Globalization, Development, and Gender Inequality across the World: A Multivariate Multilevel Approach

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Abstract

This study investigates the links between three indices of gender inequality (gender differences in secondary school enrolment, unemployment, and labor force participation) and measures of globalization and socio-economic development. It uses an innovative approach to standard macro-economic modelling, i.e., multivariate multilevel modelling, allowing a richer analysis of the interdependence among the endogenous variables. The results indicate that both economic development/growth and globalization are significantly related to these variables, alongside demography, liberal democracy and measures of aggregate economic inequality. Gender inequalities, especially in education and unemployment, are associated even after accounting for covariates. Labor force and unemployment gaps are stronger between rather than within countries while the opposite is true for educational differences.

Keywords: Globalization, development, gender inequality, multivariate multilevel models.

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1. Introduction

Analyses of gender economic inequality, and their relation to growth or stages of development and globalization, have increased in recent years (despite their notable absence from the mainstream literature on growth). This no doubt reflects a growing awareness of the issue. Gender inequality in labor markets in particular has received quite a lot of attention over the years. Blau (1987), Altonji and Blank (1999) and Blau and Kahn (2000) provide comprehensive overviews of the literature. But this attention is not equally distributed among the various facets of inequality. There is extensive literature on wage inequality; some literature on differences in participation rates; and little or no literature on differences in unemployment rates. Yet, interest on the last issue in particular is rising, see, for instance, Azmat, Güell and Manning (2004) and Bertola, Blau and Kahn (2002). With notable exceptions reviewed below, there also appears to be a lack of literature on connecting gender inequality with wider aspects of the macroeconomy like development and globalization. Are the patterns in labor market differences among genders so clearly documented by Altonji and Blank (1999) for the US valid over other countries, too? How are those patterns going to be affected by the stage of economic development, the rate of economic progress (growth), and the ubiquitous process of globalization? These are some of the questions on which there is hardly any literature and this paper attempts to address.

There are various potential channels by which development and/or globalization may affect gender inequality (see e.g. the Introduction by Lourdes Benería, Grown, and MacDonald to the special issue of *Feminist Economics* on “Globalization and Gender”, November 2000). One plausible hypothesis may be that the graph of gender (in)equality against globalization and stage of development is humped-shaped: Some international trade openness and prosperity contributes to better prospects for women, as the export-oriented industries may employ a greater proportion of women than elsewhere (the so-called "feminization of labor") and may offer them (relatively) better prospects (see Dollar and Gatti 1999; Berik 2000). At the same time, as Kucera and Milberg (2000) have shown, growing de-industrialization and widening wage differentials between skilled and unskilled have hit women disproportionately in established industrial economies[1]. This argument would suggest the existence of non-linear relations between indices of gender economic inequality and the level of development or the growth rate. A related finding is that wage compression reduces the gender wage gap, because it is primarily women at the bottom of the wage distribution that benefit (Blau and Kahn 2003). Finally, to the extent that there is occupational segregation, and to the extent that globalization or development have sector-specific effects, gender differences may also be implied.

A number of empirical papers focus on country studies (Blecker and Seguino 2002; Lovell 2000; Luzzi and Silber 1998; Pagan and Ullibarri 2000; Seguino 1997). These country studies appear to offer mixed evidence on how globalization or development affect gender inequality (see, e.g., the review by Lourdes Benería, Grown and MacDonald 2000).

In this paper, we investigate empirically the determinants of key indicators of gender economic inequality across 68 countries, to our knowledge the largest pool in the relevant literature[2], over the last 20 years or so, with particular emphasis on globalization and development/growth. The study focuses on the least well-explored aspects of gender inequality, i.e., gender differences in labor force participation, in unemployment rate and in education (see below for more details on the variables). These variables are important in their own right but also as indicators of economic participation, exclusion and human capital formation, respectively[3]. They are thus closely related. Gender gaps in unemployment and labor force participation are linked at least because unemployment discourages participation in the labor force but also because the massive increase in women's participation rates over the last 50 years (Altonji and Blank 1999) may not have been accommodated smoothly. Net enrolment in secondary education is, aside from being an indicator of gender differences in its own right, an important covariate for unemployment and participation rates. Indeed, existing literature suggests human capital to be one of the main explanatory variables in labor market outcomes, particularly rates of pay and labor market flows (Azmat, Güell and Manning 2004)[4]. Apart from these direct connections gender inequalities may be related indirectly via their individual associations with the state of the economy and other common variables. Accounting for factors, which are related with each gender gap individually, would shed light on the true extent of their immediate connection. Thus gender inequalities may relate directly or via mediated associations with economic, demographic and other covariates.

These associations between gender inequalities are acknowledged and investigated in this study via a multivariate (i.e., multiple dependent variables) statistical specification. In particular the multivariate hierarchical or multilevel model (Goldstein 1995; Snijders and Bosker 1999) is employed. This statistical specification allows the joint analysis of the effects of explanatory variables on associated endogenous variables, here gender gaps, and estimates any residual correlation between outcomes. Thus, it is implicitly assumed that the errors associated with each gender inequality are correlated across regressions, making this method a panel-data counterpart to the SURE single-equation estimation: Accounting for this correlation between errors is an advantage over panel data methods. The method does not require full data on each response variable, which presents another advantage over standard panel data techniques (Maas and Snijders 2003), especially for the large set of countries and time span of this study. The relationships are investigated over time, across countries and geographical regions. Thus the statistical specification employs three levels of analysis thereby the residual correlations of gender gaps within or between countries or regions are estimated.

The focus of the paper is on development and globalization as correlates of gender gaps, an area on which existing evidence is rather inconclusive, as suggested above. A number of empirically suggested or intuitive controls, such as demography, income or political inequality and total unemployment, are also included in the set of covariates.

To recapitulate, the following research questions are investigated in this paper:

- Are gender gaps in human capital, unemployment rate and labor force participation intrinsically associated, and, if so, at what level of aggregation?
- Is their association, if any, mediated by economic, demographic and other factors and, if so, to what extent?
- Have development and globalization affected gender gaps?

As mentioned, these issues are explored using a large panel of data via an innovative (in this field) methodology, i.e., the multivariate hierarchical specification. The state of play on the theory front is arguably not advanced enough to offer any more specific testable theoretical hypotheses. Thus, the paper is an empirical socio-macroeconomic exploration only vaguely guided by theory, as is often the case.

Whether gender differences as captured by our three variables of interest genuinely reflect gender bias and discrimination or are simply a reflection of underlying individual choices is outside the scope of this work. Thus the term 'inequality' is here employed in the most general of senses to portray 'unequal outcomes'. Genders may differ in their labor force participation rates because of choices over childcare as well as cultural and other pressures and norms. This distinction is however less relevant for two out of the three variables of interest, namely differences in unemployment and school enrolment rates, where the role of individual choice in shaping the uneven outcomes is highly unlikely.

2. Data

In order to empirically investigate gender inequalities across countries and over time the following three indicators are employed:

- *Gender differences in educational attainment* are measured as girls enrolled in secondary education over girls of secondary school age minus the counterpart boys' ratio (see Barro and Lee 1993, 1996). This variable represents women's relative human capital.
- *Female minus male unemployment rates* are unemployed females over female labor force minus unemployed males over male labor force. This difference is arguably a reflection of gender differences in social exclusion.
- *Female minus male labor force participation rates* are calculated as economically active females over female population of working age minus the counterpart male ratio. This may represent an individual's choice, perhaps especially in industrialized countries, but only partly.

Figures 1 to 3 show the respective distribution of each dependent variable for the set of countries and years examined in this work. Each gender inequality index crudely proxies the super-imposed Gaussian theoretical distribution albeit with varying degrees of skeweness and kurtosis. The gap in human capital is the most symmetrically distributed while gendered social exclusion and labor force participation are positively and negatively distributed, respectively. Perhaps not surprisingly the labor force participation gap is negative across the world. The unit of measurement of each gender inequality is in percentage points. It might be worth noting than a unit increase in unemployment gap signifies a negative outcome for women but the same change in the other two inequality measures here signals positive outcomes.

