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The Global Gender Gap in Labor Income

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Abstract: This paper introduces a new measure of economic gender inequality (EGI) based on the ratio of women's share of national labor income to men's. This measure captures both the principles of equal pay for equal work and non-discrimination. Importantly, it can be calculated from existing data and is comparable across countries and time. We show that EGI has only been improving slowly and that current aggregate EGI is equivalent to 1.2 billion women working for nothing. Moreover, this gap is expected to increase in coming decades. Instrumental variable estimates suggest that while increases in income reduce EGI, living standards will have to triple for equality to be achieved in countries such as Mexico or Turkey.

Keywords: Economic Gender Inequality, Global Distribution of Income, Modernization Hypothesis
JEL-Codes: J16, J71, D33, O15

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Economic Gender Inequality (EGI) has two components; discrimination between similarly qualified men and women, and differences in access to education, training, or particular sectors of the economy. Absent a few exceptions, there is a uniform commitment to eliminating both of these. Almost every country is a signatory to the Equal Remuneration Convention (1951), committing them 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). The last century, particularly in high-income countries, saw enormous progress, which Goldin (2014) termed 'the grand gender convergence'. Nevertheless, the evidence suggests that despite such laws, a substantial pay gap remains. In the OECD, where it might be 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%, and it is as large as 37% in South Korea.[2] Outside of the OECD, inequality is often even higher.

This paper introduces a new measure of EGI, designed to capture both departures from equal pay for equal work as well as limits to women's labor market opportunities due to discrimination, which we term the labor share ratio. This is, the labor share of income of women – the compensation of female workers as a share of their value added, divided by the labor 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 labor and product markets mean that workers of both genders must bargain over 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). Value added cannot normally be disaggregated by gender, but we do not need to to calculate our measure, all we need is the assumption that any systematic deviation

[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.

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. Firstly, 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. Secondly, this also makes aggregation meaningful and we are able to present estimates for total global EGI. Finally, our approach relies on well-understood data: the data that make up GDP statistics. Using these extant data means that we are able to measure changes in gender inequality over a period of up to 40 years, for over 70 countries.

Using these new data this paper studies how EGI varies across countries, and its changes over time. It also studies the evolution of aggregate global pay inequality. We find that whilst EGI has been slowly shrinking in most countries, that the relatively high birthrate in more unequal countries means that aggregate inequality has increased and will continue to increase until around 2050. We also find that current aggregate EGI is equivalent to 1,200 million women working for no compensation whatsoever. We then use the broad coverage provided by our new measure to analyze the causal impact of economic development and political emancipation on EGI. We find that while development reduces inequality, it does so only slowly. We find no evidence of an effect of women's political status.

This paper contributes to three related literatures. Its first contribution is to the important literature on EGI, particularly research such as Blau and Kahn (1992, 2003) Olivetti and Petrongolo (2008) and Mulligan and Rubinstein (2008) that compares the GPG across countries or studies its evolution over time. The labor share ratio has the important quality that it is directly comparable across time and place, and as it captures both the principle of 'equal pay for equal work' and discrimination it implicitly controls for differences in the form of EGI across time and place.

By introducing comparable new data on EGI, this paper's second contribution is to introduce gender to the prominent literature that studies trends in income inequality, such as Piketty and Saez (2003) and Atkinson et al. (2011). The broad coverage means that it also contributes to the related literature measuring 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.[3] Our results show that by ignoring gender differences in earnings the level of trends in actual inequality are understated. By documenting the considerable levels of EGI still routine in most of the world, our findings also provide a valuable counterpoint to the "Grand Gender Convergence" identified by Goldin (2014).

The third contribution of this paper is to the growing literature on whether EGI is a symptom or a cause of underdevelopment. A case for the former is made by Fernández (2014) who shows theoretically and empirically that improvements in women's rights can be seen as an endogenous response to economic development. In a similar spirit, there is an increasing body of microeconometric evidence that documents how local changes in female political empowerment leads to changes in policy, such as Duflo (2004) or Bhalotra and Clots-Figueras (2014).[4] Given our focus on EGI it is also related to work, notably Acemoglu et al. (2015), presenting evidence that a transition to democracy leads to a decrease in overall income inequality. A similar view, that (gender) inequality is a symptom of underdevelopment, is known in political sociology as the 'Modernization Hypothesis' (see, Inglehart and Baker, 2000), which states that rising living standards and political emancipation cause changes in values leading, *inter alia*, to improvements in gender equality. Taken together these different literatures suggest that EGI may be best understood as a symptom of underdevelopment rather than a separate pathology.

On the other hand, others such as Doepke et al. (2012) and Doepke and Tertilt (2014) have argued that gender inequality impedes economic development as it reduces

[3] 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.

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

investment in the human capital of children.[5] We provide the first causal analysis of the effects of improvements in income and political rights on EGI at the aggregate level. Our IV estimates suggest that a tripling of incomes would be required to achieve an increase from a labor share ratio of 0.4, typical of many middle-income countries, to equality. But, we find little evidence of any effect of democratization or the political power of women. Thus, while a substantial literature shows women's political empowerment leads to changes in policy making, such as Duflo (2004), we find no causal evidence that this is true for EGI at the national level. We also obtain results on other determinants, such as globalization as studied by (see, Oostendorp, 2009) and Weichselbaumer and Winter-Ebmer (2007). Our results suggest that whilst trade-liberalization improves EGI, financial liberalization achieves the opposite.

This paper is organized as follows. The next section outlines the properties of our factor-shares based index and the data we use. Section 3 describes patterns of gender equality around the world and provides estimates of the aggregate global gender gap. Section 4 studies whether rising incomes and democratization will reduce gender inequality. Section 5 briefly concludes.

2 Measuring Gender Pay Inequality

As discussed above, EGI is the product of two forms of discrimination. The first is differences in pay for the same value of work. The second is differences in value created due to inequality of opportunity. To see this we can write an individual's wage as the product of their value added and their labor share. Specifically, let each individual in a population of F women and M men each receive a wage w_i where $i \in \{1, \ldots, F+M\}$. Then,

$$w_i = \lambda_i v(\theta_i) \tag{1}$$

where θ_i is a vector of individual characteristics. Denoting $v_i = v(\theta_i)$, we note that $\lambda_i = \frac{w_i}{v_i}$ is the labor share of individual i. The lack of a subscript on $v(\theta_i)$ reflects

[5] A strand of the literature advances the stronger alternative hypothesis that gender inequality may be a path, via a more competitive manufacturing sector, to growth. (see, Seguino, 2000, Schober and Winter-Ebmer, 2011, Seguino, 2011).

the intuition that in the same job men and women with equal characteristics should create the same value.[6]

In this setting, (average) gender differences in pay for work of equal value, are captured by differences in the (average) labor share. These differences have two forms. The first is pure discrimination: women are sometimes paid less for the same 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. Both of these are captured by the ratio of the average labor share of all women, λ_F, with that of all men λ_M.[7]

EGI is also due to gender differences in occupational choice as women often disproportionately have jobs that create less value. The reasons include: Differences in opportunity, and differences in preferences. 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 favor men (see, Goldin, 1990). There are also often differences in educational opportunity (see, Altonji and Blank, 1999), access to social-networks Beaman et al. (2018), Blackaby et al. (2005), glass-ceilings (see, Albrecht et al., 2003, Arulampalam et al., 2007), and so forth. Gender differences in expected household production will also impact on hours worked: women also often engage in more (unmeasured) household production (see, Hook, 2010), and this impacts upon their pay and advancement.

Recent evidence also documents gender differences in preferences that may lead to differences in occupational choice. An important recent literature studies how differences in preferences for risk (see, Bertrand, 2011), working hours (see, Goldin, 2014), competition (see, Fershtman and Gneezy, 2001, Niederle and Vesterlund, 2007, Gneezy et al., 2009, Buser et al., 2014); 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 (see, Ichino and Moretti, 2006) or the role of outside offers (see, Blackaby et al., 2005). A premise of this

[6]Although there maybe occasional exceptions to this, such as gender differences in the ability to use a plough, (see, Alesina et al., 2013), to our knowledge there is no such evidence for vast majority of occupations vitiating our assumption of identical production functions for men and women.

[7]Appendix A rehearses this argument in more detail.

paper is that while important at an individual level, they are relatively unimportant in understanding differences in EGI between countries or over time. Moreover, it is not clear that the all of the institutions that reward risk taking, competition, or the pursuit of prestige are necessarily efficient and not better seen as a form of discrimination.

Of course, the discrimination and inequality of opportunity may interact – for example, women's educational choices will be distorted by pay discrimination. These differences will all be captured by $v(\theta_i)$.

A considerable literature, see for example Blau and Kahn (1992, 2003), Weichselbaumer and Winter-Ebmer (2007), Olivetti and Petrongolo (2008), has studied cross-country differences in EGI through the lens of the GPG. [8] In its simplest form and in our notation, denoting the median woman as $\tilde{F}$ and the median man as $\tilde{M}$, the definiton of pay equality embodied in the GPG requires that:

$$\text{GPG} = \frac{w_{\tilde{M}} - w_{\tilde{F}}}{w_{\tilde{M}}} = \frac{\lambda_{\tilde{F}} v(\theta_{\tilde{F}}) - \lambda_{\tilde{M}} v(\theta_{\tilde{M}})}{\lambda_{\tilde{M}} v(\theta_{\tilde{M}})} = 0 \tag{2}$$

Thus, while corresponding to a sensible and intuitive definition of EGI, the GPG conflates gender differences in earnings due to some forms of discrimination, such as education, but not others such as participation, with departures from equal pay for equal work. This makes cross country comparison difficult.

Amongst others Oostendorp (2009) proposes the (log) occupational wage gap to address these concerns. This measure in the notation above is $\lambda_{\tilde{F}} v(\theta_{\tilde{F}}|Occupation) - \lambda_{\tilde{M}} v(\theta_{\tilde{M}}|Occupation)$ thus it captures both the occupation-specific labor share ratio as well as differences in value added within occupation due to differences in hours, rank, human capital, or other characteristics. Oostendorp argues that as occupations are measured relatively precisely this should control for differences in human capital, but this is in contrast to the findings of Goldin (2014) who finds considerable pay inequality within even elite jobs due to differences in hours or child-rearing.[9] Furthermore, as Oostendorp (2009) notes, this measure also does not control for gender differences in occupational choice. Whilst, in principle one could condition on additional person

[8] There is also a prominent related literature which studies pay gaps within countries, such as Mulligan and Rubinstein (2008), Manning and Swaffield (2008) or Black and Spitz-Oener (2010).

[9] Other partitions are sometimes used, for example, Wolszczak-Derlacz (2013) focus on the sectoral wage gap in their analysis of trade liberalization.

and job characteristics to further improve the ease of interpretation. However, such a data intensive approach is not normally feasible, and is certainly not for the purpose of this paper. Moreover, such measures would not correspond to total EGI that we focus on.

