Preliminary and Incomplete Draft

A Proposed Approach to Measuring Employment and Job Quality in the Agrifood Sector

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Discussion Draft

15 April 2024

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A key element of the agricultural transformation is a move away from self-sufficient, subsistence farming sector to one in which much of the value added and employment involved in supplying agricultural products to final users occurs off farm. In this situation, employment and wages in primary agriculture substantially under-represent the value added and the employment opportunities created by the food system. Thurlow et al (2024) show that a substantial part of agrifood value added and employment is in sectors such as food processing, input supply, food services, and the trade and transport associated with the marketing of agricultural products. Davis et al (2023) present similar findings for employment.

But it is not just the number of jobs provided by the agrifood sector that matters. It is vitally important whether these jobs are available to both men and women; whether they involve skills that can be augmented over time; how the wage rates paid compare with those in employment generated by other sources of final demand, and whether jobs pay a "living wage".

A key step in answering these questions is obtaining data on wages paid, and employment by level of skills and by gender. Fortunately, two major data collection efforts have made very substantial progress in providing the data needed to answer these questions. The first is the GTAP databases that disaggregate labor and employment (Weingarten and Tsigas 2010) The second is the Gender Disaggregated Labor Database developed by the World Bank (Jara Nercasseau et al 2020). Both of them are available in a form with the GTAP database as its organizing framework, providing data for the 65 GTAP sectors at a level of disaggregation that allows the variables of interest to be presented by sub-sector of the agrifood sector, and to be aggregated to an overall agrifood sector. The gender dimension of the GDLD database is a vitally important enhancement and, for that reason, we focus on that database in this paper.

The next section of this preliminary draft paper considers the fundamental methodological question of whether we should measure agrifood GDP and employment from the resources employed in a set of agrifood activities or from the resources employed to provide a set of agrifood products to final demand. The following section examines the question of which activities and products to consider. The third section deals with the special data issues involved with trade and transport margins. The fourth section reviews the information available in the GDLD database on employment and job quality in the agrifood sector.

Activity or Final Demand Approaches?

A key methodological concern is whether to estimate factor returns and employment in the agrifood sector using a production approach in which the resources used to produce agrifood products based on the activities in which they are engaged, or using an expenditure approach in which factors are estimated based on those needed to produce a set of agrifood products. The first approach means measuring agrifood value added and employment on the basis of value added and employment in agri-food related activitiesor (ii) value added and employment needed to deliver final agrifood goods to their end users.

Measuring the factor inputs used in a specified set of agrifood activities has intuitive appeal and is likely more convenient than focusing on the factors used to deliver final goods to end users. All we need to do is to define a set of agrifood activities and measure the value added and employment in those activities. Because we are focusing on elements of value added, the resulting measures can be added across activities, which would not be the case if we were measuring gross outputs.

If we focus on the total factor requirements—and particularly labor inputs—needed to produce a specified vector of final goods, then we need to consider the direct and the indirect factor requirements for those specific goods. This approach is similar to that used by Canning et al (2016) and Yi et al (2021) when estimating the farm share of final expenditures on food. It requires using input-output techniques to identify all of the intermediate and factor inputs used—directly or indirectly—in producing the vector of final goods.

Both approaches should give correct answers—to slightly different questions—if properly estimated, just as Gross Domestic Product (GDP) can be estimated by assessing the value of final goods, or the direct and indirect factor returns associated with the vector of final demands, or by simply adding the factor returns obtained in all sectors of the economy. However, there is no guarantee that this equivalence will hold for an individual sector or final demand such as agrifood. On the other hand, the gap between the two measures is not likely to be large. The activity-based approach estimates the factor returns to production of all designated agrifoods, whether they are final goods or intermediates in the production of other goods. But it does not take into account the value added in producing intermediate goods. By contrast, the approach based on final demands for agricultural goods omits the direct inputs into production of non-final goods but takes into account the direct and indirect factor use in the intermediate inputs to production of those final goods. An important question to be addressed will be what differences arise between measurement based on activities and measurement based on direct and indirect requirements for producing final goods.

One possible approach to extending the activity-based approach is to create additional sectors that supply intermediates to key agrifood subsectors such as primary agriculture and food processing. Implicitly, this creates additional agrifood subsectors (see, for example, Thurlow et al 2023). Under this approach,

accountants who provide tax preparation services to farmers become agrifood accountants and their factor inputs are attributed to the agrifood sector. A challenge for this approach is that these subsectors are not recognizably "agrifood". Another question that arises is whether it is sufficient to count only the direct factor inputs to agrifood? Since production of these inputs requires intermediate inputs whose production, in turn, requires factor inputs, should not an approach like the Leontief Inverse used in Canning et al (2016) be follow? But, given that the output of the sectors covered under this approach includes goods that are used as intermediates, there seems to be a risk of double counting. If this approach were extended to the economy as a whole, would the factor inputs used in producing intermediate inputs not be counted twice, once when considering the sectors in which they are produced and once when considering them as inputs into other sectors?

