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Article

The global gender gap in labour income

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Abstract

This article introduces a new measure of economic gender inequality (EGI) based on the ratio of women's share of national labour income to men's. This measure captures both the principles of equal pay for equal work and nondiscrimination. Importantly, it can be calculated from existing data and is comparable between countries and over time. If we simply consider an unweighted average of our measure of EGI, there has been an improvement between 1994 and 2014. However, once we weight countries by population, average EGI has been increasing. Much of the higher EGI in poorer, more populous, countries is explained by the lower rates of female employment in those countries.

Keywords: economic gender inequality; global distribution of income
JEL classifications: J16, J71, D33, O15

1. Introduction

This article takes a modern view of what economic gender-equality (EGI) means. That is, as we argue, in a society with genuine economic gender-equality, there would be no difference in the total labour income of men and women. Such equality of outcomes would reflect that men and women participated equally in the labour market, worked in a similar set of roles, occupations, and industries on average, and received equal pay for equal work.

We are thus claiming that, when summing across men and women, all national differences in total labour compensation reflect inequality. That is, there is no justifiable difference in pay due to men or women preferring particular roles, having different preferences—on average—for risk or competition, or due to child-rearing and other forms of caregiving.

This article operationalizes this definition using existing data to obtain comprehensive and comparable annual data on EGI across most countries for a period of 25 years. Our approach allows us to decompose the EGI by source—differences in wages, hours, employment, and informality—and by sector. The results suggest that despite progress in some countries, progress in many countries has been extremely limited and that differences in wages are a comparatively small component of aggregate EGI.

Our definition is a more expansive and more demanding measure of EGI than the Gender Pay Gap (GPG). In support of our benchmark, we note that the list of tasks once exclusive to either men or women has shortened rapidly in recent years. Previous prohibitions on women in the armed (special) forces, certain sports, as astronauts, or firefighters have been overturned. Similarly, the list of roles, typically involving care, considered unsuited to men has likewise shortened.

Our benchmark embodies our argument that higher pay in male-dominated occupations and industries, and the concentration of men and women in particular occupations and industries, reflects systemic gender inequality rather than reflecting any economic imperative. That is, as elaborated in Section 3, in a gender-equal society, differences in preferences or other attributes would not result in systematic wage disparities.

EGI has two components: discrimination between equally qualified men and women, and differences in access to education, training, or specific sectors of the economy. With few exceptions, there is a uniform commitment to eliminating both forms of discrimination. Almost every country is a signatory to the Equal Remuneration Convention (1951), committing it to the '*principle of equal remuneration for men and women workers for work of equal value*'.[1] Similarly, almost all are signatories to The Convention on the Elimination of All Forms of Discrimination against Women (1979). This convention addresses aspects of EGI beyond equal pay for equal work, including differences in labour market participation, unemployment, and home production. The last century saw enormous progress in high-income countries, termed 'the grand gender convergence' by Goldin (2014). Nevertheless, the evidence suggests that, despite such laws, a substantial pay gap persists. In the OECD, where it is expected to be smallest, the gender pay gap (GPG)—the difference between female and male median wages, divided by male median wages—remains over 15 per cent and reaches as high as 37 per cent in South Korea.[2] Outside the OECD, inequality in wages and labour force participation is often even greater (Baoping 2022).

The measure of EGI this article introduces, which we term the labour share ratio, captures both departures from equal pay for equal work and limits to women's labour market opportunities due to discrimination. This is the labour share of income of women—the compensation of female workers as a share of their value added—divided by the labour share of men. The idea is simple: one implication of 'equal pay for work of equal value' is that the ratio of compensation to value added should be the same for men and women. Our argument is that imperfect competition in labour and product markets means that workers of both genders must negotiate their share of output. The extent to which male workers receive more, *ceteris paribus*, reflects differences in the relative bargaining strength of men and women.

Similarly, the elimination of discrimination against women implies equal access to education and training and no limitation in terms of occupation, sector, or rank. It thus also implies the elimination of most, if not all, differences in total value added (per hour) and the differences in labour market participation between men and women. While value added cannot typically be disaggregated by gender, we do not need to do so to calculate our measure. All we require is the assumption that any systematic deviation from equal value added per hour reflects a deviation from equality of opportunity. This assumption is empirically supported by the convergence documented by Goldin (2014) as well as the progressive elimination of explicit and implicit prohibitions on women working in roles previously restricted to men on the basis of presumed capability such as firefighters or front-line soldiers. Our measure therefore captures both equal pay for equal work and equality of opportunity.

This approach has three key advantages. First, by focusing on the share of the value added we are able to abstract from cross-country variation in the determinants of value added that normally make meaningful cross-country and intertemporal comparison difficult. Importantly, for example, our approach does not require us to focus on full-time equivalent employees only, and allows for differences in self-employment and informality

[1] The USA is a prominent exception, but has had a similar commitment since the 1963 Equal Pay Act.
[2] See https://www.oecd.org/gender/data/genderwagegap.htm.

across place and over time. Second, this also makes aggregation meaningful, enabling us to present estimates for total global EGI. Finally, our approach relies on well-understood data: the data that form the basis of GDP statistics. Using these data, we construct a panel for the period 1991–2018, covering over ninety countries, which together account for nearly 4 billion working-age people out of the global working-age population of approximately 5 billion in 2018.

Using these new data, this article studies how EGI varies across countries, its changes over time, and its composition. It also studies the evolution of aggregate global pay inequality. We find that while EGI has been slowly shrinking in most countries, the relatively high birthrate in more unequal countries means that aggregate inequality has increased and will continue to do so until around 2050. The results imply that aggregate EGI in 2017 was equivalent to over one billion working-age women working for no compensation whatsoever.

This article proceeds as follows. We next discuss some previous literature. Section 3 introduces our definition of Gender Labour Income Equality, and its assumptions. Section 4 discusses our measure of EGI and the data we use. Section 5 describes patterns of gender-equality around the world and provides estimates of the aggregate global gender gap. Section 6 provides a discussion of our results and Section 7 briefly concludes.

2. Related literature

Our review of the literature on EGI is necessarily partial. We focus primarily on the economics literature on labour income differences rather than other important outcomes such as education, or much of the work in adjacent fields. To keep the discussion tractable, we focus as much as possible on review articles discussing either pay gaps in the US or making international comparisons. For the same reason, we do not discuss the role of intersectionality (Greenman and Xie 2008).

The measurement of gender inequality has a long history in economics, dating at least to the seminal work of Becker (1971), with important early contributions including the theoretical and descriptive work of Zellner (1972) and Oster (1975), and the well-known decomposition by Oaxaca (1973) and Blinder (1973). Subsequent work emphasized the importance of making suitable comparisons. For example, Blau and Beller (1988) noted that, adjusting for hours and weeks worked, the gender pay gap decreased in the 1970s. This highlights the importance of taking into account changes in differences between men and women in hours worked.

Subsequent research highlighted the complex, multi-causal, nature of EGI. For instance, Blau and Kahn (1997) note that the closing gender pay gap in the 1980s occurred despite broader trends in the wage structure that were particularly detrimental to high-skill women. More recently, Ngai and Petrongolo (2017) developed and estimated a model in which the growing share of services in the economy is associated with an improvement in women's relative wages and hours.

Altonji and Blank (1999) provide a comprehensive survey of labour market differences by race and gender in the US, discussing theories of prejudice and statistical discrimination introduced by Becker (1971) and the evidence for them.

A more recent literature, reviewed by Bertrand (2011), identified the perhaps more subtle role of various psychological and social factors. This was motivated in part by persistent inequality at the top of the earnings distribution and advances in behavioural economics. As above, Bertrand, Goldin, and Katz (2010), studying the career trajectories of those with top MBAs, suggested that the large post-MBA divergence in male and female earnings is due to motherhood. Goldin (2014) likewise emphasized the role of long and particular working hours in some industries. Bertrand (2018) points out the earnings penalties associated with women's desire for more flexible working. We discuss this literature further below in arguing for Assumptions 2 and 3.

Blau and Kahn (2017) assessed the role of these different explanations in the US. They emphasize that by 2010, differences in human capital no longer accounted for much of the wage gap. Rather, they emphasize differences in occupation and industry as well as, to a lesser extent, the newer explanations focused on psychological differences.[3]

Blau and Kahn (1992, 1995, 2000) emphasize the importance of differences in the wage structure across countries in understanding differences in the gender pay gap. That is, if women are disproportionately represented in low-skill occupations, and the skill-premium is higher in the US than in other countries, then the gender pay gap will be larger. The approach of this article, which assumes that in a gender-equal society there would be no disproportionate concentration in low-skill occupations, builds on this insight.

Blau and Kahn (2003) use microdata for twenty-two countries to provide further evidence for the importance of international differences in the structure of earnings, as well as centralized bargaining, in understanding international differences in the gender pay gap. They also find that gender pay gap is lower, other things equal, in countries where female labour supply is lower. Olivetti and Petrongolo (2008) use an imputation-based approach to show that non-random selection into employment can explain half of this correlation.

The approach of this article, which focuses on gender differences in earnings across the entire population rather than those endogenously selected into work, is consistent with subsequent literature emphasizing the importance of differences in labour force participation in understanding EGI.

For example, differences in female labour supply may reflect differences in preferences. Petrongolo (2004) demonstrates that women's over-representation in part-time work in Northern Europe is consistent with their stated preferences, in contrast to Southern European women where it is not. Azmat, Güell, and Manning (2006) highlight differences in unemployment rates between men and women, particularly in Southern Europe.

One contribution of this article is to document global gender inequality over the long run. As such, it builds on the work of Olivetti and Petrongolo (2016), who present and discuss evidence of long-term convergence in labour market outcomes in 19 high-income countries. Using a shift-share decomposition, they document the role of changes in industrial sector, and particularly the rise in services, as a key explanation for variation in hours worked by women both within and between countries. Importantly, like Klasen (2020), they caution that there is evidence of stagnating or declining female labour force participation rates in some parts of the world.

Perhaps the closest paper to ours is Kleven and Landais (2017), which provides a comprehensive decomposition of the GPG and EGI for a range of countries. They use data from national surveys, principally from the Luxembourg Income Study, to decompose the GPG into differences in wages, hours, and labour market participation. They find that the decline in the GPG at higher income levels is associated with a reduction in the participation and earnings gap, but not in hours worked. Likewise, they find that the GPG falls substantially during the process of development, with the demographic transition being the most important driver of this decline. One limitation of their approach is that it relies on the availability of suitable survey data. Given this and the inclusion of country fixed effects, their estimates exclude more populated countries for which such survey data are not available (e.g., Nigeria, Indonesia, Pakistan) or for which only one survey is available (e.g., India). This also affects the geographic coverage of their results, with only South Africa having more than one survey wave in Africa. Thus, their results are most representative of

[3] Manning and Swaffield (2008) provide similar evidence for the UK, but note a substantial remaining unexplained difference.

higher-income countries. In contrast, our approach provides estimates for a much broader share of the global population, particularly in low-income countries and Africa.[4]

A further contribution of this article, by introducing comparable new data on EGI, is to introduce gender to the prominent literature that studies the global income distribution, particularly the work of Jones (1997), Milanovic (2002) and, Sala-i-Martin (2006), as well as the more recent work of Milanovic (2015). In both cases, it contributes to these literatures by conducting similar analyses, but for EGI.[5]

3. Defining EGI

3.1 Preliminaries

We consider a population of men and women, $i \in \mathcal{I} = \mathcal{F} \cup \mathcal{M}$. Individuals perform roles, productive activities including household and subsistence production, in which their labour generates hourly value added $v_i \in \mathbb{R}_+$. That is, they produce something beyond the (market) cost of the other factors of production such as capital or land.[6]

The value added an individual creates per hour depends on the roles they perform and on their performance in those roles. The average value added of a role is determined by the skills involved (such as the education and experience required) and the role characteristics (industry, task composition, equipment, location, etc.). Holding all those things constant, individuals also differ in their performance within a role due to differences in their behaviour and preferences such as risk aversion or competitiveness.

