**Icelandic Wage Price Index**

*– 30 years of experience and questioning*

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**Abstract**

*The Icelandic wage price index (IWPI) grounds on the act on wage index from 1989. The intention of the legislator was to get a price measure on the monetary compensation for an hour worked.*

*The IWPI aggregates employee wage information at the first stage by calculating Törnqvist month-to-month indices of occupation and economic activity “cells”. These cell indices aggregates into higher-level numbers for economic sectors by using a Laspeyres type formula and then chained over time.*

*The index has become widely used in the Icelandic economy as the main indicator of changes in wages and wage growth, especially in collective negotiations by the social partners, who consequently started to question the soundness of the methodology of the index.*

*External and internal methodologist made comprehensive review of the IWPI in 2018 and 2019. The review highlighted among other the issues of:*

* *method*
* *coverage and sampling*
* *item life cycle*
* *quality changes*
* *chain drift*

*The reviews concluded that:*

* *The choice of index calculation method is sound.*
* *The coverage is sufficient.*
* *The effect of the item live cycle is small and not significant.*
* *The effect of quality changes (determined by length of service and education) should be examined.*
* *The chain drift is not significant since its direction is indeterminate at each time step and its values very small.*

**Keywords:** Wages, index, price

# The Icelandic wage price index

The Icelandic wage price index, hereafter referred to as IWPI, is based on the Act on the Wage Index No 89/1989 and the purpose is to measure *changes in wages* paid by employers *for one hour of work*, between two successive points in time for fixed number of working hours.

By definition, the ***item*** used in constructing the IWPI is the hourly wage.

The ***elementary aggregate*** is the *ideal elementary aggregate* (ILO, IMF, 2004), i.e. the item itself - hourly wages paid to an employee for fixed working hours within the same occupation[[1]](#footnote-1) the same economic activity[[2]](#footnote-2) and the same employer.

Metadata on the IWPI are available at Statistics Iceland website[[3]](#footnote-3).

## Historical roots

The historical roots of the IWPI are in the indexation of financial obligations in Iceland. From year 1979 indexation was based on a composite index based on 2/3 of changes in consumer prices and 1/3 of changes in building costs. This changed in early 1989 to 1/3 of changes in consumer prices, 1/3 of changes of building costs and 1/3 of changes in wages. Consequently, each part needed to be calculated on a monthly basis. This led to the need for a legal basis for the wage index and in longer terms a renewal of the existing data collection on wages.

The legal base for the indexation of financial obligations changed in 1995 to rely solely on the Consumer Price Index but the act on the Wage index remained unchanged. The IWPI has become widely used in the Icelandic economy as the main indicator of changes in wages and wage growth, especially in collective negotiations by the social partners, who consequently started to question the soundness of the methodology of the index.

Following this criticism the Prime minister appointed a committee, in March 2018, to review wage statistics in Iceland in general, and the wage index in particular. Statistics Iceland (2018) performed an internal review of the IWPI led by the chief methodologist, Violeta Calian, and an external review was done by Dr Kim Zieschang (2019).

## Data source

The IWPI is based on the data collected through the Statistics Iceland Icelandic survey on wages, earnings and labour costs (ISWEL). The survey is based on a sample of private companies and municipalities (local government) with 10 or more employees. In addition, data are collected directly from the central government for all its employees. The data is collected monthly directly from the employers’ payroll systems and contains all labour costs and paid hours as well as background information on employees and employers. Validations checks are performed in accordance to predefined rules in order to eliminate or fix data items that are incorrect. The ISWEL is in accordance with regulations on surveys on earnings and labour costs in the European Economic Area. The ISWEL sample and weights are based on the Pay as your Earn (PAYE) data.

## Publications

Indices of the IWPI are released both monthly and quarterly[[4]](#footnote-4), as a total index according to the legal act and as sub-indices to better serve users’ needs. While the IWPI is a legal requirement, Statistics Iceland is not obliged to publish any sub-indices.

The total index of IWPI is published monthly about 20 days after the end of the reference month. The sub-indices, i.e. the breakdown of the IWPI by sectors (including level of administration for the public sector) and by occupational group and economic activity sections for the private sector, are published monthly about 85 days after the end of the reference month.

