

End point issues of the OECD Unit Labour Cost series during global financial crisis

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1. Introduction and motivation

The OECD has been publishing a set of quarterly and annual unit labour costs (ULCs) and related indicators from 1970Q1 via the OECD System of Unit Labour Costs and Related indicators (SULCRI) since March 2007. Trend-Cycle ULCs have been used as target ULC series in the quarterly OECD ULC Press Release. Due to the current global financial crisis, end point problems of trend-cycle and seasonally adjusted series have been magnified in the most recent ULC series. Thus, we are seeking optimal solutions to deal with these problems.

This paper aims to initiate a forum to discuss how best to deal with this problem by sharing OECD experiences. In order to facilitate discussions, this paper presents the evolution of trend-cycle and seasonally adjusted series between the first quarter of 1990 and second quarter of 2009 for a few strategic series, i.e. ULCs industry and manufacturing for France, Germany and Japan. Main causes of revisions are examined: if the cause is due to revisions of raw data and/or (mostly) due to change in position/timing of outliers at the end point, or change of ARIMA models? We also examine if treatment of partial unemployment measures in national accounts distorts the series, in particular for Germany but less extent for France. In this case, end points are semi-outliers as they result from the crisis but also from stimulus plans which distort the actual compensation of employees.

This paper is organised as follows. ULCs definition, the OECD SULCRI and OECD seasonal adjustment procedure for ULCs are presented in Sections 2, 3 and 4 respectively. Section 5 deals with various issues raised in the compilation of OECD ULCs during the global crisis. Conclusions and questions are listed in the last section.

¹ The authors are staff members of the OECD Secretariat but the discussions in this paper are personal ones. At the same time, please note that authors used extensively of contents in the OECD System of Unit Labour Costs and Related Indicators for the preparation of Sections 2, 3, 4 and 5.

2. Unit Labour Costs definition

ULCs are defined as the average cost of labour per unit of output². ULCs are generally calculated as the ratio of nominal labour compensation to GDP or value added volumes. Ideally, labour compensation would include wages and salaries, bonuses and all other costs such as employers' contributions to social security and pension schemes or taxes on employment as well as the compensation of self-employed. However, the available National Accounts data for labour compensation (using international standards) only refers to the compensation of employees. The compensation of self-employed is mixed with other capital returns in the gross operating surplus. In addition, taxes are excluded from the compensation of employees' calculation. Given these data limitations, an assumption is generally made on the compensation of self-employed persons, i.e. that it is equal to the compensation of employees, for which data are available. The taxes on employment are generally either disregarded or data are corrected for these additional costs from other sources.

The labour input may vary between data expressed in persons, hours or full-time-equivalent according to the implementation of the definition. Nevertheless, it is internationally recognised that actual hours worked are the measure of labour input for the calculation of the derived employment indicators as labour productivity and, consequently, the ULCs. The use of the hours worked is particularly interesting in a dynamic economic situation where it can be hypothesised that changes in the number of persons employed might be led by an earlier changes in the number of hours worked.

OECD calculation method

The OECD calculates the annual ULC from the annual national accounts data. The series used are constant price value added, compensation of employees, and employment and employees data based on both hours worked (preferred measure) and persons, all at annual frequency for the total economy and the seven economic activities defined above. The formula for the compilation of the annual ULCs is as follows:

$$\text{ULC} = \text{Total Compensation} / \text{Constant price Value Added} \quad (1)$$

In order to compile total labour compensation from annual compensation of employees, the data on employment based on hours and persons are used. The annual total Employment to Employees ratio or Self-employment (SE) ratio is compiled as follows:

² Changes in ULCs relate the growth of labour costs to the growth in output and can be further analysed via its components including compensation per unit of labour input (usually proxy by compensation per employee) and labour productivity.

$$\textit{Total hours worked / employees' hours worked} \quad (2)$$

(2) Is the preferred measure of the Self-employment ratio. If hours worked are not available, employment/employees data are used instead as follows:

$$\textit{Total number of persons employed / number of employees} \quad (3)$$

Following this, the overall labour compensation is calculated as:

$$\textit{Annual compensation of employees * SE ratio} \quad (4)$$

All annual value added volume series are rebased to the year 2005. In addition, on an annual basis, the OECD performs an adjustment for the ownership of dwellings. In the case of *Ownership of Dwellings* there are no employees, and so this component of value added has nothing to do with the relationship between output and labour costs. Consequently, it should ideally be removed from calculations of ULC indexes which cover ISIC division K.

The **annual ULCs** are then calculated by dividing total compensation of employees resulting from (4) by the annual value added volume series (base year 2005; with economic activity J_K adjusted for ownership of dwellings), as indicated in (1).

The calculation of the **quarterly ULCs** series strictly depends on the previous calculation of the annual data. Quarterly compensation of employees and value added volumes are retrieved from the OECD's Quarterly National Accounts database and eventually completed with the most suitable official proxy series from National Statistical Institutes and Eurostat. The quarterly indicator series of real output and total labour costs are benchmarked to their conceptually superior annual series (as outlined above), using the Fernández method of temporal disaggregation via the ECOTRIM software. As a result, quarterly compensation of employees is adjusted to include the compensation of self-employed by grossing up the quarterly data to the annual series, with the assumption that this does not significantly change on a quarterly basis. In the same way, the effect of the adjustment for ownership of dwellings is reflected in the quarterly benchmarked real output series. The process of temporal disaggregation itself and the filtering methods used to produce the final quarterly ULC index trend-cycle series can also help to mitigate some of the quality issues associated with quarterly proxy data. In addition, where feasible, the annual ULC series are interpolated in order to compute additional backdata for the quarterly Trend-Cycle ULC series, by applying the univariate Denton method incorporated in ECOTRIM.

