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Does Gender Inequality in Education Affect Educational Outcomes?

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Abstract

There is little doubt that education has a major effect on economic growth. Studies have traditionally used years of schooling (a quantitative variable) to measure education, but there has a shift towards using qualitative measures of education when trying to test the relationship between education and growth. In fact, there is strong evidence that the quality of education is much more important for economic growth than the quantity of education. The best way to measure the quality of education in a given country is to measure educational outcomes, and the best way to measure outcomes across countries is to look at students' performance on international tests.

Another variable that has been shown to affect economic growth is gender inequality, including gender inequality in education. Gender inequality in education likely affects education indirectly, through different channels such as by lowering the fertility rate, increasing the life span of the population, and increasing social cohesion. However, one possible channel that has not been widely explored is educational outcomes. Gender inequality in education may have a negative effect on educational outcomes, which in turn will have a negative effect on economic growth. There are many ways in which this might happen. For example, girls who are in a school system with high inequality might believe that since there is inequality in school, there will also be inequality in society as a whole, which would mean that there aren't many opportunities for them to be successful in life. This would subsequently decrease motivation and performance in school. Other examples include the possibility that more educated siblings can increase each other's educational success by supporting and helping one another, and the fact that a mother's education has been shown to have a positive effect on their children's health and nutrition.

In this paper I attempt to determine whether gender inequality in education does in fact have an effect on educational outcomes (and therefore an indirect effect on economic growth). I do this by using a cross-country regression with educational outcomes as the dependent variable and gender inequality in education as an independent variable. The data on educational outcomes comes from the PISA, TIMSS, and PIRLS international assessments that have taken place since 1995. The results of each assessment are scaled to an international average of 500, making the assessments directly comparable with one another. Other independent variables used include GDP per capita, expenditure on education, and student/teacher ratios.

I. Introduction

A great deal of literature exists that demonstrates the important role education plays in promoting economic growth. More specifically, the level of education in a given country is thought to affect that country's potential to adopt technology and therefore influences the rate of technological change, which is a key determinant of economic growth. However, there is a question of whether resources should be directed towards increasing the number of years students are in school or towards improving the quality of education. Recent literature shows that quality is in fact more important than quantity. This begs the question of what factors influence the quality of education. Both the level of resources devoted to education (from both the public and private sectors, and including both physical and human capital) and features of the school system (such as competition, decentralization, and accountability) are thought to affect the quality of education. In addition, the level of gender inequality in a country's school system might have a significant influence on educational quality. This paper explores the possible reasons for this relationship, and carries out an empirical analysis to determine whether gender inequality in education is in fact a significant determinant of the quality of schooling, as measured by outcomes on international tests.

II. Education Quality, Education Outcomes, and Economic Growth

Early literature on the relationship between education and economic growth focused on whether education should be included in growth equations as a direct or indirect input, with most articles choosing to include it as a direct input. These early studies also tended to use the number of years students spend in school as the measure of education. However, recently there has been a shift towards using the quality of education as the education variable in growth equations, and studies have shown that the quality of education is in fact more important than the quantity of education. Therefore, there has been a shift towards trying to determine the factors that influence the quality of education. One of the factors that has been examined is the level of gender inequality in a country's education system, though this relationship has not been explored in very much detail. Other factors that have been considered include expenditure on education as a percentage of GDP, expenditure on education per student, student/teacher ratio, and features of a country's school system, such as choice and competition, decentralization, and accountability.

a. Education and Economic Growth

One fundamental disagreement in the literature on education and growth concerns whether education should be included in growth equations as a direct input or whether it should be thought of as in indirect input that affects growth through its effect on the productivity of capital and labor. Some individuals might argue that given the difficulty in coming up with a comprehensive and agreed upon measure of education, it is best to try to study the effect of education on total factor productivity rather than including it directly in the production function (Miller and Upadhyay 2000). However, many studies include measures of education directly in the production function, as suggested by individuals such as Romer (1986) and Lucas (1988). Nevertheless, regardless of the view, there is little doubt that education is an important factor in economic growth. Increased education can potentially increase the technological capability of society, and it can increase growth through other channels as well (for example, benefits in the areas of crime and child care

(Stacey 1998)). With this in mind, the issue now becomes determining the best way to measure education.

b. From Quantity to Quality

If you ask a typical person to measure the education they've received, they will almost certainly measure it in terms of years of schooling. Distinctions are made between high school graduates, college graduates, high school dropouts, etc. This is the most instinctive (and simplest) way to measure education in order to test its effect on economic growth. Therefore, the earliest studies testing this relationship used quantitative measures of schooling as an input in growth equations. Now, it is worth pointing out here that education and schooling are not the same thing. As Hanushek and Woessmann (2007) note, education can come from formal schooling, but also from family, peers, culture, or other factors. This could present a problem when using schooling variables as a proxy for education. Still, measuring the education someone received from his or her family or peers as opposed to education received from schooling is either extremely difficult or impossible. Also, no one will doubt that on average, schooling plays a central role in the education of individuals. One final point to consider is that one of the main goals of economic analysis is to influence public policy. A paper studying the effects of education on economic growth will likely have something to say (either explicitly or implicitly) about the public policy actions that should be taken in relation to education. However, "interventions in the schools are generally viewed as both more acceptable and more likely to succeed than, say, direct interventions in the family" (Hanushek and Woessmann 2007, p. 3). This means that a paper that focuses on the effect of schooling on growth rather than on the effect of education on growth will not be missing much in terms of policy implications. These three points illustrate that using schooling variables as a proxy for education does not present a huge problem, and schooling variables are probably the best way to measure education in growth equations.

As previously mentioned, early studies testing the relationship between education and economic growth used quantitative measures of schooling to measure education in growth relationships. Most of the early literature tended to find a significant positive association between quantitative measures of schooling and economic growth (Hanushek and Woessmann 2007). For example, Barro (1991) finds that the initial level of schooling (using initial levels of primary and secondary school enrollment rates as a proxy) had a significant and positive effect on GDP growth. Similarly, both Krueger and Lindahl (2001) and Temple and Woessmann (2006) find that years of schooling is significantly and positively related to economic growth. Quantitative measures of schooling also tend to be very robust in growth regressions. For example, Sala-i-Martin, Doppelhofer, and Miller (2004) tested the robustness of 67 variables thought to influence economic growth. They found that primary school enrollment was one of the three most robust variables (along with the relative price of investment goods and the initial level of income). Empirically, the quantity of education in a given country seems to be very important in explaining economic growth.

While the quantity of education seems to be empirically significant and robust in growth regressions, theoretically it runs into some problems. The main issue concerns quality differences that exist between education systems. Using quantitative measures of education assumes that an additional year of schooling delivers the same increase in knowledge, no matter where that year of schooling takes place (Hanushek and Woessmann

2007). However, this assumption is not true in the real world. A year of education in the United States is not the same as a year of education in Tanzania, and quantitative measures of education ignore crucial differences in educational quality between different school systems. This issue is not quite as important for within-country regressions (though differences in schooling within a country can sometimes be very large, say between an inner-city school and a school in a wealthy suburb in the United States). For cross-country regressions, though, this is a major issue that will likely have significant impacts on the significance and magnitude of the relationship between education and economic growth. Cross-country variations in educational quality can sometimes be immense (much larger than within-country variations), and it only seems natural to try to include these quality differences in growth regressions. Therefore, due to this major weakness of quantitative measures of education, there has been a shift towards using qualitative measures of education when trying to study the relationship between education and growth.

Of course, measuring educational quality is not as straightforward as measuring the quantity of education achieved. Quality is an ambiguous term that means different things to different people. When asked to name what makes a quality school, people may give answers such as quality teachers, an efficient and effective structure, and quality textbooks. All of these are almost impossible to quantify. Therefore measuring school quality seems like a hopeless task. However, it is useful to think about what the purpose of a school actually is. A school exists in order to educate its students. Therefore a higher-quality school will do a better job of educating its students. So, rather than trying to measure impossible to quantify aspects of the school system itself, it makes sense to try to measure the level of education of its students (in other words, educational outcomes). The best way to measure and compare educational outcomes from different school systems is standardized testing. Luckily, such standardized tests do exist at the international level, and these tests give comparable measures of student education levels across countries (which will presumably tell us about educational quality differences across countries). Since the mid-1960's international agencies have conducted a number of tests that measure students' performance in subjects such as math and science (Hanushek and Woessmann 2007). While a student's knowledge is made up of more than just math and science, these subjects are taught in similar ways and with similar material throughout the world. Two plus two equals four no matter where you live. However, other subjects such as reading and writing depend very heavily on the language they are taught in, and comparing students' abilities in reading and writing at the international level is extremely difficult. Also, mathematics and science are the foundation for research and development, which has strong theoretical ties to economic growth (Hanushek and Kimko 2000). Therefore, international exams tend to test students' abilities in areas such as mathematics and science rather than in reading and writing.