# Method

The IWPI is based on (weighted) changes, between two consecutive months, of regular hourly wages paid to an employee for fixed working hours within the same occupation, the same economic activity and by the same employer, which is the elementary item of the index. This approach can be described as a „matched model” structure and is chosen for its ability to control for quality changes, especially when used in conjunction with a well-designed sample refresh.

## Calculation of the index

Törnqvist index formula (formula 1) is used at the lower aggregation levels and a matched sample model with the smallest aggregate being the item itself, i.e. changes in hourly wage for a given set of working hours within a given occupation and given economic activity.

(1)

where , and are denoting items in any cell.

At top-level the sub-indices defined by cells (for occupation + economic activity in private sector and federation of trade unions in public sector) are aggregated according to Laspeyres' formula since weights at this level are updated once a year (formula 2). Each cell is given a weight based on their share in total wages. Weights are discussed in detail below.

(2)

here are the expenditure weights[[5]](#footnote-5) of the sub-aggregates which have indices, calculated at time, and in the IWPI case these are the cell (and higher level) weights, updated once a year.

## Weights

The calculation of the IWPI involves a standard structure of expenditure weights, which are calculated for all sub-levels of the index that is for elementary aggregates, cell-aggregates and economic sectors. Weights are revised after the end of 1st quarter every year.

An employer expenditure weight is based on the ISWEL sample design. In the private sector, the employers’ weight is based on the expenditure weight of the sample layer (NACE division and size). A comparable approach is used to determine the weights of the local government (sample of municipalities). All employers in the central government have the weight 1 as data on employees in the central government are close to census data. The employer expenditure weight is fixed yearly.

Weights on the level of the elementary aggregates are based on a combination of the employers’ weight and the expenditure of an employee within a cell (defined by occupation and economic activity in the private sector and federation of trade unions in the public sector) in the ISWEL. In cases where weights are based on ISWEL data, other sources to estimate the population are not available. The expenditure for each employee is determined each time the index is computed.

Expenditure weights for cells (defined by occupation and economic activity) in the private sector are based on the expenditure of the economic activity, including employer with less than 10 employees, in the PAYE data and the expenditure of occupational groups in the ISWEL data. In the public sector, the weights for cells (defined by federation of trade unions) are based on the ISWEL data. The cell expenditure weights are fixed yearly.

Expenditure weights for economic sectors are based on the total expenditure, including employer with less than 10 employees, in the PAYE data. The sector expenditure weights are fixed yearly

## Re-adjustments

No preliminary data are published for the total index of IWPI and an already published value of the index is not subjected to revision. Nevertheless, in light of the strict demand for timeliness some retrospective corrections or necessary readjustments are made each month in order to compensate for data delays and data errors. After the first calculation for a given month (T), that given month is revised twice (in months T+1 and T+2) and those revisions contribute to the index value for latest months (T+2).

## Assessment of methods

Both the internal review (Statistics Iceland, 2018) and external review (Zieschang, 2019) concluded that the basic calculation and the architecture of the IWPI is sound. Indices as such are however prone to various sources of errors and bias as discussed in next chapter.

# Sources of errors and bias

A price index has a hierarchical structure and it may be viewed as a generalized weighted average of sub-indices, at any level of this hierarchy. At its lowest level, one finds the changes in prices of items, i.e. of hourly wages for the IWPI. It is therefore a summary measure, since it reflects only the means and nothing more of the probability distributions of the relative price variations. It is also based on sample data and calculated for successive points in time that then have to be used to describe the time evolution of the "true" index. Due to all these causes, a price index number is prone to errors and bias irrespective of the index formula.

The main types of errors and bias for any price index (Balk, 2008) are due to sampling errors, dynamic effects and chaining.

## Sampling errors

Index numbers are in general not calculated on census data. Sampling from a population of items, e.g. hourly wages, needs to be random, i.e. a probability sampling and ensure a good coverage and representativeness, including rare patterns if possible. Any deviation from these conditions may induce errors and instabilities in index estimates.

