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Regional variation in participation in private tutoring and the role of education system features

Robin Benz [1]

Interfaculty Centre for Educational Research, University of Bern, Switzerland

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ABSTRACT

The use of private tutoring to enhance academic outcomes has proliferated across the globe over recent decades. Despite increased scholarly interest in these so-called shadow education activities, the understanding of how education system features relate to the prevalence of shadow education is relatively limited. Moreover, regional variation of private tutoring within countries remains largely overlooked. This study exploits the federalist structure of Switzerland's education system to investigate how education system features incentivise or discourage participation in private tutoring. Based on a subjective expected utility framework and drawing on data from two large-scale assessment studies, the analyses reveal a substantial regional variation in participation rates in private tutoring. Multilevel regression models provide evidence that the institutional modalities of selection into general secondary education contribute to this variation and the social inequalities in the use of private tutoring.

1. Introduction

School is not the only setting where learning takes place. Students may take part in a plethora of structured learning activities outside the formal education system. These activities are often referred to as *shadow education*, a term popularised by Stevenson and Baker (1992) since they mimic formal education and aim at improving a student's chance of successfully navigating their educational trajectory. Shadow education has seen a rapid expansion worldwide, making it one of the most evident trends in 21st-century education (Baker, 2020; Baker & LeTendre, 2005; Bray, 2021; Byun et al., 2018). The increased worldwide prevalence of shadow education raises fundamental questions regarding the state of public schooling. Some scholars argue that shadow education has beneficial implications. While it provides an opportunity for slow learners to keep up with their peers, the increased competition by private supplementary education providers may strengthen teachers' intentions to improve the quality of instruction in public schools (Bray, 1999). Others see the rise of shadow education as a potential threat to educational equity since private investments in shadow education may perpetuate existing inequalities between low-achieving and high-achieving students and between poorly-resourced and well-resourced households (Grodsky, 2010; Mori & Baker, 2010). Especially if the use of shadow education is indeed related to gains in educational achievement – a highly researched yet contentious issue (e.g., Choi & Park, 2016; Guill et al., 2022; Ömeroğulları et al., 2020; Wiseman, 2021) – this raises equity-related concerns. After all, it is a widely established finding that participation rates in shadow education differ along the axes of social origin, migration background and gender (Jansen et al., 2023; Luo & Chan, 2022).

Private tutoring is among the most widespread forms of shadow education. The use of private tutoring has received great attention in both country-specific and comparative research over recent years. While several studies examine which families invest in private tutoring (e.g., C. Buchmann et al., 2010; Entrich, 2020; Kosunen et al., 2021), others shed light on potential links between the prevalence of shadow education in a country and institutional features (e.g., Guill & Lintorf, 2019; Zwier et al., 2020). Within this emerging strand of research, two issues remain largely overlooked. First, as most studies examine the use of private tutoring at the country level, potential within-country variation is neglected. The few existing studies that address the possibility of regional disparities in shadow education activities (Guill & Lintorf, 2019; Matsuoka, 2018) reveal that the country may not be the only appropriate level of aggregation when studying the uptake of private tutoring. Second, cross-country studies on the role of education system features risk shortcomings regarding conceptual equivalence since shadow education may be understood and functions differently across

E-mail address: robin.benz@unibe.ch.
[1] ORCID: 0000–0002-3930–0217

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educational contexts (Bray & Kobakhidze, 2014; Wiseman et al., 2014).

By exploiting the federalist structure of Switzerland's education system, the present study seeks to address both issues and examines the use of private tutoring among Switzerland's subnational units, the 26 cantons. Switzerland offers an unparalleled degree of heterogeneity in education policy. Despite persistent efforts to harmonise cantonal school systems, the cantons retain extensive jurisdiction over education policy in compulsory education and the general education branch at the upper secondary level (Combet, 2019; Felouzis & Charmillot, 2013; Stadelmann-Steffen, 2012).