What have studies that include the quality of education (measured by international test scores) in growth regressions found? The existing evidence shows that not only is the quality of education important for economic growth, but its' effect is much larger than that of educational quantity (Hanushek and Woessmann 2007). One of the earliest contributions to this literature was a paper by Lee and Lee (1995), which used data from tests given by the International Association for the Evaluation of Educational Achievement (IEA). They find that student achievement scores are a key determinant of economic growth, while quantitative measures of schooling (school enrollment rates and years of schooling) are insignificant when student achievement scores are included in the regression. Similarly, Hanushek and Kimko (2000) use student achievement on international tests from both the IEA and the International Assessment of Educational Progress (IAEP) to measure educational quality. Like Lee and Lee, they find that educational quality has a significant positive impact on economic growth, while educational quantity turns insignificant with the inclusion of educational quality. In fact, including educational quality increases the explanatory power of the model (as measured by R^2) by a range of .25 to .4, depending on the specifications used. Barro (2001) finds that while educational quality and quantity are both important for growth, the effect of quality is more important than the effect of quantity. In a more recent study, Hanushek and Woessmann (2007) use a variety of math and science scores (from tests such as the PISA and TIMSS tests) and find that educational quality is statistically significant and positively related to growth. Further, while years of schooling is significant when quality is left out of the regression, when quality is included it turns insignificant and has a value of close to zero. They also find that the effect of educational quality is, if anything, larger for developing countries than developed ones. In summary, the existing literature shows that the quality of education (measured by students' performance on international tests) has a significant and positive effect on economic growth. Quantitative measures of education are either insignificant or much less significant when both quantitative and qualitative measures of education are included in the same regression. Therefore when talking about the relationship between education and economic growth, it makes sense to focus on the quality of education (how much a student learns in school) rather than the quantity of education (how much time a student spends in school).

c. Gender Inequality and Growth

Another variable thought to affect economic growth is gender inequality. Gender inequality can manifest itself in many areas, such as education, employment, politics, and sports. While gender inequality is a very undesirable situation for any country, its' effect on economic growth is what's important for this paper. The first area that comes to mind when thinking about this relationship is employment. Studies testing the relationship between inequality in employment and economic growth have generally found that employment inequality has a sizeable negative impact on growth. For example, the OECD (2008) finds that much of the recent economic growth in OECD countries has come from the increased employment of women, and Klasen and Lamanna (2009) find that gender inequality in labor force participation has a large negative impact on economic growth in developing countries.

Another area in which gender inequality can affect economic growth is education. Recent work on this relationship has shown that gender inequality in education negatively affects growth (Klasen and Lamanna 2009). For example, Hill and King (1995) find that countries in which the ratio of female-to-male enrollments is less than .75 have a GNP that is about 25 percent lower than countries that are similar apart from having a higher female-to-male enrollment ratio. Knowles, Lorgelly, and Owen (2002) find that female education has a statistically significant and positive effect on labor productivity (and hence on economic growth). Klasen (2002) also finds that gender inequality in education has a negative effect on economic growth. In fact, Klasen finds that when comparing the growth rates of South and East Asia, between .75 and .95 percentage points of the regions' 2.5 percent annual difference in economic growth can be accounted for by differences in gender inequality in education. The effect of gender inequality in education also accounts for between .42 and .56 percentage points of the annual 3.3 percent difference in the growth rate between Sub-Saharan Africa and the East Asia, and between .67 and .85 percentage points of the annual 1.9 percent difference in the growth rate between the Middle East and North Africa and East Asia. In addition, the effect of gender inequality in education appears to be largest in Sub-Saharan Africa. Abu-Ghaida and Klasen (2004) determined that countries that did not meet the Millennium Development Goal of gender equality in primary and secondary education by 2005 were likely to lose an average of .4 percentage points in annual economic growth between 2005 and 2015. Finally, Klasen and Lamanna (2009) updated and extended the data set used in Klasen (2002), while using the same econometric specification. Their results confirmed the general conclusion of Klasen (2002), which is that gender inequality in education has a significant negative impact on economic growth. Overall, the existing literature seems to point to a negative relationship between gender inequality in education and economic growth, and it is worthwhile to consider the channels that this relationship occurs through.

Gender inequality in education is likely to have more of an indirect effect on growth than gender inequality in employment. This is because goods and services are actually produced during employment, while nothing is directly added to GDP as a result of education. Therefore it makes sense to focus more on indirect channels when studying the relationship between gender inequality in education and growth. One possible way in which educational inequality affects growth is through its effect on fertility. It is possible that increasing female education decreases fertility, which subsequently increases economic growth. A number of studies have shown that female education does have a significant negative impact on fertility. For example, Cochrane (1983) found that female education has a negative effect on fertility that is about three times that of male education. Ainsworth, Beegle, and Nyamete (1996) looked at fourteen sub-Saharan African countries and found that female education was negatively correlated with fertility and contraception use, and that for countries where male education is also negatively correlated with fertility, the effect of female education is much larger. Lower fertility subsequently increases economic growth, for example through raising the level of capital per worker (Galor and Weil 1996).

Another possible channel through which female education affects economic growth is by increasing the average life span of the population. An increased life span implies a healthier population, and having healthier workers will have a significant and positive effect on economic growth (ex. Bloom, Canning, and Sevilla 2004). Hill and King (1995) find that inequality in education has a negative impact on life expectancy not only for women, but also for men. For example, in countries with a female-male enrollment ratio of less than .42, males would have a life expectancy that is about four years shorter than males who live in otherwise similar countries. For females, this impact is even greater, at about 5 years. Williamson and Boehmer (1997) consider the impact of seven different female education variables on female life expectancy (in seven separate models), and find that each variable is significantly and negatively related to female life expectancy. Therefore, increased life expectancy does seem to be a channel through which gender inequality in education affects economic growth.

There are many other possible channels through which educational inequality can affect growth, such as social cohesion (ex. Lombardo 2006), investment rates (ex. Klasen

2002), and female labor force participation rates (ex. Knowles, Lorgelly, and Owen 2002). One possible channel that has not been explored in great detail is educational outcomes. We have already seen that educational outcomes (as measured by students' test scores) have a significant positive effect on economic growth. Increased gender inequality in education may have a negative effect on educational outcomes, and this will in turn have a negative effect on economic growth. This possible channel is the focus of this paper, as I will attempt to determine whether gender inequality in education does in fact have a negative effect on educational outcomes.

d. Gender Inequality in Education and Educational Outcomes

Before empirically testing the relationship between gender inequality in education and educational outcomes (measured by students' test scores), it is necessary to think through the ways that gender inequality in education might actually affect these outcomes. When looking at this relationship, it is again important to raise the distinction between schooling and education. As previously mentioned, education can come from schooling, but it can also come from family, peers, culture, etc. Students' performance on international tests measures the outcome of their education, not just the outcome of their schooling. Obviously schooling is a huge part of this education, but it is not the only part (It is also important to note that when talking about gender inequality in education, education does actually refer to schooling, as inequality in school attainment can be easily measured and more easily affected by policy, while inequality in a broader definition of education is impossible to accurately quantify and harder to affect by policy). Therefore there are two broad paths through which reduced gender inequality in education can positively affect educational outcomes: one is through increasing the quality of education students actually receive in the school system, and the other is through increasing the quality of education students receive from other aspects of their environment, such as family. These two paths could also work together; for example, a family environment more focused on education could encourage a student to work harder in school, and consequently the student might be more productive and learn more in school.

The first broad path through which gender inequality in education might affect educational outcomes is by affecting the quality of education students receive when they are in school. There are three different channels through which gender inequality in education might do this: by affecting the quality of education received by females, by affecting the quality of education received by males, and by affecting the quality of education given by teachers. For the first channel, decreased inequality in education would be expected to increase the quality of education received by females. Girls who are in a school system with high inequality might perceive inequality in the school system as being representative of society as a whole, and therefore they might believe that there aren't many opportunities in society for girls to be successful, even if they receive a good education (which may or may not be true). This would cause girls to be less motivated to learn and perform well in school. Also, when there is high inequality girls might feel socially marginalized while in school, and they might feel like they are not accepted in that environment. This would lower girls' self-esteem while in school, and lower self-esteem could translate into lower school performance (Hansford and Hattie 1982). Finally, if there is high educational inequality in a school system, the girls who are in the school system might actually perceive that there will be always be opportunities for them to be successful in life precisely because they are one of the relatively few girls being educated. Therefore they might lose motivation because they feel that no matter how they perform they will be able to take advantage of opportunities later in life (since they are an educated female in a society with relatively few), rather than losing motivation because of a perception of a lack of opportunities. This reduced motivation would then translate into lower performance. If more girls become educated, this might promote more competition among girls in school, and their motivation (and performance) would then increase. These three scenarios provide possible avenues through which decreased inequality in education would lead to improved educational outcomes for females.

Decreased educational inequality wouldn't just improve the quality of education received by females in school; it would also improve the quality of education received by males in school. One reason this might happen is that increased female education would increase the competition for boys in school. In the same way that increased female education might promote more competition among girls, an increased presence of girls in schools would mean that boys now have more students to compete with for teaching resources and for the best grades in school, and this would increase their motivation and hence their performance in school. Boys may also believe that since a school system has high inequality, this inequality exists in all aspects of society (which may or may not be true), and therefore they might feel that they are "set" after school no matter how they perform, since they won't have to compete with girls for opportunities in society. This would subsequently decrease their motivation and performance in school. This is similar to how inequality in education would decrease girls' motivation, except in that case girls would be less motivated because they feel that no matter how they perform, there won't be opportunities in society for them. In addition, an increased female presence in school might bring new perspectives and ideas to learning situations, and being exposed to a broader set of ideas and perspectives might improve the education of males in school. In these ways, decreased gender inequality in education might improve the performance of males in school as well as the performance of females.

