Representative Bureaucracy and the Policy Environment: Gender Representation in Forty-Four Countries

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Abstract

The representative bureaucracy literature focuses on how passive representation translates into substantive benefits for the represented individuals. Although scholars have found substantial empirical support for representation based on gender, most studies have examined the United States, a country with high levels of democracy and gender equality compared to much of the rest of the world. This article first investigates whether the effects of gender representation differ across countries using cross-national education data. Evidence from forty-four countries shows that representative bureaucracy findings are relatively rare across the world. Second, this article contributes to contextual theories of representative bureaucracy by examining how the policy and political environments influence the link between passive representation and policy outcomes. The findings suggest that bureaucratic representation is more effective in countries where gender equality is high and political support for women is greater. These findings indicate that representative bureaucracy is enhanced by favorable policy and political environments.

Introduction

Implementing policies responsive to the general public is a key element in democratic public administration. Because democratic systems are premised upon representation where the citizens' will is reflected through public officials, having bureaucrats who represent the interests of the citizens can augment this important political process. The theory of representative bureaucracy suggests that public officials from disadvantaged backgrounds can play a role in incorporating underrepresented groups' interests into the policy process (Mosher 1968), thereby contributing to better and more equitable policy outcomes. An extensive body of research has investigated the role of representative bureaucracy and found it has a significant relationship with policy outcomes for disadvantaged groups (Keiser et al. 2002), the way citizens view the agency's legitimacy and trustworthiness (Riccucci, Van Ryzin, and Jackson 2018), and citizens' willingness to coproduce (Riccucci, Van Ryzin, and Li 2016). While the literature has significantly advanced the theory of representative bureaucracy, many studies were initially conducted within the United States, which raise concerns about the applicability of representative bureaucracy theory to the non-US context (Bishu and Kennedy 2020).

Fortunately, efforts to test the theory of representative bureaucracy internationally have been recently made in Brazil (Meier and Funk 2017), Canada (Gidengil and Vengroff 1997), England (Hong 2017), France (Meier and Hawes 2009), Germany (Sievert 2021), Hong Kong (Burns 1980), India (Dhillon and Meier 2020), South Africa (Fernandez 2020; Naff and Capers 2014), South Korea (Park 2013; Song 2018), China (Xu and Meier 2021) and Denmark (Guul 2018). These studies, however, do not necessarily seek to account for national contexts in explaining representative bureaucracy in different countries; thus they are not comparative in nature. Given the extensive variation across countries in how political systems deal with

representation, the lack of genuinely comparative research challenges the external validity of the theory (Groeneveld et al. 2015).

The purpose of this study is to probe the generalizability of the theory with a cross-national analysis and examine the conditions that facilitate the influence of representative bureaucracy on policy outcomes. In particular, we test whether the relationship between passive and active representation remains valid across the world and under what institutional contexts representative bureaucracy matters more. To study representative bureaucracy in a cross-national context, one needs to focus on identities that exist in all countries. While race and ethnicity are common identities in many countries, there are highly homogeneous countries where racial differences are minimal. The most promising identity for such cross-national studies, therefore, is gender. While gender is an important identity in all countries, the degree of salience of gender can vary across countries because each country has different levels and patterns of institutionalized discrimination against women (Keiser et al. 2002). Moreover, the effect of gender representation could vary because women in some countries are more disadvantaged or subject to greater institutionalized sexism. This variation will be useful in determining when representative bureaucracies arise and how much impact they can have on policy outcomes.

Cross-national variations allow us to address the questions of *when* and *where* representative bureaucracy works because each country has a different environment that can influence bureaucratic representation (Meier 2019). Building upon the existing literature, we first expect that the effect of representative bureaucracy exists across countries. We also argue that environmental factors shape bureaucratic behaviors by changing the costs and benefits of adopting a representation role. Among the various environmental factors, this research focuses on the policy environment (gender equality policies) and the political environment (female

political representation) and examines how these factors influence the link between female bureaucratic representation and policy outcomes for female clients at the street level. Representation, including bureaucratic representation, after all, is a political process; and we would expect that it would be enhanced when the policy and political environments were supportive (Meier and Smith 2017).

This article makes two novel contributions to the study of representative bureaucracy. First, as far as we know, it is the first cross-national study of representative bureaucracy that uses individual-level data that allow a match-up of clients and bureaucrats (Bishu and Kennedy 2020). While scholars have called for a more systematic individual-level analysis and a cross-national perspective to the study of representative bureaucracy (Meier and Morton 2015), we have yet to gain a comprehensive understanding of when and where representative bureaucracy works. This omission is unfortunate because understanding the role of bureaucratic representation has important implications for equitable public service provision across the world. This research tackles these contemporary challenges facing representative bureaucracy scholars by testing the theory's international application and clearly demonstrating the linkage between passive and active representation.

Second, this study provides an empirical test for recent theoretical arguments that contextual factors influence the linkage between passive representation and outcomes that benefit the represented (Groeneveld et al. 2015; Meier 2019). While existing work provides insight into how individual-level (e.g., discretion, professionalism) or agency-level (e.g., critical mass, socialization) contextual factors affect bureaucratic representation (Keiser et al. 2002), our understanding of how broader institutional contexts shape the effect of representative bureaucracy is limited. By showing significant roles of the policy and political environments, our

study highlights that contextual factors matter not only at the micro-level but also at the macro-level.

The Theory of Representative Bureaucracy

The concept of bureaucratic representation—a bureaucracy that mirrors the composition of society, serves the citizens better, and consequently promotes the quality of public service (Kingsley 1944)—remains an important issue. Most studies of bureaucratic representation adopt Mosher's (1968) distinction between passive and active representation. Passive representation occurs when bureaucrats who share similar identities with the public work in organizations (Pitkin 1967; Mosher 1968), while active representation happens when those bureaucrats actively promote the interests of those being represented (Pitkin 1967; Mosher 1968). The central contention of representative bureaucracy is that passive representation can lead to active representation (Mosher 1968). Empirical research examines the link between passive and active representation, especially whether and how the presence of bureaucrats from under-represented groups contributes to policy outcomes benefiting disadvantaged clientele. The underlying logic of the positive link between passive bureaucratic representation and disadvantaged citizen outcomes is that when bureaucrats share the same values, norms, and experiences with citizens, these values get incorporated into decisions that bureaucrats make; and as a result, the decisions are more likely to promote policy outcomes for disadvantaged citizens (Selden 1997). A second linkage, termed symbolic representation, holds that clients react to bureaucrats who look like them in a positive manner and subsequently engage in behaviors (e.g., cooperation, co-production) that produce positive outcomes.

Previous research has demonstrated the positive effects of racial minority or female bureaucrats on policy outcomes for marginalized citizens in a variety of policy areas such as

education (Keiser et al. 2002), law enforcement (Hong 2017; Meier and Nicholson-Crotty 2006; Riccucci et al. 2016), health care (Zhu and Walker 2013), welfare (Davis, Livermore, and Lim 2011), firefighting (Andrews, Ashworth, and Meier 2014), and equal employment (Guul 2018; Hindera 1993). Although the theory of representative bureaucracy has been applied to multiple policy areas and evidence generally shows a positive pattern (e.g., representative bureaucracy contributes to beneficial client outcomes),[1] most research uses a single country, the United States (Bishu and Kennedy 2020).

Recent work on representative bureaucracy, however, suggests that the existence of a representative bureaucracy is contingent on a wide range of factors that likely vary across country settings (Groeneveld et al. 2015; Meier and Morton 2015; Peters, Schröter, and Maravić 2015). These theoretical arguments suggest that many contextual factors could influence whether bureaucrats are likely to engage in representation, how clients respond to representation, and how effective this representation could be. Incorporating all of the contextual factors into a single study, however, is not feasible simply because the contexts vary so dramatically and the available data sets simply do not have sufficient variation to estimate the myriad influences. Our objective here is more modest; we will examine how the political climate in regard to gender equality and political representation might enhance or limit the relationship between female bureaucrats and benefits for female clientele.

Gender Representation Across the World

Underrepresentation of women in public and political institutions (Riccucci and Saidel 1997; Smith and Monaghan 2013) and discrimination against women in society is pervasive

[1] Null findings, particularly for gender, do appear in the literature, see Hindera (1993) on the EEOC, Selden (1997) on the Farmers' Home Administration, and Fernandez, Malatesta, and Smith (2013) on federal contracting; on null findings for race, see Wilkins and Williams (2008).

across the world, but the degree of gender inequality varies across countries. Although the United Nations and developed countries have put their efforts into ensuring gender equality and improving women's empowerment through gender mainstreaming efforts (UN Women 2015), discrimination against women is still severe in the Middle East and North African countries (OECD 2019). In these countries, women are exposed to greater domestic violence, face massive obstacles to get an education, and may find it almost impossible to voice political opinions (OECD 2019). Women in many Asian countries face disadvantages generated by Confucian cultures and hierarchical social structures (Gelb and Palley 2009). East Asia countries, as a result, have the highest gender wage gap in the labor market. The educational attainment gaps between male and female students also vary significantly across countries. For instance, in Afghanistan, 59.2% of girls do not attend school, while only 16.7% of boys do not (Barro and Lee 2013).[2] In contrast, there are equal education opportunities for both boys and girls in European countries such as Denmark, Netherlands, Hungary, and France.

