Gender Inequality and the Demographic Dividend

Jeffrey Edmeades

Janna McDougall

Anju Malhotra

Margaret Greene

International Center for Research on Women

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Contact information:

Jeffrey Edmeades

Email: jedmeades@icrw.org

Telephone: 202-742-1217

ABSTRACT: Much attention in the development field has focused in recent years on research on the "demographic dividend." Considerable research has also evolved at the same time on gender inequities and the effects of efforts to overcome them for economic development. However, the implications of gender inequality for realizing the benefits of the demographic dividend have not been explored. Given decades of theorizing about the links between fertility decline and women's status, this appears to be an important oversight. This paper provides a theoretical framework for modeling the relationships between gender and the demographic dividend and tests these relationships using comparative macro-level data. We estimate a random-effects model of economic growth using ordinary least squares for the 1965-1999 period that includes a series of interaction terms between gender inequality in educational attainment and other determinants of growth, including a measure of the dividend. Our results indicate that higher levels of inequality both lower growth directly and by reducing the effectiveness of the dividend, reinforcing the importance of investing in girl's education, particularly for countries who have yet to enter their dividend period.

INTRODUCTION

Recent years have seen a revival in interest in the role of the demographic determinants of economic development, with a particular focus on the 'demographic dividend' that may result from the emergence of an age structure particularly favorable to economic growth (Bloom, Canning and Malaney 2000; Bloom, Canning and Sevilla 2003; Bloom and Williamson 1998; Lam 2006; Tuljapurkar, Pool and Rupfolo 2005). Research in this area has emphasized that the degree to which this dividend is realized depends on the adoption of national policies to improve health, lower fertility, increase human capital, and encourage participation in the formal labor force (Bloom et al. 2003). However, despite an extensive body of literature demonstrating that gender inequality is a barrier to these policy outcomes, to our knowledge no research has been conducted that directly examines the impact of gender inequality on the effectiveness of the dividend.

This is surprising given both the growing body of research examining the importance of gender inequality, such as in wages or education, for economic growth (e.g. for education see Barro and Lee 2000; Klasen 1999, 2002; for wages Seguino 2000b; Seguino 2002; for labor force participation Tzannatos 1999), and the role that women's status plays in the fertility and mortality changes that fuel the dividend (for fertility, see Galor and Weil 1996; Gatti 1999; Klasen 2002; Lagerlof 1999; Murthi and Dreze 2001; Schultz 1994; Summers 1994); (for mortality, see Schultz 1994; Summers 1994). This article addresses this gap in the literature by first developing a theoretical model linking gender inequality and the demographic dividend, and then testing this empirically using a cross-country panel dataset covering the period between 1965 and 1999.

This research contributes in a number of ways to the literature on the determinants of economic growth. First, we extend the period covered by the analysis to include the 1990-1999 period, an advance on prior studies that have typically focused on the pre-1990 period. This is important because the resulting dataset includes a more diverse range of economic and demographic experiences than has been the case in prior research in this area, particularly because it includes the years of the Asian financial crisis. Second, we build on the newer empirical models of economic growth developed to isolate the effect of demographic determinants of growth (Bloom et al. 2000; Bloom et al. 2003; Bloom and Williamson 1998; Crenshaw, Ameen and Christenson 1997) by identifying and modeling ways in which the effect of age structure differs depending on development level. Finally, we explore both the direct and indirect effect of gender inequality on economic growth by including a measure of the difference in educational attainment between men and women and then interacting this with the key variable capturing the effect of the dividend, initial development level and a measure of growth in the total population.

The findings from the analyses conducted in this paper suggest that gender inequality in education has a negative effect on growth, both directly and though reducing the effectiveness of the demographic dividend. These findings contrast with those of recent research that has found that inequality, at least in terms of wages, may have a positive effect on growth (Seguino 2000aa; 2000bb), and have a number of important policy implications. These policy implications are particularly relevant for those countries which have yet to enter the dividend period of their demographic trajectory, a group that includes most of sub-Saharan Africa and many countries in Latin America, South and Southeast Asia, and the Middle East (for a review of when individual countries and regions will reach this point, see Lam 2006).

LITERATURE REVIEW

Demographic Change, Economic Growth, and the Demographic Dividend

The debate on the role of demographic factors in shaping economic growth has been largely dominated by two opposing theoretical paradigms. The arguments of the first are based largely in a Malthusian understanding of the relationship between population and per capita output, arguing that rapid population growth stunts economic growth by overwhelming available natural and human resources (Coale and Hoover 1958; Ehrlich 1968). In contrast, the second group argues that population growth may generate economic growth though stimulating innovation and enabling countries to take advantage of the resulting economies of scale (Boserup 1981; Kuznets 1967; Simon 1981). Despite the prominence of these arguments in the population and development field, the empirical evidence of the effect of population change on economic growth is inconsistent. While there is some empirical support for both camps (Barlow 1994; Coale 1986; Jackman 1982; McNicoll 1984) the majority of cross-national research in this area has failed to find a statistically significant relationship between population and economic growth (Bloom and Freeman 1988; Kelley 1988).

In recent years, these explanations have been criticized for their focus on population size and growth rates at the expense of other potential aspects of population change that may influence economic growth, particularly fertility and mortality levels. Because identical growth rates may result from multiple combinations of birth and death rates, this focus ignores the potential variation in population age structure within countries with similar population growth rates (Coale 1986; McNicoll 1984). The failure to examine age structure as a specific determinant of economic growth is problematic because certain age distributions may be more favorable to growth than others. This is particularly the case in the intermediate stages of the demographic transition, where fertility declines rapidly in an environment of declining mortality rates. The combination of these two factors results in a ‘bulge’ in the population pyramid that is initially concentrated in the younger ages. The entry of these disproportionately large cohorts into age groups where they begin to participate in the workforce results in a reduction in the ratio of the economically dependent population (i.e. children and the elderly) to the economically productive population. Because individuals in this life stage produce more than they consume, at the aggregate level this bulge may result in an increase in per capita output. In addition, the changes in behavior that typically accompany smaller family size (such as increased saving and a higher level of investment in human capital), may also result in higher rates of economic growth (Knodel, Havanon and Sittitrai 1990; Knodel and Wongsith 1991; Rosenzweig 1990), further amplifying the effect of the changes in age structure.

Variously referred to as the demographic ‘gift’, ‘bonus’ or ‘dividend’, the emergence of this age pattern may provide countries with a unique, albeit relatively short-lived, opportunity for rapid economic growth and development.