Let $\boldsymbol{\theta}_i \in \mathbb{R}^q$ be the (q dimensional) vector of individual i's personal characteristics and those of their role, such that it captures all the characteristics that determine the value added they create through their labour. Then v_i is given by the scalar valued function of $\boldsymbol{\theta}$:

$$v(\boldsymbol{\theta_i}) = v_i \tag{1}$$

We note that the lack of an i subscript on the value-added function, $v(\boldsymbol{\theta_i})$, reflects the assumption that this function is identical for all individuals, capturing the idea that all relevant differences between individuals or roles are encapsulated by $\boldsymbol{\theta_i}$. We exclude gender from θ such that we can compare $v(\boldsymbol{\theta}_i)$ across men and women.

We decompose θ into two component vectors: the k-vector $\underline{\boldsymbol{\theta}}_{\boldsymbol{i}} \in \mathbb{R}^k$, which includes the elements of θ capturing differences in average value added between roles, and the l-vector $\overline{\boldsymbol{\theta}}_{\boldsymbol{i}} \in \mathbb{R}^l$, where $k + l = q$. The vector $\overline{\boldsymbol{\theta}}_{\boldsymbol{i}}$ contains the elements of θ, such as preferences, that determine variation in value added within roles. Of course, in practice, there will be some overlap between the determinants of average value added and individual differences, but for simplicity we abstract from this here. Likewise, we abstract from the dynamics of this relationship (Cervellati and Sunde 2005; Bagger et al. 2014) to focus on aggregate EGI at any given moment in time. Thus, consistent with our intuition, our measure will record an impact of a change in law or culture on EGI only when that change affects the labour market.

Each individual receives hourly wage $w_i \geq 0$.[7] Here, we abstract from the possibility that some workers will also receive non-monetary compensation such as health-insurance,

[4] A further alternative is the meta-analytic approach of Weichselbaumer and Winter-Ebmer (2005, 2007), who consider a broader range of countries than Kleven and Landais (2017) but at the cost of substantial variations in methods and data used in the studies they considered.

[5] Also related is Dorius and Firebaugh (2010) who study trends in aggregate gender inequality for a range of measures of literacy, life expectancy, and political representation.

[6] While many people will perform multiple roles such as having both a job and undertaking some home production, it is sufficient for our purpose to treat these as a single composite role, or equally do nothing at all.

[7] Note, some income of the self-employed, subsistence farmers, and other owners of capital will be due to their capital and not their labour. This is not included in w_i. While this is simple conceptually, it is more involved in practice as discussed in Section 3.

training, or food. Allowing for this possibility would complicate the analysis but not change the intuition.

Of course, in competitive markets, all workers will be paid their marginal product. However, imperfect competition in labour and product markets means that workers bargain over their labour share—the proportion of the value added they create that they receive as wages. Individual *i*'s labour share, λ_i, is then the ratio of their hourly wage w_i to their value added per hour v_i. That is:

$$\lambda_i = \frac{w_i}{v(\underline{\boldsymbol{\theta}}\boldsymbol{i}, \overline{\boldsymbol{\theta}}_{\boldsymbol{i}})}. \tag{2}$$

Thus, the wages of any two individuals may vary because: (1) they have different characteristics or perform different jobs as a result of differences in opportunities or preferences (i.e. $\boldsymbol{\theta}_i$ are different), or (2) because their compensation for the same value added is different.

3.2 Assumptions

Having defined our preliminaries we now are able to formally state the assumptions underlying the measure of EGI we introduce.

Assumption 1. ***(Conditional) Equality of the Sexes:***
There are no innate differences in productivity between men and women on average. That is, we assume that a man and a woman of the same age, qualification, and experience, etc., performing the same role, produce, on average, the same value added.

$$E[v(\boldsymbol{\theta}_i)] = E[v(\boldsymbol{\theta}_j)] \; \forall \; \boldsymbol{\theta}_i = \boldsymbol{\theta}_j, \;\; i \in \mathcal{M}, j \in \mathcal{F} \tag{3}$$

This is the implicit assumption behind the principle of equal pay for equal work, and we consider this assumption to be self-evident.[8]

Assumption 2. ***Equal Access:***
A gender-equal society has equality of opportunity which means that there are no differences in the average value added across the roles performed by men and women. This does not mean that men and women perform the same roles but requires that the average value added of the roles they do perform is the same.

$$\int_{\mathbb{K}} v(\underline{\boldsymbol{\theta}_F}, \overline{\boldsymbol{\theta}_F}) p_F(\underline{\boldsymbol{\theta}_F}) d\underline{\boldsymbol{\theta}_F} = \int_{\mathbb{K}} v(\underline{\boldsymbol{\theta}_M}, \overline{\boldsymbol{\theta}_M}) p_M(\underline{\boldsymbol{\theta}_M}) d\underline{\boldsymbol{\theta}_M} \tag{4}$$

where $\mathbb{K}$ is the domain of $\underline{\boldsymbol{\theta}}$. Differences in opportunity vary from the obvious effects of social prohibitions on who can do which jobs, to more subtle requirements such as selection mechanisms that implicitly favour men (Goldin 1990; England, Levine, and Mishel 2020). There are also often differences in educational opportunity (Altonji and Blank 1999), access to social-networks (Blackaby, Booth, and Frank 2005; Beaman, Keleher, and Magruder 2018), glass ceilings (Albrecht, Björklund, and Vroman 2003; Arulampalam,

[8] As well as self-evident this assumption is consistent with the literature on IQ (Flynn 1998; Flynn and Rossi-Casé 2011) and gender differences more broadly which we also discuss below in relation to Assumption 3 (Hyde 2005, 2014).

Booth, and Bryan 2007; Bertrand 2018; Duchini, Simion, and Turrell 2020) and so forth. Gender differences in expected household production also affect hours worked: women often engage in more (unmeasured) household production (Hook 2010), and this impacts their pay and advancement. This assumption therefore implies that in a gender-equal society there is no systematic difference in home production, or other motherhood penalties (Bertrand, Goldin, and Katz 2010; Kleven, Landais, and Søgaard 2019), that would lead to differences in average value added.

The literature also documents that EGI also arises from differences in value added associated with variations within occupations. Our next assumption concerns such differences in a truly equal society.

Assumption 3. ***Preference Neutrality:***
In a gender-equal society differences in the distribution of preferences by gender do not have an aggregate impact on value added.

$$\int_{\mathbb{L}} v(\underline{\boldsymbol{\theta}_F}, \overline{\boldsymbol{\theta}_F}) p_F(\overline{\boldsymbol{\theta}_F}) d\overline{\boldsymbol{\theta}_F} = \int_{\mathbb{L}} v(\underline{\boldsymbol{\theta}_M}, \overline{\boldsymbol{\theta}_M}) p_M(\overline{\boldsymbol{\theta}_M}) d\overline{\boldsymbol{\theta}_M} \tag{5}$$

Where and $\mathbb{L}$ is the domain of $\overline{\boldsymbol{\theta}}$. An important literature studies how gender differences in preferences for risk (Bertrand 2011), working hours (Goldin 2014), competition (Fershtman and Gneezy 2001; Niederle and Vesterlund 2007; Gneezy, Leonard, and List 2009; Buser, Niederle, and Oosterbeek 2014), self-promotion (Exley and Kessler 2022), confidence (Exley and Nielsen 2024), the welfare of others and prestige affect occupational choice and earnings. Other studies consider the role of yet more subtle factors such as additional absenteeism due to the menstrual cycle (Ichino and Moretti 2006) or the role of outside offers (Blackaby, Booth, and Frank 2005).

Yet, Assumption 3 states that, in an equal society, there is no aggregate impact on value added from these differences in preferences. This assumption reflects three features of the literature. First, where gender differences have been documented, they are, excluding some physical measurements, small in statistical terms such that the distributions largely overlap (Hyde 2005, 2014; Niederle 2016; Exley., Niederle, and Vesterlund 2020; Bandiera et al. 2021).[9]

Second, many of the differences identified in the literature are endogenous to institutions and beliefs and stereotypes. For example, Coffman and Klinowski (2020) show that gender differences in Chilean test-scores are in-part driven by the way in which wrong answers are penalized and that eliminating these penalties reduces the gap. Relatedly, Buser, Niederle, and Oosterbeek (2014) document that differences in competitiveness lead Dutch boys to be more likely to choose more prestigious academic pathways than their female equivalents conditional on ability. But, as Niederle (2016) notes, other education systems are organized differently such that they do not necessitate the same irreversible choices. Likewise, experimental studies such as Niederle et al. (2013) have shown that quotas can eliminate differences in competitiveness. In a gender-equal society, we would expect institutions that rewarded preferences and behaviours more common in men to have been replaced, to the extent that they were not inherently necessary. Likewise, we would expect 'masculine defaults' (Cheryan and Markus 2020)—conditions that are imposed and assumed to be standard but are biased towards men, such as over-confidence or self-promotion—to have been replaced by gender-neutral alternatives in terms of what organizations privilege.

Third, the literature has shown that many of the differences in preferences are not innate but rather due to socialization and stereotypes. Bertrand, Kamenica, and Pan (2015) document the role of the norm that men earn more than their wives on female earnings and marriage formation. In science, Leslie et al. (2015) show that in fields where 'brilliance' is perceived to be

[9] Indeed, as shown in Fig. 6, we do not see a higher labour share ratio in the most physically demanding sectors such as construction or mining, or indeed much sectoral variation at all.

necessary for success the preponderance of men is larger than in those where effort or empathy are believed to be more important. Relatedly, Bordalo et al. (2019) show that differences in men and women's stereotypes of men and women explains gender-differences in behaviour while, Gërxhani, Brandts, and Schram (2023) show that gender differences induced by competition are endogenous to context. Intriguingly, Coffman, Exley, and Niederle (2021) show beliefs about average group differences drive gender discrimination, but that this discrimination is not specific to gender. Exley and Nielsen (2024) show that even when assessors know that women are less confident they fail to account for this in judging their performance. But, importantly, that it is possible to induce Bayesian updating. Born, Ranehill, and Sandberg (2022) show that women's relative reluctance to lead male-majority teams is driven by both negative perceptions of their own performance and less support from their team. As with institutions, what links these differences is that they are not innate or physiologically determined and can be eliminated.

Assumption 4. ***Equal Pay for Equal Work:***

In a gender-equal society men and women, on average, receive the same share of the value added they create through work.

$$\overline{\lambda_F} = \frac{1}{|F|}\int_{i\in F}\lambda_i di = \overline{\lambda_M} = \frac{1}{|M|}\int_{i\in M}\lambda_i di \tag{6}$$

The extent to which $\overline{\lambda_M}$ is greater than $\overline{\lambda_F}$ reflects differences in the relative bargaining strength of men and women. These differences have two forms. The first is pure discrimination: women are sometimes paid less for work of equal value in the same job. The second is more subtle: roles that are predominantly filled by women may pay less than jobs creating the same value filled by men.[10] In Supplementary Appendix A, we discuss why, in our context, differences in the technology of production cannot explain gender differences in factor shares.

