Gender Inequality and Growth: Evidence from Sub-Saharan Africa and Arab Countries

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Abstract

This paper uses panel data from African and Arab countries and Arellano-Bond estimations to empirically assess the impact on growth of two primary *indicators* that are associated with MDG 3; namely the ratio of girls to boys in primary and secondary enrolment, and the ratio of 15-24 year-old literate females to males. Our findings indicate that gender inequalities in literacy have a statistically significant negative effect that is robust to changes in the specification. We show that higher gender inequality has an even stronger effect on income growth in Arab countries. In addition, in more open economies, gender inequality in literacy seems to have an additional effect, but this effect is positive; suggesting that trade-induced growth may be accompanied by greater inequalities. The results associated with the effects of gender inequality in primary and secondary enrolment are less robust.

Keywords: Growth, gender inequality, literacy, openness to trade, Arellano-Bond estimation
JEL classification: D63, F43

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1. Introduction

In Africa and the Arab world promoting gender equality and empowering women (MDG 3) is perhaps the most important of the eight Millennium Development Goals (MDGs). The target associated with achieving this goal is to eliminate gender disparity in primary and secondary enrolment preferably by 2005, and at all levels by 2015 (United Nations 2000). Abu-Ghaida and Klasen (2004) estimate what the costs would be in countries that fail to achieve the required level of progress towards achieving MDG 3 and find that those countries could have, by 2005, 0.1 - 0.3 percentage points lower growth rates, and 0.1 - 0.4 more children per woman. The costs by 2015 could be 2.5 percentage points higher prevalence of underweight children under the age of five, and 15 per 1000 higher mortality rates for children under five.

Gender inequalities in education tend to be greatest in poor countries and among the poor within countries (World Bank, 2001). An important strand of the literature on gender inequality in education has examined its impact on growth and development (Hill and King 1995, Klasen 1999 and 2002, Knowles et al. 2002). For example, Klasen (2002) shows that gender inequality in education has direct and indirect effects on growth. Lower female education lowers the average level of human capital and thus, has a negative impact on growth (direct effect). In addition, gender inequality has an effect on population growth and investment and thus, produces an indirect impact on growth. There are also effects from increasing female education that impact other dimensions of human development, not just economic growth. Knowles et al. (2002) argue that "there is evidence that female education, especially in developing countries, also produces social gains by reducing fertility and infant mortality, improving family and child health, increasing life expectancy, and increasing the quantity and quality of children's educational attainment" (p. 119).

Some researchers have reported the existence of a positive relationship between gender inequality in wages and economic growth (Çağatay and Özler 1995; Standing 1999; Seguino 2000). For example, Seguino (2000) uses panel data from semi-industrialized economies and various econometric specifications, and shows that GDP growth is positively related to gender wage inequality. There is some documented evidence suggesting that women are over-represented in export-oriented sectors, and particularly manufacturing. The gender differential in wage rates can to a large extent be explained by the fact that women tend to be crowded into lower paying jobs (Seguino, 2000). If lower wage reflects lower

educational levels, then the relationship between gender inequality in education and growth may turn out to be positive (Baliamoune-Lutz 2005 and 2007).

This paper uses data from a group of sub-Saharan African (SSA) and Arab countries and Arellano-Bond estimations to examine the effects on growth of two main indicators of gender inequality in education; namely the ratio of girls to boys in primary and secondary enrolment, and the ratio of young (15-24 year old) female to male literacy rates. We focus on these indicators because they are two of the four indicators that are specifically associated with MDG 3 (the other two are the share of women in wage employment in the non-agricultural sector and the proportion of seats held by women in national parliament). The aim of the study is to focus on what is often referred to as the *instrumental* effects of gender equality in education. We do not examine the *intrinsic* dimension of female education; which in essence derives from the role of education in enhancing a woman's set of capabilities (see Sen 1999).[1]

The methodology used in this paper differs from the one often employed in the existing literature in one important aspect. While most other studies focusing on the effects of gender inequality in education use either cross-sectional data for a single point in time or average data over several years and use the average from a group of countries (pooled cross sections), we use time series (7 periods made up of four-year averages) and cross sectional data and undertake a dynamic panel estimation using the Arellano-Bond procedure. It is often argued in the empirical literature that the endogeneity of some regressors in growth (or income) equations seriously weakens the validity of empirical results. Dollar and Gatti (1999), Klasen (1999), and Knowles et al. (2002) all include 2SLS estimations to account for the endogeneity of some regressors. However, finding appropriate instruments (for IV estimation) to circumvent the problem of endogeneity in dynamic panel data is, at best, extremely complicated. The Arellano-Bond estimation basically differences the endogenous and predetermined variables and uses lags of their own levels as instruments, and it seems to be an appropriate technique for modeling the type of relationships examined in this paper.

[1] This distinction is important and is often made in the literature on the effects of gender inequality in education. See for example, World Bank (2001), Subrahmanian (2002), Klasen (2002), and Abu-Ghaida and Klasen (2004). See also Jackson (1996) for an interesting discussion of the instrumentalist approach to the relationship between gender and development.

The empirical results we derive in this paper indicate that inequality in literacy has a statistically significant negative effect on income that is quite robust to changes in the specification. Moreover, in Arab countries, gender inequality has an even a greater effect on income. The estimations using inequality in primary and secondary enrolment yield less robust results. However, controlling for oil producing countries, we again show that lower female secondary education leads to lower growth (change in income) in Arab countries. Surprisingly, we find statistical evidence that the gap in secondary and primary enrolment may have a positive effect, while total secondary education (proxy for human capital) has a negative impact.

The outline of the remainder of the paper is as follows. Section 2 discusses the links between female education and growth. Section 3 describes the methodology and variable selection. Section 4 presents the empirical results. Section 5 concludes the paper.

