A methodology to project employment by occupation and sector

Kühn Stefan and Jocelyn Maillard

March 22, 2019

1 Introduction

This paper aims at providing a methodology to project employment growth by sector and occupation and disaggregated by gender on the long term for all 193 countries covered by the ILO modelled estimates. A projection aims at determining long-term trends thanks to a number of assumptions. It gives a plausible scenario to better understand the trends of the economy on the long run. It has to be separated from a short-term forecast that aims at predicting actual future short-term values (see U.S. Bureau of Labor Statistics (2018)).

The current methodology used to build those projections worldwide consists of using Labour Force Surveys to get a historical dataset. As they are conducted regularly and quite standardised in many countries, they allow to get precise information about past and present employment by occupation within each sector. Then, researchers look at demographic changes (fertility, mortality, net migration) to estimate the future labour force and the growth of demand). However, projecting employment using only historical data and demographic changes lacks precision. Indeed, this method is not able to take into account disruptive events that we may be aware of as technological, legislative or consumers' behaviours changes. That is why some institutions have developed more complex models to project employment by occupation and industry in specific countries and regions.

2 Employment Projection Models

Those most complex models are called Employment Projection Models (EPMs) or Manpower models. EPMs are characterized by the use of Leontief input-output tables to transform demand growth projection into industry output projection and then employment projection by sector and occupation. These tables describe the general interdependence of the sectors of an economy. Therefore it allows to forecast the consequences that a change in consumption in one sector would have to the rest of the economy. These models can be divided into two types according to their complexity and their scope (which usually depends on the availability of the data). The first category includes more complex models with comprehensive macroeconomic and labour market design. They allow to obtain a projection for many variables, including labour market variables as the employment demand, wages, hours worked and participation rates. This is the type of model used for example by the U.S. Bureau of Labor Statistics (BLS) for the United

States (U.S. Bureau of Labor Statistics (2018)) or by Cedefop for the European Union (Cedefop, Eurofound (2018)) The second category contains models with a more limited macroeconomic and labour market scope. They give as outcomes employment by industry and by occupation as well as unemployment. Models previously designed by the ILO for example for the Philippines (El Achkar Hilal et al. (2013)), Colombia (International Labour Organization (2013)) and Algeria (International Labour Organization (2014)) are included in this category.

Being able to project precisely growth of the components of aggregate demand is both a crucial and difficult step of modelling. Demand projection may be derived from very complex large-scale macro-econometric models (such as the E3ME used by Cedefop), smaller-scale global macro models (as developed by the Economist Intelligence Unit), to single-equation estimates. Large models start using data series built on national accounts to obtain historical purchases for each sector. Then, information coming from other publicly available data and economic theory are included. Total demand is composed of household consumption, firms' intermediate consumption and investment, government expenditures and exports. For example, models would tend to make households consumption depend on real disposable income, short-term interest rate, housing prices and unemployment rate. Firms' intermediate consumption and investments may vary according to relative costs of capital and labour or financial market's conditions. Demographic changes are also taken into account: changes in birth rates, life expectancy and net migration play a part in aggregate demand changes. Finally, it is crucial to integrate to the models future probable changes that researchers are aware of but that are not yet included into the model (for instance a law that passed but whose implementation has not been completed yet).

As an illustration, the BLS projects employment by occupation and industry following six steps that apply different procedures and models (see U.S. Bureau of Labor Statistics (2018)). First, they project the future labour force using projections of the resident population and projected behaviours of agents according to their age, their gender, their race and their ethnic categories. Second, they compute the projected aggregate economic growth. This requires many assumptions concerning the overall growth of productivity, the rate of inflation or the unemployment rate. Third, they project final demand (household consumption, private investment, government expenditures, etc.) by category of goods. Fourth, they build an input-output table to take into account connections between sectors from intermediate inputs looking at historical data. However, those tables change over time. Thus, projected structural changes as changes in energy consumption, technological progress or changes in taste have to be incorporated to obtain the correct relations between sectors. With this table, the total output by industry is obtained. Fifth, they apply the projected industry output to establishment and household surveys to retrieve the employment projection by industry. Sixth, they obtain the employment projections by occupation using again historical data gathered with surveys. Changes in technology or business practices for instance need to be analysed to obtain the best possible occupational projection. The steps are then iterated and the results modified until reaching internal consistency.

EPMs utilize the latest econometric and modelling techniques to project employment by

industry and occupation; and are expected to bring the most precise results. However, they require a large quantity of data and are costly to set up, update and maintain. It is not possible for a single institution as the ILO to build this type of model for each of the 193 countries. Nevertheless, national and regional institutions have developed and updated these models in many developed countries. Besides, the ILO has already built EPMs for a few other countries in Asia, Africa and Latin America. The results of those models can be used for our global model.