Recognizing women as a generally disadvantaged group, scholars have examined whether and how gender representation can directly or indirectly benefit female citizens. A substantial portion of that work has been in the field of education and probed the specific ways female administrators and teachers influence female student outcomes. Theoretically, gender representation could generate positive outcomes for female students in four ways. First, female teachers may actively represent and help female students when they have one-on-one interactions with students. Female teachers often communicate different expectations to female and male students (Martin and Yin 1997) and may encourage female students to overcome stereotype threats (Galdi, Cadinu, and Tomasetto 2014). Such communications between female teachers and

[2] For details, see http://barrolee.com/

students, particularly when teachers have higher expectations, ultimately benefit the female students' achievement (Dee 2005). Demographic match-ups between teachers and students are also more likely to result in recommendations that students be assigned to gifted and advanced classes and thus provide access to higher quality education (Grissom, Kern, and Rodriquez 2015).

Second, outside the classroom, female teachers may also actively represent the interest of female students by seeking to change policies that limit student access to educational opportunities. Such efforts might be within schools (e.g., access to math and computer programming classes) or might simply be in terms of getting girls to attend school in some countries. Such policy effects have been shown in the area of school discipline and race (Roch, Pitts, and Navarro 2010).

Third, another effect of representation might result not from anything the teacher does but rather changes in the behavior of the student. Working with same-gender teachers can produce role-model effects, which promote female students' motivation and in turn positively influence their academic performance (Winters 2013). This point aligns with the notion of symbolic representation—the presence of representative bureaucrats can influence disadvantaged clients' attitudes and behaviors without any bureaucratic action taken (Riccucci et al. 2018). Although the impact from student changes is difficult to distinguish from teacher impacts even with experimental data in education (see Dee 2005), some other studies show significant changes in clients' behavior that are associated with bureaucratic representation. Meier and Nicholson-Crotty (2006), for example, find that women are more likely to report a sexual assault in cities that have more female police officers (see also Schuck 2018). Riccucci et al. (2016) show that

female citizens are more willing to cooperate with the government programs and coproduce policy outcomes when women are more represented in the agency (but see Sievert 2021).

Fourth, another method of influence is contagion effects where the presence of female teachers affects the behavior of male teachers to be more supportive of female students. While interacting with their female colleagues, male teachers are more likely to understand and support female teachers' efforts to reduce gender discrimination in schools. Atkins and Wilkins (2013) demonstrate such a contagion effect in their study of race, gender, and teen pregnancy in Georgia schools. In a similar vein, Song (2018) finds that frequent interaction among teachers can enhance the positive effect of gender representation in schools.

Although most studies of gender representation in education have been conducted in the United States, the theoretical links discussed above are not limited to the U.S. The positive relationship between female bureaucrats and policy outcomes for female clients has been reported in other national contexts. For example, female administrators in Brazil are more likely to adopt women-friendly policies (Meier and Funk 2017). Gender representation in schools is positively associated with female clients' performance in South Korea (Song 2018), Ghana (Agyapong 2018), India (Dhillon and Meier 2020), and China (Xu and Meier 2021). Based on these results, the hypothesis that bureaucratic representation can be generalizable across context is tenable.

H1. Female bureaucratic representation will benefit female clients across the world.

Context and Representative Bureaucracy

In contrast to the theoretical argument for the universality of representative bureaucracy, there are also reasons why one might not expect bureaucratic representation to appear in all

countries. The theory of bureaucratic representation in regard to gender specifies that representation will exist only when a policy issue is highly salient and when bureaucrats have sufficient discretion to actively represent (e.g., Keiser et al. 2002). Keiser et al. (2002) explicitly acknowledge that the salience of gender varies greatly across countries and within countries over time. In many countries, sexism is highly institutionalized so that gender equality is not a top priority; and public policy discourages the access of women to education, health care, employment, as well as positions of authority. In such an environment with overt gender discrimination, when and where representative bureaucracy works is an open question.

For passive representation to result in outcomes that benefit the represented in the current case, one of two things must happen. Either the female teacher must act differently than a male teacher in regard to female students (active representation), or the female student must respond to the female teacher with additional effort (symbolic representation). Guul's (2018) study of employment placement in Denmark, as an example, shows that not only do female bureaucrats spend more time on cases for female clients, but female clients engage in greater efforts when they have female counselors. What conditions might encourage either female teachers or female students to invest more effort? We focus on the former (what makes female teachers take greater efforts) and propose two environmental conditions – gender equity policies and female elected officials – that serve as symbols to teachers that additional efforts would be beneficial.

Gender Equity Policies and Representative Bureaucracy

In many countries, sexism is institutionalized by culture and laws that limit women's access to education, the right to own property, or even the ability to fully participate in the political process. A favorable policy environment that limits restrictions on women, as a result,

can influence the effectiveness of representative bureaucracy by encouraging bureaucrats to adopt representation roles. To understand this process, we need to recognize that various barriers can discourage acting as a representative (Groeneveld and Van de Walle 2010; Meier 2019; Meier and Morton 2015). A precondition for active representation is that bureaucrats bring their diverse experiences and perspectives with them to work. Whether such values are conscious or unconscious, for active representation, the bureaucrat needs to take some action (Selden 1997). While it is not very explicit, Mosher's definition of representation stresses this process. He points out that it does not necessarily mean that a public servant with given background and social characteristics will *ipso facto* represent the interests of others with like backgrounds and characteristics in behavior and decisions (1968, p.13). He further notes that active representation may be expressly forbidden, and incumbents encouraged to 'lean over backwards' to avoid the appearance of partiality (1968, p.13).

The concern about bureaucratic partiality suggests that representative bureaucrats might be subject to the criticism that they are introducing favoritism into bureaucratic processes and adding biases to neutral procedures (Lim 2006). Because representation is a political process, any bureaucratic effort in the process can be criticized by those who are not represented by that effort (see Yun 2020: 139, Proposition 2). Such opposition might be more prevalent in countries that institutionalize gender inequality and limit corrective actions. Even if the representation is not perceived as political, it frequently conflicts with the demands of organizational socialization and defined roles (Yun 2020). Under these circumstances, bureaucrats who act on their backgrounds and experiences and adopt the role of a representative must bear some potential personal risks and transaction costs. Put differently, a rational bureaucrat would not act as a

representative unless that role somehow provided more benefits than costs (Meier 2019, p.45).[3]

Gender equality in society, that is having specific laws and policies that grant women rights and limit discrimination, can facilitate gender representation by increasing the bureaucrat's intrinsic benefits from representing female clients (that is, the satisfaction from helping out a disadvantaged individual). Countries with greater gender equality are more likely to establish a legal system that prohibits overt sex discrimination, protects women's political, economic, and social rights, and adopts an administrative system that promotes equal opportunity for women. These institutional efforts to promote gender equality signal female bureaucrats that promoting women's interests is socially acceptable and appropriate and that the students that they mentor will benefit. In this way, greater gender equality encourages female bureaucrats to pursue policies that benefit female citizens and female clients to act on their own behalf.

Greater gender equality in terms of political, economic, and social rights as established law and public policy in this manner acts as policy feedback for teachers (Rose 2015). Such policies create expectations that women should be treated equally and that they should have equal opportunities to succeed. Citizens in countries with greater gender equality are more likely to recognize that women have suffered from discrimination and that gender inequality is an important social problem. Additionally, they are more likely to understand that institutionalized processes may intensify the existing discrimination toward women because men disproportionately benefit from the current bureaucratic system. The more citizens recognize that bureaucratic neutralism can create greater biases in the policy process and that bureaucratic representation can lessen the biases of existing processes, the more they will perceive that the

[3] Representing the disadvantaged can be a costly risk-taking behavior for bureaucrats because they could be punished or excluded from rewards when representation is not part of the agency's mission (Meier 2019). At times acting as a representative might involve bending the rules of the organization if the rules generate disparate outcomes.

role of representative bureaucracy is legitimate. In sum, gender equality can be seen as a signal that gender representation is socially acceptable, and this perceived social approval will reduce the risk of pursuing women's interests for female bureaucrats. We therefore expect that gender equality policies will enhance the link between passive representation and policy outcomes.

H2-1. The effect of female bureaucratic representation will be enhanced when there is greater gender equality in a country.

Political Representation and Representative Bureaucracy

Given the symbiotic relationship between politics and administration, political representation should also have a significant influence on bureaucratic representation (see Choi and Hong 2021; Meier and Smith 1994; Yun 2020). The presence of female legislators can lead to adopting policies that benefit women and generating greater demand for female bureaucrats. Specifically, female legislators need to build political alliances and receive administrative support when they pursue women's interests, and this situation creates incentives for them to have more female bureaucrats in power (Jalalzai 2013; Krook and O'Brien 2012; Meier and Funk 2017). Because female bureaucrats are more likely to understand women's issues and be favorable to women's rights and interests, they are potential allies of elected officials. Legislators should be more likely to delegate policy discretion to bureaucrats if they perceive that the bureaucrats are favorable to the policy (Gailmard 2002).