2. Female education and Growth

Economists have commonly focused on per-capita income as the primary indicator of development, although there are several other indicators of development. In mainstream economic theory, education often represents one important aspect of human capital and enters the production function with a positive coefficient. Lower male or female educational levels translate into lower human capital. Thus, in theory, there is a direct effect from female education to income (or growth). There are also some solid arguments to support additional positive influences of female education on growth beyond this direct effect. These include the impact on the mother's health, the child's health and education, and fertility rates. Empirical data have, in general, supported the existence of these indirect effects. Higher female education makes women better-informed mothers and hence could contribute to lowering child mortality rates and malnutrition (Aly 1990; Smith and Haddad, 1999; Knowles et al. 2002; Klasen 2003). Increasing the proportion of educated women may also contribute to lowering fertility rates. In general, female education is negatively correlated to fertility and lower fertility levels are associated with lower dependency ratios. In turn, lower dependency ratios are associated with higher income (see Table 3).

Female education may cause a shift from a focus on *quantity* to a focus on *quality* in reproductive outcomes. Additionally, if more female education is associated with increased feminization of the labor force, this also may result in lower fertility. Female education is thought to allow women to have autonomy; control over resources and their lives (Basu 2002) and could, in some cases, have a stronger impact on fertility than does income (see Handa 2000 for the case of Jamaica). Finally, there is some empirical evidence that the effect of female adult education on the enrolment of children in the household may be greater than that of the male (Filmer 1999).

Empirical data show, in general, that there is a positive correlation between education and growth (see for example, Schultz 1994). This seems to be the general consensus. Where there is less consensus is whether both male and female education have similar (positive) contributions to growth (assuming causality is from education to growth or after factoring in the endogeneity aspect of the relationship). For example, Barro and Lee (1994) and Barro and Sala-i-Martin (1995), using cross-sectional data, find a negative coefficient on female education. However, this finding was refuted by other researchers mainly on the grounds of econometric problems in the empirical estimation, including multicollinearity (Knowles et al. 2002) and not accounting for anomalies such as the presence of high female education and low growth in Latin America, which could have been taken into account by, for example, including a Latin America dummy variable, as was done in Dollar and Gatti (1999). On the other hand, Caselli et al. (1996), using a GMM model, report a positive coefficient on female schooling and a negative coefficient on male schooling, both of which were statistically significant.

Several empirical studies have focused specifically on the role of gender inequality in education as a determinant of income or growth. Recent work includes Filmer (1999), Esteve-Volart (2000), Klasen (1999, 2002), Knowles (2002), and Klasen and Lamanna (2003). In general, the conclusions from these studies support the existence of a negative effect from gender inequality in education to income or economic growth. For example, Klasen (2002) uses OLS and TSLS estimations on data from developed and developing countries and shows that gender inequality has negative influences both directly, by reducing human capital; and indirectly, through its effect on population growth and investment. Esteve-Volart (2000) uses Barro and Lee (1994) data set for about 87 countries to explore the relationship between growth in per capita GDP and gender inequality in

primary schooling in the base year and reports that increasing the female to male primary schooling ratio leads to higher economic growth. Similarly, Knowles et al. (2002), use a neo-classical growth model, and cross-sectional data from a large group of countries (about 72), and show that higher female education contributes to higher labor productivity, whereas the effect of male education is ambiguous.

It is important to note that cross-sectional data from developed and developing countries reveal two stylized facts. First, gender inequality in education is higher in low-income countries; i.e., countries with low levels of economic development. Second, gender inequality in education tends to be high in countries with low total literacy rates (educational attainment). However, these relationships may not be linear. Dollar and Gatti (1999) show that there is a convex relationship between gender inequality in education attainment (the dependent variable) and income (regressor); as per-capita income rises from very low to a middle level, the improvements in female attainment are negligible, but when countries move from middle to higher levels of income, the effect on female educational attainment accelerates. Dollar and Gatti argue that "[o]ne plausible explanation of this relationship is that there are market failures that hinder investment in girls and that these failures diminish as countries develop". This argument, however, requires a clear definition of what constitute middle income. Several Latin American countries, for example, are at (or slightly below) what is commonly considered the middle-income range, yet they have already achieved high female educational levels. On the other hand, some Arab countries (oil producers in particular) have high income, yet female attainment levels are low. Finally, Esteve-Volart (2000) also obtains a convex relationship but with female-to-male primary schooling ratio (gender equality) being the regressor and growth being the dependent variable. This suggests the effect of female education is initially weak but accelerates as female education attains higher levels. This is quite plausible given the positive externalities (in terms of social and economic benefits) associated with female education. Indeed, if those externalities could be internalized, we should expect the marginal growth associated with higher female education in many developing countries (perhaps with the exception of some Latin American countries) to be increasing rather than diminishing.

3. Variable selection and model specification

Variable selection

We start by selecting variables that are commonly used in income or growth equations. These variables include the investment rate, human capital, and fertility rates.[2] The investment rate has also been used in equations that specifically focus on the effects of gender inequality on growth or income (Klasen 1999 and 2002, Knowles et al. 2002). Human capital is usually represented by educational attainment, secondary schooling, or a similar indicator. Most recent studies use average years of schooling from Barro and Lee (1996). In general, average years of schooling are used to proxy for stocks of educational human capital while school enrolment rates tend to proxy for investment in educational human capital (Knowles et al. 2002). In the present study we use two alternate proxies for educational human capital; youth literacy rates and secondary school enrolment. This is justified mainly by the fact that these two indicators are the ones explicitly associated with the target for achieving MDG 3.