< Figure 1: Distribution of girls minus boys net enrolment in secondary education>

< Figure 2: Distribution of female minus male unemployment >

< Figure 3: Distribution of female minus male labor force participation >

The data are from various standard sources of macroeconomic variables, such as the International Labor Organization (ILO), the United Nations, etc. These data sources and descriptive statistics can be found in Table 1.

< Table 1: Description of variables >

The two covariates of most interest in this work, i.e., development/growth and globalization, are indicated by the following variables:

- Indices of *economic development* (in its broad sense to encompass also *growth*) include real (in constant 1996 international dollar prices) GDP per capita (in logs) and its growth rate (Sala-i-Martin 1996; Temple 1999). There are no clear arguments in the literature as to whether it is ‘development’ or ‘growth’ that is related to gender differences, so we investigate both; in what follows, we shall use these terms more or less interchangeably. The non-linear hump-shaped relationship between gender inequality and development, which was discussed in the Introduction (see also Caĝatay and Özler 1995; Kucera and Milberg 2000), is investigated via either the square of GDP per capita or its growth rate.
- *Globalization* is indicated by the commonly used ratio of the sum of exports plus imports over real GDP per capita defined as openness; the Sachs and Warner

(1995, 1997) binary indicator of international trade; current account surplus or deficit over GDP as an indicator of international capital mobility (see Obstfeld 1986, 1995); and a ‘post 1989’ dummy variable to capture any additional otherwise unmeasured effects of globalization.

Previous empirical studies have suggested the following as additional control variables:

- Demographic variables, such as the female-to-male population ratio (this may have obvious implications for relative unemployment and participation rates), log-total population (as a measure of scale, see Jones 2005) and population growth rate (which, according to the Solow growth model, is an impediment to living standards).
- Income inequality (Gini coefficient, data from Deininger and Squire 1999) to capture possible inequality effects. In this study, the Gini coefficient refers to the country rather than the country-year combination[5]. In particular, we use the mean value over the period of the analysis of the Gini coefficient per country[6].
- Aggregate unemployment rate - see Bertola, Blau and Kahn (2002). This variate may quite possibly be endogenous (influenced by development in female participation and the gender unemployment rates), and therefore it is instrumented in the empirical analysis below.
- A twenty-one points polity scale to capture levels of autocracy or democratization[7], based on research done at the Center for International Development and Conflict Management, University of Maryland (www.cidcm.umd.edu). See for instance, Gurr and Jaggers 1990; Jaggers and Gurr 1995; Marshall and Jaggers 2003.) It is intuitively plausible that democratic countries encourage female human capital formation and labor force participation.

- Regional effects are of some interest in the theory of growth (Durlauf, Johnson and Temple 2005). Apart from any random between regions variation of gender gaps regional effects are investigated via two regional dummies, for sub-Saharan Africa and Latin America[8].
- In the models below, time (at centered values) is fitted as a quadratic function for capturing possible average across countries non-linear trends. Therefore the intercept represents predicted overall mean gender differences in 1990.

The data set employed in the empirical models below includes 68 countries (see Appendices A and B Tables) with varying data availability since 1981. South America is the region most represented while South Africa and Melanesia have the least observations in this study. Inevitably most countries with nearly full time series come from the industrialized world (58.6%). Indeed just over one third of the countries in this study (29, to be precise) have 19 or 20 data points. The distribution of years in the sample is roughly uniform ranging from a minimum of 2.3% and 3.7% of observations (from 2001 and 1982, respectively) to a maximum of 6% from 1993 (see Appendix B Table). It is possible that countries with incomplete data contribute in the second decade under investigation. Roughly 60% of the observations are post 1989 implying that the scale of this problem is small.

The clustering of annual data points within countries and countries within geographical regions offers a natural 3-level hierarchical structure of the data, i.e. by year, country and region. To explore the associations of gender inequality in various forms (i.e. human capital formation, labor force participation and social exclusion), a fourth (pseudo-) level reflects the multivariate structure of the model (Snijders and Bosker 1999). Thus gender inequalities may be associated in a twofold manner: indirectly, via jointly significant fixed effects of common explanatory variables and controls (as estimated in the fixed part of the model), and intrinsically, via residual (unexplained or unobserved) covariance, which is captured in the random parameters at each level, i.e. time, country and region. The next section discusses the statistical methodology.

3. Statistical Method

The effects of globalization and economic development on gender gaps are jointly estimated via *multivariate multilevel*[9] modelling. Multivariate multilevel models (henceforth MVML, see e.g. Goldstein 1995; Snijders and Bosker 1999; Yang, Goldstein, Browne, and Woodhouse 2002; Griffiths, Brown, and Smith 2004) have mostly (but not exclusively) been applied to repeated measures data. They account for the unexplained covariance between response variables, here, for instance, gender gaps in educational attainment, unemployment and labor force participation. As a result, the MVML approach allows estimating the proportion of their interdependence that is explained by globalization, development and controls.

Multilevel or hierarchical modelling is arguably a more accommodating technique than classic panel data methodologies such as the compound symmetry model or the multivariate analysis of variance (MANOVA, see, for instance, Hsiao 2003; Maas and Snijders 2003)[10]. Indeed, the advantages of this statistical tool are manifold. It "allows incomplete data" in the responses "without any problems" (Maas and Snijders 2003, p. 87) or additional computational cost on the assumption that 'missing-ness' is random[11] (Goldstein 1995). It produces more efficient estimates than single equation estimation and more powerful statistical tests of the estimated (fixed and random) parameters (Maas and Snijders 2003; Snijders and Bosker 1999). It also allows for comparisons and joint significance tests of the fixed effects of the same explanatory on more than one response variables (Snijders and Bosker 1999, pp. 200-1), here two or more gender gaps. The MVML estimates any remaining (unexplained) heteroscedasticity due to grouping, such as region here (Maas and Snijders 2003). This method improves on the earlier-generation multilevel analyses (e.g. Griffiths , Brown and Smith 2004) by the joint analysis of outcomes. It can thus provide a richer investigation of the interactions among variates than standard panel regressions, particularly in the case of simultaneous equations. Below we provide the necessary notation and specify the MVML regression model.

Let Y_{itkr}, $i = 1,2,3$, indicate the three response variables of interest; Y_{1tkr} denotes the gender gap in secondary education, Y_{2tkr} gender differences in unemployment, and Y_{3tkr} differences in labor force participation. Index $r = 1,2,...,16$ denotes geographical region (see Appendix A Table). Index $k = 1,2,...,C_r$ indicates countries in region r, with C_r the total number of countries in the region. Index $t = 1,2,...,T_k$ denotes time measured in years and T_k is the total number of years per country in the sample (see Appendix B Table). A pseudo first level identifies each response variable in the model. Under this notation, Y_{itkr} is the observed value of the *i-th* response variable at time *t* for country *k* that belongs to region *r*. Let $x_{p,tkr}$, $p = 1,2,...,P$, denote each of the *P* covariates included in the analysis, as measured at time t for country *k* belonging to region *r*. β_{0i} is the non-random intercept of the regression equation for the *i-th* response variable and $\beta_{p,i}$, $p = 1,2,...,P$, denotes slope coefficients. As discussed earlier, the statistical specification has a 4-level hierarchical structure, i.e. one for the response variable (*i*), a second for year (*t*), a third for country (*k*) and a fourth for geographical region (*r*). This structure is incorporated in our model by allowing for a random intercept, ε_{0i}, into the regression equation for each response variable (i) consisting of additive random contributions from the hierarchical levels,

$$\varepsilon_{0i} = u_{itkr} + v_{ikr} + e_{ir} \,. \qquad (1)$$

Here u_{itkr} is an inter-year random effect capturing level-2 variation, v_{ikr} is an inter-country random effect capturing level-3 variation, and e_{ir} is an inter-region random effect capturing level-4 variation. The lower level for the response variable (i) simply defines the multivariate structure and does not contribute any extra random variation to the regression model. Each one of these random effects is assumed to follow a convenient multivariate normal distribution as defined in equation (2) below. If we let $z_{sitkr} = \begin{cases} 0, & s \neq i \\ 1, & s = i \end{cases}$, $s, i = 1,2,3$ denote a dummy variable assuming the value 1 when $s = i$ and 0 otherwise, then the MVML model is compactly written as