Elected female leaders can also facilitate active representation of women's interests in the policy process. First, a legislature with a higher percentage of women is likely to introduce and adopt more bills on women's issues and women-friendly policies (Meier and Funk 2017; Park 2013; Vega and Firestone 1995; Yun 2020), including education policy (Chen 2008; Rigby 2007; Schwindt-Bayer 2006: 580). Female bureaucrats are more likely to understand the

importance of these issues and agree with the policy goals and, therefore, be more enthusiastic in the implementation of such policies (Meier and Funk 2017). The effect of bureaucratic representation can, therefore, be enhanced.

Second, the presence of women in politics can strengthen the impact of bureaucratic representation through a symbolic effect on female bureaucrats' attitudes and behavior. When female bureaucrats see more females in legislatures, female bureaucrats may think that pursuing women's interests is politically acceptable and their representation role will be supported by the legislature. Even where female legislators do not actively advocate a female agenda or women-friendly policies, a visible presence of women in the legislature may still increase female bureaucrats' confidence that they are doing the right thing (Schwindt-Bayer 2006).

Teachers might be especially sensitive to political representation. As well-educated middle-class citizens, they are likely to be knowledgeable about politics as well as participate in it (Grönlund and Milner 2006; Leighley 1990). The political activism of teachers has been documented in Brazil (Myers 2009), Mexico (Vaughan 1997), the United Kingdom (Oram 1996), Japan (Thurston 2015), Germany (Lamberti 2002), and the U.S. (Moe 2011), among others. Issues of curriculum including gender-linked issues in math and science frequently involve teachers (e.g., McCulloch, Helsby and Knight 2000). As a result, teachers should be aware of the level of gender representation in the political branches and also be aware of the support of women legislators for gender-related issues as well as funding in women's issue areas such as education.

H2-2. The effect of female bureaucratic representation will be enhanced when there is greater female political representation in a country.

Empirical Context, Data, and Methods

To test our expectations, we use educational data from forty-four countries. Education makes a useful research setting to conduct cross-national research on representative bureaucracy for several reasons. First, quality education is a salient policy issue for almost all countries. In particular, education has been considered as an effective tool for strengthening economies and reducing inequality in society. Second, despite the importance, the gender gap in education has been a serious concern in many countries. In many developing countries, girls do not even get to start primary school; even in developed countries, significant performance gaps and gender stereotypes still exist. Third, education governance reflects the nature of the political system and administrative structure of the society; thus, it can provide broad implications for how governance structure can shape the effect of bureaucratic representation.

To test our hypotheses, we use data from three different sources: the Trends in International Math and Science Study (TIMSS) in 2011, the Inter-Parliament Union (IPU) in 2010, and the Cingranelli and Richards (CIRI) human rights data project in 2005 and 2010. TIMSS serves as the base dataset for our study; it contains student performance indicators, along with the information about students, teachers, home environments, and school factors that were obtained from surveys of students, teachers, and school administrators; the unit of analysis for this study is the individual student allowing us to match each student with a specific teacher. From IPU and CIRI, we obtain variables on country-level characteristics such as percentages of women in legislatures, as well as indicators of women's social, economic, and political rights.

TIMSS is administered by the International Association for the Evaluation of Educational Achievement (IEA) and Boston College with surveys and tests conducted every four years since 1995. It is specifically designed to permit cross-national comparisons of student performance by focusing on objective performance on math, science and language exams and is widely used in

many scholarly disciplines; the *Web of Science* lists over 1200 published studies that use TIMSS data. Sixty-four countries participated in the 2011 TIMSS surveys and tests, but only forty-four countries tested 8th-grade students with data that link individual students to her or his math teacher. Thus, 18 out of 64 countries without 8th-grade data are excluded from our analysis.[4]

TIMSS is designed to produce nationally representative samples of approximately 4,000 students via a two-stage random sampling strategy. Schools are randomly selected based on stratified sampling linked to demographic or geographic characteristics (Joncas and Foy 2011). Within the selected schools, one or more classes are randomly chosen (Joncas and Foy 2011). Classes with mentally or physically challenged students or non-native speakers are also excluded.

Our data set has the advantage of being able to use individual-level data to show the level of representation in an individual country (as opposed to aggregate cross-national relationships, see Park and Liang 2021) as well as how country-level factors modify this representation relationship. Since our data consist of multiple levels of data, traditional Ordinary Least Square (OLS) models can bias estimated error variances downward. As such, we run OLS models with clustered standard errors by countries. We also use sampling weights of total students in each country provided by TIMSS for the purpose of cross-national analyses (for more discussion, see Joncas and Foy 2011).[5]

[4] In addition to those 18 countries without information on 8th grade students, Hong Kong SAR and the Palestine National Authority are also excluded from our sample since CIRI and IPU do not provide the country level data for them. The forty-four countries are included in this analysis are Armenia, Australia, Bahrain, Botswana, Canada, Chile, Finland, Georgia, Ghana, Honduras, Hungary, Indonesia, Iran, Israel, Italy, Japan, Jordan, Kazakhstan, South Korea, Lebanon, Lithuania, Macedonia, Malaysia, Morocco, New Zealand, Norway, Oman, Qatar, Romania, Russia, Saudi Arabia, Singapore, Slovenia, South Africa, Sweden, Syria, Taiwan, Thailand, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, and the United States.

[5] We get similar results using hierarchical linear modeling, but these estimates are unable to adjust for the sampling weights at the different levels of data. We also jack-knife the countries one at a time and confirm that our results are not driven by a particular case (or country).

Measures

Dependent Variable: Math Scores

TIMSS data report the results from identical exams that have been conducted in each country in the country's own language. The data are specifically designed to permit cross-country comparisons,[6] which were not possible in previous studies owing to the lack of a consistent metric to measure student performance. Specifically, we use students' TIMSS math test scores as a measure of student performance. Although education has many goals beyond performance on standardized tests,[7] gender differences in math scores are frequently used to assess gender disparities in education (see Keiser et al. 2002; Song 2018; Xu and Meier 2021; Agyapong 2018). 8th-grade TIMSS math exams in 2011 covered elementary math (20 questions), algebra (30 questions), geometry (20 questions), and data and chance (18 questions) with scores ranging between 0 and 1000.

Independent Variables

Student-Teacher Gender Congruence. A common practice in representative bureaucracy literature is using aggregated data; Keiser et al. (2002), for example, uses school-level data. An underlying assumption of this approach is that some indirect effects exist. For instance, although female math teachers do not instruct some female students, they can still be role models for individual students, thereby influencing students' math scores.[8] A limitation of aggregate

[6] For those interested in how TIMSS develops the scales comparable across countries and time, we refer them to TIMSS appendices at https://timssandpirls.bc.edu/methods/pdf/TP11_Scaling_Methodology.pdf and https://timssandpirls.bc.edu/timss2019/methods/pdf/T19_MP_Ch11-scaling-methodology.pdf.

[7] Math scores can be linked to specific match ups of teachers and students. Other indicators as completion levels, attendance, going on to additional education, or subsequent employment are often not collected in a systematically comparable method at the individual level.

[8] Female teachers could also influence girls' performance indirectly by influencing their male colleagues and by influencing the school to changes policies that currently limit the opportunities for girls. A limit of individual level studies is that they are likely to underestimate the total impact of representative bureaucracy.

research is that we cannot be sure whether representation effects are direct (that is, teacher to student in a classroom) or indirect (through external role models, policy change, or contagion). Recent studies attempt to solve this problem by focusing on direct effects and using individual-level data, such as the likelihood of students being assigned to a gifted class (Nicholson-Crotty et al. 2016), teachers' student-assessments (Ouazad 2014), or students randomly assigned to classrooms for other reasons (Dee 2005). We adopt this strategy which is more conservative in its estimation of any representative bureaucracy impacts.

The TIMSS data allow testing the *direct* effect of representation on outcomes at the individual level and can deal with cross-national contexts that can influence the level of representation. To measure the student-teacher gender congruence, we include female student and teacher dummy variables and an interaction variable between the two. Gender variables are coded as 1 when students (or teachers) are female; otherwise coded as 0. When both teachers and students are female, our student-teacher congruence measure is coded as 1; this congruence measure is the key indicator of representation.

Policy Environment: Gender Equality. To measure whether a country has a favorable policy environment toward gender issues, we employ data from the CIRI human rights projects in 2005 and 2010. The CIRI data include variables on women's political, social, and economic rights, all of which range between 0 and 3 (Cingranelli, Richards, and Clay 2014).[9] Since the

[9] In coding women's economic, political, and social rights, the CIRI human project data identify internationally recognized rights in each dimension and create a categorical measure. The economic rights are: 'equal pay for equal work; free choice of profession or employment without the need to obtain a husband or male relative's consent; the right to gainful employment without the need to obtain a husband or male relative's consent; equality in hiring and promotion practices; job security (maternity leave, unemployment benefits, no arbitrary firing or layoffs, etc.); non-discrimination by employers; the right to be free from sexual harassment in the workplace; the right to work at night; the right to work in occupations classified as dangerous; and the right to work in the military and the police force.' The political rights cover 'the right to vote; the right to run for political office; the right to hold elected and appointed government positions; the right to join political parties; and the right to petition government officials. Lastly, the social rights include 'the right to equal inheritance; the right to enter into marriage on a basis of equality with men; the right to travel abroad; the right to obtain a passport; the right to confer citizenship to children or a

women's social rights measure was retired in 2005, we use the measure from the CIRI data in 2005 while the other two measures are from 2010.[10] The lowest value indicates that a country has no law for such rights, and the highest value means that a country has established such legal rights and implemented laws to protect these rights. The three variables (women's political, social, and economic rights) loaded onto a single factor with correlations between 0.75 and 0.89 and a Cronbach's alpha of 0.78. To create a measure of gender equality as a proxy for the policy environment toward gender issues, we create an additive measure of the three rights ranging from 0 to 9.[11]

Political Environment: Percent of Women in Legislatures. To measure a favorable symbolic political environment for women in a country, we calculate the percentage of women in the national legislature using the number of seats held by women divided by the total number of seats. In the seventeen countries with bicameral legislative systems, representation is based on both houses. Since some scholars also use women in office as a proxy of gender equality (e.g., Caprioli and Boyer 2001; Melander 2005), it is important to note that our political environment measure is not the same as the women's political rights measure; the CIRI measure does not include female political representation in the legislature.

