Appendix I

Global wage trends: Methodological issues

The methodology used to estimate global and regional wage trends was developed by the ILO's Conditions of Work and Employment Programme (TRAVAIL) for the previous *Global Wage Report* (2010) in collaboration with the Department of Statistics, following proposals formulated by an ILO consultant and three peer reviews made by four independent experts.[34] This appendix describes the methodology adopted as a result of this process.

Concepts and definitions

According to the international classification of status in employment (ICSE-93), "employees" are workers who hold "paid employment jobs", i.e. jobs in which the basic remuneration is not directly dependent on the revenue of the employer. Employees include regular employees, workers in short-term employment, casual workers, outworkers, seasonal workers and other categories of workers holding paid employment jobs.[35]

The word "wage" refers to total gross remuneration, including regular bonuses received by employees during a specified period of time for time worked as well as time not worked, such as paid annual leave and paid sick leave. Essentially, it corresponds to the concept of "total cash remuneration", which is the major component of income related to paid employment.[36] It excludes employers' social security contributions.

"Wages", in the present context, refer to real average monthly wages of employees. Wherever possible, we collected data that refer to all employees (rather than to a subset, such as employees in manufacturing or full-time employees).[37] To adjust for the influence of price changes over different time periods, wages are measured in real terms, i.e. the nominal wage data are adjusted for consumer price inflation in the respective country.[38] Real wage growth refers to the year-on-year change in real average monthly wages of all employees.

Census approach

The methodology used for the global and regional estimates is a census method with non-response. In the census approach, the objective is to find wage data for all countries and to develop an explicit treatment in the case of total non-response (see "Treatment of total non-response", below). We have tried to collect wage data for a total of 177 countries and territories, grouped into six separate regions.[39]