3.3 Equality

Average value added for men, $\overline{V_M}$ and women, $\overline{V_F}$, can be written as follows:

$$\overline{V_F} = \int_{\mathbb{K}}\int_{\mathbb{L}} v(\underline{\boldsymbol{\theta}_F},\overline{\boldsymbol{\theta}_F})p(\underline{\boldsymbol{\theta}_F},\overline{\boldsymbol{\theta}_F})d\underline{\boldsymbol{\theta}_F}d\overline{\boldsymbol{\theta}_F} \tag{7}$$

$$\overline{V_M} = \int_{\mathbb{K}}\int_{\mathbb{L}} v(\underline{\boldsymbol{\theta}_M},\overline{\boldsymbol{\theta}_M})p(\underline{\boldsymbol{\theta}_M},\overline{\boldsymbol{\theta}_M})d\underline{\boldsymbol{\theta}_M}d\overline{\boldsymbol{\theta}_M} \tag{8}$$

where $p(\underline{\boldsymbol{\theta}_F},\overline{\boldsymbol{\theta}_F})$ and $p(\underline{\boldsymbol{\theta}_M},\overline{\boldsymbol{\theta}_M})$ are the density functions of individuals' opportunities and choices for women and men, respectively.[11]

[10] Our argument is similar to that of Rodrik (1999) who argues that, in part, differences in the labour share across countries reflect differences in the relative bargaining strength of workers rather than cross-national differences in production technologies.

[11] To lighten notation, we abstract from the fact that, in practice, some elements of $\boldsymbol{\theta}$ will be discrete. In, this case, properly average value added is given by:

$$\overline{C_F} = \sum_{\underline{\boldsymbol{\theta}_d}\in\mathbb{K}_d}\sum_{\overline{\boldsymbol{\theta}_d}\in\mathbb{L}_d}\int_{\mathbb{K}_c}\int_{\mathbb{L}_c} v(\underline{\boldsymbol{\theta}_c},\underline{\boldsymbol{\theta}_d},\overline{\boldsymbol{\theta}_c},\overline{\boldsymbol{\theta}_d})p(\underline{\boldsymbol{\theta}_c},\underline{\boldsymbol{\theta}_d},\overline{\boldsymbol{\theta}_c},\overline{\boldsymbol{\theta}_d})d\underline{\boldsymbol{\theta}_c}d\overline{\boldsymbol{\theta}_c}.$$

where $\underline{\boldsymbol{\theta}_c}$ and $\overline{\boldsymbol{\theta}_c}$ are the continuous components and $\underline{\boldsymbol{\theta}_d}$ and $\overline{\boldsymbol{\theta}_d}$ are the discrete components.

Economic gender-equality requires that $\overline{V_F} = \overline{V_M}$. Note, this does not require that the distribution of men and women across roles and their performance in those roles to be exactly the same, but only that there is no difference in average value added. This is a weaker requirement than an intuitive criterion such as an equal proportion of men and women in each job. That is, it allows for systematic differences in workforce composition due to differences in preferences, but assumes that there is no aggregate economic consequence of these differences. Equivalently, it does not presume that preferences disproportionately common among men, relative to women, are associated with higher value-added roles.

Assumptions 1–4 are sufficient to ensure that the supply of female labour is identical to the supply of male labour. To see this, consider a simple Cobb–Douglas utility function:

$$U(w_i, h_i) = (24 - h_i)^{\zeta} w_i^{\nu} \tag{9}$$

where h_i is the number of hours worked by individual i. It suffices to show that all the parameters of Equation (9) are the same for men and women. First, Assumption 1 ensures that there is no difference in value added associated with gender conditional on other characteristics and Assumption 2 ensures that, on average, $\underline{\boldsymbol{\theta}}$ does not differ across men and women in a way that affects average value added. This means that average value added is the same for men and women.

Assumption 3 implies that $\overline{\boldsymbol{\theta}}$ hence, in this case, that ζ and ν are the same for both men and women. Likewise, Assumption 4 ensures that, on average, there is no difference in λ_i between women and men. Together, given that there is no systematic difference in any parameter, the supply curves of male and female labour will be the same. This ensures equal w_i, and given preference neutrality, there should be no relevant difference in men and women's utility functions, and thus they choose the same h_i.

On the demand side, as noted in the introduction, Goldin (2014) and others have shown empirically that discrimination has declined substantially in many countries and continues to do so. This decline reflects changes in mores as well as legislation and enforcement. In a perfectly gender-equal society, we would expect not only for there to be little taste for wage-discrimination but also enforcement of equal pay requirements to be strict. Theoretically, one might appeal to an argument *à la* Becker (1957) and note that if product markets are competitive then firms that discriminate against women will be outcompeted. Together these two arguments suggest that there will be little room for discrimination in the demand for labour in a perfectly gender-equal society.

Equal supply and demand for male and female labour in turn implies that aggregate compensation for men and women will be the same. While it may be that, contrary to our assumptions, that even in a society that is as gender-equal as possible there are some systematic differences between men and women in relevant characteristics or preferences, we expect that these differences will be very small in aggregate. That is, if there are such characteristics there is no reason to believe that they disproportionately lead to higher male rather than female wages. Importantly, the available evidence suggests that any such differences are too small to be important for understanding differences in EGI between countries or over time.

4. Measuring gender pay inequality

Computing our measure of EGI, the labour share ratio, requires first calculating separately the labour share of men λ_M, and women λ_F, and then their ratio. In this section, we first discuss the issues in computing labour shares and how we address them, their ratio, and the data we use to do so. As we assume that in an equal society value added would be the same, the key issue is to ensure that labour income is correctly measured.

4.1 Measuring the labour share of income

The most straightforward measure of the labour share is simply the share of employees compensation in total value added:

$$\lambda^{U}_{c,t,s} = \frac{\text{Compensation of Employees}_{c,t,s}}{\text{Total Value Added}_{c,t,s}} = \frac{\overline{W}^{E}_{c,t,s} N^{E}_{c,t,s}}{Y_{c,t,s}}, \tag{10}$$

where $\overline{W}^{E}_{c,t,s} = \overline{w}^{E}_{c,t,s}\overline{H}^{E}_{c,t,s}$ are average annual earnings per employee in country c in year t in sector s, and $N^{E}_{c,t,s}$ is the number of employees in that sector, country, and year. $\overline{w}^{E}_{c,t,s}$ and $\overline{H}^{E}_{c,t,s}$ are average hourly earnings and average annual hours worked by the employee in that sector, country, and year. Normally we prefer to work with broad sectors such that $s \in (\textit{total economy}, \textit{agriculture}, \textit{industry}, \textit{services})$. Nevertheless, we also provide summary estimates of EGI for 14 sub-sectors of each economy. Using Equation (10), we can readily calculate the labour share of employees for the economy as a whole and each (sub-)sector of total economy.

However, as highlighted by Krueger (1999) and Gollin (2002), while conceptually simple, measuring the compensation of employees is more complicated in practice. The so-called naive, or unadjusted, labour share captured by Equation (10) ignores mixed-income (income recorded in national accounts as due to multiple factors of production). This method does not account for various factors, including the fact that the fact that the incomes of the self-employed will partially reflect returns to the capital employed and partly to the labour supplied. This will mean that the labour share is underestimated.

Such underestimation will be problematic in our context if the self-employed are disproportionately male or female. Gollin (2002) proposes three alternatives to Equation (10) designed to better capture self-employment income which we refer to as λ^{G1}, λ^{G2}, and λ^{G3}, respectively. The first, as may be seen in Equation (11), attributes to the Compensation of Employees all mixed income, thus over-estimating the labour share by including returns properly attributable to land, capital, etc. The second, defined in Equation (12), assumes that the share of wages in mixed income is the same as in the wider economy, thus assuming that capital per worker etc., is the same. The third, given in Equation (13) assigns to self-employed workers the same average wage as employed workers. It thus assumes that wages are the same in self-employment and employment and thus that any additional returns are attributable to other factors of production.

$$\lambda^{G1}_{c,t,s} = \frac{\overline{W}^{E}_{c,t,s} N^{E}_{c,t,s} + M_{c,t,s}}{Y_{c,t,s}} \tag{11}$$

$$\lambda^{G2}_{c,t,s} = \frac{\overline{W}^{E}_{c,t,s} N^{E}_{c,t,s}}{Y_{c,t,s} - M_{c,t,s}} \tag{12}$$

$$\lambda^{G3}_{c,t,s} = \frac{\overline{W}^{E}_{c,t,s} N^{E}_{c,t,s} + \overline{W}^{E}_{c,t,s} N^{SE}_{c,t,s}}{Y_{c,t,s}} \tag{13}$$

where $N^{SE}_{c,t,s}$ is the number of self-employment in country c in year t in sector s and $M_{c,t,s}$ represents mixed income. Note that the last equation assumes that employees and the self-employed work an equal number of hours on average.

4.1.1 Self-employment in low-income countries

However, the nature of self-employment varies considerably between countries, particularly between high- and low-income countries. While self-employment in high-income countries is often a choice, in lower-income countries it often reflects the necessity of work in subsistence agriculture (Günther and Launov 2012). This suggests that in lower-income countries, self-employed workers may earn less than those in formal employment. An appealing solution is to use additional information such as sector-specific wages to make more refined adjustments. However, the necessary data are often available for only a subset of countries and for a limited period.[12] In an effort to produce reliable estimates while maximizing sample size Feenstra, Inklaar, and Timmer (2015) employ different measures of the labour share depending on development status and data availability. For many low- and middle-income countries, this amounts to computing the labour share using λ^{G2} but proxying mixed-income with total value added in the agricultural sector.

As van Treek (2020) notes, however, this approach will overstate the labour share to the extent that other factors such as land and capital contribute to agricultural output. As well as double-counting agricultural employment (since it will be included in both as employment and again in total value added in agriculture). Using social-accounting matrices to inform and validate an alternative adjustment she proposes proxying self-employment in low- and middle-income countries and assuming the (average) wage of the self-employed is half that of the average employee in low-income countries and equal to the average wage in middle- and high-income countries.

$$\lambda^{VT}_{c,t,s} = \begin{cases} \dfrac{\overline{W}^{E}_{c,t,s} N^{E}_{c,t,s} + k\upsilon_{c,t,s}\overline{W}^{E}_{c,t,s} N_{c,t,A}}{Y_{c,t,s}} & \text{if } N^{SE}_{c,t,s} \text{ data are missing} \\ \dfrac{\overline{W}^{E}_{c,t,s} N^{E}_{c,t,s} + k\overline{W}^{E}_{c,t,s} N^{SE}_{c,t,s}}{Y_{c,t,s}} & \text{if } N^{SE}_{c,t,s} \text{ data are available} \end{cases} \tag{14}$$

where $N_{c,t,A}$ is the number of people in country c at time t working in the agricultural sector A, $\upsilon_{c,t,s}$ represents the employment share of sector s in the country total employment with $\upsilon =$ 1 for the total economy, and k captures the proportion of average wages assumed to be earned by self-employed workers. Following Feenstra, Inklaar, and Timmer (2015) and van Treek (2020) in the case that $N^{SE}_{c,t,s}$ is not observed, as is sometimes the case for some lower income countries, we proxy for it using total employment in the agriculture sector $N_{c,t,A}$. In the main analysis, following van Treek (2020), we set $k = 1/2$ for low-income countries and $k = 1$ elsewhere. Supplementary Appendix Fig. C.4 reports the labour share ratio for a range of k values for low-income countries. Again following van Treek (2020), we treat λ^{G1} and λ^{G2} as lower and upper bounds on λ^{VT} and thus if $\lambda^{VT} \notin [\lambda^{G1}, \lambda^{G2}]$, then we adjust k such that $\lambda^{VT} \in [\lambda^{G1}, \lambda^{G2}]$.