The final channel through which gender inequality in education might affect the quality of education received by students in school is by affecting teacher quality. If inequality in education were decreased, this would raise the average education level of females in society. Some of these now more-educated females will pick teaching as a career path, and the pool of available teachers would not only expand, but the teachers would be more educated and hence be of higher quality (obviously there is more to teaching than just the education of the teacher; however, all else equal, a more educated teacher is expected to be a higher quality teacher. For example, Ferguson (1991) found that when teachers performed better on a test of basic literacy, their students' test scores improved). This channel would be especially important in developing countries, where the majority of teachers are male (Oplatka 2006). Unlike the first two channels, the effect of this channel on student performance would be felt in the future, rather than soon after inequality in education is reduced. This is because it takes time for more-educated females to find their way into the teaching profession, so the effects on student performance coming from higher teaching quality would likely take about a generation to be felt.

The other broad path through which gender inequality in education might affect educational outcomes is by affecting the quality of education students receive from aspects of their environment other than school. For example, more equally educated siblings can increase each other's educational success by providing support to one another and helping each other learn what they were taught in school more effectively (Klasen 2002). Decreased educational inequality could also increase the support that students get from their peers, allowing them to perform better in school. This effect would be especially important for girls, who might be left without a strong support network of other girls if there is high educational inequality. Maybe the most important channel in this path is that decreased educational inequality would increase the education that students receive from their parents (and specifically their mothers). As stated in the World Bank's 2001 Report "Engendering Development", "a mother's schooling is positively linked to her children's educational attainment" (World Bank 2001, p. 84). Mothers who are better-educated will be able to teach their children more and will be able to provide better support for any problems their children are having in school. This in turn will increase their children's educational performance. An example of this can be seen in Rosenzweig and Wolpin (1994), where they find that in the United States each additional year of a mother's schooling increases both the PIAT (mathematics and reading) and PPVT (picture vocabulary) test scores of their children. Behrman et al. (1999) find that in India, children of literate mothers study nearly two hours more per day than otherwise identical children of illiterate mothers in the same household. This effect would not be felt right away, since it would take time for more-educated girls to grow up and have children, but it would be felt in about a generation. In addition, this effect will continue on indefinitely, as each generation of more educated children will continue to improve the educational outcomes of the subsequent generation of children.

Finally, as previously mentioned, the two paths through which decreased gender inequality in education might improve educational outcomes can work together. For example, beyond teaching their children more and providing more support for them in school related matters, a more educated mother is likely to attach a greater importance to education, which will likely result in their children attaching a greater importance to education. This in turn will likely increase their children's motivation and performance in school. Another example is that a mother's education has been shown to have a positive effect on children's health (Hill and King 1995). A more-educated mother is more likely to engage in behaviors that promote their children's health, such as having young children immunized (World Bank 2001). An increase in a mother's education is also associated with better nutrition for their children (World Bank 2001). If a child is healthier, they will likely learn more and perform better in school (ex. Florence, Asbridge, and Veugelers 2008).

Clearly, there are many channels through which decreased gender inequality in education might increase educational outcomes, measured by students' test scores. Gender inequality in education affects both the quality of education students receive while they are in school and the quality of education they receive from other aspects of their environment such as family. These two paths can also work together, such as when a family environment that attaches a greater importance to education results in an increase in a student's motivation and performance in school. Now that the theory behind the relationship between gender inequality in education and educational outcomes has been spelled out, it is necessary to think about other factors that might improve the quality of education students receive.

e. Determinants of Educational Outcomes

In order to determine if gender inequality in education affects educational outcomes, it is important to think about other variables that might affect student test scores, and especially those that can be measured and included in cross-country regressions and that can be affected by government policy. There are two broad categories of variables that might affect student test scores: variables measured within the context of a given school system structure and variables that measure the features of different school system structures. In terms of variables that don't take the structure of the school system into account, theoretically it makes sense that devoting more resources to a school system will increase student test scores. Obviously, whenever a country spends resources, there is a goal (either explicitly or implicitly) that those resources are supposed to achieve or help achieve. When a country devotes resources to the military, those resources are meant to help strengthen the national defense or win wars. If a country devotes resources to health care, hopefully that will result in a healthier population. Similarly, if a country devotes resources to education, it is likely that the purpose of at least some those resources will be to improve educational outcomes, which can be measured by student test scores. Therefore if a country devotes more resources to education than another country, that country is expected to have higher student test scores, all else equal.

There are several variables that can be used to measure the level of resources a country devotes to education. The most obvious ones are total expenditure on education relative to GDP and total expenditure on education per student (ex. Hanushek and Kimko 2000). Controlling for the number of students enrolled, an increased fraction of GDP devoted to education means better textbooks for students, better educational facilities, more resources available for students (such as computers and library books), and more resources available to teachers. All of these things would be expected to increase the quality of education that students receive and hence their performance on international tests. Similarly, an increase in total expenditure on education per student should increase the quantity and quality of educational resources available to each student, which should improve the quality of education and students' test scores. Another variable that is frequently used to measure the level of resources a country devotes to education is the student-teacher ratio (ex. Hanushek 1997 and Krueger 2000). The thinking here is that a country with a lower student-teacher ratio is, all else equal, spending more on hiring and training teachers. A lower student-teacher ratio means that each teacher has more time to devote to teaching each individual student, which will improve the quality of education those students receive and increase their performance on international tests.

Hanushek and Woessmann (2007) stress the importance of differences in the features of a country's school system in affecting educational outcomes. The three features that they believe are important are choice and competition, decentralization and the autonomy of schools, and accountability. In terms of choice and competition, the thinking is that parents seek out schools that are the most effective in educating their children. More choices for the parents and greater competition between schools will result in incentives for each school to provide a more effective education system (for example, through high quality teachers and a good curriculum) (Hanushek and Woessmann 2007). A more effective education system will in turn increase the quality of education that students receive and increase their test scores. Variables that could be used to measure choice and competition include the percentage of privately-managed schools in a country, the share of enrollment in privately-managed schools, and the share of public educational spending going to private institutions (Woessmann 2007).

Autonomy in schools is also important, since the effect of any incentives for creating a better school system (such as those created by greater competition) on student performance will depend on whether or not local school and district personnel are heavily involved in decision making (Hanushek and Woessmann 2007). The more these personnel are involved in decision making, the faster their school systems will be able to respond to incentives for improving student performance. Variables that could be used to measure autonomy include the degree of local decision making in purchasing supplies, making budget allocations, hiring and rewarding teachers, choosing instructional methods, and choosing textbooks (Woessmann 2007). In order to get more quantitative measures of autonomy comparable across countries, a number of these types of variables can be examined and combined to get an overall picture of the level of autonomy in a country's school system (ex. OECD 1998).

Finally, the accountability of local schools for student performance may have a large impact on student test scores (Hanushek and Woessmann 2007). Whether or not a country's school system has external exit exams is one variable that can be used to measure the accountability of local schools. External exit exams can be used to hold schools accountable for their students' performance, and if school personnel know their school's performance will be measured, they will likely try to maximize the performance of their students in order to look good to prospective parents and central government figures. Students in countries with external exit exams have been found to outperform students in countries that do not have these exams (ex. Bishop 1997, Fuchs and Woessmann 2007). In addition, early evidence suggests that holding teachers accountable for the performance of their students (such as through performance-related pay) increases student achievement

(Hanushek and Woessmann 2007). The three principles of choice and competition, autonomy, and accountability are closely linked (Hanushek and Woessmann 2007). For example, "the international evidence clearly suggests that school autonomy, in particular local autonomy over teacher salaries and course content, is only effective in school systems that have external exams in place" (Hanushek and Woessmann 2007, p. 72). Therefore interaction terms between choice and competition, autonomy, and accountability variables will likely do a better job of capturing the relationship between features of a country's school system and student performance than just looking at the effect of individual variables.

In summary, there are many variables that might affect student test scores. In addition to gender inequality in education, the level of resources that a country devotes to education could affect student performance. Variables used to measure these resources include the fraction of GDP devoted to education, total expenditure on education per student, and the student-teacher ratio. Variables that measure the amount of choice and competition, autonomy, and accountability in a country's school system also might affect student performance. Interaction terms between these variables are appropriate because of the close links between choice and competition, autonomy, and accountability. Now that possible determinants of educational outcomes have been explored, it is time to specify the model that will be used to test the relationship between gender inequality in education and educational outcomes.