Table A1 Regional groups

Regions	Countries and territories (with abbreviations in parentheses)
Developed economies	Australia (AUS), Austria (AUT), Belgium (BEL), Bulgaria (BUL), Canada (CAN), Cyprus (CYP), Czech Republic (CZR), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRE), Hungary (HUN), Iceland (ICE), Ireland (IRE), Israel (ISR), Italy (ITA), Japan (JAP), Latvia (LAT), Lithuania (LIT), Luxembourg (LUX), Malta (MTA), Netherlands (NET), New Zealand (NZ), Norway (NOR), Poland (POL), Portugal (POR), Romania (ROM), Slovakia (SVK), Slovenia (SVE), Spain (ESP), Sweden (SWE), Switzerland (CH), United Kingdom (UK), United States (USA)
Eastern Europe and Central Asia	Albania (ALB), Armenia (ARM), Azerbaijan (AZB), Belarus (BLS), Bosnia and Herzegovina (BOS), Croatia (CRO), Georgia (GEO), Kazakhstan (KAZ), Kyrgyzstan Republic (KYR), Republic of Moldova (MOL), Russian Federation (RUS), Serbia (SBA), Tajikistan (TAJ), The Former Yugoslav Republic of Macedonia (FYR), Turkey (TKY), Turkmenistan (TUR), Ukraine (UKR), Uzbekistan (UZB)
Asia	Afghanistan (AFG), Bangladesh (BAN), Bhutan BHU), Brunei Darussalam (BRU), Cambodia (CDA), China (CHI), Fiji (FIJ), Hong Kong (China) (HK), India (IND), Indonesia (ISA), Islamic Republic of Iran (IRA), Korea (North) (NK), Republic of Korea (KOR), Lao People's Democratic Republic (LAO), Macau (China) (MAC), Malaysia (MYA), Republic of Maldives (MDS), Mongolia (MON), Myanmar (MYN), Nepal (NEP), Pakistan (PAK), Papua New Guinea (PAP), Philippines (PHL), Singapore (SNG), Solomon Islands (SOL), Sri Lanka (SRI), Thailand (THA), Timor-Leste (TL), Viet Nam (VN)
Latin America and the Caribbean	Argentina (ARG), Bahamas (The) (BAH), Barbados (BBO), Belize (BZE), Plurinational State of Bolivia (BOL), Brazil (BRA), Chile (CHE), Colombia (COL), Costa Rica (COS), Cuba (CUB), Dominican Republic (DOM), Ecuador (ECU), El Salvador (ELS), Guadeloupe (GDP), Guatemala (GUA), Guyana (GUY), Haiti (HAI), Honduras (HON), Jamaica (JAM), Martinique (MAR), Mexico (MEX), Netherlands Antilles (NAN), Nicaragua (NIC), Panama (PAN), Paraguay (PAR), Peru (PER), Puerto Rico (PR), Suriname (SUR), Trinidad and Tobago (TT), Uruguay (URU), Bolivarian Republic of Venezuela (VZA)
Middle East	Bahrain (BAR), Iraq (IRQ), Jordan (JOR), Kuwait (KUW), Lebanon (LEB), Oman (OMA), Qatar (QAT), Saudi Arabia (SAU), Syrian Arab Republic (SYR), United Arab Emirates (UAE), West Bank and Gaza (WBG), Yemen (YEM)
Africa	Algeria (ALG), Angola (ANG), Benin (BEN), Botswana (BOT), Burkina Faso (BKF), Burundi (BUR), Cameroon (CAM), Cape Verde (CAV), Central African Republic (CAR), Chad (CHA), Comoros (COM), Congo (CON), Côte d'Ivoire (COI), Democratic Republic of the Congo (DRC), Egypt (EGY), Equatorial Guinea (EQG), Eritrea (ERI), Ethiopia (ETH), Gabon (GAB), Gambia (GAM), Ghana (GHA), Guinea (GUI), Guinea-Bissau (GUB), Kenya (KEN), Lesotho (LES), Liberia (LIB), Libya (LBY), Madagascar (MAD), Malawi (MAW), Mali (MAL), Mauritania (MAI), Mauritius (MUS), Morocco (MOR), Mozambique (MOZ), Namibia (NAM), Niger (NIG), Nigeria (NIR), Reunion (REU), Rwanda (RWA), Senegal (SEN), Sierra Leone (SL), Somalia (SOM), South Africa (SA), Sudan (SUD), Swaziland (SWA), United Republic of Tanzania (TAN), Togo (TOG), Tunisia (TUN), Uganda (UGA), Zambia (ZAM), Zimbabwe (ZIM)

To enable easier comparison with regional employment trends, our regional groupings are now compatible with those used in the ILO's Global Employment Trends (GET) model (see table A1). However, we have collapsed several GET regions into a single region for Asia and the Pacific (which includes the GET regions East Asia, South-East Asia and the Pacific, and South Asia) and also for Africa (which comprises North Africa and sub-Saharan Africa). Note that the Republic of Korea and Singapore are now grouped with Asia (and no longer with the advanced countries) and that all 27 member countries of the EU are included under "developed economies". Further, the

division between "Central and Eastern Europe" and "Eastern Europe and Central Asia" is no longer maintained, with all former transition countries (apart from members of the EU) and Turkey included in a single grouping, "Eastern Europe and Central Asia". For these regions, the regrouping means that regional wage trends published in the current *Global Wage Report* cannot be directly compared to figures in the previous edition. There have been no changes to the regions Latin America and the Caribbean, or the Middle East. However, some data revisions by national statistical offices mean that regional wage trends have been updated since publication of the last edition. Overall, we succeeded in obtaining wage data from 124 countries and territories, with regional coverage indicated in table A2. We have data from all developed economies and all countries in Eastern Europe and Central Asia. In other regions, although repeated attempts were made to obtain wage figures from national statistical offices and/or international repositories, in some instances wage data were not available. The coverage for the remaining regions ranges from 41.2 per cent (Africa) to 75.0 per cent (Middle East). However, since the database includes wage data for the largest and more prosperous countries, the coverage in terms of employees and the total wage bill is higher than the simple count of countries would suggest. In total, our database contains information for 94.3 per cent of the world's employees who together account for approximately 97.7 per cent of the world's wage bill.