4.1.2 Hours worked

One additional possibility is that average hours worked may differ between employment and self-employment. To the extent that hours worked are lower (higher) in self-employment than employment, λ^{VT} will over-estimate (underestimate) the labour share. This is of particular concern here as a subtle, yet significant, aspect of EGI is that in all countries women do more domestic work such as care or housework which limits the hours they can work in employment or self-employment (Hook 2010; Ferrant, Pesando, and Nowacka 2014).

To address this, we modify λ^{VT} to incorporate hours worked as follows:

[12] An alternative approach is to focus on the corporate (Karabarbounis and Neiman 2014) or manufacturing sectors (Rodrik 1999). But, this approach is better suited to high-income countries since these sectors often account for only a small fraction of total employment in low- and middle-income countries.

$$\lambda^{\ddagger}_{c,t,s} = \frac{\overline{W}^{E}_{c,t,s} N^{E}_{c,t,s} + k\overline{w}^{E}_{c,t,s} \overline{H}^{SE}_{c,t,s} N^{SE}_{c,t,s}}{Y_{c,t,s}} \tag{15}$$

where $\overline{H}^{SE}_{c,t,s}$ are the average annual hours of self-employed. Following a similar logic to Feenstra, Inklaar, and Timmer (2015) and van Treek (2020) in the case that $\overline{H}^{SE}_{c,t,s}$ or $N^{SE}_{c,t,s}$ is not observed then we proxy for it using total employment and average annual hours in agriculture sector $\overline{H}_{c,t,A} N_{c,t,A}$. As for λ^{VT} we adjust k, if necessary, such that $\lambda^{\ddagger} \in [\lambda^{G1}, \lambda^{G2}]$.

4.2 Measuring the labour share ratio

We will present results using both the *unadjusted* or naive labour shares of female $\lambda^{U}(F)$, and male $\lambda^{U}(M)$ and their ratio ρ^{U} as well as the *adjusted* labour shares of female $\lambda^{\ddagger}(F)$, male $\lambda^{\ddagger}(M)$ and their ratio $\rho^{\ddagger}$.

To compute ρ requires calculating the labour share separately for men and women as follows:

$$\lambda^{U}_{c,t,s}(F) = \frac{\overline{W}^{E}_{c,t,s}(F) N^{E}_{c,t,s}(F)}{Y_{c,t,s}}, \lambda^{U}_{c,t,s}(M) = \frac{\overline{W}^{E}_{c,t,s}(M) N^{E}_{c,t,s}(M)}{Y_{c,t,s}}. \tag{16}$$

which implies:

$$\rho^{U}_{c,t,s} = \frac{\lambda^{U}_{c,t,s}(F)}{\lambda^{U}_{c,t,s}(M)} = \frac{\overline{W}^{E}_{c,t,s}(F) N^{E}_{c,t,s}(F)}{\overline{W}^{E}_{c,t,s}(M) N^{E}_{c,t,s}(M)}. \tag{17}$$

Calculating $\lambda_{c,t,s}(M)$ and $\lambda_{c,t,s}(F)$ requires data on both value added and compensation by gender. However, as Equation (17) makes clear, the value-added terms cancel by assumption, and so we need only gender-specific data on the compensation of workers.[13]

We can compute $\rho^{\ddagger}$ similarly:

$$\rho^{\ddagger} = \frac{\lambda^{\ddagger}(F)}{\lambda^{\ddagger}(M)} = \frac{\overline{W}^{E}_{c,t,s}(F) N^{E}_{c,t,s}(F) + k\overline{w}^{E}_{c,t,s}(F) \overline{H}^{SE}_{c,t,s}(F) N^{SE}_{c,t,s}(F)}{\overline{W}^{E}_{c,t,s}(M) N^{E}_{c,t,s}(M) + k\overline{w}^{E}_{c,t,s}(M) \overline{H}^{SE}_{c,t,s}(M) N^{SE}_{c,t,s}(M)}. \tag{18}$$

Note k is not gender specific, and thus we assume that gender differences in self-employment incomes differ in proportion to incomes in employment. If, however, men choose self-employment for economic reasons while women are obliged to work in subsistence self-employment, then k would vary with gender. In this case, our assumption of equal k will be conservative.

To isolate the role of hourly earning ($\overline{w}^{E}_{c,t,s}$) and employed hours ($\overline{H}_{c,t,s} N_{c,t,s}$) in $\rho^{\ddagger}$, we also calculate *employment share ratio* as below:

$$\varphi^{\ddagger} = \frac{\overline{H}^{E}_{c,t,s}(F) N^{E}_{c,t,s}(F) + \overline{H}^{SE}_{c,t,s}(F) N^{SE}_{c,t,s}(F)}{\overline{H}^{E}_{c,t,s}(M) N^{E}_{c,t,s}(M) + \overline{H}^{SE}_{c,t,s}(M) N^{SE}_{c,t,s}(M)}. \tag{19}$$

[13] Note, as computing λ^{G1} and λ^{G2} involves Mixed Income we cannot calculate them separately for men and women. Thus, when computing $\lambda^{\ddagger}(M), \lambda^{\ddagger}(F)$ we impose that the gender free $\lambda^{\ddagger} \in [\lambda^{G1}, \lambda^{G2}]$ and derive a value of k to be used in $\lambda^{\ddagger}(M), \lambda^{\ddagger}(F)$ calculations.

Table 1. Summary statistics of the variables used in EGI calculation.

	Observations	Mean	SD	Max
Male employees (millions)	3503	4.70	10.42	94.83
Female employees (millions)	3499	3.14	7.66	70.30
Male employees weekly hours worked	2089	43.33	6.46	68.00
Female employees weekly hours worked	2079	39.20	7.74	68.00
Male population ages 15-64 (millions)	7419	11.31	43.76	511.38
Female population ages 15-64 (millions)	7419	11.02	41.17	484.43
Male labour force participation rate	4585	0.74	0.08	0.96
Female labour force participation rate	4550	0.50	0.16	0.91
Male unemployment (%)	4538	7.60	5.77	36.96
Female unemployment (%)	4538	9.54	7.49	47.18
Male self-employed (millions)	2818	3.04	12.38	238.85
Female self-employed (millions)	2818	1.76	5.17	88.71
Male self-employed weekly hours worked	1508	42.87	4.87	68.00
Female self-employed weekly hours worked	1508	36.66	6.33	68.00
Gross value added (billions US dollar)	5501	244.23	1048.78	19838.00
Male employees mean nominal annual earnings	1713	18134.59	20444.12	131947.38
Female employees mean nominal annual earnings	1712	13808.04	16241.16	130554.45

Notes: The mean earnings are in current US dollar and only for countries for which reliable official exchange rate data were available from Penn World Table (PWT 10.0). Weekly hours greater than 68 are replaced with 68 hours per week. These statistics include all those countries and years for which the desired data were available for each respective variable. Source: Authors' calculations.

4.3 Data used in the construction of EGI

An advantage of our approach is that it uses national accounting data and other well-understood macroeconomic aggregates. While these data have been criticized, particularly for Sub-Saharan Africa (Jerven 2013), they are compiled according to a well-defined standard designed to ensure comparability across countries and years.[14] This is a considerable advantage compared to the meta-analysis approach taken by Oostendorp (2009). Perhaps most importantly, the labour share ratios obtained are dimensionless and thus do not suffer from an index-number problem. Likewise, relative to the survey based approach of Kleven and Landais (2017), the available data cover many more countries and much more of the world population.

The dataset is a country level panel taken from three major sources: International labour Organization (ILO), United Nations System of National Accounts (SNA), and The World Bank World Development Indicators (WDI). To reproduce and extend the Gollin's (2002) labour share calculations, value added data on agriculture, industry, services, manufacturing and total economy's value added are taken from WDI. Annual value added of sub-sectors such as mining, education, construction, electricity, transport, storage and communications, wholesale and retail trade, etc, are taken from SNA.

To calculate the gender-specific disaggregated labour shares at economy and sub-sectors levels we combine the SNA and WDI data with ILO data on annual employment, mean weekly hours actually worked and mean nominal monthly earnings of employees (all disaggregated by gender and sector). The weekly and monthly data are annualized using the ILO standard harmonization process: 5 days in a week, 4.33 weeks in a month and 52 weeks/12 months in a year. Earnings refer to gross earnings paid in cash and in kind (including bonuses, gratuities, housing, and family allowances paid by the employer directly to the employee) at regular intervals including pay during holiday/annual leave but excludes employers contributions to social security and pension schemes, and severance and termination pay. Summary statistics of the key variables used in the EGI calculation are provided in Table 1.

[14] Moreover, our estimates require sufficiently detailed GDP data that we are often forced to exclude those observations which Jerven (2013) argues should be taken least seriously.

For the global inequality calculations and inequality plots by income groups, data on working age population, per capita gross domestic product and gross national income are collated from WDI, and labour force, labour force participation, unemployment, sectoral employment shares are taken from ILO. All the calculations are carried on data in national currencies except in Table 1 where the relevant variables are converted into current US dollar using official exchange rate data from Penn World Table (PWT 10.0).[15] For some countries, data for one or more variables are missing for one or more years after the first observation or just before the first observation. The missing data primarily consist of earnings and weekly work hours. This is due to the fact that in many countries, labour market surveys were conducted at most once every two years throughout the 1990s and 2000s. We impute these missing observations using the Expectation Maximization procedure algorithm of Honaker and King (2010). The imputations enable us to draw the trends in EGI for a balanced panel of countries, avoiding any effects from changes in the composition of countries over time.

5. Gender inequality around the world

This section presents our new inequality data and demonstrates the existence of a large global gender gap. It begins by presenting the evidence that women do indeed have a lower labour share, how this inequality varies across countries, and how these differences have changed over time. It then moves on to document and discuss the aggregate extent of global EGI.

Before we present disaggregated analyses of our preferred gender inequality measure, Table 2 provides decade by decade mean labour share of men and women and the ratios of different labour share measures outlined in Section 3. Looking at Table 2 we can reach the following broad conclusions about EGI. First, the total labour share in national income is approximately 50 per cent. Second, a large part of the EGI arises from inequalities in labour force participation and women working for fewer paid hours than their male counterparts. Third, EGI has decreased over time, but progress has been slow, even in the last decade. The female labour share is still around 40 per cent lower than that of men. Fourth, self-employed women are on average working for more hours, particularly in Africa and South America, so relying on $\lambda^{VT}(M)$ and $\lambda^{VT}(F)$ alone to understand EGI would be misleading. Fifth, the total labour share is lowest in the services sector, yet this sector has the lowest EGI, and EGI is highest in the industrial sector. Finally, EGI in self-employment is lower than among paid employees (compare Rows 2 and 3 of Table 2) and this is driven by differences in Africa and Asia.