All the ULC compilations are performed on raw series. Then, seasonally adjusted and trend-cycle quarterly ULC series are compiled using ARIMA models and parameters as estimated using the TRAMO-SEATS method in the DEMETRA software. In the process, a correction for trading day and Easter effects is included. The models are changed on an annual basis in July. However, during the quarterly update, a re-estimation of the ARIMA model could be deemed necessary in case of poor diagnostic tests for the seasonal adjustment. Once all country data (including the euro area) are compiled, various geographical zone aggregates are also calculated.

3. OECD System of Unit Labour Costs and Related Indicators

The OECD has been publishing a set of quarterly and annual ULCs and related indicators via the OECD System of Unit Labour Costs and Related indicators (SULCRI) since March 2007³. It consists of a very complete dataset of OECD country data for ULCs and components at annual and quarterly frequencies.

Indicators compiled

The following indicators are available at a quarterly frequency:

- Unit labour cost index: raw, seasonally adjusted and trend-cycle;
- Total labour costs: raw temporally disaggregated national currency series; and
- Real output: raw temporally disaggregated national currency series.

And more than ten additional indicators are also provided with annual frequency.

Level of detail

The indicators are available for all OECD member countries, non-OECD EU member countries, the euro area, together with zone aggregate totals (OECD total, Major Seven economies, OECD Europe, European Union, OECD total less high inflation countries). Annual ULCs are also available for Brazil and South Africa. ULCs are available for eight economic activities according to ISIC rev. 3:

- Total Economy;
- Manufacturing (ISIC D);
- Industry (ISIC C_E);
- Construction (ISIC F);
- Trade, Transport and Communication (ISIC G_I);
- Finance and Business Services (ISIC J_K);
- Market Services (ISIC activity based proxy G_K); and
- Business Sector excluding Agriculture (ISIC activity based proxy C_K).

³ “The OECD System of Unit Labour Cost and related indicators”, OECD Statistics Working Paper, March 2008

Timeliness and data sources

Quarterly ULCs, Total Labour Costs (benchmarked) and Real Output (benchmarked) are updated in the OECD Data warehouse “OECD.Stat Extracts” on a quarterly basis at t+135 and in the Main Economic Indicators (MEI) electronic and paper publications at t+120. Annual ULCs and related indicators are updated on an ongoing basis when annual national accounts data are updated. The OECD Annual and Quarterly National Accounts databases are used as source data. When National Accounts data are not available, they are replaced by the most suitable national proxy series (e.g. quarterly compensation of employees can be approximated by gross wages and salaries or constant price value added by the industrial production index). These series are updated either by direct Excel Web queries using National or European Statistical Institutes’ databases (Eurostat or BEA for instance) or by country files the OECD receives every month for the update of Main Economic Indicators database.

The OECD System of Unit Labour Cost and Related Indicators provides detailed metadata on country data sources at <http://stats.oecd.org/mei/default.asp?lang=e&subject=19>. This includes information on series lengths, link dates to not-currently-published times series used to form long time series including the sources used, adjustments made to address breaks in series, sources of proxy data for quarterly indicators, and a range of other notes on the expected quality of data.

4. OECD seasonal adjustment procedure for Unit Labour Costs

The OECD SULCRI provides high quality quarterly Unit Labour Cost (ULC) estimates for raw, seasonally adjusted and trend data. Due to the inherently volatile nature of derived series such as ULC’s, the OECD encourages users to focus on the Trend-Cycle estimates provided. OECD produces seasonally adjusted and Trend-Cycled ULC series using the TRAMO-SEATS package in the software Demetra; the Trend-Cycle series includes all non-seasonal and non-irregular movements in the underlying time series. This series can be regarded as a smoothed seasonally adjusted series, where the degree of smoothing is dependent on the underlying ARIMA model and will thus vary from a series to another.

The OECD SULCRI undertakes a comprehensive review of its seasonal adjustment methodology once a year between July and August. This timing has been chosen due to the extensive updating carried out by the OECD Annual National Accounts team in the May and June which is the main source of the ULC input data. This review involves re-evaluating all series for model and outlier (i.e. additive outlier, transitory change, and level-shift) changes. For the remainder of the year, seasonal adjustment undertaken using TRAMO-SEATS in Demetra is done allowing the coefficients of the model to change but with the

underlying ARIMA model fixed. It should also be noted here that after extensive investigations and tests it was decided for most series the level-shift operator to be switched off. That is, level shifts which distort the continuity of the long time series are not allowed⁴ unless a legitimate level shift due to an observed economic event has occurred (thus approximately 98% of ULC seasonally adjusted and trend-cycle series are free of level shift outliers).