Instead, if given our assumption that differences in θ reflect only discrimination and under our assumption that $v(\cdot)$ is the same for men and women, then wages $w_i = v(\theta_i)\lambda_i$ will only be unequal if there is inequality of opportunity, i.e. differences in θ_i, or departures from equal pay for equal work, i.e. differences in λ_i. Thus, we define the absence of EGI as requiring:

$$\rho \equiv \frac{w_F}{w_M} = \frac{v(\theta_F)}{v(\theta_M)} \frac{v_M}{v_F} = 1 \tag{3}$$

The assumption of no gender difference in $v(\cdot)$ means that the ratio of the female to male labor share $\zeta = \frac{\overline{\lambda}_F}{\overline{\lambda}_M}$ is equivalent to departures from equal pay for equal work, as would be measured by an infeasible ideal GPG obtained by conditioning on all of the elements in θ. Specifically, we have GPG $= \zeta - 1$. Where:

$$\zeta \equiv \frac{\lambda_F}{\lambda_M} = \frac{w_F / v(\theta_F)}{w_M / v(\theta_M)} \tag{4}$$

Which means that:

$$\rho \equiv \frac{w_F}{w_M} = \frac{\lambda_F}{\lambda_M} \frac{v_M}{v_F} = \underbrace{\zeta}_{\text{Equal Pay}} \underbrace{v_M / v_F}_{\text{Discrimination}} \tag{5}$$

Thus, our measure of EGI, the labor share ratio, is equivalent to the 'ideal' GPG, ζ multiplied by differences in value added due to discrimination.

Our parameterization has the important advantage for our purpose that it uses consistent data, and abstracts from $v(\theta)$, θ_i, and λ_i. This eliminates the increased difficulties in interpretation when trying to make comparisons over time or place as both $v(\theta)$, the technology of production, and the distribution of θ_i will vary across time and place. This means that interpretation of changes in the wage gap will now conflate changes in θ, changes in λ, and changes in $v(\cdot)$. This makes clear the challenges faced by previous studies that have, for example, attempted to conduct meta-analyses of

the GPG across countries (see, Weichselbaumer and Winter-Ebmer, 2007, Schober and Winter-Ebmer, 2011, Seguino, 2011). It may well be that there are particular applications where conditioning only on some elements of θ provides a useful and interpretable quantitity but in general they will make comparison more difficult across time and place and so we do not pursue this issue here.

2.1 Measuring the labor Share Ratio

Our focus on compensation and value added has much in common with the literature on the overall labor share in that accurate measurement of compensation is essential. An important advantage of the labor-share approach is that ρ may be calculated using System of National Accounts (SNA) and International Labor Organization (ILO) data. That is the data used to calculate national accounts statistics. As we discuss below we augment these data with data on hours worked from the United Nations Industrial Development Organization (UNIDO). A naive calculation of the labor share is uncomplicated and may be computed purely following (1) using data on value added and compensation per worker from the SNA data.[10] Thus, using E and SE superscripts to denote the employed and self-employed respectively a simple measure of the labor share is:

$$\overline{\lambda}^{E} = \frac{\sum_i w_i^E}{\sum_i v_i^E + \sum_i v_i^{SE}} \tag{6}$$

However, such a calculation will be biased as it will attribute all of the returns to self-employment to capital. This will be problematic in our context if the self-employed are disproportionately male or female. Gollin (2002) suggests assigning to self-employed workers the same average wage as employed workers.

$$\overline{\lambda}^{E+SE} = \frac{\sum_i w_i^E + \overline{W^E} N^{SE}}{\sum_i v_i^E + \sum_i v_i^{SE}}. \tag{7}$$

Where, N^E and N^{SE} are the number of workers in employment and self-employment respectively. There is a further issue which may be important in our context and this is the number of hours worked. This calculation assumes that the number of hours worked is the same in self-employment and that for a given hour of

[10] In principle one might be interested in other moments, but we focus on the average.

work the value added is the same. The evidence suggests (see, Hook, 2010), women are responsible for a disproportionate share of household production and thus they may engage in less market production. The evidence also suggests that part-time workers are more likely to be self-employed. Thus failing to account for this difference is likely to overstate the labor share. Conversely, if part time work were associated with a weakened bargaining position, then failing to adjust for hours worked may understate it. We thus use data from the ILO to calculate an alternative measure of the labor share, $\overline{\lambda}_H^{E+SE}$, that attributes to the self-employed the average hourly wage of the employed multiplied by the average number of hours worked by the self-employed.

Thus, if W_H^E is the hourly wage of the employed and H^{SE} is the number of hours worked by the self-employed then the hours and self-employment adjusted labor share is given by:

$$\overline{\lambda}_H^{E+SE} = \frac{\sum_i w_i^E + \overline{W_H^E} H^{SE} N^{SE}}{\sum_i v_i^E + \sum_i v_i^{SE}}. \tag{8}$$

We maintain the assumption that average wages per hour are the same for the employed and the self-employed. Any violation of this assumption will lead to biases in our estimate of the labor share. Given that our focus is on the ratio of women's compensation to men's it is useful to think about the possible bias of this ratio. We are most concerned that this bias will be negative, leading us to overstate gender inequality. This will be the case only if hourly wages are higher for men but lower for women in self-employment compared to employment or vice-versa. If both women and men are paid more or less per hour in self-employment than employment then the bias will be positive, leading us to under-estimate gender inequality. Thus, for there to be a substantial negative bias the pay difference between employment and self-employment would need to be large and of opposite sign for men and women. One way in which this might happen is due to differences in occupation. To address concerns about measurement error we, as well as for reasons of data availability, we calculate $\overline{\lambda}_H^{E+SE}$ solely for the manufacturing sector where it is harder to imagine such large distortions persisting.[11]

Thus, we consider two measures of gender inequality the 'unadjusted' measure is

[11] To see this, denote the true value of the labor share as λ^{*E+SE} then we may define the bias in the

calculated using data for the entire economy according to (6). The 'adjusted' measure is calculated according (8) using data only for the manufacturing sector and is adjusted both for self-employment and for hours worked. As we shall see in the next section, the qualitative patterns in the two measures are extremely similar.

Our approach relies on well-understood data: the data that make up GDP statistics. Whilst, these data have been criticised, particularly for Sub-Saharan Africa (see, Jerven, 2013), they are compiled according to a well-defined standard designed to ensure comparability across countries and years.[12] This is a considerable advantage compared to the meta-analysis approach taken by Oostendorp (2009). Perhaps most importantly, the ratios obtained by calculating (3) using (6) and (8) are dimensionless and thus do not suffer the from an index-number problem.

3 Gender Inequality around the World

This section presents our new inequality data and establishes the existence of a large global gender gap. It begins by presenting the evidence that women do indeed have a lower labor share, the extent to which this varies across countries, and how this difference has tended to persist through time. It then moves on to document and discuss the aggregate extent of global gender inequality.

As discussed previously, we calculate an adjusted, λ_H^{E+SE} and an unadjusted, λ^E measure of EGI. We then, as in (3), may correspondingly define an adjusted, ρ_H^{E+SE}, and an unadjusted, ρ^E, measure of the labor share ratio. Figure 1 contains a scatter plot of the average labor share of men on the x-axis and the labor share of women on the y-axis by country for 2005. Hence, the dashed 45^{deg} line represents $\rho = 1$ or gender equality (in means). It is immediately clear that in every country $\rho < 1$.

labor share as $\mathbb{E}[\overline{\lambda}_H^{E+SE} - \lambda^{*E+SE}]$. Then the bias of the associated labor share ratio ρ is given by

$$\mathbb{E}[\rho - \rho^*] = \frac{(\overline{\lambda}_H^{E+SE} - \lambda^{*E+SE})_F}{(\overline{\lambda}_H^{E+SE} - \lambda^{*E+SE})_M} = \left(\frac{\overline{W}_F^E - W_F^{SE}}{\overline{W}_M^E - W_M^{SE}} \frac{H_F^{SE} N_F^{SE}}{H_F^{SE} N_M^{SE}} \right) \tag{9}$$

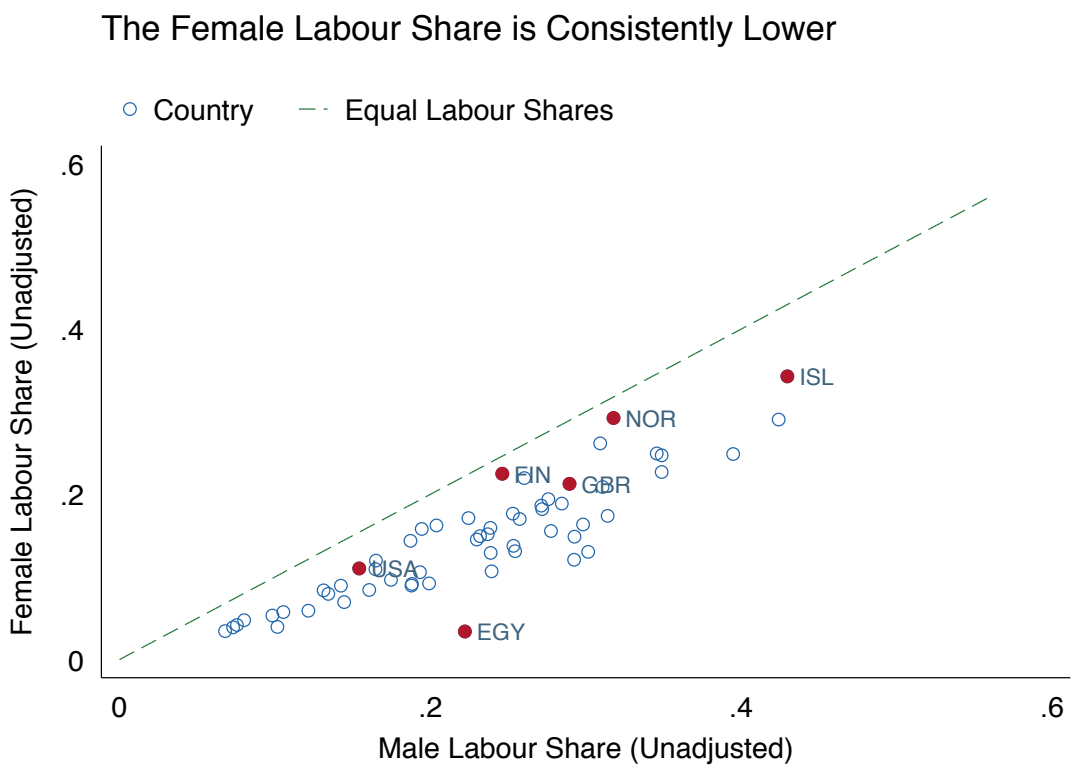
. $\overline{W}_F^E - W_F^{SE}$ and $\overline{W}_M^E - W_M^{SE}$ are not observed but the others are weakly positive and observed directly. Thus, only if $\overline{W}_M^E - W_M^{SE} < 0$ and $\overline{W}_F^E - W_F^{SE} > 0$ or vice-versa will this ratio be biased downwards, overstating inequality. Hence, in practice, the bias is very unlikely to be negative.

[12] 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.

