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**Gender Norms, Occupational Choices, and  
the Innovation Gender Gap**

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# Gender Norms, Occupational Choices, and the Innovation Gender Gap

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**Abstract:** The innovation gender gap partly stems from an underrepresentation of women in STEM occupations, which is traceable to gender-biased educational and occupational choices. One determinant for such biased choices is gender norms. However, gender norms also directly affect the innovation gender gap. We disentangle the direct effect of gender norms from their indirect effect via educational and occupational choices. We conduct a municipality-level analysis that combines voting data to measure gender norms with patent data to measure innovation outcomes. Applying structural equation modeling to disentangle the effects, our results show that more traditional gender norms in a municipality are associated with a significantly lower number of patents filed by women in this municipality and that the indirect effect via educational and occupational choices accounts for 5.3% of the total effect. These results are important for policymakers: while gender norms are highly persistent and difficult to change even in the long term, promoting gender equality in educational and occupational choices is more effective in the short term and may therefore yield important and faster reductions in the innovation gender gap.

**Keywords:** Innovation Gender Gap, Gender Norms, Education, Educational Choices, Female Inventors, Regional Patenting

**JEL:** J24, O30, J16, I24, I25, I26

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## 1. Introduction

Despite long-standing initiatives for improving gender equality in the economy, women remain strongly underrepresented among inventors. For example, Whittington & Smith-Doerr highlighted this innovation gender gap and its persistence already in 2005. Even though this gap is narrowing, with the worldwide percentage of women among patent inventors at 12.7% in 2017 and 17.7% in 2023 (UK Intellectual Property Office, 2019; WIPO, 2024), Jung and Ejeremo (2014) find it doing so at a slower pace than in other societal areas (e.g., education). Two main problems result from this innovation gender gap. First, the underrepresentation of women in innovation leads to an underrepresentation of women's needs and interests in innovation outcomes (e.g., Koning et al., 2021), thereby contributing to the reproduction of structural inequalities (e.g., Dahlin et al., 2023; Forman et al., 2019). Second, the innovation potential of half the workforce (i.e., women) remains largely untapped, potentially leading to reduced innovation outcomes overall. These problems are particularly prominent in highly developed countries, which strongly rely on innovation for their competitiveness and for ensuring productivity and future wealth (e.g., Acemoglu & Restrepo, 2018; Howitt & Aghion, 1998).

Previous research has shown that education in science, technology, engineering and mathematics (STEM) fields is a crucial factor for innovation (e.g., Makkonen & Lin, 2012; Metcalfe, 2005). Not surprisingly, providing workers with the necessary skills for participating in innovation activities constitutes a key objective of education systems (Bloom et al., 2019), and researchers have been extensively investigating the role of academic STEM education on innovation (e.g., Bianchi & Giorcelli, 2020; Toivanen & Väänänen, 2016; Winters, 2014). As STEM fields are usually male dominated, the underrepresentation of women in academic STEM education explains part of the innovation gender gap (e.g., Hunt et al., 2013). Moreover, a small but growing literature shows that not only workers with university STEM education but also workers with vocational education and training (VET) in STEM foster innovation (e.g., Backes-Gellner, 1996; Backes-Gellner & Lehnert, 2021; Lewis, 2023; Rupietta & Backes-Gellner, 2019; Toner, 2010). Thus, in addition to the underrepresentation of women in academic STEM fields, their underrepresentation in VET STEM fields can further amplify women's underrepresentation among patent inventors.

Moreover, recent research suggests that gender norms are another important direct determinant of innovation. Qin et al. (2023) show that more traditional gender norms are linked to gender inequalities in patenting. In addition, gender norms may also indirectly affect

innovation through occupational choices. Kuhn and Wolter (2023) and Palffy et al. (2023b) show that gender norms affect occupational choices and the representation of women in STEM fields. However, the extent to which gender norms affect innovation directly or indirectly remains unclear. We therefore want to disentangle and quantify the importance of their direct effect, (i.e., all potential channels but occupational choices) from their indirect effect through educational or occupational choices. Disentangling these direct and indirect effects is important because previous research has shown that while gender norms per se are very persistent even in the long term (Gruneau, 2022; Janssen et al., 2016; Kuhn & Wolter, 2023; Palffy et al., 2023b), occupational choices are malleable and biases can be reduced effectively in the shorter term (Delfino, 2024; Palffy et al., 2023a; Pietri et al., 2021). Thus, educational interventions to reduce gender-biased occupational choices could be important to reduce the innovation gender gap in the short term if the indirect effect is substantial. Therefore, disentangling what percentage of the innovation gender gap induced by gender norms is driven by a direct effect or by the indirect effect via occupational choices is highly important for innovation policy.

We analyze whether and, if so, to what extent gender norms have a direct effect on innovation and an indirect effect through educational or occupational choices. To do so, we investigate how regional differences in gender norms affect regional patenting. By estimating these relationships in a structural equation model, we are able to disentangle the direct effect of gender norms on innovation from their indirect effect through educational or occupational choices.

We use data from Switzerland because they are ideal for our empirical analysis for three reasons. First, because of its frequent popular votes we are able to reliably measure gender norms across Swiss municipalities. These popular votes reveal the true differences in social attitudes towards gender equality at very disaggregated levels because they are free of the social desirability bias common in survey data (Janssen et al., 2016; Kuhn & Wolter, 2023; Lalive & Stutzer, 2010; Palffy et al., 2023b). Second, Switzerland is among the most innovative countries (e.g., the World Intellectual Property Organization's Global Innovation Index) (see Dutta et al., 2024) and therefore presents an important innovation case study.<sup>1</sup> Third, the Swiss education system offers two different types of educational pathways (academic and VET) both of which are important for innovation with significant percentages of the population choosing each pathway, thereby providing valuable inputs for our analysis. Approximately 70% of Swiss

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<sup>1</sup> Even though Switzerland is a highly innovative country, the female percentage of inventors is as low as 9% (Niggli & Rutzer, 2021).

adolescents choose a VET pathway, for which we can identify the occupation they choose out of more than 200 occupations for upper-secondary education (i.e., at around ages 15-16, in the last year of compulsory schooling). Another roughly 20% choose an academic pathway, for which we can also identify their field of study.<sup>2</sup> Thus we have a sufficient sample size and reliable data on the occupational and educational choices in VET and academic education.

Consequently, for our analysis we create a unique dataset that combines four data sources to leverage these advantages. First, to measure gender norms, we use the municipality-level<sup>3</sup> voting outcomes of a constitutional referendum on gender equality. In doing so, we follow the measurement of regional gender norms used by Lalive and Stutzer (2010), Janssen et al. (2016), Kuhn and Wolter (2023), and Palffy et al. (2023b). Second, to measure the percentage of women with either academic or VET STEM degrees<sup>4</sup> at the municipality level, we use the Swiss Labor Force Survey (SLFS). Third, to measure innovation outcomes at the municipality level, we use patent data from the European Patent Office's Worldwide Patent Statistical Database (PATSTAT).<sup>5</sup> Patenting activities are an established indicator to measure innovation in STEM fields across countries and regions (Acs et al., 2002; Bottazzi & Peri, 2003; Furman et al., 2002), thus constituting the most appropriate measure for innovation to answer our research question. We use the information on all patent applications with at least one inventor in Switzerland, including, among other items, the filing dates, the inventors' names, and their addresses. Fourth, to identify the gender of all these patent inventors, we use Raffo's (2021) gender-name dictionary and apply it to the PATSTAT data.

The outcome variable we use in our analysis of the direct and indirect effects of gender norms on regional innovation is "women's patent quantity", i.e., patent applications by women, per municipality and year. We apply a structural equation modeling framework, which allows us to simultaneously examine the direct and indirect effects of multiple variables on our outcome variable and thus disentangle direct from indirect effects. Our results show that—as hypothesized—gender norms have both direct and indirect effects on innovation. The direct effect of a one percentage point stronger traditional gender norm in a municipality is a reduction of 0.539% in women's patent quantity in that municipality; the indirect effect is a reduction of

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<sup>2</sup> The remaining 10% of individuals does not acquire any post-compulsory education.

<sup>3</sup> In Switzerland, municipalities are the smallest administrative and political unit, functionally comparable to a U.S. county.

<sup>4</sup> In our analysis, we consider individuals with qualifications at the upper-secondary level (i.e., diplomas) and tertiary level (i.e., degrees). For the ease of reading, we use "degree" throughout the paper and not "either degree or diploma".

<sup>5</sup> We thank Dietmar Harhoff from the Max-Planck-Institute for Innovation and Competition in Munich for providing the patent data for this project.

0.030%. Thus the indirect effect accounts for 5.3% of the total effect of gender norms on women's patent quantity, suggesting that occupational and educational choices notably mediate the effect of gender norms on innovation. This finding underlines the role of occupational choices in the innovation gender gap.

Moreover, we conduct three additional analyses that show further important effects on the innovation gender gap. First, to ensure whether the increase in women's patent quantity is not merely a substitute for men's patent quantity, we use the overall patent quantity in a municipality (i.e., total patent applications of women and men) as an additional outcome variable. We find that a larger percentage of women with a STEM degree also positively affects a municipality's overall patent quantity. Hence, increases in the number of women in STEM fields lead to a net increase in overall patenting, implying that female inventors do not simply replace male inventors.

Second, we consider women's patent quality in a municipality as indicated by patent citations as an alternative outcome to assess the impact of social gender norms on innovation quality. We again find a similar pattern, i.e., a negative direct effect of traditional gender norms on women's patent quality and a negative indirect effect through educational and occupational choices. These findings suggest that policies to reduce the innovation gender gap by increasing the number of women in STEM do not compromise but improve innovation quality. Third, we use the share of women's patent quantity relative to overall patent quantity as an alternative outcome that directly measures the innovation gender gap. Results of this analysis are also in line with our main results, showing that municipalities with less traditional gender norms have a higher share of women's patents, i.e., a lower innovation gender gap.

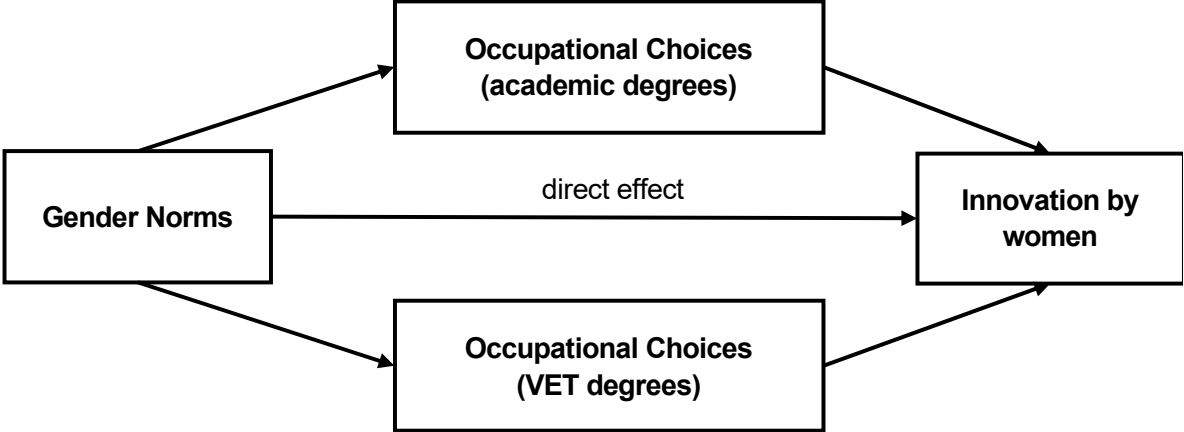
Our findings also yield important policy implications. As gender norms have an indirect effect on innovation through STEM education, policy interventions aimed at reducing gender-biased educational or occupational choices can effectively narrow the innovation gender gap in the shorter term (as opposed to gender norms that are persistent even in the long term) and increase the overall innovation level. Reducing gender-biased educational or occupational choices is thus not only important from an equity perspective but also for innovation policy.

## **2. Literature and Hypotheses**

To develop our conceptual framework and hypotheses, we draw from three strands of literature. First, we assess the literature on gender norms and their role in innovation. Second, we build on the literature that examines the role of gender norms in determining occupational choices.

Third, we consider the literature on the role of STEM education in innovation. Figure 1 visualizes the conceptual framework, displaying the potential relationships between gender norms, occupational choices and innovation by women according to these three strands of literature.

Figure 1: Conceptual Framework



Notes: Figure 1 shows our conceptual framework that we derive from the literature in Sections 2.1 to 2.3.

2.1 Gender Norms and Innovation

Gender norms are social norms describing one set of typical “expected” behaviors for men and another one for women.<sup>6</sup> Empirical research has analyzed the effect of gender norms on various economic outcomes, finding higher levels of gender inequality when gender norms are more traditional. For example, more traditional gender norms increase the gender pay gap (Janssen et al., 2016; Lalive & Stutzer, 2010), decrease the educational attainment of women (Kosteas, 2013), lower women’s labor force participation (Antecol, 2000; Fernández, 2013; Fernández & Fogli, 2009; Grewenig et al., 2020), and reduce the likelihood of women to become entrepreneurs (e.g., Feldmann et al., 2022).

However, less evidence exists so far on the effects of gender norms on women’s participation in innovation. Qin et al. (2023) show that a stronger gender bias in cultural tightness (i.e., stronger traditional gender norms) is related to gender inequalities in patenting.

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<sup>6</sup> Social norms originate in social identity, which Akerlof and Kranton (2000) define as an individual’s self-image and identification with a certain group. Therefore, this identity is often associated with different social categories and the ways in which a society tells people in those categories how they should behave. Deviating from such socially expected behavior comes at a cost (Akerlof & Kranton, 2000). Thus, individuals on average act in line with the expected behavior. These expectations are called “social norms” (Bertrand et al., 2020; Pearse & Connell, 2016; Smith et al., 2021).