5.1 Labour share ratio

For the reasons discussed in Section 3, we focus on the adjusted measure of EGI $\rho^{\ddagger}$, equivalent results for ρ^{U} are provided in Supplementary Appendix C. Figure 1 contains a scatter plot of the labour share of men in total value added, $\lambda^{\ddagger}(M)$ on the x-axis and the labour share of women $\lambda^{\ddagger}(F)$ on the y-axis by country for 2014. Hence, the dashed 45° line represents perfect equality (e.g., $\rho^{\ddagger}=1$). It is immediately clear that in every country $\rho^{\ddagger}<1$. Perhaps as expected, the countries closest to the line are the Nordic countries, and some countries in the former Soviet Union. The labour share is highest in Nicaragua, Cambodia, Kyrgyzstan, and the Netherlands where it is around \$0.65\$. While high, this figure is reasonably similar to the \$0.6\$ for men and women estimated by Feenstra, Inklaar, and Timmer (2015). These countries also have the highest value of the female labour share. The absolute value of the female labour share of total value added is also important as the

[15] The statistics in Table 1 are reported for all available observations to demonstrate the extent of global gender inequality in different labour market outcomes, as such, they are not necessarily for only those countries (or include all those countries) that are included in the calculation of our GEI measure.

Table 2. Average cross-country gender income inequality.

	Overall	1990s	2000s	2010s	Asia	Europe	Oceania	Americas	Africa
Hourly wage ratio $\left(\frac{\overline{w}(F)}{\overline{w}(M)}\right)$	0.868	0.847	0.876	0.901	0.845	0.854	0.881	0.938	0.856
Labour share ratio (ρ^U)	0.506	0.487	0.519	0.556	0.418	0.658	0.569	0.567	0.382
Labour share ratio $\left(\frac{\lambda^{VT}(F)}{\lambda^{VT}(M)}\right)$	0.529	0.508	0.545	0.581	0.455	0.636	0.594	0.515	0.500
Labour share ratio $(\rho^\ddagger)$	0.552	0.532	0.566	0.597	0.469	0.613	0.589	0.577	0.552
Female labour share $(\lambda^\ddagger(F))$	0.172	0.167	0.174	0.189	0.144	0.189	0.196	0.177	0.176
Male labour share $(\lambda^\ddagger(M))$	0.321	0.326	0.318	0.322	0.312	0.315	0.338	0.313	0.343
Agriculture labour share ratio (ρ^U)	0.297	0.295	0.309	0.306	0.335	0.329	0.259	0.168	0.330
Agriculture labour share ratio $\left(\frac{\lambda^{VT}(F)}{\lambda^{VT}(M)}\right)$	0.423	0.422	0.440	0.444	0.474	0.427	0.296	0.225	0.537
Agriculture labour share ratio $(\rho^\ddagger)$	0.441	0.440	0.455	0.459	0.477	0.429	0.351	0.251	0.576
Female labour share $(\lambda^\ddagger(F))$ Agriculture	0.168	0.172	0.167	0.174	0.167	0.203	0.099	0.137	0.167
Male labour share $(\lambda^\ddagger(M))$ Agriculture	0.404	0.407	0.397	0.399	0.355	0.457	0.325	0.437	0.380
Industry labour share ratio (ρ^U)	0.284	0.301	0.288	0.273	0.279	0.334	0.245	0.277	0.246
Industry labour share ratio $\left(\frac{\lambda^{VT}(F)}{\lambda^{VT}(M)}\right)$	0.285	0.302	0.289	0.274	0.284	0.330	0.249	0.274	0.250
Industry labour share ratio $(\rho^\ddagger)$	0.281	0.294	0.285	0.274	0.274	0.323	0.250	0.279	0.246
Female labour share $(\lambda^\ddagger(F))$ Industry	0.072	0.077	0.069	0.071	0.049	0.111	0.072	0.094	0.037
Male labour share $(\lambda^\ddagger(M))$ Industry	0.245	0.253	0.236	0.246	0.202	0.345	0.313	0.235	0.184
Services labour share ratio (ρ^U)	0.625	0.587	0.661	0.740	0.483	0.910	0.573	0.766	0.367
Services labour share ratio $\left(\frac{\lambda^{VT}(F)}{\lambda^{VT}(M)}\right)$	0.617	0.582	0.651	0.731	0.484	0.903	0.585	0.724	0.376
Services labour share ratio $(\rho^\ddagger)$	0.680	0.652	0.703	0.763	0.546	0.928	0.688	0.792	0.472
Female labour share $(\lambda^\ddagger(F))$ services	0.127	0.125	0.134	0.149	0.081	0.203	0.106	0.139	0.088
Male labour share $(\lambda^\ddagger(M))$ services	0.172	0.174	0.178	0.190	0.157	0.205	0.146	0.171	0.159

Sources: International labour Organization, World Bank World Development Indicators and the authors' own calculations.

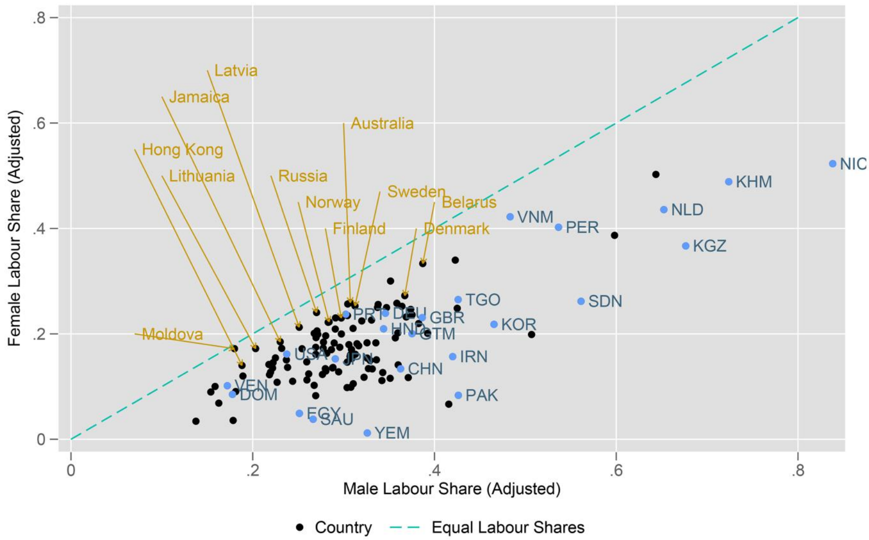

Figure 1. Scatter plot of female and male labour share in 2014 (adjusted data).

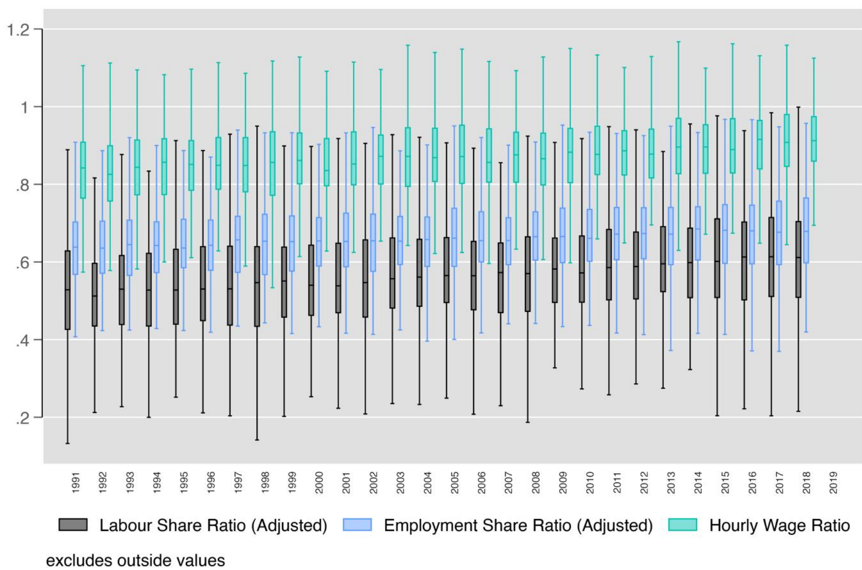

Figure 2. Evolution of the cross-country distribution of $\rho^{\ddagger}$.

relative shares of labour and capital share have important implications for inequality (Piketty and Saez 2003). An often overlooked implication is that if gender differences in capital ownership mean that capital income disproportionately accrues to men, then a higher (female) labour share ratio will reduce the inequality of total (capital+labour) income.

There are a substantial number of countries where the labour share is low for both men and women. But Egypt, Saudi Arabia, and Yemen stand out given that the value added of men is close to the average but that of women is close to zero. This likely reflects a combination of both high inequality of opportunity and pay discrimination.

Despite the substantial inequalities shown by Fig. 1 and Supplementary Appendix Fig. C.1. the mean country is more equal today than it has been in the past. Figure 2 presents box plots summarizing the cross-country distribution of $\rho^{\ddagger}$ between 1991 and 2018. Comparing the black horizontal lines in each we can see that there has been an increase of just under 10 per cent age points in the cross-country median value of $\rho^{\ddagger}$ over the period from 0.52 to 0.62. The change in the mean was similar, increasing from 0.51 to 0.60.

The top and the bottom of each box depict the 75^{th} and 25^{th} percentiles of the distribution of $\rho^{\ddagger}$ in that year. These have seen similar increases to the median, with the 75^{th} percentile increasing from 0.62 to 0.71 and the 25^{th} percentile increasing from 0.41 to 0.51. This suggests several conclusions.

First, the symmetry of the increase suggests that there has been neither rapid convergence by the most-unequal countries, nor particularly large improvements in the most-equal countries. Rather, there has been a relatively uniform increase.

Second, the exception to this broadly symmetric increase is the persistence of extremely low values of $\rho^{\ddagger}$ at the bottom of the distribution. This is captured by the lower adjacent values, depicted by the lower whisker in each year.[16] This highlights that the low female labour shares in countries such as Egypt or Saudi Arabia reported in Fig. 1 are not unique to that particular year. While, there is a large, unexplained, up-tick in 2018, otherwise the average of the first three years is similar to that of the 2015—2017.

Third, a further feature of the data is that the changes from year to year in the median, or other points on the distribution, are not always positive, reflecting that EGI sometimes decreases.

Fourth, looking at the blue and green boxes suggests that while there is evidence of a gentle upwards trend in the hourly wage ratio, the employment ratio has been almost constant. This suggests, in line with further results below, that while pay discrimination has been falling access to the formal labour market and other forms of gendered inequality of opportunity have not reduced in the same way.

Fifth, we have re-calculated $\rho^{\ddagger}$ for k values from 0.05 to 1 as reported in Supplementary Appendix Fig. C.4. The figure suggests that increasing the k value (increasing the proportion of employee average wages assumed to be earned by self-employed workers) increases $\rho^{\ddagger}$. However, the maximum impact is no more than 1 per cent. The increase in $\rho^{\ddagger}$ is due to the multiplicative effects, Equation (18), of self-employed women working for more hours compared with men.