3 Presentation of the new methodology

The methodology proposed in this paper adopts the following steps. First, we use historical data to get a baseline dataset. The UN provides historical values for the components of demand and the the sectoral value added. Furthermore, the ILO modelled estimates provides a panel dataset of employment by sector and employment for 193 countries. The ILO uses labour force surveys to gather comparable micro-data for as many countries as possible. This way, historical values of employment by sector and by occupation is recorded for a large number of countries. Then, econometric models are run to fill the missing values for countries and years for which information is not provided. This allows to obtain a historical fully balanced panel dataset that is a perfect baseline for the employment projection.

Second, we exploit existing projected data. The projection of the size of the labour force by country up to 2030 is available in the ILO modelled estimates. It is very useful to calculate the growth of each component of aggregate demand. We also use data from Oxford economics to collect the distribution of aggregate demand from 1990 to 2030 for around 170 countries (including 40 countries with partial information). They also provide projection of sectoral value added up to 2030 for around 140 countries. Finally, the EPMs give projections of various labour market variables by occupation and sector for at least one specific year. They exist for 38 countries, from the different regions of the world. The results have been harmonised as precisely as possible so that sectors and occupations are classified according to the latest international classification standards (respectively the ISIC 4 and the ISCO-08 classifications).

Third, using the baseline dataset, we test individual country time series models and panel data models with country fixed effects and with diverse regional clustering to predict components of aggregate demand. Then, we use a weighted average of the econometric models that best predict historical values of the composition of aggregate demand to project those values up to 2030. To conduct those projections, we use the demographic projections and make assumptions about the state of the economy from a macroeconomic perspective (interest rate, prices of raw materials, real disposable income, etc.). Using historical trends, linkages between sectors, technological changes or changes we know about, we can project the sectoral value added. Therefore, our judgement is here of importance. Besides, at any point during these projections, we can use projections from similar countries to use as comparison with our projection. This can be a valuable tool to check the consistency between the projections or the effect of a specific assumption choice especially as countries for which projections already exist have better available data.

Fourth, we exploit the projections of the components of demand and the sectoral value added to project the employment by sector and by occupation using again the econometric models that best predict historical values. Historical trends are crucial for the projection as for an identical level of sectoral growth, the employment does not vary identically from a sector to another. The elasticity of employment with respect to sectoral value added is strongly dependant on the sector and can be identified thanks to those historical trends. The employment elasticity represents the change in employment that comes with a differential variation of sectoral value added. An elasticity of 0.2 means that an increase of sectoral value added of 1 percent leads to a growth of employment of 0.2 percent. This elasticity depends mainly on two factors: the sectoral composition and the technology used in the whole production process. Sectors are indeed composed of sub-sectors with various labour intensities. If a labour intensive sub-sector grows quicker than the other sub-sectors, the sectoral elasticity of employment with respect to output increases. Technological innovations modify the elasticity of employment by increasing the productivity of workers or replacing workers by capital. Both of those changes limit the growth of employment. The elasticity of employment is also different from a country to another for a same sector and may vary over time due to the macroeconomic situation. Uncertainty, instability, the size of the labour force or taxes on labour also modify the employment elasticity. For instance, armed conflicts, hyperinflation are associated negatively with employment elasticity as explained in Kapsos (2006). Here again, we need to make educated guess about the consequences of those structural changes.

For countries with EPMs, we trust the trends given by those models. However, the latest data point in each of those models is necessarily outdated. Therefore, we compute the trend in the distribution of employment implied by each EPM and apply it to the more recent data. This way, we can obtain an adjusted projected data point for the projection year of each specific EPM. These points are considered as real data to be predicted by our global model. Then, we can use those trends to compare with similar countries. We use our judgement to make the needed modifications.

Finally, we check that the projections are balanced and consistent so that the total distribution of employment by sector and by industry equals 100 per cent and make the appropriate modifications.

References

Cedefop, Eurofound (2018). "Skills forecast: trends and challenges to 2030". Luxembourg: Publications Office. Cedefop reference series; No 108.

El Achkar Hilal, S., T. Sparreboom, and D. Meade (2013). "The Philippines Employment Projections Model: Employment targeting and scenarios". International Labour Office. Employment Policy Department. Employment Working Paper No. 140.

International Labour Organization (2013). "Modelo de proyección de Empleo para Colombia". Employment Policy Department.

International Labour Organization (2014). "Emploi et croissance en Algérie: Défis, perspectives et options politiques". Research Department.

Kapsos, S. (2006). "The employment intensity of growth: Trends and macroeconomic determinants". In *Labor Markets in Asia*, pp. 143–201. London: Palgrave Macmillan.

U.S. Bureau of Labor Statistics (2018). "Handbook of Methods. Employment Projection".