Similarly, Bell et al. (2019) analyze the importance of inventors' personal backgrounds, finding that exposure to inventors during childhood increases the probability of inventing for both men and women. They show that women who grow up in a location with more women inventors are also more likely to become inventors, suggesting that the environment (which gender norms are part of) plays an important role. Other research points towards mechanisms on why gender norms might affect innovation. Given an individual has a STEM degree, women are still less likely than men to choose STEM occupations (e.g., Meoli et al., 2024), less likely to work in patent-intensive STEM fields (Lubczyk & Moser, 2024), and less likely to engage in research and development (R&D) activities (e.g., Hunt, 2016; Muscio & Vallanti, 2024). At the same time, Whittington and Smith-Doerr (2005) show that, even among inventors, women patent at a significantly lower rate than men, while the quality and impact of their patents is equal to or better than those of men's patents. These gender differences in the participation in innovation likely result from gender norms, which act through various channels beyond occupational and educational choices that we do not explicitly disentangle in this paper.

Similar patterns of gender gaps exist in other areas of innovation such as academic publishing. On one hand, women have different publication patterns than men: they (a) choose less competitive journals (Mayer & Rathmann, 2018), (b) have a stronger preferences for open-access outlets (Schmal et al., 2023), and (c) are also less likely to appear in more prestigious author positions, i.e., first, last, or single authors (West et al., 2013). On the other hand, Hengel (2022) finds that women's academic publications are, on average, better written, suggesting that women have to fulfill higher standards. Another example for a persisting gender gap likely resulting from gender norms is women's entrepreneurial activities (Kaiser & Mata, 2025). Taken together, this evidence supports the argument that gender norms are an important determinant of the innovation gender gap.

Thus, these empirical studies show that gender norms determine women's labor market outcomes and participation in innovation activities. Following social norm theory (Akerlof & Kranton, 2000), we argue that being an inventor is a behavior typically expected from men, suggesting that traditional gender norms would form an obstacle for women to become inventors. Consequently, women are *ceteris paribus* less likely to become inventors than men. Thus we argue that the stronger the traditional gender norms are in a municipality, the lower is the likelihood of women to become inventors in that municipality. This argumentation leads us to the following hypothesis:

*H1: Municipalities with stronger traditional gender norms have lower innovation activities by women.*

## *2.2 Gender Norms and Occupational Choices*

Another research strand analyzes how gender norms affect educational or occupational choices, with recent studies showing that traditional gender norms increase the likelihood of gender-typical choices. As STEM fields in academic education are typically male-dominated, women are therefore less likely to choose STEM fields (de Grip & Willems, 2003; Humlum et al., 2012; Hunt et al., 2013; Kahn & Ginther, 2018; Kuhn & Wolter, 2023; Osikominu et al., 2020; Palffy et al., 2023b; Zafar, 2013). The same is true for VET occupations: Kuhn and Wolter (2023) and Palffy et al. (2023b) find that adolescents are less likely to aspire for or choose a gender-atypical VET occupation when living in a municipality with stronger traditional gender norms. The findings of these studies emphasize that these gender differences in occupational choices are driven by supply rather than demand, because they analyze adolescents' actual choices (supply side) that are unconfounded by firms' hiring decisions (demand side). Therefore, we conclude that stronger traditional gender norms in a municipality decrease the percentage of women with STEM degrees, from both VET and academic education. This argumentation leads us to the following hypotheses:

*H2a: Municipalities with stronger traditional gender norms have lower percentages of women with an academic STEM degree.*

*H2b: Municipalities with stronger traditional gender norms have lower percentages of women with a VET STEM degree.*

## *2.3 STEM Education and Innovation*

A large literature studies the determinants of innovation with respect to fields of education, showing that skills in STEM fields are most important for innovation compared to other fields. For example, Bianchi and Giorcelli (2020), who exploit a policy change in Italy that led to an abrupt increase in the number of university STEM graduates, find that students receiving a STEM diploma are more likely to patent in STEM-oriented fields, therefore changing the direction of inventions. Similarly, Winters (2014) finds that a regional increase in STEM graduates significantly increases regional patent quantity.

Another strand of literature studies the establishment of new universities with STEM fields and shows an effect of the subsequent increase in STEM graduates on regional innovation. For example, Toivanen and Väänänen (2016) find that the introduction of technical universities in Finland led to an increase in both patent quantity and patent quality in the affected regions. Similar results have been shown for Italy (Cowan & Zinovyeva, 2013) and the United States (Andrews, 2023).

While most of the prior research on education and innovation focuses on universities (i.e., academic tertiary education), a more recent and growing strand of literature studies VET as an additional source of STEM effects on innovation. Research on Universities of Applied Sciences (UASs)<sup>7</sup> (i.e., applied higher education institutions, which focus on applied research and recruit students from VET pathways), find that these institutions significantly boost regional innovation as well. Lehnert et al. (2020) show that firms employ more R&D personnel after the introduction of UASs, Pfister et al. (2021) show an increase in overall patenting quantity and quality, and Schlegel et al. (2022) show that the effect size depends on regional economic conditions such as labor market size and industry structures.

Another strand of literature highlights that VET is important for innovation not only through tertiary VET degrees but also through a high quality middle-skilled workforce with upper-secondary VET degrees (Backes-Gellner, 1996; Lewis, 2023; Rupietta & Backes-Gellner, 2019; Toner, 2010), particularly in economies with a large percentage of vocationally well-trained workers (Toner, 2011). For example, Schultheiss and Backes-Gellner (2024) show that equipping middle-skilled VET workers with novel technological skills through updates of VET curricula help to speed up the diffusion of novel technologies across firms. This effect is particularly pronounced for firms that are not operating at the innovation frontier and without own R&D (often small and medium-sized firms), because they can draw on the skills of newly trained VET workers in efficiently implementing new technologies. Furthermore, Schultheiss et al. (2023) show that the establishment of UASs, in addition to their effect through tertiary VET degrees, also increases the likelihood of workers with a secondary VET degree to work in R&D-related tasks. The reason is that UAS graduates build bridges between graduates from academic universities and upper-secondary VET graduates, thus improving innovation outputs through better skill complementarity as an innovation input.

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<sup>7</sup> UASs are tertiary-level vocational institutions that grant bachelor's and master's degrees. Entry to these programs usually requires a VET diploma with a vocational baccalaureate and some practical work experience.

In sum, previous literature shows that STEM education fosters innovation through (1) different types of STEM education (i.e., academic and VET) and (2) different levels of STEM education (i.e., tertiary and upper-secondary). Thus, we argue that the underrepresentation of women—induced by social gender norms—in either academic or VET STEM education reduces innovation activities by women. This argumentation leads us to the following hypotheses:

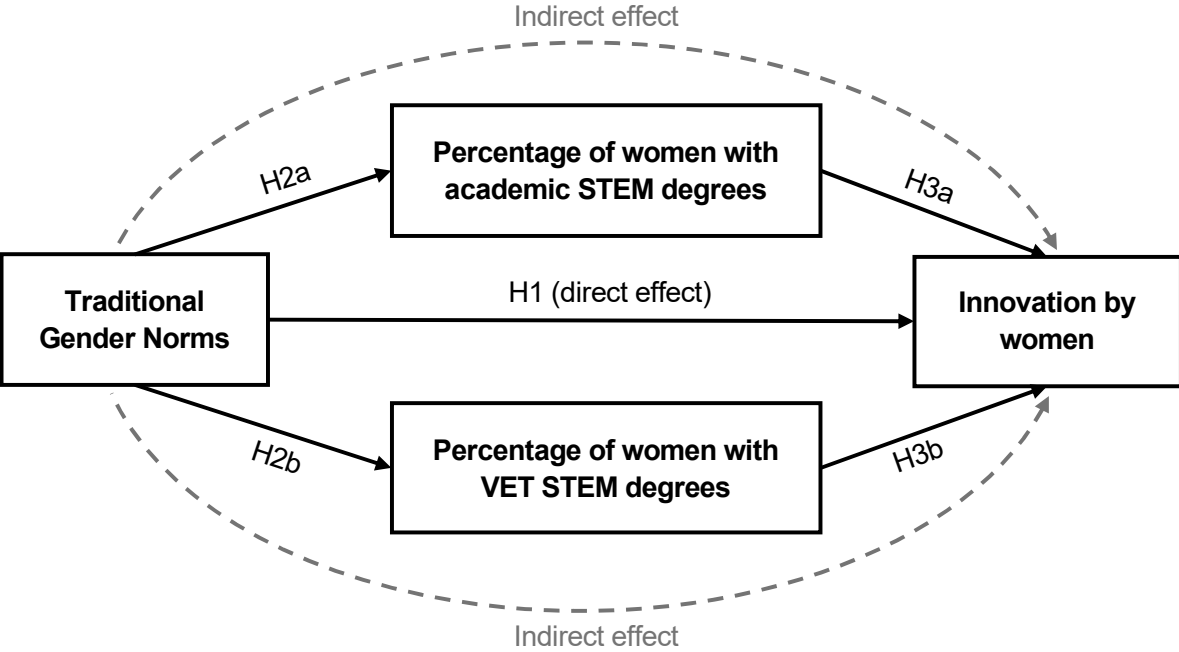
*H3a: Municipalities with higher percentages of women with an academic STEM degree have higher innovation activities by women.*

*H3b: Municipalities with higher percentages of women with a VET STEM degree have higher innovation activities by women.*

#### *2.4 Combining the Effects of Education and Gender Norms on Innovation*

Figure 2 depicts all the expected relationships stated in our hypotheses in Sections 2.1 through 2.3. We hypothesize a direct negative effect of traditional gender norms on innovation (H1), negative effects of traditional gender norms on the percentages of women with academic and VET STEM degrees (H2a and H2b), and positive effects of the percentages of women with academic and VET STEM degrees on innovation activities by women (H3a and H3b). As a consequence of these effects, we also expect an indirect effect of traditional gender norms via educational and occupational choices, which we can calculate by combining the estimated direct effects in hypotheses 2a and 3a, and 2b and 3b, respectively (dashed lines in Figure 2).

Figure 2: Gender Norms, Education and Innovation Outcomes: Structural Model



Notes: Figure 2 models the hypothesized relationship between traditional gender norms and innovation by women. Each path represents a relationship that we estimate in our model. The percentage of women with academic STEM degrees and the percentage of women with VET STEM degrees are the mediators for modeling the indirect effect between gender norms and innovation by women.

**3. Data**

We construct our municipality-level dataset by combining four main data sources that we describe in the following: (1) results from a constitutional referendum on gender equality to measure gender norms, (2) the Swiss Labour Force Survey (SLFS) to measure the educational composition of the workforce, (3) patent data to measure innovation, and (4) Raffo’s (2021) gender-name dictionary to identify the gender of inventors in the patent data. Table 1 provides a summary of the descriptive statistics.

Table 1: Descriptive Statistics

Municipality Level Variables	mean	sd	min	max
<i>Innovation Outcomes</i>				
Women's patent quantity (per year and municipality)	0.822	3.360	0	56.397
Total patent quantity (per year and municipality)	9.547	25.934	0	391.837
<i>Gender Norms</i>				
Traditional Gender Norms (disapproval rate in the 1981 constitutional referendum)	0.400	0.120	0.115	0.715
<i>Occupational Choices</i>				
Percentage Women Academic STEM	0.100	0.139	0	1
Percentage Women VET STEM	0.056	0.048	0	0.429
Percentage Men Academic STEM	0.276	0.218	0	1
Percentage Men VET STEM	0.264	0.097	0	0.75

Notes: Authors' calculations of the descriptive statistics based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations (297 municipalities). Reading example: A municipality produces on average 9.547 patents per year, 0.822 of these patents are women's patents. The average disapproval rate in the 1981 referendum was 0.400 = 40%. In the workforce with a VET degree, 5.6% of individuals were women holding a STEM degree and 26.4% were men holding a STEM degree (the remaining 68% in the VET workforce holds a degree in a non-STEM field).

### 3.1 Gender Norms

To measure social gender norms at the municipality level, we follow Lalive and Stutzer (2010), Janssen et al. (2016), Palffy et al. (2023b), and Kuhn and Wolter (2023), by using voting data from a constitutional referendum on gender equality. This is an exceptionally direct and policy-relevant measurement of gender norms for two reasons. First, the voting outcome reveals true rather than stated preferences. Given the immediate constitutional consequences of the vote (i.e., actual changes of the constitution), it accurately reflects individuals' genuine support for gender equality, thus avoiding the social desirability bias typically present in survey-based measures. Prior literature also explicitly identifies the 1981 referendum as the best proxy for gender norms in terms of accuracy and validity (Janssen et al., 2016; Kuhn & Wolter, 2023; Lalive & Stutzer, 2010; Palffy et al., 2023b). Moreover, a recent study on women's entrepreneurship has reused the same measure as a proxy for gender norms (Kaiser & Mata, 2025), further indicating its acceptance in the literature.

Second, prior research also empirically underscores the external validity of the 1981 referendum as a measure for gender norms. Regional differences in the voting outcome consistently explain long-term gender differences in labor-market outcomes, such as job satisfaction, wages, and occupational choices, even decades later (Janssen et al., 2016; Kuhn &

Wolter, 2023; Lalive & Stutzer, 2010; Palffy et al., 2023b). In addition, these regional differences in the 1981 voting outcome strongly correlate with regional differences in later voting outcomes on gender issues (Janssen et al., 2016; Palffy et al., 2023b), reinforcing that the 1981 voting outcome reflects persistent gender norms rather than temporary attitudes.

