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Calibrating relative wages induced by changed skill rates in long run projections

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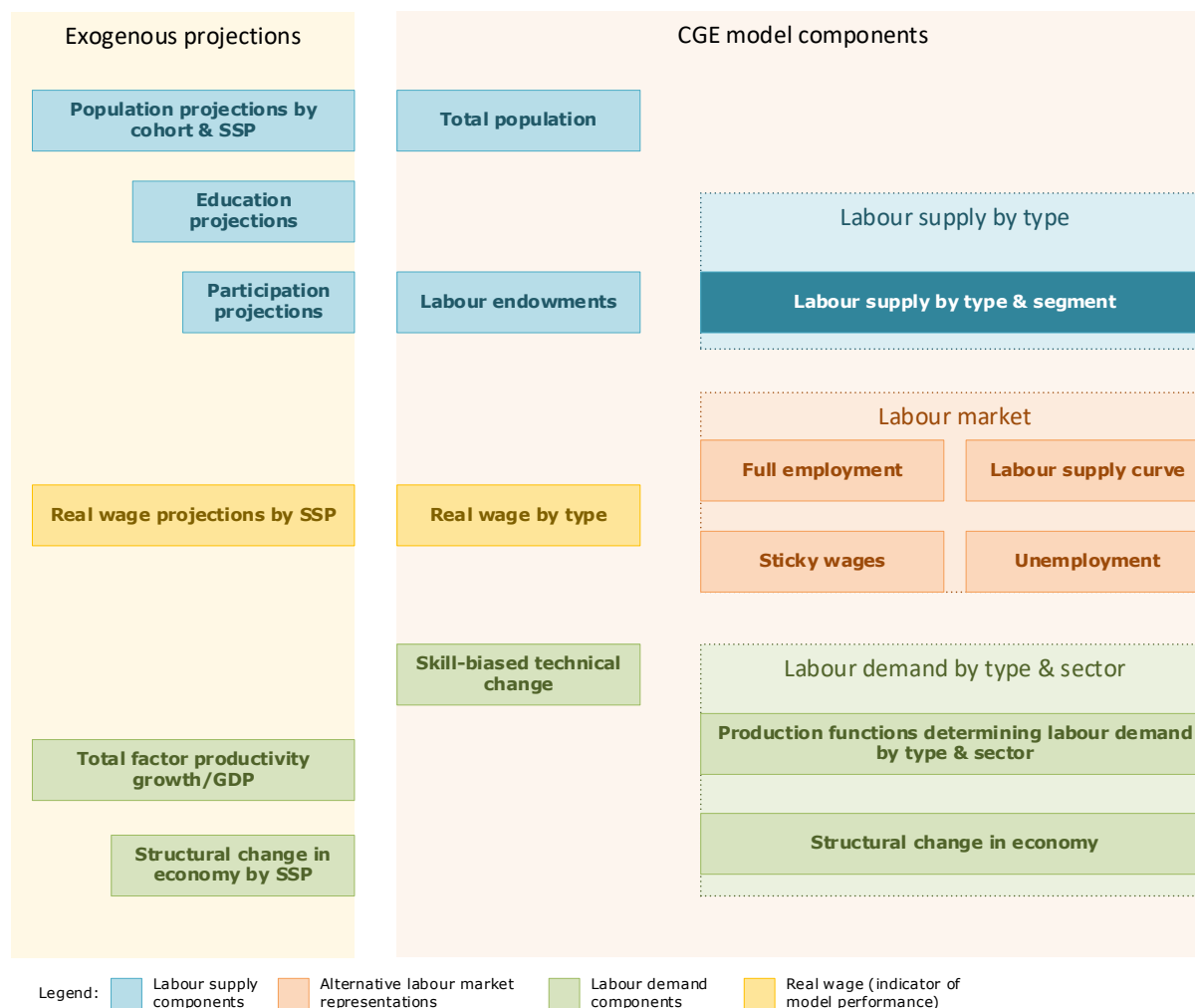
Abstract

