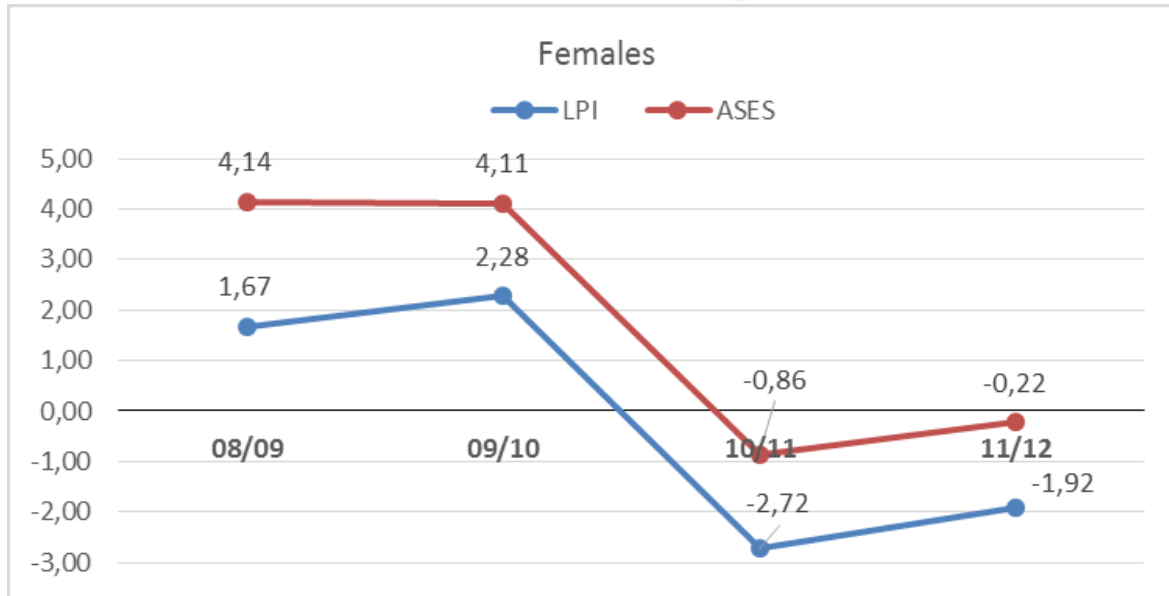
Where,
$$\hat{\sigma}_a^2 = \frac{1}{n^a - p} \sum_c^{n^a} (e_c^a)^2$$