As the regional level of analysis, we use the municipality-level voting outcome. The reason is that the municipality constitutes the smallest administrative regional unit in Switzerland and thus the most fine-grained measurement that best represents the gender norms in an individual's daily life and the heterogeneity across municipalities. Differences in the municipality-level voting outcome reveal important differences in gender norms: While across all municipalities the required majority of voters approved the amendment (60.3%), which was consequently added to the constitution, the approval rates varied substantially across municipalities, ranging from 28.5% to 88.5% in our regression sample.

The 1981 constitutional amendment is particularly suitable for our analysis because it focuses on guaranteeing the equality of women and men in general and in the labor market. Importantly, the amendment was not tied to any specific policy instrument, so that voters would not be voting for or against a particular policy when voting on the amendment (e.g., financial policy, social policy, educational policy, etc.) but only on guaranteeing the underlying right to gender equality. Moreover, as the 1981 vote predates our observation period, we can avoid reverse causality issues.<sup>8,9</sup> However, we also perform robustness tests using more recent votes that dealt with other gender-related policy issues (see section 4.3.1).

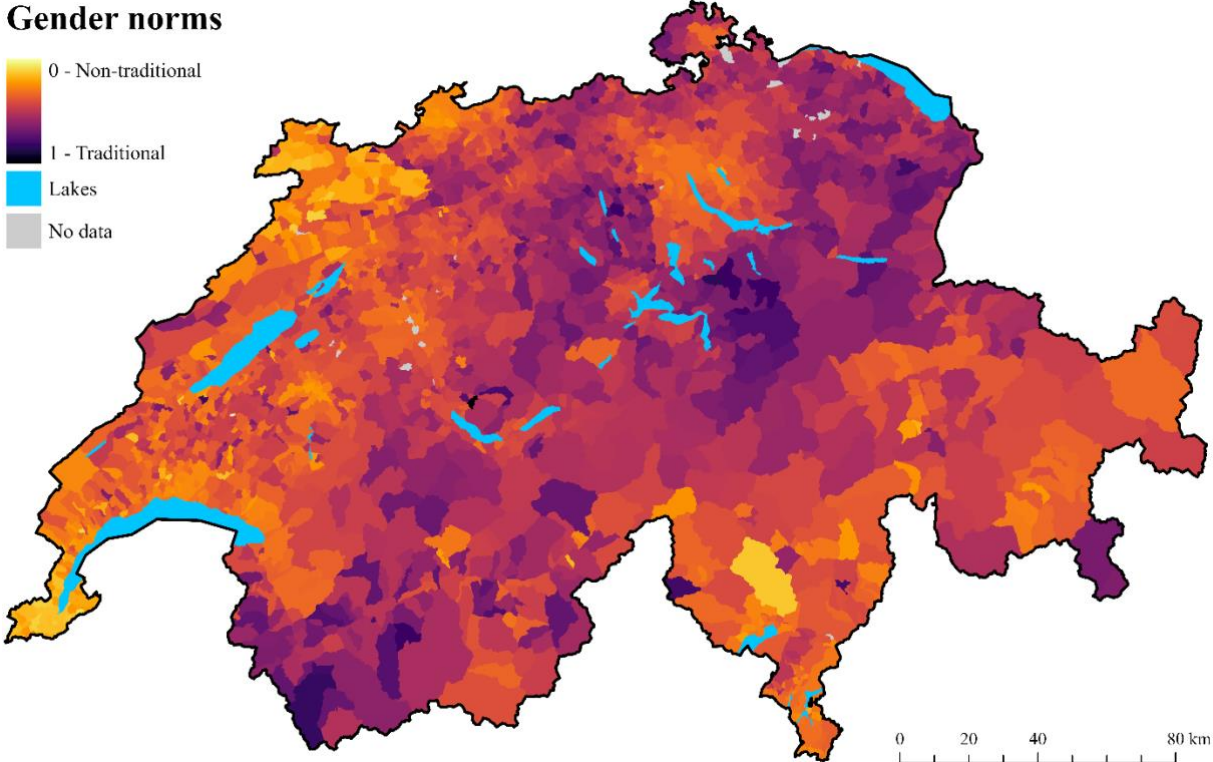
To measure the strength of traditional gender norms, we use the voter disapproval rate in the 1981 constitutional amendment, i.e., the share of voters against gender equality. Our variable *TraditionalGenderNorms<sub>m</sub>* captures this disapproval rate at the municipality level *m*. A disapproval rate closer to 1 denotes stronger traditional gender norms. A disapproval rate closer to 0 denotes weaker traditional gender norms, i.e., stronger preferences for equality between women and men. In our dataset, the disapproval rate ranges from 11.5% (the least traditional municipality) to 71.5% (the most traditional municipality) with an average of 40.0%. Figure 3 shows the municipality-level variation in gender-norms, highlighting the differences across municipalities.

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<sup>8</sup> Studies have shown that social (gender) norms and their differences among municipalities are very stable over time (e.g., Cantoni et al. 2019; Janssen et al., 2016).

<sup>9</sup> For a more detailed discussion on the use of voting data as a proxy for gender norms, see Lalive and Stutzer (2010), Janssen et al. (2016), Palffy et al. (2023b), and Kuhn and Wolter (2023).

Figure 3: Strength of traditional gender norms across Swiss municipalities



Notes: Authors’ illustration based on voting data from the Swiss Federal Statistical Office. Figure shows the strength of traditional social gender norms expressed as the voter disapproval rates on the 1981 gender equality amendment in each municipality (i.e., the fraction of a municipality's population that voted against the gender equality amendment).

3.2 Occupational Choices

To measure educational and occupational choices, we use the SLFS from 2007 through 2019. The SLFS constitutes a representative sample of the Swiss working population from age 15 (Swiss Federal Statistical Office, 2023). The survey provides information on individuals’ level of education (i.e., lower secondary, upper secondary, and tertiary), type of education (i.e., VET and academic), and occupational field of education (at the five-digit level according to the Swiss Standard Classification of Occupations, CH-ISCO-19<sup>10</sup>). From this information, we calculate the municipality-level educational composition of the workforce (i.e., the VET STEM percentages and the academic STEM percentages).

<sup>10</sup> The first four digits of CH-ISCO-19 are identical to the International Standard Classification of Occupations (ISCO-08) by the International Labor Organization (ILO). The fifth digit accounts for the peculiarities of the Swiss labor market.

To do so, we apply two sample restrictions. First, we consider only individuals who are employed and who hold at least an upper secondary degree.<sup>11</sup> To assess their level and type of education, we use their highest educational degree. To determine whether this degree is in a STEM field, we use Gutfleisch and Kogan’s (2022) STEM definition and apply it to the observed CH-ISCO-19 occupation. Second, we aggregate the data at the municipality-year level. For data protection, SLFS municipality information is available only for municipalities with more than 5,000 inhabitants. In total, therefore, we can observe educational or occupational choices only in the largest 297 of the 2,148<sup>12</sup> municipalities in Switzerland. Importantly, however, these 297 municipalities account for 59% of the Swiss population.

For this sample, we calculate the percentage of women with STEM degrees within the academic workforce and the percentage of women with STEM degrees within the VET workforce. Specifically, we calculate the percentage of women with an academic STEM degree (*PercWomenAcademicSTEM*) per year  $y$  and municipality  $m$  as the number of women with an academic STEM degree relative to all observed individuals with an academic degree (regardless of gender and STEM or non-STEM). Similarly, we calculate the percentage of women with a VET STEM degree (*PercWomenVETSTEM*) per year  $y$  and municipality  $m$  as the number of women with a VET STEM degree relative to all observed individuals with a VET degree (regardless of gender and STEM or non-STEM):

$$(1) \quad \text{PercWomenAcademicSTEM}_{y,m} = \frac{F_{y,m}^{Ac,STEM}}{F_{y,m}^{Ac} + M_{y,m}^{Ac}}$$

$$(2) \quad \text{PercWomenVETSTEM}_{y,m} = \frac{F_{y,m}^{VET,STEM}}{F_{y,m}^{VET} + M_{y,m}^{VET}}$$

where  $F_{y,m}^{Ac}$  denotes the number of women with an academic degree,  $M_{y,m}^{Ac}$  the number of men with an academic degree,  $F_{y,m}^{VET}$  the number of women with a VET degree, and  $M_{y,m}^{VET}$  the number of men with a VET degree. Accordingly,  $F_{y,m}^{Ac,STEM}$  denotes the number of women with an

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<sup>11</sup> Corresponds to the International Standard Classification of Education (ISCED) level 3 and higher. We do not include individuals with only compulsory education (i.e., a lower secondary diploma at ISCED Level 2), because this level of schooling is part of the mandatory schooling system, during which students do not choose any occupations, types, or levels.

<sup>12</sup> Given the trend towards municipality mergers, we have updated all data to the municipality stock as of 2022.

academic STEM degree and  $F_{y,m}^{VET,STEM}$  the number of women with a VET STEM degree. For example, if we observe 100 vocationally educated individuals in a municipality in one year and ten of them are women with a VET STEM degree, the respective value of  $PercWomenVETSTEM_{y,m}$  is 10%. In our sample,  $PercWomenAcademicSTEM_{y,m}$  is 9.98%, and  $PercWomenVETSTEM_{y,m}$  is 5.60%. Appendix Figures A1 and A2 illustrate the distribution of these two variables across the municipalities available in the SLFS. For comparison, the numbers for men are much higher as men are in general more likely to choose STEM degrees. The percentage of men with an academic STEM degree relative to the total number of individuals with academic degrees is 27.63% and the percentage of men with a VET STEM degree is 26.42%, respectively (Appendix Table A1).

Unfortunately, the SLFS observes individuals only at rare and random points in time during their labor market career. Therefore, individuals' relocations may affect our results if the individuals' municipality of residence indicated in the SLFS differs from the municipality of residence where they were living when they chose their education or occupation and if the gender norms in these municipalities differ. If so, large numbers of relocations would add substantial statistical noise to our estimations. However, given the mobility patterns of individuals in Switzerland, we are confident that relocations do not systematically bias our results for three reasons. First, the mobility of individuals in Switzerland is generally very low. For example, the vast majority of individuals who choose an upper-secondary VET program do so in the region where they grew up (e.g., Ebner et al., 2006; Neuenschwander et al., 2007). Second, Palffy et al. (2023b) show that the willingness to commute or relocate is not larger in municipalities with stronger traditional gender norms than in municipalities with weaker traditional gender norms. Third, Pfister et al. (2021) show that for at least five years after graduation, 75% of UAS graduates, who previously completed an upper-secondary dual VET program in the region surrounding the UAS, still reside in the region where they graduated. Therefore, for the large majority of the Swiss population the municipality indicated in the SLFS very likely corresponds to the municipality where they chose their occupation. Even for individuals who relocate, their relocations do not follow a systematic structural pattern that would bias our results.

### 3.3 Innovation Outcomes

To measure innovation activities, we use patent data from the PATSTAT Worldwide Patent Statistical Database (October 2023 version). This database provides comprehensive

information on patent applications worldwide and is publicly available at the European Patent Office (EPO). We use the information on all patents filed at the EPO with at least one inventor from Switzerland.

We use annual municipality-level patent quantity as an established measure for innovation activities (e.g., Cowan & Zinovyeva, 2013; Hall & Harhoff, 2012; Pfister et al., 2021; Trajtenberg, 1990). For our purpose of measuring innovation activities by women, we separate women's patent quantity (i.e., the annual number of patent applications by female inventors in a municipality) from men's patent quantity, proceeding in three steps to do so. First, to identify the year of invention, we use the priority year of the patent filing. Second, to localize the municipality of an invention, we geocode the inventors' address information available in the EPO data.<sup>13</sup> As a patent can have more than one inventor and as those inventors can reside in different municipalities, we use fractional weights to calculate the quantity of the patent applications per municipality.<sup>14</sup> Third, to determine women's patent quantity at the municipality level we need to identify the gender of inventors. To do so, we use Raffo's (2021) gender-name dictionary (for methodological information, see Lax Martinez et al., 2016; Lax Martínez et al., 2021) and apply it to the patent data. To improve precision, we apply the German dictionary to the German-speaking municipalities, the French dictionary to the French-speaking municipalities, and the Italian dictionary to the Italian-speaking municipalities of Switzerland. We then apply the worldwide dictionary to all names that have not been attributed at this stage. Overall, we are able to assign a gender to 99.58% of the entries.<sup>15</sup> This set of information enables us to calculate the quantity of patent applications by gender at the municipality level.<sup>16,17</sup>

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<sup>13</sup> For geocoding, we use the ArcGIS World Geocoding Service and update its result with information from de Rassenfosse et al.'s (2019) inventor geolocation database for any unidentified geolocations.

<sup>14</sup> For example, if a patent lists three inventors—one from municipality A, one from municipality B, and one from another country—the patent counts as one-third of a patent application in municipality A and one-third in municipality B. The remaining fraction from the out-of-country inventor does not enter our analyses.