Boundaries of the Agrifood Sector

Some GTAP sectors clearly warrant inclusion in a broader measure of the agrifood sector. The sub-sectors of interest are shown in Table 1, drawing from the definitions of GTAP sectors in Table A.1

Table 1. GTAP sub-sectors of interest

	GTAP Sectors
Primary Agriculture	1-14
Agricultural Processing	19-25, 26 (Beverages & Tobacco)
Other manufactures using agrifood inputs	27 (Textiles), 28 (Wearing Apparel), 29 (Leather products), 30 (Wood products), 31 (Paper and paper products)
Trade & Transport margins	50 (Whlsale & retail); 55 (Warehousing); 52-54 (Transport)
Food Services	51 (accommodation, food and services)

The first question that arises from examination of Table 1 is where to draw the boundaries of the Agrifood Sector itself. A second is how to identify the factor inputs into the Trade and Transport margins on marketing of agricultural products. Each of these questions is addressed in turn in the following sections.

Which Agrifood Subsectors to Include?

While the Primary Agriculture sub-sectors are relatively well defined, with perhaps the only major controversy being whether to include fishing and forestry. Most of the GTAP Agricultural Processing subsectors—such as those milling rice and producing meat or dairy products— also clearly belong to a broader agrifood sector. Beverages and tobacco clearly rely strongly on agricultural products, with many

of these products produced on farm in subsistence economies and moving to the manufacturing sector as the agricultural transformation proceeds, although others such as soda water or sweetened carbonated beverages, often have little or no link to agriculture. Food services are clearly highly relevant to what is normally thought of as the agrifood sector and the main challenge is that these are typically (and certainly in the case of GTAP) included within a broader sector such as Accommodation, Food and Services (GTAP Sector 51).

A key question is whether to include the manufacturing sectors that draw heavily on agriculture for their intermediate inputs. While Thurlow et al (2023) do not include these activities in their measures of agrifood GDP and employment, Davis et al (2023) include textiles (13), leather products (15), wood products (16) and paper (17). The dividing line with respect to textiles is challenging, with some textiles--such as bolts of cotton cloth—heavily derived from agriculture while others, such as synthetic tire cord, having no tangible link to agriculture. Another problem is that, particularly within the advanced economies, only a small share of textile output is sold directly to consumers, with most textile output used as intermediate inputs into wearing apparel and other sectors. If textiles are to be included, then it seems likely to be important to include wearing apparel as well. But does including activity in the design and manufacture of clothing—or at least the share of it that involves agricultural inputs—stretch the boundary of the agrifood sector too far? Similar issues arise in the wood products sector, where much of the output is intermediate goods, such as wood used in housing and in construction. But does including all or part of the housing sector extend the boundaries of the agrifood sector beyond reasonable limits?

Trade and Transport Margins

Estimation of the factor use associated with Trade and Transport margins on outputs and incorporating them into an input-output structure for analysis pose a different set of challenges. These do not arise on the production side of the agrifood sector, but on the marketing side. Where agrifood sectors use trade and transport as intermediate inputs—as when a farmer hires a trucking company to transport hay to feed to animals, these are correctly recorded as intermediate inputs from the transport sector. On the marketing side, however, when trade and transport inputs are used to transfer and/or transform farm products for use by final demanders, these inputs are recorded as direct sales by trade and transport to the final users in any input-output table presented at basic prices. As a consequence, the link between these trade and transport inputs and sales of agrifood products is lost. By contrast, when an IO is presented at purchasers' prices, data on the costs of providing margin services have generally been used to convert basic prices into producer prices.

While the GTAP input-output data are presented at both basic prices and at purchasers' prices, the allowance for trade and transport margins is very small because it focuses only on international trade margins. As a consequence, all of the domestic margin services are allocated to composite trade and transport activities, without distinguishing the value of these services applying to Agrifood products. One option for filling this lacuna is to use a simple rule, such as the rule that these services are used in proportion to the share of agrifood in total employment excluding margin services (Davis et al 2023, p11). Alternatively, where data on margin expenditures are available (as in Thurlow et al 2023), the share of these services in the total availability of margin services might be used to apportion the outputs of these sectors between margin services used for agriculture and those for other activities. The data collected by Peterson (2006) for a version of GTAP 6 including margin services might provide a more detailed source of margin data per unit of output. New data collected for the next version of the GTAP database provide much more detailed information that should help to deal with this problem.