5. Various issues magnified in the compilation of OECD ULCs during global crisis

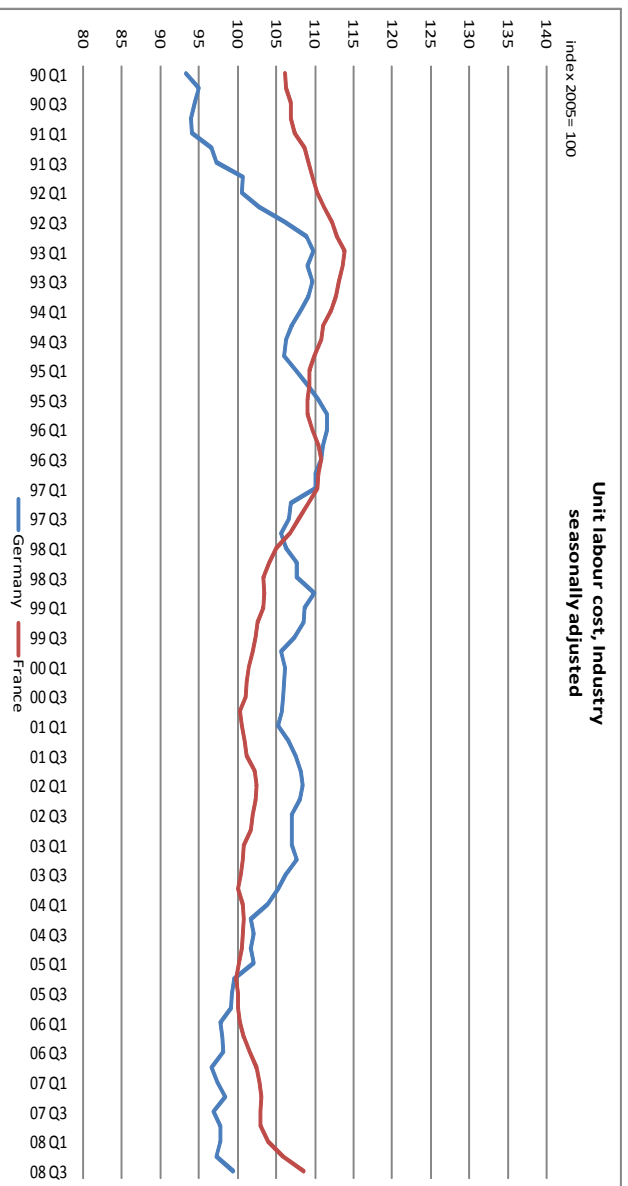
In this section empirical applications of seasonal adjustments during the crisis (revisions analysis, change of ARIMA models, treatment of outliers) are shown. Exceptional behaviours at end points in specific economic conditions are evidenced via the ULC industry in Germany and ULC industry in France.

5.1 What happened to German and French industry Unit labour costs before Lehman Brothers' filing for bankruptcy

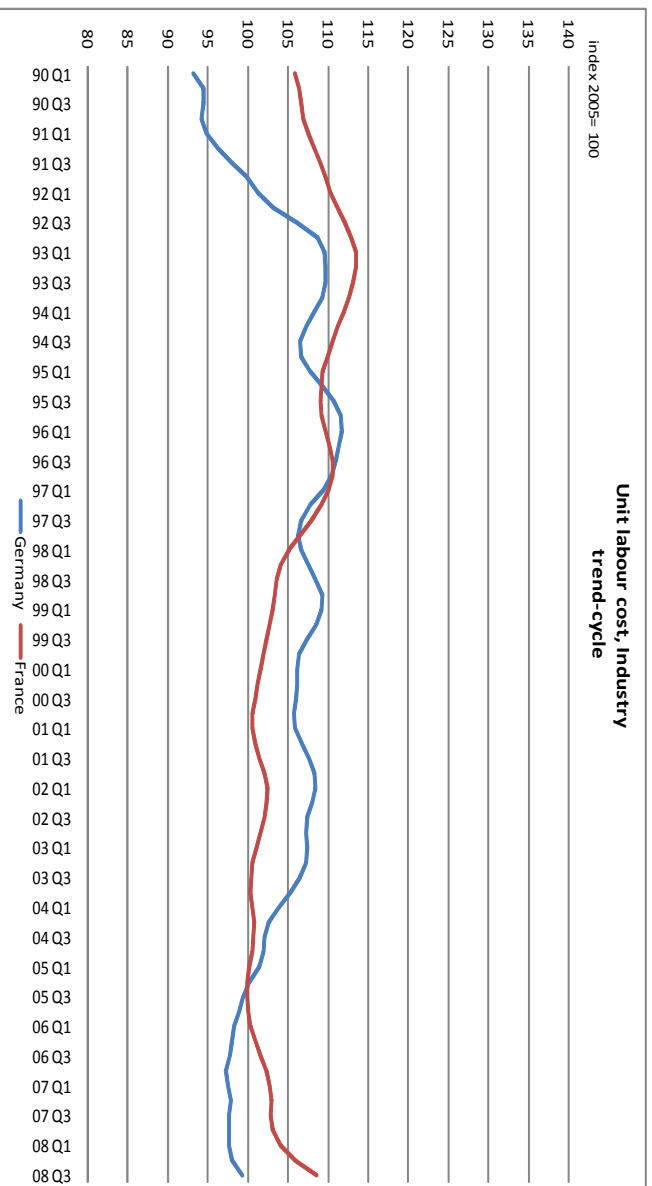
The two graphs below show seasonally adjusted and trend-cycle indices of industry ULCs for France and Germany from 1990Q1 to 2008Q3, i.e. quarter when the Lehman Brothers filed for bankruptcy which triggered bank runs and deepened the global financial crisis for the next two quarters. We notice that the seasonally adjusted and trend-cycle series for France and Germany just slightly deviate from each other until 2008Q3; no outliers are found in the past twenty years before 2008Q3 according to the latest ARIMA model update. Only noticeable difference is that, between 2005Q1 and 2008Q3, ULC in industry for France has been increasing whereas that of Germany remained stable, which corresponds to the consensual view that industrial competitiveness of Germany has been stronger than that of France during this period.

⁴ The TRAMO-SEATS package in its default mode tries to fit the best model. For long time series it may often implement a level shift outlier at certain places to obtain a better model fit before and after this level shift outlier. This is seen as undesirable for the continuity of long time series and thus is avoided where possible.

Graph 1



Graph 2



5.2 What happened after Lehman Brothers' filing for bankruptcy and the deepening of the global financial crisis

Graphs 3 and 4 below are the same ones as the Graphs 1 and 2, respectively except adding three more quarters, i.e. 2008Q4 to 2009Q2, to investigate the impact of Lehman Brothers' filing for bankruptcy. Although France and Germany were already on recession from 2008Q2, the fall in their value added in industry (denominator of the ULC) was the deepest in 2008Q4 and 2009Q1. How does the deepest point of the crisis translate in the seasonally adjusted and trend-cycle indices of industry ULC in France and Germany?