III. Methodology

In this section, I will specify the model that I use to test my hypothesis. First, the operationalization of educational quality will be discussed. Then the independent variables, including gender inequality in education, will be specified. Finally, I will discuss the treatment of missing data.

a. Dependent Variable

In order to test the hypothesis that gender inequality in education has a significant effect on educational outcomes, I used a linear regression model of the form:

$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \ldots\ldots + b_nX_n$ where Y is the dependent variable, $X_{1,2\ldots n}$ are the independent variables, and $b_{1,2\ldots n}$ are the coefficients. In this specific case, educational outcomes is the dependent variable and gender inequality in education is one of the independent variables. In order to quantify and measure educational outcomes, I used countries' average scores on various international tests. The tests that I utilized were: Trends in International Mathematics and Science Study (TIMSS) 1995, TIMSS 1999, TIMSS 2003, TIMSS 2007, Programme for International Student Assessment (PISA) 2000, PISA 2002, PISA 2003, PISA 2006, PISA 2009, Progress in International Reading Literacy Study (PIRLS) 2001, and PIRLS 2006. The data on TIMSS and PIRLS comes from the National Center for Education Statistics (NCES 2012), while the data on PISA comes from the OECD (OECD 2012). The following table gives some information about these tests:

Table 1: Tests Used for Dependent Variable

Test	Administered By	Grades Tested	Subjects Tested	Countries[a] Tested
TIMSS 1995	International Association for the Evaluation of Educational Achievement (IEA)	3rd, 4th, 7th, 8th, Final Year of Secondary School	Math, Science, Math Literacy, Science Literacy, Advanced Math, Physics	45
TIMSS 1999	IEA	8th	Math, Science	38
TIMSS 2003	IEA	4th, 8th	Math, Science	46
TIMSS 2007	IEA	4th, 8th	Math, Science	58
PISA 2000	OECD	15-Year Old	Reading Literacy, Math Literacy, Science Literacy	32
PISA 2002[b]	OECD	15-Year Old	Reading Literacy, Math Literacy, Science Literacy	11
PISA 2003	OECD	15-Year Old	Reading Literacy, Math Literacy, Science Literacy	41
PISA 2006	OECD	15-Year Old	Reading Literacy, Math Literacy, Science Literacy	57
PISA 2009	OECD	15-Year Old	Reading Literacy, Math Literacy, Science Literacy	65
PIRLS 2001	IEA	4th	Reading Literacy	35
PIRLS 2006	IEA	4th	Reading Literacy	45

[a] "Countries" here is taken to mean both nations and participating jurisdictions (such as Hong Kong)
[b] In 2002, due to interest beyond the OECD, 11 additional non-OECD countries participated in a second administration of PISA 2000. I will refer to these results as PISA 2002 because that is the year these countries actually took the test
Sources: OECD, NCES

The rationale for using these tests is simple: besides including results from a wide range of countries, grades, and subject areas, in each case the results are scaled to an international average of 500. This means that scores can be compared across tests, and no additional conversion is necessary before entering the scores into the model. In order to get a single score for every country for each separate test, I averaged the results from each different grade and subject area, where applicable. For example, if a country scored 500 in 8^{th} grade mathematics and 530 in 8^{th} grade science, and those were the only two areas where that country participated, that country's average score would be 515 for that test. Since countries' participation varied by subject and by grade, averaging the scores to get one overall score makes it easy to compare countries' overall performance, both within and across different tests. The average score for each country was then used as the dependent variable in the model. There were some instances in which the scores for certain countries were split up into different regions (for example, the Flemish and French regions of Belgium were measured separately in certain cases), or just certain parts of countries were tested (for example, in certain cases only the Flemish region of Belgium was tested). In the former case, I averaged the scores from each region to get an overall score for each country. In the latter case, I took the scores from those particular regions to be indicative of the country as a whole, and used the average of those scores as the score for that country. After averaging all of the scores to get a single score for each country for each separate test, there were a total of 456 observations for 92 different countries.

b. Independent Variables

Now that the dependent variable (educational outcomes) is set, it is time to move on to the independent variables. Seeing as the hypothesis is that gender inequality in education has a significant effect on educational outcomes, there obviously will be measures of gender inequality in education in the model. The World Bank's World

Development Indicators database (World Bank 2012) provides several different measures of gender inequality in education, including the ratio of female to male primary enrollment, the ratio of female to male secondary enrollment, and the ratio of female to male tertiary enrollment. However, only the measures of inequality in primary and secondary school will be used, because the channels through which gender inequality might affect educational outcomes (for example, more equally educated siblings can provide more effective support to one another) primarily focus on the primary and secondary levels. Also, the international tests used in the model only test students in primary and secondary school, so it is appropriate to use independent variables that are concerned with these levels of schooling. Therefore, the ratio of female to male tertiary enrollment will not be included in the model, while the ratio of female to male primary enrollment and the ratio of female to male secondary enrollment will be included. These two variables will be kept separate (not averaged) in order to determine if inequality in primary school might be more important than inequality in secondary school, or vice versa. Since the ratios are female to male, a higher ratio means that there is less inequality, and therefore a positive correlation is expected between these ratios and test scores.

Another independent variable included in the model is GDP per capita. It is expected that GDP per capita will have a positive correlation to test scores, because GDP per capita can be thought to represent the level of resources a country has, and some of these resources can be used to help support education. GDP per capita can be taken to measure the absolute amount of resources a country has, and therefore it is an absolute measure of the resources a country can devote to education (as opposed to a variable such as expenditure on education as a percentage of GDP, which will also be included in the model and is more a measure of the relative importance a country's government places on education). At first glance, it might seem that GDP per capita is included for the same reasons as a variable such as expenditure on education per student, which is that it is an absolute measure of the resources devoted to education. However, a variable such as expenditure on education per student focuses on spending by the government on education, while GDP per capita represents the potential resources that can be spent by any segment of society on education. Most importantly, GDP per capita is a good approximation of the level of resources that a family can spend on their children's education. Theoretically, the more resources (in an absolute sense) a family has, the more they will (also in an absolute sense) spend on their children's education. This spending could take the form of tutoring programs, school supplies, supplemental materials, or various other things. With more resources spent on their education (from the family as well as the government, and possible other sources such as community programs), children will likely do better in school and achieve higher test scores. There are also additional channels through which GDP per capita might affect test scores. For example, a higher GDP per capita might lead to more free time for parents, some of which they can devote to helping their children with schoolwork. It is not necessary to go over all of the possible channels here; the important thing to take away is that GDP per capita might have a significant positive effect on test scores, and therefore it will be included as an independent variable in the model. In this case, the GDP per capita data comes from the World Development Indicators Database (World Bank 2012).

While it is important to include a measure of absolute resources that have the potential to be devoted towards education in the model, it is also important to include a measure of the relative level of public educational spending in a country. As previously mentioned, the most common variable used to measure this is public expenditure on education as a percentage of GDP. This variable shows the relative level of resources that a country's government devotes to education. It is expected that the higher this ratio, the more resources will be available to students, and a higher ratio can also be taken to indicate a greater emphasis on education in that country. For this model, I included a measure of public expenditure on education as a percentage of GDP from the UNESCO Institute for Statistics' Data Centre (UNESCO 2012). In this case, public expenditure includes both current and capital expenditures. However, this data set had a lot of missing data points, so I searched for an additional measure of the relative level of educational spending in a country, one with more complete data. The additional measure would serve as a substitute for the UNESCO public expenditure variable, allowing for an alternative model that would have more observations than the original model. This alternative model would also provide a good test of robustness to alternative specifications for the original model. An additional measure with more complete data was located, this time from the World Development Indicators database (World Bank 2012). This variable is called "Adjusted Savings: Education Expenditure (% of GNI)" where education expenditure is defined as "the current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment." Theoretically the UNESCO variable is superior, since the World Bank variable only includes current operating expenditures, while the UNESCO variable includes both current and capital expenditures and therefore more closely reflects total public expenditure on education as a percentage of GDP. Therefore the fundamental, original model will include the UNESCO measure of the relative level of educational spending. However, the World Bank measure does provide more data points, and also provides a good alternative specification to the original model. Consequently, this measure will be substituted for the UNESCO measure in an alternative model, with all other independent variables remaining the same.

While public expenditure on education as a percentage of GDP and operating expenditures on education as a percentage of GNI provide good measures of the relative level of resources a country devotes to education, it would be a mistake to conclude that higher ratios automatically mean a country is spending more resources per student, or putting a greater emphasis on education. There are other factors that can influence these variables, most importantly the funding needs of the education system. A country might spend a high proportion of GDP on education, but this could be because a relatively high percentage of their population is enrolled in school. Therefore, that population would have greater funding needs than a population that has a low proportion of their population in school, and it would be expected that the country with more of their population in school will spend a greater percentage of GDP (or GNI) on education. To take into account this factor, and to try to isolate the effect of either the UNESCO or World Bank educational spending variable on test scores, the model will include a measure of funding needs. In order to measure this, I calculated the percentage of the population enrolled in secondary school and the percentage of the population enrolled in primary school. First, I collected data on secondary enrollment and primary enrollment from the UNESCO Institute for Statistics' Data Centre (UNESCO 2012), and population data from the World Development Indicators Database (World Bank 2012). I then divided the secondary and primary enrollment by the population to get the percentage of the population enrolled in secondary school and in primary school. These variables then provide a measure of funding needs, and it is expected that the higher these percentages are in a given country, the higher the relative level of education expenditure will be in that country. Consequently, a higher percentage of the population in secondary and primary school combined with low expenditure on education would be expected to lead to lower test scores (since there are less resources spent per student), and vice versa. Once again, I chose to separate out funding needs into primary school and secondary school, in order to see if one has a greater effect than the other.