Control Variables

Both individual student and school characteristics are controlled. Socioeconomic status is a well-known predictor of student academic performance. Given that education is one of the

husband; the right to initiate a divorce; the right to own, acquire, manage, and retain property brought into marriage; the right to participate in social, cultural, and community activities; the right to an education; the freedom to choose a residence/domicile; freedom from female genital mutilation of children and of adults without their consent; and freedom from forced sterilization.'

[10] Our results remain the same without the women's social rights measure (results available upon request). We include the measure, even though the measure may have changed over time, since women's social rights are important when it comes to measuring gender equality (for more details, see Sainsbury (1999))

[11] From 0 to 9 is a theoretical range of the gender equity variable. In our dataset, it ranges between 1 and 9.

most stable aspects of socioeconomic status, we include parental educational attainment to control for socioeconomic status. Student characteristics and their inputs are also important factors that affect academic performance. The model controls for student age, whether the student was born in the country, and total instructional hours per day for each student.

School resources, characteristics, and environments also can influence student academic achievement. To capture educational resources, the school's capacity in providing instructional materials is used. The survey asks schools how much their capacity to provide instruction is affected by a shortage or inadequacy of 'instructional materials (e.g., textbooks)' (0 = not at all, 1= a little, 2 = some, 3 = a lot). Responses to this question are used to measure a lack of educational resources. Teacher experience is measured by the years of teaching experience of teachers (logged), and class size is measured by the number of students in the classroom (logged). Summary statistics of all variables are presented in Table 1.

[Table 1 about here]

Findings

Our empirical analyses have two goals. The first is to investigate the relationship between bureaucratic representation and student performance in a cross-national setting to determine how general the phenomenon is, and the second is to examine how the political and policy environment moderates the relationship. To test our first hypothesis, we ran forty-four individual regressions, one for each country to estimate the influence of female student and math teacher gender congruence on math test scores. Table 2 presents the key coefficients. The takeaway from the table is that the relationship is highly variable across countries. In only five of the forty-four countries (Chile, New Zealand, Slovenia, Taiwan, and the United Kingdom) is the

relationship positive and statistically significant. In six cases, Bahrain, Jordan, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, there is a strong negative relationship indicating girls do substantially worse with a female math teacher. The findings clearly indicate that in this particular instance, girls' math scores and female teachers, a more representative bureaucracy does not always produce policy outcomes benefiting the represented group.

Before proceeding with the contextual analysis, some qualifications of these findings relative to the others in the literature in education are merited. The use of individual data is a more demanding test of the theory than when using aggregate data because any results from changes in policy, female teachers influencing male teachers, or from girls adopting a female role model other than the math teacher cannot be estimated with individual-level data. Second, TIMSS tests are not an official performance indicator in any country, and to the extent that the content of TIMSS tests differs from the material tested in the individual country, it may attenuate the relationship. The most conservative conclusion, as a result, is that the relationship between representation and outcomes benefiting the represented varies across countries. This variation reinforces the theoretical argument that contextual factors are important, and we proceed to test two of them.

[Table 2 about here]

Tables 3, 4, and 5 each include two models: one base model (without any interaction terms) and another one with either two- or three-way interactions that include both the interaction of student and teacher gender and the interaction of student gender, teacher gender, and the measure of gender policy or representation.

[Table 3 about here]

Table 3 shows the relationship of bureaucratic representation to student math

performance. Model 1, the base model, suggests that, on average, students with female teachers tend to perform better than those with male teachers in our sample.[12] Model 2 adds the interaction term between teacher and student gender to investigate the association between bureaucratic representation and student outcomes. The results in Model 2 with the interaction term are opposite to what the representative bureaucracy literature would suggest. On average, in our sample of forty-four countries, the female student and teacher gender congruence is negatively associated with female student math performance. In other words, on average across the countries female students tend to perform better with male teachers than with female teachers.

[Table 4 about here]

Tables 4 and 5 investigate the moderating role of policy and the political environment on the relationship between bureaucratic representation and student performance, respectively. Model 1 in Table 4 suggests that, on average, the higher gender equality the society has, the better the students perform, and that again, female teachers are more likely to perform better than male teachers. Model 2 in Table 4 includes the three-way interaction term between student gender, teacher gender, and societal policies on gender equality (a proxy of policy environment toward gender issues). *Ceteris paribus,* taking the second derivatives with respect to female teachers (FT) and female students (FS), the marginal effects of gender congruence between female students and teachers can vary depending on degree of gender equality across countries ($\frac{\partial^2 y}{\partial x_{FT} \partial x_{FS}} = -70.682 + 10.987 \times$ Gender equality). Since values on the gender equity range from 1 to 9 in our sample, the results suggest that the marginal effects of gender congruence are *only*

[12] This basic fact complicates models of representation. This means that women teachers positively influence boys' and girls' scores. The gender representation effect, therefore, is somewhat underestimated.

positive in countries where gender equality is at least greater than or equal to 7.[13] To further illustrate this, we visualize the relationship in figure 1.

[Figure 1 about here]

Figure 1 shows the predictive margins of gender (in)congruence between teachers and students on student math scores, conditioned on gender equality. The figure suggests that when gender equality is low, female students perform better on math exams if they have male math teachers rather than female ones. As gender equality increases in a country, however, female students are better off having female math teachers. The slope of female gender congruence is also steeper than the slopes of gender incongruence. To illustrate further, if gender equality improves in society, female students with female teachers receive the most benefits when compared to other gender incongruence cases (e.g., female students with male teachers or male students with female teachers).

The predicted math scores are the highest when a society has high levels of gender equality and when female students have female math teachers. For male students, they are also more likely to achieve high scores on math exams when female teachers are assigned to them, in general. As the society values gender equality more, however, the performance gap between female and male teachers for male students' math scores becomes narrower and eventually irrelevant where gender equality is very high. Although male students tend to perform better with female teachers in general, it is important to note that the slope of male gender congruence is steeper than both slopes of male gender incongruence (male students and female teachers) and female gender incongruence (female students and male teachers) in the figure. In sum, findings

[13] In our sample the countries with gender equality greater or equal to 7 are Australia, Canada, Finland, Italy, New Zealand, Norway, Sweden, United Kingdom, and the United States.

suggest that 1) female teachers are more likely to be effective in promoting positive outcomes for female students in a society with higher gender equality where policy environment tends to be favorable toward gender-related issues and that 2) in such a society, although both male and female math teachers are almost equally effective for male students, female students are far better off with female math teachers in achieving higher math scores in TIMSS exams.

[Table 5 about here]

Table 5 presents the results about the moderating roles of the political environment in the relationship between gender congruence of students and teachers and student math performance. Model 1 in the table, the base model, shows that compared to male teachers, on average, female teachers are more effective in teaching math courses in our sample. Having more women in legislatures is also positively associated with female student performance. Model 2 in table 5 includes the three-way interaction term between gender of student and teacher and percentage of women in legislatures (a proxy for more favorable political environments toward women's issues in general). Taking the second derivatives with respect to the gender of teachers and students, *ceteris paribus*, the marginal effects of gender congruence between female students and teachers can range between -60.03 and 41.86 ($\frac{\partial^2 y}{\partial x_{FT} \partial x_{FS}} = -60.034 + 2.196 \times$ % Women in legislatures), with the range of the percentage of women in legislatures between 0 and 46.4. Bureaucratic representation is more likely in a country where the percentage of women in legislatures is greater than or equal to 27.34.[14] We, again, draw a figure to further illustrate the relationship.

[Figure 2 about here]

[14] In our sample the countries where the percentage of women in legislatures is greater than or equal to 27.34 are Australia, Finland, Macedonia, New Zealand, Norway, South Africa, Sweden, and Taiwan.

Figure 2 depicts the relationship between the gender (in)congruence of teachers and students and the percentages of women in legislatures. When female representation in legislatures is greater than or equal to 14 percent, female students with female math teachers are more likely to perform better on math exams than ones with male teachers. If the precondition is not met, female students are better off with having male math instructors. Additionally, the slope of female gender congruence in the predictive plot is steeper than the slopes for gender incongruence; once again, female students with female teachers improve their performance the most when women political representation increases compared to other gender incongruence cases (e.g., female teachers and male students or male teachers and female students). For male students, although the slope of male gender congruence is steeper than that of gender incongruences, male students with female teachers are more likely to achieve higher math scores in general. As the percentage of female legislators increases, however, the effectiveness of both female and male math teachers converges in terms of promoting male student math scores; male students eventually perform better when instructed by male teachers in a county where female political representation is greater than or equal to 42 percent.[15]

Although the coefficients in the tables might appear small, it is important to recognize that the interactions can generate substantively large results. In figure 1 in a country scored zero on gender equity, girls with female math teachers score 19 points lower on average than those with male math teachers. In a country scored nine on gender equality, girls with female math teachers score 31 points higher than those with male math teachers. This 50-point swing is approximately 0.45 standard deviations on the individual math scores, a substantial change in math scores associated with the gender of the math teacher in a single year of instruction.