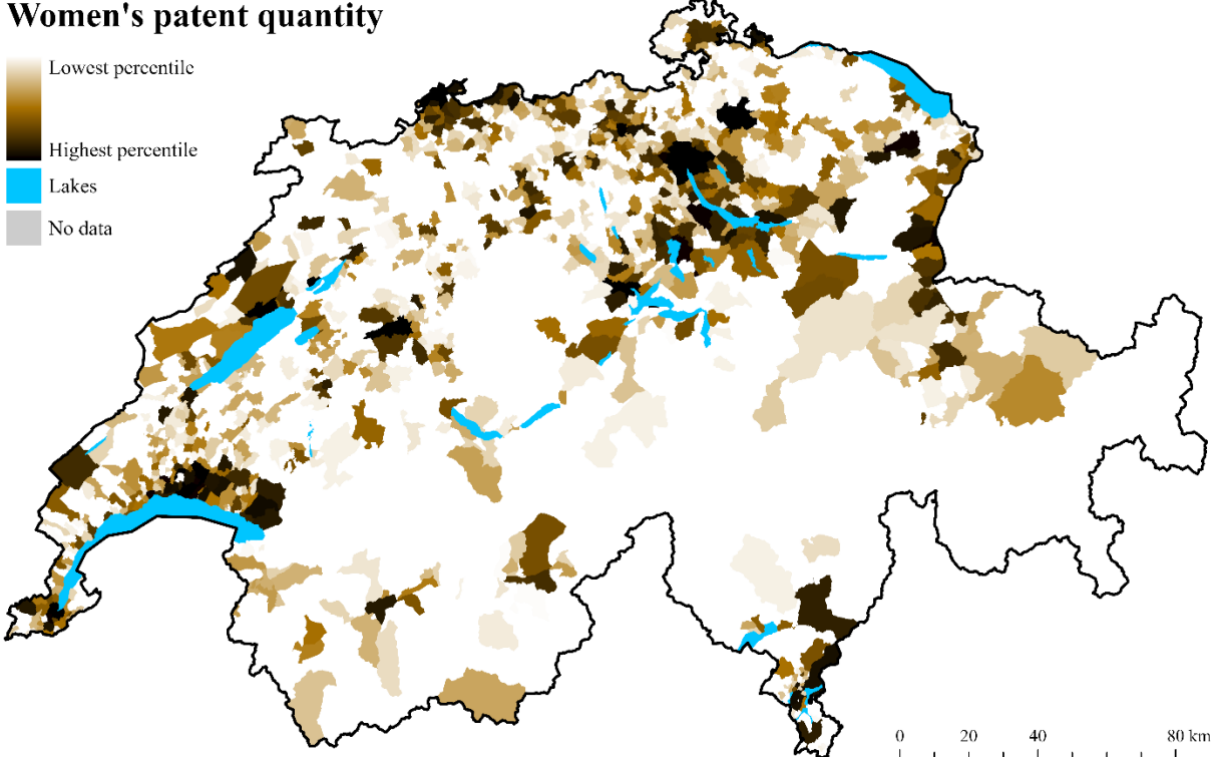
<sup>15</sup> No attribution of gender occurs in the following three cases: a firm is listed as an inventor, a name does not appear in any of the gender-name dictionaries, or a name is listed only with the inventor's initial letter or is completely missing.

<sup>16</sup> For example, if a patent lists two inventors—a woman from municipality A and a man from municipality B—the patent counts as one-half of a woman's patent application in municipality A and none of a woman's patent application in municipality B.

<sup>17</sup> To reduce the skewness of the patent data, we transform the number of patents. As our data contains observations with zero-patent values, we apply the inverse hyperbolic sine transformation. We run a robustness test with logged values (Table B1 in the Appendix) and a robustness test in which we use the patenting rate (i.e., the representation of the number of patents relative to 10,000 individuals in the workforce) (see Table B2 in the Appendix). Our main results remain robust to these alternative specifications.

Our patent sample includes all patents with at least one inventor to whom we can assign both a Swiss municipality and the gender. Moreover, it is restricted to patent applications filed between 2007 (the first year in the SLFS data) and 2019 (to allow for a time lag of three years for citations as our patent quality indicator, see Section 4.2.2). Therefore, the final patent sample that we use to calculate our innovation outcomes contains information on 64,524 patents. Overall, patent quantity in our sample per year and municipality equals 9.55, of which 0.82 are women’s patents. We illustrate the distribution of women’s patents (percentiles) across municipalities in Figure 4.

Figure 4: Women’s patent quantity across Swiss municipalities (2007-2019 average)



Notes: Authors’ illustration based on PATSTAT data. Figure shows the distribution of average women’s patent quantity between 2007 and 2019, with the color range indicating percentiles to emphasize differences across municipalities.

3.4 Control Variables

To account for the size of the local labor market we include the logged number of the local workers. Additionally, to account for men’s contribution to patenting, we control for STEM percentages among men (*PercMaleAcademicSTEM* and *PercMaleVETSTEM*). Furthermore, we control for local labor market characteristics following Schlegel et al. (2022).

Specifically, we include<sup>18</sup> control variables for (1) the level of education, i.e., the percentage of tertiary educated people in a municipality; (2) the unemployment rate in a municipality; (3) the percentage of non-Swiss citizens in a municipality; and (4) the age structure, i.e., the percentage of individuals between 20 to 64 and above 64, respectively. We also include firm structure, which is the number of firms and the high-tech intensity as the percentage of employees in high-tech industries.<sup>19</sup> Moreover, to account for time trends in patenting, we include year fixed effects.

### 3.5 Empirical Model

To test the hypothesized relationships between gender norms, occupational choices, and women's patent quantity, we adopt a structural equation modeling (SEM) approach. This approach allows us to model occupational choices as a mediator of the effect of gender norms on innovation, i.e., to examine the direct effect of gender norms on innovation as well as the indirect effect (via women's choices of STEM occupations (Gunzler et al., 2013; Sobel, 1987; Wang & Sobel, 2013)). We build the model according to the hypotheses derived in Section 2. Our equations are the following:

$$(3) \quad \begin{aligned} &PercWomenAcademicSTEM_{y,m} \\ &= \alpha_0 + \alpha_1 TraditionalGenderNorms_m + \alpha_3 X_{y,m} + \varepsilon_{y,m} \end{aligned}$$

$$(4) \quad \begin{aligned} &PercWomenVETSTEM_{y,m} \\ &= \beta_0 + \beta_1 TraditionalGenderNorms_m + \beta_3 X_{y,m} + \varepsilon_{y,m} \end{aligned}$$

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<sup>18</sup> In the estimations with occupational choices as outcome (i.e., percentage of women with academic STEM degrees and percentage of women with VET STEM degrees), we do not use control variables that are either not relevant (i.e., the number of firms, the size of the workforce, and year fixed effects) or directly related to education (i.e., percentage of men with academic STEM degrees and percentage of men with VET STEM degrees).

<sup>19</sup> For high-tech intensity, we follow the Swiss Federal Statistical Office (SFSO, 2024) definition of high-tech industries (at the 2-digit level according to the NOGA-08 general classification of economic activities) to calculate the percentage of high-tech employment at the municipality level. The following industries are aggregated to the high-tech sector: manufacture of chemicals and chemical products (NOGA-08 Code 20); manufacture of basic pharmaceutical products and pharmaceutical preparations (21); manufacture of computer, electronic and optical products (26); manufacture of electrical equipment (27); manufacture of machinery and equipment (28); manufacture of motor vehicles, trailers and semi-trailers (29). We do not include the industries 25 (manufacture of fabricated metal products) and 32 (other manufacturing) in our analyses as only subdivisions are classified as high-tech. However, our results hold if we run a robustness test with a broader high-tech definition (including the industries 25 and 32; results available upon request).

$$\begin{aligned}
(5) \quad & \text{WomensPatentQuantity}_{y,m} \\
& = \gamma_0 + \gamma_1 \text{TraditionalGenderNorms}_m \\
& + \gamma_2 \text{PercWomenAcademicSTEM}_{y,m} \\
& + \gamma_3 \text{PercWomenVETSTEM}_{y,m} + \gamma_4 X_{y,m} + \gamma_5 Z_{y,m} + \varepsilon_{y,m}
\end{aligned}$$

The subscripts  $y$  and  $m$  denote years and municipalities, respectively. The vectors  $X_{y,m}$  and  $Z_{y,m}$  contain the controls for labor market characteristics as outlined in Section 3.4.

To estimate this model, we use maximum likelihood estimations and cluster standard errors at the municipality level. In Equations (3) and (4),  $\alpha_1$  and  $\beta_1$  measure the effect of gender norms on women's choices of academic and VET STEM occupations, respectively. In Equation (5),  $\gamma_1$  measures the direct effect of gender norms on women's patent quantity. To calculate the indirect effect of gender norms via the percentage of women with academic STEM degrees, we multiply the estimated coefficients  $\hat{\alpha}_1$  and  $\hat{\gamma}_2$ . Similarly, to calculate the indirect effect of gender norms via the percentage of women with VET STEM degrees, we multiply  $\hat{\beta}_1$  and  $\hat{\gamma}_3$ .

In Section 4.3, we provide several robustness tests that support the specification of the model. Specifically, the inclusion confounding factors potentially determining gender norms, occupational choices, and innovation (sections 4.3.2 and 4.3.3) as well as the application of alternative measures for gender norms from later voting outcomes (section 4.3.1) support the assumption that gender norms are exogenously determined. Furthermore, robustness tests for the variable specifications (section 4.3.4) and choice of standard errors (section 4.3.5) support the specifications of the model.<sup>20</sup>

## 4. Results

### 4.1 Main Results

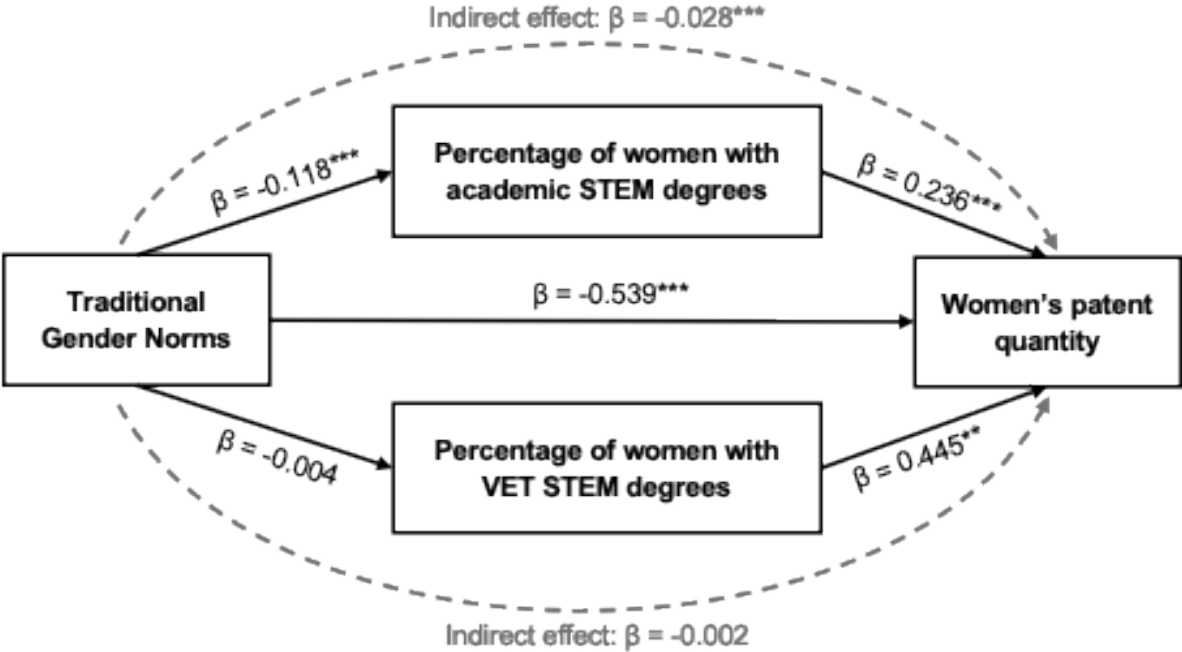
Figure 5 summarizes our results, with Table 2 reporting the coefficients, standard errors, and p-values of the structural relationships. The model's standardized root mean square residual (SRMR) equals 0.015, confirming that our model well represents the data (e.g., Ballen & Salehi, 2021; Hair et al., 2013; Hu & Bentler, 1999). The coefficient of determination (CD) equals 0.381. We find support for all our hypotheses except for hypothesis 2b. Supporting hypothesis 1, we find a negative direct effect of the strength of traditional gender norms in a municipality on women's patent quantity in that municipality; a one percentage point stronger traditional

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<sup>20</sup> In addition, tests for the linearity of the relationships by including squared terms of the main variables show small and insignificant coefficients, thus supporting a linearity assumption.

gender norm directly decreases women's patent quantity by 0.539%. Supporting hypothesis 2a, our results show that the strength of traditional gender norms also negatively affects the percentage of women with academic STEM degrees; a one percentage point stronger traditional gender norm directly decreases the percentage of women with academic STEM degrees by 0.118 percentage points. If we compare the highest disapproval rate of 71.5% (i.e., the municipality with the most traditional gender norms) with the lowest disapproval rate 11.5% (i.e., the municipality with the least traditional gender norms) in our sample, the estimated difference in the percentage of women in academic STEM is 7.080 percentage points. However, regarding hypothesis 2b, our results show that the effect of traditional gender norms on the percentage of women with VET STEM degrees, although negative as expected, is only small and statistically insignificant. Supporting hypotheses 3a and 3b our results show that both academic and VET STEM degrees strongly and positively affect women's patent quantity, i.e., the higher the percentage of women in academic STEM fields and in VET STEM fields in a municipality's workforce, the higher women's patent quantity in that municipality; an increase in the percentage of women with academic STEM degrees by one percentage point increases women's patent quantity by 0.236% and an increase in the percentage of women with VET STEM degrees by one percentage point increases women's patent quantity by 0.445%. These effects are quite substantial. For interpretation: a one standard deviation (SD) increase of women in academic STEM leads to an increase of 3.280% in women's patent quantity and a one SD increase of women in VET STEM to an increase of 2.136% in women's patent quantity. Thus, educational and occupational choices in both academic education and VET are important determinants of changes in gender-biased innovation outcomes.