Sixth, to check our results are not overly affected by including the imputed data, in Supplementary Appendix Fig. C.5 we report the cross-country distribution of $\rho^{\ddagger}$ as reported in Fig. 2 for only those countries having complete data. Figure 2 and Supplementary Appendix Fig. C.5 are more or less the same except for two significant differences. One can see that $\rho^{\ddagger}$ is significantly lower in the latter figure for the first three years. This is due to missing data in some of these years for more equal countries like France and Portugal. The other feature of Supplementary Appendix Fig. C.5 is the higher variance around the mean. This is because the complete data are an unbalanced panel. When more equal or unequal countries exit (enter) the sample due to missing data in a particular year, it causes significant variation in $\rho^{\ddagger}$. Overall, the median value of $\rho^{\ddagger}$ was 0.54 in 1996 and increased to 0.67 in 2018. Similarly, the mean value of $\rho^{\ddagger}$ increased from 0.49 in 1996 to 0.63 in 2018 in the complete data.

To understand whether the distribution of EGI just reflects differences in economic development, we consider the distribution by income group. Using the World Bank categorization, Fig. 3 plots the distribution of the labour share ratio for high- and upper- and

[16] The whiskers report the upper and lower adjacent values which are, respectively, the values of x_i such that $x_i > 1.5 \times IQR + X_{75}$ and $x_i < X_{25} - 1.5 \times IQR$, respectively.

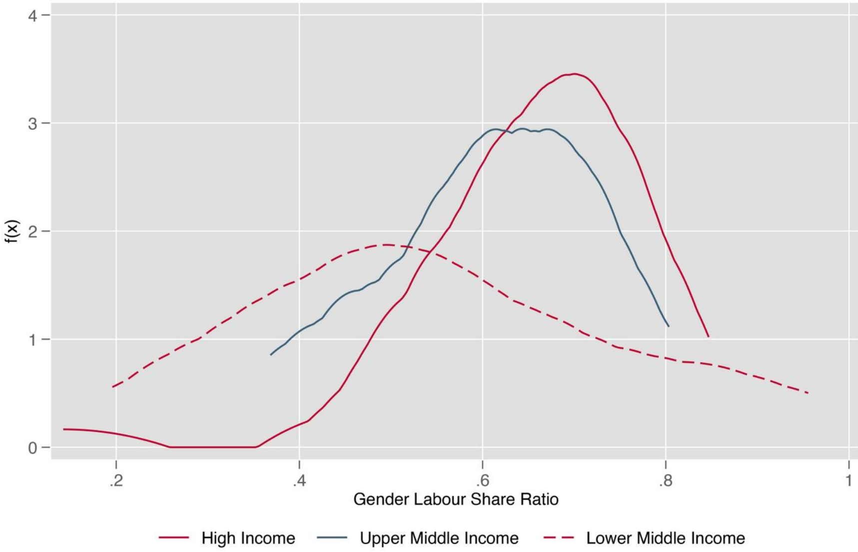

Figure 3. Distribution of $\rho^{\ddagger}$ by country income group.

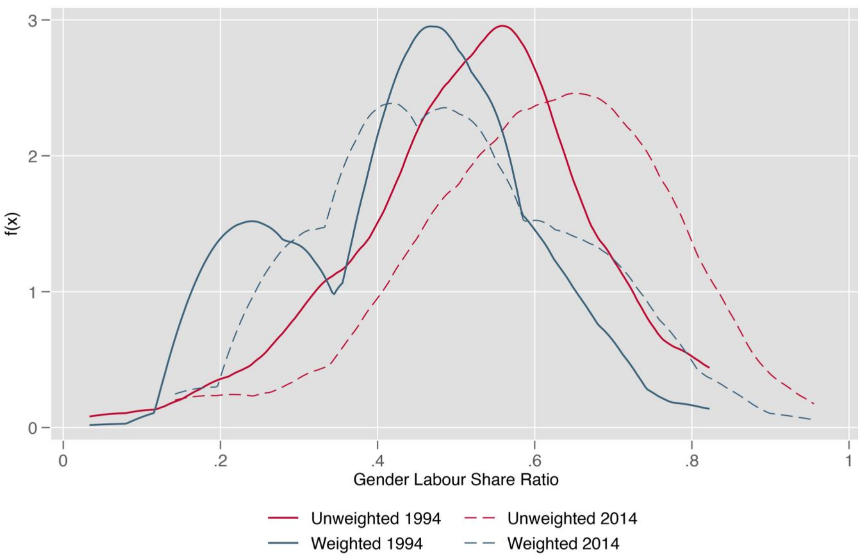

Figure 4. Population weighted distribution of $\rho^{\ddagger}$ in 1994 and 2014.

lower-middle-income countries. Immediately, we can see that, as we expect, the high-income distribution is right-most, and the lower-middle-income distribution left-most. But, there is considerable overlap between, and heterogeneity within, categories. The difference between the high-income and the upper-middle-income categories is relatively minor compared to between these and the lower-middle-income category, but even this difference is second order compared to the within-category variation. Thus, it would seem that gender inequality is not an automatic consequence of development.

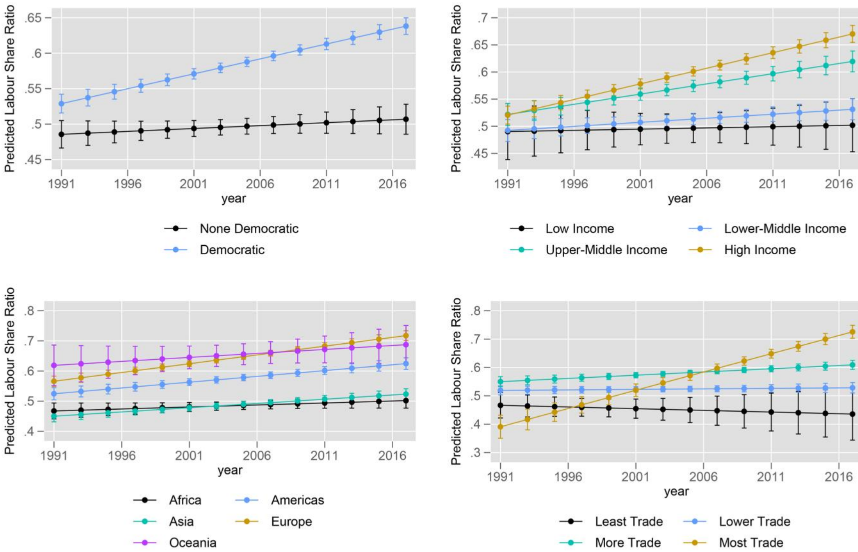

Figure 5. Trends in $\rho^{\ddagger}$ by country income group, democratic status and region.

Figure 2 treats countries as the unit of observation. This implicitly gives greater weight to women in smaller countries than those in large economies. This opens the possibility that changes in the cross-country distribution of $\rho^{\ddagger}$ fail to fully capture the change in the distribution of women's experience of EGI. To understand this, Fig. 4 reports kernel density estimates of the distribution of $\rho^{\ddagger}$ weighted by population. Comparing the distributions for 1994 (the solid blue line) and 2014 (the dashed blue line), we can see that our main conclusion is unaffected—there has been reduction in EGI across the distribution. However, comparing the weighted data with the unweighted data (the red lines) reveals that unweighted distribution will underestimate global EGI. In particular, we can see a considerable mass around 0.2 in 1994 for the weighted data that are not apparent in the unweighted data. This is also reflected by a thicker left tail in the 2014 data. The lower mass of distribution in 1994 resulted from highly populated-more unequal countries like Pakistan, India, and Egypt. Overall, the weighted distributions are located to the left of the unweighted distributions, suggesting that EGI is concentrated in relatively more populated economies.

A natural question is whether there have been systematic differences in EGI trends in different groups of countries. We group countries by one of $\mathcal{Z} = \{\text{democraticstatus}, \text{incomegroup}, \text{region}, \text{trade-openness}\}$. Given these groups, we estimate regressions of the following form:

$$\rho^{\ddagger}_{i,t} = \alpha + \tau_1 t + \tau_2 t^2 + \gamma_z D_z t + \varepsilon_{i,t} \tag{20}$$

where t is year and τ_1 and τ_2 are common linear and quadratic time trends, respectively. $z \in \mathcal{Z}$ is one of the set of categorical variables, and D_z is a dummy variable for each category in z. γ_z thus captures the parameters of interest, the category-specific linear differences in the trend from the estimated common linear trend. $\varepsilon_{i,t}$ is the error term.[17]

The first panel in Fig. 5 reports results by democratic status. As in Acemoglu et al. (2019), we define a country as a democracy in a given year if Freedom House codes it as

[17] Our analysis is non-causal, and as such we allow group membership to change over time. This means that the results are representative at all points in time, but we should be cautious of potential reverse causality.

"free" or "partially free" or Polity IV assigns it a positive score (Polity IV ranks countries from −10 to 10) and non-democratic otherwise. The results show that while there is a continuous reduction in EGI in the democratic world, EGI remained flat in the none-democratic world. These results are consistent with the literature on women's political empowerment and other forms of equality (Chattopadhyay and Duflo 2004).

Panel two of Fig. 5 reveals no improvement in low-income countries, such as Uganda, Chad, and Niger, over the last thirty years. In the lower-middle-income countries, which include countries with large populations such as Bangladesh, Egypt, India, Indonesia, Nigeria, Pakistan, and the Philippines, $\rho^{\ddagger}$ increased on average by around 5percentage points. This means that a large proportion of the global female population experienced only a limited increase in their compensation relative to their male compatriots over the last thirty years.

High- and upper-middle-income countries were better placed in 1990 in terms of EGI and also experienced a reasonable improvement over the last thirty years. The upper-middle-income countries saw approximately 11 points increase, whereas the high-income countries experienced a 17 points improvement.

The third panel in Fig. 5 plots the predicted values of $\rho^{\ddagger}$ by different regions. This tells a similar story—there has been a limited reduction in EGI in Asia and Africa. Similar to the results for high- and upper-middle-income countries, we see a more pronounced upwards trend in $\rho^{\ddagger}$ in Europe and Oceania (Australia and New Zealand), and to a lesser extent the Americas.

In the last panel in Fig. 5, we divided countries into four groups based on the KOF Globalization Index in trade, declaring those with a trade globalization index score of above 75 as the most globalized in trade (Dreher, Gaston, and Martens 2008; Gygli et al. 2019). These results suggest that countries most open to trade, have seen the largest reductions in EGI. This may reflect trade openness and policies that reduce EGI being jointly determined, or the impact of trade openness itself on EGI as documented by Juhn, Ujhelyi, and Villegas-Sanchez (2013), Juhn, Ujhelyi, and Villegas-Sanchez (2014), and Tang and Zhang (2021).

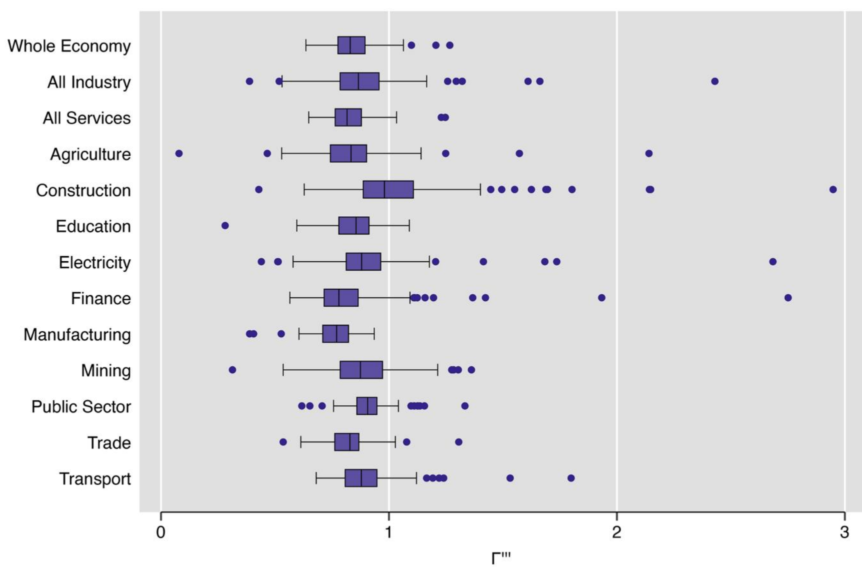

Figure 6. Cross-country distribution of $\rho^{\ddagger}\frac{N(M)}{N(F)}$ by sector.