$$Y_{itkr} = \sum_{s=1}^{3} z_{sitkr} \left(\beta_{0s} + \sum_{p=1}^{P} \beta_{ps} x_{ptkr} + u_{stkr} + v_{skr} + e_{sr} \right)$$

$$\begin{aligned}
&(u_{1tkr}, u_{2tkr}, u_{3tkr})^T \sim MVN(0, \Omega_u), \quad \{\Omega_u\}_{si} = \text{cov}(u_{stkr}, u_{itkr}), \\
&(v_{1kr}, v_{2kr}, v_{3kr})^T \sim MVN(0, \Omega_v), \quad \{\Omega_v\}_{si} = \text{cov}(v_{skr}, v_{ikr}), \\
&(e_{1r}, e_{2r}, e_{3r})^T \sim MVN(0, \Omega_e), \quad \{\Omega_e\}_{si} = \text{cov}(e_{sr}, e_{ir}) \\
&\text{cov}(u_{itkr}, u_{itkr}) = \sigma^2_{u_i}, \quad \text{cov}(v_{ikr}, v_{ikr}) = \sigma^2_{v_i}, \quad \text{cov}(e_{ir}, e_{ir}) = \sigma^2_{e_i} \\
&\text{cov}(u_{stkr}, u_{itkr}) = \sigma_{u_{si}}, \quad \text{cov}(v_{skr}, v_{ikr}) = \sigma_{v_{si}}, \quad \text{cov}(e_{sr}, e_{ir}) = \sigma_{e_{si}}, \quad s \neq i
\end{aligned} \qquad (2)$$

Effectively, z_{itkr} values are such that only relevant terms are retained in any of the models. $\sigma^2_{u_i}$ is the between years unexplained variance of the *i-th* response variable while $\sigma_{u_{si}}$ is the between years unexplained covariance between the *s-th* and *i-th* responses. $\sigma^2_{v_i}$ is the between countries unexplained variance of the *i-th* response variable while $\sigma_{v_{si}}$ is the between countries unexplained covariance between the *s-th* and *i-th* responses. $\sigma^2_{e_i}$ is likewise the between regions unexplained variance of the *i-*

th response variable while $\sigma_{e_{si}}$ is the between regions unexplained covariance between the *s-th* and *i-th* responses.

Multilevel models such as the one specified above account for nested sources of variability (Snijders and Bosker 1999), for instance, here years within countries within regions. Each response variable's residual variance is decomposed within and between units of analysis. Gender gap variation beyond that explained by the covariates can be disentangled into within country, inter-country and between regions. The *intra*-country correlation may be calculated as $\sigma^2_{v_i} / \left(\sigma^2_{u_i} + \sigma^2_{v_i} + \sigma^2_{e_i}\right)$ while $\sigma^2_{e_i} / \left(\sigma^2_{u_i} + \sigma^2_{v_i} + \sigma^2_{e_i}\right)$ is the *intra-region* correlation or the fraction of total variability that is due to region (Snijders and Bosker 1999). Decomposing residual (co-) variation, i.e. after globalization, development and controls have been accounted for, of gender inequalities within and across countries and regions informs the research questions of this research.

To sum up, the multivariate hierarchical specification employed here presents an advantage over more standard panel data estimation methods because it accounts for the interdependence between the various indicators of gender inequality at different levels of aggregation and can draw inferences from incomplete outcome data. The empirical models below have been estimated using the software package MlWiN v.2.0 via IGLS approximation.

4. Results

4.1. General Remarks

To address the possible endogeneity suggested above, the total unemployment rate is instrumented by its first lag[12]. Table 1 above describes both observed unemployment rates and the instrumented variable, i.e. unemployment rate (IV), which enters in the empirical models below. Simple bivariate correlations of quantitative covariates of gender gaps were moderate, raising thus no suspicion of multicollinearity (see Appendix D Table).

A three-equations multilevel model with random intercept is discussed here. It is presented in the later Tables 3 and 4. A baseline model, with just the constant and eighteen (six from each level) random parameters is given as a benchmark in Table 2. Table 2 has two parts: The first four rows of figures present the fixed parameters of the baseline model. The estimated random parameters in the second part are the three covariances, $\hat{\sigma}_{si}$, and correlations, [$\hat{\rho}_{si}$], for each $s \neq i$, and the three variances, $\hat{\sigma}_i^2$, for s=i, where s,i = female minus male secondary education net enrolment, unemployment and labor force participation, of respective random variation, u, v, e, at each level of analysis, i.e. time (t), country (k) and region (r). This is the so-called 'empty' model (Snijders and Bosker 1999), which estimates simple or crude associations between responses, i.e. gender gaps. A semi-'empty' model is also presented under the heading 'Trend' in Table 2 as a second benchmark. The Trend model accounts for non-linear trend in gender gaps via a second polynomial of time (at centered values, i.e. the year 1990, to ease interpretation), implying a hump-shaped effect of time on gender gaps.

<Table 2: Baseline models of gender gaps in net enrolment in secondary education, unemployment rates and labor force participation.>

Estimated fixed parameters of MVML models on gender gaps in education, unemployment and labor force participation along with (multi-parameter) Wald tests and an indication of their statistical significance are given in Table 3. Wald tests, which are χ^2 distributed for each set of covariates (Greene 1997), i.e. economic growth/development, globalization, and demography, are presented under the corresponding set of covariates in Table 3 with the appropriate degrees of freedom. Each estimate in the Tables of modelling results has an indication of its statistical significance. This is based on Wald tests, which are χ^2 distributed with one degree of freedom, ($\chi^2(1)$). Joint Wald tests, which are $\chi^2(2)$ distributed for both parameters of the time polynomial are shown in Tables 2 and 3 below the parameters themselves.

The last column of Table 3 shows Wald statistics for the joint effect of each covariate on all three gender gaps under investigation here. Apart from the two polynomials of time and growth, these are $\chi^2(3)$ distributed. The respective joint effect of each polynomial, i.e. time and growth, on all gender gaps is tested by comparing the estimated Wald statistics to a $\chi^2(6)$ distribution. By analogy, the joint effect of each regional dummy on unemployment and labor force participation gender gaps is tested via a comparison of its Wald test against a $\chi^2(2)$ distribution[13]. The relative importance of these sets of covariates for predicting each dependent variable as well as the relative importance of each covariate for the simultaneous prediction of gender gaps will be discussed in the sub-sections on fixed effects below.

Table 4 presents random parameters of between-regions, -countries and -years (co-) variation of gender gaps in secondary education, unemployment and labor force participation with an indication of their statistical significance. This is based on Wald statistics (χ^2 (1)). The results of Table 4 are later compared to the random parameters of the Baseline and Trend models, which are given in Table 2, for assessing the effects of covariates on residual (co-) variation of gender gaps. Covariance parameters, $\hat{\sigma}_{si}$, and correlation coefficients, [ρ_{si}] for $s \neq i$, are displayed in the off-diagonal cells of the variance-covariance matrices in the Tables 2 and 4. Multi-parameter Wald statistics for the random variation and covariation of the dependent variables at each level of analysis, i.e. regions, countries and years, are also displayed.

These are compared to the $\chi^2(6)$ theoretical distribution. The p-values for all Wald tests for random parameters have been corrected to account for one-tail tests (Snijders and Bosker 1999, p. 90).

Standard errors of (fixed or random) parameters are given in parentheses next to the respective estimate. It should be noted that for the case of incomplete data Wald tests of the MLMV estimated models are approximate and "valid for large data sizes" (Maas and Snijders 2003, p 87).

4.2. Fixed parameters

The estimated non-linear trend has the strongest effects on gender gaps with and without other covariates. Relative female labor force participation and unemployment rise over time at the same (first order) rate albeit with slightly differing humps (diminishing rates of increase). The significance of the (quadratic) time trend, effectively summarising unexplained factors, deserves more investigation in future work. Work not presented here showed that there is significant between countries random variation of the trend coefficients of gender gaps in unemployment and labor force participation but none in educational attainment.