Based on a subjective expected utility (SEU) framework, this study investigates how differing education system features in Swiss cantons incentivise or discourage investments in private tutoring in the run-up of two critical educational transitions. Using data from Switzerland's large-scale assessment study, COFO, the analyses reveal a substantial regional variation in participation rates in private tutoring. Multilevel regression models provide evidence that education system features – specifically the modalities of selection into the academic path of secondary education – contribute to this variation. At the same time, the incentive structure induced by education system features contributes to social inequality in the use of private tutoring, although to a limited extent.

The following section summarises the state of the research and establishes a theoretical framework. The third section provides information on the data, measures, and methods used. After presenting the results in the fourth section, concluding remarks reflect upon the implications of the findings and identify potential limitations of this study.

2. Background

2.1. Concept and prevalence of private tutoring

Following the definition of Bray's (1999) seminal study, private tutoring is defined by three characteristics. First, it is characterised by its *privateness*. Privateness means that learning units are offered in exchange for a fee, in contrast to, for instance, unpaid informal tutoring by significant others or free-of-charge remedial lessons offered by (public) schools. Second, private tutoring is *supplemental*, as it addresses learning contents covered in school. Consequently, attending courses on skills not taught in school does not fall under the definition of private tutoring. Third, private tutoring is *academic*, thus excluding lessons on subjects or skills that are not part of the examination procedures in formal education (Bray, 1999; Zhang & Bray, 2020).

Yet, the term' private tutoring' is often non-trivial since it is marked by ambiguities coupled with overlapping related concepts. Especially in cross-national studies such as PISA or TIMMS, there is leeway for semantic misunderstandings of the concept. The room for ambiguity is amplified by inconsistencies in survey item translations across different cultural environments and disparities in question wording across commonly considered data sources and survey waves (Bray et al., 2020; Bray & Kobakhidze, 2014). In addition, participation in private tutoring is frequently subsumed under related – but also extending beyond – concepts, such as *outside-school time* (e.g., Suter, 2019) or *extended education* (e.g., Stecher, 2019). These issues create complexities for analyses on private tutoring, leaving the cross-country comparability of findings not always ensured.

Private tutoring not only takes place in different forms but also serves different purposes. Previous research consistently shows that most students receive private tutoring in mathematics, whereas demand is lower for tutoring in languages or science (e.g., Baker et al., 2001; Guill et al., 2020). Moreover, students may take up private tutoring either for remedial purposes to keep up with their peers or for enrichment purposes to further exceed their peers (Lee et al., 2009; Park et al., 2016). Overall, most private tutoring serves remedial purposes (Baker et al., 2001), although tutoring for enrichment purposes is more common in some Far Eastern countries such as South Korea or China (e.g., Byun et al., 2018; Zhang & Bray, 2017).

Participation in private tutoring has proliferated across the globe over recent years. What was initially considered a "cultural oddity" of Far Eastern education systems (Baker, 2020, p. 311) is now an increasingly widespread phenomenon. It is estimated that approximately one in three 15-year-old students in the more than 60 countries covered in the 2012 PISA study use some form of private tutoring (Byun et al., 2018; Zwier et al., 2020). In European countries, the share of students participating in private tutoring has increased substantially over the recent two decades (Baker & LeTendre, 2005; Bray, 2021). In Switzerland, Hof and Wolter (2014) reported, based on PISA 2012 data, that 34 % of Swiss students use private tutoring in ninth grade, which corresponds to a ten percentage point increase compared to 2009. Evidence from the Canton of Ticino showed that 30 % of students in upper secondary school had taken private remedial lessons (Zanolla, 2013). With a participation rate of around 17 %, private tutoring is less common in Swiss primary schools (Grunder et al., 2013).

2.2. Factors related to participation in private tutoring

Several recent studies have examined which student and family background characteristics are related to the uptake of private tutoring. Given that shadow education predominantly serves remedial purposes, it is not surprising that many studies find a strong negative relationship between academic performance in school and participation in private tutoring. Accordingly, high-achieving students are less likely to participate in private tutoring (Baker et al., 2001; Byun et al., 2018; Entrich & Lauterbach, 2020; Luplow & Schneider, 2014).