5.2 EGI and sectoral composition

As a first step in understanding cross-country variation, we now consider, as provided in Fig. 6, the distribution of the ratio of annual earnings per worker for each sector separately. We focus on the ratio of annual labour earnings per worker $\frac{\overline{w}^{E}_{c,t,s}(F)[\overline{H}^{E}_{c,t,s}(F)+k\overline{H}^{SE}_{c,t,s}(F)]}{\overline{w}^{E}_{c,t,s}(M)[\overline{H}^{E}_{c,t,s}(M)+k\overline{H}^{SE}_{c,t,s}(M)]}$ rather than $\rho^{\ddagger}$, as at the sector level, the latter is hard to interpret as it will depend on both the ratio of male to female employment in that sector and any inequality in their compensation.

Looking at the data as a whole the first thing we note is that there is relatively little variation across sectors. The annual wage ratio is highest in construction and mining. This may reflect differences in the roles undertaken by men and women in those sectors. This seems particularly likely for construction, where, for a large share of observations, female annual wages are higher than those of men. Looking at Fig. 6, which plots $\rho^{\ddagger}$ by sector we can see that the labour share ratio in those sectors is close to 0, implying that very few women work in those sectors but that those who do, do so in better paid managerial positions, etc. Supplementary Appendix Figs. C.2 and C.3 in the Appendix report the distribution of $\rho^{\ddagger}$ within sectors by continent, and income group, respectively. The cross-sectoral pattern is reasonably consistent across continents and income groups, although, as expected, we both higher averages and greater variation within sectors in higher-income countries.

Slightly more subtly we can see that, construction aside, the annual earnings ratio distribution is similar across sectors and there are very few cases where women's annual wages are larger than those of men. Our interpretation of this is that the absence of large differences across countries in the ratio re-emphasizes that differences in labour market participation and hours worked are more important drivers of EGI than differences in hourly wages.

5.3 Aggregate inequality

This section shifts our focus from country-level analysis to the distribution of EGI at the global population level. That is, we ignore the average differences between countries that were previously our focus, and now consider the total global extent of EGI ignoring national borders.

Differing population sizes and population growth rates mean that the rightwards shift in the weighted and unweighted distributions of $\rho^{\ddagger}$ reported in Fig. 4 may imply that while EGI has been reduced for the average woman, total EGI may have increased.[18] Measuring overall EGI requires calculating the total deviation from equality in each country and aggregating this across countries. It is convenient to interpret the resulting quantity as the number of unpaid equivalents.

Consider the following simple example—if for a total, evenly split, population of 200 men and women total compensation for men is 100 and 20 for the women, then this would imply a labour share ratio of $\rho = 20/100 = 0.2$.While one interpretation is that each woman receives one fifth of the income of each man, an equivalent is that one of the women earn the same as their male equivalents and the others are unpaid. The advantage of this is that it provides a straightforward summary statistic.

Thus, for each country c in our data the number of unpaid equivalent women is simply $(1-\rho^{\ddagger}_{c}\frac{N_c(M)}{N_c(F)})P_c(F)$. The logic behind the multiplication of $\rho^{\ddagger}_{c}$ with the employment ratio is explained below. The total number of unpaid equivalent women in the world, aggregate world EGI, is then simply the sum over the set of all countries C. That is,

[18] The literature on aggregate global income inequality shows that differences between nations are able to explain the majority of global inequality (Milanovic 2015). Thus, Jones (1997), Milanovic (2002), and Sala-i-Martin (2006) show that, despite rises in within country inequality rapid growth in China and to a lesser extent India have reduced total world inequality.

$$\Gamma_t = \sum_{c \in C} P_{c,t}(F)\left(1 - \rho^{\ddagger}_{c,t}\frac{N_{c,t}(M)}{N_{c,t}(F)}\right), \tag{21}$$

where $P_{c,t}(F)$ represents working-age women population in country c in time t, $N_{c,t}(M)$ and $N_{c,t}(F)$ denote total employment of men and women respectively. In a country with no inequality whatsoever $(1-\rho^{\ddagger}_{c,t})$ must be zero. Gender bias against women would mean $(1-\rho^{\ddagger}_{c,t}) > 0$ and vice versa. The multiplication of $\rho^{\ddagger}_{c,t}$ in Equation (21) by the ratio of male to female employment removes the effects that come from differences in the number of employed men and women. Thus, $\rho^{\ddagger}_{c,t}\frac{N_{c,t}(M)}{N_{c,t}(F)}$ shows the inequality that only arises from differences in working hours and hourly earnings. This, quantity is the ratio of female to male incomes and thus is similar in its interpretation to the GPG, as captured by η in Supplementary Appendix Equation B.4., albeit parameterized differently and our measure takes care of the differences in average working hours among self-employed; See, Supplementary Appendix B for a full discussion of this relationship.

Of course, as discussed above, EGI is driven not only by differences in earnings per hour and hours worked but also by differences in unemployment and labour market participation. Another advantage of our Γ_t is that it allows us to consider EGI among those out of the formal labour market. We can decompose Γ to assess the relative importance of each of these factors.

The number of unpaid equivalent among the employed due to per hour earnings differences is given by:

$$\Gamma^{W}_t = \sum_{c \in C}\left(N^{E}_{c,t}(F) + N^{SE}_{c,t}(F)\right)\left(1 - \frac{\overline{w}^{E}_{c,t}(F)}{\overline{w}^{E}_{c,t}(M)}\right) \tag{22}$$

where $N_{c,t}(F) = \left(N^{E}_{c,t}(F) + N^{SE}_{c,t}(F)\right)$ is the total number of women in employment. Next we compute the number of unpaid equivalents among the employed due to differences in both per hour earnings and hours worked.

$$\Gamma^{WH}_t = \sum_{c \in C} N_{c,t}(F)\left(1 - \rho^{\ddagger}_{c,t}\frac{N_{c,t}(M)}{N_{c,t}(F)}\right) \tag{23}$$

We can analogously compute the number of unpaid equivalents in the female labour force as a whole by re-computing Equation (23) now including the unemployed:

$$\Gamma^{WHU}_t = \sum_{c \in C}\left(N_{c,t}(F) + U_{c,t}(F)\right)\left(1 - \rho^{\ddagger}_{c,t}\frac{N_{c,t}(M)}{N_{c,t}(F)}\right) \tag{24}$$

where $U_{c,t}(F)$ is the number of women in the labour force but unemployed. This calculation thus assumes, conservatively, that were all unemployed women to be employed, they would face the same average level of wage inequality as faced by employed women since the actual inequality they would experience is unobservable.

A key form of EGI, as discussed previously, is gender difference in rates of participation in the formal labour market. Looking at Table 1, we see that the cross-country average labour force participation rate is 74 per cent among men but only 50 per cent for women. As discussed in Supplementary Appendix A, this is unlikely to mean that 24 per cent of the women are economically inactive, they are much more likely to be working, but in unpaid home production, childcare and similar activities traditionally assigned to women. That is, they are working but not receiving wages.

We thus ask two related questions. First, what would be the number of additional unpaid equivalents recorded if female labour market participation rates were the same as men's?

This is given by modifying Equation (21) to adjust for the male labour force participation rate:

$$\Gamma_t^{WHUP} = \sum_{c \in C} P_{c,t}(F) \Upsilon_{c,t}(M) \left(1 - \rho^{\ddagger}_{c,t} \frac{N_{c,t}(M)}{N_{c,t}(F)}\right), \tag{25}$$

where $\Upsilon_{c,t}(M)$ is the male labour market participation rate. Like Equation (24), this is predicated on the idea that were more women to participate in the formal labour market they would face similar rates of discrimination to those who currently do. Again this is conservative as one can imagine that women on the margin of labour market participation are more vulnerable to discrimination than the average women in employment. By imputing to these women the discrimination faced by employed women, we are saying that women engaged in subsistence agriculture or home production face average discrimination at least as great of the average employed women. Consider the example of home production. We assume the running of a household in terms of cooking, cleaning, and care are equally valuable to men and women. Combining this assumption with the well documented fact that women do disproportionate amounts of home production in almost every society then their labour share in home production will be much lower. A similar argument applies to subsistence farming.

The second question is what would be the number of unpaid equivalents if we considered all working-age women? This quantity will capture the reality that there are very few working age women who are involved neither in market nor non-market production. The latter may involve subsistence agriculture and/or home production such as cooking, cleaning, or care. There are of course some exceptions to this. Some women, like some men, live lives purely of leisure. But, these will be disproportionately concentrated in the richest countries where male labour market participation rates are very high and thus this final section of the female population will be small anyway. This quantity is given by $\Gamma_t - \Gamma_t^{HWUP}$.

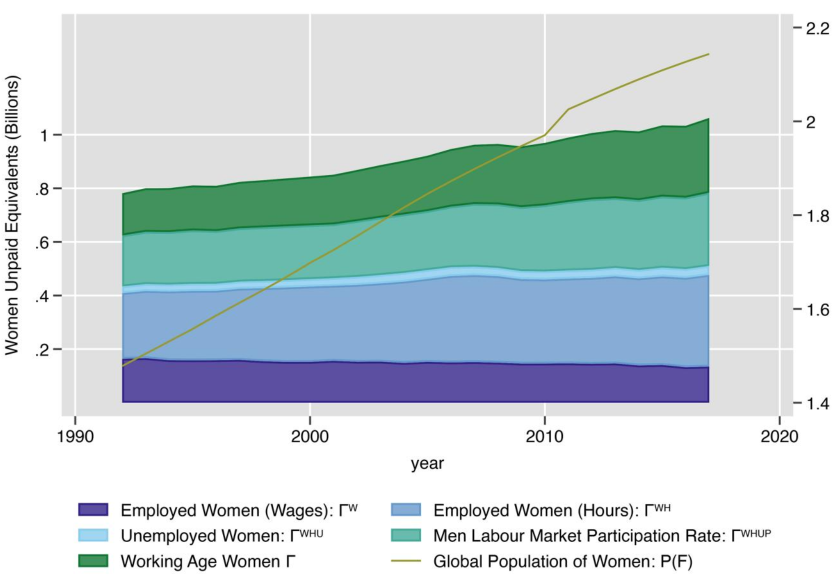

Figure 7. Aggregate global EGI.

We separate $\Gamma_t - \Gamma_t^{HWUP}$ and $\Gamma_t^{HWUP} - \Gamma_t - \Gamma_t^{HWU}$ as they involve slightly different assumptions. In the case of the latter, the counterfactual is clear. In a gender-equal society rates of labour market participation would be the same. Thus, calculating what inequality would be if women participated at the same rate as men is relatively natural as it only involves the observed rate of labour market participation for men and women, and differences in women's observed employment income. The former quantity requires instead a comparison with men who are also not in the labour market. Now the assumption is that in which the labour market is unequal that home production is not more equal.

