Documentation to calculate the monthly unemployment rate

1.0 Introduction

The new IESS framework regulation is intended to harmonise the social statistics domain. Part of the regulation will also be addressing the production of monthly unemployment rates (MUR) based on the Labour Force Survey (LFS). The computation of this indicator is based on an integrated model which takes into consideration administrative data on unemployment which national governments collect for statistical and non-statistical purposes.

At a national level, data on registered unemployment is recorded by Jobsplus, the public employment service provider. This data is collected on a monthly basis, and whilst the methodology and levels are not directly comparable amongst Member States (MS), the month to month changes could be used as an indicator for developments over the short term. The LFS provides the comparable quarterly benchmarks for unemployment levels to which the indicator of monthly movements based on registered data is linked.

This documentation goes through the mixed approach method which is the methodology adopted by Malta to calculate the MUR. The combination of LFS and Jobsplus data allows a quick and efficient response to users' needs.

2.0 Data sources

The sources of data used for the compilation of MUR are LFS and Jobsplus. A total of eight series are required from both sources as identified below:

Jobsplus monthly data on registered unemployment and registered employment since January 2005 for the following categories:

15 - 24	M_U25	Unemployed Males between 15 and 24 years
15 - 24	F_U25	Unemployed Females between 15 and 24 years
25 - 74	M_O25	Unemployed Males over 24 years
25 - 74	F_O25	Unemployed Females over 24 years

15 - 24	M_E_U25	Employed Males between 15 and 24 years
15 - 24	F_E_U25	Employed Females between 15 and 24 years
25 - 74	M_E_O25	Employed Males over 24 years
25 - 74	F_E_O25	Employed Females over 24 years

Quarterly LFS data on employment and unemployment are in line with International Labour Organisation (ILO) definitions.

3.0 Benchmarking – Modified Denton Method

The compilation of monthly unemployment rates necessitates the transformation of a quarterly series to produce a monthly series using a monthly source of data. This can be done through the use of various temporally disaggregation methods such as Chow Lin or using benchmarking methods such as Modified Denton Method. For the compilation of national MUR's, the Modified Denton method is being used as the benchmarking technique.

3.1 Overview of the Modified Denton Method

The Modified Denton method, as described in (Chen, 2007) is a disaggregation method which uses an indicator to disaggregate low frequency into high frequency data. This is done by minimizing the differences between any two consecutive benchmark factors. Through this approach monthly unemployment levels are proxied by the quarterly value of the LFS (K_q) divided by the registered unemployment I_t. The minimization is done subject to the condition that the average value of the three monthly unemployment figures given by Denton method (X_t) within a quarter remain equal to the actual quarterly value of the LFS.

$$\min_{x_1,\ldots x_{3\beta}} \sum_{t=2}^{3\beta} \left[\frac{X_t}{I_t} - \frac{X_{t-1}}{I_{t-1}} \right]^2, t \in \{1,\ldots,(3\beta)\}$$

Subject to

$$\frac{1}{3} \sum_{3q-2}^{3q} X_t = K_q \quad \text{for each q}$$

K_q = level of quarterly benchmark from LFS for quarter q;

I_t = level of indicator from Jobsplus for month t

t = time, where t = 3q - 2 is equal to the first month of quarter q,

t = 3q is the third month of quarter q

β = last quarter q for which the quarterly benchmark (LFS) is available

The input (primary) series are

K_q: Quarterly continuous LFS measured in levels (whether employment or unemployment depends on the context)

I_t: Monthly registered Jobsplus data in levels (whether employment or unemployment depends on the context)

The output series are

X_t: Monthly continuous disaggregated Denton output in levels (employment and unemployment levels)

3.2 Application of Modified Denton Method in JDemetra 2.2

The Modified Denton method application, as described in section 3.1, is installed in JDemetra 2.2. The method applied is the multiplicative model with the average as type of temporal aggregation, which produces monthly interpolation figures till the latest LFS data on hand. This monthly disaggregated series produces the Non-Seasonally Adjusted (NSA) figures for the employment and unemployment series till the latest LFS quarterly data available. As a result, forecasting is essential for the last 3 to 4 months, where LFS data is not available.

3.3 Forecasting the last 3 to 4 months

A forecasting technique is used to estimate data related to the last 3 to 4 months where LFS data is not available. Different approaches are used when forecasting employment and unemployment series.