Concerning demographic characteristics, it is widely established across different cultural contexts that students from higher socioeconomic backgrounds participate more often in private tutoring than students from lower socioeconomic backgrounds (Byun et al., 2018; Entrich, 2020; Jansen et al., 2023). Three explanations for this finding are frequently put forward. First, affluent families are more able to meet the costs of private tutoring, whereas the fees to be paid may restrict participation among low socioeconomic status (SES) families. Second, high-SES parents may facilitate their child's participation in private tutoring because they are better informed about the education system and exhibit more intensive involvement in their child's education. Third, some authors characterise engagement in shadow education activities as a means for status maintenance – a strategy more often pursued by high-SES families (Entrich & Lauterbach, 2020; Jansen et al., 2023; Park et al., 2016).

Questions about how education systems shape the demand for paid private tutoring only recently came into consideration (Luo & Chan, 2022). Based on comparative cross-country analyses, several scholars argue that shadow education is more prevalent in highly selective and competitive educational contexts. It has been repeatedly proposed that high-stakes testing acts as an important driver behind private tutoring (Baker et al., 2001; C. Buchmann et al., 2010; Zwier et al., 2020). High-stakes tests are standardised and most often centrally administered examinations, and the test results have far-reaching consequences for test takers' educational opportunities. High-stakes testing is likely to fuel competition among test takers and, in turn, the demand for shadow education to improve one's chances of success. However, the empirical evidence for this claim remains inconclusive. Some country-specific analyses find empirical support for high-stakes testing being related to higher participation in private tutoring. For instance, Kosunen and colleagues (2021) show with data from Finland that attending paid preparatory courses is more common in study fields with highly competitive entrance exams and that students from higher SES participate in these courses more often. Similarly, Guill and Lintorf (2019) find evidence that private tutoring is more common in German federal states whose modalities of entering secondary education resemble high-stakes testing. In contrast, recent comparative studies find, at best, only limited support for the relationship between high-stakes testing and the prevalence of private tutoring. While Zwier and colleagues (2020), using PISA

2012 data considering 54 countries, find no global effect of high-stakes testing on take-up of shadow education, the authors provide evidence that the well-established relationship between SES and shadow education use is more pronounced in countries with widespread high-stakes testing. Another study by Entrich (2020) also finds no support for a direct relationship between high-stakes testing and the prevalence of private tutoring. Although acknowledging the presumed relevance of high-stakes testing, the author concludes that using a crude binary indicator in a comparative cross-country setting may not fully capture the heterogeneity of high-stakes testing across different countries.

The degree of an education system's selectivity that might motivate certain families to invest in shadow education for their children may also arise from tracking into different, hierarchically structured school types at the secondary level. Whilst a large body of research debates the various implications of tracking on educational behaviour (e.g., Hanushek & Wößmann, 2006; Van De Werfhorst & Mijs, 2010), surprisingly little attention is paid to the effects of tracking on the use of private tutoring. Entrich (2020) and Zwier and colleagues (2020) present findings that private tutoring is more widespread in highly stratified education systems. Evidence for lower secondary education in Germany (Entrich & Lauterbach, 2020; Lorenz & Stubbe, 2020) and Switzerland (Hof & Wolter, 2012, 2014) suggests that students in academic tracks use private tutoring more often than students attending tracks leading to vocational education. Comparative cross-country studies observe similar results (Byun et al., 2018; Entrich, 2020). These findings, incidentally, contradict Betts' (2011) assumption of a substitution effect, according to which parents would reduce investments in private supplemental education once their child attends the most demanding educational track. Yet, as demonstrated by Bol and colleagues (2014), the role of tracking on the use of private tutoring may be attenuated in education systems with high-stakes exams, underlining the need of considering different education system features jointly.