Table A2 Coverage of the Global Wage Database, 2010 (%)

Regional group	Country coverage	Employee coverage	Approximate coverage of total wages
Africa	41.2	59.5	79.3
Asia	69.0	98.3	99.3
Eastern Europe and Central Asia	100.0	100.0	100.0
Developed economies	100.0	100.0	100.0
Latin America and the Caribbean	64.5	85.3	83.9
Middle East	75.0	76.4	91.3
World	70.1	94.3	97.7

Note: Country coverage refers to the number of countries for which we found wage data as a percentage of all the countries in the region, while employee coverage refers to the number of employees in countries with data available as a percentage of all employees in the region (as of 2010). The approximate coverage of total wages is estimated based on the assumption that wage levels vary across countries in line with labour productivity (i.e. GDP per person employed, as of 2010), expressed in 2005 PPP$.

Treatment of item non-response

In some countries for which we found data, the statistical series were incomplete, in the sense that data for some years were missing. Table A3 provides coverage information for each year from 2006 to 2011. As expected, the coverage of the database becomes lower for the most recent years since some statistical offices are still processing these data (most notably China, where wage data for 2011 are not yet available). As a consequence, for 2011 we have real observations for only about 74.5 per cent of the world's total wages, compared to 94.3 per cent in 2010.

While the coverage in the most recent year is good in the developed economies and in Eastern Europe and Central Asia, we have too few real observations for the Middle East in 2010 and 2011 to make a reliable estimate, and therefore the most recent wages trends for the Middle East are likely to change. We also flag regional growth rates as "provisional estimates" when they are based on coverage of *c.* 75 per cent and as "tentative estimates" when the underlying coverage of our database is between 40 and 74 per cent to draw attention to fact that they might be revised once more data become available.

Table A3 Coverage of the Global Wage Database, 2006–11 (%)

Regional group	2006	2007	2008	2009	2010	2011
Africa	79.6	78.1	65.2**	64.8**	64.9**	43.2**
Asia	95.8	96.0	96.2	96.4	96.5	(38.1)
Eastern Europe and Central Asia	98.4	99.0	98.9	98.7	98.6	97.2
Developed economies	100.0	99.2	100.0	99.2	99.4	86.7
Latin America and the Caribbean	84.9	84.7	84.4	84.0	82.6	79.0
Middle East	91.7	91.9	91.7	68.0**	(22.4)	(12.0)
World	97.4	96.8	96.9	95.6	94.3	74.5*

Notes:

* Growth rates published as "provisional estimates" (based on coverage of *c.* 75 %).

** Growth rates published as "tentative estimates" (based on coverage of *c.* 40– *c.* 74%).

() Growth rates published but likely to change (based on coverage of less than 40%).

See text for estimation of coverage. A country is counted as covered only when a real observation is available, either from the preferred series or from a secondary series.

To address this kind of item non-response (i.e. gaps in the data for countries covered) we used a "model-based framework" to predict missing values.[40] This is necessary in order to hold the set of responding countries constant over time and so avoid the undesired effects associated with an unstable sample. Depending on the nature of the missing data points, we used several complementary approaches that are described in detail in Technical Appendix I of the 2010/11 edition of the *Global Wage Report*.

Treatment of total non-response

Response weights

To adjust for total non-response (when no time-series wage data are available for a given country) a "design-based framework" was used in which non-response was considered as a sampling problem. Because non-responding countries may have wage characteristics that differ from those of responding countries, non-response may introduce a bias into the final estimates. A standard approach to reduce the adverse effect of non-response is to calculate the propensity of response of different countries and then weight the data from responding countries by the inverse of their response propensity.[41] This implies that no imputations are made for non-responding countries.

In this framework, each country responds with a probability φ_j and it is assumed that countries respond independently of each other (Poisson sampling design). With the probabilities of response, φ_j, it is then possible to estimate the total, Y, of any variable y_j:

$$Y = \sum_{j \in U} y_j \tag{1}$$

by the estimator:

$$\hat{Y} = \sum_{j \in R} \frac{y_j}{\varphi_j} \tag{2}$$

where U is the population and R is the set of respondents. This estimator is unbiased if the assumptions are true (see Tillé, 2001). In our case, U is the universe of all countries and territories listed in table A1 and R are those "responding" countries for which we could find time-series wage data.