Another potential measure of resources that a country devotes to education is student/teacher ratios. However, rather than measuring the amount of money spent on an education system or the total pool of money which could potentially be spent on children's education, student/teacher ratios measure the human capital available to each student. The higher the student/teacher ratios, the less time a teacher can devote to each individual student, which results in a lower quality of education and lower test scores. A low student/teacher ratio means that a teacher can spend more time with each individual student, increasing the students' quality of education and raising their test scores. A low student/teacher ratio might also mean that a country invests more time hiring and training teachers, once again showing the importance that country places on education. Therefore, the model includes student/teacher ratios at the primary and secondary school levels, with the data coming from the World Development Indicators Database (World Bank 2012). Separate variables for primary and secondary school were included in order to see if student/teacher ratios at different levels of schooling had different effects on test scores.

As previously mentioned, Hanushek and Woessmann (2007) emphasize the importance of three features of a country's school system when determining the factors that influence educational outcomes. These are choice and competition, decentralization and the autonomy of schools, and accountability. Woessmann (2007) suggests that the percentage of students enrolled in private schools can provide a good measure of choice and competition in a country's education system. The thinking is that the more choices parents have and the greater the competition between schools, the more incentives schools will have to increase the quality of their education. This in turn will lead to better educational outcomes for their students. As a result, the model will include a variable that measures the percentage of students enrolled in private schools. The UNESCO Institute for Statistics' Data Centre (UNESCO 2012) has measures of the percentage of students enrolled in private schools, and they break it down into primary and secondary school levels. However, the data from the secondary level was not complete enough to include in the model (the data only went back to 1998), so therefore only the data from the primary school level was included. It is expected that the greater the percentage of primary enrollment in private schools, the higher test scores will be, since choice and competition between schools will be greater.

In addition to choice and competition, Hanushek and Woessmann (2007) believed that decentralization and autonomy of schools and accountability also would influence test scores. Unfortunately, there are no good measures of these variables currently available that both provide cross-country data using consistent criteria and go back to 1995. Therefore, no variables that measure either decentralization and the autonomy of schools or accountability are included in the model. While this is certainly unfortunate, it represents a chance for future improvement. I believe a comprehensive model of the determinants of educational outcomes should include variables that measure these factors, and therefore I believe that an effort should be made to come up with variables measuring these factors using criteria that are consistent across countries. While those variables might not have enough history to be useful in cross-country, longitudinal studies of educational outcomes right away, eventually they will have existed for long enough to warrant inclusion. At that point, our understanding of the determinants of educational outcomes over time can only increase.

Our independent variables are now set. To summarize, the dependent variable is test scores, using results going back to 1995 from multiple occasions of the TIMSS, PISA, and PIRLS international assessments. The independent variables are the ratio of female to male primary enrollment, the ratio of female to male secondary enrollment, GDP per capita, a measure of the relative level of public resources devoted to education (either public expenditure on education as a percentage of GDP or operating expenditures on education as a percentage of GNI), percentage of the population enrolled in secondary school, percentage of the population enrolled in primary school, primary student/teacher ratio, secondary student/teacher ratio, and percentage of primary enrollment in private schools. The following tables present some basic information about the variables used in the models:

Table 2: Independent Variable Name, Abbreviation, Hypothesis, and Source

Variable Name	Variable Abbreviation	Hypothesis	Data Source
Dependent Variable			
Test Score	Score	N/A	OECD, NCES
Variables Measuring Gender Inequality in Education			
Ratio of Female to Male Primary Enrollment	PrimEnrollRatio	$\beta > 0$	World Bank
Ratio of Female to Male Secondary Enrollment	SecEnrollRatio	$\beta > 0$	World Bank
Variables Measuring Resources Spent (or That Can Be Spent) on Education			
GDP per capita	GDP	$\beta > 0$	World Bank
Public Expenditure on Education (% of GDP)	EduExp	$\beta > 0$	UNESCO
Operating Expenditure on Education (% of GNI)	OperEduExp	$\beta > 0$	World Bank
Primary Student/Teacher Ratio	PrimPupilTeacher	$\beta < 0$	World Bank
Secondary Student/Teacher Ratio	SecPupilTeacher	$\beta < 0$	World Bank
Variables Measuring Features of School System			
Percentage of Primary Enrollment in Private Schools	PrivEnrollPrim	$\beta > 0$	UNESCO
Control Variables			
Percentage of Population Enrolled in Secondary School	SecEnrollPop	$\beta < 0$	UNESCO/World Bank
Percentage of Population Enrolled in Primary School	PrimEnrollPop	$\beta < 0$	UNESCO/WorldBank

Table 2.1: Independent Variable Mean, Standard Deviation, and # of Observations

Variable	Mean	Standard Deviation	# of Observations
Ratio of Female to Male Primary Enrollment	98.742	2.213	423
Ratio of Female to Male Secondary Enrollment	101.256	6.297	410
GDP per Capita	15156.206	13784.610	447
Public Expenditure on Education (% of GDP)	4.937	1.307	340
Operating Expenditure on Education (% of GNI)	4.579	1.363	432
Primary Student/Teacher Ratio	17.707	5.886	355
Secondary Student/Teacher Ratio	13.910	5.029	317
Percentage of Primary Enrollment in Private Schools	11.460	17.141	385
Percentage of Population Enrolled in Secondary School[a]	.093	.020	423
Percentage of Population Enrolled in Primary School[a]	.079	.032	434
[a]: The values for these variables are in decimal form, not percentage form			

c. Missing Data

Unfortunately, as is often the case, some independent variables included in the model have a fair amount of missing data. In order to increase the number of observations available, I attempted to fill in some of this missing data. In order to do this, I looked for missing data points that were surrounded by two years of available data. If the data for that variable held relatively steady for that particular country, I took the average of those two surrounding years and used that number to fill in the missing data point. This did not happen very often (the maximum amount of missing data points filled in for any one variable was thirteen). However, filling in the missing data did slightly increase the number of observations available, making it a worthwhile endeavor.

It should be noted that when talking about the number of observations in each model in the next section, I am referring to the total number of instances where there is data available for each relevant variable in the model. Only observations with data for each variable are included. Therefore, if there is missing data for a certain country and a certain year (for example, Australia doesn't have primary student/teacher ratio data for 2000), the data for that country and that year will not be included in the model. It should also be noted that some countries have two observations for a given year, when two separate tests were administered in that year (for example, both the PIRLS and PISA exams were administered in Austria in 2006). These are kept as separate observations, though the data for the corresponding independent variables are the same for both.

IV. Results

In this section, I will first present the results of my base model, using two alternative measures of the relative level of resources a country devotes to education. These base models include all variables related to both primary and secondary school. However, in an effort to better understand the determinants of education quality, I will also look separately at the effect of primary school variables and secondary school variables on test scores.

a. Model #1

The first model (there will be a total of six models) that I ran is the basic, fundamental model of the determinants of educational outcomes that I looked at. It consists of the dependent variable (test scores) as well as all of the independent variables: the ratio of female to male primary enrollment, the ratio of female to male secondary enrollment, GDP per capita, public expenditure on education as a percentage of GDP (the theoretically superior measure of the relative level of resources devoted to education in a country), percentage of the population enrolled in secondary school, percentage of the population enrolled in primary school, primary student/teacher ratio, secondary student/teacher ratio, and percentage of primary enrollment in private schools. The following tables show the output of this model. There were a total of 226 observations.

Table 3: Model #1 Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.772[a]	.596	.580	42.0907284

a. Predictors: (Constant), PrimEnrollPop, EduExp, SecEnrollPop, SecEnrollRatio, PrivEnrollPrim, GDP, PrimEnrollRatio, SecPupilTeacher, PrimPupilTeacher

Table 3.1: Model #1 ANOVA

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	565369.602	9	62818.845	35.458	.000[a]
	Residual	382671.954	216	1771.629		
	Total	948041.556	225			

a. Predictors: (Constant), PrimEnrollPop, EduExp, SecEnrollPop, SecEnrollRatio, PrivEnrollPrim, GDP, PrimEnrollRatio, SecPupilTeacher, PrimPupilTeacher

b. Dependent Variable: Score

Table 3.2: Model #1 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	238.427	149.778		1.592	.113
	PrimEnrollRatio	2.471	1.628	.086	1.518	.131
	SecEnrollRatio	.283	.588	.025	.481	.631
	GDP	.002	.000	.332	5.866	.000
	EduExp	3.098	2.743	.058	1.129	.260
	PrimPupilTeacher	.999	.964	.094	1.036	.301
	SecPupilTeacher	.283	1.027	.023	.276	.783
	PrivEnrollPrim	-.175	.215	-.042	-.814	.417
	SecEnrollPop	55.779	173.870	.016	.321	.749
	PrimEnrollPop	-1257.987	135.896	-.661	-9.257	.000

a. Dependent Variable: Score

Unfortunately, based on the results from this model, the ratio of female to male primary enrollment and the ratio of female to male secondary enrollment were not significant at the 95% level. The only variables that were significant at the 95% level were GDP per capita (in a positive direction) and percentage of the population enrolled in primary school (in a negative direction). It was expected that GDP per capita would have a positive effect on test scores, so the direction of the correlation makes sense. At first, it would seem that the direction of the correlation between percentage of the population enrolled in primary school and test scores does not make sense. However, the point of including that variable in the first place was to take into account the fact that greater funding needs might be leading to greater spending on education by the government, and that greater spending doesn't automatically translate into more resources available per student. It was mentioned that higher spending on education combined with a lower proportion of the population enrolled in school might lead to higher test scores, since there would be more resources available per student. I believe that the negative correlation between percentage of the population enrolled in primary school and test scores reflects the fact that, all else equal, more resources will be available per student if the percentage of the population enrolled in primary school is lower. However, it is interesting that while percentage of the population enrolled in primary school is significant and negatively correlated, percentage of the population enrolled in secondary school is insignificant in the positive direction.