< Table 3: Fixed effects on gender gaps in net enrolment in secondary education, unemployment rates and labor force participation>

Globalization, economic development/growth, and population are significantly associated with each gender gap under investigation. The joint effects on all three dependent variables (gender gaps) indicate that the population growth rate, the post 1989 dummy for globalization, female to male population, democracy rating, GDP per capita, inequality index, current account as percentage of GDP, (instrumented) total unemployment rate, population and the per capita (quadratic form of) growth rate are, in this order, associated with all three responses jointly. The dummy for Sub-Saharan Africa significantly affects gender gaps in unemployment and labor force participation jointly. Unlike the previous covariates however openness (exports + imports over GDP per capita) is not related to all three gender gaps *jointly*. The order of joint effects is indicated by the Wald tests given in the last column of Table 3.

Individual associations of each set of covariates on each index of gender gap separately show some notable differences: Demographic covariates are only associated with the labor force participation gap; the female-to-male population rate increases the corresponding relative participation rate, as does the level and the growth rate of the general population. Thus, more populous countries, and those with a greater share of women in their populations, tend to have a relatively greater participation rate of women.

Greater living standards, as evidenced by GDP per capita, tend to favour female participation in education but also to be adversely related to female labor force participation. One interpretation of this is that more affluent societies can afford to devote more time to child rearing. Growth does not seem to directly affect education or unemployment gender gaps but favours (non-linearly with diminishing rate) women's participation in the labor market. Unemployment in the general population is positively related with relative female unemployment. Thus the incidence of unemployment is felt primarily by women. Perhaps counter-intuitively it is also associated with improvements in the women's relative education. Income inequality (the Gini coefficient) is adversely related to women's participation in employment but it is associated with positive outcomes of their schooling and unemployment rates.

In countries and periods with more (liberal) democracy relative women's participation in the labor force is reduced but democracy is unrelated to their share in social capital and exclusion (as manifested by education and unemployment, respectively). The first result may seem counter-intuitive as one would expect that more democratic states would provide help for childrearing. But it is plausible if such state assistance takes the form of direct financial aid to mothers rather than state nurseries or incentives to hire nannies. It is also reinforced by the respective coefficient of economic development.

Globalization indices, while formally significant across all three dependent variables, seem to affect educational differences and labor force participation most notably. There seems to be no clear-cut pattern here, but trade openness is associated with improvements in women's position unemployment-wise. Female schooling has considerably improved since 1990 worldwide for reasons, which are not otherwise captured in the model and deserve further investigation. The percentage of current account surplus/deficit over GDP is marginally related to reductions in relative female labor force participation.

The three regional fixed effects, which shift the intercepts, imply that Latin American countries systematically have more unemployed women than men compared to the rest of the world while Sub-Saharan Africa shows less female social exclusion and more labor force participation.

In view of the various arguments about non-linear effects of growth or development (see the Introduction), we also entered the GDP per capita squared instead of the growth squared[14]. The results do not in general change except that both GDP per capita and its square become insignificant; various other coefficients are also rendered insignificant, so that this specification is not judged as a successful one. Thus, we conclude that, with the exception of non-linear time trends and the growth square in the labor force participation equation, there is little evidence of non-linear effects of the type discussed in the literature.

To investigate the effects of globalization further, we have also entered the (log of) per capita TV ownership, an indicator of both globalization and development, but without much effect: it only seemed to take on the role of GDP per capita, hence it is not shown. The Sachs-Warner index of international trade was also entered after appropriately restricting the sample size (as this index is not widely available) but did not essentially increase the information from the models. It merely replaced openness, i.e., exports plus imports over GDP, and current account surplus/deficit over GDP effects.

4.3. Random parameters

Despite the above-discussed relationships, there remains significant unexplained between and within-countries variability of gender differences (see the estimated variances in Table 4). By contrast, the regional (co-)variation of gender differences in social capital and exclusion disappears after accounting for demography, growth, globalization and the two regions of Latin America and Sub-Saharan Africa. The gap in labor force participation shows some unexplained regional variability. An important in our opinion result is that the residual inter-region correlation between gender gaps is essentially zero, when the state of the economy and other controls have been accounted for. The lack of significance for the between regions non-zero random parameters (especially in the baseline models, see earlier Table 2) is possibly due to the small number of observations at this level.

< Table 4: Random variation of intercept for gender gaps in net enrolment in secondary education, unemployment rates and labor force participation>

After having accounted for (non-linear) trend and all other covariates, between-countries unexplained variability of gender differences in labor force participation greatly exceeds its between-years residual variability, unlike differences in unemployment and secondary education enrolment. In particular the respective intra-country correlations are 98.35%, 59.48% and 34.38% (calculated as $\sigma^2_{vi} / (\sigma^2_{ui} + \sigma^2_{vi} + \sigma^2_{ei})$ at estimated values). In other words, most of the unexplained variability of labor force participation and social exclusion is cross-sectional rather than time-series related, overwhelmingly so for the former. On the other hand the majority of residual variability of relative female social capital is temporal rather than across countries.

Gender differences in social capital (as manifested in secondary school enrolment) are essentially unrelated to gaps in labor force participation between countries. All their within-country (residual) correlation was due to the non-linear trend. Perhaps surprisingly, labor force participation and unemployment gender gaps are unrelated between countries. Within countries they show a very low positive correlation, which is partly explained by trend (see reduction from the baseline to the trend model in Table 2). There only exists modest residual negative between-country correlation of differences in social capital and exclusion. This implies that in countries with more female social capital there is less female unemployment (i.e. social exclusion) and this association is not due to globalization, growth or other covariates in the model. In fact the negative correlation is strengthened in the model compared to the baseline (see Table 4 versus Table 2 results). This may be explained by the contrasting income inequality coefficients on each dependent, which, if ignored, dampen the intrinsic negative relationship between relative female social capital and exclusion. The within countries correlation between these gender inequalities is negligible.

An LR test for the joint importance of the nine (three at each level) random covariances between gender inequalities of the final model (Table 4) evidenced that their inclusion significantly explains their variation[15]. As mentioned, this predominately reflects between and within countries correlations of inequalities in social capital and exclusion, and unemployment and labor force participation, respectively. Therefore gender inequalities are best investigated jointly rather than individually.

5. Conclusions

This paper investigates the links between various indices of gender inequality, measures of socio-economic development, and globalization. The measures of gender inequality, which are investigated here, i.e. the female-minus-male secondary school enrolment, unemployment and labor force participation rates, are the least studied in the literature, which, as mentioned, is primarily concerned with wage differentials. The study employs the biggest possible panel of country-year points. The unbalanced sample favours the ‘Western’ world but a substantial number of Central and South American as well as Asian countries are included for (nearly) the entire study period, i.e. the last fifth of the 20th century. Therefore our analysis draws reasonably reliable inferences for most of the world except Africa.

The multivariate multilevel modelling method used here allows the joint analysis of the effects of explanatory variables on the three measures of gender inequality and accommodates incomplete data (unbalanced panel) with no loss in efficiency (Maas and Snijders 2003). It also estimates the structure of their unexplained (residual) variability and association between the variables under investigation.

This study shows that labor force participation gaps are effectively identical within countries while unemployment gaps are moderately similar controlling for non-linear trend and various covariates of gender inequalities. The residual variation of the economic gender differences is higher between countries than within. Female minus male human capital however varies largely within countries. Regional (unexplained) heterogeneity is generally negligible except for labor force participation gaps.

Gender inequalities in unemployment and schooling are negatively correlated between countries for reasons that however need further investigation as our set of covariates did not diminish this intrinsic association. All other possible correlations between gender gaps under investigation here diminished when the (non-linear) trend, globalization, growth and controls were included in the model. Thus (except for the above-mentioned social capital and exclusion correlation) the three outcomes are linked due to associations with economic, demographic, and other country characteristics especially at the regional level.