Figure 5: Main direct and indirect effects of traditional gender norms on women’s patents



Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. (297 Municipalities). Solid arrows depict direct effects. Dotted lines depict indirect effects. Standard errors clustered at the municipality level. \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. SRMR=0.015, CD=0.381.

Table 2: Results of structural equation model

Path between variables (direct effects)		Estimates		
From	To	β	se	p-value
H1: Traditional Gender Norms	→ Women’s patent quantity	-0.539***	0.208	0.010
H2a: Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.027	0.000
H2b: Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.682
H3a: Women with academic STEM degrees	→ Women’s patent quantity	0.236***	0.072	0.001
H3b: Women with VET STEM degrees	→ Women’s patent quantity	0.445**	0.214	0.038

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. (297 Municipalities). Standard errors clustered at the municipality level. \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. SRMR=0.015, CD=0.381.

Based on the estimated effects for hypotheses 2 and 3, we can calculate the overall indirect effect of gender norms on women’s patent quantity via educational and occupational choices (dashed lines in Figure 5). Table 3 shows that this indirect effect is also negative and highly significant. A one percentage point stronger traditional gender norm in a municipality significantly decreases women’s patent quantity by 0.030%. This indirect effect is mostly driven by differences in academic educational choices (with a highly significant negative effect of 0.028%). The estimated effect for occupational choices in VET is also negative but much smaller and statistically insignificant (0.002%).

Table 3: Indirect effects

Indirect relationship	Estimates		
	$\beta$	se	p-value
Traditional Gender Norms → Women with academic STEM degrees → Women’s patent quantity	-0.028***	0.010	0.008
Traditional Gender Norms → Women with VET STEM degrees → Women’s patent quantity	-0.002	0.004	0.678
Total indirect effect from Traditional Gender Norms to Women’s patent quantity	-0.030**	0.012	0.010

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. (297 Municipalities). Standard errors clustered at the municipality level. \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01.

These results suggest that educational and occupational choices partially mediate the effect of gender norms on innovation, underlining the role of occupational choices in innovation activities and for reducing the innovation gender gap. Overall, the total effect of a one percentage point stronger traditional gender norms is a decrease of 0.569% in women’s patent quantity, i.e., the direct effect of 0.539% plus the indirect effect of 0.030%. If we compare the highest disapproval rate of 71.5% (i.e., the municipality with the most traditional gender norms) with the lowest disapproval rate 11.5% (i.e., the municipality with the least traditional gender norms) in our sample, the estimated difference in women’s patent quantity is 34.14%<sup>21</sup> which indicates a meaningful effect of gender norms on innovation outcomes. This total effect consists

<sup>21</sup> ((71.5-11.5)\*0.569)

of a direct and an indirect effect via educational and occupational choices, with the indirect effect accounting for 5.272% of the total effect of gender norms on women's patent quantity ( $0.030/(0.539+0.030)$ ). This is a sizeable share of the total effect, considering that gender norms can affect women's contribution to innovation through various channels beyond the educational and occupational choices (e.g., firm culture, childcare decisions, role models) as part of the estimated direct effect.

#### *4.2 Further Analyses*

To investigate whether an increase in women's patent quantity merely replaces men's patenting or increases the overall number of patents, we provide further analyses that use the total number of patents (from both male and female inventors) as an alternative outcome measure (total patent quantity). Moreover, to analyze whether the increase in women's patent quantity comes at the cost of reduced patent quality, we examine innovation quality measures. Finally, we apply the share of women's patents among all patents as a direct measure of the innovation gender gap.

##### *4.2.1 Effect on Total Patent Quantity*

To analyze whether more traditional gender norms also have a direct or indirect effect on total patent quantity, we use the total number of patents per year and municipality as an outcome. Figure B1 in the Appendix shows that a larger percentage of women in STEM (both academic and VET) also increases total patent quantity, i.e., not only women's patent quantity. The direct effect of a one SD increase in the percentage of women with academic STEM degrees (13.9 percentage points) is an increase of 3.3% in total patent quantity; the direct effect of a one SD increase in the percentage of women with VET STEM degrees (4.8 percentage points) is an increase of 4.9%. Thus an increase of the percentage of women in STEM does not lead to a replacement of men's patents by women's patents but generates an overall increase in patenting activities. Table 4 additionally depicts the standard errors and p-values. The upper panel of Table 4 presents the results of the direct relationships, showing that total patent quantity increases through more women with STEM degrees. The lower panel of Table 4 shows that the indirect effect of traditional gender norms on total patent quantity is significantly negative and thus similar to the indirect effect on women's patent quantity.

Table 4: Results of structural equation model on total patent quantity

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
Traditional Gender Norms	→ Total patent quantity	0.323	0.420	0.442
Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.027	0.000
Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.682
Women with academic STEM degrees	→ Total patent quantity	0.293*	0.151	0.052
Women with VET STEM degrees	→ Total patent quantity	1.013**	0.410	0.013
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Total patent quantity		-0.035*	0.021	0.098
Traditional Gender Norms → Women with VET STEM degrees → Total patent quantity		-0.004	0.010	0.680
Total indirect effect from Traditional Gender Norms to total patent quantity		-0.039*	0.023	0.090

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations (297 municipalities). Standard errors clustered at the municipality level. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . SRMR=0.015, CD=0.461.

#### 4.2.2 Patent Quality Measures as Additional Outcome Variables

To analyze whether the increase in patent quantity comes at the cost of reduced patent quality, we include three established quality indicators as additional proxies for innovation (e.g., Pfister et al., 2021; Squicciarini et al., 2013). First, we use citations, i.e., the number of patent citations three years after publication. Second, we use family size, i.e., the number of patents filed in different countries, related to each other by protecting the same invention. Third, we use claims, i.e., the number of priority claims per patent. For all three indicators, we use the fractionated average per municipality and year. Specifically, we fractionate the quality measure of each patent by the number of inventors. We then attribute each fraction to the municipality of the respective inventor and aggregate the quality measure at the municipality-year level.<sup>22</sup> We provide the descriptive statistics including the patent quality measures in Table A1 in the Appendix.

As with women's patent quantity, we find similar results for women's patent quality. Figure B2 in the Appendix and Table 5 report the results with the average number of citations per women's patent as the outcome. They show that weaker traditional gender norms increase the quality of women's patents: a one SD (12 percentage points) weaker traditional gender norm

<sup>22</sup> Consistent with patent quantity, we apply the inverse hyperbolic sine transformation for all quality measures.

in a municipality has a direct effect of increasing women’s patent quality by 6.4%. This finding implies that the additional quantity in women’s patents that we find in Section 4.1 does not come at the cost of lower quality as measured by the number of citations. The results are similar for the other quality measures (i.e., the family size and claims, results reported in Tables B3 and B4 in the Appendix). Thus weaker traditional gender norms are associated not only with women’s patent quantity but also with their quality. The effect results from a significant direct effect as well as from a partial indirect effect through occupational choices. The indirect effect accounts for 2.7% of the total effect of gender norms on women’s patent quality as measured by citations ( $0.015/(0.532+0.015)$ ). The direct effect of a one SD increase in the percentage of women with academic STEM degrees (13.9 percentage points) on women’s patent quality is 1.5%; the direct effect of a one SD increase in the percentage of women with VET STEM degrees (4.8 percentage points) is 2.2%.

Table 5: Results of structural model with women’s patent quality (citations)

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
Traditional Gender Norms	→ Women’s patent quality	-0.532***	0.141	0.000
Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.027	0.000
Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.682
Women with academic STEM degrees	→ Women’s patent quality	0.109**	0.055	0.047
Women with VET STEM degrees	→ Women’s patent quality	0.459**	0.204	0.024
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women’s patent quality		-0.013*	0.007	0.065
Traditional Gender Norms → Women with VET STEM degrees → Women’s patent quality		-0.002	0.005	0.683
Total indirect effect from Traditional Gender Norms to Women’s patent quality		-0.015*	0.008	0.075

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. (297 Municipalities). Standard errors clustered at the municipality level. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . SRMR=0.015, CD=0.128.

#### 4.2.3 Women’s Patent Share as Additional Outcome Variable

In an additional analysis, we use a direct measure of the innovation gender gap, instead of focusing on women’s patenting activities, as an alternative outcome variable. Specifically, we use the share of women’s patent quantity relative to total patent quantity to assess whether gender norms affect not only women’s patenting activities but also the relation between

women’s and men’s patenting activities. If gender norms affect men’s patent quantity similarly to women’s patent quantity, an increase in women’s patent quantity would not lead to a reduction of the gender innovation gap. Results using women’s patent share as outcome variable show that municipalities with less traditional gender norms indeed exhibit a lower innovation gender gap (Table 6). A one SD (12 percentage points) weaker traditional gender norm is associated with a 2 percentage points higher share of women’s patent quantity to total patent quantity. This result is economically significant given that the average ratio of women’s patents in our regression sample is 6.8%.

Table 6: Results with women’s patent share (women’s patent quantity/total patent quantity).

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
Traditional Gender Norms	→ Women’s patent share	-0.164***	0.060	0.006
Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.027	0.000
Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.682
Women with academic STEM degrees	→ Women’s patent share	0.075	0.050	0.132
Women with VET STEM degrees	→ Women’s patent share	0.043	0.066	0.516
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women’s patent share		-0.009	0.006	0.134
Traditional Gender Norms → Women with VET STEM degrees → Women’s patent share		-0.000	0.006	0.746
Total indirect effect from Traditional Gender Norms to Women’s patent share		-0.009	0.005	0.122

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations (in case of missing values due to 0 values in the denominator, we impute by the municipality average). Standard errors clustered at the municipality level. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . SRMR=0.015, CD=0.063.

### 4.3 Robustness Tests

#### 4.3.1 Persistence of Gender Norms and Robustness of Results to Alternative Measures of Gender Norms

To ensure our results are not reliant solely on the 1981 vote as a measure of gender norms, we follow prior work and test their robustness by incorporating more recent votes on other gender-related policy issues. Specifically, we follow Janssen et al. (2016), Kuhn & Wolter (2023), and Palffy et al. (2023a), but we consider in total more, i.e., six, subsequent voting outcomes: (1) a 1985 revision of the civil code on the marital law, (2) a 1999 amendment on

the introduction of paid maternity leave, (3) a 2000 constitutional amendment to ensure equal gender representation within government and public administrations, (4) a 2004 amendment on the introduction of paid maternity leave, (5) a 2013 constitutional amendment for improved childcare supply to promote a better work-family balance, and (6) a 2020 constitutional amendment to introduce a right to paternity-leave of two weeks in Switzerland. In addition, we (7) use the municipality-level average of all four voting outcomes as a further alternative measure that reduces the potential influence of outliers in single years. Palffy et al. (2023b) analyze the municipality-level correlations between the 1981 vote and three subsequent votes (2000, 2013, and 2020) in detail and find very high correlations, i.e., regional differences in gender norms hardly change over time. In Appendix Figure A3, we replicate Palffy et al.'s (2023b) analysis for the municipalities in our sample and for all six subsequent votes, finding similarly high correlations that support the stability of regional differences in gender norms over time.<sup>23</sup> Table A1 in the Appendix provides the summary statistics for the seven alternative measures.

Throughout all seven alternative voting outcomes (1985, 1999, 2000, 2004, 2013, 2020, and average), our main results on the effects of gender norms on occupational choices and women's participation in innovation remain stable (see Appendix Table B5). Thus our findings are independent of how we operationalize gender norms, and they implicitly confirm the long-term persistence of social gender norms.

#### *4.3.2 Robustness of Results to Regional Religious Heritage*

In our analysis of the effect of gender norms on women's participation in innovation, religious heritage (i.e., the share of Protestants in a region) may represent a potential omitted variable. As Protestantism may simultaneously affect both, innovation and gender norms (Becker et al., 2024; Bénabou et al., 2015; Feldmann, 2007), municipalities' Protestant heritage rather than gender norms might drive our results. Therefore, as an additional robustness test we include in our analysis the Protestant share of a municipality in 1980 (i.e., one year prior to the 1981 vote on gender equality, our proxy for regional gender norms). Indeed, we find a moderate positive correlation (0.196) between the Protestant share and the share of voters in favor of gender equality. However, when including the Protestant share as a control variable in our main estimation, we find that although it partly explains differences in women's patent quantity, the magnitude of the estimated direct effect of gender norms on women's participation in

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<sup>23</sup> See Palffy et al. (2023b, p. 386) for details on the methodology of this correlation analysis.

innovation decreases only slightly, from -0.539 to -0.490, and remains economically and statistically significant (Appendix Table B6). This robustness of our main results indicates that regional gender norms reflect more than just the Protestant heritage.

#### *4.3.3 Robustness of Results to Regional Innovation History*

Another potential omitted variable bias could arise from municipalities' innovation history. This history might be correlated to more recent innovation activities and, simultaneously, might have shaped gender norms, implying that current innovation outcomes would reflect historical innovation patterns rather than gender norms. Therefore, in an additional robustness test we include historical patenting as a control variable. Specifically, we include the historical patenting rate, i.e., the number of patents relative to the workforce in 1980, the first complete year in the EPO data preceding the measurement of gender norms in 1981. While historical patenting is positively related to later patenting of women (2007-2019), the estimated direct effect of gender norms on women's patent quantity decreases only slightly, from -0.539 to -0.448 (Appendix Table B7). Therefore, we conclude that innovation history does not predominantly drive the effect of regional gender norms on women's participation in innovation.