Perhaps as expected, the countries closest to the line are Nordic countries such as Norway and Finland. Similarly, the country with the absolute highest value of the female labor share is Iceland. The absolute value of the female labor share is also important as the relative shares of labor and capital share have important implications for inequality (see, Piketty and Saez, 2003). One, sometimes neglected, implication of this is that if gender differences in capital ownership mean that capital income disproportionately accrues to men, then a higher (female) labor share ratio will reduce the inequality of total (capital+labor) income.

There are a substantial number of countries where the labor share is low for both men and women, but Egypt stands out given that the value added of men is relatively average and that of women is close to zero. This perhaps reflects a combination of both high inequality of opportunity and pay discrimination.

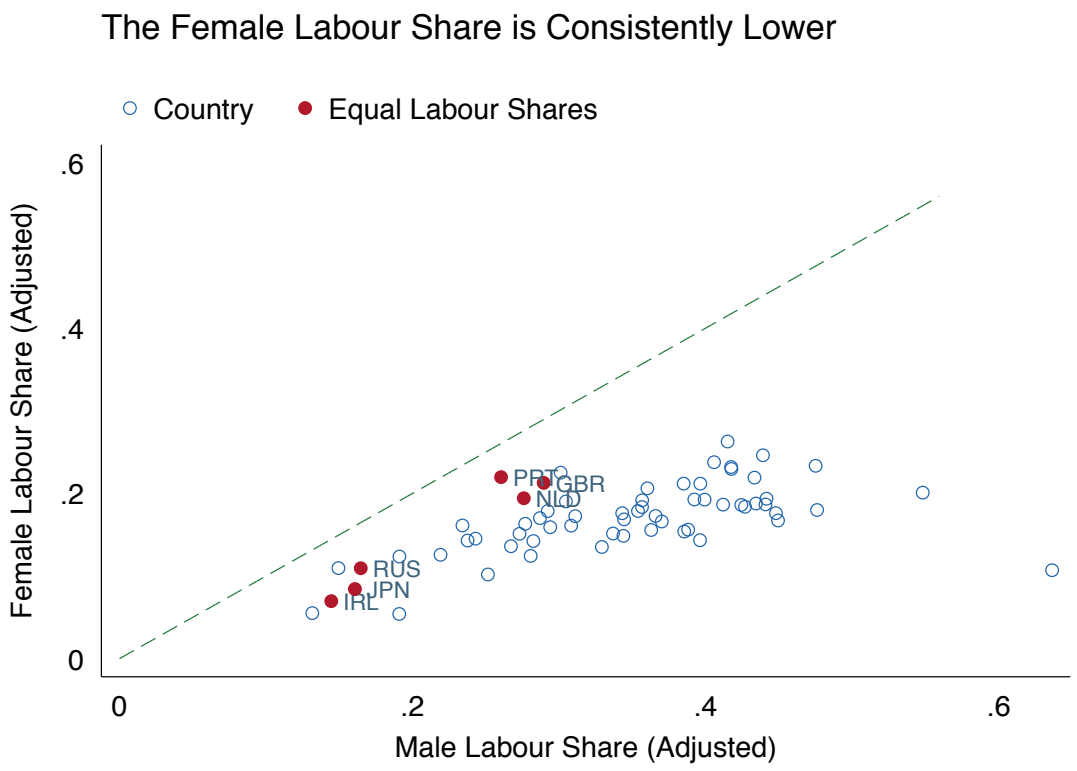
Figure 1: Scatter Plot of Female and Male labor Share in 2005 (Unadjusted Data)



A similar scatter of male and female labor shares, but using the adjusted data, is reported in Figure 2. The key finding, that $\rho < 1$, remains true *a fortiori*. The average distance from the line of average equality is now larger. We now find, perhaps again

unsurprisingly, that the average female labor share is highest in the Netherlands. But, perhaps less expectedly ρ is now highest in Portugal. We also observe that higher values of ρ are not a simple function of development. The labor share ratio of Russia is better than that of Japan or Ireland, perhaps reflecting the legacy of socialist rule. The unadjusted data suggested that female labor shares were close to 0 in a number of countries. The adjusted data shift the average labor share of both genders upwards, but those of men by more, thus suggesting that the unadjusted data may understate gender inequality.

Figure 2: Scatter Plot of Female and Male labor Share in 2005 (Adjusted Data)



Despite the substantial inequalities shown by Figures 1 and 2 the mean country is more equal today than it has been in the past. Figure 3 plots both the adjusted and the unadjusted data since 1970 and shows that there has been an increase of over 10 percentage points in both series. This in fact will understate actual progress as our sample contains fewer, and on average richer, countries in the 1970s than later on. Nevertheless, as revealed by Figures 1 and 2 overall progress has still been slow. One notable feature of the series is that they are non-monotonic suggesting that gender

inequality sometimes increases. One possibility is that this may be related to the economic cycle with gender equality suffering during recessions. We investigate this formally in Section 4, but find no evidence that this is the case. A second notable feature of the data is that they show a marked up-tick at the very end of our period. This might reflect the increased attention given to gender-equality by the Millennium Development Goals in Less Developed Countries, or the achievements of long-standing campaigns for equal pay in richer countries. Regardless of the cause, it may signal accelerated convergence in the future.

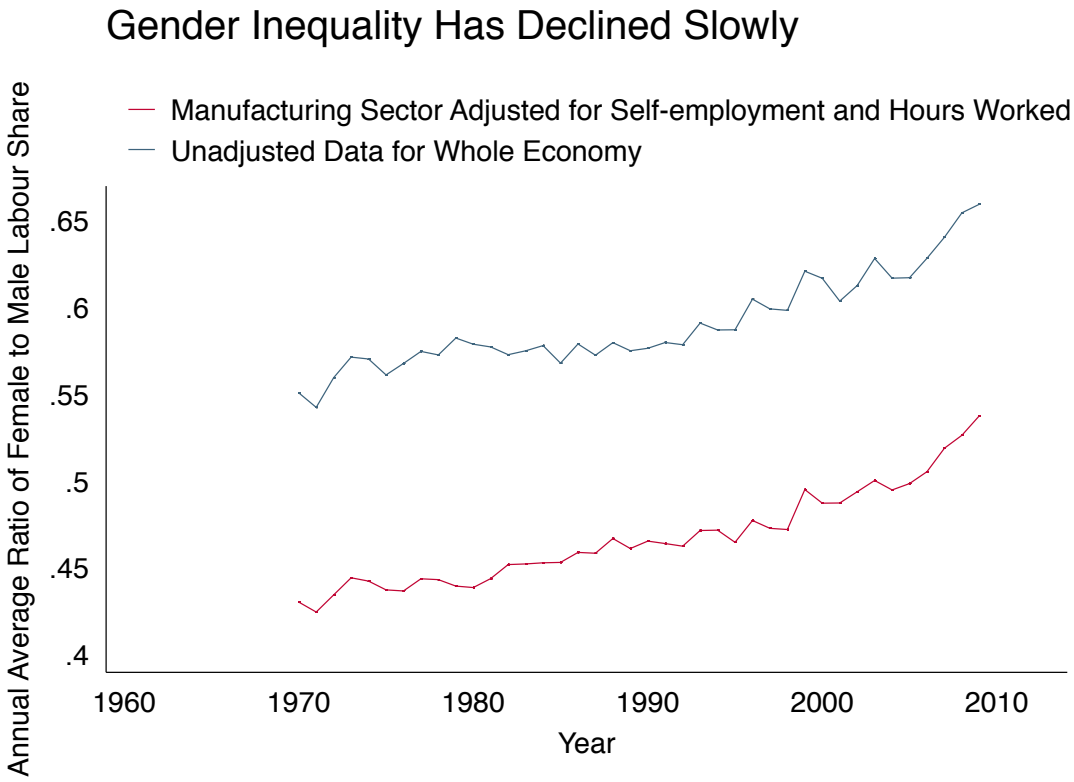
One question that studying the average of ρ cannot address is whether the observed improvement represents a uniform increase or is concentrated in a subset of countries. To understand this Figure 4 shows how the distribution of ρ has changed between 1975 (solid lines) and 2005 (dashed lines). For both ρ^E and ρ_H^{E+SE} the distribution has shifted substantially to the right as we saw previously. Interestingly, whilst both the distributions have become less left-skewed there remains a tail of highly unequal countries, particularly in the unadjusted data. Comparing the distributions of the adjusted and the unadjusted data confirm the suggestion in Figure 3 that the unadjusted data may tend to understate gender inequality.

Finally, we consider the distribution by income group. Using the World Bank categorization, Figure 5 plots the distribution of the labor share ratio for High, and Upper and Lower Middle Income countries. Immediately, we can see that, as we expect, the High Income distribution is right-most, and the Lower 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 are relatively minor compared to between these and the Lower Middle 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. We return to this in Section 4.

3.1 Aggregate Inequality

Having established the key features at the country level the remainder of this section focuses on the distribution of gender inequality at the population level. That is, we

Figure 3: Evolution of Cross-Country Mean of ρ_H^{E+SE} and ρ_H^{E+SE}.

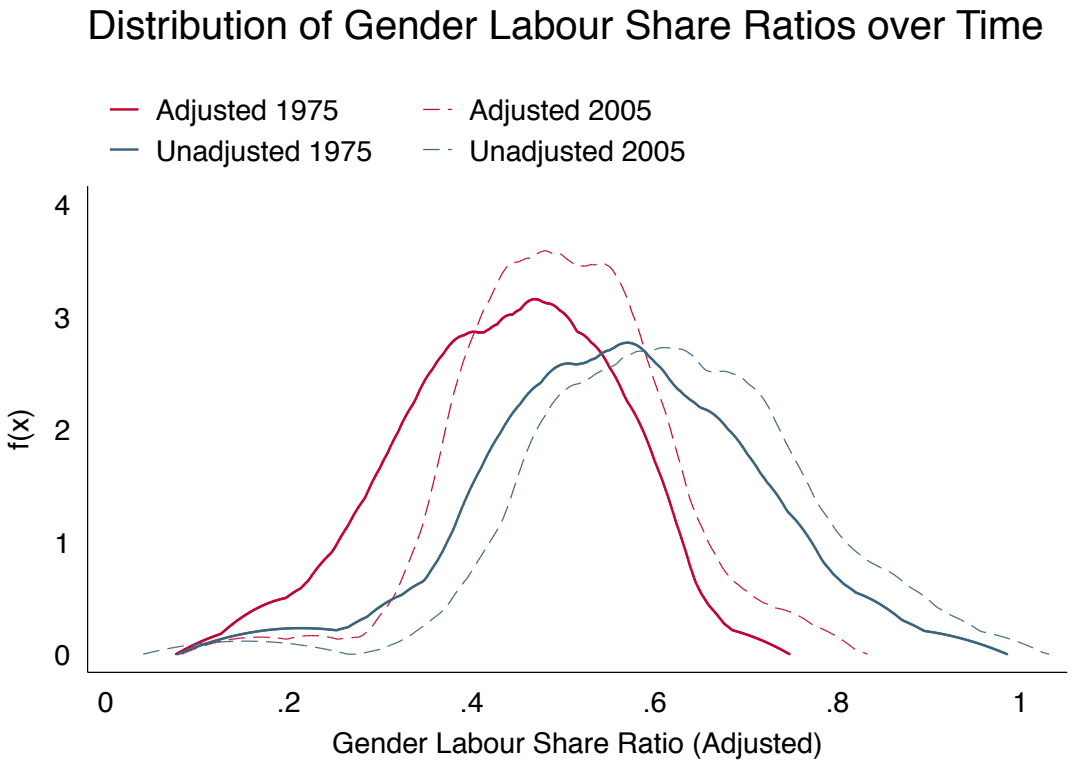


ignore the average differences between countries that were previously our focus, and now consider the total global extent of gender inequality ignoring national borders. Differing population sizes and population growth rates mean that the moderate improvement in Gender-Inequality we find at the country level need not imply that labor market inequality has improved for the average woman.[13] Measuring overall gender inequality requires calculating the total deviation from gender inequality in each country and aggregating these across countries. If we were able to observe the difference between each individual woman's renumeration and the counterfactual she would receive if she had been born a man of similar background, etc., in the same job, $1 - \rho_i$, then total world gender inequality $\tilde{\rho}_W$ would be simply:

$$\tilde{\rho}_W = \sum_{c \in C} \sum_{i=1}^{N_c} |1 - \rho_i| \tag{10}$$

[13]The literature on aggregate global income inequality shows that differences between nations are able to explain the majority of global inequalityMilanovic (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.