The difficulty is, however, that the response propensity of country j, φ_j, is generally not known and must itself be estimated. Many methods of estimation of the response propensity are available from the literature (see e.g. Tillé, 2001). In our case, the response propensity was estimated by relating the response or non-response of a given country to its number of employees and its labour productivity (or GDP per person employed in 2005 PPP$). This is based on the observation that wage statistics are more readily available for richer and larger countries than for poorer and smaller countries. We choose the number of employees and labour productivity since these variables are also used for calibration and size weighting (see below).[42]

For this purpose, we estimated a logistic regression with fixed effects as follows:

$$prob(response) = \Lambda(\alpha_h + \beta_1 x_{j2010} + \beta_2 n_{j2010}) \tag{3}$$

where x_{j2010} is ln(GDP per person employed in 2005 PPP$) of country j in the year 2010, n_{j2010} is ln(number of employees) in 2010, and Λ denotes the logistic cumulative distribution function (CDF).[43] The fixed effects, α_h, are dummies for each of the regions with incomplete data (Asia and the Pacific, Latin America and the Caribbean, Middle East, Africa), while the two remaining regions with complete data form the omitted benchmark category. The logistic regression had a universe of $N = 177$ cases and produced a pseudo $R^2 = 0.380$. The estimated parameters were then used to calculate the propensity of response of country j, φ_j.

The response weight for country j, ϕ_j, is then given by the inverse of a country's response propensity:

$$\phi_j = \frac{1}{\varphi_j} \tag{4}$$

Calibration factors

The final adjustment process, generally called calibration (see Särndal and Deville, 1992), is designed to ensure consistency of the estimate with known aggregates. This procedure ensures appropriate representation of the different regions in the final global estimate. In the present context, a single variable "number of employees", n, in a given

year t was considered for calibration. In this simple case, the calibration factors, are given by γ_{jt}:

$$\gamma_{jt} = \frac{n_{ht}}{\hat{n}_{ht}}, \; j \in h \tag{5}$$

where h represents the region to which country j belongs, n_{ht} is the known number of employees in that region in year t, and $\hat{n}_{ht}$ is an estimate of total number of employees in the region and the same year that was obtained as a sum product of the uncalibrated weights and the employment data from the responding countries within each region.[44] The resulting calibration factors for the year 2010 were 1.00 (Developed economies; Eastern Europe and Central Asia), 0.975 (Asia and the Pacific), 1.045 (Latin America and the Caribbean), 1.042 (Africa) and 1.086 (Middle East). Since all calibration factors are either equal to or very close to 1, these results show that estimates $\hat{n}_{ht}$ were already very close to the known number of employees, n_{ht}, in each region. Note that the calibration process was repeated for each year so that the weight of each region in the global estimate changes over time in proportion to its approximate share in the global wage bill.

Calibrated response weights

The calibrated response weights, ϕ'_{jt}, are then obtained by multiplying the initial response weight with the calibration factor:

$$\phi'_{jt} = \phi_j \times \gamma_{jt} \tag{6}$$

The regional estimate of the number of employees based on the calibrated response weights is equal to the known total number of employees in that region in a given year. Thus, the calibrated response weights adjust for differences in non-response between regions. The calibrated response weights are equal to 1 in the regions where wage data were available for all countries (Developed economies; Eastern Europe and Central Asia). They are larger than 1 for small countries and countries with lower labour productivity since these are underrepresented among responding countries.

Estimating global and regional trends

One intuitive way to think of a global (or regional) wage trend is in terms of the evolution of the world's (or a region's) average wage. This would be in line with the concept used for other well-known estimates, such as regional GDP per capita growth (published by the World Bank) or the change in labour productivity (or GDP per person employed).