being
$$e_c^a = l_a^c - x_c' \hat{\beta}^a$$

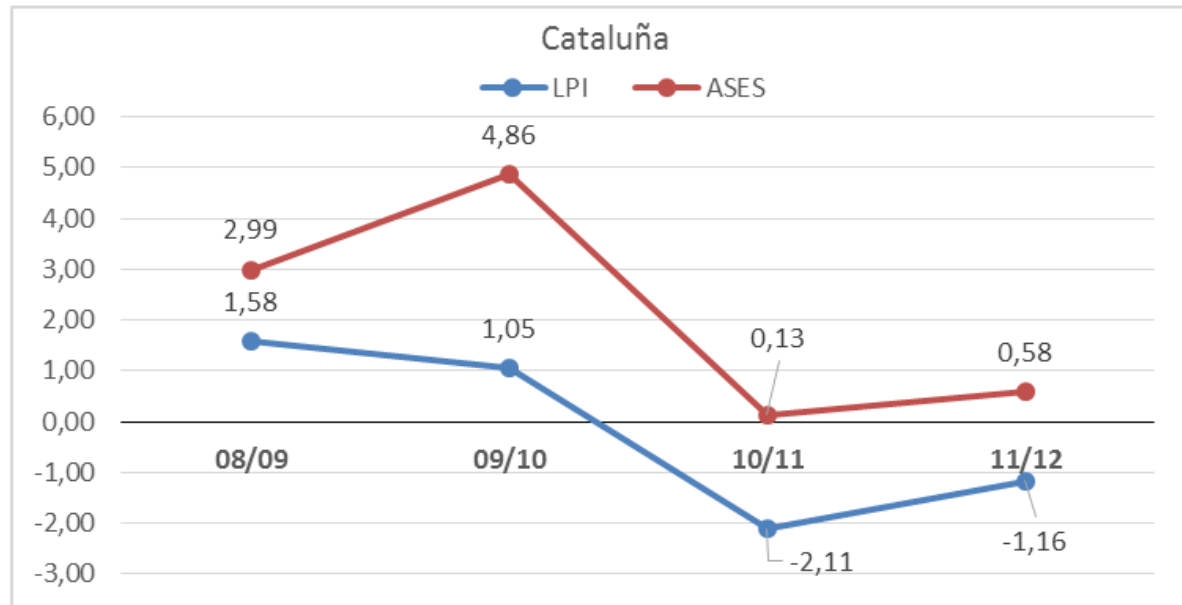
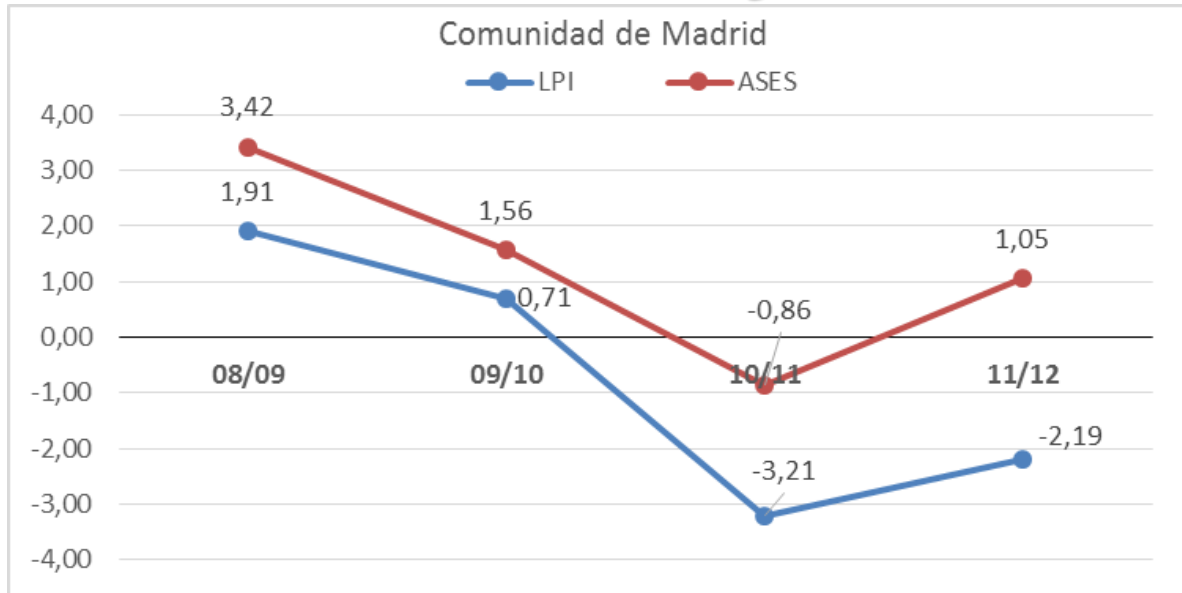
Preliminary results