Figure 4: Distribution of ρ_H^{E+SE} and ρ_H^{E+SE} in 1975 and 2005.



Where C is the set of countries and N_c is the population of Country c. Given we can never observe the necessary counterfactual, we consider two alternatives:

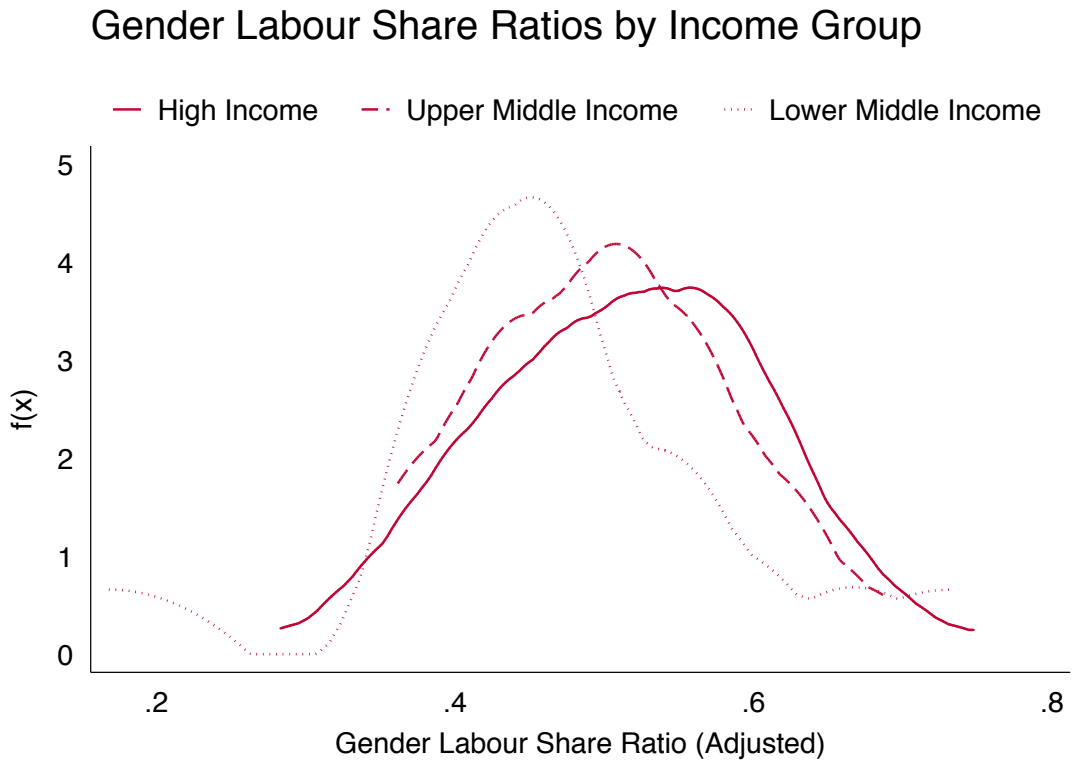
$$\tilde{\rho}_W^S = \frac{\sum_{c \in C} \frac{N_c}{N} \sum_{s \in S} \frac{N_s}{N_C} |1 - \overline{\rho}_s|}{\sum_{c \in C} N_c} \tag{11}$$

And:

$$\tilde{\rho}_W^M = \frac{\sum_{c \in C} \frac{N_c}{N} |1 - \overline{\rho}_C|}{\sum_{c \in C} N_c} \tag{12}$$

Equation 11 calculates the average inequality in country C as the working-age female population weighted average of the labor share ratios in each sector $S \in Agriculture, Industry, Services$. This measure will capture gender inequality across the entire labor force, but as discussed above, will be misleading if differences in hours

Figure 5: Distribution of ρ_H^{E+SE} by Income.



worked and self-employment are important. We thus also compute average inequality based on inequality in the manufacturing sector as in Equation 12. One complicating factor is how to treat those not engaged in market-work. It may well be that those who are not engaged in market-based labor would receive a lower than average share of valued-added. The alternatives, given the data available, are either to assign a notional value of ρ to these individuals, or to exclude them and risk under-estimating gender inequality. Here we choose the latter, but note that this will mean our estimates of total inequality are likely to be conservative. A second complicating factor, is that we do not measure the labor share at all for some countries, in some years. In this case we impute the $20th$ percentile of the distribution of country averages. This is again a conservative assumption because the countries that do not collect the necessary data tend to be LDCs and ρ is positively correlated with income. We alternatively use the median, which would imply, implausibly, that countries are missing approximately at random, but the key inferences are unaffected.

Figure 6 plots $\overline{\rho}_S$ and $\overline{\rho}_M$. It is clear that global EGI is increasing. This is

because, whilst the average country demonstrates improving gender inequality over the period, population growth rate differences mean that the average woman lives in an increasingly iniquitous countries. Any suggestion that this difference in the populated weighted and unweighted averages is merely a statistical nicety is dispatched when we consider the results quantitatively. The most straightforward interpretation of $\bar{\rho}$ is that it is the amount of inequality equivalent to a given number of women not being paid at all. Thus in 1970, on the more conservative economy-wide, but unadjusted measure, global inequality was equivalent to 600 million women being unpaid (and the rest receiving the same average labor share as their male equivalents). Comparison with the green line describing the total global population of women reveals that these 600 million women were 60% of the then population of working age women. By 1990, inequality was equivalent to 800 million unpaid women, out of a population of around 1.5 billion. Thus representing an improvement in the percentage but not the aggregate. By the end of our period the number of unpaid women is approaching 1 billion, which is still just under half the total population. On the basis of our preferred manufacturing measure, initial inequality was equivalent to 700 million unpaid women. By 2010 this had risen to $1,200$ million women, or about the entire female population of India and China.

These figures are shocking. Inequality equivalent to a lower bound of 1200 million women working for nothing, is also equivalent to one third of all women working for nothing. These figures are particularly shocking given that they are by construction conservative. Moreover, the over $2,400$ million project increase in global population by 2050 is almost entirely expected to occur in LDCs, particularly in Africa United Nations (2015), suggesting that unless rapid improvements are made in these countries aggregate gender inequality will continue to increase for the foreseeable future.

One potential criticism of these estimates is that they treat women who are not recorded as in the labor force as receiving the same share of their value added as women better recorded. This assumption is a substantive one – differences in the extent or form of labor market activity likely reflect available market opportunities and other forms of gender inequality more than it represents gender differences in

preferences or productivity. To justify this claim, it is instructive to consider two reasons why such an assumption may be seen to lead aggregate inequality being overstated. The first is that women may disproportionately work in sectors where the labor-share is not meaningful or well measured. The second, is that women may not be in the labor force and thus not facing any inequality.

The first reason, is an argument that that for many women inequality may be overstated by the average, measured, labor share. It is based on the observation that particularly in LDCs, women disproportionately work in the home and or in subsistence farming. The claim is then that we overstate inequality when we attribute the average labor share ratio to such women, whose economic activity and thus whose labor share is not well measured, and whose labor share may in fact be higher. Our approach then attributes to women the inequality they would face were they to enter the conventional labor market. To the extent that women are able to choose whether they enter this market, that a substantial number of them do not suggests that their (effective) pay is higher in the subsistence or household sectors. Yet, this would not be true for all of them were inequality lower. Moreover, by repressing moves into other sectors, inequality also holds down average productivity in subsistence agriculture, at a cost to the women working in it.

Moreover, a substantial body of research has demonstrated that these traditionally female jobs tend to be poorly compensated in both absolute and proportionate terms.[14] Thus, it is hard to see that women working in these sectors would choose to do so, for the same reward, in the absence of gender discrimination.

The first reason argued that for many women inequality may be overstated, the second reason argues that it is inappropriate to attribute any inequality at all to women, not participating in the labor market. This argument, that those not in the labor market do not face labor market inequality, is perhaps a tenable philosophical position. But, as an empirical matter the global population of such women of leisure is relatively small. Normally, married women in rich families in rich countries. We conclude then, that are few women, globally, for whom the labor share ratio is

[14]For example, Goldin (2014) shows that this margin of discrimination is still substantial, albeit decreasing, in the US.

irrelevant. Nevertheless, Figure 7 displays the results of deflating our measure by the female labor market participation rate. This is only available from 1990 onwards, and averages around 0.5, with a small increase from 0.49 to 0.53 over the period. Unsurprisingly therefore, measured inequality is now reduced by around one half, and the rate of increase similarly falls. Note, however, that this measure is extremely conservative as it assumes that there is no discrimination for all women who work either in the home or informally. This is contrary to all of the available evidence, and for that reason this measure will systematically understate inequality. Our preferred interpretation is that given there is some ambiguity over the labor share ratio in non-market sectors of the economy this calculation represents the lower bound, given that it is implausible that the unmeasured women have labor share ratios larger than 1.

Labor-market inequality is only one aspect of gender inequality, however, and in the next section we show that our measure is correlated with other dimensions of inequality suggesting that gender inequality, more broadly defined, may also be getting worse not better.