This model does not support the hypothesis that greater inequality in education leads to lower test scores. While the coefficients on both the ratio of female to male primary enrollment and the ratio of female to male secondary enrollment were positive (which is expected), neither variable was significant at the 95% level. Based on the t-value and corresponding p-value, the ratio of female to male primary enrollment did have a much greater effect on test scores than the ratio of female to male secondary enrollment. In fact, the p-value for the ratio of female to male primary enrollment was not extremely far from .05, which suggests that if more observations were included or if the model were tweaked slightly, it is possible that this variable would be significant at the 95% level. That seems much less likely for the ratio of female to male secondary enrollment.

Overall, this model had an R-square of .596 and an adjusted R-square of .580. So, while the independent variables do not explain a huge portion of the variance in test scores, they still explain a good amount. This means that this model can be useful in understanding the factors that do or do not influence test scores. Again, this is the fundamental model of the determinants of educational outcomes that I tested. However, as I mentioned before, more observations could be tested by using a different measure of the relative level of resources a country devotes to education. This alternative measure is operating expenditures on education as a percentage of GNI. While theoretically not as good as public expenditure on education as a percentage of GDP (used in this last model), it will allow additional observations to be included in the model, which might change the results. The next model uses operating expenditures on education as a percentage of GNI rather than public expenditure on education as a percentage of GDP, providing a good test of robustness for the original, fundamental model.

b. Model #2

The only thing different about this model is the substitution of operating expenditures on education as a percentage of GNI for public expenditure on education as a percentage of GDP. There were a total of 274 observations for this model, an increase of 48 over the previous model. The following tables show the output:

Table 4: Model #2 Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
2	.759[a]	.577	.562	42.4883569

a. Predictors: (Constant), PrimEnrollPop, SecEnrollPop, SecEnrollRatio, PrivEnrollPrim, OperEduExp, PrimEnrollRatio, GDP, SecPupilTeacher, PrimPupilTeacher

Table 4.1: Model #2 ANOVA

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	649079.211	9	72119.912	39.950	.000[a]
	Residual	476588.765	264	1805.260		
	Total	1125667.976	273			

a. Predictors: (Constant), PrimEnrollPop, SecEnrollPop, SecEnrollRatio, PrivEnrollPrim, OperEduExp, PrimEnrollRatio, GDP, SecPupilTeacher, PrimPupilTeacher

b. Dependent Variable: Score

Table 4.2: Model #2 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
2	(Constant)	264.105	138.062		1.913	.057
	PrimEnrollRatio	1.566	1.480	.053	1.058	.291
	SecEnrollRatio	.812	.542	.070	1.499	.135
	GDP	.002	.000	.319	6.155	.000
	OperEduExp	7.013	2.431	.141	2.885	.004
	PrimPupilTeacher	1.392	.926	.130	1.504	.134
	SecPupilTeacher	.202	.983	.016	.205	.838
	PrivEnrollPrim	-.119	.203	-.027	-.585	.559
	SecEnrollPop	-67.089	162.801	-.019	-.412	.681
	PrimEnrollPop	-1295.716	119.135	-.686	-10.876	.000

a. Dependent Variable: Score

Once again, the ratio of female to male primary enrollment and the ratio of female to male secondary enrollment were not significant at the 95% level. Also, like in the first model, GDP per capita and the percentage of the population enrolled in primary school were both significant at the 95% level, and both in the same direction as their correlations in the first model. However, this time an additional variable was significant at the 95% level: operating expenditures on education as a percentage of GNI. As expected, the correlation between this variable and test scores is positive. What is interesting is that despite being theoretically inferior to public expenditure on education as a % of GDP (since it only takes into account current operating and not capital expenditures), it is significant while public expenditure was not. This suggests that current operating expenditures (such as wages and salaries) have a significant effect on test scores, while capital expenditures (such as investments in buildings and equipment) do not. Perhaps human capital is more important than physical capital in education. Higher wages and salaries for educators will not only encourage them to perform their jobs better, but will also attract more intelligent and better-equipped individuals to the education profession. These motivated and intelligent educators can then in turn increase the quality of education and motivate students to perform better in school, which will translate to higher test scores. On the other hand, if a school system has better buildings and equipment, that doesn't mean their students will be more motivated, or that there will be high-quality teachers in the system. If a student does not want to learn or doesn't understand something, no amount of technology can change that. On the contrary, if a student is motivated and has high-quality teachers, they can potentially overcome a lack of technology and facilities. That human capital is more important than physical capital for the quality of education is an interesting hypothesis, one that should be explored in more detail in future research.

Like the first model, this model does not support the hypothesis that greater gender inequality in education leads to lower test scores. Once again the coefficients were positive, but the variables were not significant at the 95% level. Based on the t-values and corresponding p-values, this time the ratio of female to male secondary enrollment had a greater effect on test scores than the ratio of female to male primary enrollment, though in this case the difference was much less pronounced. Neither variable had an extremely high p-value, but neither had one very close to .05 either. Hence, this model does not provide support for the idea that gender inequality in education is significantly related to educational outcomes.

Overall, this model had an R-square of .577 and an adjusted R-square of .562. These are slightly less, but not much different, than the corresponding values for the first model, which is interesting because this model included 48 more observations. Just like with the first model, the R-square and adjusted R-square values for this model mean that this model can be useful in trying to understand the factors that do or do not affect educational outcomes.

c. Model #3

Since both the ratio of female to male primary enrollment and the ratio of female to male secondary enrollment were insignificant in both models, I decided to dig a little deeper to see if there really was a difference between the effects of gender inequality in primary school and gender inequality in secondary school. The first model suggested this, since gender inequality in primary school had a much larger effect on test scores than gender inequality in secondary school in that model (though both variables were insignificant). Also, looking at both models, whenever there were corresponding variables for primary and secondary school, every time but once the primary school level had a larger effect than the secondary school level. This suggests that test scores are primarily influenced by factors at the primary school level. Perhaps habits are formed young, and crucial aspects of a child's educational development take place during the primary school years. This would mean that there is a critical window during which a child needs to be exposed to certain educational input, whether that is textbook material, motivation, technology, or a number of other things. Beyond that critical period, which would end when the child leaves primary school in this case, it is much more difficult to influence a child's educational outcomes. In terms of gender inequality in education, this would mean that the channels through which inequality might affect educational outcomes are primarily open during the primary school years. The idea of a critical window for educational outcomes, especially concerning gender inequality in education, is an interesting one, and it merits further research. I will attempt to scratch the surface on this idea here, beginning with a new model. In this latest model, whenever there are corresponding variables for primary and secondary school, I left out the variable dealing with secondary school, in order to focus just on variables dealing with primary school. I also included those variables that were not split up into primary and secondary school levels. For the variable measuring the relative level of educational spending in a country, in this case I included public expenditure on education as a percentage of GDP. The result is that the independent variables in this model are: the ratio of female to male primary enrollment, GDP per capita, public expenditure on education as a percentage of GDP, primary student/teacher ratio, percentage of primary enrollment in private schools, and percentage of the population enrolled in primary school. The dependent variable, of course, is test scores. There were a total of 260 observations for this model. The following tables show the output:

Table 5: Model #3 Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
3	.784[a]	.614	.605	41.5379349

a. Predictors: (Constant), PrimEnrollPop, EduExp, GDP, PrivEnrollPrim, PrimEnrollRatio, PrimPupTeacher

Table 5.1: Model #3 ANOVA

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	694372.858	6	115728.810	67.074	.000[a]
	Residual	436526.208	253	1725.400		
	Total	1130899.067	259			

a. Predictors: (Constant), PrimEnrollPop, EduExp, GDP, PrivEnrollPrim, PrimEnrollRatio, PrimPupTeacher

b. Dependent Variable: Score

Table 5.2: Model #3 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	154.029	129.806		1.187	.236
	PrimEnrollRatio	3.596	1.286	.130	2.797	.006
	GDP	.002	.000	.347	7.520	.000
	EduExp	3.898	2.390	.071	1.631	.104
	PrimPupTeacher	1.299	.658	.119	1.974	.049
	PrivEnrollPrim	-.029	.177	-.007	-.163	.871
	PrimEnrollPop	-1237.221	114.385	-.647	-10.816	.000

a. Dependent Variable: Score

This time, the ratio of female to male primary enrollment is significant at the 95% level. In addition, GDP per capita, the percentage of the population enrolled in primary school, and primary student/teacher ratio are all significant at the 95% level (though primary student/teacher ratio is just barely significant at this level). GDP per capita and percentage of the population enrolled in primary school were significant in the other two models as well, and the direction of their correlation is as expected. The two new significant variables are primary student/teacher ratio and the ratio of female to male primary enrollment. The positive correlation between equality (not inequality, since a higher ratio means more equality) and test scores is expected. However, a positive correlation between primary student/teacher ratio and test scores is not expected. As previously mentioned, a higher student/teacher ratio is expected to lead to lower test scores because teachers can spend less time with each individual student, resulting in a lower quality of education received by those students. This implies a negative correlation between primary student/teacher ratio and test scores, but this is not the case. I do not have a good explanation for this fact. Perhaps there is another factor that causes both higher test scores and higher student/teacher ratios. For example, maybe in well-functioning education systems teachers are more efficient, so they can handle more students in their classroom. Or maybe education systems that perform well will attract more students that otherwise might not enroll, leading to higher student/teacher ratios. There would need to be further analysis in order to determine the reason for this counterintuitive correlation direction.