While the potential importance of age structure for growth has been theorized for some time (Coale 1986; Coale and Hoover 1958; Kuznets 1966; Kuznets 1967), it is only relatively recently that this has been explored empirically (Ahlburg, Kelley and Mason 1996; Birdsall, Kelley and Sinding 2001; Bloom, Canning and Sevilla 2002; Bloom and Williamson 1998; Chu and Lee 2000; Crenshaw et al. 1997; Mason 2001; Mason, Merrick and Shaw 1999). While research in this area has differed in terms of methodological approach, geographic focus, and the approach taken to measuring demographic change, their conclusions suggest a consistent and substantial positive effect of the demographic dividend on economic growth (Bloom et al. 2000; Bloom et al. 2002; Bloom and Williamson 1998). However, this research also suggests that economic growth is not a guaranteed result of the emergence of a favorable age structure. Rather, whether or not the demographic dividend is realized depends to a significant extent on the policy environment prevalent in individual countries. Bloom, Canning, and Sevilla (Bloom et al. 2002) identify four key policy areas that influence the success of the dividend: public health, family planning, education, and economic policies that encourage an open and flexible economy (Bloom et al. 2002). Despite the substantial bodies of literature documenting the importance of gender inequality and women’s status to the successful implementation of each of these policies, research on the demographic dividend has to this point lacked a gendered perspective. In the following section, we discuss the theoretical and empirical linkages between economic growth and gender inequality, and then discuss how these relate to the demographic dividend.

Gender Inequality and Economic Growth

As a number of authors have noted, the economics field has yet to fully accept the importance of gender and gender-based inequality to macroeconomic outcomes (Seguino 2002; Stotsky 2006). As a result, it is only relatively recently that empirical analyses of the determinants of economic growth have included any measures of gender inequality, and the theoretical justification for their inclusion has been almost entirely instrumental in nature. While this in part reflects a lack of familiarity among economists with the arguments developed in other fields for the relationship between gender and economic growth, the inclusion of gender in empirical growth models has also been hampered by a number of practical considerations. The multifaceted nature of the concept of gender presents a number of measurement challenges, as myriad social, demographic, and economic factors may be relevant in any given context. As a result, economic growth may be influenced by multiple dimensions of gender inequality, either individually, or in conjunction with each other. This complexity makes operationalizing measures of gender inequality difficult, particularly at the macro level where detailed gender-disaggregated data are often unavailable. As a result, most measures of gender inequality are typically somewhat crude and simplistic, making a nuanced assessment of the effect of gender inequality on economic growth difficult.

Despite these challenges, a growing body of empirical research has emerged in recent years examining this relationship. This research has focused primarily on two aspects of gender inequality: gendered gap in labor force experience, and differences in terms of human capital accumulation. The measures of inequality emphasized by the former group include occupational sex segregation (Meyer 2003; Tzannatos 1999), gendered differences in earned wages (Forbes 2000; Mammen and Paxson 2000; Seguino 2000a, 2000b; Standing 1999; Tzannatos 1999), and differences in rates of participation in the non-agricultural labor force (Mammen and Paxson 2000; Tansel 2002). The findings of these studies suggest that the effect of labor force inequalities on economic growth depend to a significant extent on the measure of inequality used. While occupational sex segregation and an unequal participation in the non-agricultural labor force have been found to deter growth, a large differential in the wages received by men and women may have the effect of stimulating growth, at least in the short run (Mammen and Paxson 2000; Seguino 2000a, 2000b). These findings at least in part reflect the groups of countries included in the analyses, as none of these studies draw from a sample of countries that are representative of the world as a whole.

The research focusing on human capital accumulation, which typically includes a wider range of countries, has used number of health based measures (Baldacci et al. 2004; Forsythe, Korzeniewicz and Durrant 2000), such as life expectancy (Forsythe et al. 2000) and nutritional outcomes (Smith and Haddad 1999), and differences in educational attainment to measure gender inequality (Barro and Lee 1994; Barro and Sala-i-Martin 1995; Benavot 1989; Dollar and Gatti 1999; Kalaitzidakis, Mamuneas and Savvides

2001; Klasen 1999, 2002; Knowles, Lorgelly and Owen 2002; Lagerlof 1999, 2003; Yamarik and Ghosh 2004). The majority of the quantitative research done in this area has focused on the last of these, particularly over the past decade. The reasons for this are both practical and substantive. From a practical standpoint, education is the most easily measured indicator of human capital (Birdsall, Ross and Sabot 1997), and focusing on educational inequality avoids some of the challenges associated with other measures of inequality. While the available data on education are typically not gender-disaggregated, particularly prior to 1980, the dataset compiled by Barro & Lee (Barro and Lee 2000) does include estimates of educational attainment for both males and females from 1955 to the present, for a wide range of countries[1]. A further advantage to using educational attainment in cross-national analyses is that the definitions used are based on established and internationally recognized definitions and data is routinely collected at the national level. More substantively, education is a key component of economic growth that has been shown to significantly influence growth in a wide variety of contexts (Barro 1991; Kalaitzidakis et al. 2001), and inequality in educational attainment is acknowledged to be an important indicator of underlying gender-based inequality (Summers 1994).

Early efforts to introduce measures of gender inequality in education into models of economic growth found that inequality had no effect or even boosted growth (Barro and Lee 1994; Barro and Sala-i-Martin 1995). However, the empirical evidence supporting a positive effect of gender equity in education on economic growth has grown considerably in recent years (Abu-Ghaida and Klasen 2004; Dollar and Gatti 1999; Hill and King

[1]This is not the case for the other cross-national datasets on educational attainment, such as that developed by Cohen and Soto, which does not include information on men and women separately.

1993, 1995; Klasen 2002; Knowles et al. 2002). While a number of potential mechanisms through which improving educational equity may encourage growth have been identified in this literature, four have emerged as particularly significant. Firstly, reducing the gap between males and females in educational attainment typically results in an increase average human capital throughout the population, thereby also increasing the potential for economic growth (Klasen 2002).

Secondly, women's education results in both direct and indirect positive externalities that lead to increases in economic growth. In particular, well educated women tend to invest more in the education of their children, increasing both the quality and quantity of the intergenerational transfer of human capital (Klasen 2002). Indirectly, educational equality operates through demographic effects to boost economic growth (Klasen 2002; Lagerlof 2003), particularly through lower fertility rates and decreased child mortality (Abu-Ghaida and Klasen 2004; Bloom and Williamson 1998; Galor and Weil 1996; Klasen 2002; Lagerlof 2003). These demographic changes may contribute to economic growth by stimulating savings and investment, as household and national assets are spread amongst fewer dependents and workers, and by increasing the share of workers relative to the rest of the population (the demographic dividend) (Bloom et al. 2000; Bloom and Williamson 1998; Klasen 2002).