A major dimension that must be taken into account when analyzing the effects of gender inequality is the impact of greater integration in the world economy. A global division of labor between developed and developing countries may have resulted from globalization and this may affect women differently relative to men. Previous studies have tried to account for the importance of the international sector by including an indicator of distortions in the trade regime such as the black market premium on foreign exchange (Barro and Lee 1994, Barro and Sala-i-Martin 1995, Dollar and Gatti 1999, Knowles et al. 2002). We use openness to international trade, measured as the ratio of trade (exports and imports) to GDP, as an indicator of a country's extent of integration in world markets.[3] It is important to emphasize that gender inequality may have an ambiguous relationship with openness to trade. On the one hand, greater openness may cause a developing country's exports to expand and could narrow the gap between skilled and unskilled labor, thus improving the relative wage of women who tend to constitute a large portion of the unskilled labor force. On the other hand, increased openness to trade could cause

[2] Klasen (1999, 2002) uses population growth while we use changes in fertility rates and female share of the labor force instead of population growth primarily because they may be better suited for capturing the *indirect* effects of gender education and gender inequality on income. Also, fertility rates have been used in the growth equations in studies by Barro and Barro and co-authors, and in Dollar and Gatti (1999).

[3] Klasen (1999, 2002) includes the same measure of openness to trade in his estimation of the effect of gender inequality in education on growth.

important shifts in the demand for skilled labor and hence cause the wage gap between skilled and unskilled workers to widen (see for example Wood [1997] on Latin America). This may increase gender inequality as women tend to be over-represented in the pool of unskilled labor. Indeed, other studies have found that trade liberalization did not necessarily reduce inequalities between men and women (Standing 1999; Çağatay 2001; Baliamoune-Lutz 2005 and 2007). Several studies (for example, Çağatay 2001; Fontana and Wood 2000) have also reported that in agriculture-based economies, greater openness to trade may cause higher gender inequality. This is quite relevant to the case of many African and Arab countries as they tend to have agriculture-based economies. Moreover, openness to international trade may be influenced by gender inequality in wages (which could in turn be caused by inequality in education). The availability of cheap labor in the form of mainly uneducated female workers could contribute to the growth of the export sector.

Another variable that seems to be missing from many previous studies of the effects of gender inequality in education is the share of women in the labor force. Ertück and Darity (2000) find that changes in the gender composition of employment resulting from the global division of labor may impede the gains from trade liberalization, and argue that developing countries may be faced with divergent paths; increasing feminization rate with falling per-capita income, or rising per-capita income with decreasing feminization rates. To the extent that some of the countries in this study are on the former path, we may find a higher percentage of women in the labor force to be associated with a lower income. Indeed, Table 1 shows that SSA has a percentage of female labor force (42%) that is almost as high as that of high-income countries (43%) and significantly higher than the percentage in the MENA region (28%) and in upper middle-income countries (36%). Yet, SSA has the lowest indicators of economic and human development. Interestingly, the correlation (Table 3) between the female share of the labor force and per-capita income (in log) is negative and quite large in magnitude (-0.65).

Pritchett (2001) performs OLS and IV estimations on cross-sectional data from a large group of countries (70 to 91 countries depending on the specification) and finds no association between higher educational attainment (as a component of human capital) and growth. He suggests three possible factors that may account for this result, bad (or what he

calls perverse) institutional/governance environment, a rapid decline in marginal returns to education (caused by excess supply of educated labor), and educational quality that is so poor that there was no contribution to human capital. Our model tries to control for the first factor by including the variable democracy in the equation. We admit that perhaps better measures would be more formal indicators of governance such as the ones developed by Kaufmann et al. (1999) and updated in the subsequent years, but the unavailability of data for the early periods in our sample prevented its use in the present study. We should point out that democracy is also included as a regressor in the growth equations in essentially all the studies by Barro and by Barro and co-authors, while Dollar and Gatti (1999) use the rule of law as a regressor.

Finally, culture and religion were found to be an important factor in explaining why women tend to have fewer opportunities to go to school. For example, Dollar and Gatti (1999) show that religion "systematically explains differences in gender inequality". In this paper, we try to account for culture by using interaction terms between gender inequality and a dummy variable for Arab countries in order to test the effect of the 'Arab culture'.[4]

We use seven 4-year average periods starting with 1974-77. We have tried to include all African and Arab countries for which data were available for all variables used in the estimation during a given period, a total of 41 countries. Thus, the panel is unbalanced and we have different numbers of observations depending on the variables included in the estimation. Appendix A describes the variables and identifies the source of data used in this study, and provides a list of the countries included in the sample. Table 3 includes correlation coefficients. We note from the figures displayed in the table that the correlations between the indicators of gender inequality and fertility rates (in log) are significant (0.51 and 0.53). Similarly, the correlations between gender inequality on the one hand, and income, openness, life expectancy, and investment rates are negative and statistically significant. In addition, the correlation between the gap in youth literacy and

[4] The effect of religion as we observe the real world is complex. As an example, adult female to male literacy ratios in 2000 varied from 0.58 in Morocco (a moderate Muslim country with a fairly good representation of women in the parliament and a high participation of women in the labor force (Klasen and Lamanna, 2003), to 0.80 in Saudi Arabia (generally considered the Muslim country with the most unequal gender rights), to 0.89 and 0.91 in Indonesia (the largest Muslim country in the world) and Malaysia, respectively. Note that women in Indonesia have held the highest office in government (Megawati Sukarnoputri as president of Indonesia) while those in Saudi Arabia are not allowed to vote or even drive. Therefore, although, the two can be strongly correlated, we think culture, not religion, should be included in this analysis. In this specific sample, it happens that Muslim and Arab countries almost coincide (Sudan and Mauritania are Muslim counties but are not included in Arab countries, instead we include them in SSA).

the gap in primary and secondary enrolment is very large (0.9). Finally, it is interesting (though this is expected) to observe that, on average, countries with higher educational gaps also have lower total literacy rates. The correlation between adult literacy and the gap in youth literacy and secondary and primary enrolment ratios is about -0.90, and -0.81, respectively.