The German seasonally adjusted industry ULC displays the strongest increase (+**22.4%**) between 2008Q3 and 2009Q1, which is the record increase since the start of the series (1970Q1), then shows slight decrease of 2.6% in 2009Q2. Thus, it increased by 19.8% during 3 quarters between 2008Q3 and 2009Q2. By comparison, the German trend-cycle series increases by just **5.3%** for the same period. Indeed, these significant gaps of the growth rates of the seasonally adjusted and trend-cycle series are due mainly to the detection and correction of transitory changes on 2008Q4 and an additive outlier on 2009Q1, as outliers which are by definition not picked up by the trend-cycle series.

However, for France, no outlier was found at the end of the seasonally adjusted ULC in industry. Therefore, the seasonally adjusted and trend-cycle series are very close to each other, just like before the deepening of the crisis. They both show the same increase (+9.2%) from 2008Q3 to 2009Q2.

According to the *ESS Guidelines on Seasonal Adjustment*, Section 1.4 – Outlier detection and correction, an outlier is defined as “abnormal values of the series. [...] However, outliers should remain visible in the seasonally adjusted data (unless they can be associated to data errors), because they give information about some specific events (like strikes etc.). Outliers are not easy to manage, especially at the end of the series when it is difficult to distinguish a turning point from an outlier.”

In the specific case of Germany, the outliers detected in 2008Q4 (transitory change) and 2009Q1 (additive outlier) for industry ULC can be explained by the combination of the effects of the recession and expansionary fiscal policy, especially the recently implemented short-time workers' scheme. Under this scheme, short-time working compensation is paid by the German government to employers who then transfer it to their employees. This short time working compensation is considered in National Accounts

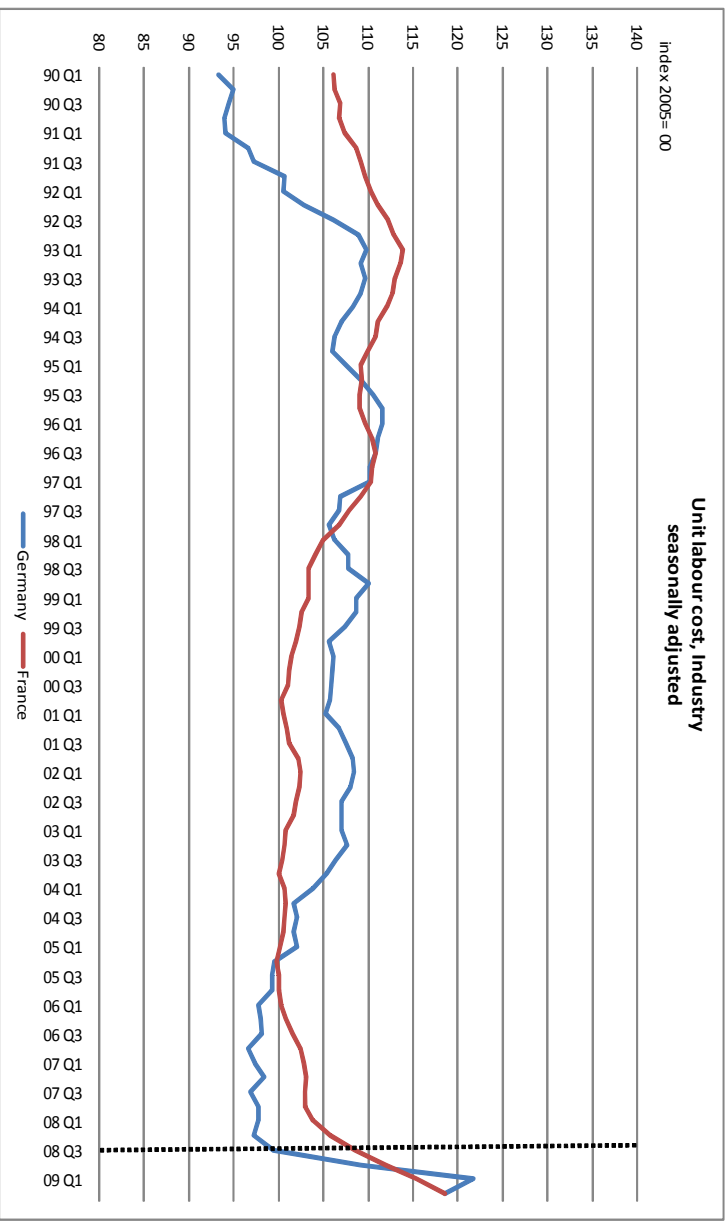
as a subsidy from the government to the enterprises and therefore is part of compensation of employees, which is a component of a unit labour cost.

Consequently, it offsets a part of the decrease of German compensation of employees during the crisis. As this short time working compensation has no influence on the produced units of output (constant price value added) by workers, this, together with the crisis, could explain the record increase of German seasonally adjusted industry ULC between 2008Q3 and 2009Q1. However, this significant increase is distorted by government intervention. Consequently, it is difficult to separate the contributions of the recession from government intervention on this record increase. The end points of the seasonally adjusted industry ULC for Germany shall be taken cautiously and will surely be subject to revisions in the next quarters, if the recovery is long lasting and the government gradually reduces the scale of its expansionary fiscal policy. The “advantage” of the trend-cycle series is that it does not pick up the transitory change and additive outliers and therefore considerably dampens the effects of government intervention and of the recession. Still, the trend-cycle series increases, showing that German competitiveness has deteriorated during the crisis.