The fixed parameters have been described in detail earlier so we only briefly summarise them here. Both sets of explanatory variables under investigation, economic development/growth and globalization, play an important role in understanding gender differences. Labor force participation gaps seem to be related with demographic variables, level of institutional democracy, development, and globalization. Gender differences in unemployment are associated with openness and other indices of economic performance, such as the aggregate unemployment rate and the Gini index of inequality. Relative female secondary school attainment shifts upwards after 1989 due to otherwise unmeasured aspects of globalization and is associated with the level of economic development, total unemployment and inequality. Thus, indices of economic development/growth and alternative globalization measures are important for all three indices of gender gap investigated here. Evidence in favour of non-linear effects that may be implied by the arguments mentioned in the Introduction has not been found.

This study arguably delineates empirically associations of gender gaps, particularly with reference to state of economic development or growth and globalization, in a coherent manner. As is commonly the case, there are aspects of this work that merit further effort. It is worth seeing whether there are any clearer patterns of influence than those detected here; this may be aided if the literature offers more developed hypotheses. Further issues include the nature of the time trend and causality. The nature of the ubiquitously significant quadratic time trends merits further investigation. The causation might be the inverse of what was hypothesized here, i.e. from gender inequalities to growth. (It is highly unlikely that gender gaps may affect globalization.) Indeed a few papers that tackle the issue of cross-country differences (notably by Seguino 2000a, 2000b; Klasen 2002; and Knowles, Lorgelly, and Owen 2002) investigate the effect of gender inequality (e.g. in schooling) on growth and on the whole find it to be statistically significant. This may explain the lack of significance of (non-linear) growth effects on female social capital and exclusion in our models. Inverse causation is also a possibility for inequality: Schultz (1998) estimates that roughly one twentieth of world interpersonal income inequality is due to gender differences in education (two thirds being due to inter-country differences and three-tenths to inter-household within-country inequality)[16]. The current models may have ignored various sources of endogeneity within the set of covariates. For instance, political variables have been evidenced to be important in explaining growth (see e.g. Barro 1995; Kurzman, Werum and Burkhart 2002).

Finally, the model does not account for spatial correlation or autocorrelation. Investigating them would considerably increase the model's complexity but these and the aforementioned issues are in the agenda for future developments.

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ENDNOTES

1 Thus, the mentioned graph of indices of gender inequality against per capita GDP may resemble the counterpart graph of general income inequality; this is the (hump-shaped) “Kuznets curve” (Kuznets 1955; Barro 2002; Lundberg and Squire 2002).

2 To our knowledge, there is no previous literature on gender economic inequality (apart from wages) across countries to date while existing work on comparative wage differentials draws inferences from a small number of countries.

3 The connection to wage inequality (and the voluminous literature behind it) is intentionally left to future work.

4 The others are in general related to age, marital status, and number of children, which are less relevant at the national aggregate-level analysis of the present study.

5 National indices of ‘accept’ quality have been used except for Argentina, Austria, Cyprus, Israel, Paraguay, Switzerland, Uruguay, which are ‘estimates based on national accounts or surveys of less than full national coverage’. The use of the Gini coefficient as a country-level variable is justified by the evidence that most of its variability is between countries rather than over time (Li, Squire and Zou 1998).

6 The relation between growth and inequality is rather poorly understood (see Lundberg and Squire 2002; and Barro 2002; for a head start in empirical work). The connection may possibly be non-linear (the so-called Kuznets curve whereby inequality is lowest at the middle range of development or growth). This relation may have implications for gender inequality, as inequality at large may impinge on gender inequality; if so, it reinforces the need to check for non-linear effects of development or growth (see above).

7 The democracy measure is derived from evaluations of four characteristics of national governments: (1) the competitiveness of political participation, (2) the

openness of executive recruitment, (3) the competitiveness of executive recruitment, and (4) constraints on the chief executive. This measure has been criticized for capturing only procedural aspects of democracy and failing to measure consensual democratic procedures and aspects of consolidated democracy (Bollen and Paxton 2000; Kurzman, Werum and Burkhart 2002; Munck and Verkuilen 2002).

8 The question 'is sub-Saharan Africa different?' is well known in the theory of growth, and the debate still goes on; e.g., Rodrik (1999) provides an answer in the negative. The two regional dummies we include seem to be the only important ones (persistently significant in the literature) in the wide-ranging survey of Durlauf, Johnson and Temple (2005) on growth empirics – see their Appendix 2. Having said that, it should be noted that the sample of sub-Saharan countries in this study has been shaped by data availability and may not be representative of the region. Thus the later result should be interpreted with caution.

9 The term 'multilevel' is employed here as equivalent to 'hierarchical'.

10 Maas and Snijders (2003) compare the two methods with special attention to incomplete data and validity of statistical tests. Yang et al (2002) extend the multivariate multilevel analysis of repeated measures to accommodate non-random missing-ness in the responses.

11 This is equivalent to the MAR assumption that recording failures do not depend on the unrecorded value (Little and Rubin 1987). This is not an unreasonable assumption for our data (see Appendix C).

12 Unemployment is thus instrumented out of the models. 89% of unemployment rates' variation is explained by previous year's unemployment in the auxiliary regression. The simple bivariate correlation between predicted and observed unemployment is 0.95.

13 Regional dummy variables with essentially zero coefficients, such as Latin America on educational and labor force participation gaps and Sub-Sahara on the latter, have been omitted from the model for parsimony.

14 These results and others referred to that are not shown for economy of space are available upon request.

15 The difference of -2LL between a model with suppressed covariances and the final model, i.e. including the estimated covariances given in Table 4, is 25.47, which is Chi-square distributed with 9 degrees of freedom implying that the covariances are jointly significant at a (two-tail) significance level of 0.01.

16 This estimate might be argued to be a lower bound to the actual importance of gender inequality as a generator of income inequality at large, as more gender inequality exists than that due to educational differences among genders alone (e.g., because of a gender bias in types of employment or industry, or simply outright discrimination).