Dixon et al (1982, p151) provide an illustration of the way an input-output table may be reformulated—while preserving its usability for IO analysis using equation (5)—to allocate margins to specific agrifood products. They do this by adding rows reflecting margin expenses attributable to specific products as additional rows of intermediate inputs. Expenditures on these margin services for domestically produced goods then contribute to the producers' prices for these goods and the analysis can proceed exactly as before, while now correctly attributing the factor inputs associated with those margin services to the agrifood sector, rather than to final sales by the trade and transport service sectors.

Identifying Direct and Indirect Factor Requirements

One way of assessing the factor inputs required to produce a given set of final outputs can be obtained using the open-economy input-output model. A useful exposition of this model is given in OECD (2018, p162), beginning with two simple equations:

(1) $\boldsymbol{y} = \boldsymbol{A^D y} + \boldsymbol{f^D} + \boldsymbol{x}$

(2) $\boldsymbol{m} = \boldsymbol{A^M y} + \boldsymbol{f^M}$

where the first equation is the supply-demand equation for domestic goods and the second for imported goods. The term **y** is a vector of gross output; $\boldsymbol{A^D}$ is a matrix of intermediate use, with each element specified as the value of an intermediate input in that row as a share of the gross output value of the good represented in the column; $\boldsymbol{f^D}$ is a vector of final demands for domestically produced outputs and $\boldsymbol{x}$ is a vector of exports of commodities. The term $\boldsymbol{m}$ is a vector of imports; $\boldsymbol{A^M}$ is a matrix of coefficients of intermediate use of imported goods; and $\boldsymbol{f^M}$ a vector of imports used to meet final demands.

Solutions to this model are given by:

(3) $\boldsymbol{y} = (\mathbf{I}-\boldsymbol{A}^{\boldsymbol{D}})^{-1}(\boldsymbol{f}^{\boldsymbol{D}} + \boldsymbol{x})$

(4) $\boldsymbol{m} = \boldsymbol{A}^{\boldsymbol{M}}(\mathbf{I}-\boldsymbol{A}^{\boldsymbol{D}})^{-1}(\boldsymbol{f}^{\boldsymbol{D}} + \boldsymbol{x}) + \boldsymbol{f}^{\boldsymbol{M}}$

where $(\mathbf{I}-\boldsymbol{A}^{\boldsymbol{D}})^{-1}$ is the Leontief inverse considering only domestic intermediate use.

Equation (3) allows us to identify the matrix of factor inputs required to produce any given vector of total demands for domestic goods:

(5) $\boldsymbol{V}^{\boldsymbol{D}} = \boldsymbol{V}\cdot(\mathbf{I}-\boldsymbol{A}^{\boldsymbol{D}})^{-1}\,\mathrm{diag}(\boldsymbol{f}^{\boldsymbol{DX}})$

Where $\boldsymbol{V}^{\boldsymbol{D}}$ is the $q*n$ matrix of q factor demands for production of n domestic goods, whether sold domestically or exported; $\boldsymbol{V}\cdot$is the matrix of direct q factor demand shares associated with the $n*n$ matrix of intermediate input demands, $\boldsymbol{A}^{\boldsymbol{D}}$, expressed as a proportion of the total value of output, including domestic and imported intermediates and factor use; and $\boldsymbol{f}^{\boldsymbol{DX}}$ is the vector of final demands for both domestic uses and exports of the n domestically-produced goods, which is diagonalized to allow us to estimate the vector of factors demanded in each sector.

When we diagonalize the complete vector of final demands for domestic goods, equation (5) should return the observed matrix of total factor demands in the economy. If we consider only part of the total demand vector—such as the final demands for specified agrifood outputs—then equation (5) will return the matrix of factor inputs (and hence value added) needed to produce those final outputs. Where our matrix of direct factor input requirements allows us to identify particular categories of workers (eg male/female or skilled/unskilled), this matrix will allow us to identify the total employment and the sectors of employment needed to produce the specified agrifood commodities.

A stylized application

A stylized application of this formula to GTAP 11 data for high-income countries yields some interesting and surprising results. For simplicity, it considers three sectors: Primary agriculture; Food Processing and Accommodation and Food Services (without splitting Food Services from Accommodation). The purpose of this analysis is primarily to investigate whether measuring agrifood employment and value added differs whether measured from the factors needed to deliver final goods or from factor use in the designated activities.

When we measure factor returns in value terms, considering only the activities in which these factors are engaged, we obtain the results in Table 2.

Table 2. Shares of factor returns accrued by Sector, %

	Agriculture	Processed Food	Accomodation & Food	"Agrifood total"
Land	49.7	0	0	49.7
Labor	1.3	1.8	4.5	7.6
Capital	1.3	2.2	2.9	6.4

When we measure factor returns taking into account the value-added factors needed to deliver these products to final demand (including export demand), we obtain the quite different set of results seen in Table 3.