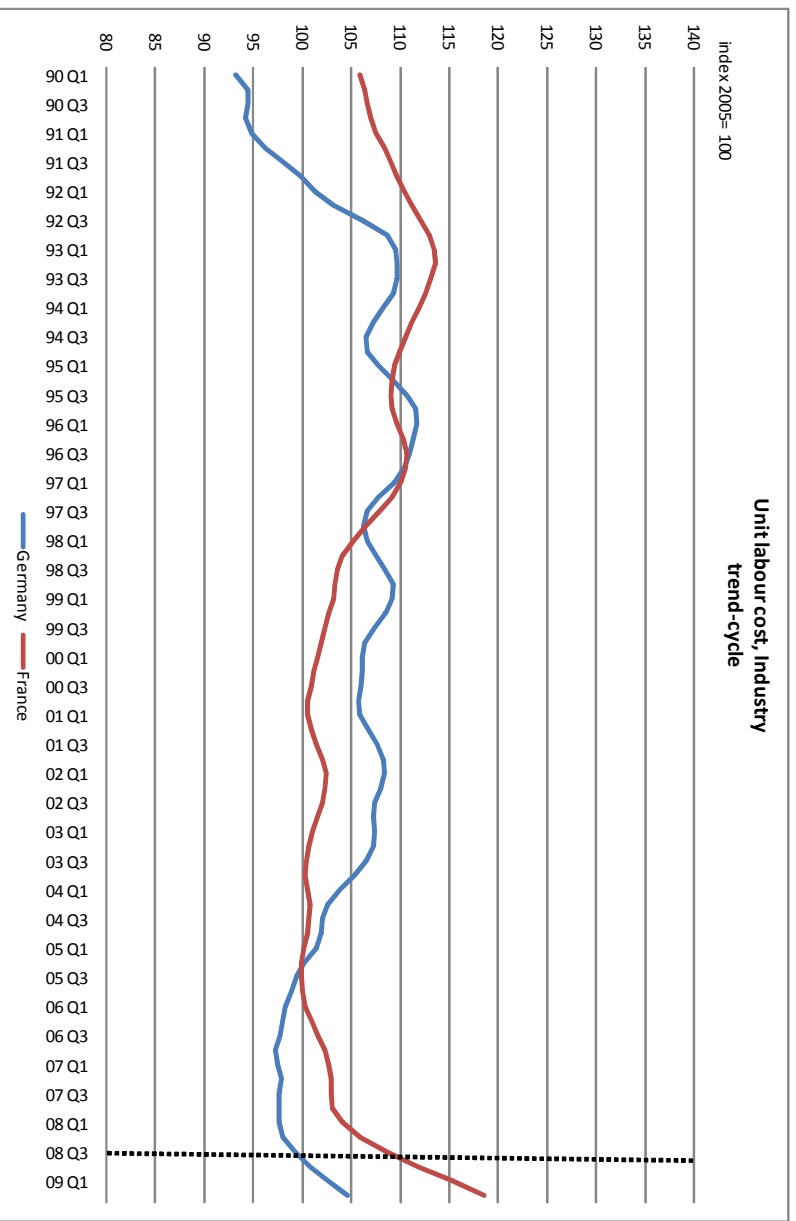
In the case of France, the recession was much less severe than in Germany and the French government also extended the application of partial unemployment measures to enable enterprises to keep their staff. These partial unemployment measures probably avoided a larger decrease of compensation of employees due to the crisis. As a result, the industry ULC strongly increased at the end points but no outlier was found⁵.

⁵ Nevertheless, a level shift is detected at 2008Q4, picked up by the trend-cycle if we run Demetra’s default model. As mentioned in section 2, the OECD ULC seasonal adjustment methodology does not detect level shifts.