In addition, the dependency ratio within households and nationally, a substantial body of literature suggests that women tend to save and invest more and more productively than men. Recent research has noted that women tend to have a higher saving rates than men

(Floro 2001; Seguino and Floro 2003; Stotsky 2006), are more likely to invest in productive ways (Stotsky 2006), and are more likely to devote household resources towards basic requirements and investment in their children. As a result, enhancing women's capacity to save or make investment decisions is likely to result in aggregate increases in savings, more productive investment behavior, and greater intergenerational transmission of wealth and human capital than solely investing in men[2]. Educated women are also better able to ensure the health of themselves and other household members, magnifying the effect of education on growth.

Finally, and underlying many of the above mechanisms through which women's schooling contributes to growth, education increases women's capabilities and overall well-being, enhancing women's abilities to make choices and act on them freely (Abu-Ghaida and Klasen 2004; Arends-Kuenning and Amin 2001; Nussbaum 2000; Sen 1997, 1999). The implications of this for growth include women's increased say over their fertility, household consumption, savings, and expenditure, and their participation in the labor force. Research in this area indicates that more educated women are more likely to have lower fertility (Abu-Ghaida and Klasen 2004; Klasen 2002; Lagerlof 1999), higher labor force participation and saving rates, and higher expenditures (partly due to increased income), all of which have been shown to have a positive effect on economic growth.

[2] In fact, a number of studies have argued that investing in women's education generates a higher rate of return than men's education for these same reasons (Dollar and Gatti, 1999; Schultz, 1993). If this is the case, disadvantaging women may have an even greater impact on growth than is typically argued, particularly in the longer term.

Gender Inequality, the Demographic Dividend, and Economic Growth

The above discussion suggests a number of reasons to expect gender inequality to influence the degree to which the demographic dividend is realized in terms of economic growth. In addition to playing a key role in the demographic changes that underlie the demographic transition, and thus the dividend, gender inequality may have a significant influence over many of the key economic mechanisms linking changes in age structure to growth.

Gender inequality may influence both the size and the quality (in terms of economic productivity) of the labor force. Most of the literature on the dividend implicitly assumes that shifts in the size of the population in the most economically productive age groups will be mirrored by equally large shifts in the size of the labor force. While this is generally true, the degree to which women are able to participate in the formal, non-agricultural economy is very dependent on social norms regarding gender-appropriate behavior. In the most extreme cases, women are largely barred from attending school and participating in non-familial employment, and face significant restrictions on their individual mobility. As a result, women in these situations contribute only indirectly to economic production, virtually halving the potential gains implied by numerical increases in the population within the working ages. Gender inequality may also lead to an inefficient allocation of labor resources within the labor force, either by excluding women from certain occupations or by reducing their ability to advance professionally.

In both cases, this implies that more able female workers may be replaced by less able male workers, reducing overall productivity.

Inequalities in terms of human capital accumulation may also reduce the effectiveness of the dividend in a number of ways, both in terms of health and education. Because education plays a key role in enhancing economic productivity at the individual and aggregate levels, the lower average levels of education in the population resulting from gender discrimination can be expected to lower growth, dampening the effect of increases in the size of working-age cohorts that lie behind the dividend effect. While this is true regardless of the type of economic activity women are engaged in, it is particularly important when combined with a growing non-agricultural sector that both demands and rewards the skills attained through formal education.

Both through direct effect and in dampening the positive effects of the demographic dividend, overall economic productivity will be lower if women are disadvantaged in terms of human capital accumulation. While all aspects of human capital may be important for growth, we limit our discussion here to education. The importance of skills gained through formal education in boosting economic output from the non-agricultural sector implies that the productivity of the dividend cohorts will be lower when there is inequality in educational opportunities, therefore lowering the growth potential of the dividend in much the same way as restricting women's labor force participation. Much the same applies to the indirect effects that educating women may have on growth. For example, the economic losses resulting from lower savings as a consequence of women's exclusion from formal education are magnified during a country’s dividend period, further reducing the arithmetic effect of larger working-age cohorts.

RESEARCH HYPOTHESES

On the basis of the methodological facility and substantive importance of gender inequality in education discussed previously, and the role that education plays in realizing the positive effects of the demographic dividend, we focus our analysis on the educational dimension of gender inequality. We developed four basic hypotheses that guide our analysis of the relationship between educational inequality and the demographic dividend:

1. Gender inequality in education has a direct and detrimental effect on growth, even controlling for demographic factors, including the age structure that drives the dividend.
2. The effect of the dividend will be lower when initial development levels are higher due to the higher growth potential in less developed economies.
3. Gender inequality in education moderates the effects of a number of key determinants of growth, lessening their effect.
4. The effect of the dividend will be lower at higher levels of inequality.

DATA AND METHODS

The analytical approach we follow in this paper builds on existing models exploring the effect of the demographic dividend on economic growth. We base our empirical approach on that developed by Bloom, Canning, and Malaney (Bloom et al. 2000), who use panel data from a wide range of countries from 1965 to 1990, and extend this both by including a measure of gender inequality in secondary education (the ratio of female to male years of completed secondary school) and including data for the period between 1990 and 1999. This allows us to empirically identify the independent effect of differences between male and female educational attainment, and thus provide a more detailed explanation of the pathways through which the dividend is realized in terms of economic growth.

We use an updated version of the dataset used by Bloom, Canning, and Malaney (Bloom et al. 2000) that includes data from a variety of sources for a large sample of countries and time periods. Table 1 provides a description of the variables used in the analyses in this paper, including where they were obtained from and the relevant descriptive statistics. All countries with data on the full set of variables are included in the analyses (resulting in a dataset of roughly 470 records drawn from 82 countries)[3] , with a further two countries removed because they proved to be outliers that significantly altered the findings of the models[4].

[3] Please see Appendix 1 for a full list of these countries.
[4] These countries were: Ghana and South Africa. A visual examination analysis of the regression residuals suggested that in at least one time period these countries were outliers, and the entire country record was removed from the analyses dataset.