Econometric specification

We use the Arellano-Bond estimation to examine the effects of educational gaps between women and men while taking into account the possible endogeneity of several right-hand-side (RHS) variables (such as fertility, female labor force, investment, human capital, and inequality). Our equation includes a lagged dependent variable (initial income)[5]. Since we are using panel data we have to deal with random and fixed effects. In particular, the presence of random effects creates correlation between the error term and the lagged dependent variable. The Arellano-Bond Generalized Method of Moments (GMM) specification[6] takes care of this problem. It differences the endogenous and predetermined variables and uses lags of their own levels as instruments. We examine the relationship between gender inequality in education and income starting from the following specification:

$$y_{i,t} = \alpha y_{i,t-1} + \mathbf{X}_{i,t}\beta + \eta_i + \xi_t + \varepsilon_{i,t} \qquad (1)$$

where y is income per capita in log form and $\mathbf{X}$ is a row vector of the factors determining income, some of which are endogenous, η_i is the individual (country) fixed effect, and ξ_t is a time-specific effect. Applying the Arellano-Bond specification yields the following:

$$\Delta y_{i,t} = \alpha \Delta y_{i,t-1} + \Delta \mathbf{X}_{i,t}\beta + \eta_i + \xi_t + \varepsilon_{i,t} \qquad (2)$$

In our model, investment, human capital, fertility, the share of women in the labor force, democracy, openness, and gender inequality are treated as endogenous. We also include (exogenous) dummy variables for 'SSA' and 'oil', and some interaction terms that are

[5] Since we use averages for a 4-year periods, we consider the lagged value of income (y_{t-1}) as the initial income for the determination of y_t which allows us to test for conditional convergence.
[6] See Arellano and Bond (1991) for more details.

treated as predetermined since they reflect the interaction between an exogenous variable and a predetermined variable. Estimation results are discussed in the next section.

4. Estimation results

Table 4 displays the results from estimating the model with gender inequality in education (gapylit) defined as the gap between youth female literacy rates and youth male literacy rates (see Appendix A for more details). We have also reported Sargan test results to assess the validity of the over-identifying restrictions. Based on the test results we fail to reject the null hypothesis that the over-identifying restrictions are valid in all cases (as well as in those reported in Table 5). The validity of the GMM estimation is based on the condition of no second-order autocorrelation. Thus, we report the values for the Arellano-Bond test that average autocovariance in residuals of order 2 is zero. The results confirm that there is no second-order autocorrelation.

The results associated with equation 1 (Eq. 1) indicate that the coefficients on income and investment are positive and statistically very significant. There is a substantial work on growth (or income) convergence using cross sectional data from OECD and developing countries, but there is no strong argument to be made for expecting the same to take place in our group of countries. In fact, it has been shown that African countries with relatively higher income do on average grow faster (see Baliamoune 2002). As can be seen from the figures in Table 2, there is no indication that the standard deviation of income per capita in the group of African and Arab countries in our sample has a downward trend. On the contrary, in 1980 and 1995, the standard deviation was much larger than in 1975. One possible reason why there is little convergence in Africa is the recurrence of conflict in some of the lower-income countries. All other variables in this equation turn out with insignificant coefficients. In equation 2, we replace fertility with the female share of the labor force. Fertility rates tend to be highly correlated with gender inequality and the nonsignificance of its coefficient may be due to multicollinearity. In equation 2, both human capital (youth literacy rates) and gender inequality are statistically significant (at the 10-percent level) and have the expected signs; positive for the former and negative for the latter. In addition, the coefficient on the share of women in total labor force (flaborf) is statistically significant but with a negative sign. This is hardly surprising. SSA has a relatively high female share of the labor force (as mentioned earlier), most of which are in

the agricultural sector and are over-represented in the pool of unskilled labor. If one subscribes to the *feminization U* proposition (see for example, Çağatay and Özler 1995), then higher female share of the labor force reflects lower development. However, since we have taken into consideration the endogeneity of the variable flaborf, finding a negative coefficient may convey the low productivity of jobs held by women. As the female share in total labor force increases, the male share, which tends to be relatively large in higher productivity sectors falls, hence the negative effect on income growth. The SSA dummy variable is significant and has the negative sign often reported in cross-country studies.

In equations 3-6 we include interaction terms. First, we include a term interacting the variable 'Arab' with gender inequality. Then we add a term interacting openness to trade with gender inequality. We drop the SSA dummy variable because of its high correlation with the dummy variable 'Arab'. The estimates associated with the four equations clearly show that gender inequality has a robust negative effect on income growth while our measure of educational human capital has a positive impact. In Arab countries, gender inequality has an even stronger negative impact. Interestingly, the interaction between gender inequality and openness produces a positive effect. This suggests that some of the growth caused by greater openness may also be the due to higher gender inequality, with a large share of uneducated women being employed in export sectors. There is documented empirical evidence that export-oriented sectors (manufacturing) employ a large share of the female labor force (see for example, Seguino 2000). In the case of Africa, many of the exports are agricultural products where a large portion of female labor is employed, and this could explain the positive sign on the interaction between the gender gap and openness.