Graph 3



Graph 4

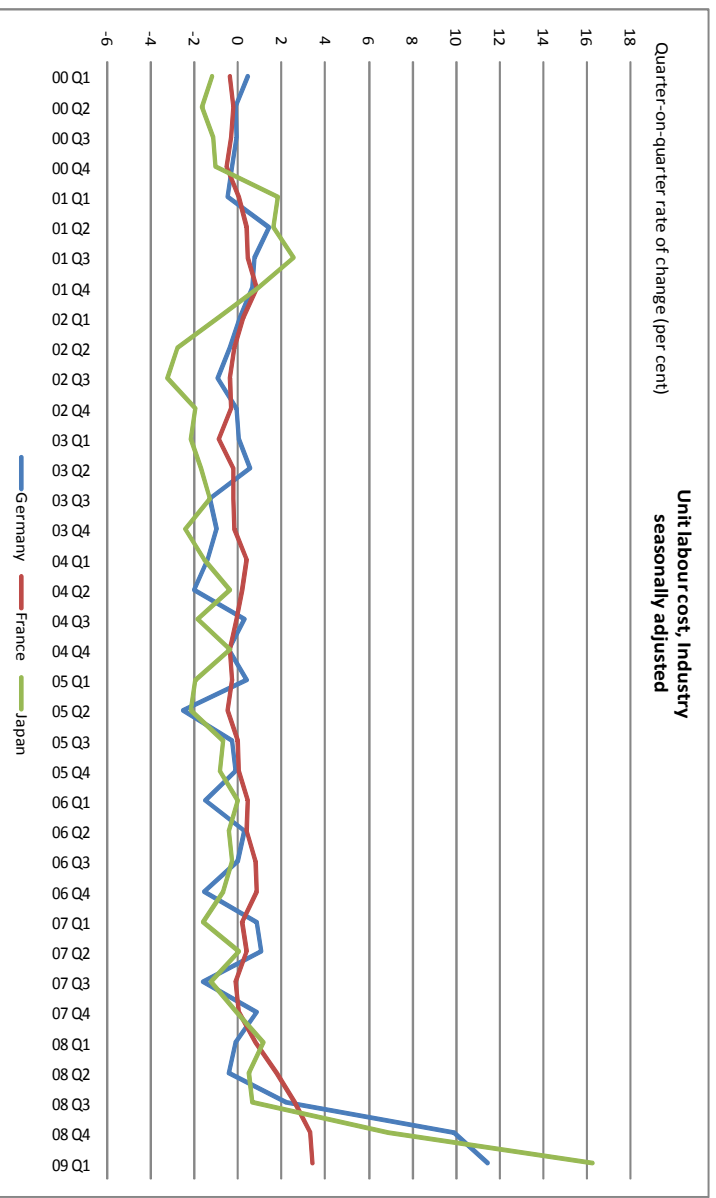


5.3 International comparison issues due to end points - France, Germany and Japan

The detection and correction of outliers occurred at end points can lead to different end-point interpretations of the seasonally adjusted and trend-cycle series. To illustrate our point, we take the industry ULC for Germany, France and Japan. End-point outliers are present for the industry ULC for Germany (transitory change at 2008Q4 and additive outlier at 2009Q1) and Japan (additive outliers at 2008Q4 and 2009Q1) but not for France. By definition, the trend-cycle series do pick up neither transitory changes nor additive outliers. Apart from any transitory changes and additive outliers, the trend-cycle series is generally close to the seasonally adjusted series. But exceptional end-point outliers, as encountered during the recent crisis, can magnify the difference between the trend-cycle and seasonally adjusted figures at the end of the series. Graphs 5 and 6, and Tables 1 and 2 illustrate this fact. If we analyse the evolutions of the seasonally adjusted and trend-cycle industry ULC for Germany, France and Japan, we notice that the growth rates of the seasonally adjusted and trend-cycle series significantly diverge at the end points, when outliers are found. In the case of Japan, as tables show, this divergence can lead to opposite interpretations of the results: we observe a deceleration of the trend-cycle industry ULC (+0.41% in 2008Q4 and +0.24% in 2009Q1) whereas we observe an acceleration of the seasonally adjusted figures (+6.89% in 2008Q4 and +16.29% in 2009Q1). In the case of Germany, we observe an acceleration for both seasonally adjusted and trend-cycle industry ULC but the quarter-on-quarter growth rates for the trend-cycle series are significantly lower than those of the seasonally adjusted series. For France, as no outliers were found at the end of the series, the quarter-on-quarter growth rates for the seasonally adjusted and trend-cycle series remain very close to each other.

Finally, as tables indicate, if we rank France, Germany and Japan in terms of quarter-on-quarter growth rates for the seasonally adjusted and trend-cycle industry ULC in 2008Q4 and 2009Q1, we notice that the countries' ranks significantly differ. Therefore, this relative instability of the series at the end points makes international comparisons more difficult, especially for economic activities such as manufacturing and industry, which have been and are the hardest hit by the crisis.

Graph 5



Graph 6

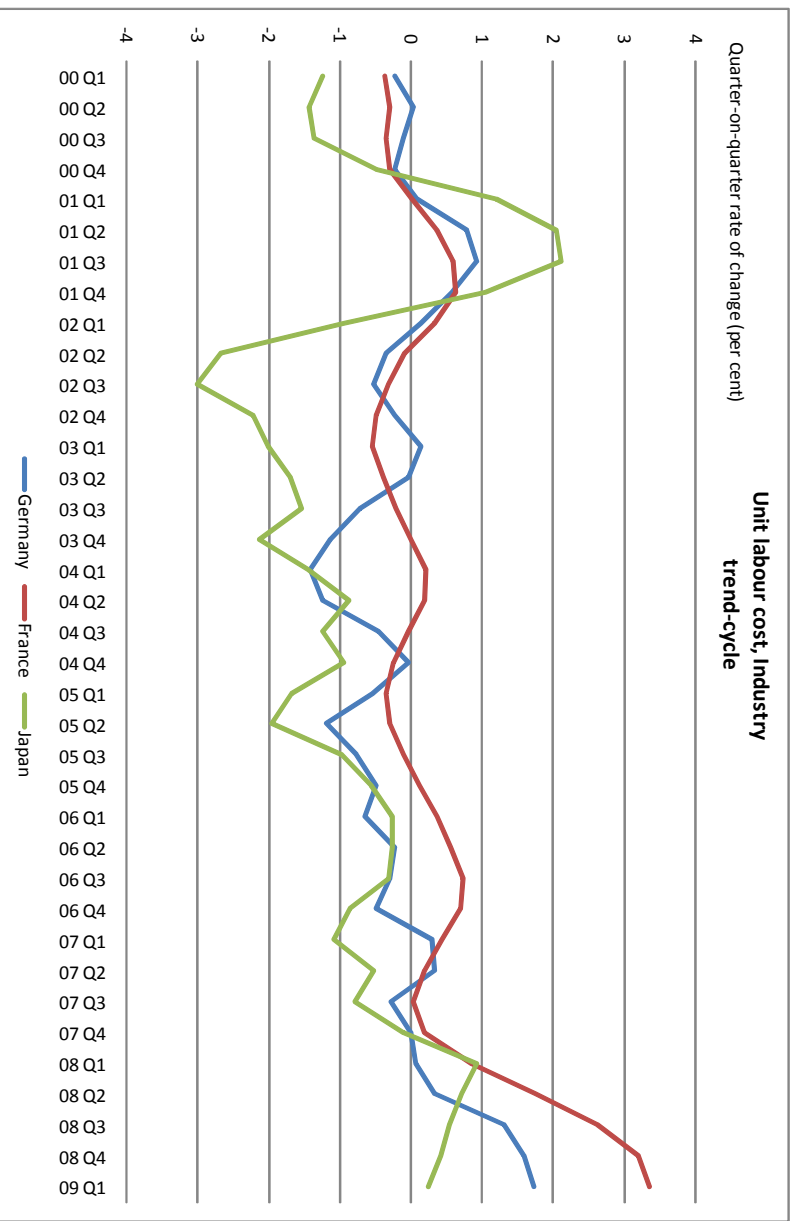


Table 1. Quarter on quarter rate of change (Seasonally adjusted figures)

	2008 Q4	Ranking	2009 Q1	Ranking
<i>Germany</i>	9.91	1	11.43	2
<i>France</i>	3.34	3	3.42	3
<i>Japan</i>	6.89	2	16.29	1

Table 2. Quarter on quarter rate of change (Trend-cycle figures)

	2008 Q4	Ranking	2009 Q1	Ranking
<i>Germany</i>	1.58	2	1.72	2
<i>France</i>	3.20	1	3.35	1
<i>Japan</i>	0.41	3	0.24	3

5.4 Some issues raised from the revisions' analysis of the seasonally adjusted and trend-cycle indices of industry unit labour costs for France and Germany

The revisions derived from the analysis of the seasonally adjusted and trend cycle series for this empirical series illustrates exceptional end point problems. Especially when extraordinary economic conditions are happening simultaneously: the crisis and an expansionary fiscal intervention. The revisions derived from the ARIMA models from the MEI indicators for the unit labour costs can be summarized in the following table.