Table 3. Shares of factor returns generated supplying Agrifood goods to final demand, %

	Agric	Processed Food	Accommodation & Food	"Agrifood Total"
Land	22.3	19.3	5.9	47.5
Labor	0.9	3.9	8.3	13.2
Capital	1.0	4.4	6.8	12.1

Table 3 shows that the share of labor and capital needed to meet final demands for food in high income countries is much higher than the share directly employed in the activities directly supplying those products. This striking finding needs careful interpretation if it is to understood and accepted. It is, of course, important to recall that much of the factor use in the "Agrifood total" is not in activities identified as agrifood. An accountant providing services to a farmer who sells food to final demand is, for example, counted.

Interestingly, the higher share of factor use in agrifood is not seen to be the case for primary agriculture, but is strongly the case for Processed Food and for Accommodation and Food. In the case of primary agriculture, the fact that the final demand approach measures only factors used in producing products sold directly from agriculture to final users sharply reduces the estimated importance of factor use in agriculture, relative to the sector-of-employment approach. This is compensated for to some degree when employment in sectors supplying intermediates to agriculture is considered. But, because agriculture uses a relatively small share of intermediate inputs (51 percent vs 76 percent in food processing) and sells a relatively small share of its output directly to final demand, its employment share on this measure is smaller than its share of direct employment. Processed Food and Accommodation and Food Services, by contrast, sell far higher share of their output to final demand, and use far higher shares of intermediate inputs, including, of course, from agriculture.

These results are extremely preliminary. The share of employment in agrifood will certainly decline when it becomes possible to separate Food Services from Accommodation. And will certainly increase when we are able to adequately account for the margin services needed to transfer food from producers to its consumers. What they do show, however, is the fact that the share of factors needed to supply final agrifood goods my differ substantially from the share of factors needed to supply final agrifood goods to those who demand them.

Preliminary Results – Employment and Job Quality Across Sectors

This analysis uses the GDLD database to identify the share of total labor employment by gender and skill level (non-skilled and skilled) in each sector. The GDLD provided an unprecedented opportunity to do cross country analyses on both the quantity and quality of jobs. The quantitative analysis is based on shares of total employment in each sector and the qualitative analysis relies on the trends in relative wages across sectors. GDLD estimates wages using numerous micro-surveys from various countries, and as such are considered more reliable than estimates from national account statistics. To facilitate cross-country comparisons, we estimate wage premia in defined sectors relative to primary agriculture.

The GDLD database provides detailed estimates on the volume of labor and wages by gender and skill level for 64 "activities" in GTAP terminology, which roughly translates to 64 distinct sectors or sub-sectors of the economy in common terminology. For tractability, these 64 activities are aggregated into 14 distinct "sectors" as defined earlier to allow flexibility in subsequent definitions of direct and indirect (apportioned as discussed above) uses of agri-food products. The 14 sectors are defined as follows:

1. AGF: Primary agriculture – including all activities related to crop and livestock products.
2. FFS: Forestry and fishing – typically included in primary agriculture in national accounts
3. FPR: Food processing – processing of all final food and beverage products
4. NPR: Non-food processing – processing of non-food agricultural products such as textiles, leather, etc.
5. AFS: Accommodation and food services – as per GTAP accounts from which food services yet to be apportioned out.
6. CNS: Construction activities
7. TPT: Transport – from which agri-food shares yet to be estimated
8. TRW: Trade and warehousing/support services of which agri-food shares yet to be estimated
9. EXT: Extractive industries (coal, oil, gas, mineral, etc.)
10. MGF: Manufacturing - chemical, metal, plastic, rubber products, machinery and transport vehicles, etc. from which agricultural chemicals, machinery, vehicles, etc. yet to be estimated

11. MFX: Petroleum, coal, basic pharmaceutical, paper products and publishing
12. EEQ: Computers, electronics, electric and optimal products/equipment
13. UTL: Utilities – electricity/water/gas manufacture and distribution
14. SVS: Services – all other services broadly defined.