### Coverage

The ISWEL survey is a stratified clustered sample survey with stratum based on two digit economic activity and size. While the survey design assumes full inclusion of the whole labour market, for all companies with 10 or more employees in sections A-S according to Ísat2008, this has never been fully accomplished. Currently, the following economic activities are fully included in ISWEL: Manufacturing (C), Electricity, gas steam and air conditioning supply (D), Water supply, sewerage, waste management and remediation activities (E), Construction (F), Wholesale and retail trade; repair of motor vehicles and motorcycles (G), Transportation and storage (H), Accommodation and food service activities (I), and Financial and insurance activities (K).

The following economic activities are partly covered: Information and communication (J, only big companies in economic divisions 58–61), Engineering activities (M, only economic division 71), Public administration and defence; compulsory social security (O), Education (P), Human health and social work activities (Q) and Arts, entertainment and recreation (R). Economic activities O, P, Q and R only include employees in the public sector.

About 90% of the Icelandic labour force worked in economic activities fully or partly covered by ISWEL in 2018 according to registers.

### Assessment of the sampling errors

Both the internal review (Statistics Iceland, 2018) and external review (Zieschang, 2019) concluded that the data set is extensive and the ISEWL’s coverage appears to be a robust foundation for wage measurement. From the time of the review, data for economic activity I has been added to the dataset of the IWPI.

## Dynamic effects

The population of items evolves over time, thus the price and weight distributions are affected, and may introduce errors if the assumptions or methods for calculating the index do not accommodate these dynamics.

### Changes in population

As the population is constantly changing, a static sample does not reflect newly appearing items nor missing and disappearing items. Compensations are made by applying adequate sample refresh and using large samples.

### Life cycle effect

Influences of life cycle evolution and the effect of persistent products might introduce a bias into the index. Matched samples method for calculating price index numbers may introduce bias if the products (hourly wages of employer-employee transactions, in the case of IWPI) have systematic price or weight trends at different points in their life cycle and if the age distribution of the products in the sample does not mirror consistently the one in the whole population.

This may addressed by modelling and choice of elementary aggregate

### Assessment of the dynamic effects

Both the internal review (Statistics Iceland, 2018) and external review (Zieschang, 2019) concluded that the sample size is adequate. The internal review pointed out that a systematic sample refresh should be applied to the ISWEL survey, which has been lacking in practice.

Regarding the life cycle effect, the internal review (Statistics Iceland, 2018) concluded that the choice of elementary aggregate is in accordance with the general index theory and statistical tests for life cycle dependency of relative prices and for weights show very weak effects.

Modelling the (mean value) elementary index as a linear *function of the age* of the items shows a very weak such dependency as can be seen in Table 1.

**Table 1. Coefficients of modelling the elementary index as a linear function of age**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Coefficients: |  |  |  |  |
|  | Estimate | Std. Error | t value | t value |
| (Intercept) | .00001 | .000003 | 4.069 | .00008 |
| age | 8.3e-08 | 4.6e-08 | 1.787 | 0.0762 |

Residual standard error: .00002, on 132 degrees of freedom

Outliers do exist, for both very short and very long life of items, as illustrated in Figure 1. This figure represents the variation with items' age for the mean values of the index numbers of elementary aggregates in the private economical sector, at a given time.

|  |
| --- |
| **Figure 1. Life cycle effects. Mean values of index numbers, by age of items, at a given time**. |

The following influence of the life cycle (age) of items was observed: the distribution of elementary index values are very similar for each fixed age of items, at various points in time; the differences in distributions of the elementary index numbers for different ages at fixed points in time, are statistically significant but very small. The aggregated index numbers may be still affected by the age composition of the sample if this composition is significantly different from the one observed in the population. This might be addressed by an adequate sample refresh.

For full explanation on methods of assessment, see Statistics Iceland (2018).

## Combining bilateral index information into time series of multiple time points

This may be done by using direct, chained or multilateral index numbers. The IWPI uses a chaining method. The effect of the chaining was explored in the internal review of the IWPI (Statistics Iceland 2018).

### Estimating the chaining effect

#### Short term chaining

Numerical calculations of the drift size on main economic sectors were performed (Statistics Iceland, 2018), by comparing chained index numbers with direct ones for a linking period of only three months, in order to illustrate the short-term drift.

Figure 2 shows that the values of the direct and chained index changes between two time points are close to each other but the direct index variation is smaller than the chained one, especially for high values of both index changes. These higher values are however much fewer as well. The data is for the private sector where the red line presents zero difference.