The global average wage, $\bar{y}$, at the point in time t can be obtained by dividing the sum of the national wage bills by the global number of employees:

$$\bar{y}_t = \frac{\sum_j n_{jt} \times \bar{y}_{jt}}{\sum_j n_{jt}} \tag{7}$$

where n_{jt} is the number of employees in country j and $\bar{y}_{jt}$ is the corresponding average wage of employees in country j, both at time t.The same operation can be repeated for the subsequent time period $t+1$ to obtain $\bar{y}^*_{t+1}$, using the deflated wages $\bar{y}^*_{t+1}$ and the

number of employees n_{t+1}, where * refers to real wages. It is then straightforward to calculate the growth rate of the global average wage, r.

However, while this is a conceptually appealing way to estimate the global wage trends, it involves some difficulties that we cannot at present overcome. In particular, aggregating national wages, as done in equation (7), requires them to be converted into a common currency, such as PPP$. This conversion would make the estimates sensitive to revisions in PPP conversion factors. It would also require that national wage statistics be harmonized to a single concept of wages in order to make the level strictly comparable.[45]

More importantly, the change in the global average wage would also be influenced by composition effects that occur when the share of employees shifts between countries. For instance, if the number of paid employees fell in a country with high wages but expanded (or stayed constant) in a country of similar size with low wages, this would result in a fall of the global average wage (while wage levels remained constant in all countries). This effect makes changes in the global average wage difficult to interpret, as one would have to differentiate which part was due to changes in national average wages and which part was due to composition effects.

We therefore gave preference to an alternative specification to calculate global wage trends that maintains the intuitive appeal of the concept presented above but avoids its practical challenges. To ease interpretation, we also want to exclude effects that are due to changes in the composition of the world's employee population. We therefore avoid the danger of producing a statistical artefact of falling global average wages that could be caused by a shift in employment to low-wage countries (even when wages within countries are actually growing).

When the number of employees in each country is held constant, the global wage growth rate r_t can be expressed as a weighted average of the wage growth rates in the individual countries:

$$r_t = \sum_j w_{jt} \times r_{jt} \tag{8}$$

where r_{jt} is wage growth in country j at point in time t and the country weight, w_{jt}, is the share of country j in the global wage bill, as given by:

$$w_{jt} = n_{jt} \times \bar{y}_{jt} / \sum_j n_{jt} \times \bar{y}_{jt} \tag{9}$$

While we have data for the number of employees, n_{jt}, in all countries and relevant points in time from the ILO's Global Employment Trends Model,[46] we cannot estimate equation (9) directly since our wage data are not in a common currency. However, we can again draw on standard economic theory, which suggests that average wages vary roughly in line with labour productivity across countries.[47] We can thus estimate $\bar{y}_{jt}$ as a fixed proportion of labour productivity, LP:

$$\hat{\bar{y}}_{jt} = \alpha \times \mathrm{LP}_{jt} \tag{10}$$

where α is the average ratio of wages over labour productivity. We can therefore estimate the weight as:

$$\hat{w}_{jt} = n_{jt} \times \alpha \times \mathrm{LP}_{jt} / \sum_j n_{jt} \times \alpha \times \mathrm{LP}_{jt} \quad (11)$$

which is equal to:

$$\hat{w}_{jt} = n_{jt} \times \mathrm{LP}_{jt} / \sum_j n_{jt} \times \mathrm{LP}_{jt} \quad (12)$$

Substituting $\hat{w}_{jt}$ for w_{jt} and introducing the calibrated response weight, ϕ'_j, into equation (8) gives us the final equation used to estimate global wage growth:

$$r_t = \frac{\sum_j \phi'_j \times \hat{w}_{jt} \times r_{jt}}{\sum_j \phi'_j \times \hat{w}_{jt}} \quad (13)$$

and for regional wage growth:

$$r_{ht} = \frac{\sum_j \phi'_j \times \hat{w}_{jt} \times r_{jt}}{\sum_j \phi'_j \times \hat{w}_{jt}}, \; j \in h \quad (13')$$

where h is the region of which country j is part. As can be seen from equations (13) and (13′), global and regional wage growth rates are the weighted averages of the national wage trends, where ϕ'_j corrects for differences in response propensities between countries.