Figure 6: Aggregate Global Gender Inequality

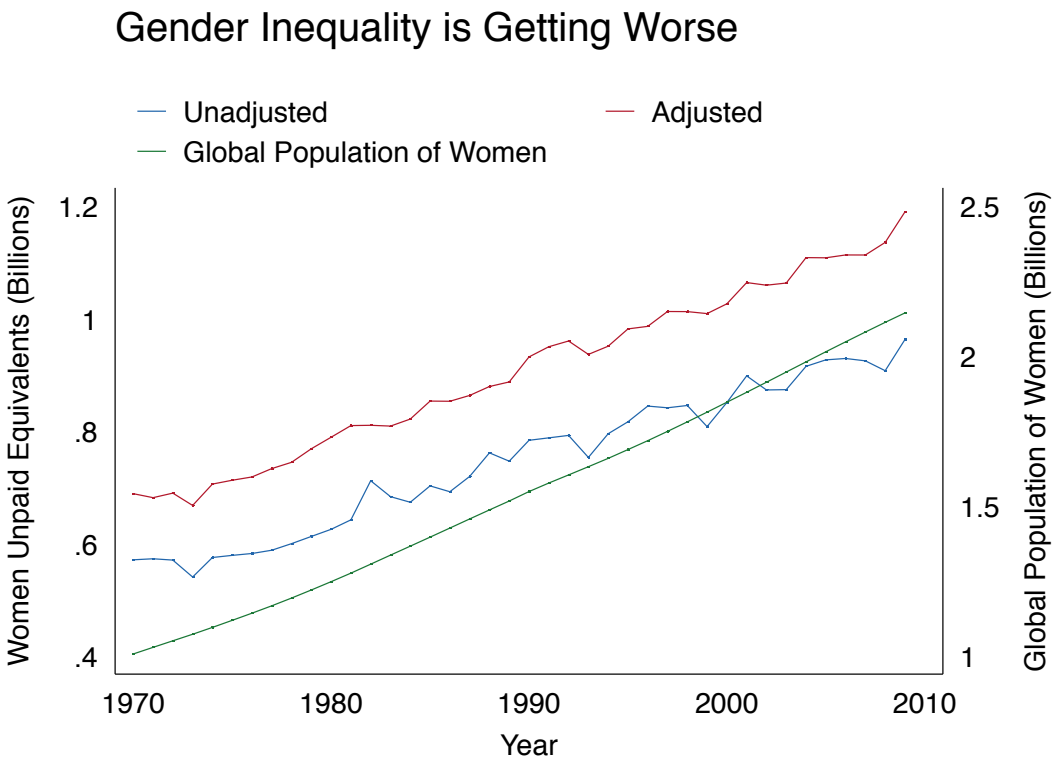
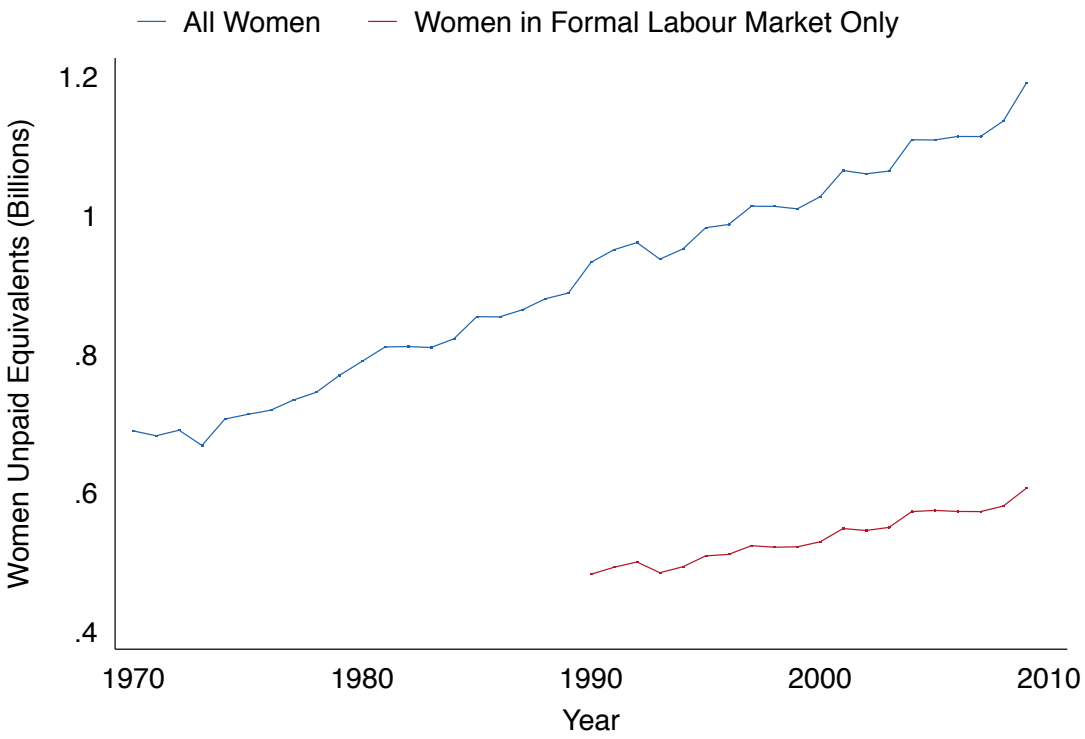


Figure 7: Aggregate Gender Inequality – Adjusting for Female labor Force Participation



4 Causes of Gender Inequality

This section studies the causal determinants of gender inequality. In particular we ask whether increased incomes improve gender inequality, and whether democracy and more specifically the political agency of women lead to reductions in discrimination. These questions are important for at least two reasons. Firstly, if it is the case that increased incomes rapidly lead to improvements in gender equality then this suggests that convergence in income per capita will lead to a rapid reduction in aggregate inequality. Equivalently, it also means that women in the LDCs will benefit substantially from growth. Alternatively, if improvements in living standards alone do not lead to reductions in inequality then this suggests that women will benefit comparatively little from development and that aggregate inequality may continue to rise for the foreseeable future.

A recent and prominent literature has considered how female empowerment may lead to economic development, which may in turn lead to further improvements in Gender Equality. A key issue in this literature is whether such feedback effects between gender empowerment and growth are sufficiently large to give rise to a virtuous circle of increasing women empowerment and increasing growth. Doepke et al. (2012) outline a model in which this takes place, and Fernández (2014) presents theory and evidence that as development takes place men become increasingly concerned about their daughters, leading to greater property rights for women. de la Croix and Vander Donckt (2010) consider how greater equality would lead to lower fertility thus hastening the demographic transition crucial for development. Relatedly, Doepke and Tertilt (2014) consider theoretically the effects of targeting transfers to women on development. Seguino (2000), Blackden et al. (2006) present cross-country evidence that there is a positive relationship between the two. But, Duflo (2012) cautions that the empirical evidence suggests that feedback effects may be insufficient for 'take-off' and that a 'continuous policy commitment to equality for its own sake may be needed'.[15]

[15]A largely separate literature studies the effects of gender equality on growth. Partly due to limited data availability, much of it has focused on the effects of educational inequality on growth Klasen (2002), Lorgelly (2010) but Dollar et al. (1999), Klasen and Lamanna (2009) do find that gender differences in labor market participation also retard growth. Others have studied the effect of trade-liberalization or

A second dimension of development is the expansion of individual rights and political agency. Women in less developed countries often have even fewer rights and less political power as well as in some cases suffering limited physical integrity and various forms of social control. Duflo (2004) studies the random reservation of seats for women on Village Councils in India and finds that increased female political power leads to the greater provision of infrastructure targeted at women. Bhalotra and Clots-Figueras (2014) find that increased political power of women leads to improved health outcomes, while Bhalotra and Rawlings (2011) show that gender inequality in investments in the health of women and girls is a key margin for the inter-generational transmission of health. We do not study these dimensions directly but as can easily be seen in Figure 8, which compares ρ with the Gender Empowerment Measure of the UN employed by Doepke et al. (2012), there is a strong positive correlation between labor market inequality and other dimensions of gender inequality. Doepke et al. (2012) show that whilst the slope describing the relationship between GEM (or several disaggregated measures) and per capita incomes is positive it 'is not very steep, in particular when moving from middle-income to low-income countries.' Considering Figure 9 we can see that this is similarly true for labor market discrimination.

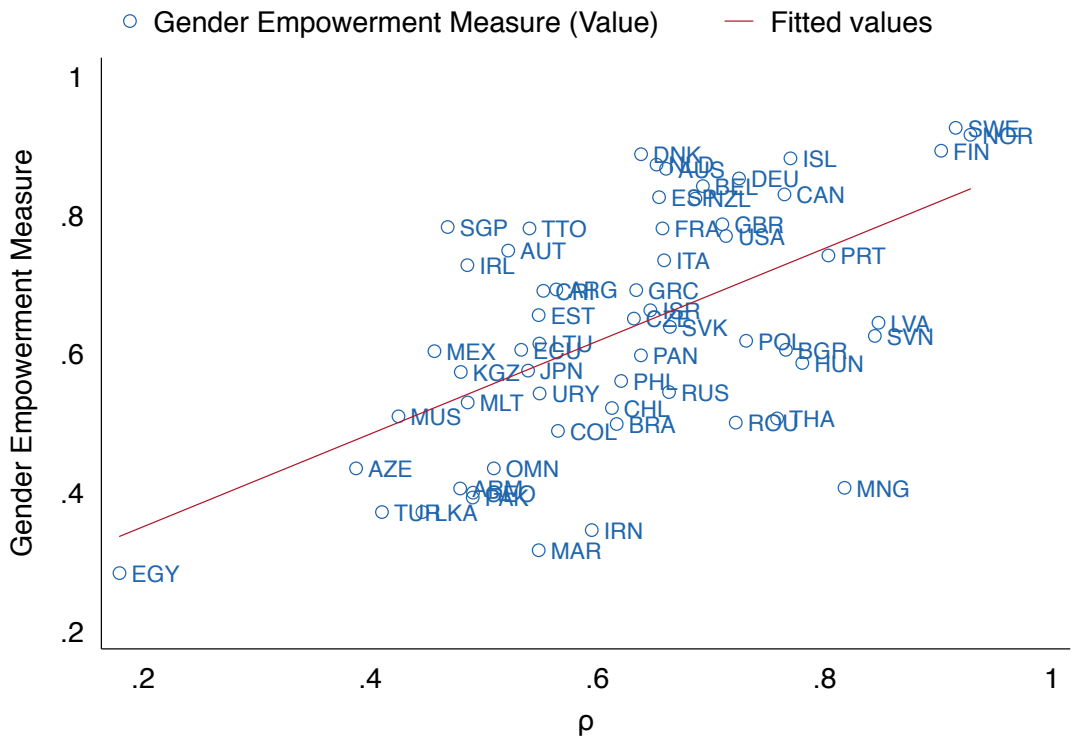
We build on this work by providing a causal analysis of the effects of income, y_{it} on gender-equality over the long-term. We also compare the importance of democracy, D_{it} versus women's political rights and agency more specifically, W_{it}. We assume the population relationship is linear. Then we have:

$$\rho_{it} = \beta y_{it} + \gamma D_{it} + \omega W_{it} + \lambda X'_{it} + \epsilon_{it} \tag{13}$$

There is also, given the literature discussed above every reason to believe that y_{it} will be endogenous and we thus employ an instrumental variable approach. The basic premise of our IV strategy is to use external macroeconomic shocks which cannot be plausibly driven by domestic changes in gender equality. We measure these shocks with four different variables. The first is the gravity-weighted average of trading

globalization on gender equality. Oostendorp (2009) finds that growth as well as trade and investment liberalization tend to be correlated with reductions in gender inequality – particularly in poorer countries. Additional evidence is provided by Neumayer and de Soysa (2011), Chen et al. (2013), Potrafke and Ursprung (2012), Cooray and Potrafke (2011), Richards and Gelleny (2007).