Smyth (2009) outlines an alternative explanation for disparities between different groups of students in terms of participation in private tutoring: since high-SES students tend to enter academically more demanding school types, "the interaction between social class mix and expectational climate may result in a 'hot house' effect with students feeling under pressure to excel academically" (ibid.: 19). Consequently, if some students in such educational contexts take up private tutoring, this might induce a self-reinforcing process that puts peers under pressure to imitate this behaviour. A study using data from Japan tests this assumption and finds that students in schools with a more affluent student body are more likely to use private tutoring and that this relationship is even more pronounced among high-SES students (Matsuoka, 2015). In a similar vein, findings from China (Pan et al., 2022) and South Korea (T. Kim et al., 2022) indicate that the degree of in-school peers' engagement in private tutoring is positively related to students' propensity to participate in private tutoring. Building on this literature, one recent study extends this view by suggesting processes of social contagion within neighbourhoods. Specifically, SES aggregated on the neighbourhood level appears to have a positive and independent impact on using private tutoring (Matsuoka, 2018). This is in line with a consistent finding from previous studies suggesting that students living in urban areas show higher participation rates in private tutoring than students living in rural areas (Byun et al., 2018; Hof & Wolter, 2014).

In summary, previous research characterises private tutoring as a worldwide phenomenon of increasing relevance for students and the education system as a whole. While there are robust findings on how individual-level characteristics, most notably socioeconomic background, shape demand for private tutoring, evidence on the effects of school system characteristics remains relatively sparse and inconclusive. With few exceptions (Guill & Lintorf, 2019; Matsuoka, 2018), research on private tutoring ignores regional variability. Assuming countries as monolithic regarding the prevalence of shadow education might obfuscate substantial within-country disparities and, thus, hinders a more profound understanding of factors influencing participation in these activities. The possibility of keeping overarching societal and cultural characteristics constant and instead focusing on regionally differing education system features may offer fruitful insights regardless of cultural idiosyncrasies.

2.3. Private tutoring as rational investments

This study draws on rational choice theory (RCT) to explain the demand for private tutoring and why this demand might differ across the different institutional arrangements of Swiss cantons. In its classical conceptualisation, RCT assumes that individuals are informed and forward-looking decision-makers determined to maximise utility while considering the costs and benefits of their educational decisions. Applied to shadow education, RCT suggests that students and their parents only invest in private tutoring if the benefits exceed the costs. In light of well-understood socioeconomic gradients in educational decision-making (Boudon, 1974; Breen & Goldthorpe, 1997; Erikson & Jonsson, 1996), meaningful adaptions of classical RCT have been brought forth. In particular, Esser (1999) suggested a model based on subjective expected utility theory (SEU). The SEU model stresses that educational decisions are based on educational motivation while considering investment risk. Educational motivation resembles subjectively expected educational returns and the imminent risk of status demotion due to decisions which do not preserve the initial social status. Investment risk refers to the direct and indirect costs weighted by an actor's degree of uncertainty concerning educational success (Becker, 2003; Esser, 1999).

Given are two alternatives that students and their parents face regarding an investment in private tutoring: either investing in private tutoring (PT) or not ($\neg PT$). The subjective expected utility SEU comprises the consequences of each alternative. On the one hand, this includes the educational benefits B, namely access to selective areas in the education system, academic credentials or later labour market outcomes. On the other hand, SEU is determined by the expected indirect and direct costs C and the amount of status demotion $-SD$. Individuals calculate their SEU by considering the expected probability of a beneficial investment in private tutoring P and the expected probability of status demotion in case of a suboptimal decision Q.

Taken together, the SEU of investing or not investing in private tutoring will be:

$$SEU(\neg PT) = Q \times -SD$$

$$SEU(PT) = P \times B + (1-P) \times Q \times -SD - C$$

The model proposes that individuals invest in private tutoring only if the SEU of participating in private tutoring exceeds the SEU of not participating in private tutoring:

$$SEU(PT) > SEU(\neg PT)$$

$$P \times B + (1-P) \times Q \times -SD - C > Q \times -SD$$

By mathematical transformation, this can be simplified to:

$$B + Q \times -SD > C/P$$

with $B + Q \times -SD$ resembling the educational motivation and C/P the investment risk.