Forecasting the employment series

Forecasts of employment data are done by using the Denton output for the four employment monthly series presented in section 2 of this document. An ARIMA model using JDemetra 2.2 is fitted to the data and forecasted employment series are extracted directly following the model selection. More information on time series modelling is presented in section 4 of this document.

Forecasting the unemployment series

For the unemployment series, the forecasts are done in a more complex way as Jobsplus data is being used. From the disaggregated Denton output for the four unemployment monthly series, presented in section 2 of this document, the BI ratio is computed as follows:

BI ratio$_{t-1}$ = X_{t-1} (Demetra disaggregated output)/ I_{t-1} (original)

Where, t-1 represents the previous month and

X_{t-1}: Monthly continuous disaggregated Denton output in levels (unemployment series only)

I_{t-1} : Monthly registered unemployment Jobsplus data in levels

An ARIMA model using JDemetra 2.2 is fitted to the BI ratio. The forecasted BI ratio series are extracted directly following the model selection (for the last 3 to 4 months where the LFS data is not available). More information on time series modelling is presented in section 4 of this document.

The forecasted BI ratio for the last 3 to 4 months is used to calculate the benchmarked NSA estimates as follows:

NSA unemployment estimate$_t$ = BI ratio$_t$ / I_t

These final estimates produce the NSA monthly unemployment rate.

4.0 Seasonal adjustment

Analysis of time series typically seeks to establish the general pattern of the data, any long term movements, and whether any unusual occurrences have had major effects on the series. This type of analysis is not straightforward when one is dependent on raw time series data, because there will normally be short-term effects, associated with the time of the year, which have a bearing on other movements. (Nau, 2014) The purpose of seasonal adjustment (SA) is to remove systematic calendar related variations associated with the time of the year, i.e. seasonal effects. This facilitates comparisons between consecutive time periods.

4.1 Seasonal Adjustment procedure

In all economic data there is a seasonal effect. If the seasonal effect is removed than one can compare t-1. For monthly data one can compare data as follows:

- Raw data publish t with (t-12) months
- SA data publish t with (t-1) months

To seasonally adjust an aggregated series one can use two approaches:
INDIRECT: SA (Aggregate) = SA(A) + SA(B) + SA(C) + SA(D)
DIRECT: SA(Aggregate) = SA(A+B+C+D)

For the MUR, the indirect approach is used and seasonal adjustments are carried out on the NSA levels (computed in section 3) and not on the rates directly. As a result, the 8 series referred to in section 2.0 of this document are used.

Preliminary Steps for model identification

Graphical representation of each single time series is important to identify patterns depending on the economic structure. When analysing series it is important to take into consideration the economic situation of the country at a specific point in time so as to analyse data more appropriately.

Following model fitting, if the seasonal pattern is not present and seasonal tests fail, it is advisable not to include the seasonal pattern, and quote the original unadjusted series.

Another factor which is important to consider when carrying out seasonal adjustments, is the length of the time series. When adjusting monthly data one should have a minimum of 3 years (36 readings). Ideally a series should be between 7 and 10 years, more than this length would imply using out of date information which might have a bearing on the SA outcome, whereas a shorter series might reflect in poorer SA results (Eurostat, 2018). In the case of the MUR, SA is done from 2010 onwards.

According to Nau (2014), the appropriate form of seasonal ARIMA model is classified as:

ARIMA = (**p, d, q**) x (**P, D, Q**)
where

p, d, q are the orders of the regular part of the model and
P, D, Q are the orders of the seasonal part
p / P is the order of the Auto Regressive (AR) model / seasonal model
q / Q is the order of the Moving Average (MA) model / seasonal model
d / D is the order of differencing to make the time series stationary / seasonality stationary

4.2 Application of Tramo/Seats ARIMA in Demetra+

The seasonal adjustments are carried out with JDemetra 2.2 using the Tramo/Seats application for ARIMA models. New models for seasonal adjustment are identified, following the release of LFS data for the last quarter of each year. Models are identified and fixed each year, but coefficients of ARIMA models could be estimated each month.

Nau (2014) describes optimal time series model fitting and practical ways for model selection. The focus of the time series modelling is put on the detection of seasonality, the quality of the ARIMA model, the stability of the adjustment and the revision analysis. JDemetra 2.2 provides a wide range of measures to assess the quality, accuracy and reliability of the time series model selection (Grudkowska, 2017).