Turning to the results of estimations using the second indicator of gender inequality in education, namely the gap between female and male primary and secondary enrolment ratios (Table 5), we note that they are rather different. The first 3 equations show that the only variables with statistically significant coefficients are lagged income and oil in all three equations, and SSA and gender inequality in equation 1. Neither one of the interactive terms is significant. In equations 4-6, we use a term interacting female secondary education with the dummy variable 'Arab', and this term has a statistically significant coefficient in all three equations. In addition, we include the interaction between openness and female

secondary education, and between the share of females in the labor force and female secondary education. However, both interaction terms have insignificant coefficients. Surprisingly, although its magnitude is very small, the coefficient on the proxy for educational human capital is negative and statistically significant, and the one on the gap in primary and secondary education is positive and statistically significant in two specifications.

In summary, the results reported in Table 4 yield strong statistical evidence that educational human capital has a positive impact and the gender gap in literacy has a negative influence on income growth. Moreover, controlling for oil, the effect is stronger in Arab countries. Interacting openness to trade with gender inequality shows a positive effect on income growth, and including this term in the estimation makes the effect of openness statistically significant although very small in magnitude. This may be consistent with the empirical literature. In general, it is not clear whether trade is always beneficial to developing countries. While earlier empirical work has documented the positive impact, a number of recent studies have obtained different results, with some authors reporting that trade liberalization is not significantly associated with growth or that trade liberalization may, indeed, have a negative impact on growth (Mukhopadhyay 1999; Rodriguez and Rodrik 2001; Baliamoune 2002). For example, Mukhopadhyay (1999) finds that the liberalization of imports for some SSA countries has led to a decline in growth in the late 1980s and early 1990s. Also, Baliamoune (2002) shows that increased openness to trade in African countries has led to income divergence, rather than convergence, within Africa; with openness causing income in poorer countries to grow slower relative to higher-income countries. We also find that democracy is not significant in any of the equations. This could be due either to low scores for the majority of countries in our sample or the fact that causality may very well be from income growth to democracy. On the other hand, the estimates reported in Table 5 do not show robust results, but female secondary education has a consistently positive impact in Arab countries. Given that secondary and primary education may suffer from serious measurement problems and they do not reflect drop rates, and that literacy rates may be a better proxy for the stock of educational human capital, the discussion in the next section will focus mainly on the results associated with inequality in literacy.

5. Conclusion

We have performed Arellano-Bond estimations using panel data from a number of African and Arab countries to try to assess the empirical links between gender inequality in education and growth (proxied by changes in income). The focus was on two major *indicators* that are explicitly associated with MDG 3; namely the ratio of girls to boys in primary and secondary enrolment ratios, and the ratio of literate 15-24 year old females to males. The empirical results indicate that gender inequalities in literacy have a statistically significant and robust negative effect. Interestingly, in more open economies gender inequality in literacy seems to have an additional effect but this effect is positive, thus suggesting that growth resulting from greater integration may be associated with (or benefiting from) greater inequalities. Moreover, in Arab countries, higher gender inequality is shown to have an even stronger effect on income growth. The results associated with the effect of gender inequality in primary and secondary enrolments are less robust but there is robust statistical evidence that female secondary education has a positive effect on growth in Arab countries. It is important to note that more recently (in the 1990s) there has been a significant fall in illiteracy rates in most Arab countries and a trend towards narrowing the gender gap in education at a rate faster than that observed in East Asia (Klasen and Lamanna 2003). Still, one should keep in mind that this rapid fall in the gap may convey a catching-up effect since educational levels in Arab countries are in general lower for men and women. More importantly, the observed narrowing in the gap is not inconsistent with our findings, which show that the negative effects from gender inequality in literacy on income growth in Arab countries can be higher than in sub-Saharan African countries. Thus, The fall in educational gender gaps is viewed as a cause for relief but also for call that the programs and resources underlying this trend should be extended to all areas and not limited to urban areas, as is the often the case in North African Arab countries.

The findings in the present study (using literacy rates) associated with the variables investment and human capital are in line with the empirical literature on growth. However, we do not find evidence of conditional convergence as our results suggest divergence (higher-income countries grow faster). Our findings are qualitatively consistent with the results reported in Klasen (1999, 2002), and Klasen and Lamanna (2003). In particular, the results for Arab countries are in line with the findings reported in Klasen and Lamanna

(2003).[7] The authors provide point estimates indicating that the growth reduction (per year) due to the gender gap in education in the Middle East and North Africa is about 0.7 percentage points but they stress that the cost of the gender gap in employment is even higher. This is consistent with the data on the female share of the labor force and female literacy rates. While the gap in education has been narrowed, moving Arab countries closer to other regions, the gap in employment is very large. In 2000, the share of women in the total labor force was 27.71%, the lowest in all world regions (Table 1). On the other hand, given that in our model we find that the female share of the labor force has a negative impact on growth (perhaps due to very large percentages in SSA), we should be careful in interpreting the women's share of the labor force as a suitable indicator of female equality in employment.

This paper contributes at least two new elements to the empirical literature on the effects of gender inequality in education. First, we include a larger number of Arab and African countries (41 countries) to examine the effects of gender inequality in education, and the group of countries we use is more homogenous than the samples used in Klasen (1999, 2002) and Knowles et al. (2002)[8], since they include developed and developing countries. Second, this is the first time Arellano-Bond estimations, which allow us to tackle the issue of endogeneity in dynamic panel data, is used for this type of investigation.[9] We should also point out that a potential limitation stems from the use of a short panel (4-year periods) that may not adequately capture long-term variation. However, in this study a tradeoff needed to be made; smaller sample versus shorter panel.

Finally, an important question must be raised. If female education is good for growth why don't countries try to increase the levels of female education? Empirical studies cite several reasons including culture, religion, and market failures. Dollar and Gatti (1999) argue that "[t]he fact that increases in income lead to lower gender inequality suggests that there may

[7] We must point out, however, that Klasen and Lamanna (2003) use a fixed-effects model which would normally lead to biased estimates with dynamic panel data, such as growth models containing a dependent lagged variable (initial income) on the RHS.