In light of the diversity in terms of providers (e.g., professional learning centres, teachers, older students) and settings (e.g., one-to-one lessons, group lessons, exam preparation courses, online tutoring), this study cannot draw on reliable information about the direct costs of private tutoring. While regional variation in pricing is plausible, vast differences across Swiss cantons are unlikely. This study, therefore, assumes that the direct costs of private tutoring are constant across the cantons of Switzerland. Hence, the investment risk is primarily driven by the expected probability that the investment in private tutoring is beneficial.

Although families invest in private tutoring for different reasons – be it for remedial or enrichment purposes (Byun et al., 2018; Lee et al., 2009; Park et al., 2016) – they do so with the same objective: improving the child's academic performance. If a student already performs well in school, there is little room for improvement. This implies that the investment risk is higher for high-achieving students. High-achieving students are therefore expected to be less likely to partake in private tutoring.

Concerning the expected amount of status demotion for suboptimal educational choices, the motive of intergenerational status maintenance is a decisive factor (Becker & Hecken, 2009; Breen & Goldthorpe, 1997; Entrich & Lauterbach, 2020; Van De Werfhorst & Hofstede, 2007). Although all families are equally concerned with the desire to avoid downward social mobility, families from high social strata require distinct actions, such as greater investments in education, to ensure status maintenance. With access to more selective areas of the education system being a hallmark for ensuring privileged positions in society, investments in private tutoring is a more appealing strategy for high-SES families. In addition, perceptions of benefits and costs may vary among social groups. As Boudon (1974) argues, families from low social strata both overestimate the actual costs and underestimate the actual benefits of investments in education. Consequently, children from privileged socioeconomic backgrounds should be more likely to participate in private tutoring.

Esser's (1999) model further postulates that the *SEU* of investing in private tutoring should be highest when a low investment risk coincides with a high educational motivation. Provided that the investment risk is lower when students perform subpar in school and that high-SES students exhibit a higher educational motivation due to their increased amount of status demotion in case of a suboptimal decision, low-achieving high-SES students are expected to be even more likely to invest in private tutoring than low-achieving low-SES students.

Apart from motives of intergenerational status maintenance, educational motivation is affected by perceptions of educational benefits, which likely depend on the academic goals students pursue and the extent to which investing in private tutoring helps students to reach these goals. In the Swiss context portrayed here, as in other countries, later life outcomes are highest among university graduates (Falcon, 2020; Korber & Oesch, 2019). Therefore, students geared towards entering higher education – such as those pursuing general rather than vocational education – should perceive the benefits of private tutoring as higher. Since previous research (e.g., Becker & Hecken, 2009; M. Buchmann et al., 2016) has repeatedly shown that educational preferences vary – among other factors – by gender, migration background and prior educational experiences, considering these sources of variation in an empirical application of the SEU model is vital.

2.4. The role of education system features

Education system features may affect families' rational decision-making by creating or removing incentives for investing in private tutoring. The Swiss education system provides a promising case for examining this claim due to its unparalleled degree of institutional heterogeneity among its subnational units, the cantons. Switzerland's education system is generally characterised by high stratification and extensive tracking (M. Buchmann et al., 2016). Usually, following kindergarten and six years of primary education, students are divided into school types with differing ability requirements in lower secondary education.[2] At the upper secondary level, one main characteristic is the differentiation between vocational education and training (VET), which about two-thirds of students enter, and general education, which grants access to universities (FSO, 2020; SCCRE, 2018). While the Swiss cantons are obliged to cooperate in certain areas, they retain a significant degree of autonomy regarding the organisation of compulsory education (Combet, 2019; Felouzis & Charmillot, 2013; Stadelmann-Steffen, 2012). The institutional heterogeneity is particularly apparent regarding the modalities of transitioning from primary education to lower secondary education and from lower secondary education to upper secondary education (see Table 1).