**Figure 2. Chained versus direct index variations.**

#### Medium term chaining

For the long-term drift illustration, periods of one, two and three years (during 2016-2018) were analysed and the error values found for the index number were still the same size as the rounding errors. It is worth pointing out that the same effect size has been found for short-term intervals, as described in the above paragraphs. This shows that the drift does not accumulate with time for reasonable time series data of prices and weights, at least for moderately long (few years) periods.

**Figure 3. Relative difference between chained and direct index as a function of the chain length.**

The three symbols denote three different chains, each starting at different moments in time: 0 (the blue diamonds), 12 (the red squares), and 16 (the green triangles) months.

Figure 3 shows also that the drift may be of either sign, and the at least for few years, it does not grow with time.

### Assessment of the chaining effect

The conclusion of the analysis (Statistcs Iceland, 2018) is that the accumulated drift is small as it is only of the order of magnitude of the rounding errors for the (higher aggregates level) index, at least for short (months) and medium terms (several years). It can only be inferred that this behaviour is conserved for longer term, due to the structure of the drift as a sum of alternating sign terms of comparable sizes.

# Conclusions and discussion

This paper summarizes an external (Zieschang, 2019) and an internal review(Statistcs Iceland, 2018) on the IWPI, done in 2018.

The conclusions of these two papers are that the data used for calculating the index is of good quality and the method is standard for a price index.

There are two recommendations made by the reviewers to Statistics Iceland for improving the calculation of the wage price index:

1. A systematic sample refresh should be designed and applied to the ISWEL data in order to accommodate for dynamical changes
2. Estimating the size and accumulation of effects due to education and length of service in the dataset. This analysis is in the final stages and will be published soon in working paper by Statistics Iceland.

# References

Balk, B. M. (2008). Price and quantity index numbers, models for measuring aggregate change and difference. 1st edition. Cambridge University Press.

Hagstofa Íslands (2009a). ÍSTARF95 (Based on ISCO-88). Reykjavík: The author.

Hagstofa Íslands (2009b). *ÍSAT2008* (Based on NAC rev. 2). Reykjavík: The author.

ILO, IMF, OECD, Eurostat, United Nations, and World Bank (2004). *Consumer price index manual: Theory and practice*, ILO Publications, Geneva. Retrieved 23.07.2018 from <http://gauss.stat.su.se/master/es/CPIM-TP.pdf>

Statistics Iceland (no date). *The Act on the Wage Index No 89/1989*. <https://statice.is/about-statistics-iceland/laws-and-regulations/act-on-the-wage-index/>. Translated from Icelandic: <https://www.althingi.is/lagas/nuna/1989089.html>

Statistics Iceland (2018). Methodology of the Icelandic Wage Index. Statistics Iceland, Reykjavík. Retrieved 09.05.2019 from <http://hagstofan.s3.amazonaws.com/media/public/2018/e2c06929-b8a3-4866-8086-8f6291f943d9_SG5weZE.pdf>

Zieschang, K. (2019). Review of the Icelandic Wage Price Index. In *Launatölfræði á Íslandi.* Retrieved 09.05.2018 from <https://www.stjornarradid.is/lisalib/getfile.aspx?itemid=40395405-2616-11e9-942f-005056bc4d74>

1. A four digit number according to the Ístarf95 occupation classifications of Statistics Iceland (based on ISCO-88). In addition there is a 5th digit in the occupational code to distinguish status of the employee, i.e. general workers, foreman and craft worker. [↑](#footnote-ref-1)
2. A five digit number according to on Ísat2008 economic activity classification of Statistics Iceland (based on NACE2008 rev.2.). [↑](#footnote-ref-2)
3. <https://www.statice.is/statistics/society/wages-and-income/> [↑](#footnote-ref-3)
4. https://statice.is/statistics/society/wages-and-income/wage-index/ [↑](#footnote-ref-4)
5. An expenditure weight for any sub-aggregate is the ratio between the value of the sub-aggregate and the value of the aggregate at the next higher level. The value is defined as the product between price and quantity, i.e. hourly wages and number of employee hours. [↑](#footnote-ref-5)