We use these data to estimate a random-effects model of economic growth using ordinary least squares (OLS) over the 1965-1999 period. The dependent and independent variables are all time-varying, each corresponding to a five-year period within this time frame. This is the equivalent of running five cross-sectional regressions with the assumption of common coefficients across the time periods included (see Bloom et al. 2000 for a detailed description of this approach). The independent variables include some measured only in the base year of each period (e.g. 1965 for the 1965-1969 period), and others that measure change over the five-year period. The dependent variable is the logged annual average percentage growth of real GDP per capita in purchasing power terms over each of the five year periods between 1965 and 1999.

Two major weaknesses have limited previous research using this modeling approach. The first is multicollinearity; many determinants of economic growth are highly correlated, which may limit the reliability of coefficient estimates and their standard errors. We take three steps to avoid this problem – first, we include one measure of the gender gap in education and one measure of total educational attainment, rather than individual variables for male and female attainment, which are highly correlated. Next, we include growth of the total population in the models but exclude growth of the working age population, as the measures are highly correlated with each other. Lastly, we center several key variables, particularly those used in interaction terms (the demographic dividend ratio, population growth, and initial GDP), around their means.

The second limitation of economic growth modeling stems from potential problems with simultaneity. Although we expect that gender equality in education will lead to higher growth rates, economic growth may also lead to reductions in gender inequality (Dollar and Gatti 1999; Forsythe et al. 2000). We address this limitation by focusing on gender inequality in secondary education in the population over 15 years old, which is largely determined by past rather than current economic conditions. As a result, while current GDP growth may result in lower educational inequality, there is a significant time lag before current economic progress results in changes in average school attainment at the population level. It is also possible that growth in GDP contributes to reductions in total population growth, rather than the reverse relationship. To examine this possibility, we re-estimated our models using an instrumental variable approach, using total population growth rate in the 1960-1964 period, total fertility rate in 1965 and infant mortality rate in 1965 as instruments for the total population growth rate (see Appendix 2 for these results). These variables are appropriate instruments because they refer to time periods before those included in our analyses, and therefore cannot be influenced by the growth rates in subsequent years[5].

The first model replicates the demographic specification of Bloom, Canning and Malaney (Bloom et al. 2000), with the addition of a control variable for the relative contribution of agriculture to GDP, which acts as measure of the structure of the economy. The

[5] As noted by Bloom, Canning, and Malaney (2000) and others, these instruments may be problematic if economic growth in a given period is highly correlated with past economic growth, as previous growth may have influenced the population variables. However, prior research suggests that the use of five year periods rather than individual years largely avoids this issue (Easterly, W., M. Kremer, L. Pritchett, and L. Summers. 1993. "Good policy or good luck: Country growth-performance and temporary shocks." *Journal of Monetary Economics* 32(3):459-483.).

independent variables include: a number of measures typically used in analyses of economic growth (GDP per capita the base year (a proxy for initial development level), whether the country is located in the tropics, whether it is landlocked, a measure of the quality of its social and economic institutions, a measure of the degree to which the country was 'open' in terms of economic trade over the five-year period, and the average years of secondary education in the population in the base year); a number of demographic characteristics of the country (the ratio of working-age to total population in the base year (the central measure of the demographic dividend a country experienced), growth of the total population over the five-year period, and population density in the base year); and a series of dummy variables adjusting for time period[6]. We expect that the lower a country's GDP relative to its steady state income level, the faster it will grow, that growth of the total population will slow economic growth, and that increases in the ratio of the working age to the total population will lead to faster growth, as found in the economic growth literature (see for example Bloom et al. 2000; Bloom and Williamson 1998). The multiple regression equation used to estimate this model is:

$$g_y = \beta_0 + \beta_1(y) + \beta_2(g_p) + \beta_3 \log(W/P) + \beta_4(X) + \varepsilon \tag{1}$$

where g_y refers to the growth of real GDP per capita in purchasing power terms over each of the five year periods, y is the GDP per capita the base year, g_p is the growth of the total population over the 5 year period, $\log(W/P)$ is the log of the ratio of working age to total

[6] For a description of the rationale behind the inclusion of these variables, please see Bloom, Canning, and Malaney (2000), pages 263-264.

population, X is the vector of factors known to affect economic growth, and ε is random error. The regression analyses for this basic model are presented in Table 2 as Model 1.

We then add the ratio of female to male average years of secondary schooling at the beginning of the five year period to the model, dividing the ratio into three categories: country-periods where women are favored over men (Inequality 1 in the tables), country-periods with moderate inequality (where the ratio is between 0.75 and 1, labeled Inequality 2 in the tables), and country-periods with high inequality (where the ratio is below 0.75, reference category). This is modeled in the following way:

$$g_y = \beta_0 + \beta_1(y) + \beta_2(g_p) + \beta_3 \log(W/P) + \beta_4(I_1) + \beta_5(I_2) + \beta_6(X) + \varepsilon \qquad (2)$$

where I_1 is the group of countries where female education exceeds male education and I_2 is the group of countries with nearly equal male and female education. The model tests how educational inequalities directly affect economic growth, and we expect that countries with lower levels of inequality will experience higher growth (Dollar and Gatti 1999; Klasen 2002; Knowles et al. 2002; Yamarik and Ghosh 2004). This model is labeled Model 2 in Table 2.

Next, we include an interaction between the initial GDP level and the demographic dividend ratio to explore if the effect of the dividend is contingent on initial development level (Model 3 in Table 2). We expect that the dividend will have less of an effect at higher levels of GDP, where the potential for rapid growth is less than at lower levels, essentially in keeping with standard convergence arguments. The resulting model takes the form:

$$g_y = \beta_0 + \beta_1(y) + \beta_2(g_p) + \beta_3 \log(W/P) + \beta_4(I_1) + \beta_5(I_2) + \beta_6 [\log(W/P) * g_p] + \beta_7(X) + \varepsilon \qquad (3)$$

Finally, we test how educational inequalities modify or enhance the effects of known determinants of economic growth (Model 4 in Table 2). Our primary interest is in how gender inequalities affect the relationship between the demographic dividend (i.e. the ratio of working age to total population) and economic growth, which we model through the inclusion of an interaction term between the inequality and dividend measures. Secondly, we examine whether the effect of initial development level on growth depends on educational inequality by including an interaction between the two. Thirdly, the model tests whether educational inequalities condition the effect of population growth on economic growth, by including a term that reflects the interaction between educational inequality and population growth. The inclusion of these interactions to the model yields the equation:

$$g_y = \beta_0 + \beta_1(y) + \beta_2(g_p) + \beta_3 \log(W/P) + \beta_4(I_1) + \beta_5(I_2) + \beta_6 [\log(W/P) * g_p] + \beta_7 [\log(W/P) * I_1] + \beta_8 [\log(W/P) * I_2] + \beta_9 [y * I_1] + \beta_{10} [y * I_2] + \beta_{11} [g_p * I_1] + \beta_{12} [g_p * I_2] + \beta_{13}(X) + \varepsilon \qquad (4)$$

We expect that gender inequality in education will decrease the effectiveness of the demographic dividend, such that at higher levels of inequality the ratio of working age to total population has a less positive effect on economic growth. Next, we anticipate that gender inequality dampens the convergence effect of initial development level, as equitable education policy is a factor on which convergence is conditional. That is, for two countries of a given initial GDP and a given steady state income level, the one with a more equal distribution of education will grow faster than the one with a more unequal distribution of education. Thirdly, we expect that the growth of the total population will exert a negative effect when education is not distributed equally between genders, and the growth limiting effects of increases in total population will be less at lower levels of inequality.