Figure 8: ρ is positively correlated with GEM

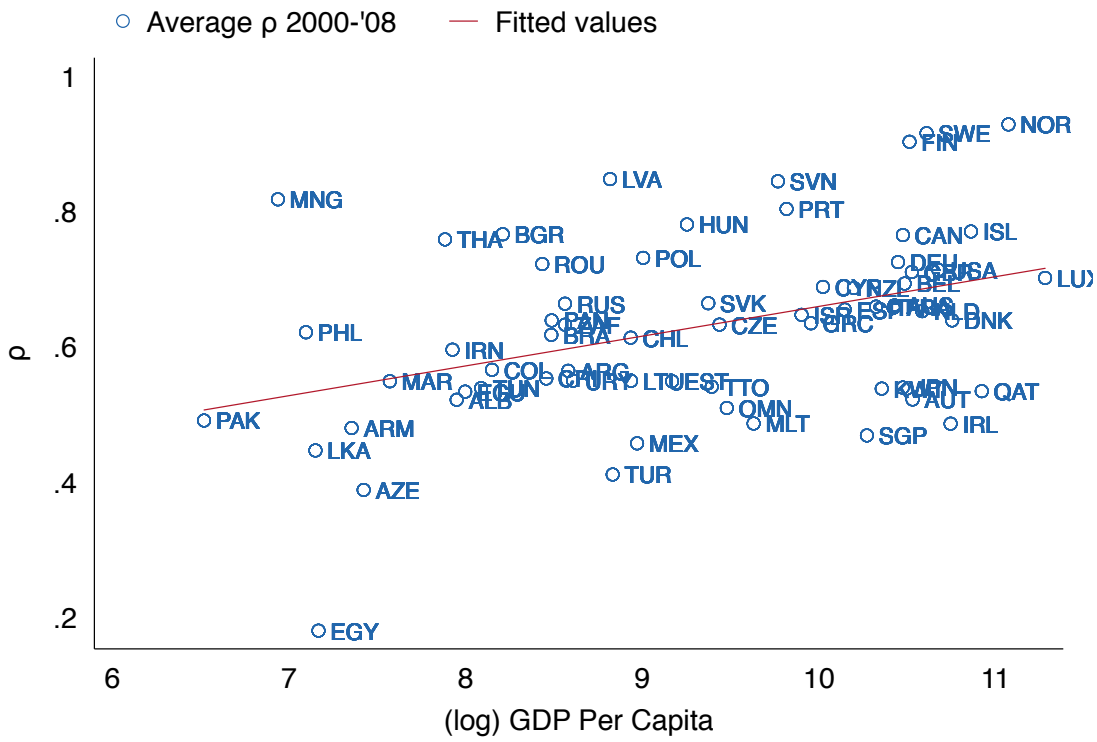


partner GDP growth. To capture better the fact that many developing economies are particularly sensitive to changes in agricultural and mineral commodity prices we construct two indices that capture terms of trade changes based on ex-ante shares of each commodity in trade as in Deaton and Miller (1996). Finally, we use the presence of IMF or WB emergency assistance, which tend to be a response to financial crisis to capture the effects of these shocks. The construction of each of these instruments is described in Appendix C.

We introduce fixed effects to allow for time-invariant country-specific factors that may determine (economic) gender inequality. Given it represents in part a complex-nexus of legal, cultural and socio-economic factors gender inequality tends to only to change slowly.[16] Our specification captures this in two ways. Firstly, we allow for an autoregressive component in the error term. Secondly, to capture the idea that changes in income or democracy might be best conceived as inducing deviations from

[16]For example, Doepke et al. (2012) discuss the slow evolution of women's legal and political rights in the United States and the United Kingdom since the 17^{th} Century.

Figure 9: ρ is positively correlated with Income



this long-run trend we include country specific linear trends.

$$\epsilon_{it} = \phi \rho_{i,t-1} + \mu_i + \tau_i t + \psi_{it} \tag{14}$$

Where we will assume, for now, that $\psi_{it} \sim N(0, \Sigma)$ with Σ clustered by country. The need to include fixed effects, μ_i, means that our estimates of ϕ will be biased and thus so will our other parameters. However, on average we have around 19 observations per country and thus we expect the Nickell bias to be of the order $1/19$. We prefer this to the alternative of GMM estimation. However, in Table D.3 we employ the strategy of Acemoglu et al. (2015) and show a range of unbiased estimates obtained by fixing ϕ to a range of values.

Our key assumption is that Democracy, or more precisely democratization, is exogenous. Given that we include country-specific trends and fixed effects this is equivalent to an assumption that the precise timing of democratization, is essentially random. In fact, the difficulty of predicting episodes of democratization is by now

well-established.[17]

Our initial specification is deliberately parsimonious. Whilst, including additional controls might improve the precision of our estimates, if we include other variables that might also be driven by income or democracy on the right-hand side then we will again have an endogeneity problem.[18] This precludes including in our main regression other potential determinants of gender equality that have been discussed in the literature, such as Globalization and Trade or Financial Liberalization (see, Oostendorp, 2009, Potrafke and Ursprung, 2012), as there are good reasons to imagine these may well be endogenous to income and democracy. However, once we have established consistent estimates of the effects of income and democracy we then, include measures of a number of proximate causes and related outcomes, such as Globalization in Table 2.

We begin by estimating a restricted specification in which we omit Democracy, and constrain the set of time trends, τ_i to be equal to zero. We also ignore, for now, concerns about endogeneity and report simple OLS estimates. These results are reported in the first column of Table 1. We see that ϕ is positive and significant, and with a coefficient of nearly 0.7 suggesting substantial persistence in gender inequality. The coefficient on (log) GDP per Capita is also significant and precisely estimated, but is perhaps surprisingly small at 0.028. This coefficient implies that a tripling of income per capita will lead to only a long run effect 9% increase in ρ.[19] Column 2 reports the results now including country specific linear time trends. ϕ is now smaller, as should be expected, but still significant. β the coefficient on income is also slightly smaller. One, interpretation of these results is that they reflect the very slow progress made in virtually every country over the period we study. This slow progress is also reflected by the lack of any estimated impact of either the overall quality of democracy, or female political empowerment In both cases, the associated coefficients are small, negative, and imprecise. These two aspects of democracy are proxied using indices taken from the dataset produced by the V-Dem project Coppedge et al. (2016) which represents a

[17] For example, Chenoweth and Ulfelder (2015) notes the limited forecasting ability of explanations that emphasize the structure of society rather than the agencies of particular actors.

[18] This is the so-called *Bad Control* problem.

[19] The long-run effect is given by $\beta/(1-\phi)$.

new-standard in the measurement of different aspects of democracy, on a comparable basis, over time.[20]

Columns 5-8 of Table 1 relax the assumption that growth is exogenous. Columns 5 and 6 excludes the unit-specific trends, and whilst there is still no evidence for any effect of democracy or women's political empowerment, the coefficient on GDP per capita is now over 50% larger. Columns 7 and 8 now include the trends, and now the estimated coefficient is substantially larger, at 0.13 and 0.17 respectively. This implies a long run effect of $0.173/(1-0.442) = 0.31$ implying that a tripling of income would be sufficient to raise ρ from approximately 0.4 as in Pakistan, Mexico, or Turkey, to close to 1 as in Norway, Sweden, or Finland. Such an increase in living standards would obviously take time, but unlike the OLS coefficients these suggest that improvements in income alone could lead to wholesale improvements in women's lot. These results are robust to a wide range of alternative choices of instruments and measures of democracy and female empowerment, as can be seen in Tables D.1 and D.2 in the Appendix.

To understand the mechanisms through which income growth leads to improvements in labor market gender equity we now augment our specification with a variety of potentially endogenous controls. These estimates are likely biased, but nevertheless may be informative about the channels through which rising living standards affect gender equality. We begin by studying the role of Globalization, using the KOF index, as in (Potrafke and Ursprung, 2012) . The estimated coefficient is small and imprecisely measured, suggesting that Globalization is not associated with EGI, as captured by our measure. Table D.4 in the Appendix reports results for each of the sub-indices of the KOF Index. The key result here is that the coefficient on actual flows in the first column, which capture the Trade and Foreign Direct Investment flows studied by Oostendorp (2009), is (whilst small) positive and significant contrary to Oostendorp (2009) findings. Similarly, the coefficient on restrictions to these flows in the second column is negative and significant, but still small. A natural interpretation of these three results is that trade and investment flows are positive for gender equality, but

[20]The V-Dem project augments coding by a large number of individual country and period experts, with anchoring vignettes and a Bayesian measurement model to produce extremely detailed, comparable, and reproducible estimates of the nature of democracy in specific countries and years.

other aspects of globalization are relatively unimportant.[21]

One much debated policy available to governments, and historically encouraged by multilateral organizations is financial reform or liberalization. Columns 2 and 3 report specifications including the indices proposed by Chinn and Ito (2006) and Abiad et al. (2010) which both suggest that financial reform is associated with worsening EGI, other things equal, although only the latter measure is significant. The results in Table D.5 in the Appendix suggest that pro-competition reforms, privatization, and international capital flows are those aspects of financial reform associated with worsening EGI. Columns 4 and 5 consider whether women suffer unequally from recessions, or benefit particularly from booms. However, there is no distinct effect of a recession (defined as growth of less than -2%), and while the coefficients on (log) per capita income and its square in column 5 are consistent with a quadratic relationship in column 5, only the quadratic term is significant and we can not reject the hypothesis that the two coefficients are equal. Interestingly, however, as reported in column 1 of Table D.6 in the Appendix, in this specification the Women's political empowerment index is now significant. This may reflect the increasing importance of women's political rights at higher levels of income.

As discussed above, one argument that has been made in the literature is that EGI might promote the growth of the manufacturing sector and exports. Columns 6 and 7 thus include the gender imbalance in the manufacturing and service sectors (the ratio of female to male employees in these sectors), but no evidence is found of any effect.

Finally, columns 8 and 9 report the results of including measures of reproductive and education equality. As discussed above, women's control of their own fertility is an important dimension of gender equality, but reduced fertility also reduces the number of children that need to be cared for, a burden often disproportionately borne by women. We thus use the fraction of the working-age population as a statistic which reflects both the recent history of fertility rates and the burden of child care.[22]. The estimated coefficient is negative as expected, and precise. It is however, in common with many of our other estimates, relatively small. A decrease in the dependency rate

[21] Two of the other coefficients are significant, they both have the opposite sign expected, and in every case they are very small.

[22] It also reflects the burdens of care for older people which also tends to fall largely on women.

of 10% is only associated with an increase in gender equality of 0.0002%. Column 2 of Table D.6 shows that the same effect is found considering only the crude birth rate.