Table 3: Revisions of ARIMA models - Partial concurrent adjustment

Date of revision	Period of reference	Revision policy
August 2007	Q1 2007	Annual re-identification of the model, filters, outliers and calendar regressors
November 2007	Q2 2007	Re-estimation of parameters and factors
February 2008	Q3 2007	“
May 2008	Q4 2007	“
August 2008	Q1 2008	Annual re-identification of the model, filters, outliers and calendar regressors
November 2008	Q2 2008	Re-estimation of parameters and factors
February 2009	Q3 2008	“
May 2009	Q4 2008	“
August 2009	Q1 2009	“
September 2009	Q1 2009	Annual re-identification of the model, filters, outliers and calendar regressors
October 2009	Q2 2009	Re-estimation of parameters and factors

In this case, we perform a partial concurrent adjustment revision policy, consisting in re-identifying the model, filters, outliers and calendar regressors once a year and re-estimating parameters and factors each quarter between annual revisions. The partial concurrent adjustment strategy generates accurate seasonally adjusted data but will lead to revisions.

Graphically, the revisions for the seasonally adjusted and trend-cycle figures for the OECD unit labour cost in industry show how the ARIMA models performed and learned each time that new data came. Especially in this empirical work, we observe for France and Germany that the adaptability for seasonally adjusted series and trend cycle series are more sensitive at the end, i.e. August 2009, September 2009 and October 2009 revisions.

According to the *ESS Guidelines on Seasonal Adjustment*, section 3.1 – General revisions policy, revisions of seasonally adjusted data take place for two main reasons:

- First, seasonally adjusted data may be revised due to a revision of the unadjusted (raw) data; and
- Second, revisions of seasonally adjusted data can also take place because of a better estimate of the seasonal pattern due to new information provided by new unadjusted data and due to the characteristics of the filters and procedures removing seasonal and calendar components.

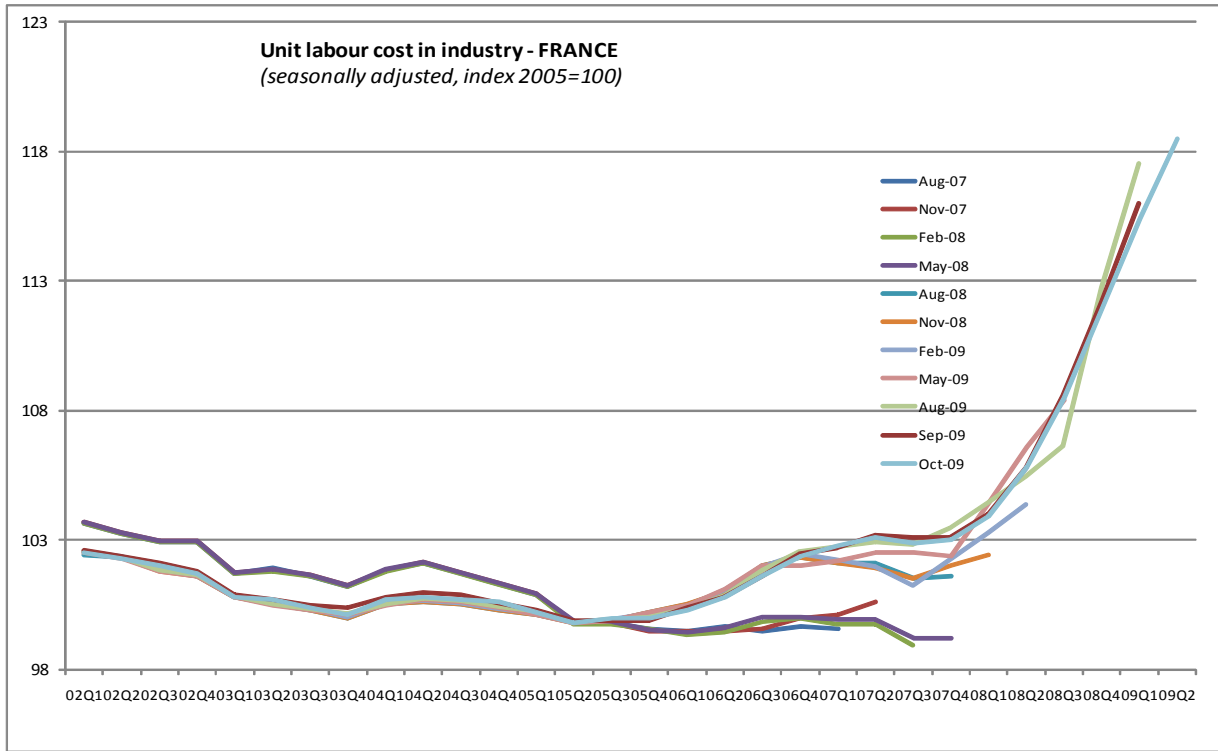
5.4.1 France

For France, according to graphs 7 and 8, for the last three data revisions (August 2009, September 2009 and October 2009), we notice an extraordinary behaviour of the seasonally adjusted and trend-cycle industry ULC at the end points, even when no outliers are detected.