[8] Knowles et al. (2002) include two non-African Arab countries (Jordan and Syria) and 16 African countries, including North Africa, while Klasen (1999, 2002) does not show the list of countries.

[9] Citing Hendry (1995, p. 287), Knowles et al. (2002) argue that by removing the country-specific effect (by differencing the time-series) in a dynamic panel, the GMM estimation eliminates the between-country variation in levels. The authors rightly point out that this is of particular concern if the cross-section variation in the levels is larger than that of the time series. However, our paper includes a group of countries that is more homogenous than the ones in other studies and the data on literacy (and schooling) have changed a lot over time (within countries) so that the time-series variation is likely to be greater than the cross-section variation.

be market failures that hinder investment in girls in developing countries and that these are typically overcome as development proceeds" (p. 22). In the presence of market failures that may cause underinvestment in female education, the role of public policy in reallocating resources and creating an environment for equal opportunities is vital. It is also important to consider the supply (the provision of education) and demand (household investment in education) dimensions of gender equality in education.

On the demand side, demand for girls' education tends to be more sensitive to costs, distance to school, and school quality than demand for boys' education (World Bank 2001). Four major groups of factors that determine a household's decision to send girls to school are identified by Subrahmanian (2002). They are households livelihood and aspirations; the macroeconomic environment of the labor market; the prospects and capacities of individual children; and factors relating to schooling provision, including quality, proximity, and inclusiveness. It is clear that some of these factors may be difficult to influence by public policy, but factors relating to supply, such as school proximity (especially in rural areas), inclusiveness, quality, equal opportunities in employment can be altered by appropriate policies. On the demand side, the task could be much harder, as the factors include perceptions about the role of women that are often influenced by culture and/or religion. Civil society (NGOs) may perhaps be more successful than public policy, in raising awareness of the social and economic benefits of female education.

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Table 1: Sub-Saharan Africa, MENA and other regions of the world: Selected Indicators

	Labor force, female (% of total labor force)	Life expectancy at birth, total (years)	Literacy rate, youth total (% of people ages 15-24)	Ratio of female to male youth literacy rates (%)	Ratio of girls to boys in primary and secondary education (%)	GDP per capita, PPP (current international $)	Age dependency ratio (dependents to working-age population)
Upper middle income	36.22	71.34	96.71	100.70	101.44	8817	0.56
Sub-Saharan Africa (SSA)	41.96	46.53	77.30	88.38	81.74	1808	0.89
Middle East & North Africa (MENA)	27.71	67.87	79.99	85.32	88.08	5403	0.69
Middle income	42.07	69.48	95.14	97.49	98.26	5339	0.53
High income	43.14	77.87	..	..	101.24	26345	0.48

Data are for 2000, except those for ratio of girls to boys in primary and secondary education (%) in SSA and MENA and middle-income countries, which are for 1998.

Source: Word Development Indicators, World Bank (2003).
See Appendix A for variable description.

Table 2. Mean (first row figures) and standard deviation (second row figures) for selected variables in selected years

	Education spending (%GNI)	Age Dependency	Fertility rate	Per-capita Income growth	Income per capita ppp	Saving rate (% of GDP)	Investment rate (% of GDP)	Female adult illiteracy (%)	Male adult illiteracy (%)	Ratio F / M adult illiteracy	Female youth illiteracy (%)	Male youth illiteracy (%)	Ratio F / M youth illiteracy	Female labor force (% of total)
1970	3.20	0.90	6.65	3.91		17.71	16.41	78.36	56.92	1.44	65.47	41.19	1.80	35.55
	1.13	0.11	0.87	6.48		18.17	7.12	18.50	17.93	0.32	23.77	20.01	0.78	13.95
1975	3.38	0.90	6.61	1.76	1940	17.35	22.69	73.69	51.77	1.50	58.79	36.18	1.88	35.84
	1.24	0.13	1.02	8.68	3996	24.61	10.47	19.74	18.21	0.37	24.85	19.55	0.94	13.40
1980	3.67	0.90	6.46	-0.42	2620	15.24	21.73	68.35	46.73	1.54	52.04	31.61	1.96	36.12
	1.34	0.14	1.13	8.88	5112	23.73	8.92	21.12	18.21	0.40	25.64	19.06	1.17	12.90
1985	3.93	0.90	6.21	-0.74	2461	11.65	18.52	62.66	41.84	1.59	45.08	27.46	2.02	36.42
	1.58	0.14	1.19	7.14	3812	19.35	8.95	22.06	18.07	0.44	25.91	18.35	1.50	12.17
1990	3.83	0.89	5.77	-1.38	2705	10.42	18.85	56.93	37.22	1.64	38.51	23.61	2.12	36.71
	1.85	0.14	1.22	10.13	3843	19.30	7.47	22.62	17.80	0.50	25.50	17.42	2.23	11.50
1995	3.93	0.87	5.26	1.91	3346	10.73	21.14	51.22	32.93	1.69	32.74	20.33	2.40	37.36
	1.78	0.15	1.27	6.14	4741	16.18	12.10	22.78	17.31	0.57	24.69	16.49	4.15	10.58
2000	3.90	0.83	4.80	0.86	3252	13.41	19.46	45.42	28.88	1.74	27.66	17.58	2.49	37.92
	2.02	0.16	1.29	4.67	3864	17.25	7.94	22.64	16.72	0.64	23.40	15.46	4.82	9.72

Source: Word Development Indicators, World Bank (2003)
See Appendix A for variable description.