The model presented in equation 4 provides a formal statistical test of the negative influence of gender inequality on three robust predictors of economic growth. However, a strong theoretical rationale exists to suggest that gender equality is actually fundamental to economic growth, and inequality can reduce the effects of all growth determinants. One model to test this hypothesis is unfeasible with existing statistical methods, as including interaction terms between gender inequality and *every* determinant of economic growth would yield extreme multicollinearity. To avoid this problem, we model the interactive growth model under the demographic specification, including the interaction between the demographic dividend and initial GDP level, separately for each of the three levels of inequality (Models 5 – 7 in Table 3). While this does not allow for formal tests of the differences between the two groups, the results provide useful interpretational support for the model described by equation 4. The following equation describes these models:

For $I = i$:

$$g_y = \beta_0 + \beta_1(y) + \beta_2(g_p) + \beta_3 \log(W/P) + \beta_4 [\log(W/P) * g_p] + \beta_5(X) + \varepsilon \qquad (5)$$

where i represents 1) female advantage, 2) moderate inequality favoring males, and 3) extreme inequality favoring males. As with model 4, we expect that at extreme inequality, all determinants of economic growth will be less effective than when females are favored or experience less educational discrimination.

RESULTS

Table 2 reports the findings from our cross-country regressions for models 1 – 4. Model 1 (Column 1) replicates the Bloom, Canning and Malaney (Bloom et al. 2000) demographic specification. As expected, the demographic dividend measure (the ratio of working-age to total population) has a strong and positive effect on economic growth, a finding consistent with other work using this approach (Bloom et al. 2000; Bloom and Williamson 1998), while the initial level of GDP per capita has a strong negative effect on growth (convergence). Other factors on which income convergence is conditional show the expected effect on economic growth (tropical location and landlocked geography slow growth; institutional quality and economic openness have a positive effect on growth; level of total schooling in the population (a stock measure of human capital), growth in the total population, and the percentage of the GDP from agriculture all exert negative pressure on economic growth, and population density has almost no effect on economic growth), after controlling for time period. These results are fairly robust across all models.

Column 2 of Table 2 presents the estimates from our basic additive model, which measures the direct effect of educational inequality on growth. The ratio of the working age to total population again has a significant and positive effect on economic growth, and all established determinants of economic growth behave in the expected fashion. Educational equality has a positive effect on GDP growth, supporting recent findings from the economic growth literature (see for example Dollar and Gatti 1999; Klasen 2002; Knowles et al. 2002; Yamarik and Ghosh 2004). The coefficient estimates for both educational inequality categories also suggest that while female advantage and near educational equality do not appear to have statistically different effects from each other, extreme educational inequality seems to act as a strong damper on growth.

Our third model departs from traditional economic growth models exploring the role of demographic variables on economic growth by entering into the model the interaction between the demographic dividend ratio and the initial level of GDP. The effects of growth determinants examined in models 1 and 2 (including the demographic dividend ratio and educational equality) remain robust to this specification, and addition of the interaction terms improves the overall explanatory power of the model. The coefficient on the interaction term is highly significant, large in magnitude and negative, which suggests that at higher levels of initial income, the demographic dividend has a stronger effect on economic growth than at lower levels of GDP.

Next, column 4 in Table 2 presents findings from the model examining how the effects of the demographic dividend, initial level of GDP and total population growth depend on gender inequality, and improves predictive value of the model. The most striking finding in this model is that the demographic dividend does depend on the level of educational inequality, and strongly so. The effect of the demographic dividend is significantly larger in country-periods where women either are advantaged in education or are nearly equal than in country-periods where they are highly disadvantaged. This effect appears stronger in country-periods with female advantage than country-periods with moderate inequality. These findings suggest that educational equality plays an important role in creating an environment in which the demographic dividend can be optimally realized.

Furthermore, educational inequality appears to dampen the possibility of income convergence; the effect of initial GDP is significantly more negative at lower levels of inequality than at high inequality. That is, educational equality seems to be a necessary condition to achieve faster growth towards a steady state income for a given level of initial GDP. Thirdly, at the highest levels of gender inequality population growth exerts a significantly negative effect on economic growth. However, when educational attainment is distributed more equally between males and females, increasing population size positively contributes to economic growth. It appears that when large population cohorts are well and equally educated, demographic forces that may otherwise strain resources in fact lead to greater GDP growth, in keeping with existing theories regarding the demographic dividend.

These results support the theory and empirical evidence that gender inequality works through multiple mechanisms to influence economic growth. The direct, negative effect of gender inequality on growth is robust across each specification estimated in models 2 – 4. Furthermore, in addition to the indirect effect of educational equality through externalities such as increased savings and investment, increased demand for social services, increased spending and childbearing changes that lead to the emergence of the demographic dividend, education inequality appears to mediate at least three established relationships to economic growth. First, inequality reduces the extent to which the positive effects of the demographic dividend on economic growth are realized. Second, educational inequality is a condition that dampens the speed at which countries converge towards their steady state income. Thirdly, educational inequality ensures that growth in the population detracts from economic growth, rather than boosting it.

Finally, models 5 – 7 in Table 3 support these findings and suggest that gender inequality acts as a fundamental brake on economic development. Although its positive effect is robust across all of our models and throughout a variety of earlier studies (Bloom et al. 2000; Bloom and Williamson 1998), the demographic dividend has only a weak positive and statistically insignificant effect on economic growth at the highest levels of inequality (Column 1, Table 3). Again confirming the results of model 4, the convergent effect of initial GDP increases as the distribution of education becomes more equitable across the population, and at lower levels of inequality, growth in the total population does not exert downward pressure on GDP growth. Finally, the interaction between the demographic dividend and initial level of GDP is consistent in direction across the three levels of inequality, but not in magnitude or significance. These results are consistent with the fully interactive model (model 4).