In column 9 we consider another key dimension of gender equality, education. Taking the ratio of female to male primary enrollment as our measure we find no effect. However, this may be because of the substantial lags between primary education and entry into the workforce. Columns 3-9 of Table D.6 report results using range of other measures of gender inequality in education and whilst we find significant coefficients associated with (the ratio of) expected years of schooling and tertiary education, these are not of the expected sign likely reflecting endogeneity bias.

Table 1: Effects of Income and Democratization on Economic Gender Inequality

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\rho_{i,t-1}$	0.695***	0.472***	0.482***	0.466***	0.672***	0.665***	0.454***	0.442***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
(log) GDP per Capita	0.028***	0.022***	0.019**		0.035***	0.036***	0.131**	0.173**
	(0.000)	(0.009)	(0.024)		(0.000)	(0.002)	(0.011)	(0.029)
Electoral Democracy			−0.011		0.005		0.003	
			(0.198)		(0.333)		(0.809)	
Women's Political Empowerment				−0.007		0.008		0.062
				(0.694)		(0.631)		(0.113)
Estimator	OLS	OLS	OLS	OLS	IV	IV	IV	IV
Trends	No	Yes	Yes	Yes	No	No	Yes	Yes
Observations	1324	1324	1259	1319	1184	1158	1184	1158
R^2	0.686	0.222	0.233	0.210	0.689	0.688	0.135	0.049
Kleibergen-Paap p-value					0.00	0.00	0.00	0.00
Hansen J p-value					0.04	0.05	0.30	0.26

The dependent variable is $\rho_{i,t-1}$, the ratio of the female to male labor share ratio in country i and year t. $\rho_{i,t-1}$ is its first lag. *(log) GDP per capita* is the natural logarithm of per capita GDP (PPP). *Electoral Democracy Index* and *Women political empowerment index* are both taken from the V-DEM project Coppedge et al. (2016). Both indices take values in the interval 0 to 1 with higher values representing a greater degree of democracy and female political empowerment respectively. Columns 1 - 4 report OLS estimates. Columns 5 - 8 report IV estimates using the (lag) gravity weighted trade shocks, agricultural and mineral commodity price shocks, and IMF/WB interventions. All specifications include fixed effects. Columns 2,3,4,7, and 8 additionally include country specific linear time trends.

* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors, clustered by country, in parentheses.

Table 2: Mechanisms through which Income and Democratization affect Economic Gender Inequality

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(log) GDP per Capita	0.118**	0.140***	0.144**	0.124*	−0.529	0.144**	0.148**	0.135***	0.100*
	(0.015)	(0.005)	(0.044)	(0.058)	(0.133)	(0.021)	(0.019)	(0.005)	(0.051)
$\rho_{i,t-1}$	0.444***	0.441***	0.432***	0.449***	0.420***	0.443***	0.442***	0.446***	0.466***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
KOF Globalization	−0.000								
	(0.205)								
Chinn-Ito		−0.007							
		(0.107)							
Financial Reform			−0.015**						
			(0.020)						
Recession				−0.000					
				(0.992)					
(log) GDP per Capita^2					0.040*				
					(0.065)				
Ratio Women Industry						−0.000			
						(0.986)			
Ratio Women Services							−0.004		
							(0.545)		
Share Population 15-64								−0.002**	
								(0.021)	
Ratio Girl Primary Enrollment									−0.000
									(0.858)
Estimator	IV	IV	IV	IV	IV	IV	IV	IV	IV
Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1229	1221	967	1241	1241	950	950	1241	1087
Kleibergen-Paap p-value	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00
Hansen J p-value	0.32	0.27	0.51	0.11	0.91	0.25	0.22	0.44	0.34

KOF Globalization Index is the overall measure compiled by Dreher et al. (2008). The *Chinn-Ito Index* measures capital account openness and is normalized to take values between 0 and 1 and taken from Chinn and Ito (2006). The *Financial-Reform Index*, again normalized, is from Abiad et al. (2010) and summarizes seven different aspects of financial repression. *Recession* is defined as growth of as growth of less than -2% in a given year. *Ratio Women Industry* is the ratio of female to male employees in the Industrial Sector. *Ratio Women Services* is the equivalent for the Service Sector. *Share Population* $15-64$ is the percentage of the population aged $15-64$. *Ratio Girl Primary Enrollment* is the ratio of girls to boys enrolled in primary school. All other details as for Table 1.

5 Conclusion

This paper has presented a new approach to measuring EGI based on the ratio women's share of national labor income to men's. This approach corresponds precisely to the combination of the concepts of equal pay for equal work and equality of opportunity enshrined in international treaties. The resulting data are also easily compared across time and place, and we are thus able to provide new evidence about EGI varies across countries and how it has evolved over time. We find that gender inequality, 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 $1,200$ million 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.

The factor shares approach also provides data for around 70 countries for up to 40 years. We use these data to undertake a causal analysis of whether modernization leads to improvements in EGI or whether improvements in the treatment of women in the labor market are driven by a separate process. Our IV estimates suggest that a tripling of incomes would be required to achieve an increase from a labor share ratio of 0.4, typical of many middle-income countries, to equality. We also find little evidence of any effect of democratization or the political power of women. Other results suggest that whilst free-trade improves women's status, financial liberalization achieves the opposite.

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A Do labor share ratios measure inequality?

Our argument is that imperfect competition in labor and product markets mean that workers of both genders must bargain over their share of output. The extent to which male workers received more, *ceteris paribus*, reflects differences in the relative bargaining strength of men and women. Our argument is similar to that of Rodrik

(1999) who argues that, in part, differences in the labor share across countries reflect differences in the relative bargaining strength of workers rather than cross-national differences in production technologies. Similarly, we now discuss, why in our context, differences in the technology of production can not explain gender differences in factor shares.

The most immediate implication of (3) is that since it deals in factor *shares* any differences in output between men and women are allowed for. This in turn implies that any deviations from $\rho = 1$ in a competitive economy, if they do not represent discrimination, reflect differences in the technology of production. But, such an argument is hard to sustain. To see this consider the case where $v(\theta)$ is a simple Cobb-Douglas production function with inputs of labor, capital, and human capital, so $\theta_i = \{H_i, L_i, K_i\}$. Then $v(\theta_i) = A_i L_i^{\alpha_i} H_i^{\beta_i} K_i^{1-\alpha_i-\beta_i}$ where we assume constant returns so $\alpha_i + \beta_i = 1$. Then, the return to labor and the human capital embodied in it is $\lambda_i = \alpha_i + \beta_i$ and $w_i = (\alpha_i + \beta_i v(\theta_i))$. Defining α_M and α_F as the average return to labor for men and women, and similarly β_F and β_M then we can write the labor share ratio as $\rho = \frac{\alpha_F + \alpha_M}{\alpha_M + \alpha_F}$. Thus, if lower female labor shares are argued to be due to $\alpha_M + \beta_M > \alpha_F + \beta_F$ then we should expect women to have a correspondingly higher exponent on Capital and thus, in a competitive economy, to be concentrated in capital intensive roles. This is both at odds with casual empiricism and more importantly the micro-econometric evidence, such as that in Arai (2003).

In our data, human capital will be conflated with labor. But, again, any argument that the male labor share is higher because men for some reason make better use of human capital is contradicted by the empirical evidence (see, Pitt et al., 2012) and moreover would imply that capital intensity should be lower. If the argument is more plausibly that men often have higher levels of human capital due to parental decisions and institutional factors then this is adjusted for by our focus on the labor share ratio. This argument can easily be extended to other constant returns production functions.

Thus, an argument that differences in labor shares are argued to reflect differences production technology must now be an argument that the returns to scale in female production are lower than that from male production. Why this might be is not obvious, but given that estimates of the returns to scale in the overall economy are normally

close to unity (see, Basu and Fernald, 1997) this implies that women have decreasing returns to scale and men increasing returns. Such a claim not only embodies extremely strong assumptions about differences in production between men and women, but also has odd implications for the economy as a whole. For example, it would imply that in the richest economies men are increasingly comparatively productive compared to women yet this is the opposite of what we find in our data.

A more subtle argument is that it is not that men's and women's production functions are different, but instead that differences in preferences mean that they tend to work in different sectors of the economy and differences in the labor share reflect this. However, were this to be true, it again would require that women to work in more capital intensive sectors. Moreover, we find a similar pattern of EGI across all sectors of the economy but we will also present estimates for the manufacturing sector only to address this concern.

A yet more subtle argument is that the economy lacks factors of production. But that scarce capital is unequally distributed again reflects differences in gender bargaining power, not efficiency. This is borne out by the evidence provided by Udry (1996) who shows that variable inputs are inefficiently allocated in favor of men when they controlled production within agricultural households. In particular, Udry (1996) provides evidence that differences in gender productivity are due to non-Pareto efficient allocations of fertilizer and labor. Finally, we provide an empirical argument that suggests that even when we compare service sectors, there still remain substantial differences in ρ across countries and almost always $\rho < 1$. However, allocation of capital on the basis of gender rather than efficiency is precisely labor market discrimination.

An alternative approach would be to consider a directed search model of the labor market in which there may be gender differences in preferences. For example, if women were assumed to be more risk-averse (on average) then this would imply that the average wage of women might be lower as they would be more likely take lower paying jobs rather than risk unemployment. However, were this to be true, other things equal, observed unemployment for women would be lower. In fact as documented by Azmat et al. (2006), Olivetti and Petrongolo (2008), unemployment

rates are normally substantially higher for women.

B Labor Share Data

The dataset is a country level panel taken from three major sources International labor Organization (ILO) and United Nations System of National Accounts (SNA) and United Nations Industrial Development Organization(UNIDO). We use the SNA to reproduce and extend the Gollin (2002) labor share calculations. We use the ILO and UNIDO data to calculate the hours of work adjusted labor share of the total economy and the manufacturing sector. All of these variables are disaggregated by gender except wages and salaries which, for the are substituted by earning per month data from ILO.

C Construction of Instrumental Variables

The analysis of whether economic growth and democratization lead to improvements in gender equality, and how rapidly, in Section 4 employs four instrumental variables. The first is a gravity-weighted trade shock measure. The second and third measure terms of trade shocks via changes in the prices of commodity imports and exports for agricultural and mineral commodities respectively. The final instrument proxies for financial crises using IMF or World-Bank crisis-interventions. We now outline the construction of these variables in turn.

Gravity

We estimate a standard Trade-Gravity model of the form:

$$T_{ijt} = \alpha_0 Y_{it}^{\alpha_1} Y_{jt}^{\alpha_2} D_{ijt}^{\alpha_3} e^{\theta_i d_i + \theta_j d_j} \tag{15}$$

Where Y_{it} and Y_{ij} are the GDPs of countries i and j in year t. D_{ijt} is a vector containing measures of the 'distance', broadly conceived, between i and j in year t. In our case this includes whether the countries are contiguous, share a common language, colonial history, currently colonial relationship, common legal system, a

common currency, are members of the same regional trade agreement, and whether the origin or destination country are members of GATT, and their respective GDP per capita. d_i and d_j are fixed-effects for the origin and destination countries respectively. These capture other, unmeasured, country characteristics that may cause them to export a particularly large or small amount.