Wages are a critical signal in CGE models, determining employment by sector and providing a main source of income for private households. Wage and changes in sectoral employment are also critical for policy decisions and evaluations, thus warranting close attention. CGE wages result from an interplay of model assumptions on (1) labour supply (labour endowments by type, supply by market segments); (2) labour demand (substitutability by sector, structural change); and (3) labour market functioning (assumptions on employment and wage adjustment possibilities). As better capturing long run changes in skilled and unskilled labour ratios is critical for food security and distributional consequences of policies, we focus on developing an empirical approach to judge (and calibrate) skilled to unskilled wage developments in CGE projections. Building Jones' human capital accounting framework we derive a wage equation linking skilled to unskilled wage ratios to real output per worker (a proxy of human capital) and shares of unskilled to skilled labour. We add the parametrized Jones wage equation to the MAGNET global CGE model providing us a measure to judge endogenous MAGNET wage developments, and different means to adjust MAGNET projections. To link with literature we add a decomposition of the average wage change by skill into sectoral productivity increase and structural change driven by employment changes by sector. Using 6 scenarios varying in labour endowment projections (3 variants), labour supply substitution elasticity (2 variants) and targeting of the projected Jones wage ratios (1 variant) we explore the impact of different model assumptions on wage developments. Specifically we compare TFP, employment weighed labour substitution elasticities, wages by skill, skilled to unskilled wage ratio, and the relative contributions of sectoral productivity versus structural change to average wage developments.

Key words: baseline development; labour market; economic development; technological change

1   Wages – a key but mixed signal in CGE models

Wages are a critical signal in CGE models, determining employment by sector and providing a main source of income for private households. Wage and changes in sectoral employment are also critical for policy decisions and evaluations, thus warranting close attention. Wages are the outcome of an interplay of a multitude of model assumptions on labour supply, labour demand and labour market functioning (Figure 1).

Figure 1: Drivers of wages in a CGE model

The bottom (green) parts in Figure 1 highlight demand side drivers of wages - factors affecting the demand for labour by sectors - for which exogenous data may be used (left hand side yellow area) or treated as endogenous in the model (right hand side red area). Key drivers are technological change, total factor productivity growth (TFP) possibly combined with skill-biased technical change affecting the remuneration of different types of labour. In addition to productivity the structure of the economy matters as there are rather persistent differences in (average) labour productivity across sectors. Structural change is normally endogenous in CGE projections but may be steered in case projected developments do not align well with historic trends that can be expected to persist in the future. Apart from structural change the production structure, and especially the extent to which different types of labour can be substituted with each other and /or capital, are key demand side factors for labour affecting wage formation.

The middle orange block summarizes different assumptions on labour market functioning. The regular global CGE assumption is full employment - wages adjust to absorb all labour supplied to the economy. Alternative approaches are labour supply curves (Shutes 2012), assuming sticky wages (Dixon and Rimmer 2002) or an unemployment closure where real wages are fixed and labour supply adjusts. Relevant employment assumptions depend to on the time horizon; unemployment assumptions do not sit well with long run assumptions of substantial flexibility in the economy.

The blue upper parts then describe the factors (exogenous and endogenous) that affect the supply of labour to the economy, including education and participation projections which affect the supply of labour by skill. Apart from different types of labour global CGE models generally also include a distinction between agricultural and non-agricultural labour markets to capture the empirical observation of persistent lower wages in agriculture (Herrendorf and Schoellman 2018).
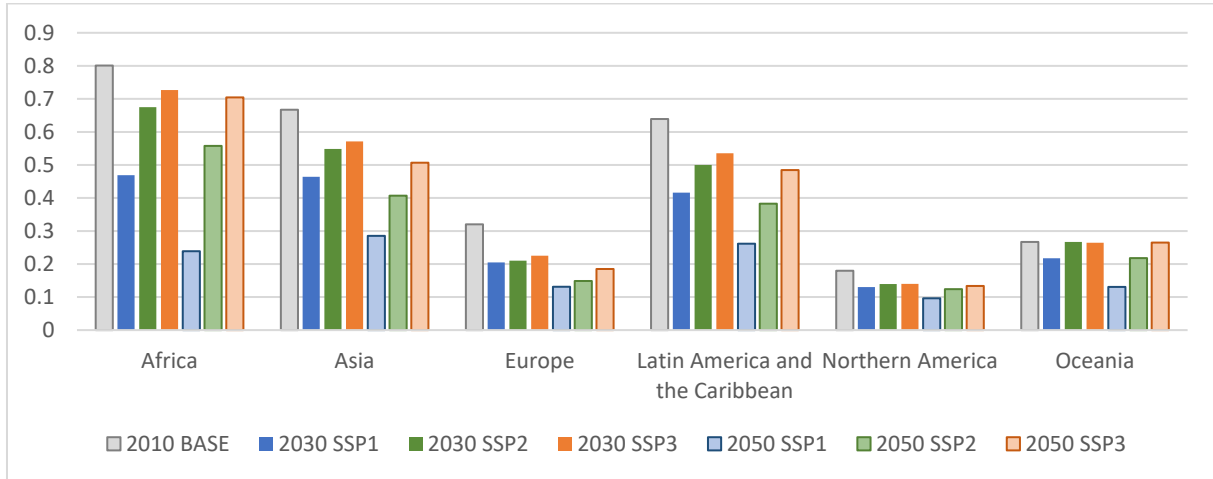
Given the multitude of interrelated assumptions on demand, supply and market functioning a solid basis to judge the performance of the labour market projections is critical. This holds for underpinning assumptions used in modelling various components of the model and exogenous drivers. Wages are most easily observed and thus studied in existing literature and therefore a key measure to judge labour market projections - in practice this is easier said than done. There are no established sources of global real wage projections by skill type comparable to GDP and population projections, while the existing empirical literature studies wages from various partial and not easily consolidated perspectives.