The first notable feature that differs between cantons concerns the selection method for general education. How students are allocated to the different educational tracks affects the strategic behaviour of students and their parents to ensure desired track placement. The most prominent criterion of track allocation into general education is school performance indicated by final grades and often coupled with binding teacher recommendations. In contrast, in some cantons, admission to general education depends on a student's results in standardised entrance exams. While overall performance in school is relatively stable over time (e.g., Helbling et al., 2019) and can be managed continuously, taking a one-off high-stakes entrance exam is associated with a higher degree of uncertainty, thus increasing the risk of status demotion (*Q*) when families opt against investing in private tutoring. Yet, as the content of these entrance exams is predictable due to their standardisation, cantonal education systems carrying out these exams create an incentive to enrol in private tutoring, mainly in form of exam preparation courses. More formally, private tutoring in preparation for standardised entrance exams should hold a superior probability of being a beneficial investment (*P*).

A second feature that varies substantially between cantons is the degree of inclusiveness of general education. According to Gamoran (1992), who coined the term, a tracked education system is more inclusive if it assigns relatively more students to tracks that grant university entry certificates upon completion. The share of students attaining a university entry certificate (Gymnasiale Maturität), the so-called baccalaureate rate, varies from 12.5 % in Glarus to 34.2 % in Geneva (FSO, 2020). These persistent differences in inclusiveness between cantons cannot be explained by cantonal differences in achievement (SCCRE, 2018) but rather stem from the number of places in schools of the general education track (Leemann et al., 2022). At least in the medium term, the supply of places in general education is fixed, making admission to general education less dependent on actual performance but rather on the relative position in the performance distribution. From an SEU perspective, a negative relationship between the degree of inclusiveness and participation rates in private tutoring is expected. Cantons with a low degree of inclusiveness may incentivise investments in private tutoring as there is fiercer competition for a limited number of places in general education, which ultimately drives the perception of private tutoring being beneficial (*P*) as it may serve as a means to ensure a comparative advantage over those who do not invest in private tutoring. At the same time, the prospect of status demotion of not attending general education due to the missed benefits private tutoring could have yielded (*Q*) may be more urging in cantonal education systems characterised by a low degree of inclusiveness.

The third notable difference between cantons relates to the timing of tracking into general education. In Switzerland, the transition into lower secondary education occurs after six years of primary school. At this

[2] Cantons employ different models of lower secondary education. Most cantons opt for a streamed model, in which students are divided into two to four school types with differing ability requirements based on their achievement at the end of primary education. Other cantons rely on forms of subject-specific ability grouping within schools rather than different school types (EDK-IDES, 2016, 2017; SCCRE, 2018).

Table 1
Characteristics of cantonal education systems.

Canton	Selection method for general education at the end of primary education: Entrance exam[1]	Selection method for general education at the end of lower secondary education: Entrance exam[1]	Baccalaureate rate: Inclusiveness of general education[2]	Timing of tracking into general education: Early tracking[3]	Gross cantonal product per capita (in Swiss Francs)[4]	Cantonal graduate population[4]	N: COFO 2016	N: COFO 2017
Aargau (AG)	No	No	16.6 %	No	61689	23.0 %	1108	855
Appenzell Ausserrhoden (AR)	No	Yes	16.4 %	No	56527	26.3 %	474	415
Appenzell Innerrhoden (AI)	Yes	No	19.4 %	Yes	61570	32.4 %	202	133
Basel-Landschaft (BL)	No	No	23.1 %	No	68730	30.6 %	703	818
Basel-Stadt (BS)	No	No	29.7 %	No	168891	24.2 %	607	565
Bern (BE)	No	No	18.5 %	No	76897	24.0 %	1827	1408
Fribourg (FR)	No	No	22.1 %	No	59407	30.2 %	1444	1399
Geneva (GE)	No	No	34.2 %	No	98436	28.6 %	653	852
Glarus (GL)	Yes	Yes	12.5 %	Yes	68116	25.1 %	371	240
Graubünden (GR)	Yes	Yes	19.2 %	Yes	71240	27.2 %	920	787
Jura (JU)	No	No	21.5 %	No	63477	28.0 %	677	576
Lucerne (LU)	No	No	19.2 %	Yes	66220	24.4 %	1089	904
Neuchâtel (NE)	No	No	25.8 %	No	87582	28.9 %	645	606
Nidwalden (NW)	No	No	19.0 %	Yes	70259	27.3 %	408	258
Obwalden (OW)	No	No	16.4 %	Yes	66019	30.4 %	436	239
St. Gallen (SG)	No	Yes	14.8 %	Yes	72479	22.5 %	1132	789
Schaffhausen (SH)	No	Yes	13.7 %	No	86478	25.8 %	660	504
Schwyz (SZ)	No	Yes	17.7 %	No	59867	21.9 %	747	612
Solothurn (SO)	No	No	18.2 %	No	66024	23.0 %	743	875
Thurgau (TG)	No	Yes	14.2 %	No	60198	22.4 %	990	845
Ticino (TI)	No	No	32.9 %	No	82479	27.0 %	692	656
Uri (UR)	No	No	13.3 %	Yes	53347	23.4 %	348	279
Valais (VS)	No	No	20.1 %	No	53383	25.1 %	1531	1450
Vaud (VD)	No	No	31.5 %	No	68257	26.8 %	1007	880
Zug (ZG)	No	No	23.8 %	Yes	152708	26.8 %	1141	552
Zurich (ZH)	Yes	Yes	20.1 %	Yes	96613	22.7 %	1685	1439