Figure 1: Distribution of girls minus boys net enrolment in secondary education

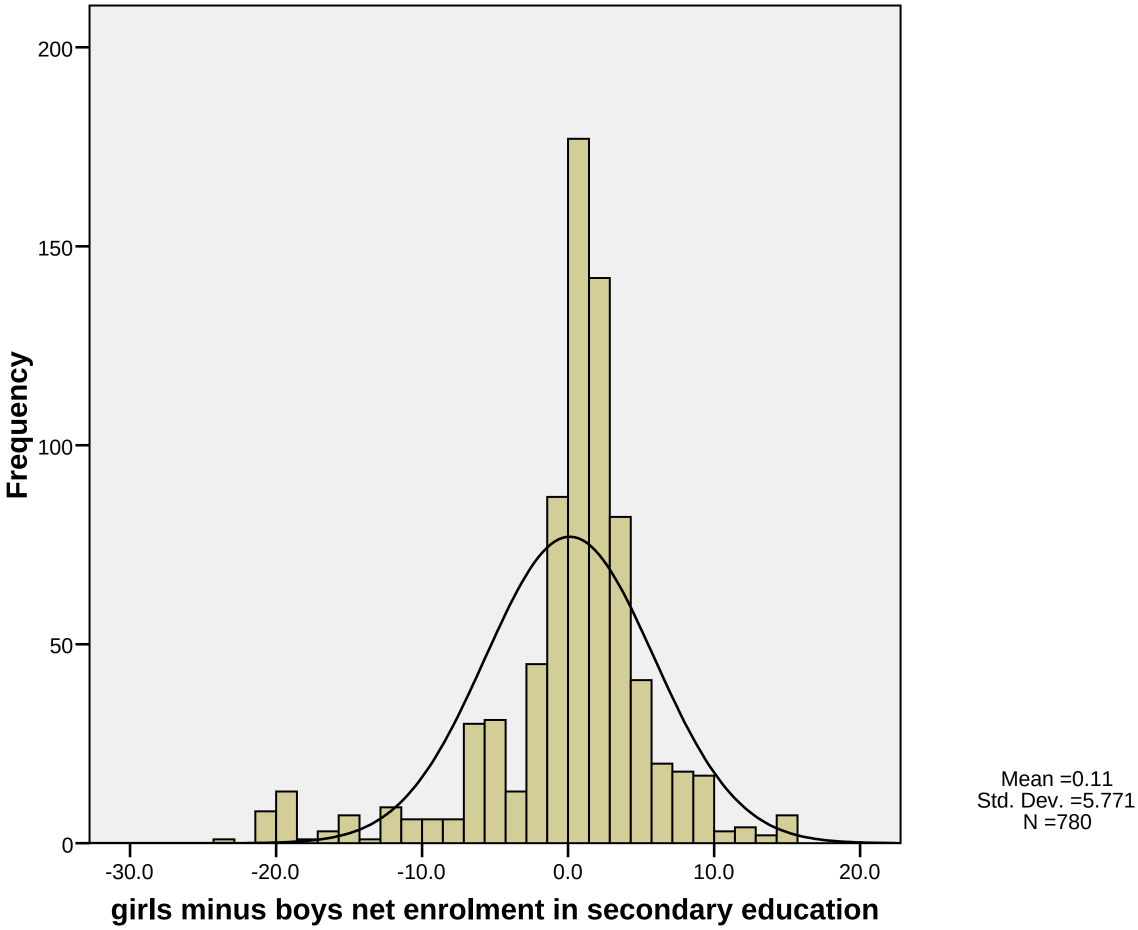

Figure 2: Distribution of female minus male unemployment

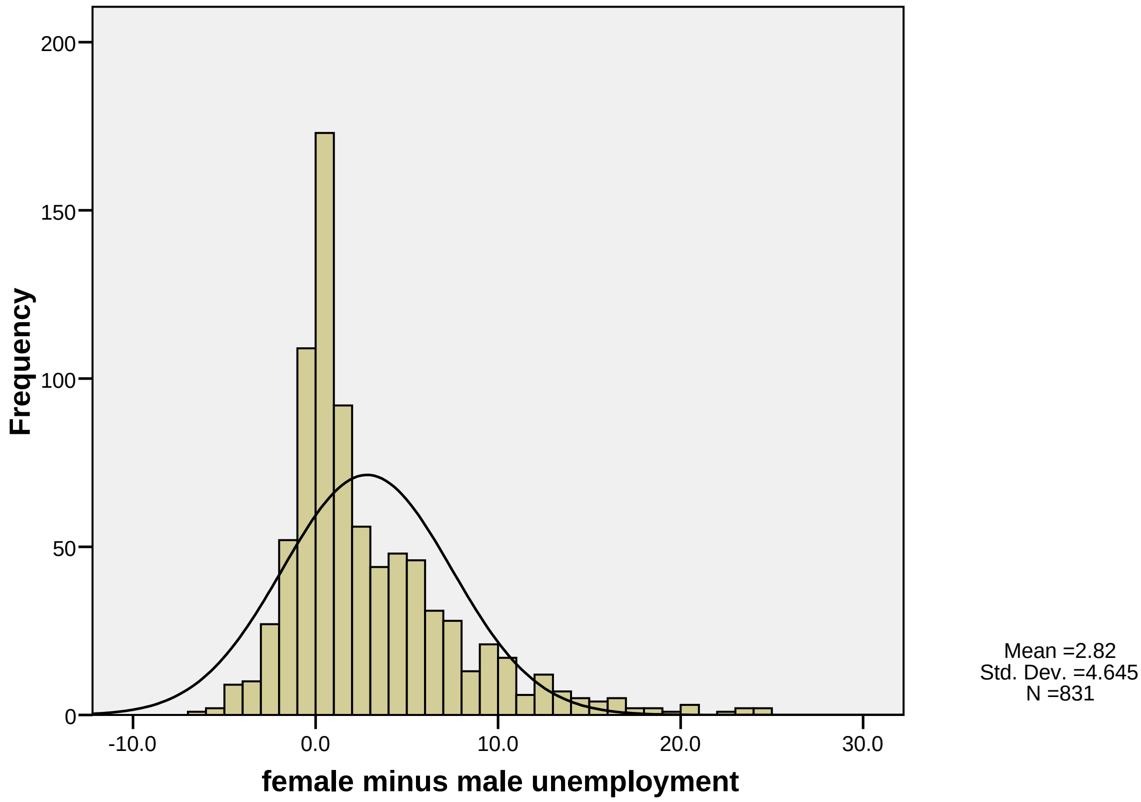

Figure 3: Distribution of female minus male labour force participation

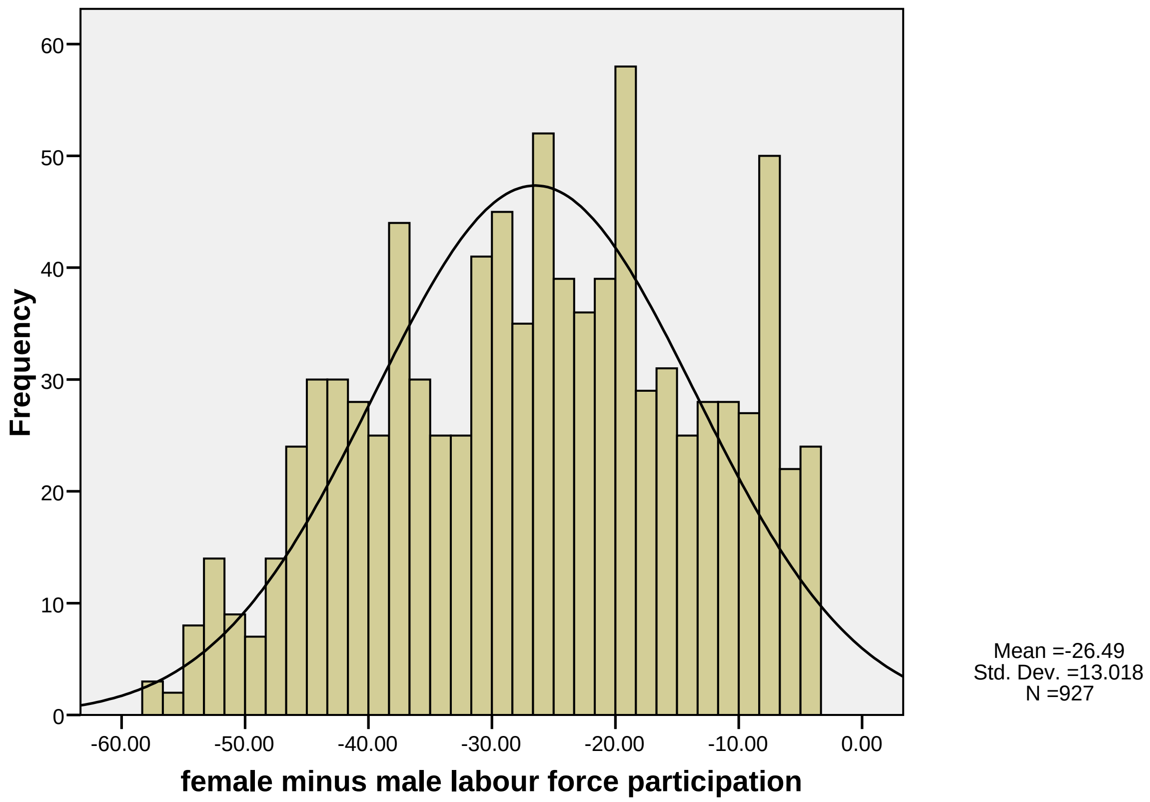

Table 1: Description of variables

Responses	Valid N	Mean	Min	Max	St.Dev.
Female minus male net enrolment in secondary education $_{tkr}$ [a]	780	0.1	-23.1	15.1	5.8
Female minus male unemployment rates $_{tkr}$ [b]	831	2.8	-6.1	24.5	4.6
Female minus male labor force participation rates $_{tkr}$ [b]	927	-26.5	-58.0	-3.8	13.0
Covariates					
<u>Demographic</u>					
Female to male population $_{tkr}$ [c]	927	1.0	0.9	1.2	0.03
Population $_{tkr}$(ln) [c]	927	9.5	6.4	12.6	1.4
Population growth $_{tkr}$	927	0.013	-0.003	0.037	0.009
<u>Political</u>					
Polity $_{tkr}$ [d]	927	17.8	0	21	5.2
<u>Economic</u>					
GDP per capita $_{tkr}$ (ln) [e]	927	9.1	6.5	10.4	0.8
Growth $_{tkr}$	927	0.018	-0.207	0.179	0.039
Unemployment rate $_{tkr}$ [b]	927	8.1	0.2	42.2	4.8
Unemployment rate $_{tkr}$ (IV)	927	8.1	0.7	40.2	4.7
Inequality (Gini coefficient) $_{kr}$ [f]	927	39.2	25.6	62.3	8.4
<u>Globalization</u>					
Openness ((Exports+Imports)/GDP)$_{tkr}$ [e]	927	64.7	9.1	341.0	45.1
Current account as % GDP $_{tkr}$	927	-2.0	-51.3	17.6	6.5
Sachs-Warner openness index [g]	490	70%	-	-	-
Post 1989 $_{tkr}$	927	60.5%	-	-	-
<u>Regional dummy variables</u>					
Latin America $_{r}$	927	35.4%	-	-	-
Sub-Sahara $_{r}$	927	3.0%	-	-	-