2   Large projected changes in skill rates not captured in current projections

While there are no established global sources of wage projections the population components of the SSPs do include projections of the education level which can be translated into skilled and unskilled labour supply. Figure 2 summarizes these projections (Lutz et al. 2018) in terms of the share of unskilled labour. It shows a steep decline in unskilled labour especially in current low income regions projected to increase their per capita GDP strongly in the coming decades. In Africa, for example, the unskilled labour share drops from 0.80 to 0.24 by 2050. Given the still high population growth in Africa this implies a dramatic increase in the number of skilled people. In high income regions population growth is more modest while unskilled labour shares also decline further, although asymptotically.

These projected changes in skill rates affect relative wages of skilled and unskilled labour which has distributive consequences. Furthermore, a better educated population will be more productive given the persistent link between education levels and wages (Psacharopoulos and Patrinos 2018). Ignoring these increases in human capital will exaggerate the calibrated TFP parameters in CGE projections. Despite the large impact of changes in skill rates they receive scant attention in the literature (Kuiper et al. 2019). For example, while Hertel et al. (2016) show the importance of factor supply assumptions in projections of food demand and prices, there is no mentioning of labour or its changing productivity over time.

Figure 2: Share of unskilled in population over 15 by continent and scenario (2010, 2030 & 2050)

Note: Share in population of 15 and older; unskilled defined as people over 15 with no education + incomplete primary + primary + lower secondary (following the definition in Lee and Lee 2016). SSP1 = Rapid development; SSP2 = Medium development; SSP3 = Stalled development. Data source: Lutz et al. (2018), authors' calculations.

3   Contributions of this paper

As better capturing changes in labour supply are critical for food security projections and distributional consequences of policies (Kuiper et al. 2019) this paper focuses on developing an empirically founded approach for judging, and if needed calibrating, relative wage developments with changing skill rates in long run CGE projections.

Building on the human capital accounting framework of Jones (2019) we derive a wage equation linking the ratio of skilled to unskilled wages to real output per worker (a proxy of human capital) and shares of unskilled to skilled labour. The key parameter in this equation is the elasticity of substitution between skilled and unskilled labour. Knowing that the generally accepted elasticity of substitution between skilled and unskilled labour ranges between 1 and 2 (Lee and Lee 2016, p.167) we have a way of gauging whether our admittedly rough approximation of human capital serves its purpose in the current context of deriving a wage equation useful for CGE modelling where labour types are not perfectly substitutable. Furthermore from our estimation we obtain an elasticity of substitution for labour that corresponds with the projected wage developments, thus providing empirical ground for changes to the labour nesting in our CGE production functions. We estimated the Jones wage equation using the Occupational Wages around the World (OWW) database (Oostendorp 2012), GDP data from the World Development Indicators (WDI) database, labour shares of GDP from the Penn World Table (Feenstra, Inklaar, and Timmer 2015) and educational attainment data from Lutz et al. (2018). The latter also includes education projections by SSP up to 2100 allowing use to use the estimated wage equation for relative wage projections by SSP.

We add the parametrized Jones wage equation to the MAGNET global CGE model (Woltjer et al. 2014) to judge the MAGNET wage projections when we include different projections for skilled and unskilled labour endowments. We will then explore different MAGNET projections by adjusting exogenous labour endowment shocks (3 variants), adjusting production structures to bring labour substitution elasticities in line with our estimates and the number used commonly used in the empirical literature (2 variants) and finally targeting the projected wage developments using a shifter on labour productivity (1 variant). Based on guidance from a review of the rich empirical literature on changes in

wages developments during economic development we compare the scenarios in terms of TFP, employment weighed labour substitution elasticities, wages by skill, skilled to unskilled wage ratio, and the relative contributions of sectoral productivity versus structural change to average wage developments.

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