DISCUSSION

This study adds to the economic growth and demographic dividend literatures in a number of ways. First, our findings confirm results from a range of recent studies that demonstrate that gender inequality in educational attainment slows economic growth. When countries put girls at a disadvantage relative to boys, they incur a significant cost in overall economic productivity, in addition to the social costs of ignoring the rights of girls. Secondly, we extend existing models of the effect of the dividend on growth by empirically accounting for the differential impact of the dividend at different levels of GDP. Finally, we account for the ways in which gender inequality in education may influence growth in a much more comprehensive way than has been previously done, modeling its effect on a variety of determinants of growth. The results of this analysis suggest that inequality has a broadly negative effect on growth by reducing the effectiveness of a number of key drivers of growth.

While there are a number of results of note from our analyses, we focus our discussion primarily on the impact of gender inequality on the effectiveness of the dividend in delivering higher rates of economic growth. Our findings suggest that while the dividend does have an overall positive effect on growth, this effect is greater in situations where women are less disadvantaged. This finding is important for a number of reasons. Because the demographic dividend is largely a one-time phenomenon, policies that ensure the efficacy of favorable population age structure are critical to capitalizing on its potential for economic growth. While this has been hypothesized in prior research on the dividend, we are able to demonstrate this effect empirically, providing further impetus for the implementation of policies to encourage female achievement in education.

A very large body of research has examined the ways in which gender-based educational inequalities may be reduced. Policies to reduce educational inequalities can be grouped into four broad categories: a) policies that affect demand for schooling, b) policies that affect access to schooling, c) policies to improve the quality of schooling and d) policies not directed specifically towards education. Several national level policies have been shown to be effective in increasing demand for schooling. Actions to eliminate school fees can reduce both gender and wealth gaps in enrollment, but can also increase class sizes and failure rates (Lloyd et al. 2005). More successful, however, have been conditional cash transfer programs. Such subsidies are often targeted towards rural poor girls, and are frequently conditional upon academic performance, a minimum attendance record or remaining unmarried (Lloyd et al. 2005). Conditional grants have been shown to increase school enrollment, improve grade attainment and decrease drop-outs, although it is not clear that they are always cost-effective (Lloyd et al. 2005).

In addition to undertaking policies to increase the demand for schooling among girls, governments should also implement policies to increase both the supply and quality of educational options for girls. Two main policy actions have been demonstrated to be particularly effective in achieving these aims. The first is to directly increase the physical access to schooling for girls. Constructing more schools in a given area can increase the percentage of students completing primary school and improve the average grades earned (although the strategy has not been evaluated for its effects on reducing the gender gap in attainment) (Lloyd et al. 2005). This is particularly important for secondary schools, as secondary schooling has been shown to more strongly affect equity and development outcomes than primary schooling and most people live within a reasonable distance of a primary school (Lloyd et al. 2005). Additionally, policies that mandate the development of alternative schools, including community schools, non-formal education programs (see for example, the approach adopted by BRAC in Bangladesh, Lloyd et al. 2005) or private schools, can improve enrollment rates for girls and boys (Lloyd et al. 2005). Secondly, changes in policy have the potential to greatly enhance the effectiveness of education in encouraging growth through improving its quality and social accessibility for girls. Actions directed towards increasing the ratio of teachers to students and improving teacher pedagogy and practices have been shown to improve school outcomes. Perhaps most importantly, interventions to increase the girl-friendliness of schools, improve teachers' gender-related attitudes and to create an environment where girls are free from harassment from boys, teachers and administrators can improve girls' school attendance, achievement and attainment (Lloyd et al. 2005).

In addition to policies directly targeted towards the education sector, actions outside of the constellation of schools can also improve educational equity. Programs to decrease unintended childbearing and to improve child health can improve girls' educational outcomes (Lloyd et al. 2005). Finally, interventions aimed at changing unfavorable gender norms are imperative to modify the way families and communities view daughters and their potential.

CONCLUSION

Gender inequality, at least in terms of education, has serious, negative implications for economic growth, both directly and via the ability of countries to take advantage of their 'demographic dividend'. In terms of the direct effect, lower levels of inequality are associated with higher levels of growth. However, we also find that the effect of the dividend is significantly higher when gender inequality in education is lower. These findings suggest that countries wishing to take advantage fully of their demographic dividend must address issues of gender inequality, particularly in education. While this is a concern for many countries in the midst of the development process, it is of particular concern for those countries whose working age population has yet to peak, as is the case for much of Africa and parts of Latin America, South and Southeast Asia and the Middle East. Rapid policy action to reduce gender inequality is needed both because the changes in educational achievement require significant time to take effect, and because the dividend is a 'one-time' opportunity that, once missed, will not present itself again.

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Table 1: Description, means and standard deviations of variables included in the analysis

Variable Definition and Source	Mean	S.D.	N	n
Dependent Variable				
Mean annual growth rate in log of real GDP per capita over five-year period *(Heston, Summers and Aten 2006)*	1.75	3.45	1106	174
Gender Specific Education Variables				
Ratio of female to male average years of secondary schooling for the population over 15 in the base year *(Barro and Lee 2000)*	0.71	0.30	678	100
Inequality Group 1 of country-years where inequality ratio exceeds 1 *(Barro and Lee 2000)*	0.15	0.36	678	100
Inequality Group 2 of country-years where inequality ratio falls between 0.75 and 1 *(Barro and Lee 2000)*	0.35	0.48	678	100
Demographic Variables				
Log of ratio of 15-64 to total population in the base year, centered around the overall mean (demographic dividend ratio) *(The World Bank 2008)*	0.00	0.11	1246	178
Log of mean annual growth in total population over the five-year period, centered around the overall mean *(The World Bank 2008)*	-0.07	1.37	1246	178
People per square kilometer in the base year *(Gallup, Sachs and Mellinger 1999)*	105.23	166.77	1112	182
Other Explanatory Variables				
Log of real GDP per capita in the base year, centered around the overall mean *(Heston et al. 2006)*	0.01	1.10	1011	174
Dummy variable representing countries located in a tropical climate *(Gallup et al. 1999)*	0.18	0.26	880	110
Dummy variable representing landlocked countries *(Gallup et al. 1999)*	0.18	0.38	1040	130
Average quality of institutions, for 1982 and 1997 *(Knack and Keefer 1995)*	6.52	1.87	1032	129
Average openness of the economy, for 1982 and 1997 *(Sachs and Warner 1995)*	0.12	0.32	1080	135
Log of mean years of secondary schooling for population over 15 in the base year *(Barro and Lee 2000)*	-0.26	1.12	679	100
% of GDP from agriculture (forestry, hunting, fishing, crop cultivation, and livestock production) *(The World Bank 2008)*	21.63	15.79	828	171
Interaction Terms				
Base year GDP * demographic dividend ratio	0.08	0.10	970	167
Inequality 1 * demographic dividend ratio	0.00	0.04	671	99
Inequality 2 * demographic dividend ratio	0.02	0.07	671	99
Inequality 1 * base year GDP	0.10	0.33	644	98
Inequality 2 * base year GDP	0.27	0.61	644	98
Inequality 1 * population growth	-0.09	0.38	671	99
Inequality 2 * population growth	-0.17	0.65	671	99