#### *4.3.4 Robustness of Results to Potential Outlier Observations*

To test the sensitivity of our results to outliers in our measure of educational choices, we perform two further robustness tests. As the percentage of women with academic STEM degrees takes the extreme value of 1 in some observations (23 out of 3,861 municipality-year observations), a value indicating that the entire academic workforce would consist of women with STEM degrees in a given year and municipality, we exclude such extreme outliers in robustness tests to ensure they are not the main drivers of our results.<sup>24</sup>

To do so, we (1) exclude all observations for which the percentage of women with academic STEM degrees lies in the top percentile of the distribution and (2) exclude the 10% smallest municipalities according to their population. Both robustness tests reveal very similar results to our original specification (see Appendix Tables B8 and B9). This finding clearly indicates that potential outlier observations do not drive our main results.

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<sup>24</sup> Although a value of 1 is unlikely in reality, it may empirically occur because the SLFS is only a random sample of the Swiss labor force (i.e., not the full population). Thus, in a given year, the SLFS sample may contain very few individuals per municipality (particularly in smaller municipalities). In such cases, a value of 1 can occur if the randomly sampled academic workforce consisted of only women with a STEM degree.

#### *4.3.5 Results with Bootstrapped Standard Errors*

To assess the reliability of our estimates, we rerun our main analysis with bootstrapped standard errors. Specifically, we apply municipality-level clustered nonparametric bootstrapping with 1,000 replications (e.g., Hayes, 2017; Mack et al., 2025). Our results remain robust, with only slight changes in the standard errors. We provide the results in Appendix Table B10.

### **5. Conclusion**

In this paper, we analyze whether and, if so, to what extent regional differences in social gender norms affect regional innovation outcomes. Particularly, we disentangle the direct effect from the indirect effect through educational and occupational choices. To do so, we combine three measures. First, we use municipality-level voting outcomes as a highly reliable measure for gender norms. Second, we calculate the percentages of women in a municipality's workforce with different types of educational degrees in STEM fields as a measure for educational and occupational choices. Third, we construct the quantity of women's patent applications as a measure for gender-biased patenting and innovation outcomes.

Applying structural equation modeling to municipality-level data from Switzerland, we find that in municipalities with weaker traditional gender norms, women's patent quantity is significantly higher. Specifically, a one percentage point weaker traditional gender norm has a direct effect of increasing women's patent quantity by 0.54%. For a one standard deviation weaker traditional gender norm in a municipality (equivalent to 12 percentage points), this direct effect corresponds to a 6.5% increase in women's patents in that municipality. To contextualize the size of this effect, empirical research on policies aimed at fostering (female) innovation yield similar effect sizes. For example, Giuri et al. (2020) found that organizational reforms at universities that introduced, e.g., transfer offices to support women's involvement in academic patenting by 6.9% to 13.6%. Similarly, Lim (2025) found that the adoption of paid family-leave policies led to an increase in firms' total patents by 7% to 10%, and Chen et al. (2018) found that a ten percentage-point higher fraction of female directors increases firms' total patents by 6%. In addition, studies investigating major educational reforms provide another contextualization. In Switzerland, the introduction of Universities of Applied Sciences—a major reform of the Swiss education system—increased regional patenting activity by 6.8% (Pfister et al., 2021). A similar effect size (about 7%) was found for a university expansion in Italy (Cowan & Zinovyeva, 2013).

In addition to the direct effect of 6.5% for a one standard deviation weaker traditional gender norm, we find an indirect effect of 0.36% through educational and occupational choices, meaning that 5.3% of the total effect of gender norms on women's patenting can be attributed to educational and occupational choices. This indirect effect size is also non-negligible, particularly given that educational and occupational choices are more malleable than gender norms and are thus easier to change by short and cost-effective information interventions, as for example shown by Palffy et al. (2023a). In addition, we also find economically relevant direct effects of occupational and educational choices on women's patent quantity, with a one standard deviation increase in the percentage of women in academic (VET) STEM associated with an increase in women's patent quantity of about 3.3% (2.1%). In light of these direct effects, policies to promote gender equality in occupational and educational choices can further reduce the innovation gender gap by counteracting other reasons than gender norms for gender differences in occupational and education choices as well.

In a further analysis, we assess whether women's patenting may simply substitute for men's patenting by analyzing the total number of patents as an alternative outcome. We find no evidence for such substitution because a larger percentage of women with STEM degrees also has a positive effect on the overall patenting activities in a municipality. Thus, substitution effects do not seem to drive our results. Furthermore, by using patent quality indicators as outcomes, we also show that the increase in patent quantity does not come at the cost of lower quality. On the contrary, weaker traditional gender norms in a municipality and higher percentages of women in STEM increase not only the quantity but also the quality of women's patents in that municipality. Using the share of women's among all patents as an alternative outcome that directly measures the innovation gender gap, we also find that municipalities with weaker traditional gender norms have a lower innovation gender gap.

In addition, we conduct robustness tests to investigate Protestant heritage and historical innovation patterns, two factors that previous literature has identified as potential drivers of both regional gender norms and women's participation in innovation, as potential omitted variables. As both factors only partly explain the estimated direct effect of regional gender norms on women's patent quantity, we conclude that they are not the predominant drivers of our main results. These findings strengthen a causal interpretation of our results.

Our study contributes to the literature on gender norms, education, and innovation in three ways. First, our paper is the first to disentangle the direct effects of gender norms on innovation from the indirect effects mediated by educational and occupational choices. Second,

our results confirm previous findings on the strong connection between STEM education—for both academic education and VET—and innovation. Third, we also confirm that regional differences in gender norms directly affect regional innovation, as measured by women’s patent quantity and quality.

Our results contribute to a broader understanding of the innovation gender gap and offer insights into the value of policy interventions aimed at promoting gender equality in education and innovation. We show that a sizeable part of the gender norm effect on innovation arises indirectly through the occupational choices of women (i.e., because they less frequently choose STEM fields in municipalities with stronger traditional gender norms). These findings underline the role of educational and occupational choices for innovation, and suggest that policy interventions aimed at promoting gender equality in education are not only important in and of themselves but will also be effective in narrowing the innovation gender gap. These insights are important because gender norms tend to be stable over time, as clearly demonstrated in both our own and several earlier analyses (e.g., Janssen et al., 2016; Palffy et al., 2023b), making them difficult to change in the short term. In contrast, as previous studies have shown (e.g., Palffy et al., 2023a), educational and occupational choices have a much higher potential for shorter-term changes. Firm initiatives aimed at increasing the visibility and attractiveness of STEM roles to women could complement such efforts (e.g., Baron et al., 2024). While we acknowledge that broader institutional interventions—such as quotas or affirmative-action policies—may also influence innovation outcomes, assessing their effectiveness lies beyond the scope of our analysis and would require different data and identification strategies. Nevertheless, our findings highlight an important channel—educational and occupational choices—through which gender norms affect innovation and where targeted interventions can have measurable impact. Our results are transferable to settings and countries where gender norms are to some extent traditional, with women underrepresented in STEM and thus in innovation. The implications of our results likely extend beyond patenting to other areas of innovation, such as academic publishing, where persistent and significant gender gaps remain (e.g., Hengel, 2022; Koffi, 2025; Mayer & Rathmann, 2018; Schmal et al., 2023; West et al., 2013).

Our study has several limitations that provide new avenues for future research. First, as our interest lies in analyzing codified innovation in STEM fields, we use patenting activities as a widely used proxy for regional innovation. However, we recognize that patents capture only one aspect of inventive behavior of firms and individuals. For example, although women are

underrepresented in patent-intensive STEM fields they might still select into inventive (but not patent-intensive) industries and occupations. Therefore, a valuable extension of our study would be an analysis of other inventive behavior and output such as copyright, trademarks, academic publishing, and R&D employment. Second, we do not assess the content of the patented invention (e.g., whether the inventions better address women's needs and interests). Future research could take into account the content of the patents by analyzing how gender norms affect the development of patents with gender-specific contents.

Third, based on prior evidence (Kuhn & Wolter, 2023; Palffy et al., 2023b) we consider individuals' choices of VET STEM occupations as supply-side driven. However, these choices could potentially also be demand-side driven, i.e., by firms' hiring decisions. While the estimated direct effect of gender norms on women's participation in innovation captures this potential demand-side mechanism, future research could more explicitly address the role of firms' hiring decisions in determining the innovation gender gap. Fourth, we analyze the composition of graduates in formal education at the municipality level. Therefore, to shed light on educational decisions and patenting activities at the individual rather than the municipality level, future research should draw on full individual inventor biographies that contain both formal and informal educational pathways and link these biographies with gender norms and patent data. Fifth, while we calculate the quantity of women's patents by the fraction of each patent that is attributed to a female inventor, we do not account for compositional effects of inventor teams. A potential extension to our study would be for future research to assess the effect of gender norms on the gender composition of inventor teams and the respective innovation outcomes. Such a team-level analysis could also offer valuable insights into whether weaker traditional gender norms increase women's patent quantity through fostering gender diversity in inventor teams or through promoting all-female inventor teams.

## Declaration of generative AI an AI-assisted technologies in the writing process

During the preparation of this work, the authors used *ChatGPT* in order to improve language and readability. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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## Appendix

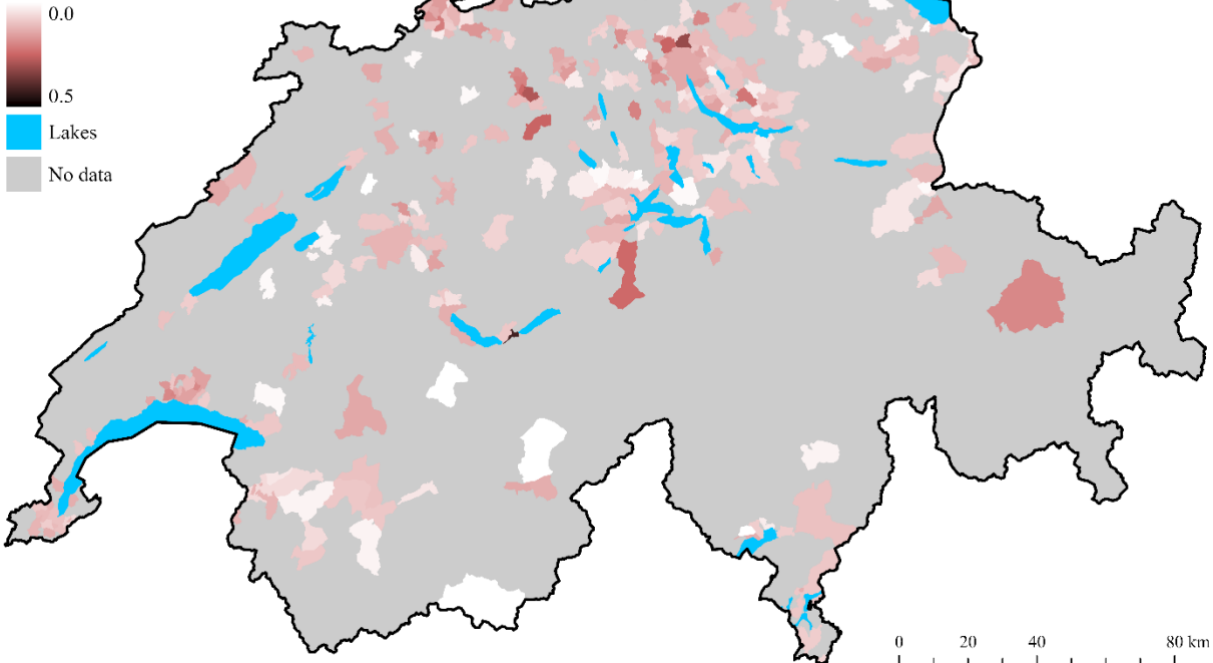
Table A1: Descriptive statistics including the patent quality measures & alternative votes

Municipality Level Variables	mean	sd	min	max
<i>Innovation Outcomes</i>				
Total patent quantity (per year and municipality)	9.547	25.934	0	391.837
Women's patent quantity (per year and municipality)	0.822	3.360	0	56.397
Total patent citations (per year and municipality)	0.682	0.787	0	19.444
Women's patent citations (per year and municipality)	0.408	1.053	0	19.000
Total patent family size (per year and municipality)	6.324	5.005	0	179.511
Women's patent family size (per year and municipality)	3.563	6.311	0	80.383
Total patent claims (per year and municipality)	0.758	0.502	0	17.140
Women's patent claims (per year and municipality)	0.379	0.666	0	10.939
<i>Gender Norms</i>				
Traditional Gender Norms (disapproval rate in the 1981 constitutional referendum)	0.400	0.120	0.115	0.715
Traditional Gender Norms (disapproval rate in the 1985 constitutional referendum) (N=3,822)	0.437	0.118	0.139	0.761
Traditional Gender Norms (disapproval rate in the 1999 constitutional referendum)	0.619	0.162	0.183	0.884
Traditional Gender Norms (disapproval rate in the 2000 constitutional referendum)	0.828	0.056	0.584	0.936
Traditional Gender Norms (disapproval rate in the 2004 constitutional referendum)	0.459	0.143	0.144	0.764
Traditional Gender Norms (disapproval rate in the 2013 constitutional referendum)	0.466	0.122	0.186	0.733
Traditional Gender Norms (disapproval rate in the 2020 constitutional referendum)	0.406	0.117	0.135	0.639
Traditional Gender Norms (average of 1981, 1985, 1999, 2000, 2004, 2013, 2022) (N=3,822)	0.515	0.112	0.248	0.761
<i>Occupational Choices</i>				
Percentage Women Academic STEM	0.100	0.139	0	1
Percentage Women VET STEM	0.056	0.048	0	0.429
Percentage Men Academic STEM	0.276	0.218	0	1
Percentage Men VET STEM	0.264	0.097	0	0.75

Notes: Authors' calculations of the descriptive statistics based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations (297 municipalities).