Using the data used by Head et al. (2010) we estimate (15) using the Poisson pseudo Maximum Likelihood estimator proposed by Silva and Tenreyro (2006). We then obtain predicted flows for each pair of countries for each year. Our instrument is then:

$$S_{it} = \sum_j \widehat{T_{ijt}} \times \Delta Y_{jt} \tag{16}$$

Commodities

Our commodity price shock instruments, follow the approach of Deaton and Miller (1996) are given by the product of changes in the global price for each commodity in a given year multiplied by the share of that commodity in a country's trade in a fixed year. By fixing a year, we are able to rule out changes in the composition of the economy in response to price shocks. We use the year 2000 as our fixed year.

$$C_{it} = \sum_c \Delta P_{ct} \times X_{c,2000} \tag{17}$$

The data on commodity prices and trade are taken from COMTRADE.

Crises

Our crisis instrument, is based on the data of Boockmann and Dreher (2003) and Dreher (2006), and is defined as the total number of World Bank projects and IMF Arrangements agreed or in effect in a particular year.

D Additional Tables

Table D.1: Effects of Income and Democratization on labor Market Gender Inequality, Alternative Instruments

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(log) GDP per Capita	0.127**	0.173**	0.654	0.564	0.121*	0.149	0.127**	0.272*	0.297*
	(0.030)	(0.029)	(0.231)	(0.161)	(0.080)	(0.227)	(0.030)	(0.056)	(0.064)
$\rho_{i,t-1}$	0.457***	0.442***	0.308*	0.312**	0.459***	0.452***	0.457***	0.410***	0.416***
	(0.000)	(0.000)	(0.089)	(0.036)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Women's Political Empowerment	0.042	0.062	0.247	0.216	0.040	0.050	0.042	0.101	0.109
	(0.170)	(0.113)	(0.272)	(0.199)	(0.234)	(0.321)	(0.170)	(0.104)	(0.115)
Estimator	IV	IV	IV	IV	IV	IV	IV	IV	IV
Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments	Gravity, Commodities, Crises	Gravity, Commodities, Crises	Gravity	Lag Gravity	Commodities	Crises	Commodities, Crises	Lag Gravity, Crises	Gravity, Crises
Observations	1233	1158	1116	1158	1233	1233	1233	1158	1116
Kleibergen-Paap p-value	0.00	0.00	0.22	0.12	0.00	0.01	0.00	0.03	0.05
Hansen J p-value	0.55	0.26			0.27		0.55	0.25	0.26

Specifications are all identical except for different instrument sets. *Commodities* refers to the agricultural and mineral commodity shock instruments. *Gravity* refers to the gravity-weighted trade shock instrument. *Lag Gravity* refers to the first-lag of *Gravity*. *Crises* refers to the IMF or World-Bank intervention instrument.All other details as for Table 1.

Table D.2: Effects of Income and Democratization on labor Market Gender Inequality, Other Measures of Democracy and Female Empowerment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(log) GDP per Capita	0.174**	0.137**	0.139**	0.161**	0.132**	0.131**	0.130**	0.132**	0.083	0.090
	(0.027)	(0.011)	(0.011)	(0.022)	(0.011)	(0.011)	(0.011)	(0.011)	(0.387)	(0.336)
$\rho_{i,t-1}$	0.442***	0.454***	0.452***	0.443***	0.454***	0.453***	0.454***	0.454***	0.247***	0.249***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Women's Political Empowerment	0.059									
	(0.119)									
Electoral Democracy	0.003									
	(0.882)									
Women's civil liberties		0.026								
		(0.178)								
Women's civil society participation			0.014							
			(0.351)							
Women's political participation				0.018						
				(0.326)						
Egalitarian democracy					0.008					
					(0.673)					
Deliberative democracy						0.001				
						(0.929)				
Participatory democracy							0.002			
							(0.909)			
Liberal democracy								0.005		
								(0.733)		
Share Women Lower House									0.000	
									(0.443)	
Share Women Upper House										0.000
										(0.557)
Estimator	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV
Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1158	1184	1184	1158	1184	1184	1184	1184	625	617
Kleibergen-Paap p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hansen J p-value	0.27	0.26	0.27	0.33	0.30	0.30	0.30	0.30	0.09	0.08

Columns 1-8 report alternative dimensions of democracy contained in the V-Dem data (Coppedge et al., 2016) Columns 9 and 10 report the proportion of seats in the lower and upper houses of the legislature held by women. These data are taken from the Inter-Parliamentary Union http://www.ipu.org/wmn-e/world.htm. All other details as for Table 1.

Table D.3: Effects of Income and Democratization on labor Market Gender Inequality, Assuming Different Values of ϕ

	$\rho = 0$	$\rho = 0.25$	$\rho = 0.5$	$\rho = 0.75$	$\rho = 1$	$\rho = 0$	$\rho = 0.25$	$\rho = 0.5$	$\rho = 0.75$	$\rho = 1$
(log) GDP per Capita	0.119***	0.088***	0.057***	0.026***	0.005	0.348***	0.249***	0.150**	0.051	−0.048
	(0.000)	(0.000)	(0.000)	(0.000)	(0.424)	(0.001)	(0.002)	(0.020)	(0.401)	(0.504)
Women's Political Empowerment	−0.010	−0.004	0.002	0.009	0.015	0.118**	0.086**	0.055	0.023	−0.008
	(0.670)	(0.843)	(0.882)	(0.563)	(0.352)	(0.030)	(0.045)	(0.111)	(0.451)	(0.815)
Estimator	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV
Trends	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Observations	1158	1158	1158	1158	1158	1158	1158	1158	1158	1158
Kleibergen-Paap p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hansen J p-value	0.10	0.06	0.05	0.06	0.15	0.29	0.30	0.25	0.14	0.08

Each column reports a different assumed value of the AR(1) coefficient ϕ. Columns 1-5 do not include country specific trends. Columns 6-10 do. All other details as for Table 1.

Table D.4: Effects of Income and Democratization on labor Market Gender Inequality, Other Measures of Globalization

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lngdppc	0.124***	0.123**	0.111***	0.117**	0.123**	0.127***	0.117**	0.128***
	(0.009)	(0.010)	(0.010)	(0.018)	(0.010)	(0.009)	(0.017)	(0.008)
L. Labour Share Ratio Unadjusted	0.445***	0.450***	0.440***	0.444***	0.443***	0.442***	0.450***	0.447***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Economic Globalization	−0.000							
	(0.343)							
Actual Flows		0.000**						
		(0.033)						
Restrictions			−0.000***					
			(0.004)					
Social Globalization				−0.000				
				(0.250)				
Personal Contact					−0.001*			
					(0.059)			
Information Flows						−0.000*		
						(0.097)		
Cultural Proximity							−0.000	
							(0.842)	
Political Globalization								−0.000
								(0.697)
Estimator	IV	IV	IV	IV	IV	IV	IV	IV
Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1229	1229	1229	1229	1229	1229	1229	1229
Kleibergen-Paap p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hansen J p-value	0.29	0.17	0.39	0.30	0.14	0.19	0.24	0.25

All variables are sub-components of the KOF index (Dreher et al., 2008) in Table 2. All other details as for Table 1.

Table D.5: Effects of Income and Democratization on labor Market Gender Inequality, Other Measures of Financial Openness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(log) GDP per Capita	0.131*	0.107	0.127*	0.131*	0.146**	0.135*	0.128*	0.148**	0.139**
	(0.068)	(0.114)	(0.081)	(0.059)	(0.037)	(0.053)	(0.071)	(0.038)	(0.049)
$\rho_{i,t-1}$	0.445***	0.492***	0.446***	0.444***	0.431***	0.445***	0.440***	0.429***	0.439***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Directed credit/reserve requirements	0.000								
	(0.864)								
Aggregate Credit Ceilings		0.002							
		(0.555)							
Credit Controls			0.001						
			(0.600)						
Interest rate controls				−0.000					
				(0.782)					
Entry barriers/pro-competition measures					−0.003**				
					(0.014)				
Banking Supervision						0.001			
						(0.644)			
Privatization							−0.004*		
							(0.078)		
International capital flows								−0.003***	
								(0.004)	
Security Markets									−0.002
									(0.258)
Estimator	IV	IV	IV	IV	IV	IV	IV	IV	IV
Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	967	565	967	967	967	967	967	967	967
Kleibergen-Paap p-value	0.03	0.02	0.03	0.02	0.01	0.01	0.02	0.01	0.02
Hansen J p-value	0.25	0.02	0.22	0.29	0.44	0.25	0.18	0.55	0.34

All variables are sub-components of the Financial Reform index (Abiad et al., 2010) in Table 2. All other details as for Table 1.

Table D.6: Effects of Income and Democratization on labor Market Gender Inequality, Other Demographic Controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(log) GDP per Capita	−0.523	0.124**	0.158**	0.177**	0.180*	0.124**	0.100*	0.158**	0.177**
	(0.219)	(0.011)	(0.021)	(0.035)	(0.057)	(0.011)	(0.051)	(0.021)	(0.035)
(log) GDP per Capita^2	0.045*								
	(0.099)								
$\rho_{i,t-1}$	0.401***	0.449***	0.429***	0.428***	0.418***	0.449***	0.466***	0.429***	0.428***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Women's Political Empowerment	0.117**								
	(0.045)								
Crude Birth Rate		−0.001*							
		(0.064)							
Secondary Enrollment Ratio			−0.000						
			(0.676)						
Tertiary Enrollment Ratio				−0.000**					
				(0.021)					
Expected Years of Schooling Ratio					−0.126**				
					(0.022)				
Life Expectancy Ratio						0.093			
						(0.247)			
Primary Enrollment Loss Ratio							−0.007		
							(0.857)		
Secondary Enrollment Loss Ratio								−0.010	
								(0.676)	
Tertiary Enrollment Loss Ratio									−0.030**
									(0.021)
Estimator	IV	IV	IV	IV	IV	IV	IV	IV	IV
Trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1158	1241	984	927	815	1241	1087	984	927
Kleibergen-Paap p-value	0.01	0.00	0.00	0.04	0.08	0.00	0.00	0.00	0.04
Hansen J p-value	0.98	0.16	0.19	0.12	0.03	0.18	0.34	0.19	0.12

Crude Birth Rate is the Crude Birth Rate per $1,000$ people. *Secondary (Tertiary) Enrollment Ratio* is the ratio of girls to boys enrolling in secondary (tertiary) education. *Expected Years of Schooling Ratio* is the ratio of women's to men's expected years of schooling. *Life Expectancy Ratio* is the ratio of women's to men's life expectancies. *Primary Enrollment Loss Ratio* is the ratio of the percentage of girls to the percentage of boys who enroll in primary education but fail to complete it. *Secondary (Tertiary) Enrollment Loss Ratio* is the ratio of the percentage of girls to the percentage of boys who enroll in secondary (tertiary) education but fail to complete it. All other details as for Table 1.