[15] In our sample, Sweden and South Africa have greater than or equal to 42 percent of female legislators.

Similarly, within the range of the data on political representation, girls gain an additional 53 points with female math teachers at the maximum observed representation (46%) versus the minimum observed representation (0%).

As noted above, the measure of gender equality and the percentage of women in the legislature are positively correlated. When both are included in the model with the interactions, the collinearity is exceedingly high (average VIF 16.24 and three-way interaction VIFs of 42.36 and 57.24), making precise interpretations difficult. Even in that equation (not shown), the gender equity policy interaction with female teacher-student congruence remains statistically significant; the legislative representation interaction is not. Clearly there is a relationship between gender policy equity and female legislative representation; sorting out their precise influence on bureaucratic representation, however, requires a significantly larger and more diverse data set than the present one (which itself has substantial variation). Lastly, as a robustness check, we test a set of models including other types of national context variables such as trust in people, religious fractionalization (Alesina et al. 2003), economic development (GDP per capita), Hofstede's (1984) masculine-feminine culture, regional dummies, and the quality of government (see the online appendix). The primary results on the moderating relationship hold the same even after controlling for the other national context variables.

Discussion and Conclusion

Much literature treats bureaucratic representation as if it were an unrestricted choice by bureaucrats, yet bureaucrats face numerous constraints on their actions by law, tradition, and politics (Groeneveld et al. 2015; Meier and Morton 2015). Although bureaucrats can represent, representation is rarely ever the primary function of the bureaucracy. The generally subordinate role of bureaucracy means that bureaucrats who decide to represent take more risks than those

who play it safe in more traditional bureaucratic roles (Meier 2019). The current study suggests a highly political element of representative bureaucracy – that bureaucrats will be more likely to represent (or more successful in that representation) when there is external political support for such bureaucratic actions. To test this hypothesis, we examine gender representation in education and how the policy and political environments can facilitate the process, using data from forty-four countries.

Our findings first suggest that all other things being equal, the influence of female teacher representation is, on average, greater for male students than for female students across the countries in our sample for the time period examined. More importantly, however, the relationship between female teacher representation and student outcomes becomes positive for female students only in countries where gender equality or/and the degree of female political representation are high. The initial result contradicts the theory of representative bureaucracy that suggests that higher gender representation would *always* bring better policy outcomes for female clients. This counterintuitive result requires a more nuanced discussion. It implies that the occurrence of gender representation might not be constant but vary according to institutional factors that counteract gender discrimination in society. In education, societal stereotypes that boys have better math skills than girls exist and depict math and science as male domains (Keller 2001; Nosek et al. 2009), although research does not support this widespread view (see Lindberg et al. 2010). Those stereotypes are problematic because they can affect female students' self-efficacy and beliefs about their competence in mathematics (Keller 2001) and affect actual performance (Johns, Schmader, and Martens 2005). In a society where those perceptions prevail, even female teachers might not recognize the problem of such stereotypes.

Combating such stereotypes is likely to be easier in contexts that discourage gender discrimination, contexts that support gender equity in general. In such environments, teachers are more likely to be aware of existing gender stereotypes and can be more confident that their efforts to assist girls will not be discouraged. In those countries where gender equality is high, female students may also have more opportunities for future success and see the benefits of learning math by observing role models. For instance, in a country where female professionals are more visible in fields requiring high math skills, female students would not necessarily have lower levels of confidence in learning math. This will help female teachers and students teach and learn mathematics without coloring mathematics as a male domain.

Moving from the specific case of female teacher representation and student math scores to broader issues of bureaucratic representation, this study has implications for both the generality of existing work and the theory of representative bureaucracy. Given that representation is not a primary function of the bureaucracy, one might expect a rational bureaucrat to seek cues on whether or not representation might be considered valuable both within and outside the bureaucracy. In the present case, when a nation supports greater gender equality either via the establishment of public policy or through increased political representation, a rational bureaucrat is likely to perceive that representation will be tolerated or perhaps even rewarded. A bureaucrat interested in gender representation is likely to see much different benefits and costs of that representation in Sweden, for example, than in Saudi Arabia. To emphasize, when women's rights are legally protected and those laws are enforced, the costs and risks of representing a specific group should be lower for female bureaucrats. Higher levels of political support for women-friendly policies can also encourage female bureaucrats to implement those policies.

While the present empirical analysis uses gender and cross-national variation to assess the relationship between bureaucratic representation and a supportive political environment, the general logic should be applicable to within-country variation in bureaucratic location, variation in the policy area, and variation in the identity being represented. The implications are that the effectiveness of racial representation in the United States, for example, might be more effective in states or localities where greater support for racial equity exists. Similarly, a policy area that is highly salient in terms of race or gender might also enhance the efforts of bureaucrats to represent. Additionally, the logic that representative bureaucracy is enhanced with greater political support should apply to any identity that might be represented – gender, race, ethnicity, disability, socioeconomic status, and so on.

Although this research is among the first studies to investigate the theory of representative bureaucracy in a cross-national setting at the individual level, it is not without limitations. First, our dependent variable is student performance, which might be the results of active representation, symbolic representation, or some combination of two; our analyses, however, do not empirically distinguish the impacts of student changes in motivations or attitudes (symbolic representation) from teacher impacts (active representation). More systematic analysis is needed to better understand the theoretical mechanism and to examine other indicators of educational performance. Second, this study employs cross-sectional data since schools, and individual identifiers in the TIMSS are not the same over the years. It is important that future research investigates further a dynamic mechanism using panel data. Third, our measure of political representation may have varying meanings in different regime types and election systems. Future research could dive into a deeper understanding of the role of political representation and its relationship with bureaucratic representation at both national and local

levels. Lastly, due to the lack of degrees of freedom at a country level, we are not able to control for all other relevant national-level characteristics. We did auxiliary analysis with several national level contextual variables and found they did not alter the basic conclusions. Future research, however, may want to investigate the effects of bureaucratic representation by taking into account other contextual factors such as political systems, administrative traditions and reforms, labor market conditions, gender ratios, and so forth.

To conclude, even if policy issues are salient and bureaucrats have sufficient discretion in their daily jobs, it is possible that we might not be able to observe a positive relationship between bureaucratic representation and clientele outcomes. This is more likely to be the case in a society with institutionalized discrimination where the policy environment tends to be unfavorable toward bureaucratic representation. Evidence from forty-four countries highlights that considering the policy and political environments is critical to better understand bureaucratic representation. This research further stresses the need to expand the range of institutional contexts studied and calls for comparative and contextual theories of representative bureaucracy.

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Tables and Figures

Table 1. Descriptive statistics for all variables

Variable	Obs	Mean	Std. Dev.	Min	Max
TIMSS math scores	179,804	466.43	110.94	14.09	918.10
Student gender (female=1; male=0)	179,804	0.52	0.50	0	1
Teacher gender (female=1; male=0)	179,804	0.59	0.49	0	1
Gender equality	179,804	4.71	1.96	1	9
% Women in legislatures	179,804	16.40	10.47	0	46.40
Student age	179,804	14.61	0.91	10	23
Instructional hours per day	179,804	5.14	1.07	3	10
Born-in-country (yes=1; no=0)	179,804	0.89	0.31	0	1
Instructional resource	179,804	1.77	1.20	0	3
Teacher experience (logged)	179,804	2.54	0.80	0	4.09
Class size (logged)	179,804	3.37	0.36	0.69	4.78
Parent education	179,804	2.55	1.32	0	4

Note. Parental education is on a five-point scale (0 = did not go to school, 1 = lower-secondary education, 2 = upper-secondary education, 3 = post-secondary education but not university, 4 = university or higher education) and instructional resource is on a four-point scale (0 = not at all, 1= a little, 2 = some, 3 = a lot).