Figure A1: Percentage of women with academic STEM degrees across Swiss municipalities (2007-2019 average)

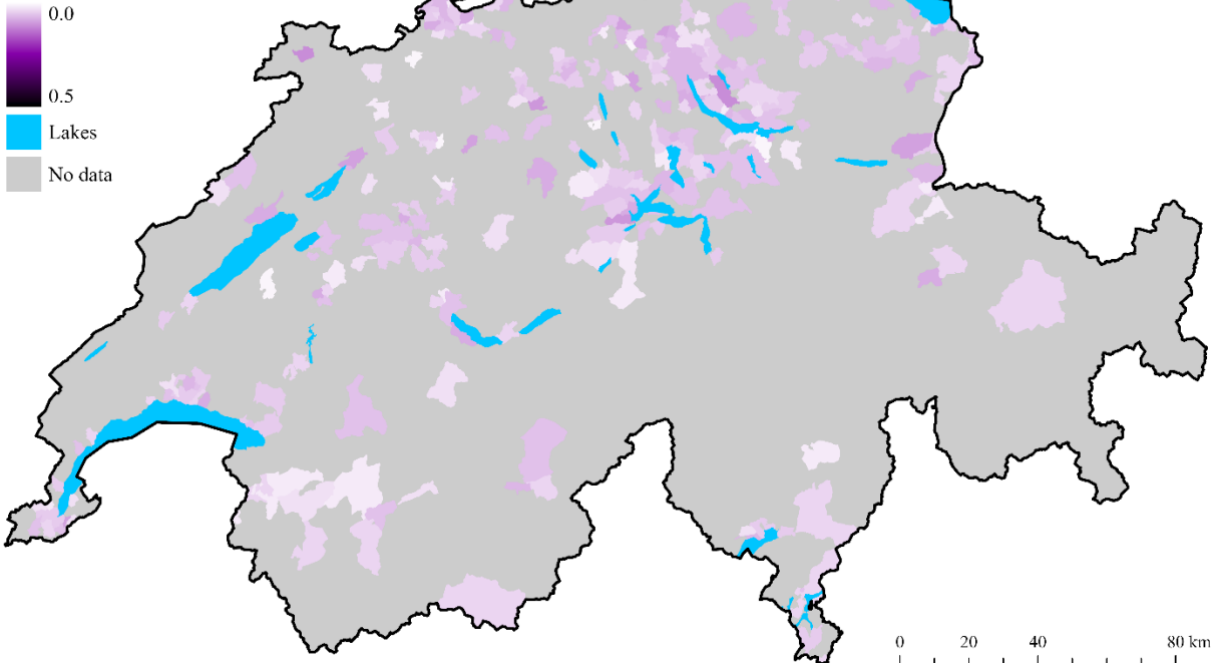
**Percentage of women with academic STEM degrees**



Notes: Authors' illustration based on the SLFS 2007-2019. Figure shows the average percentage of women with academic STEM degrees between 2007 and 2019 for the municipalities available in the SLFS data.

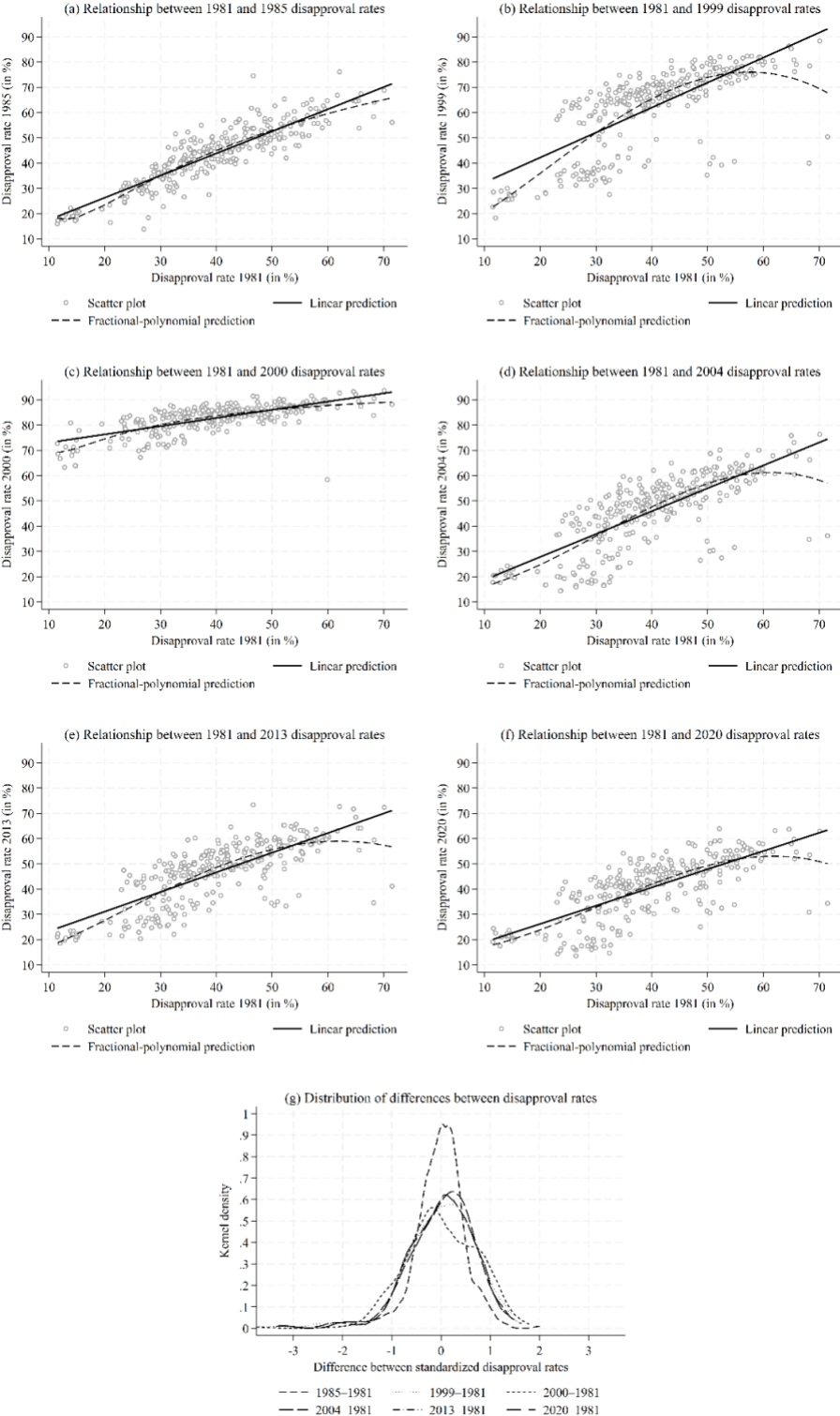
Figure A2: Percentage of women with VET STEM degrees across Swiss municipalities (2007-2019 average)

**Percentage of women with VET STEM degrees**



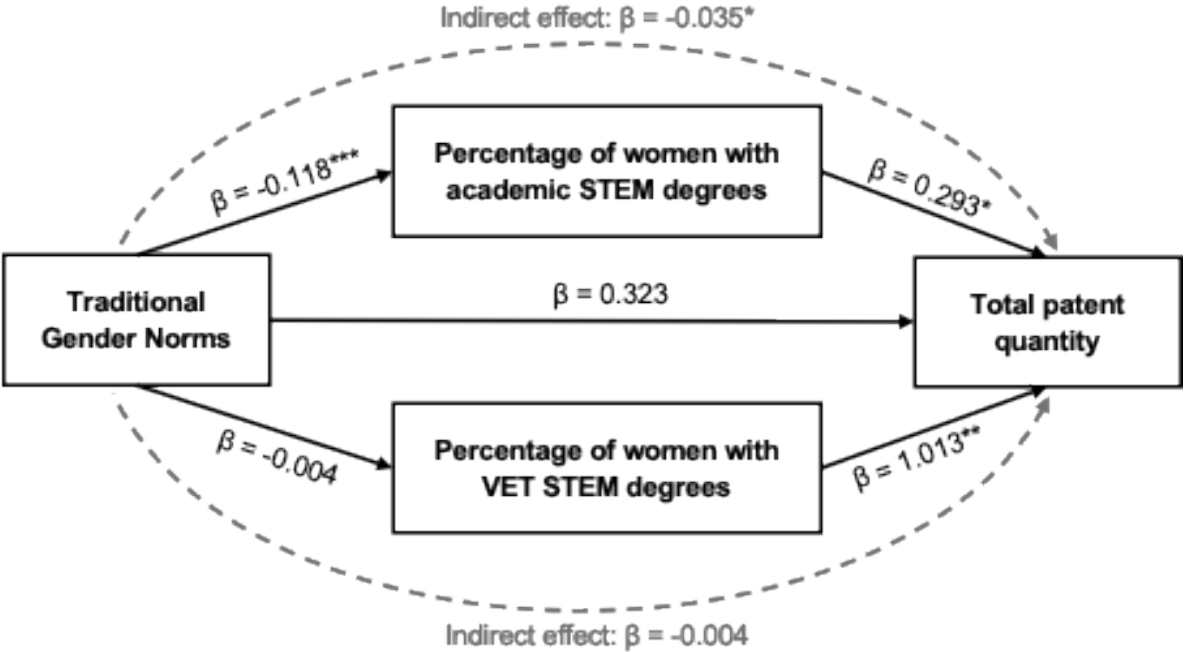
Notes: Authors' illustration based on the SLFS 2007-2019. Figure shows the average percentage of women with academic VET degrees between 2007 and 2019 for the municipalities available in the SLFS data.

Figure A3: Relationship between 1981 voting outcomes and later voting outcomes



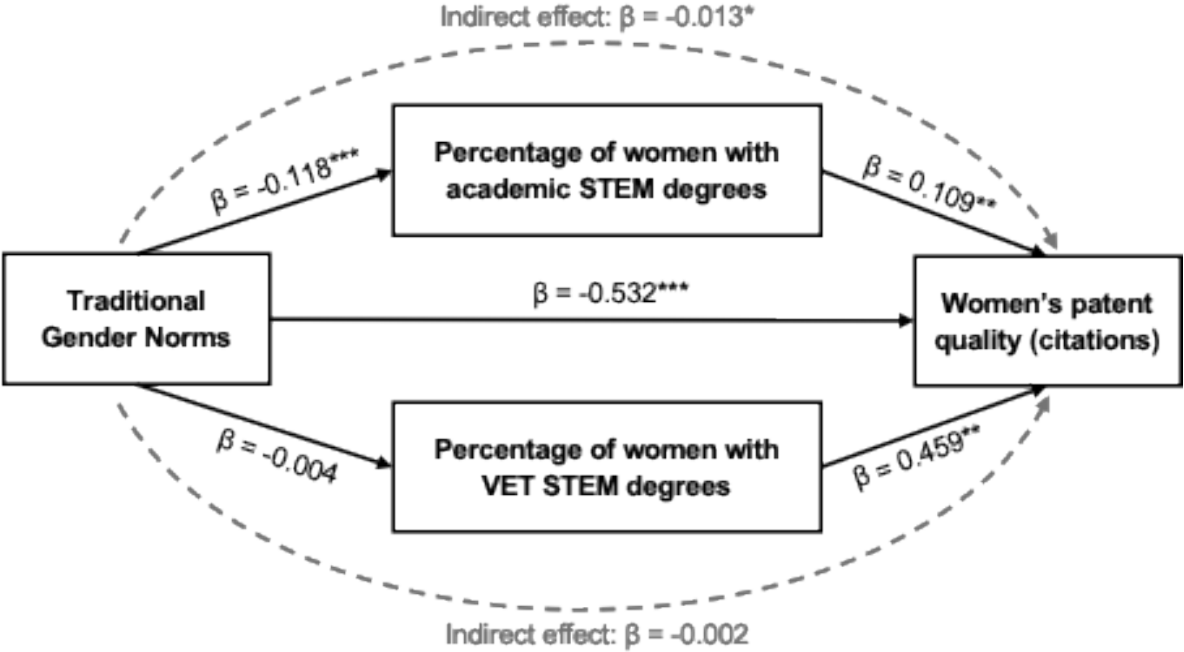
Notes: Authors’ calculations based on voting data from the Swiss Federal Statistical Office, representation based on Palffy et al. (2023, p. 408). One outlier observation of the standardized difference between the 2000 and 1981 disapproval rates lies outside the scale in panel (d). Analyses for the 1985 voting outcome include fewer observations due to data unavailability for three municipalities in our sample.