[a] UNESCO, World Education Indicators – see also Barro and Lee (1993, 1996).
[b] ILO, Key Indicators.
[c] UN, DESA, Population Division.
[d] www.cidcm.umd.edu/inscr/polity.
[e] Penn Tables.
[f] Deininger and Squire (1999).
[g] Sachs and Warner (1995; 1997)
t: years; *k*: countries; *r*: regions.

Table 2: Baseline models of gender gaps in net enrolment in secondary education, unemployment rates and labor force participation.

Female minus Male:	Net Enrolment in Secondary Educ'n		Unemployment		Labor Force Participation	
	Baseline	Trend	Baseline	Trend	Baseline	Trend
	Fixed Parameters					
Intercept	-17.21 (3.20)***	2.82 (3.10)	-20.54 (7.13)***	-18.61 (7.40)**	-26.17 (2.51)***	-26.93 (2.55)***
Time (centered)		-2.03 (0.15)***		0.74 (0.13)***		0.55 (0.01)***
Time (centered)^2		-0.54 (0.03)***		-0.11 (0.03)***		-0.01 (0.00)***
Wald test (d.f.=2)		*663.81****		*42.61****		*2,443.07****
Female minus Male:	*Between-Regions Estimated Random Parameters (σ^2_{ir}, σ_{isr} [ρ_{si}]) i,s=1,2,3; r: regions*					
Net Enrolment in Secondary Educ'n	59.48 (56.99)	44.94 (49.26)				
Unemployment	140.76 (95.47)	112.26 (89.58)	605.60	653.75		
	[0.74]	[0.66]	(287.20)**	(305.43)**		
Labor Force Participation	12.29 (32.27)	30.50 (31.07)	-7.84 (71.56)	8.44 (74.84)	71.63 (35.65)**	72.98 (36.60)**
	[0.19]	[0.53]	[-0.04]	[0.04]		
	Between-Countries Estimated Random Parameters (σ^2_{ikr}, σ_{iskr} [ρ_{si}]) i,s=1,2,3; k: countries; r: regions					
Net Enrolment in Secondary Educ'n	311.81 (77.22)***	327.98 (73.58)***				
Unemployment	-123.29 (76.03)	-140.32 (75.13)**	670.61	678.96		
	[-0.27]	[-0.30]	(141.42)***	(142.66)***		
Labor Force Participation	14.42 (27.86)	-11.84 (27.86)	15.25 (37.34)	21.60 (38.58)	98.72 (19.59)***	105.51
	[0.08]	[-0.06]	[0.06]	[0.08]		(20.68)***
	Between-Years Estimated Random Parameters (σ^2_{itkr}, σ_{istkr} [ρ_{si}]) i,s=1,2,3; t: years; k: countries; r: regions					
Net Enrolment in Secondary Educ'n	956.92 (46.09)***	542.44 (26.15)***				
Unemployment	-14.22 (22.32)	-13.05 (16.40)	447.55	425.93		
	[-0.02]	[-0.03]	(21.59)***	(20.55)***		
Labor Force Participation	-35.75 (3.76)***	-0.24 (1.37)	16.09 (2.50)***	5.17 (1.22)***	11.37 (0.55)***	2.95 (0.14)***
	[-0.34]	[-0.01]	[0.23]	[0.15]		

* 0.10 > p-value > 0.05; ** 0.05 > p-value > 0.01; *** 0.01 > p-value. Deviance (joint Wald test) of 6 parameters for Time and Time^2 of the 'Trend' Model equals 3,123.38***. The respective Wald test values for the between-regions, -countries and -years random parameters (six at each level) of the baseline model are 9.22, 63.60*** and 1,290.26***. They are essentially identical in the 'Trend' model (9.21, 67.99*** and 1,289.59***, respectively).

Table 3: Fixed effects on gender gaps in net enrolment in secondary education, unemployment rates and labor force participation.

Female minus Male:	Net Enrolment in Secondary Educ'n	Unemployment	Labor Force Participation	*Wald test (df=3)* $^{@}$
Intercept	-143.07 (67.82)***	-30.19 (88.38)	-70.95 (14.87)***	
Time (centered)	-3.75 (0.31)***	0.58 (0.29)**	0.58 (0.03)***	*1,044.82**** *(d.f.=6)*
Time (centered)^2	-0.50 (0.03)***	-0.09 (0.03)***	-0.01 (0.00)***	
Wald test (d.f.=2)	*588.10****	*12.58****	*456.31****	
Demography				
Female to male population	11.14 (58.39)	4.50 (78.76)	49.96 (9.29)***	*29.28****
Population (ln)	0.29 (1.75)	0.91 (2.46)	2.79 (0.78)***	*12.79****
Population growth	-304.37 (238.89)	-225.54 (244.67)	153.55 (21.70)***	*54.91****
Wald test (d.f.=3)	*1.77*	*1.02*	*99.28****	
Polity	-0.01 (0.26)	-0.11 (0.25)	-0.10 (0.02)***	*24.16****
Development/growth				
$GDP_{per\ capita}$ (ln)	9.14 (3.20)***	6.04 (3.95)	-1.54 (0.56)***	*21.03****
Growth	9.12 (21.83)	28.63 (19.80)	5.016 (1.54)***	*16.11***
Growth^2	-202.87 (260.38)	-153.02 (236.06)	-38.25 (18.39)**	*(d.f.=6)*
Unemployment (IV)	0.61 (0.27)**	0.73 (0.27)***	0.01 (0.02)	*13.23****
Inequality (Gini coeff.)	0.92 (0.30)***	-1.20 (0.52)**	-0.54 (0.21)***	*17.72****
Wald test (d.f.=4)	*14.07****	*11.80***	*27.11****	
Globalization				
Openness	0.04 (0.04)	-0.11 (0.05)**	0.00 (0.00)	*5.60*
Current account	-0.16 (0.19)	0.22 (0.18)	-0.05 (0.01)***	*15.98****
Post 1989	18.08 (3.15)***	1.84 (2.84)	-0.09 (0.22)	*33.65****
Wald test (d.f.=3)	*35.47****	*6.86**	*12.38****	
Region				
Latin America	-	18.53 (8.83)**	-	
Sub-Saharan Africa	-	-43.20 (14.48)***	13.34 (6.70)**	*13.87**** *(d.f.=2)*

* 0.10 > p-value > 0.05; ** 0.05 > p-value > 0.01; *** 0.01 > p-value. $^{@}$ Unless otherwise given.

Table 4: Random variation of intercept for gender gaps in net enrolment in secondary education, unemployment rates and labor force participation.