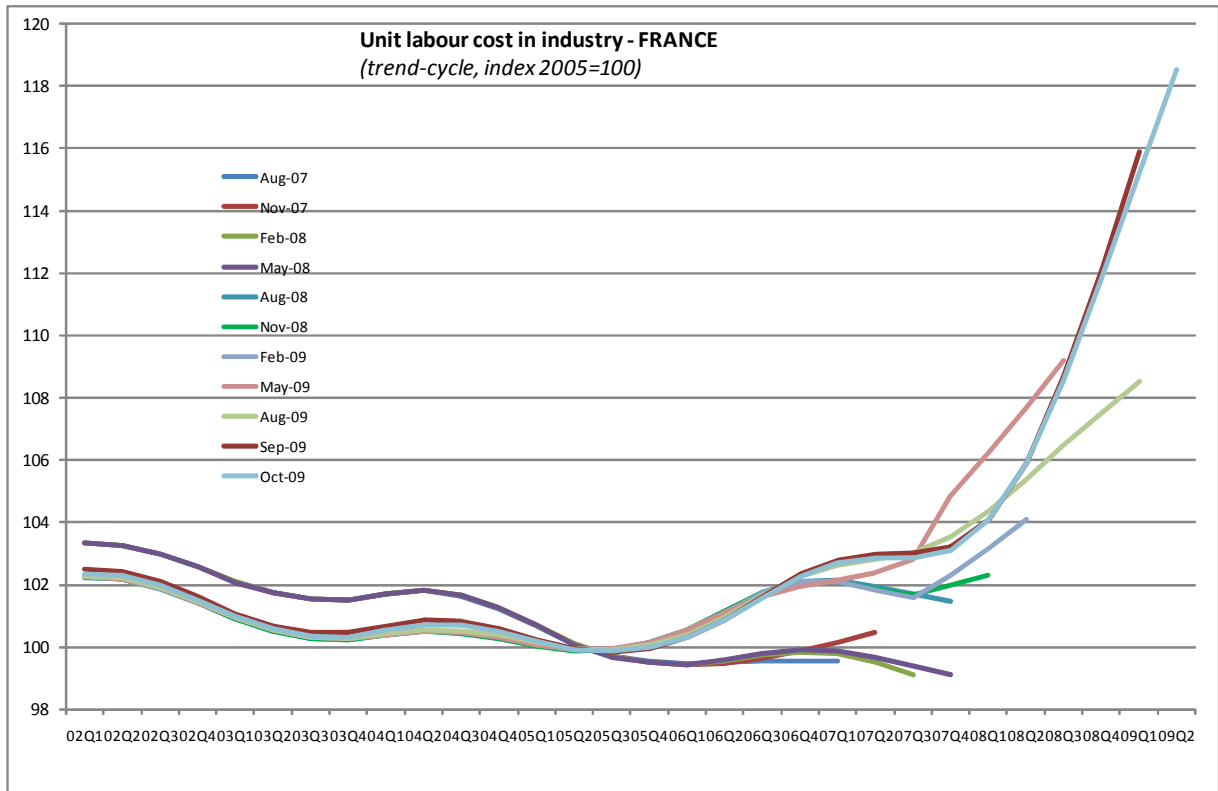
At the 2008Q1 reference period, we observe a significant gap between the levels of the seasonally adjusted and trend-cycle series, observed during the August 2008 revision compared with the pre-August 2008 revisions. This is due to the annual re-identification of the model, filters, outliers and calendar regressors, in August 2008.

France was in recession between 2008Q2 and 2009Q1. During this period, we notice that the revisions in the industry ULCs go up and they are continuously increasing from the post August 2008 revisions onwards. The revisions of the French trend-cycle series evolve over time; we can observe that the trend-cycle takes “time” to learn from the end points of the unadjusted data due to the asymmetric filters.

Graph7



Graph 8



5.4.2 Germany

For Germany, according to the graphs 9 and 10, in the October 2009 edition of *Main Economic Indicators* publication, the revision of the seasonally adjusted and trend-cycle figures show that special end points (considered as outliers) can affect the series for many quarters back. In fact, for the last three revisions we observe how the seasonally adjusted series strongly increases according to the outliers found (in October 2009, transitory change at 2008Q4 and additive outlier at 2009Q1). As explained in section 5.2, the treatment of short time working compensation in national accounts distorts the series upwards. In this case, end points are “semi” outliers as they result from the crisis but also from stimulus plans which distort the actual compensation of employees.

From 2006Q4, we observe a significant gap between the level of the seasonally adjusted and trend-cycle series, noticed after the October 2009 revision compared with the past revisions. This is due to country revisions to the unadjusted data. Before 2006Q4, we observe that the patterns of the seasonally adjusted and trend-cycle series are close to each other in each revision date.

As for France (see Section 5.4.1), we can observe that the German trend-cycle takes “time” to learn from the end points of the unadjusted data due to the asymmetric filters.

6. Conclusions and Questions

Due to the global financial crisis, end point issues for trend-cycle and seasonally adjusted ULC series (particularly industry and manufacturing) have been magnified from 2008Q4 to 2009Q1. As we have shown, the revisions of the ARIMA models can lead to different statements regarding policy recommendations and business cycle fluctuations.

From our own experience, using trend-cycle series can dampen the end point distortion, although it could underestimate the actual impact of the economic crisis. However, this distortion can also be temporary, if the German and French governments gradually exit from their stimulus plans in the next quarters or years.

Thus, we would propose to discuss the following issues with participants:

- What do participants think about the OECD using trend-cycle ULC series as headline indicators for its ULC Press Release?
- How do participants think the OECD could improve its current ULC seasonal adjustment procedure as described in Section 4?
- How are participants dealing with the end point issues raised in Section 5?

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Metadata related to the OECD System of Unit Labour Cost and Related Indicators are available at:

<http://stats.oecd.org/mei/default.asp?lang=e&subject=19>

Quarterly Unit Labour Costs data is available in the OECD data warehouse “OECD.Stat Extracts” at:

http://stats.oecd.org/Index.aspx?DataSetCode=ULC_QUA