Table 2. Examining the effects of student-teacher gender congruence on 8th grade student TIMSS math scores in each country

Country	Female Students	T-score	Female Teacher	T-score	Gender Congruence	T-score	R-Squared	N
Armenia	-2.363	-0.290	6.550	0.389	7.330	0.852	0.070	4426
Australia	2.251	0.373	5.941	0.724	-1.648	-0.190	0.233	3056
Bahrain	41.554**	5.226	56.556**	7.243	-66.713**	-6.660	0.248	8691
Botswana	3.101	0.862	-1.329	-0.227	-1.639	-0.305	0.213	2804
Canada	-0.968	-0.458	2.212	0.684	-0.514	-0.172	0.103	9079
Chile	-33.038**	-6.957	-8.586	-1.169	25.905**	3.420	0.270	3880
Finland	4.472	1.255	1.221	0.262	-7.377	-1.550	0.177	2582
Georgia	-2.259	-0.157	9.477	0.501	3.426	0.228	0.124	2412
Ghana	-24.142**	-7.849	-4.158	-0.356	-7.832	-1.338	0.138	4346
Honduras	-23.199**	-7.338	-8.423	-0.993	4.360	0.729	0.143	2719
Hungary	-7.490	-1.227	8.033	1.158	2.447	0.356	0.263	4111
Indonesia	9.472*	2.528	5.795	0.655	-5.069	-1.009	0.187	4474
Iran	13.627	0.624	-1.249	-0.132	-20.113	-0.813	0.268	5256
Israel	11.447	1.376	4.580	0.398	-6.100	-0.698	0.262	3041
Italy	-12.493	-1.616	4.505	0.631	1.409	0.171	0.125	2979
Japan	-9.329**	-3.020	-11.050+	-1.793	9.149	1.327	0.128	3494
Jordan	19.083	1.524	55.035**	4.827	-44.405**	-2.705	0.144	6288
Kazakhstan	-13.170	-1.308	30.230+	1.959	12.575	1.218	0.141	3736
Lebanon	-6.461	-1.435	11.201	1.238	-1.336	-0.179	0.227	2752
Lithuania	0.885	0.058	-7.443	-0.503	6.809	0.444	0.163	3360
Macedonia	-4.213	-0.476	10.957	0.902	11.383	1.079	0.164	2234
Malaysia	3.433	0.285	9.712	0.647	9.027	0.700	0.156	3650
Morocco	-14.742**	-5.353	-7.550	-1.198	5.976	1.128	0.236	6065
New Zealand	-13.426	-1.626	-11.708	-0.991	25.981*	2.373	0.169	2123

Norway	-6.279+	-1.784	-2.825	-0.559	7.173	1.382	0.076	2150
Oman	62.124**	6.957	90.617**	7.233	-94.735**	-6.919	0.238	6219
Qatar	57.082**	6.082	56.346**	4.218	-92.804**	-5.551	0.252	3338
Romania	7.138	1.261	8.333	0.933	5.119	0.741	0.231	4115
Russia	0.823	0.081	6.388	0.575	-2.838	-0.269	0.111	4184
Singapore	7.450	1.018	30.404**	2.968	-4.051	-0.429	0.116	4155
Slovenia	-12.637*	-2.522	0.949	0.171	9.626+	1.818	0.135	3197
Saudi Arabia	25.739**	3.963	97.253**	4.480	-106.238**	-4.197	0.109	3285
South Africa	-14.108**	-3.108	21.048*	2.407	-4.139	-0.522	0.443	6447
South Korea	-3.582	-0.461	7.711	0.876	0.705	0.073	0.133	4003
Sweden	1.561	0.344	-1.600	-0.307	0.853	0.145	0.099	1872
Syria	-1.113	-0.130	-21.695+	-1.862	-13.628	-1.050	0.091	3575
Taiwan	-5.507	-1.355	-11.403	-1.647	12.247+	1.901	0.178	4466
Thailand	12.794+	1.676	16.873	1.262	2.918	0.306	0.187	3261
Tunisia	-21.192**	-7.330	-4.032	-0.732	5.881	1.239	0.271	3615
Turkey	0.514	0.127	13.122+	1.859	1.629	0.281	0.176	6085
Ukraine	4.617	0.406	33.695**	3.149	-8.081	-0.679	0.147	2867
United Arab Emirates	35.189**	4.299	40.189**	5.447	-51.183**	-5.202	0.196	8365
United Kingdom	-5.136	-0.767	-13.382	-1.291	18.493+	1.789	0.242	1774
United States	-1.639	-0.429	-0.298	-0.045	0.729	0.162	0.128	5273

Note. + p<0.10, * p<0.05, **p<0.01; robust standard errors are clustered by school; two-tailed tests.

Table 3. Examining the relationship between student-teacher gender congruence and 8th grade student TIMSS math scores

	Model 1	Model 2
Student gender (female=1; male=0)	-2.039	15.822*
	(2.013)	(7.320)
Teacher gender (female=1; male=0)	14.818*	29.112**
	(6.359)	(8.366)
Student gender × Teacher gender		-29.910**
		(10.765)
Student age	-12.940*	-13.474*
	(5.802)	(5.677)
Instructional hours per day	-4.033	-4.041
	(3.510)	(3.479)
Born-in-country	29.748**	29.229**
	(9.315)	(9.288)
Instructional resource	21.793**	21.496**
	(3.800)	(3.770)
Teacher experience	4.911	4.747
	(4.390)	(4.347)
Class size	6.676	7.006
	(12.976)	(12.956)
Parent education	26.232**	26.141**
	(1.956)	(1.904)
Constant	503.286**	504.441**
	(103.685)	(102.954)
R-Squared overall	0.223	0.227
AIC	2156616	2155636
BIC	2156717	2155747
N	179,804	179,804

Note. + p<0.10, * p<0.05, **p<0.01; standard errors are in parentheses and clustered by countries; two-tailed tests.

Table 4. Examining the relationship between student-teacher gender congruence and TIMSS math scores conditioned by levels of gender equality

	Model 1	Model 2
Student gender (female=1; male=0)	-1.926	32.048+
	(2.007)	(17.452)
Teacher gender (female=1; male=0)	15.463*	51.451**
	(6.692)	(17.914)
Gender equality	10.609**	11.953**
	(2.384)	(2.609)
Teacher gender × Gender equality		-5.720*
		(2.647)
Student gender × Teacher gender		-70.682*
		(26.468)
Student gender × Gender equality		-4.939+
		(2.618)
Student gender × Teacher gender × Gender equality		10.987*
		(4.161)
Student age	-14.401*	-15.051**
	(5.625)	(5.521)
Instructional hours per day	-3.144	-3.293
	(3.414)	(3.404)
Born-in-country	23.674*	23.965*
	(10.846)	(10.559)
Instructional resource	16.594**	16.734**
	(3.493)	(3.465)
Teacher experience	5.190	4.811
	(4.272)	(4.257)
Class size	12.708	12.462
	(13.300)	(13.240)
Parent education	24.124**	24.153**
	(1.929)	(1.893)
Constant	468.552**	470.445**
	(103.820)	(102.922)
R-Squared overall	0.255	0.259
AIC	2149013	2148189
BIC	2149124	2148341
N	179,804	179,804

Note. + p<0.10, * p<0.05, **p<0.01; standard errors are in parentheses and clustered by countries; two-tailed tests.

Table 5. Examining the relationship between student-teacher gender congruence and TIMSS math scores conditioned by levels of female political representation

	Model 1	Model 2
Student gender (female=1; male=0)	-2.251	30.885*
	(2.024)	(14.495)
Teacher gender (female=1; male=0)	16.709*	46.797**
	(6.279)	(13.464)
% Women in legislature	1.443+	1.868*
	(0.771)	(0.823)
Teacher gender × % Women in legislatures		-1.167*
		(0.511)
Student gender × Teacher gender		-60.034**
		(20.584)
Student gender × % Women in legislatures		-1.113*
		(0.514)
Student gender × Teacher gender × % Women in legislatures		2.196**
		(0.802)
Student age	-14.200*	-14.814*
	(5.731)	(5.635)
Instructional hours per day	-4.805	-4.769
	(3.393)	(3.347)
Born-in-country	29.014**	28.654**
	(9.865)	(9.737)
Instructional resource	19.092**	18.970**
	(3.553)	(3.509)
Teacher experience	5.383	4.953
	(4.187)	(4.123)
Class size	6.577	6.953
	(13.054)	(13.050)
Parent education	25.079**	25.012**
	(2.011)	(1.954)
Constant	509.040**	506.272**
	(105.822)	(105.327)
R-Squared overall	0.240	0.245
AIC	2152719	2151533
BIC	2152830	2151685
N	179,804	179,804

Note. + p<0.10, * p<0.05, **p<0.01; standard errors are in parentheses and clustered by countries; two-tailed tests.

Figure 1. How does policy environment moderate the relationship between gender (in)congruence and student math scores?