[1] The indicator only considers mandatory entrance exams. Source: Eberle and Brüggenbrock, 2013; EDK-IDES, 2018; SCCRE, 2018. [2] The indicator represents the share of graduates from baccalaureate schools. Source: FSO, 2020. [3] Early tracking refers to the existence of long-cycle baccalaureate schools, which can be entered directly after primary education. Source: EDK-IDES, 2016, 2017, [4] Source: Nidegger, 2019, 2021. N refers to the sample sizes of the two COFO studies. Own calculations.

point, eight cantons allow for early entry into general education via so-called long-cycle baccalaureate schools. In the remaining 18 cantons, students who completed primary education first attend a lower secondary school for two or three years before they can enter the general education track at the upper secondary level. Early tracking into general education may induce a temporal shift in families' propensity to invest in private tutoring. Given the superior benefits of entering general education, families may be incentivised to invest in private tutoring to increase their child's chances of accessing general education at the earliest occasion. Put differently, without early tracking into general education, the expected probability of private tutoring being beneficial (*P*) is reduced at the end of primary education but increased at the end of lower secondary education. Similarly, the risk of status demotion in case of a suboptimal choice of not investing in private tutoring (*Q*) should be greater at the end of lower secondary education in cantons where entry to general education is only possible at this transition.

Cantonal education system features incentivise or discourage investments in private tutoring by altering the perceived probabilities of private tutoring being beneficial and of the risk of status demotion in case of a suboptimal choice not to invest in private tutoring. Against the background that perceptions of these probabilities likely vary by SES (Boudon, 1974; Breen & Goldthorpe, 1997) and that high-achieving students may have a generally lower *SEU* of participating in private tutoring, the question arises as to whether all students respond evenly to education system features.

3. Data, measures and methods

3.1. Data

To investigate participation in private tutoring in Switzerland and the role of cantonal education system features, this study draws on cross-sectional data from two survey waves of Switzerland's large-scale assessment study COFO (French: Vérification de l'atteinte des compétences fondamentales, English: Assessment of the attainment of basic competences).[3] Beyond the assessment of educational competences, COFO includes a comprehensive background questionnaire covering a variety of student characteristics presumed to be related to competence development and educational pathways. The two surveys considered were administered in 2016 (Nidegger, 2019) and 2017 (Nidegger, 2021). The 2016 COFO survey covers information from 22'423 students in their last year of lower secondary education (9th grade). The sample of the 2017 COFO survey comprises 20'177 students who were in 6th grade, the final year of primary education in most cantons.[4] In both surveys, students were selected randomly via either a

[3] A replication package of this article is available on OSF (https://osf.io/tygcm/).