Female minus Male:	Net Enrolment in Secondary Educ'n	Unemployment	Labor Force Participation
Between-Regions Estimated Random Parameters (σ^2_{ir}, σ_{isr} [ρ_{si}]) i,s=1,2,3; r: regions			
Net Enrolment in Secondary Educ'n	0.00 (0.00)		
Unemployment	0.00 (0.00)	0.00 (0.00)	
Labor Force Participation	0.00 (0.00)	0.00 (0.00)	38.06 (23.94)
Wald test (d.f.=6)			*2.53*
Between-Countries Estimated Random Parameters (σ^2_{ikr}, σ_{iskr} [ρ_{si}]) i,s=1,2,3; k: countries; r: regions			
Net Enrolment in Secondary Educ'n	273.85 (56.03)***		
Unemployment	-140.96 (59.19)** [-0.34]	613.96 (113.80)***	
Labor Force Participation	-1.22 (24.73) [-0.01]	37.89 (35.40) [0.15]	109.12 (21.24)***
Wald test (d.f.=6)			*78.15****
Between-Years Estimated Random Parameters (σ^2_{itkr}, σ_{istkr} [ρ_{si}]) i,s=1,2,3; t: years; k: countries; r: regions			
Net Enrolment in Secondary Educ'n	522.70 (25.19)***		
Unemployment	-13.52 (15.95) [-0.03]	418.24 (20.17)***	
Labor Force Participation	-1.36 (1.23) [-0.04]	4.52 (1.11) *** [0.14]	2.47 (0.12)***
Wald test (d.f.=6)			*1,289.94****

* 0.10 > p-value > 0.05; ** 0.05 > p-value > 0.01; *** 0.01 > p-value.

Appendix A Table: Regions and countries in the empirical models

Regions	%	Countries	%	Number of Years
Eastern Africa	1.9	Kenya	0.2	2
		Mauritius	0.8	7
		Uganda	0.5	5
		Zambia	0.3	3
		Zimbabwe	0.1	1
Northern Africa	2.7	Egypt	1.5	14
		Morocco	1.2	11
Southern Africa	1.1	Botswana	0.2	2
		Namibia	0.3	3
		South Africa	0.5	5
Eastern Asia	4.5	Hong-Kong	0.3	3
		Japan	2.2	20
		South Korea	2.0	19
South-central Asia	3.6	Bangladesh	0.6	6
		Pakistan	2.0	19
		Sri-Lanka	0.9	8
South-eastern Asia	7.6	Indonesia	0.3	3
		Malaysia	1.4	13
		Philippines	2.0	19
		Singapore	1.7	16
		Thailand	2.0	19
Western Asia	6.1	Cyprus	1.7	16
		Israel	2.2	20
		Jordan	0.1	1
		Syria	0.5	5
		Turkey	1.6	15
Northern Europe	12.8	Denmark	2.2	20
		Finland	2.2	20
		Ireland	2.0	19
		Norway	2.2	20
		Sweden	2.2	20
		UK	2.2	20
Southern Europe	8.5	Greece	2.2	20
		Italy	2.2	20
		Portugal	2.2	20
		Spain	2.0	19
Western Europe	10.9	Austria	1.5	14
		Belgium	2.0	19
		France	2.0	19
		Germany	1.0	9
		Netherlands	2.2	20
		Switzerland	2.2	20
Caribbean	4.6	Dominican Republic	0.8	7
		Jamaica	1.8	17
		Trinidad-Tobago	2.0	19

Appendix A Table: Regions and countries in the empirical models (continued)

Regions	%	Countries	%	Number of Years
Central America	9.8	Costa Rica	2.2	20
		El Salvador	1.5	14
		Guatemala	0.6	6
		Honduras	1.3	12
		Mexico	1.0	9
		Nicaragua	1.5	14
		Panama	1.7	16
South America	16.7	Argentina	2.0	19
		Bolivia	1.0	9
		Brazil	1.8	17
		Chile	2.0	19
		Colombia	2.0	19
		Ecuador	1.3	12
		Guyana	0.1	1
		Paraguay	1.8	17
		Peru	1.3	12
		Uruguay	1.2	11
		Venezuela	2.0	19
Northern America	4.2	Canada	2.2	20
		USA	2.0	19
Australia/New Zealand	3.7	Australia	2.2	20
		New Zealand	1.5	14
Melanesia	1.2	Fiji	1.2	11

Appendix B Table: Years in the empirical models

Year	%
1981	4.1
1982	3.7
1983	4.1
1984	4.2
1985	4.3
1986	4.4
1987	4.7
1988	5.0
1989	5.0
1990	5.6
1991	5.6
1992	5.8
1993	6.0
1994	5.9
1995	6.0
1996	6.0
1997	5.7
1998	5.7
1999	5.7
2000	2.3

Appendix C: Testing Missing-ness of Responses

In the dataset we analyze, missing values occur for two of our response variables: female minus male net enrolment in secondary education, and female minus male unemployment rates. To investigate the validity of the MAR assumption required for the MVML model to provide nearly unbiased and efficient parameter estimates for incomplete data, we apply simple logistic regression for the pattern of missing-ness (0=not-missing, 1=missing). If a sizeable degree of missing-ness can be explained by other measured variables, this is evidence for MAR against NMAR (non-randomly missing data, i.e. that recording failures depend on the unrecorded value - Little and Rubin, 1987).

Appendix C Table: **Logistic Regression Prediction of Missing Patterns**

Female minus male net enrolment in secondary education
N = 927
Classification Table (Row %)

	Predicted		
Observed	Missing (1)	Not Missing (0)	Total
Missing (1)	127 (86%)	20 (14%)	147
Not Missing (0)	20 (3%)	760 (97%)	780
Total	147	780	927

ROC area(1) = 0.984
OR(2) = 241.3

Female minus male unemployment rates
N = 927
Classification Table (Row %)

	Predicted		
Observed	Missing (1)	Not Missing (0)	Total
Missing (1)	71 (74%)	25 (26%)	96
Not Missing (0)	25 (3%)	806 (97%)	831
Total	96	831	927

ROC area(1) = 0.955
OR(2) = 91.56

(1) Area under the relative operating characteristic (ROC) curve. A value of 1 indicates that the binary classification model has perfect ability to discriminate between zeros and ones, possibly subject to calibration of the probability threshold used to make the 0/1 prediction decision. A value of 0.5 indicates no discriminating ability.
(2) Ratio of the odds of a "1" prediction being correct, to the odds of a "1" prediction being wrong.

Indeed, as Appendix C Table shows, completely observed explanatory variables in our dataset are capable to predict correctly (and without classification bias) approximately 86% and 74% of the missing patterns for the two response variables respectively.

Appendix C Table provides strong indication that a sizeable proportion of the observed missing-ness can be attributed to measured explanatory variables, and thus is very likely to be MAR. The MAR assumption may be further justified by the argument that the small amount of the unexplained missing-ness could be due to one or more unmeasured variables that are moderately correlated with the response, and thus does not necessarily imply non-randomly missing data; according to Joseph Schaffer and John Graham (2002), in many social science applications of longitudinal (or multilevel) data models, this situation is the rule rather than the exception. If indeed this is the case here then failure to account for these unmeasured variables is likely to introduce only a small amount of bias.

Appendix D Table: Bivariate correlations of covariates

	Females/ Males	Population (ln)	Polity	GDP $_{per\ capita}$ (ln)	Unemploy-ment (IV)	Gini	Openness	Current account $_{\%GDP}$
Females/Males	1.00							
Population (ln)	-0.07 (0.04)*	1.00						
Polity	-0.38 (0.00)**	-0.09 (0.01)**	1.00					
GDP$_{per\ capita}$ (ln)	0.49 (0.00)**	0.01 (0.83)	0.52 (0.00)**	1.00				
Unemployment (IV)	0.10 (0.00)**	-0.14 (0.00)**	0.07 (0.04)*	-0.12 (0.00)**	1.00			
Gini	-0.31 (0.00)**	0.01 (0.78)	-0.31 (0.00)**	-0.55 (0.00)**	-0.04 (0.22)	1.00		
Openness	-0.20 (0.00)**	-0.50 (0.00)**	-0.13 (0.00)**	0.10 (0.00)**	-0.00 (0.96)	-0.04 (0.20)	1.00	
Current account $_{\%GDP}$	0.07 (0.03)*	0.11 (0.00)**	0.06 (0.05)	0.39 (0.00)**	-0.13 (0.00)**	-0.25 (0.00)**	0.10 (0.00)**	1.00

* 0.05 > p-value > 0.01
** 0.01 > p-value.