Mean represents the overall mean for all country years; N represents country-years; n represents countries

Table 2: Regression results explaining growth in *per capita* GDP: Cross-country results, 82 counties, 1965-1999

	Demographic Specification (1)	Additive Model (2)	Simple Interactive Model (3)	Complex Interactive Model (4)
Demographic dividend ratio	6.835**	6.749**	8.604***	2.260
	(2.22)	(2.18)	(2.86)	(0.61)
Log GDP per capita in base year	-2.662***	-2.821***	-2.651***	-2.298***
	(5.82)	(6.00)	(6.32)	(5.11)
Tropics	-1.579*	-1.638*	-1.880**	-2.047***
	(1.67)	(1.73)	(2.40)	(2.64)
Landlocked	-0.199	-0.189	0.223	-0.093
	(0.37)	(0.35)	(0.45)	(0.19)
Quality of Institutions	0.973***	0.992***	1.130***	1.225***
	(5.48)	(5.53)	(6.67)	(7.31)
Openness of economy	0.633	0.566	0.499	0.346
	(1.30)	(1.16)	(1.20)	(0.85)
Total schooling	-0.087	-0.100	-0.185	-0.260
	(0.26)	(0.30)	(0.58)	(0.80)
Growth in total population	-0.350	-0.309	-0.235	-0.748***
	(1.32)	(1.15)	(0.88)	(2.61)
Agriculture	-0.060**	-0.060**	-0.044*	-0.045**
	(2.42)	(2.40)	(1.90)	(2.00)
Population density	0.001	0.001	0.001	0.002**
	(1.11)	(1.09)	(1.10)	(2.03)
Dummy, 1965-70	0.540	0.507	0.229	0.283
	(0.98)	(0.91)	(0.42)	(0.53)
Dummy, 1970-74	1.042*	0.997*	0.750	0.800
	(1.80)	(1.72)	(1.27)	(1.35)
Dummy, 1975-79	0.428	0.416	0.091	0.076
	(1.00)	(0.97)	(0.21)	(0.18)
Dummy, 1980-84	-1.432***	-1.454***	-1.689***	-1.550***
	(3.58)	(3.61)	(4.19)	(3.76)
Dummy, 1985-89	-0.502	-0.529	-0.682*	-0.571
	(1.37)	(1.45)	(1.83)	(1.54)
Dummy, 1990-94	-0.996**	-1.025**	-1.078***	-1.092***
	(2.41)	(2.48)	(2.58)	(2.61)
Dummy, Inequality 1		0.500	0.447	0.725
		(1.08)	(1.01)	(1.38)
Dummy, Inequality 2		0.591*	0.634**	0.912***
		(1.76)	(2.00)	(2.90)
Initial GDP * demographic dividend ratio			-6.622***	-5.149***
			(3.77)	(2.66)
Inequality 1 * demographic dividend ratio				26.525***
				(3.95)
Inequality 2 * demographic dividend ratio				10.553**
				(1.96)
Inequality 1 * initial GDP				-1.902**

				(2.17)
Inequality 2 * initial GDP				-0.913*
				(1.85)
Inequality 1 * population growth				1.279**
				(2.14)
Inequality 2 * population growth				1.282***
				(2.69)
Constant	-3.108***	-3.479***	-3.969***	-4.497***
	(2.58)	(2.74)	(3.41)	(3.99)
Observations	467	467	467	467
Number of countries	82	82	82	82
Overall R^2	0.26	0.27	0.31	0.35

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Explanation of Regression Models:

1) Replication of Demographic Specification, OLS Regression from Bloom, Canning and Malaney (2000), excluding growth in the working-age population and log life expectancy.
2) Basic additive model regressing GDP growth on the demographic dividend ratio, educational inequality, and other growth determinants.
3) Simple interactive model regressing GDP growth on the interaction of the demographic dividend ratio and initial GDP, the demographic dividend ratio, educational inequality and other growth determinants.
4) Complex interactive model, adding interactions between educational inequality and a) the demographic dividend ratio, b) initial GPD and c) population growth to the previous model.

Table 3: Regression results explaining growth in *per capita* GDP, by level of inequality: Cross-country results, 82 counties, 1965-1999

	Highest Inequality (5)	**Moderate – Low Inequality (6)**	**Female Exceeds Male Education (7)**
Demographic dividend ratio	1.951	13.211***	14.099*
	(0.55)	(2.59)	(1.73)
Log GDP per capita in base year	-2.422***	-2.940***	-3.545***
	(5.33)	(3.40)	(2.74)
Tropics	-2.100***	0.501	-4.340**
	(2.77)	(0.21)	(2.18)
Landlocked	0.370	-0.547	0.000
	(0.62)	(0.71)	(.)
Quality of Institutions	1.355***	1.220***	0.855**
	(6.50)	(4.16)	(2.20)
Openness of economy	0.814	-0.842	-0.832
	(1.46)	(1.19)	(1.14)
Total schooling	-0.201	-1.049	1.192
	(0.51)	(1.60)	(1.61)
Growth in total population	-0.813***	0.620	1.099
	(2.73)	(1.38)	(1.61)
Agriculture	-0.035	-0.037	-0.074
	(1.33)	(0.68)	(1.64)
Population density	0.002**	0.003	-0.005
	(2.21)	(1.40)	(1.15)
Dummy, 1965-69	0.308	-0.529	0.940
	(0.39)	(0.73)	(0.70)
Dummy, 1970-74	1.059	0.342	-1.335
	(1.27)	(0.40)	(1.01)
Dummy, 1975-79	0.371	-0.190	-1.068
	(0.53)	(0.36)	(0.90)
Dummy, 1980-84	-0.860	-1.608***	-4.106***
	(1.20)	(3.36)	(3.38)
Dummy, 1985-89	-0.420	-0.359	-1.609**
	(0.57)	(0.79)	(2.09)
Dummy, 1990-94	-1.376	-1.428***	-0.212
	(1.61)	(3.30)	(0.28)
Initial GDP * demographic dividend ratio	-7.675***	-2.887	-2.959
	(2.98)	(0.82)	(0.41)
Constant	-5.721***	-3.726**	0.477
	(4.00)	(2.12)	(0.21)
Observations	228	163	76
Number of countries	53	46	23
Overall R^2	0.39	0.32	0.51