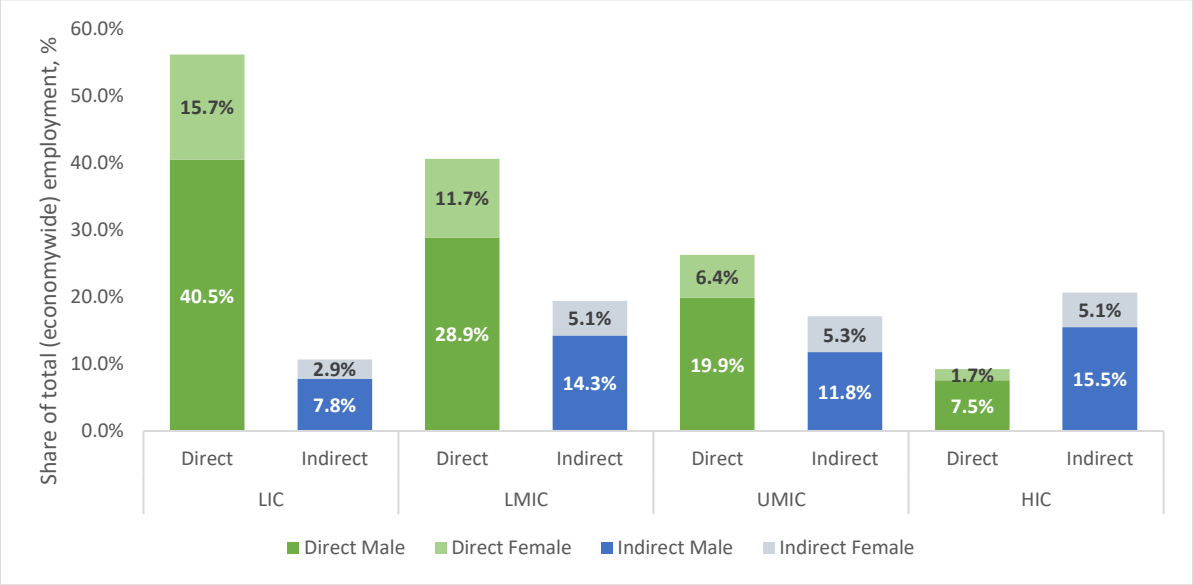
It is important to note that the analysis that follows is based on the raw GTAP sectoral data, with AGF, FFS and NPR considered as agri-food sectors in totality. The indirect factor requirements in other sectors that use agri-food products as intermediate inputs or the shares of margin industries related to the agri-food system are not estimated in these preliminary findings. The share of these indirect employment sectors that is linked to agri-food final goods are a work in progress and will be included in the final results.

Trends in agri-food employment: quantity trends

The first set of results is unsurprising in that the share of the agri-food sector in total employment declines with development, proxied here by the World Bank classification of countries by income (the World Bank uses gross national income per capita thresholds to classify countries by income level as low, lower-middle income, upper-middle income, and high-income countries). Using these groupings, Figure 1 shows total employment in primary agriculture (AGR+FFS) and agricultural processing sectors (APR+NPR) falls progressively as countries transition from low to high income status.

The shares of sectors with indirect employment related to the agri-food sector are not yet accurately estimated, but employment in the accommodation and food services (AFS), transport (TPT) and trade and warehousing (TRW) does show a rising trend, but is less dramatic. As noted, these estimates of indirect employment are an overestimate. At the same time, overall indirect employment is also underestimated as other sectors with agri-food links are not captured. These three sectors overestimate the shares of agri-food related to these sectors because they also deliver other goods and services (e.g. accommodation in addition to food services in AFS, and transport of non agri-food goods in TPT). On the other hand, indirect employment is underestimated to the extent that current estimates do not include employment in economic activities that provide intermediate inputs to primary agriculture (e.g., fertilizers or farm machinery) or in sectors where agri-food goods may be used as intermediate inputs (e.g, cassava starch or plant based products used as industrial inputs). The refinement of the estimates with more accurate measurement of indirect sectors and proper accounting for the "hidden" indirect contribution of the agri-food sector is under way and will be included in the next iteration of this paper.

Figure 1: Share of agri-food employment in total employment by country income classification.



Source: Authors' estimates using GDLD database, World Bank.
Note: LIC refers to Low-income countries; LMIC to Lower-middle income countries; UMIC to Upper-middle income countries; and HIC to High-income countries as defined by the World Bank.

The second point to note is that both the direct and indirect employment are dominated by males. The share of female labor is not trivial, but is significantly less than the share of male employment in each sector (direct or indirect) and income classification. While this pattern is consistent across countries, it is notable that the share of males in direct agricultural employment rises consistently from LIC to HIC status. Indirect employment shows a more stable share across income classes.