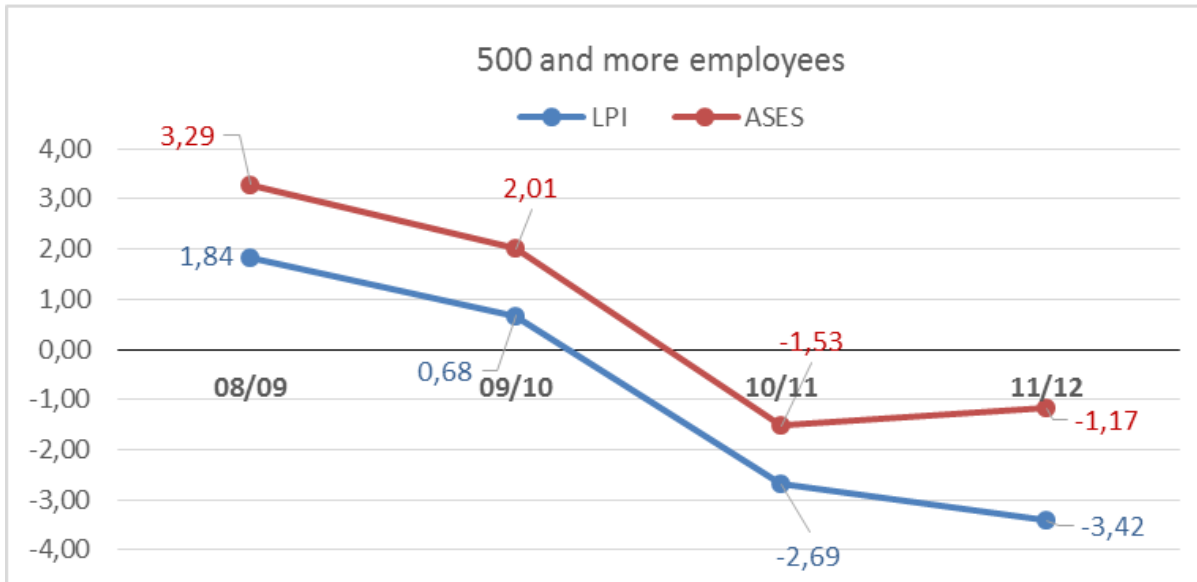
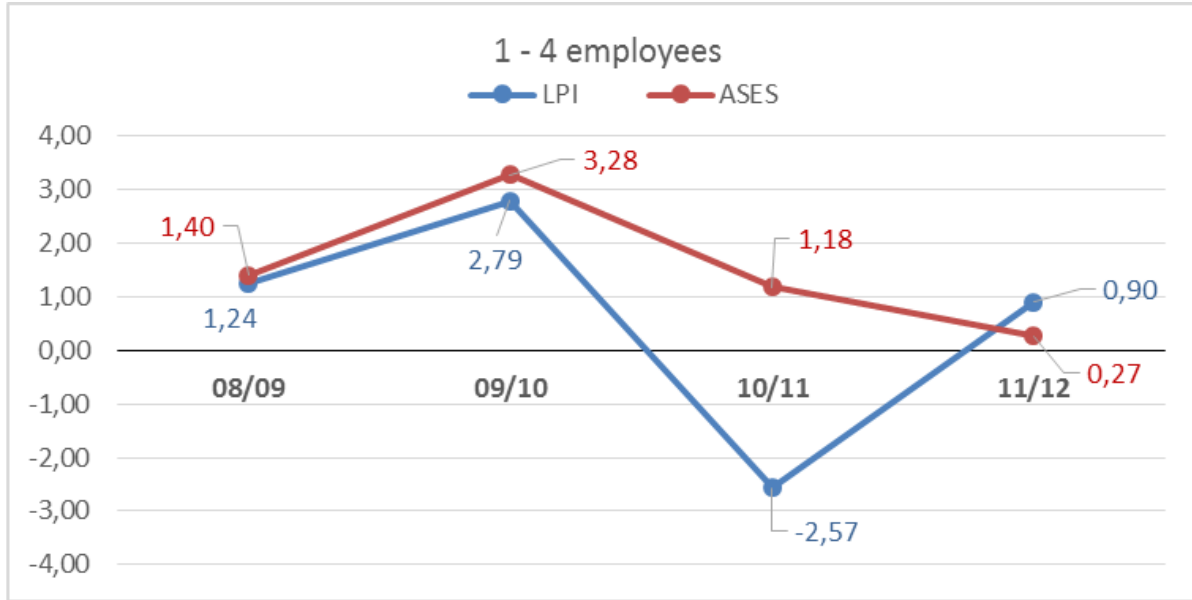
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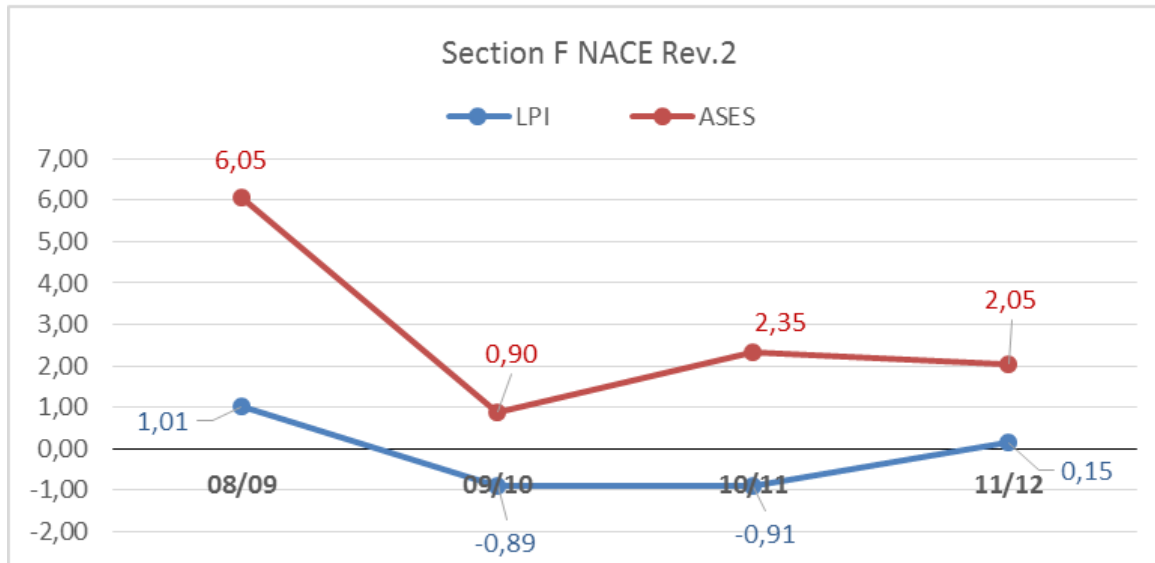
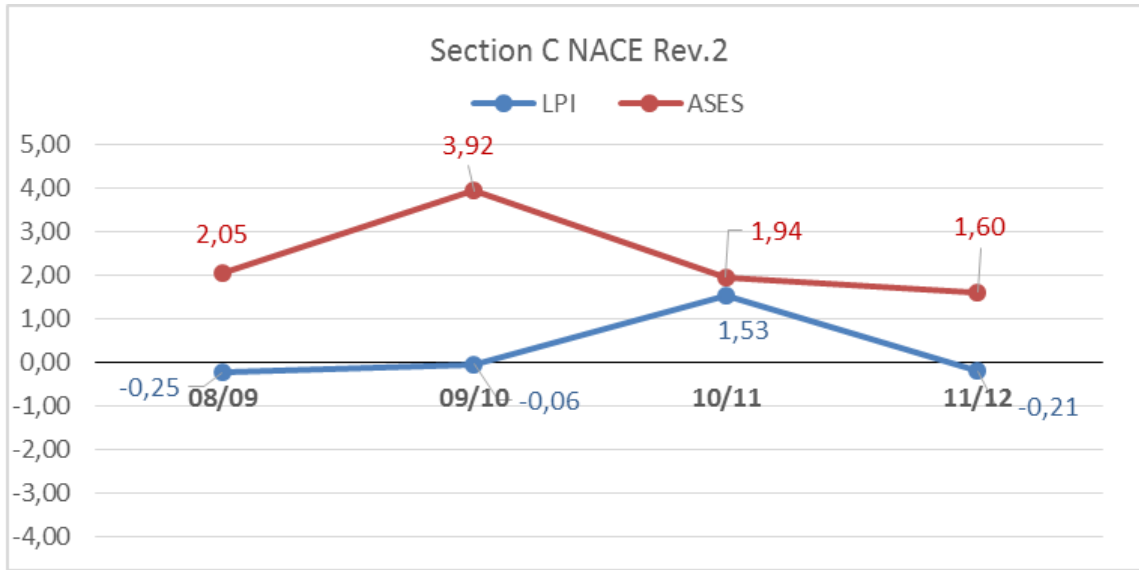
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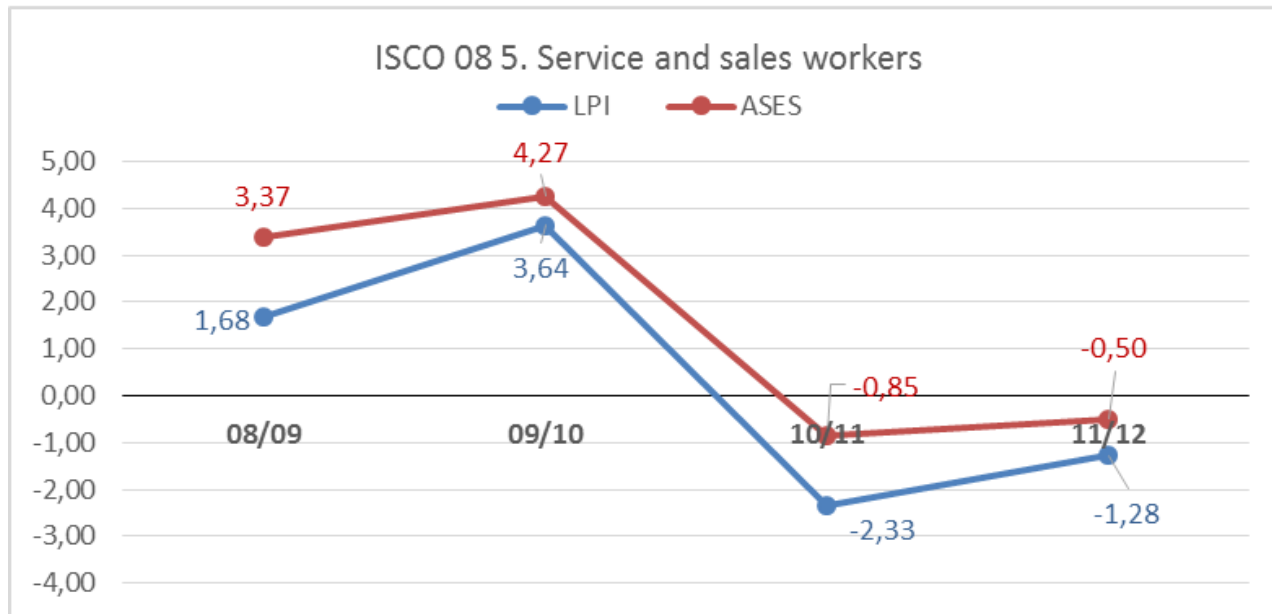
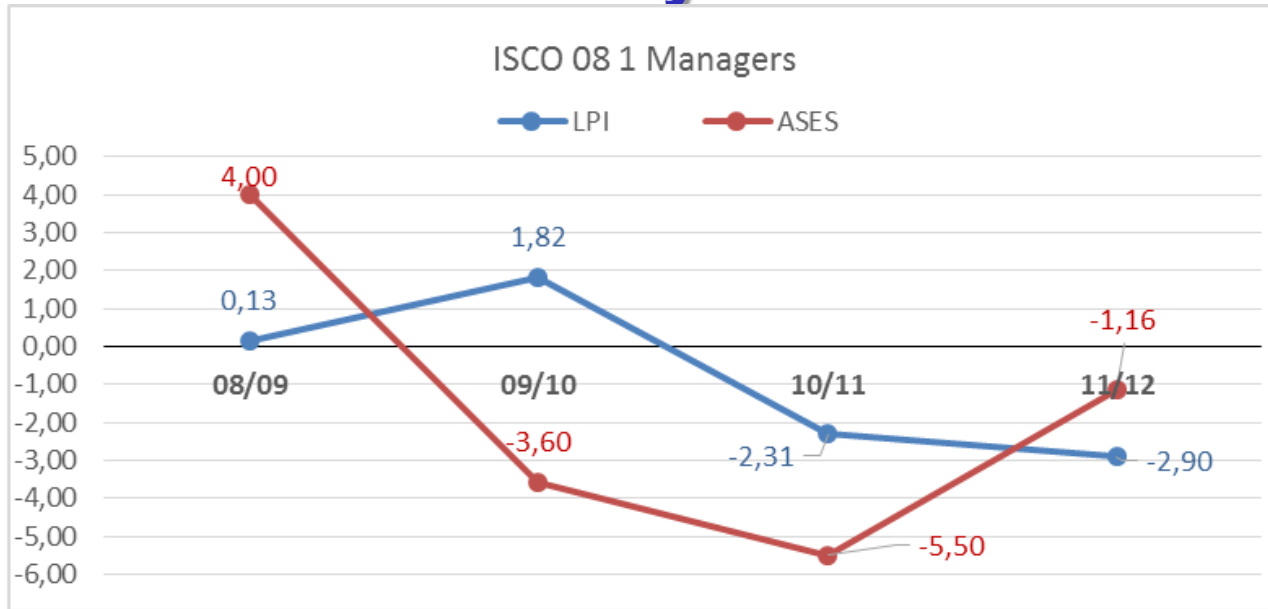
Preliminary results



Preliminary results



Preliminary results



Conclusions

- The results obtained using this methodology show that the changes in the employment composition in recent years have had an impact in the evolution of the hourly earnings shown by the classical surveys.
- The advantage of this method is its low cost because it is performed only by using existing sources.
- It is a novel technique that has already been used in other statistics as the Housing price index (HPI). The design and development process of the HPI has been carried out in coordination with the Statistics Office of the EU (Eurostat).
- It seems that this kind of indicator should be a short term indicator, quarterly at least, but the cost and burden to carry out a short term survey as the ASES give sense to obtain this statistic only annually.

Thanks for your attention

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