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Explanation of Regression Models:

5) For country-years where the ratio of female to male years of education is less than 0.75, simple interactive model regressing GDP growth on the interaction of the demographic dividend ratio and initial GDP, the demographic dividend ratio, educational inequality and other growth determinants.

6) For country-years where the ratio of female to male years of education is 0.75 – 1, simple interactive model regressing GDP growth on the interaction of the demographic dividend ratio and initial GDP, the demographic dividend ratio, educational inequality and other growth determinants.
7) For country-years where the ratio of female to male years of education is greater than 1, simple interactive model regressing GDP growth on the interaction of the demographic dividend ratio and initial GDP, the demographic dividend ratio, educational inequality and other growth determinants.

Appendix 2: Regression results explaining growth in *per capita* GDP, using an instrumental variables approach: Cross-country results, 82 counties, 1965-1999

	Demographic Specification (8)	**Complex Interactive Model (9)**	**Highest Inequality (10)**	**Moderate Inequality 114)**	**Female Exceeds Male Education (12)**
Growth in total population	0.183	-1.855	-1.190	-0.148	0.616
	(0.35)	(1.74)	(1.44)	(0.21)	(0.49)
Demographic dividend ratio	9.880	-6.114	-0.510	7.154	12.546
	(2.44)*	(0.70)	(0.07)	(1.06)	(1.49)
Dummy, Inequality 1	0.658	0.625			
	(1.26)	(0.98)			
Dummy, Inequality 2	0.671	0.783			
	(1.64)	(1.85)			
Log GDP per capita in base year	-2.798	-2.420	-2.535	-2.640	-4.564
	(6.72)**	(5.51)**	(5.06)**	(3.87)**	(2.93)**
Tropics	-1.894	-2.057	-2.124	2.191	-4.082
	(2.14)*	(2.73)**	(2.49)*	(0.97)	(1.20)
Landlocked	-0.132	-0.193	0.313	-0.447	0.000
	(0.25)	(0.40)	(0.50)	(0.58)	(.)
Quality of Institutions	1.022	1.190	1.339	1.080	0.849
	(5.91)**	(7.53)**	(6.44)**	(3.96)**	(1.77)
Openness of economy	0.439	0.572	0.999	-1.150	-0.779
	(0.88)	(1.23)	(1.46)	(1.52)	(0.84)
Total schooling	-0.051	-0.320	-0.250	-1.169	0.776
	(0.18)	(1.19)	(0.72)	(2.26)*	(0.69)
Agriculture	-0.055	-0.053	-0.042	-0.032	-0.115
	(2.58)**	(2.45)*	(1.61)	(0.80)	(1.75)
Population density	0.002	0.002	0.002	0.002	-0.007
	(1.00)	(1.28)	(1.07)	(1.13)	(1.37)
Dummy, 1965-70	0.409	0.471	0.385	-0.531	0.410
	(0.68)	(0.74)	(0.41)	(0.61)	(0.20)
Dummy, 1970-74	0.996	0.882	1.112	0.319	-1.476
	(1.85)	(1.62)	(1.34)	(0.42)	(0.75)
Dummy, 1975-79	0.386	0.099	0.422	-0.179	-1.418
	(0.86)	(0.22)	(0.57)	(0.30)	(1.14)
Dummy, 1980-84	-1.521	-1.443	-0.758	-1.592	-4.401
	(3.60)**	(3.24)**	(1.00)	(2.91)**	(4.40)**
Dummy, 1985-89	-0.616	-0.461	-0.300	-0.303	-1.917
	(1.51)	(1.07)	(0.40)	(0.58)	(2.40)*
Dummy, 1990-94	-1.109	-1.055	-1.322	-1.329	-0.343
	(2.82)**	(2.63)**	(1.82)	(2.84)**	(0.47)
Initial GDP * demographic dividend ratio		-5.621	-7.622	-1.224	0.665
		(2.67)**	(2.60)**	(0.37)	(0.07)
Inequality 1 * demographic dividend ratio		36.575			
		(3.21)**			
Inequality 2 * demographic dividend ratio		19.641			
		(1.89)			
Inequality 1 * initial GDP		-1.876			
		(1.93)			

Inequality 2 * initial GDP		-0.728			
		(1.19)			
Inequality 1 * population growth		2.350			
		(2.07)*			
Inequality 2 * population growth		2.393			
		(2.05)*			
Constant	-3.735	-4.081	-5.545	-3.269	1.719
	(3.04)**	(3.64)**	(3.88)**	(1.96)	(0.60)
Observations	460	460	227	161	72
Number of country	81	81	52	45	22

Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%
Explanation of Regression Models:

8) Replication of Demographic Specification, Instrumental Variables Regression from Bloom, Canning and Malaney (2000), excluding growth in the working-age population and log life expectancy.
9) Complex interactive model using the instrumental variables approach, adding interactions between the demographic dividend ratio and initial GDP and educational inequality and a) the demographic dividend ratio, b) initial GPD and c) population growth to the previous model
10) For country-years where the ratio of female to male years of education is less than 0.75, simple interactive model using an instrumental variables approach to regress GDP growth on the interaction of the demographic dividend ratio and initial GDP, the demographic dividend ratio, educational inequality and other growth determinants.
11) For country-years where the ratio of female to male years of education is 0.75 – 1, simple interactive model using an instrumental variables approach to regress growth on the interaction of the demographic dividend ratio and initial GDP, the demographic dividend ratio, educational inequality and other growth determinants.
12) For country-years where the ratio of female to male years of education is greater than 1, simple interactive model using an instrumental variables approach to regress GDP growth on the interaction of the demographic dividend ratio and initial GDP, the demographic dividend ratio, educational inequality and other growth determinants.