On the bright side, this model does provide some support for the hypothesis that gender inequality in education has a significant effect on educational outcomes. The fact that the ratio of female to male primary enrollment is significant at the 95% level in this case is encouraging. When focusing on variables dealing with primary school, gender inequality is a significant factor influencing test scores. This suggests that further research (using more complete data, or different variables) should be conducted into the relationship between gender inequality at the primary school level and test scores. While this model does not provide definitive proof of a significant relationship, it shows that there is a good chance further research will demonstrate that gender inequality at the primary school level does significantly influence test scores.

Overall, this model had an R-square of .614 and an adjusted R-square of .605. These values are actually higher than the corresponding values for the first two models, which is surprising because there are less independent variables in this model. What this suggests is that the variables that were dropped for this model (those dealing specifically with the secondary level of education) are not that important in predicting test scores, while the remaining variables (including those focusing on the primary level of education) are important factors in predicting test scores.

As was the case for the first two models, substituting operating expenditures on education as a percentage of GNI for public expenditure on education as a percentage of GDP will result in an alternative model that will provide more observations and a good test of robustness for this latest model. This is exactly what I did in this next model.

d. Model #4

The only thing different about this model from model #3 is the substitution of operating expenditures on education as a percentage of GNI for public expenditure on education as a percentage of GDP. There were a total of 315 observations for this model, an increase of 55 observations over the previous model. The following tables show the output:

Table 6: Model #4 Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
4	.768[a]	.589	.581	42.0508939

a. Predictors: (Constant), PrimEnrollPop, OperEduExp, GDP, PrivEnrollPrim, PrimEnrollRatio, PrimPupilTeacher

Table 6.1: Model #4 ANOVA

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	781924.269	6	130320.712	73.699	.000[a]
	Residual	544629.524	308	1768.278		
	Total	1326553.794	314			

a. Predictors: (Constant), PrimEnrollPop, OperEduExp, GDP, PrivEnrollPrim, PrimEnrollRatio, PrimPupilTeacher

b. Dependent Variable: Score

Table 6.2: Model #4 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
4	(Constant)	192.312	121.609		1.581	.115
	PrimEnrollRatio	3.060	1.212	.108	2.525	.012
	GDP	.002	.000	.350	8.134	.000
	OperEduExp	6.107	2.067	.119	2.954	.003
	PrimPupilTeacher	1.409	.611	.129	2.305	.022
	PrivEnrollPrim	-.003	.162	-.001	-.018	.985
	PrimEnrollPop	-1223.967	103.329	-.645	-11.845	.000

a. Dependent Variable: Score

In this model, all but one of the variables were significant at the 95% level. Like in the previous model, the ratio of female to male primary enrollment was significant at that level (though not at the 99% level). Once again, the positive direction of the correlation was expected. Also significant were GDP per capita, primary student/teacher ratio (though not at the 99% level), and percentage of the population enrolled in primary school. The direction of the correlations for GDP per capita and percentage of the population enrolled in primary school are as expected, though the direction of the correlation for primary student/teacher ratio is not what was expected (this was discussed in the context of the previous model). The new variable introduced here, operating expenditures on education as a percentage of GNI, is also significant at the 95% level (with a positive correlation, as expected). The fact that operating expenditures on education as a percentage of GNI is significant here, while public expenditure on education as a percentage of GDP was not in the previous model, supports the idea drawn from models 1 and 2 that operating expenditures on education have a significant effect on test scores, while capital expenditures do not. Implicit in that idea is that human capital is more important than physical capital in determining educational outcomes. This model lends additional support to that idea, further underscoring the need for additional research of the effects of human capital versus physical capital on educational outcomes.

Once again, the ratio of female to male primary enrollment was significant at the 95% level, albeit not at the 99% level. Still, this model provides some additional support for the hypothesis that gender inequality in education has a significant effect on educational outcomes. The fact that this significance still held from the previous model, despite more observations and a different variable measuring the relative level of educational spending, shows that the significance from the previous model probably wasn't just a fluke. Again, the significance of the ratio of female to male primary enrollment in this model suggests that additional research should take place to determine if gender inequality at the primary level is a significant factor in determining educational outcomes.

This model had an R-square of .589 and an adjusted R-square of .581. Though these numbers are lower than the corresponding values in the previous model, they are nearly the same as the corresponding numbers from the first model, and higher than the corresponding numbers from the second model (which also included operating expenditures on education as a percentage of GNI). Like in the third model, the conclusion that can be drawn from these numbers is that variables dealing specifically with the secondary level of education are not important factors in predicting test scores, while the remaining variables (including those dealing specifically with the primary level of education) are important factors in predicting test scores. Overall, this model serves to confirm the findings of previous models, strengthening the arguments formulated from those models.

e. Model #5

The results of the previous two models beg an obvious question: what would be the results from a model that focused on variables dealing with the secondary level of schooling, rather than the primary level of schooling? This next model attempts to find out the answer. In this model, whenever there were corresponding variables for primary and secondary levels of schooling, I left out those dealing with primary school. This focuses the model on those variables dealing specifically with secondary school. I also included those variables that were not broken down into primary and secondary levels. In this case, public expenditure as a percentage of GDP was used to measure the relative level of educational spending in a country. As a result, the independent variables in this model are: the ratio of female to male secondary enrollment, GDP per capita, public expenditure on education as a percentage of GDP, secondary student/teacher ratio, and percentage of the population enrolled in secondary school. The dependent variable is test scores. There were a total of 248 observations for this model. The following tables show the output:

Table 7: Model #5 Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
5	.604[a]	.365	.352	50.8701359

a. Predictors: (Constant), SecEnrollPop, SecPupTeacher, SecEnrollRatio, EduExp, GDP

Table 7.1: Model #5 Summary

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	360349.942	5	72069.988	27.850	.000[a]
	Residual	626240.517	242	2587.771		
	Total	986590.459	247			

a. Predictors: (Constant), SecEnrollPop, SecPupTeacher, SecEnrollRatio, EduExp, GDP

b. Dependent Variable: Score

Table 7.2: Model #5 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
5	(Constant)	521.258	60.281		8.647	.000
	SecEnrollRatio	-.417	.607	-.037	-.687	.493
	GDP	.002	.000	.453	7.692	.000
	EduExp	-2.999	2.789	-.059	-1.075	.283
	SecPupTeacher	-4.364	.657	-.358	-6.637	.000
	SecEnrollPop	479.648	202.046	.137	2.374	.018

a. Dependent Variable: Score

There are three variables that are significant at the 95% level here. These are GDP per capita, secondary student/teacher ratio, and percentage of the population enrolled in secondary school. GDP per capita is positively correlated with test scores, which is what we have observed in the previous models. Here secondary student/teacher ratio is negatively correlated with test scores, which is what we would theoretically expect. A lower secondary student/teacher ratio means that teachers have more time to devote to each individual student. It also may represent greater investment in the hiring and training of teachers by a country, meaning that country places great emphasis on education. These factors will then lead to a greater quality of education for students, and consequently higher test scores. What is interesting is that in the previous two models, primary student/teacher ratio was significant and positively correlated with test scores, the opposite of what was expected. The reasons for this are unclear. Maybe certain features of the models are causing this contradiction, or perhaps student/teacher ratios really do have different effects at different levels of schooling. I will not delve into this more deeply, as doing so would divert from the purpose of this paper.

Percentage of the population enrolled in secondary school is positively correlated with test scores in this model. However, looking back at the discussion of the corresponding variable for the primary school level, the correlation is expected to be negative. The reasons for this positive correlation and contradiction with the corresponding variable from the primary school level (which was found to be negatively correlated with test scores) are, again, unclear. Perhaps there is reverse causation at play here, with higher test scores (representing a higher-quality education system) inducing previously skeptical parents to enroll their children in the school system. Parents might take awhile to make this decision, which is why the effect only shows up at the secondary level. Again, delving more deeply into this will take us beyond the scope of this paper.

The critical thing to take away here is that the ratio of female to male secondary enrollment is not significantly correlated with test scores. The first model had indicated that there might be a real difference between the effect of gender inequality at the primary level and gender inequality at the secondary level on test scores. Here we are beginning to see additional evidence for that idea. While the ratio of female to male primary enrollment was significant in models 3 and 4, here the ratio of female to male secondary enrollment is not, despite the reduction in the number of independent variables in this model. Digging deeper into the original, fundamental model seems to have indicated that there really is a significant difference between gender inequality in education at the primary and secondary levels. Also working against the idea that gender inequality at the secondary level is a significant determinant of educational outcomes are the R-square and adjusted R-square numbers of this model, which are .365 and .352, respectively. Those numbers indicate that the variables in this model do a poor job of explaining the variance in test scores.