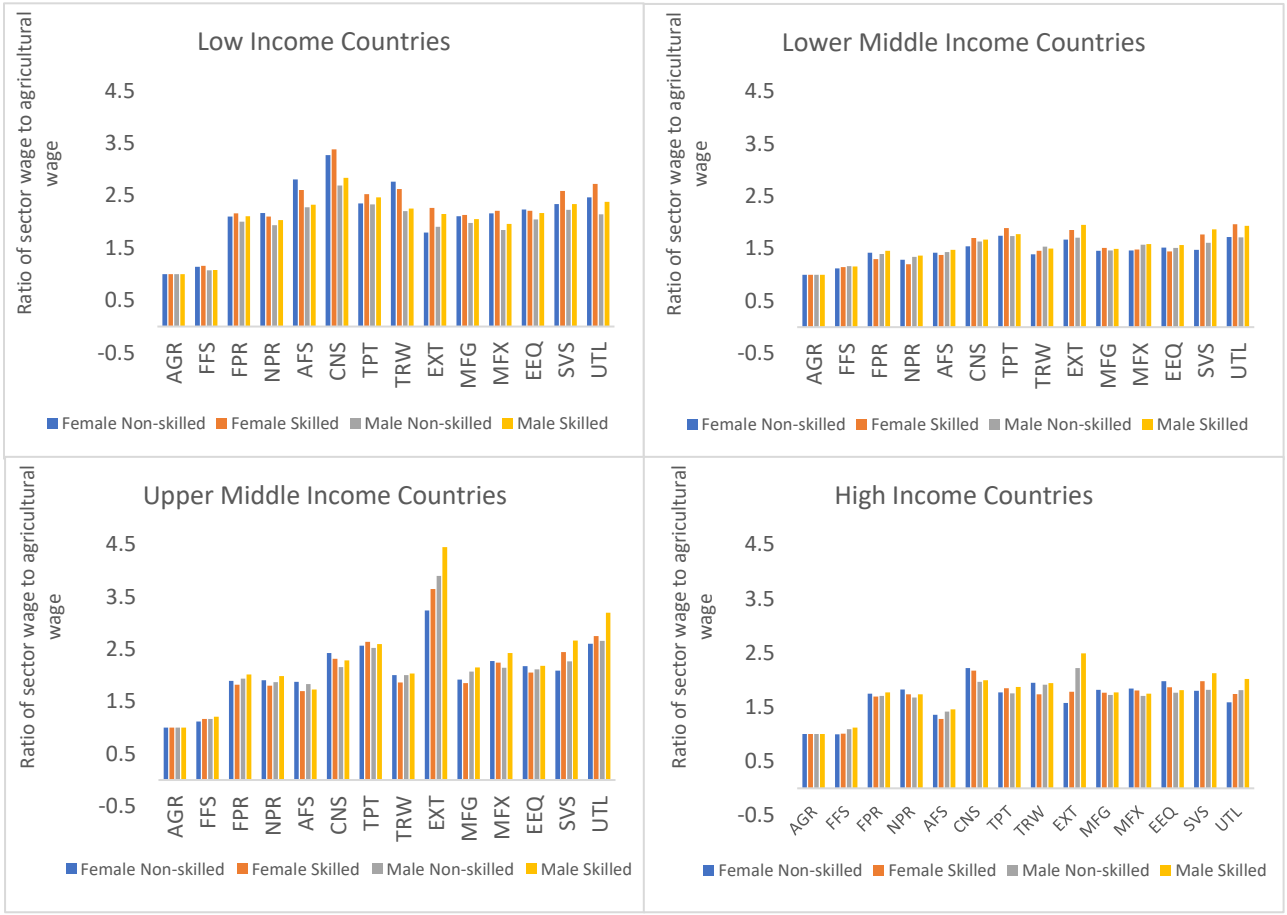
Finally, the pattern by skill levels (with the GDLD defining non-skilled workers as those with less than nine years of education, and skilled workers otherwise) provides some interesting important insights. Within direct agri-food employment, the share of non-skilled workers declines steadily from LIC to HIC but the share of skilled employment shows a non-linear pattern. As countries transition from low to lower-middle income status, the shares of skilled workers rises substantially from 7 percent of the total workforce in LICs to 13 percent in LMICs, before falling sharply to 4 percent in UMICs and 1.5 percent in HICs. Within direct agri-food employment, employment rises somewhat in primary agriculture (from 6 to 8 percent) but is more pronounced in the processing sectors (from 2 percent to 5 percent). These trends suggest two points: as education levels increase in low income countries, agri-food processing provides an important opportunity for skilled labor to transition out of primary agriculture. Yet, the trends in primary agriculture employment suggest some friction in the labor markets. Some of the educated workers appear to remain in primary agriculture, which may reflect frictions in labor mobility – including insufficient skilled job opportunities to transition to, or other factor policies. With sustained development, skilled workers appear to find opportunities in other sectors, transitioning rapidly out of agri-food into

other sectors. This pattern is also seen in the gross indirect agri-food employment patterns but more refined estimates for these sectors (as discussed above) to meaningfully interpret the employment trends.