Figure 7 reports Γ_t and its composition for each year from 1991 to 2017. The data suggest that in 1991 $\Gamma = 800$ million, rising to a little over one billion by 2017. This suggests that global EGI increased over the period by around one quarter. The purple line plots (on the right-hand y-axis) the global working age female population. Over the same period this has increased from around 1.6 billion to 2.4 billion. This means that while in 1991 EGI was equivalent to one in two working age women being unpaid, by 2017 it had fallen to just over two in five. Put differently, in 1991 it took on average the earnings of two women to equal those of a single man, but by 2017 the earnings of five women were equal to those of just over two men.

This increase in the absolute number of unpaid equivalents and decrease in the proportion thereof reflects that the increase in Γ_t is because the rate of population growth has outstripped the slow increase in $\rho^{\ddagger}$ documented in Fig. 2.

Given that the global working age population will continue to increase, albeit at a decreasing rate, for at least the next 20 years, with a total forecast increase of around 500 million working age women by 2042, if the historic growth of $\rho^{\ddagger}$ is maintained then it seems possible that Γ will not fall for quite some time to come.[19]

Considering the composition of Γ makes clear the relative roles of gender inequality among those in the labour market, and EGI due to differences in labour market participation. The purple region describes the number of unpaid equivalents solely due to differences in average hourly wages, Γ_t^W. We can see that in 1992, this alone accounted for around 164 million unpaid equivalent women. There has, however, been a small decline in this number over the period with it falling to 135 million by 2017. This perhaps reflects reductions in pay discrimination in both high-income countries and elsewhere.

On the other hand, the number of unpaid equivalents associated with differences in overall earnings between employed men and women has grown. At the beginning of the period Γ_t^{WH} accounted for around half of, or 400 million, the total number of unpaid equivalents. While it has increased by around 40 million over the subsequent 25 years, Γ^{WH} has accounted for declining share of Γ. A corollary of this is that the role of hours worked $\Gamma^{WH} - \Gamma^{W}$ has increased over the same period.

A quantitatively small, but consistent, source of EGI is excess unemployment among women as depicted by the light blue seam in the picture. This shows that $\Gamma^{WHU} - \Gamma^{WH}$ has grown over the period from around 25 million unpaid equivalents to 34 million.

The two green areas report unpaid equivalents associated with women's work outside the labour market. The light green area reports $\Gamma^{WHUP} - \Gamma^{WHU}$ or the number of unpaid equivalents associated with differences in men and women's labour market participation. That is, the number of additional unpaid equivalents we would record if women had the same rate of labour market participation as men, but faced the same rate of inequality as women already in the labour market. We can see that this is an important form of labour market inequality, equivalent to 190 million unpaid women at the beginning of our period and increasing to around 273 million by 2017.

Finally, the dark green area reports $\Gamma_t - \Gamma_t^{HWUP}$, the number of unpaid equivalents if we assume that all working age women not in employment face, on average, the same level of

19 UN World Population Prospects (2017) via https://ourworldindata.org/grapher/population-by-age-group-to-2100?country=~OWID_WRLourworldindata.org, accessed Jun 2022.

discrimination as those in the labour market. As discussed above this quantity requires the additional assumption that the population of global women who work either in employment or in some form of home production is small. On this basis, the additional number of unpaid equivalents was 157 million in 1992 and had risen to just under 280 million by 2017. One way to interpret the scale of $\Gamma_t - \Gamma_t^{HWUP}$ is that it would require over 13 per cent of working age women worldwide to be women of leisure which seems too high to be plausible. While relaxing our assumption would no doubt reduce our estimate slightly, there is good reason to believe that our estimate is in fact an underestimate given that the assumption that women not in employment face equal discrimination to those who are not is probably a conservative one.

6. Discussion

Taken together our results suggest that EGI is substantial at a global level, and that slow progress in reducing it in the face of rapid population growth means that average EGI globally is increasing and today amounts for around 1 billion women working without compensation.

Yet, it is important to note what our measure of EGI what does not contain. First, by construction EGI does not capture other aspects of inequality such as access to education, health, or political representation. Carmichael, Dili, and Rijpma (2014, Chapter 12) develop a composite index based on proxies for health, socio-economic status, marriage age differences, and political equality with which they are able to evaluate long term trends in gender-equality. Such indices have the advantage of capturing a broader conception of gender inequality at the cost of lacking a precise definition of equality, or direct translation of the dimensions of inequality to the data used to quantify them.

Second, it also does not capture differences in hours worked in the household, which are likely to be substantial (Miranda 2011).

Third, it does not capture differences in job quality—for example, the extent to which jobs are precarious, dangerous, unpleasant, physically or emotionally demanding, or the extent to which they are fulfilling. One of the assumptions in Section 2 is that the distribution of occupations is similar, but if, for example, women are subject to violence or sexual harassment at work, there could remain inequality in work even if total compensation of men and women is the same.

Fourth, our calculation of $\rho^{\ddagger}$ implicitly assumes that the number of working-age men and women is similar. This reflects our presumption that in a gender-equal society there would be no such large differences, as practices such as selective abortion would not occur (Sen 1990). We do not make this assumption when we present the sector level estimates, or compute aggregate inequality. It would be straightforward to modify $\rho^{\ddagger}$, as we do for the sector specific estimates to adjust for any such differences.

Fifth, our approach relies on the fact that, by assumption, total value added is the same for men and women in a gender-equal society. We believe this assumption is the most reasonable choice, but it is worthwhile noting that it would be straightforward to substitute an alternative benchmark, such as the current observed maximum.

Finally, the ILO data we work with do not distinguish between self-employment and informal employment. Of course, informal and self-employment are quite different. Given suitable data, it would be valuable in future work to better distinguish between the two.

Our results highlight that overall progress has been slower than might be imagined given the increased awareness globally of gender inequality over the period, including initiatives such as the Millennium Development Goals.

Nevertheless, the improvements are significant, the 25^{th} percentile in 2018 is similar to the median in 1991, as is the 1991 75^{th} percentile and 2018 median. But, extrapolating from the average increase in $\rho^{\ddagger}$ of one third of a percentage point per year implies that it will be over a century before the median country (in our sample) has labour market gender-equality. That is, while higher-income countries tend to have lower EGI, the rate of convergence is slow.[20]

One interpretation is that achieving rapid reductions in EGI will require additional policy interventions. We leave an analysis of the impact of policy on $\rho^{\ddagger}$ for future work, but Kleven and Landais (2017) document the role of increased equality in educational attainment and particularly the demographic transition in reducing earnings inequality. Cubas (2016) argues that women's labour force participation increases with improvements in infrastructure and access to household appliances. Weichselbaumer and Winter-Ebmer (2007) study the role of international conventions and 'economic freedom' on wage gaps. Wolszczak-Derlacz (2013) examined the impact of trade and competition on sectoral gender wage gaps. Olivetti and Petrongolo (2016) conducted a cross-country analysis of the impact of family policies on gender gaps in labour market outcomes. Blau and Kahn (2013) analysed the impact of family-friendly policies on the gender wage gap in the U.S., and Hegewisch and Gornick (2011) reviewed the impact of work–family policies on women's employment and earnings. Matsa and Miller (2013) leveraged the Norwegian introduction of gender quotas for corporate board seats to show that additional female board members lead to changes in corporate strategy.

This in turn raises the question as to how policy can be changed, which is beyond the scope of this article, but we note there is a body of microeconometric evidence that documents how local changes in female political empowerment leads to changes in policy, such as Chattopadhyay and Duflo (2004) or Bhalotra and Clots-Figueras (2014).[21]

Our finding that there are not large differences across sectors is in contrast with much of the prior literature, and as such deserves further examination. In particular, we do not find evidence of larger wage gaps in agriculture or manufacturing. Previous work has documented patterns of occupational segregation in both in many countries (Seguino 2000; Mandel and Semyonov 2005; Blau and Kahn 2017; Das and Kotikula 2019; Barth, Kerr, and Olivetti 2021). This work has further highlighted that in many cases women are crowded into low-wage occupations due *inter alia* to a lack of access to education; capital; limits to mobility, and a disproportionate share of household production. A related literature has argued theoretically, at both the micro (Udry 1996) and the national levels (Klasen 2018) although Bandiera and Natraj (2013) caution about the difficulty of making causal inferences based on cross-country regressions. An alternative strand of the literature advances the alternative hypothesis that it may not be due to the consequences of investment of changes in intra-household bargaining (Doepke and Tertilt 2019), or because gender inequality may be a path, via a more competitive manufacturing sector, to growth (Seguino 2000; Schober and Winter-Ebmer 2011; Seguino 2011).

That we do not find evidence of consistent differences in EGI across sectors is not incompatible with these findings. This is for two reasons. First, our focus on the earnings ratio means that for EGI can be similar across two sectors despite very different average compensation. Second, our results do not preclude the possibility that in a given country, such as the export-orientated semi-industrialised countries studied by Seguino (2000), there are important differences between sectors. It will be valuable for future work to leverage the fact that our approach

[20] There is also a literature on the consequences of economic gender inequality for economic performance. For example, Klasen and Lamanna (2009), Klasen (2018) conducted cross-country analyses of the impact of gender inequality in education and employment on economic growth. Cuberes and Teignier (2016) developed a theoretical model and provided empirical evidence on the aggregate effects of gender gaps in entrepreneurship and labour force participation. Carpinella and Johnson (2016) quantitatively analysed the output costs of gender discrimination. Regarding the intergenerational transmission of inequality, Chetty et al. (2016) analysed the effect of childhood environment on gender gaps in adulthood, and Heckman and Mosso (2014) reviewed the literature on the economics of human development and social mobility. Duflo (2012) reviewed the relationship between women's empowerment and economic development, discussing the evidence on the impact of gender-equality on economic growth and the effectiveness of policies promoting women's empowerment. Baskaran et al. (2024) suggested that female politicians have a causal effect on economic growth.

[21] See Banerjee and Duflo (2005) for a review of the literature on gender inequality and development.

provides a comparable measure of EGI across time, place, and sector to better understand the role of segregated labour markets in the persistence of EGI and the process of development.

We also find that some evidence that reductions in EGI are sometimes subsequently reversed. It would be valuable for future research to understand which components of EGI drive this, and in which sectors, etc.

7. Conclusion

This article has presented a new approach to measuring EGI based on the ratio of women's share of national labour income to men's. This approach aligns closely with the combination of the concepts of equal pay for equal work and equality of opportunity enshrined in international treaties. The resulting data can be readily compared across time and place, and we are thus able to provide new evidence about EGI variations across countries, its composition, and how it has evolved over time. We find that EGI, despite the progress documented by Goldin (2014), remains substantial at a global level. We present the first estimates of aggregate global EGI and suggest that this is equivalent to around one billion women working for no compensation whatsoever. Moreover, given demographic projections, this number can be expected to rise as population growth is projected to be concentrated on the poorest, and least gender-equal, countries over the next four decades. Our decomposition shows that differences in hours worked and labour market participation are more important than differences in hourly wages. However, wage differences alone are equivalent to \$135\$ million women working without compensation.

Supplementary material

Supplementary material is available at the *Oxford Economic Papers* Journal online. These are the data and replication files and the Supplementary Appendix.

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