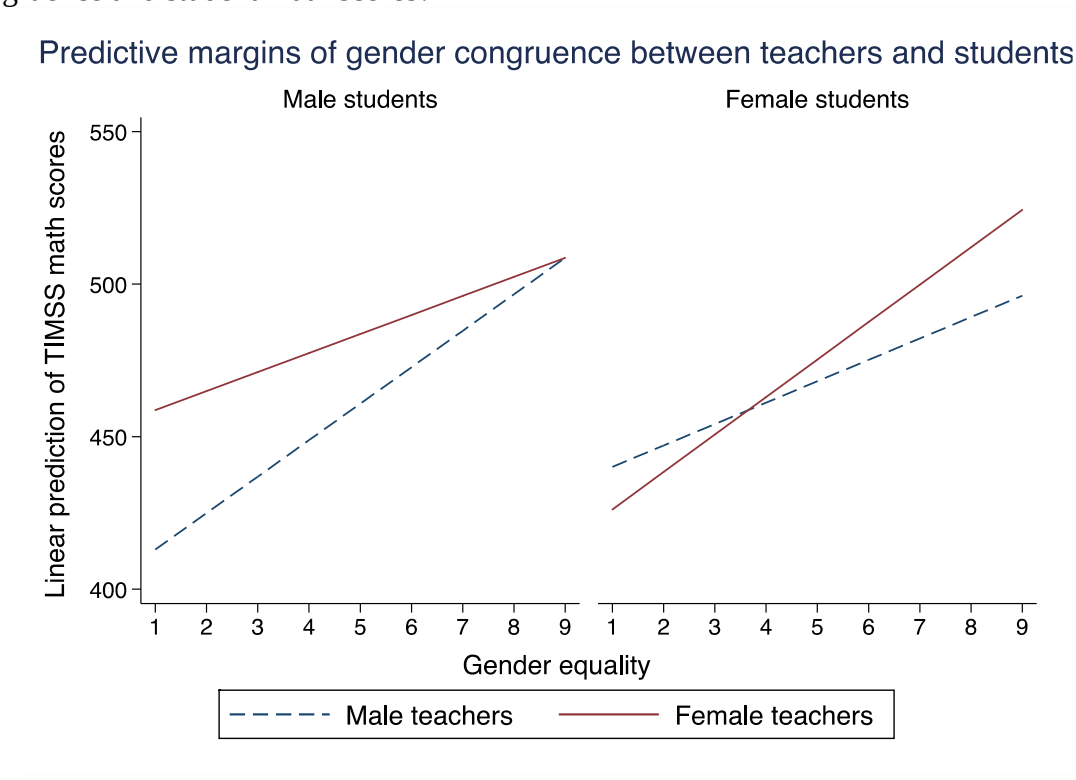
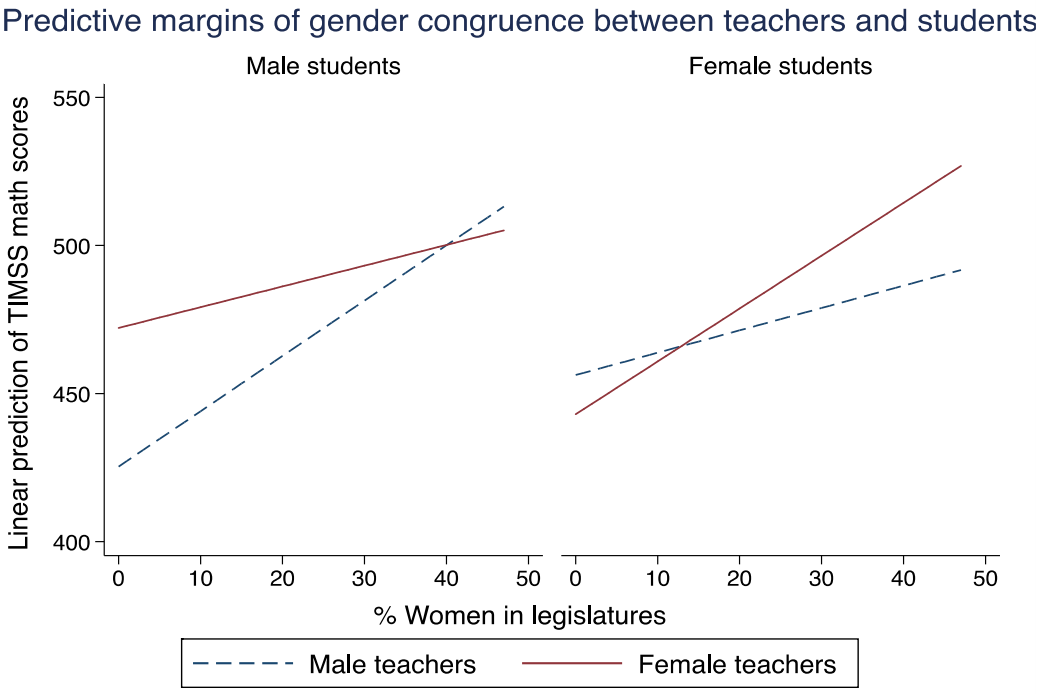


Figure 2. How does political environment moderate the relationship between gender (in)congruence and student math scores?



Online Supplementary Appendix for:
Representative Bureaucracy and the Policy Environment: Gender Representation in Forty-Four Countries

The online appendix contains tables that we ran as a robustness check controlling for other potential confounding factors at the national level such as trust in people, religion, level of economic development, region, and quality of government. From Table OA1 to OA5, each table includes two models one examining the moderating role of gender equity and another exploring the moderating role of political representation while controlling for an additional confounding factor. Table OA6 includes all national confounding factors in previous models together except for trust in people.[16]

Table OA1 below includes median values of trust in people from the World Value Survey. The results on the moderating relationships hold after controlling for the variable.

Table OA1. Exploring the moderating role of gender equity and political representation while controlling for median values of trust in people at the national level among twenty-seven countries.

	Model 1	Model 2
Student Gender (Female=1)	41.236*	29.209
	(19.716)	(18.077)
Teacher Gender (Female=1)	53.173*	31.452
	(23.267)	(18.510)
Gender Equality	28.725**	
	(8.192)	
Teacher Gender × Gender Equality	-8.222+	
	(4.025)	
Student Gender × Teacher Gender (Female=1)	-69.035*	-49.225+
	(31.917)	(26.663)
Student Gender × Gender Equality	-8.221*	
	(3.515)	
Student Gender × Teacher Gender × Gender Equality	13.066*	
	(5.731)	
% Women in Parliament		2.940
		(2.178)
Teacher Gender × % Women in Parliament		-0.387
		(0.745)

[16] We exclude the 'trust in people' variable given that seventeen countries will be dropped (for more details see the list of countries under Table OA 1). We would like to note that even if we include the trust variable in our final models in Table OA6. The results for gender equality still hold while political representation show insignificant relationship at the traditional statistical significance level (p=0.13).

Student Gender × % Women in Parliament		-1.112+
		(0.625)
Student Gender × Teacher Gender × % Women in Parliament		1.774+
		(1.013)
Trust in People (Median)	-103.067*	-51.600
	(45.398)	(52.221)
Student Age	-18.747*	-16.629*
	(7.679)	(7.205)
Instructional hours per week	-5.096	-8.326*
	(4.240)	(3.988)
Born-in-country (Yes=1)	10.530	26.744*
	(13.457)	(13.008)
Instructional Resource (not at all=0; a lot=3)	16.537**	19.429**
	(3.905)	(4.894)
Teacher Experience, logged	-2.196	-2.004
	(5.588)	(5.208)
Class Size, logged	15.713	3.795
	(16.527)	(12.699)
Parent Education (No school=0; Bachelor=4)	25.210**	25.262**
	(2.257)	(2.366)
Constant	599.580**	628.682**
	(134.080)	(111.350)
R-Squared overall	0.2619	0.2359
N	111,797	111,797

Note. + p<0.10, * p<0.05, **p<0.01; standard errors are in parentheses and clustered by countries; two-tailed tests; Botswana, Canada, Finland, Honduras, Hungary, Indonesia, Iran, Israel, Italy, Lithuania, Macedonia, Norway, Oman, Saudi Arabia, Syria, United Arab Emirates, and United Kingdom are excluded due to missing observations from the World Value Survey Wave 6.

Table OA2 includes the religious fractionalization measure in 2001 by Alesina el al. (2003) as a proxy for the religion variable. Though the data is outdated, we would like to note that it is the most recent and valid fractionalization measure available now. The measure is based on probabilities that randomly selected two individuals in a county would not have the same religious group. Our results after controlling for the variable hold the same.

Table OA2. Exploring the moderating role of gender equity and political representation while controlling for religious fractionalization at the national level among forty-four countries.

	Model 1	Model 2
Student Gender (Female=1)	28.245	24.694
	(17.283)	(15.294)
Teacher Gender (Female=1)	44.570*	36.189*
	(19.342)	(14.015)
Gender Equality	9.941**	

	(2.652)	
Teacher Gender × Gender Equality	-4.566	
	(2.826)	
Student Gender × Teacher Gender (Female=1)	-62.056*	-48.182*
	(26.892)	(21.215)
Student Gender × Gender Equality	-4.220	
	(2.596)	
Student Gender × Teacher Gender × Gender Equality	9.386*	
	(4.223)	
% Women in Parliament		1.508+
		(0.773)
Teacher Gender × % Women in Parliament		-0.691
		(0.517)
Student Gender × % Women in Parliament		-0.837
		(0.541)
Student Gender × Teacher Gender × % Women in Parliament		1.653*
		(0.790)
Religious Fractionalization	37.941	49.917+
	(28.884)	(27.198)
Student Age	-16.542**	-17.077**
	(5.275)	(5.342)
Instructional hours per week	-3.233	-4.342
	(3.320)	(3.176)
Born-in-country (Yes=1)	25.595*	29.724**
	(10.532)	(9.840)
Instructional Resource (not at all=0; a lot=3)	16.115**	17.460**
	(3.270)	(3.387)
Teacher Experience, logged	5.259	5.471
	(4.170)	(4.054)
Class Size, logged	10.080	5.022
	(12.096)	(12.413)
Parent Education (No school=0; Bachelor=4)	23.285**	23.529**
	(1.869)	(1.914)
Constant	493.991**	532.877**
	(96.474)	(101.649)
R-Squared overall	0.2645	0.2574
N	179,804	179,804

Note. + p<0.10, * p<0.05, **p<0.01; standard errors are in parentheses and clustered by countries; two-tailed tests.

Table OA3 adds an economic development measure, GDP per capita (logged) from World Bank Development Indicator. The moderating relationship holds the same.