Figure B1: Results of direct and indirect effects of traditional gender norms on total patent quantity



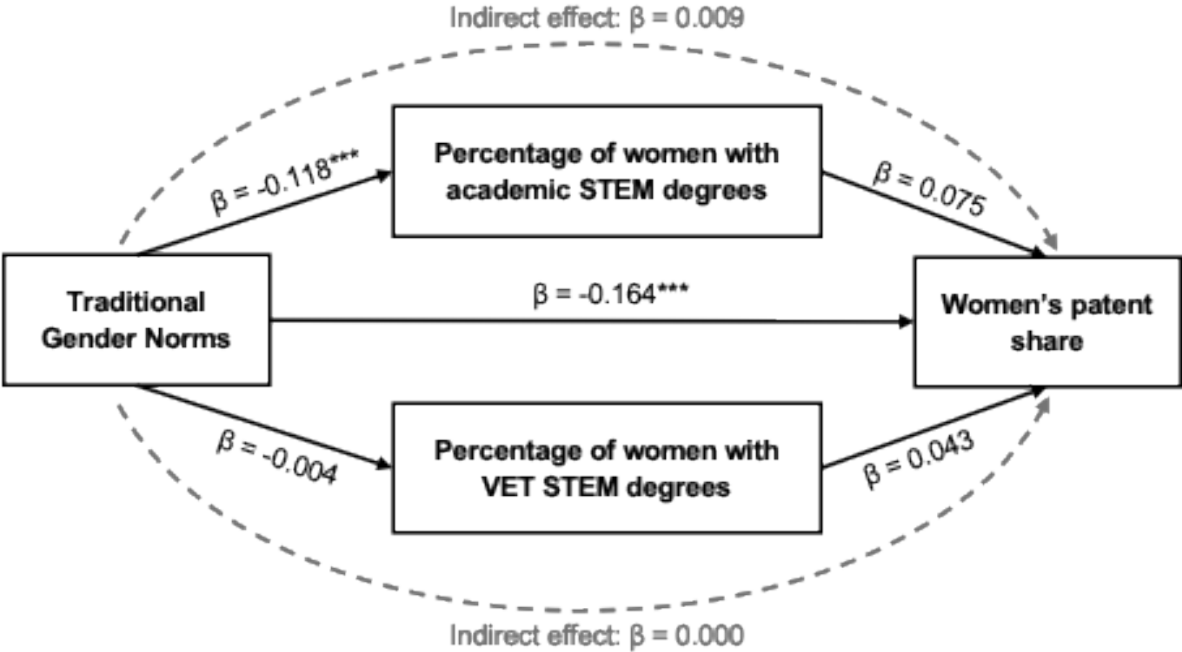
Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations (297 municipalities). Solid arrows depict direct effects. Dotted lines depict indirect effects. Standard errors clustered at the municipality level. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . SRMR=0.015, CD=0.461.

Figure B2: Direct and indirect effects of traditional gender norms on women’s patent quality (citations)



Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations (297 municipalities). Solid arrows depict direct effects. Dotted arrows depict indirect effects. Standard errors clustered at the municipality level. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . SRMR=0.015, CD=0.128.

Figure B3: Results with women’s patent share (women’s patent quantity/total patent quantity).



Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations (297 municipalities, in case of missing values due to 0 values in the denominator, we impute by the municipality average). Solid arrows depict direct effects. Dotted arrows depict indirect effects. Standard errors clustered at the municipality level. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . SRMR=0.015, CD=0.063.

Table B1: Results of structural model with ln(women's patent quantity + 1)

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
H1: Traditional Gender Norms	→ Women's patent quantity	-0.430***	0.164	0.009
H2a: Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.027	0.000
H2b: Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.682
H3a: Women with academic STEM degrees	→ Women's patent quantity	0.188***	0.057	0.001
H3b: Women with VET STEM degrees	→ Women's patent quantity	0.358**	0.167	0.032
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women's patent quantity		-0.022***	0.008	0.006
Traditional Gender Norms → Women with VET STEM degrees → Women's patent quantity		-0.001	0.004	0.678
Total indirect effect from Traditional Gender Norms to Women's patent quantity		-0.024**	0.010	0.009

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. (297 Municipalities). Standard errors clustered at the municipality level. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . SRMR=0.015, CD=0.388. Interpretation example: A one percentage point stronger traditional gender norm is associated with a 0.43% decrease in the number of women's patents.

Table B2: Results of structural model with women's patent rate

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
H1: Traditional Gender Norms	→ Women's patent quantity	-1.161**	0.568	0.047
H2a: Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.027	0.000
H2b: Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.682
H3a: Women with academic STEM degrees	→ Women's patent quantity	0.900***	0.266	0.001
H3b: Women with VET STEM degrees	→ Women's patent quantity	1.573**	0.794	0.047
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women's patent quantity		-0.106**	0.041	0.011
Traditional Gender Norms → Women with VET STEM degrees → Women's patent quantity		-0.007	0.016	0.677
Total indirect effect from Traditional Gender Norms to Women's patent quantity		-0.113**	0.045	0.014

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. (297 Municipalities). Standard errors clustered at the municipality level. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . SRMR=0.015, CD=0.064. Interpretation example: A one percentage point stronger traditional gender norm is associated with a direct decrease of 0.0116 women's patents per workforce of 10,000 individuals.

Table B3: Results of structural model with women's patent quality (patent family size)

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
Traditional Gender Norms	→ Women's patent quality	-1.512***	0.417	0.000
Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.027	0.000
Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.682
Women with academic STEM degrees	→ Women's patent quality	0.435***	0.166	0.009
Women with VET STEM degrees	→ Women's patent quality	0.967**	0.463	0.037
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women's patent quality		-0.051**	0.023	0.024
Traditional Gender Norms → Women with VET STEM degrees → Women's patent quality		-0.004	0.010	0.685
Total indirect effect from Traditional Gender Norms to Women's patent quality		-0.055**	0.024	0.023

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. (297 Municipalities). Standard errors clustered at the municipality level. \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. SRMR=0.015, CD=0.202.

Table B4: Results of structural model with women's patent quality (claims)

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
Traditional Gender Norms	→ Women's patent quality	-0.544***	0.130	0.000
Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.027	0.000
Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.682
Women with academic STEM degrees	→ Women's patent quality	0.141**	0.058	0.014
Women with VET STEM degrees	→ Women's patent quality	0.230	0.160	0.151
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women's patent quality		-0.017**	0.008	0.035
Traditional Gender Norms → Women with VET STEM degrees → Women's patent quality		-0.001	0.002	0.689
Total indirect effect from Traditional Gender Norms to Women's patent quality		-0.018**	0.008	0.029

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. (297 Municipalities). Standard errors clustered at the municipality level. \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. SRMR=0.015, CD=0.152.

Table B5: Results using alternative voting outcomes (1981, 1985, 1999, 2000, 2004, 2013, 2020)

Path between variables (direct effects)		Popular Vote							
From	To	1981	1985	1999	2000	2004	2013	2020	Average
H1: Traditional Gender Norms	→ Women's patent quantity	-0.539*** (0.208)	-0.556*** (0.208)	-0.423** (0.178)	-1.670*** (0.603)	-0.657*** (0.213)	-0.871*** (0.240)	-1.160*** (0.258)	-0.904*** (0.266)
H2a: Traditional Gender Norms	→ Women with academic STEM degrees	-0.118*** (0.027)	-0.086*** (0.028)	-0.052** (0.021)	-0.155*** (0.057)	-0.069*** (0.023)	-0.067** (0.029)	-0.090*** (0.029)	-0.099*** (0.030)
H2b: Traditional Gender Norms	→ Women with VET STEM degrees	-0.004 (0.010)	-0.009 (0.011)	0.005 (0.007)	-0.013 (0.021)	-0.001 (0.009)	-0.002 (0.010)	-0.006 (0.010)	-0.003 (0.011)
H3a: Women with academic STEM degrees	→ Women's patent quantity	0.236*** (0.072)	0.244*** (0.072)	0.247*** (0.072)	0.241*** (0.071)	0.239*** (0.071)	0.245*** (0.071)	0.230*** (0.069)	0.236*** (0.071)
H3b: Women with VET STEM degrees	→ Women's patent quantity	0.445** (0.214)	0.441** (0.215)	0.474** (0.214)	0.439** (0.215)	0.478** (0.214)	0.478** (0.214)	0.484** (0.213)	0.478** (0.215)
<b>Indirect relationships</b>									
Traditional Gender Norms → Women with ac. STEM degrees → Women's patent quantity		-0.028*** (0.010)	-0.021** (-0.010)	-0.013** (0.006)	-0.037** (0.018)	-0.017** (0.007)	-0.016* (0.009)	-0.021** (0.009)	-0.023** (0.010)
Traditional Gender Norms → Women with VET STEM degrees → Women's patent quantity		-0.002 (0.004)	-0.004 (0.005)	0.002 (0.004)	-0.006 (0.009)	-0.001 (0.004)	-0.001 (0.004)	-0.003 (0.005)	-0.002 0.005
Total indirect effect from Traditional Gender Norms to Women's patent quantity		-0.030** (0.012)	-0.025** (-0.011)	-0.011 (0.008)	-0.043** (0.020)	-0.017** (0.009)	-0.017** (0.010)	-0.024** (0.011)	-0.025** (0.012)
SRMR		0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
CD		0.381	0.379	0.379	0.383	0.384	0.386	0.394	0.385
Number of observations (year by municipality)		3,861	3,822	3,861	3,861	3,861	3,861	3,861	3,822

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. Results using 1985 and average voting outcome include fewer observations due to data unavailability for three municipalities in our sample. Standard errors clustered at the municipality level in parentheses.

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01.

Table B6: Results including Protestant heritage (1980) as control variable

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
H1: Traditional Gender Norms	→ Women's patent quantity	-0.490**	0.211	0.021
H2a: Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.027	0.000
H2b: Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.682
H3a: Women with academic STEM degrees	→ Women's patent quantity	0.222***	0.072	0.002
H3b: Women with VET STEM degrees	→ Women's patent quantity	0.429**	0.210	0.041
Control: Protestant heritage (1980)	→ Women's patent quantity	0.124	0.091	0.173
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women's patent quantity		-0.026**	0.010	0.011
Traditional Gender Norms → Women with VET STEM degrees → Women's patent quantity		-0.0021	0.004	0.678
Total indirect effect from Traditional Gender Norms to Women's patent quantity		-0.028**	0.011	0.014

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. Standard errors clustered at the municipality level. \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. SRMR=0.015, CD=0.383.

Table B7: Results including innovation history (1980) as control variable

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
H1: Traditional Gender Norms	→ Women's patent quantity	-0.448**	0.211	0.034
H2a: Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.027	0.000
H2b: Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.682
H3a: Women with academic STEM degrees	→ Women's patent quantity	0.227***	0.072	0.002
H3b: Women with VET STEM degrees	→ Women's patent quantity	0.427**	0.211	0.043
Control: Innovation history	→ Women's patent quantity	0.005**	0.002	0.021
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women's patent quantity		-0.027***	0.010	0.010
Traditional Gender Norms → Women with VET STEM degrees → Women's patent quantity		-0.002	0.004	0.678
Total indirect effect from Traditional Gender Norms to Women's patent quantity		-0.028**	0.011	0.012

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. Standard errors clustered at the municipality level. \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. SRMR=0.014, CD=0.385.

Table B8: Results excluding observations in the top percentile of “Percentage of women with academic STEM degrees”

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
H1: Traditional Gender Norms	→ Women’s patent quantity	-0.476**	0.212	0.025
H2a: Traditional Gender Norms	→ Women with academic STEM degrees	-0.151***	0.022	0.000
H2b: Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.688
H3a: Women with academic STEM degrees	→ Women’s patent quantity	0.321**	0.159	0.044
H3b: Women with VET STEM degrees	→ Women’s patent quantity	0.382*	0.229	0.096
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women’s patent quantity		-0.048*	0.025	0.054
Traditional Gender Norms → Women with VET STEM degrees → Women’s patent quantity		-0.002	0.004	0.687
Total indirect effect from Traditional Gender Norms to Women’s patent quantity		-0.050*	0.026	0.053

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,518 year by municipality observations. Standard errors clustered at the municipality level. \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. SRMR=0.022, CD=0.428.

Table B9: Results excluding the 10% smallest municipalities according to population size

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
H1: Traditional Gender Norms	→ Women’s patent quantity	-0.555**	0.224	0.013
H2a: Traditional Gender Norms	→ Women with academic STEM degrees	-0.113***	0.028	0.000
H2b: Traditional Gender Norms	→ Women with VET STEM degrees	-0.010	0.010	0.351
H3a: Women with academic STEM degrees	→ Women’s patent quantity	0.282***	0.084	0.001
H3b: Women with VET STEM degrees	→ Women’s patent quantity	0.497**	0.245	0.043
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women’s patent quantity		-0.032***	0.012	0.007
Traditional Gender Norms → Women with VET STEM degrees → Women’s patent quantity		-0.005	0.005	0.361
Total indirect effect from Traditional Gender Norms to Women’s patent quantity		-0.037***	0.013	0.006

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,474 year by municipality observations. Standard errors clustered at the municipality level. \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. SRMR=0.015, CD=0.387.

Table B10: Main results with bootstrapped standard errors (1,000 replications)

Path between variables (direct effects)		Estimates		
From	To	$\beta$	se	p-value
H1: Traditional Gender Norms	→ Women's patent quantity	-0.539***	0.209	0.010
H2a: Traditional Gender Norms	→ Women with academic STEM degrees	-0.118***	0.026	0.000
H2b: Traditional Gender Norms	→ Women with VET STEM degrees	-0.004	0.010	0.689
H3a: Women with academic STEM degrees	→ Women's patent quantity	0.236***	0.072	0.001
H3b: Women with VET STEM degrees	→ Women's patent quantity	0.445**	0.215	0.039
Indirect relationships		$\beta$	se	p-value
Traditional Gender Norms → Women with ac. STEM degrees → Women's patent quantity		-0.028***	0.010	0.006
Traditional Gender Norms → Women with VET STEM degrees → Women's patent quantity		-0.002	0.005	0.713
Total indirect effect from Traditional Gender Norms to Women's patent quantity		-0.030***	0.011	0.009

Notes: Based on PATSTAT data, voting data from the Swiss Federal Statistical Office and the SLFS 2007-2019. N=3,861 year by municipality observations. Bootstrapped standard errors (1,000 replications) clustered at the municipality level. \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01. SRMR=0.015, CD=0.387.