Simultaneously, several tests can be used to check for the seasonal pattern. Checks in JDemetra 2.2 include Freidman and Kruskall-Wallis tests where the time series is checked for stable seasonality and a combined seasonality test is used to assess moving seasonality (Grudkowska, 2017).

In addition, JDemetra 2.2 provides automatic outlier detection and correction procedures for additive outliers (AO), Transitory change (TC) and Level shift (LS) outliers.

Following time series modelling, the Trend, Seasonal and Irregular components can be extracted. The seasonal component provides the seasonally adjusted levels necessary to compute the seasonal monthly unemployment rate.

5.0 Quality measures

The challenge of MUR estimation boils down estimating accurately the monthly pattern within an existing quarterly benchmark i.e. the month-to-month changes.

To assess the accuracy of the different methods, it is then proposed to analyze the volatility and revisions of the month-to-month changes in MUR data. This is done for both NSA and SA series. However, the IESS regulation bases the quality measures on the final SA estimates.

5.1 Volatility

EUROSTAT (2015) recommended that for an acceptable total monthly unemployment rate (MUR), the volatility should be based on two tests:

- The frequency of double large (>0.2) inversions < 5%

The frequency of double large inversions calculated as the proportion of observations surrounded by two consecutive large inversions in opposite directions. A large inversion is recorded when the monthly unemployment rate varies by 0.2 percentage point or more. This indicator should remain below 5 %;

- The correlation between month-on-month changes belongs to the [-0.3; 0.75] interval.

The correlation of month-on-month changes calculated as the correlation coefficient between the series of the month-on-month changes and the same series lagged by one month (i.e. first order autocorrelation coefficient). This indicator should remain within the [-0.3; 0.75] interval;

5.2 Revision

Due to the method adopted, revisions are present in the estimates calculated. Revisions are caused by the following:

1. Inclusion of the most recent LFS data in the calculation NSA process.

The monthly estimates are released at approximately 30 days from the reference month. Later, when the quarterly LFS estimates are produced, the NSA estimates of the three months are recalculated. The NSA monthly estimates are then revised, at the moment of release of the first month following the reference quarter.

2. Updates to the seasonally adjusted (SA) series whenever new monthly data are added.

The monthly seasonally adjusted series are estimated every month including the latest available data, and updating the estimate of the models parameters. With reference to the seasonally adjusted data, therefore, revisions are observed every month.

3. Updates of seasonal adjustment models with complete annual data

Following the release of LFS data for the last quarter of each year, new models for seasonal adjustment are identified. Hence, revisions are observed every month.

4. Revisions in LFS data

Periodically, the monthly estimates will be subject to revision due to revisions in LFS data. Changes in LFS estimates are done intermittently to align the estimates with population figures.

EUROSTAT (2015) recommended that for an acceptable total monthly unemployment rate (MUR), revision quality indicator should be based on the two tests:

- The frequency of very large revision in levels (>0.3) < 10%

The frequency of very large revisions in levels calculated as the proportion of monthly observations in levels that are revised by more than 0.3 percentage points between the first estimate and the revised data that are released six months later. This indicator should remain below 10%;

- The frequency of large revision in month-on-month changes (>0.2) < 10%

The frequency of large revisions in month-on-month changes calculated as the proportion of observations with month-on-month changes that are revised by 0.2 percentage point or more between the first estimate and the revised data that are released six months later. This indicator should remain below 10%.

5.3 Margin of error

For evaluating the accuracy of the estimates produced by a sample survey, it is necessary to take into account the sampling error that arises from observing the variable of interest only on a part (sample) of the population. In general, statistical offices do not publish sampling errors referring to seasonally adjusted estimates. In most cases, the sampling errors of the non-seasonally-adjusted estimates are used, considering that these are similar to those related to the corresponding seasonally adjusted estimates. Hence, the margin of error for the MUR estimates are in line with those published by NSO in the LFS Quarterly news releases.

6.0 Conclusion

Continuous monitoring of the MUR, along with their quality measures are done each month to consolidate the calculation of national monthly unemployment rates. Apart from these factors, one has to keep in mind the economic situation of the country whilst analysing such series.

Reference

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