Therefore, the R-square and adjusted R-square numbers from models 3 and 4, as well as the corresponding numbers from this model, all lead to the same conclusion: those variables dealing specifically with secondary school (including gender inequality at the secondary level) are not particularly important in predicting test scores, while those variables dealing specifically with primary school (including gender inequality at the primary level) are important predictors of test scores. Still, as with models 1 and 3, it would be useful to see how the results of this model hold up to an alternative specification with more observations and a different measure of the relative level of educational spending.

f. Model #6

The only thing different about this model from model #5 is the substitution of operating expenditures on education as a percentage of GNI for public expenditure on education as a percentage of GDP. There were a total of 303 observations for this model, an increase of 55 observations over the previous model. The following tables show the output:

Table 8: Model #6 Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
6	.568[a]	.322	.311	51.7492443

a. Predictors: (Constant), SecEnrollPop, SecPupTeacher, SecEnrollRatio, OperEduExp, GDP

Table 8.1: Model #6 ANOVA

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
6	Regression	378176.480	5	75635.296	28.243	.000[a]
	Residual	795361.332	297	2677.984		
	Total	1173537.812	302			

a. Predictors: (Constant), SecEnrollPop, SecPupTeacher, SecEnrollRatio, OperEduExp, GDP

b. Dependent Variable: Score

Table 8.2: Model #6 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
6	(Constant)	508.654	56.690		8.973	.000
	SecEnrollRatio	-.468	.572	-.041	-.820	.413
	GDP	.002	.000	.388	7.143	.000
	OperEduExp	3.973	2.472	.084	1.607	.109
	SecPupTeacher	-4.070	.637	-.322	-6.390	.000
	SecEnrollPop	301.018	192.196	.087	1.566	.118

a. Dependent Variable: Score

In this model, only two variables are significant at the 95% level: GDP per capita and secondary pupil/teacher ratio. The positive direction of the correlation between GDP per capita and test scores has been observed in every model so far, and to reiterate, is expected. The direction of the correlation between secondary student/teacher ratio and test scores is also expected, as discussed in the context of the previous model. One difference between the results of this model and the previous one is that the percentage of the population enrolled in secondary school is not significant here. This is noteworthy because in the previous model this variable had been significant, but in the opposite direction of what was expected. The fact that it wasn't significant in this model shows that the positive significant correlation in the previous model should not be given too much weight. That counterintuitive finding was likely just an aberration caused by the specific specifications of that model.

Again, the critical takeaway from this model is the lack of significance for the ratio of female to male secondary enrollment. This fact serves to support and strengthen the conclusion drawn from the previous model, which is that there is a significant difference in how gender inequality at the secondary level and primary level affect test scores. It seems that gender inequality at the primary level does have a much greater effect on test scores than gender inequality at the secondary level. Whether there is a significant correlation between gender inequality at the primary level and test scores would need to be answered by further research. However, it seems safe to say that gender inequality at the secondary level is much less important for determining educational outcomes, if it is important at all. The low R-square (.322) and adjusted R-square (.311) numbers, like in the previous model, support the above conclusions, as well as the idea that primary level variables are more important in determining educational outcomes than secondary level variables.

V. Conclusions

The main question that this paper attempts to answer is: does gender inequality in education affect educational outcomes? In the course of trying to answer this question, six different models of the determinants of educational outcomes were examined, and the results of those models were both interesting and informative. There were two variables that were significant at the 95% level in each model in which they were included. These were GDP per capita and percentage of the population enrolled in primary school. In fact, these variables were significant at the 99% level as well in every model in which they were included. GDP per capita was included all six models, and in each case the direction of the correlation was positive. These facts indicate that GDP per capita is in fact a significant determinant of educational outcomes, with a higher GDP per capita leading to higher test scores. This would make sense, because a higher GDP per capita indicates that a country has more resources that can potentially be devoted to education, whether those resources come from the government, the family, or other aspects of society. A higher GDP per capita also might result in more free time for parents, who can then use that time to help their children with schoolwork. The relationship between GDP per capita and test scores likely works through many other channels as well (for example, a higher GDP per capita might result in a more socially cohesive society, leading to a higher quality of education for all students). A thorough investigation of these channels would be an interesting topic for further research.

In addition to GDP per capita, percentage of the population enrolled in primary school was also significant at the 95% level (and the 99% level) in every model in which it was included. There were four different models (models 1-4) that contained this variable, and in each instance the correlation was negative. Therefore it seems that percentage of the population enrolled in primary school (a measure of funding needs) is a significant determinant of educational outcomes, with an inverse relationship between the two variables. The direction of this relationship might seem confusing at first, but remember that this variable was included because of its relation to variables measuring the relative level of resources a country devotes to education. If this level is very high, it might mean that a country is devoting a lot of resources per student, or that it places a very high emphasis on education. However, it could just mean that a greater percentage of the population is enrolled in school, resulting in a greater need for funding. To take this fact into account, it is necessary to include variables measuring funding needs (in the case of the above models, funding needs are represented by the percentage of the population enrolled in a certain level of school). If a country devotes a relatively high level of resources to education, and the percentage of the population enrolled in school is low, this means that there will be more resources available per student, and as a result test scores are likely to be higher. However, a low level of resources devoted to education combined with a high proportion of the population in school will lead to less resources available to each student, and consequently to lower test scores. Therefore, all else equal, a lower proportion of the population enrolled in school results in more resources available per student, and this will lead to higher test scores. This is why the direction of the correlation between percentage of the population enrolled in primary school and test scores is negative.

Another conclusion that the above models seem to support is that operating expenditures on education (such as wages and salaries) have a significant effect on education outcomes, while capital expenditures on education (such as those on buildings and equipment) do not. This is supported by the fact that operating expenditures on education as a percentage of GNI was significant in models 2 and 4, while public expenditure on education (which includes capital expenditures) as a percentage of GDP was not significant in any model. Also, in the last two models (those focusing on secondary level variables), operating expenditures had a greater effect on test scores than public expenditure (as indicated by the t-values and corresponding p-values). Therefore, it seems that human capital is more important than physical capital when it comes to educational outcomes. Having high-quality teachers and administrators (which is expected if wages and salaries are higher) seems to be more important than having new facilities or up-to-date equipment. If this is indeed true, it means that countries should rebalance their priorities away from physical capital and towards human capital.

Of course, the critical conclusions that can be drawn from the above models relate to gender inequality in education. While the results do not conclusively indicate that gender inequality at either the primary or secondary level significantly influences test scores, it seems that gender inequality at the primary level has a much larger effect on test scores than gender inequality at the secondary level. Though gender inequality at the primary level was not significant at the 95% level in models 1 and 2, it was significant in models 3 and 4, which focused on variables dealing with primary school. In each case, the ratio of female to male primary enrollment was positively correlated with test scores (aka less inequality leads higher test scores), which is what was expected. Gender inequality at the secondary level, on the other hand, was not significant in any model in which it was included. Also, in model number one, which is the fundamental model I tested, gender inequality at the primary level had a much bigger (albeit insignificant) effect on test scores than gender inequality at the secondary level. Therefore, future research on the effect of gender inequality in education on educational outcomes should focus specifically on gender inequality at the primary level. The channels through which gender inequality in education affects test scores seem to be primarily located at the primary school level. I do not think it would be surprising if future models with more complete data found that gender inequality at the primary level significantly affects educational outcomes. Conversely, based on the results of the above models, there is no evidence to indicate that gender inequality at the secondary level is a significant predictor of educational outcomes.

The fact that gender inequality at the primary level seems to be more important than gender inequality at the secondary level raises this question: is this relationship present for other variables as well? Based on the results of the above models, it seems like that is the case. The explanatory power of models 3 and 4 (those focusing on the primary level) is nearly double the explanatory power of models 5 and 6 (those focusing on the secondary level). In fact, dropping the secondary level variables from models 1 and 2 actually increases the explanatory power of the models, while dropping the primary level variables significantly lowers the explanatory power. Also, in the base model (model 1), whenever there were corresponding variables with primary and secondary levels, the primary level variable always had a greater effect on test scores than the secondary level variable. These findings suggest that educational outcomes are primarily determined by factors at the primary school level. Therefore, primary school represents a "critical window" during which a child's present and future educational performance can be significantly influenced. Beyond primary school, it is much more difficult to influence a child's educational performance. This idea is one that merits future research, because if it is true that there is a "critical window" for educational outcomes during primary school, then countries might be able to increase their students' educational outcomes by redirecting resources toward primary school.

Finally, it must be noted that these results should be, as always, interpreted with caution. While I attempted to build a comprehensive model of the determinants of educational outcomes, there were some shortcomings. For example, due to data limitations I was not able to include variables that measure the decentralization and autonomy or accountability in a country's school system. Also, many of the independent variables included in the model had a fair amount of missing data. Though some of the missing data points were filled in, many observations were not included in one or more models because there was missing data for at least one independent variable. In some instances, whole countries were left out because of data availability problems. These missing observations could potentially skew the results of the models. However, despite these problems, I believe that this paper provides a good initial look into the question of whether gender inequality in education affects educational outcomes. Hopefully, future studies will be undertaken to expand upon both the models presented in this paper and the conclusions drawn from them.

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