Trends in wage premia: quality trends

The GDLD provided an unprecedented opportunity to also study the trends in wages across sectors. As noted earlier, these wages/income estimates are estimated using micro-surveys from various countries, and as such are considered more reliable than estimates from national account statistics. To facilitate cross-country comparisons, we estimate relative wage premia, defined as are sector wages (derived as weighted average of all activities that are aggregated into each of the 14 final sectors of analysis) relative to the wage in primary agriculture. These premia are estimated for both genders (male and female) and skill levels (non-skilled and skilled). The main results are summarized in Figure 2.

Figure 2: Wage premia by Sector: averages across country income groups



Source: Authors' estimates using GDLD database, World Bank.
Note: Sector definitions in the figure are as follow: AGR=Agriculture; FFS=Forestry and Fisheries; FPR=Food processing; NPR=Non-food agricultural products processing; AFS=Accommodation and food services; CNS=Construction; TPT=Transport; TRW=Trading and Warehousing services; EXT=Extractive industries; MGF=Manufacturing; MFX=other industry including petroleum, coal, basic pharmaceutical, paper products and publishing; EEQ= Computers, electronics, electric and optimal products/equipment; UTL=Utilities, including electricity/water/gas manufacture and distribution; SVS=Services – all other services broadly defined.

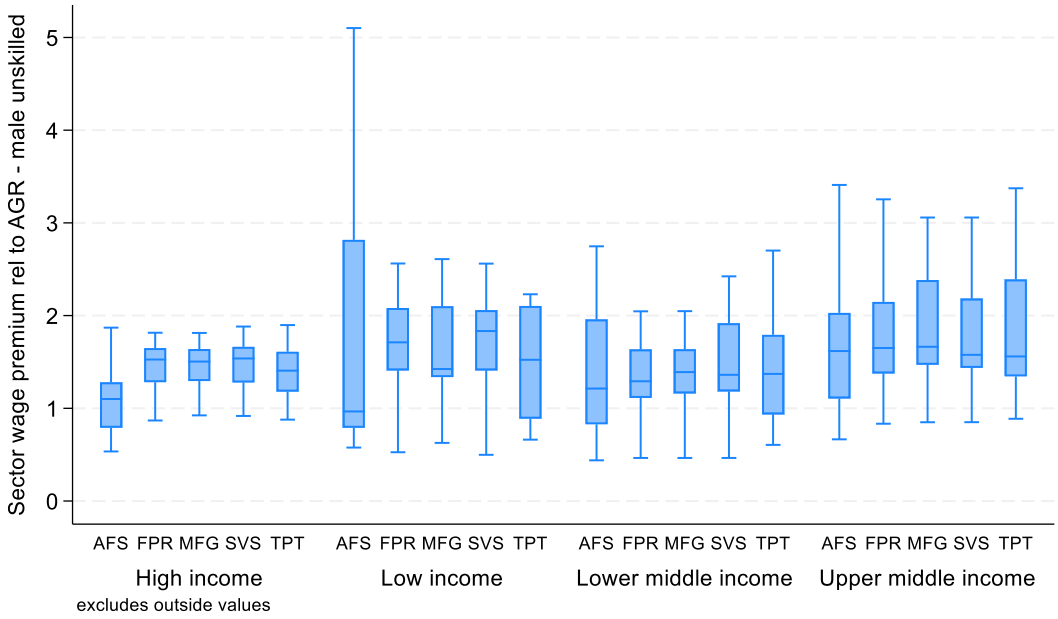
The first thing that jumps out from the figure is that all sectors, other than primary agriculture (AGR and FFS) show a substantial wage-premium relative to agriculture. This large premium in all sectors outside primary agriculture, and including the agri-food processing sectors, however needs some further investigation to better interpretation. This caution flows from concerns raised in the agricultural wage-gap literature (references….) that points to substantial measurement errors in national accounts and aggregated statistics when it comes to estimates of agricultural workers. Since agriculture does not employ workers full time, except perhaps during short "peak" periods (sowing or harvesting), the blunt classification of workers their stated primary occupation (as is the convention in national accounts) appears to be problematic. A second concern is the need for correction of wages to real wages to provide a more meaningful comparison. Most non-agricultural wages related to urban jobs where as most agricultural wages are for rural based jobs. Given large differences in the cost of living between rural and urban areas, a proper comparison requires adjusting the wages appropriately.

Leaving aside the differences in agriculture vs non-agricultural wages, an important finding from the figure is the consistency of the wage premium across sectors. The wage premia are more varied in LIC but become tend to converge as income level rises (the one notable exception being the extractive industries in UMICs). The higher variability in LICs needs more detailed analysis but, a priori, it may reflect the process of development, with some sectors being "first movers" in absorbing labor from primary agriculture (as in AFS or construction). Analysis using median premia by country income groups (not shown here) indicates a more stable premium across sectors suggesting country specific factors, including the structural characteristics of the economy, are important beyond income classification into broad groups. Such idiosyncratic factors are evident in the sample graph in Figure 3, which shows the relative wage premium unskilled for selected sectors for male unskilled labor.