Table 3. correlation coefficients

	linc	logfert	flaborf	adlit	ylit	gapps	gapylit	open	lifexp	edexp	agedep	sav	invest
logfert	-0.5702												
flaborf	-0.6503	0.2350											
adlit	0.5584	-0.6121	-0.2722										
ylit	0.5411	-0.5486	-0.2958	0.9703									
gapps	-0.3781	0.5137	0.0685	-0.8096	-0.7645								
gapylit	-0.5018	0.5327	0.1560	-0.8967	-0.8811	0.8997							
open	0.4056	-0.2299	-0.2561	0.4133	0.3934	-0.3782	-0.4331						
lifexp	0.7463	-0.5489	-0.7294	0.5518	0.5633	-0.3947	-0.4530	0.3025					
edexp	0.4006	-0.2724	-0.1854	0.3947	0.3780	-0.3676	-0.3115	0.3957	0.3030				
agedep	-0.6394	0.7302	0.4427	-0.3924	-0.3256	0.3567	0.3790	-0.2331	-0.4936	-0.1461			
sav	0.5053	-0.0585	-0.4221	0.0937	0.1589	0.0820	-0.0012	0.1774	0.3452	0.1958	-0.2140		
invest	0.2697	-0.1608	-0.2123	0.2649	0.2721	-0.2433	-0.2597	0.6164	0.2181	0.2615	-0.1820	0.1586	
growth	0.0918	-0.0074	-0.0201	0.0624	0.0772	-0.0923	-0.1123	0.3189	0.0643	0.0881	0.0028	0.0696	0.4566

See Appendix A for variable description.

Table 4 : Arellano-Bond GMM Estimation; dep variable: income per capita (in log). The measure of gender inequality in education based on the gap between female and male youth literacy rates

	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6
linc	0.485 ***	0.421***	0.429***	0.427***	0.442***	.446***
	(0.063)	(0.067)	(0.063)	(0.063)	(0.062)	(0.063)
linvest	0.159***	0.142***	0.146***	0.138***	0.137***	0.132***
	(0.039)	(0.039)	(0.037)	(0.036)	(0.036)	(0.037)
open	0.0000	0.0001	0.0001	0.002**	0.002**	0.002**
	(0.0006)	(0.0006)	(0.0006)	(0.001)	(0.001)	(0.001)
lnylit	0.264	0.403*	0.338*	0.416**	(0.365)**	0.429**
	(0.215)	(0.209)	(0.203)	(0.197)	(0.205)	(0.200)
gapylit	-0.026	-0.096*	-0.090*	-0.218***	-0.214***	-0.226***
	(0.047)	(0.056)	(0.055)	(0.074)	(0.074)	(0.077)
democ	0.003	0.004	0.003	0.002	0.003	0.003
	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)
fertility	0.011				0.103	
	(0.159)				(0.152)	
flaborf		-0.037**	-0.025**	-0.020	-0.021*	-0.022*
		(0.016)	(0.013)	(0.012)	(0.012)	(0.012)
Arab_gap_ylit			-0.886***	-0.812***	-0.975***	-0.853***
			(0.307)	(0.301)	(0-.361)	(0.304)
open_gap_ylit				0.001**	0.001**	0.001**
				(0.0004)	(0.0004)	(0.0005)
Exogenous variables						
SSA [a]	-0.020	-.055***				
	(0.016)	(0.019)				
Oil	-0.023*	-0.010	-0.020	-0.032**	-0.032**	-0.029*
	(0.013)	(0.015)	(0.014)	(0.014)	(0.015)	(0.014)
Obs	137	132	132	132	132	132
m2[b], z	-1.22	-1.35	-1.34	-1.46	-1.39	-1.41
[pr >z]	[0.22]	[0.18]	[0.18]	[0.14]	[0.16]	[0.16]
Sargan test[c], chi2	127.49	124.70	131.85	128.94	126.22	125.82
[prob>chi2]	[0.26]	[0.31]	[0.26]	[0.29]	[0.31]	[0.36]

Values for the constant term are omitted. Based on the Wald test (not shown) we reject the null hypothesis of joint nonsignificance in all cases at the 1-percent or 5-percent level.

[a] The dummy variable SSA is omitted in equations 3-6 due to it strong correlation (-0.68) with the interaction term Arab_gapylit

[b] Arellano-Bond test that average autocovariance in residuals of order 2 is 0.

[c] Sargan test of over-identifying restrictions.

See Appendix A for variable description and data source.

Table 5 : Arellano-Bond GMM Estimation; Dep variable: income per capita (in log).

The measure of gender inequality in education based on the gap between female and male primary and secondary education