Table OA3. Exploring the moderating role of gender equity and political representation while controlling for economic development at the national level among forty-two countries.

	Model 1	Model 2
Student Gender (Female=1)	41.113**	33.537*
	(13.191)	(12.918)
Teacher Gender (Female=1)	66.666**	52.333**
	(13.320)	(11.496)
Gender Equality	7.347**	
	(2.315)	
Teacher Gender × Gender Equality	-7.861**	
	(1.964)	
Student Gender × Teacher Gender (Female=1)	-88.845**	-65.755**
	(24.082)	(21.736)
Student Gender × Gender Equality	-6.720**	
	(2.157)	
Student Gender × Teacher Gender × Gender Equality	14.568**	
	(4.173)	
% Women in Parliament		1.004
		(0.779)
Teacher Gender × % Women in Parliament		-1.378*
		(0.512)
Student Gender × % Women in Parliament		-1.366*
		(0.516)
Student Gender × Teacher Gender × % Women in Parliament		2.752**
		(0.995)
GDP per capita, logged	14.019**	15.116**
	(3.315)	(3.118)
Student Age	-10.095*	-9.439*
	(4.435)	(4.153)
Instructional hours per week	-4.431	-4.860+
	(2.826)	(2.816)
Born-in-country (Yes=1)	17.014	18.677+
	(11.052)	(10.811)
Instructional Resource (not at all=0; a lot=3)	13.782**	14.877**
	(2.592)	(2.714)
Teacher Experience, logged	5.517	5.563
	(4.073)	(3.997)
Class Size, logged	0.729	-1.798
	(11.225)	(11.180)
Parent Education (No school=0; Bachelor=4)	24.722**	25.228**
	(1.620)	(1.665)
Constant	294.924**	294.836**
	(106.782)	(101.646)
R-Squared overall	0.2997	0.2944

N	173,104	173,104

Note. + p<0.10, * p<0.05, **p<0.01; standard errors are in parentheses and clustered by countries; two-tailed tests; Macedonia and Taiwan are excluded due to missing observations from the World Bank Development Indicator data.

Table OA4 includes regional dummies and show the relationships still hold.

Table OA4. Exploring the moderating role of gender equity and political representation while controlling for economic development at the national level among forty-four countries.

	Model 1	Model 2
Student Gender (Female=1)	23.424	22.495+
	(15.731)	(11.818)
Teacher Gender (Female=1)	30.353	22.536+
	(18.907)	(12.742)
Gender Equality	10.320*	
	(4.077)	
Teacher Gender × Gender Equality	-2.958	
	(2.848)	
Student Gender × Teacher Gender (Female=1)	-46.458+	-39.217*
	(26.016)	(17.668)
Student Gender × Gender Equality	-3.478	
	(2.393)	
Student Gender × Teacher Gender × Gender Equality	7.013+	
	(4.146)	
% Women in Parliament		1.061+
		(0.534)
Teacher Gender × % Women in Parliament		-0.435
		(0.481)
Student Gender × % Women in Parliament		-0.849+
		(0.421)
Student Gender × Teacher Gender × % Women in Parliament		1.492*
		(0.691)
Asia	115.448**	115.538**
	(28.233)	(29.530)
Europe	61.693**	67.852**
	(22.611)	(23.693)
Middle East	53.580*	40.226+
	(22.493)	(22.800)
North and South America	41.244	52.656+
	(26.344)	(29.675)
Student Age	-11.795**	-14.086**
	(3.788)	(4.552)
Instructional hours per week	-1.922	-2.635

	(2.998)	(3.060)
Born-in-country (Yes=1)	19.279+	19.144+
	(10.786)	(10.699)
Instructional Resource (not at all=0; a lot=3)	13.626**	14.807**
	(2.312)	(2.674)
Teacher Experience, logged	4.323	3.224
	(3.071)	(3.063)
Class Size, logged	8.561	6.528
	(7.463)	(7.553)
Parent Education (No school=0; Bachelor=4)	24.561**	24.663**
	(1.881)	(2.088)
Constant	385.275**	463.134**
	(74.240)	(85.410)
R-Squared overall	0.3267	0.3177
N	179,804	179,804

Note. + p<0.10, * p<0.05, **p<0.01; standard errors are in parentheses and clustered by countries; two-tailed tests; reference dummy=Africa.

Table OA5 adds the quality of government variable from the World Governance Indicator. The quality of government variable is created via explanatory factor analysis using five items voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. All items are loaded onto a single factor with loadings between 0.82 and 0.98 and the Cronbach's alpha of the items is 0.96. Our results remain the same after controlling for the quality of government.

Table OA5. Exploring the moderating role of gender equity and political representation while controlling for the quality of government among forty-three countries.

	Model 1	Model 2
Student Gender (Female=1)	40.306*	26.556
	(17.442)	(15.857)
Teacher Gender (Female=1)	70.398**	47.891**
	(19.887)	(15.376)
Gender Equality	2.771	
	(5.879)	
Teacher Gender × Gender Equality	-8.108**	
	(2.979)	
Student Gender × Teacher Gender (Female=1)	-93.451**	-56.809*
	(28.616)	(23.616)
Student Gender × Gender Equality	-6.190*	
	(2.652)	
Student Gender × Teacher Gender × Gender Equality	14.413**	

	(4.570)	
% Women in Parliament		0.657
		(1.010)
Teacher Gender × % Women in Parliament		-1.061+
		(0.603)
Student Gender × % Women in Parliament		-0.952
		(0.572)
Student Gender × Teacher Gender × % Women in Parliament		2.066*
		(0.936)
Quality of Government	26.530+	24.959**
	(13.215)	(9.024)
Student Age	-15.002**	-14.867**
	(4.917)	(4.965)
Instructional hours per week	-5.924+	-5.827+
	(2.979)	(3.161)
Born-in-country (Yes=1)	27.937**	27.593**
	(10.194)	(10.161)
Instructional Resource (not at all=0; a lot=3)	13.381**	13.386**
	(2.641)	(2.625)
Teacher Experience, logged	7.089*	7.036*
	(3.376)	(3.356)
Class Size, logged	9.322	9.413
	(12.006)	(12.312)
Parent Education (No school=0; Bachelor=4)	22.307**	22.341**
	(2.006)	(2.017)
Constant	538.121**	537.345**
	(94.417)	(90.853)
R-Squared overall	0.2823	0.2809
N	175,689	175,689

Note. + p<0.10, * p<0.05, **p<0.01; standard errors are in parentheses and clustered by countries; two-tailed tests; Romania is excluded due to missing observations from the World Governance Indicator data.

Lastly, Table OA6 includes all national context variables (except for trust in people) used above models such as religious fractionalization, economic development, regional dummies, and quality of government, even though including all national context variables significantly reduce the degree of freedom at the national level. The results in Models 1 and 2 suggest that the relationships still hold even after we control other national context variables as well as regional dummies.

Table OA6. Exploring the moderating role of gender equity and political representation while controlling for religious fractionalization, economic development, regional dummies, and quality of government among forty-one countries.

	Model 1	Model 2
Student Gender (Female=1)	39.805**	26.432*
	(14.000)	(12.521)
Teacher Gender (Female=1)	54.607**	34.390**
	(15.493)	(11.819)
Gender Equality	-2.194	
	(5.095)	
Teacher Gender × Gender Equality	-6.418*	
	(2.398)	
Student Gender × Teacher Gender	-81.658**	-50.258*
	(23.848)	(19.423)
Student Gender × Gender Equality	-6.028**	
	(2.201)	
Student Gender × Teacher Gender × Gender Equality	12.611**	
	(3.949)	
% Women in Parliament		-0.182
		(0.670)
Teacher Gender × % Women in Parliament		-0.740
		(0.508)
Student Gender × % Women in Parliament		-0.969+
		(0.489)
Student Gender × Teacher Gender × % Women in Parliament		1.942*
		(0.845)
Religious Fractionalization	54.789*	50.254*
	(21.716)	(21.336)
GDP per capita, logged	11.342**	10.962**
	(2.843)	(3.013)
Quality of Government	22.915*	19.613*
	(8.899)	(7.327)
Asia	97.068**	97.075**
	(28.281)	(28.140)
Europe	90.873**	85.884**
	(25.053)	(23.455)
Middle East	71.897**	72.236**
	(24.376)	(24.011)
North and South America	38.465+	33.942
	(22.459)	(20.875)
Student Age	-7.667**	-6.924*
	(2.510)	(2.723)
Instructional hours per week	-2.389	-1.874

	(2.023)	(2.081)
Born-in-country (Yes=1)	20.449+	19.211+
	(10.574)	(10.657)
Instructional Resource (not at all=0; a lot=3)	8.794**	8.944**
	(1.647)	(1.510)
Teacher Experience, logged	4.642+	4.832+
	(2.464)	(2.480)
Class Size, logged	7.497	8.122
	(6.389)	(6.533)
Parent Education (No school=0; Bachelor=4)	21.731**	22.149**
	(1.603)	(1.620)
Constant	226.005**	210.130*
	(79.062)	(80.022)
R-Squared overall	0.3632	0.3616
N	168,989	168,989

Note. + p<0.10, * p<0.05, **p<0.01; standard errors are in parentheses and clustered by countries; two-tailed tests; Macedonia, Romania, and Taiwan are excluded due to missing observations from the World Governance Indicator data.