Notably the premium in agri-food processing sectors is comparable to other sectors, such as manufacturing and services for most countries. The premia seem to be the highest in LICs but to decline as income levels rise.

Two main conclusions arise from this analysis. Shining the light only on primary agriculture significantly underestimates its contribution to the overall economy in terms of both value added, the number of jobs as well as the quality of jobs it directly or indirectly creates throughout the economy. Secondly, as the composition of the broader agri-food system changes from primary agriculture to becoming more processing and service oriented with development, the contribution of the agri-food sector to the overall value added in the economy and to employment, especially the quality of employment, also increases.

Figure 3: Variations in wage premia within country groupings



Source: Authors' estimates using GDLD database, World Bank.
Note: Sector definitions are the same as in Figure 2.

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Appendix

Table A.1 Sectors Represented in GTAP 10 and 11		
1	pdr	Rice: seed, paddy (not husked)
2	wht	Wheat: seed, other
3	gro	Other Grains: maize (corn), sorghum, barley, rye, oats, millets, other cereals
4	v_f	Veg & Fruit: vegetables, fruit and nuts, edible roots and tubers, pulses
5	osd	Oil Seeds: oil seeds and oleaginous fruit
6	c_b	Cane & Beet: sugar crops
7	pfb	Fibre crops
8	ocr	Other Crops
9	ctl	Cattle: bovine animals, live, other ruminants, horses and other equines, bovine semen
10	oap	Other Animal Products:
11	rmk	Raw milk
12	wol	Wool: wool, silk, and other raw animal materials used in textile
13	frs	Forestry: forestry, logging and related service activities
14	fsh	Fishing: hunting, trapping and game propagation
15	coa	Coal: mining and agglomeration of hard coal, lignite and peat
16	oil	Oil: extraction of crude petroleum, service activities incidental to oil and gas extraction
17	gas	Gas: extraction of natural gas, service activities incidental to oil and gas extraction
18	oxt	Other Mining Extraction (formerly omn): mining of metal ores; other mining and quarrying
19	cmt	Cattle Meat:
20	omt	Other Meat:
21	vol	Vegetable Oils
22	mil	Milk: dairy products
23	pcr	Processed Rice: semi- or wholly milled, or husked
24	sgr	Sugar and molasses
25	ofd	Other food
26	b_t	Beverages and Tobacco products
27	tex	Manufacture of textiles
28	wap	Manufacture of wearing apparel
29	lea	Manufacture of leather and related products
30	lum	Lumber: manufacture of wood and of products of wood and cork, except furniture;
31	ppp	Paper & Paper Products: includes printing and reproduction of recorded media
32	p_c	Petroleum & Coke: manufacture of coke and refined petroleum products
33	chm	Manufacture of chemicals and chemical products
34	bph	Manufacture of pharmaceuticals, medicinal chemical and botanical products
35	rpp	Manufacture of rubber and plastics products
36	nmm	Manufacture of other non-metallic mineral products
37	i_s	Iron & Steel: basic production and casting

Table A.1 Sectors Represented in GTAP 10 and 11		
38	nfm	Non-Ferrous Metals:
39	fmp	Manufacture of fabricated metal products, except machinery and equipment
40	ele	Manufacture of computer, electronic and optical products
41	eeq	Manufacture of electrical equipment
42	ome	Manufacture of machinery and equipment n.e.c.
43	mvh	Manufacture of motor vehicles, trailers and semi-trailers
44	otn	Manufacture of other transport equipment
45	omf	Other Manufacturing: includes furniture
46	ely	Electricity; steam and air conditioning supply
47	gdt	Gas manufacture, distribution
48	wtr	Water supply; sewerage, waste management and remediation activities
49	cns	Construction: building houses factories offices and roads
50	trd	Wholesale and retail trade; repair of motor vehicles and motorcycles
51	afs	Accommodation, Food and service activities
52	otp	Land transport and transport via pipelines
53	wtp	Water transport
54	atp	Air transport
55	whs	Warehousing and support activities
56	cmn	Information and communication
57	ofi	Other Financial Intermediation:
58	ins	Insurance (formerly isr):
59	rsa	Real estate activities
60	obs	Other Business Services nec
61	ros	Recreation & Other Services:
62	osg	Other Services (Government)
63	edu	Education
64	hht	Human health and social work
65	dwe	Dwellings: ownership of dwellings (imputed rents of houses occupied by owners)