	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6
linc	0.339***	0.388***	0.387***	0.366***	0.380***	0.385***
	(0.090)	(0.087)	(0.104)	(0.086)	(0.092)	(0.085)
linvest	0.051	0.062	0.067	0.106**	0.106**	0.099**
	(0.056)	(0.050)	(0.052)	(0.052)	(0.053)	(0.048)
open	-0.0005	-0.0006	0.0001	-0.0004	-0.0005	-0.0014
	(0.0007)	(0.0006)	0.001	0.0006	(0.0006)	(0.0008)
Secondenr	-0.048	-0.0009	-0.0009	-0.005**	-0.005**	-0.005**
	(0.194)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
gapps	0.503**	0.308	0.231	0.422*	0.383*	0.336
	(0.249)	(0.226)	(0.321)	(0.216)	(0.225)	(0.226)
democ	0.009	0.008	0.006	0.005	0.005	0.008
	(0.006)	(0.005)	(0.007)	(0.005)	(0.005)	(0.005)
fertility	0.294		0.184	0.143	0.085	
	(0.211)		(0.212)	(0.144)	(0.184)	
flaborf		0.007	0.010	-0.0002	0.0035	-0.004
		(0.013)	(0.013)	(0.011)	(0.014)	(0.011)
Arab_gapps			-0.059			
			0.0369			
open_gap-ps			0.0003			
			(0.0003)			
Arab_femsecenr				0.004**	0.004**	0.0033*
				(0.0019)	(0.0021)	(0.0019)
flabforce_femsecenr					0.0001	
					(0.0001)	
open_ femsecenr						0.00002
						(0.00002)
Exogenous variables						
SSA	-0.043*	-0.003			0.015	
	(0.0245)	(0.023)			(0.031)	
Oil	-0.055***	-0.042*	-0.056**	-0.041*	-0.043*	-0.033
	(0.021)	(0.023)	(0.025)	(0.022)	(0.0225)	(0.023)
obs	67	66	66	66	66	66
m2[b], z	-0.33	-0.42	-1.46	-0.97	-0.96	-069
[pr >z]	[0.73]	[0.67]	[0.15]	[0.33]	[0.33]	[0.49]
Sargan test[c], chi2	48.77	60.53	41.78	58.76	58.12	60.09
[prob>chi2]	[0.282	[0.32]	[0.20]	[0.24]	[0.26]	[0.26]

Values for the constant term are omitted. Values for the constant term are omitted. Based on the Wald test (not shown) we reject the null hypothesis of joint nonsignificance in all cases at the 1-percent or 5-percent level.

[a] The dummy variable SSA is omitted in equations 3-6 due to it strong correlation (-0.68) with the interaction term Arab_gapylit

[b] Arellano-Bond test that average autocovariance in residuals of order 2 is 0.

[c] Sargan test of over-identifying restrictions.

See Appendix A for variable description and data source.

Appendix A

A1. Data description and source

Arab: A dummy variable taking the value of 1 if the country is an Arab country and 0 otherwise. Sudan and Mauritania are members of the Arab league but are not included in Arab countries in this paper due to significant cultural differences.

agedep: Age dependency ratio; dependents to working-age population. Age dependency ratio is the ratio of dependents—people younger than 15 and older than 64—to the working-age population—those ages 15-64. Source: World Development Indicators CD-ROM (WDI).

fertility: Fertility rate, total (births per woman). Total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with prevailing age-specific fertility rates. Source: WDI.

logfert: Log of fertility.

flaborf: Labor force, female (% of total labor force). Female labor force as a percentage of the total show the extent to which women are active in the labor force. Source: WDI.

invest: investment or Gross fixed capital formation (% of GDP); gross domestic fixed investment as a % of GDP. Source: WDI.

linvest: log of investment.

linc: log of GDP per capita, PPP (current international $). PPP GDP per capita is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. Source: WDI.

Illiteracy rate: adult female or male (% of females or males ages 15 and above): Adult illiteracy rate is the percentage of people ages 15 and above who cannot, with understanding, read and write a short, simple statement on their everyday life. Source: WDI.

Illiteracy rate, youth female or male (% of females or males ages 15-24): Youth illiteracy rate is the percentage of people ages 15-24 who cannot, with understanding, read and write a short, simple statement on their everyday life. Source: WDI.

lnylit: log of youth literacy rates (total).

gapylit: The difference between absolute equality (ratio of 1) and the actual ratio of youth female to male literacy rates. Source: Authors calculation.

open: Trade (% of GDP): The sum of exports and imports of goods and services measured as a share of gross domestic product. Source: WDI.

Arab_gap_ylit: Interaction term between the variable gapylit and the dummy variable 'Arab'.

open_gap_ylit: Interaction term between the variable gapylit and the variable open.

Ratio of girls to boys in primary and secondary education (%): The percentage of girls to boys enrolled at primary and secondary levels in public and private schools. Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Source: WDI.

gapps: calculated (by the author) as the difference between absolute equality (ratio of 1) and the actual ratio of girls to boys in primary and secondary education (%).

Secondenr: Secondary enrolment (total, gross) The percentage of girls and boys enrolled in secondary levels in public and private schools. Gross enrolment is total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Source: WDI.

femsecenr: Female secondary enrolment (gross) The percentage of girls enrolled in secondary levels in public and private schools. Gross enrolment is total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Source: WDI.

Arab_gapps: Interaction term between the variable gapps and the dummy variable 'Arab'.

open_gapps: Interaction term between the variable gapps and the dummy variable open.

Arab_femsecenr: Interaction term between the variable femsecenr and the dummy variable 'Arab'.

flabforce_femsecenr: Interaction term between the variable femsecenr and the flaborf.

open_ femsecenr: Interaction term between the variable femsecenr and the open.

democ: An indicator of institutional democracy. Source: *Polity IV Project,* Marshall, Monty G. and Jaggers, Keith (2003).

Oil: A dummy variable taking the value of 1 if the country is an oil producing country and 0 otherwise.

SSA: A dummy variable taking the value of 1 if the country is in sub-Saharan Africa and 0 otherwise.

A2. List of countries

Botswana
Burkina Faso
Burundi
Cameroon
Central African Republic
Chad
Congo, Dem. Rep.
Congo, Rep.
Eritrea
Ethiopia
Gambia, The
Ghana
Guinea-Bissau
Kenya
Lesotho
Malawi
Mali
Mauritania
Mauritius
Mozambique
Namibia
Niger
Nigeria
Rwanda
Senegal
South Africa
Sudan
Tanzania
Togo
Zambia
Zimbabwe

Algeria
Egypt, Arab Rep.
Jordan
Kuwait
Morocco
Oman
Saudi Arabia
Syrian Arab Republic
Tunisia
United Arab Emirates