[4] In the Italian-speaking canton of Ticino (TI), students in the sample have already entered comprehensive lower secondary schooling (EDK-IDES, 2016, 2017).

single-stage or a two-step sampling scheme within 23 cantons and the language regions of the remaining three bilingual cantons (Verner & Helbling, 2019a; Verner & Helbling, 2019b).[5] The target population of both surveys resembles the entire student cohort in the respective grade, excluding students in separated special educational needs schools, students with severe cognitive or physical impairments and students whose knowledge of the test language is insufficient to take part in the assessment.

In response to missing data, multiple imputation by chained equations (Acock, 2005; White et al., 2011) as implemented in the R package *mice* (Van Buuren & Groothuis-Oudshoorn, 2011) was employed for all observations for which the dependent variable was fully observed (N_{2016}: 22'240, N_{2017}: 18'396). The percentage of missing values across the study variables varied between 0 % and 14 % (see Table 2). Incomplete variables were imputed under fully conditional specification, including all study variables, using single-level and multilevel imputation methods (Grund et al., 2018). The imputation models created 20 multiply-imputed datasets for each COFO survey (Von Hippel, 2020). Estimates from complete-case analyses are nearly identical to the results using multiply-imputed datasets (see Table S1 in the supplementary materials).

3.2. Measures

A binary variable indicating whether or not students have received paid private tutoring in the school year of the survey constitutes the dependent variable.[6] Students' grade point average (GPA) – ranging from one to six, with six being the highest grade – for several enquired subjects serves as the indicator for educational achievement and is used as a proxy for the investment risk.[7] Since evaluations of the benefits of private tutoring likely depend on students' convictions that they can successfully achieve in school, a composite measure of students' academic self-concept enters the models as a control variable. To assess whether students experienced an achievement-related setback over the course of their previous educational career, a dummy variable measuring whether or not students have repeated a grade is included in the models. In addition, the models for students at the end of lower secondary education control for students' lower secondary track in terms of the requirement level of the school type they currently attend.[8]

According to the developed SEU model, the educational motivation for investing in private tutoring depends strongly on the perceived risk of status demotion. Following Esser's (1999) assumptions, this risk is higher among families from higher social strata. A composite measure including the highest parental education, highest parental occupational status (ISEI) and the number of books at home is created to quantify a student's SES, which is used to represent the educational motivation.[9] In light of the previously documented gender gap in private tutoring (e.g., C. Buchmann et al., 2010; Entrich & Lauterbach, 2020; Stevenson & Baker, 1992), the regression models include a dummy variable for female students. To account for potential immigrant optimism (Kao & Tienda, 2002), a control variable contrasts students without a migration background with first- and second-generation migrants.

Considering the role of cantonal education systems, the present study focuses on three institutional features (Table 1). First, the selection method for the general education track is operationalised by a dummy variable indicating the existence of high-stakes entrance exams (Eberle & Brüggenbrock, 2013; EDK-IDES, 2018; SCCRE, 2018). This measure reflects the situation of the approaching educational transition (i.e., the transition from primary into lower secondary education or the transition from lower secondary into upper secondary education). Second, the baccalaureate rate serves as the measure of the inclusiveness of cantonal education systems (FSO, 2020). Third, the timing of tracking into general education is represented by a dummy variable that takes a value of one if students can enter general education directly after primary school and a value of zero otherwise (EDK-IDES, 2016; EDK-IDES, 2017). It is likely that regional disparities in the prevalence of private tutoring reflect – to some extent – structural characteristics of the cantons' student populations. In response to possible confounding factors on the cantonal level, the models include control variables for the gross cantonal product per capita and the cantonal graduate population. For ease of interpretation, continuous predictors on the cantonal level are normalised to a range of zero to one. Table 2 presents descriptive statistics of both data sources.

3.3. Analytical approach

For the multivariate analysis, mixed-effects logistic regression models with students nested within cantons are estimated (Hox et al., 2017). These models facilitate a systematic analysis of the effects of various covariates measured at different levels by considering the multilevel structure and dividing the total variance onto the different levels.

The modelling approach starts with estimating an intercept-only model to calculate the approximate intra-class coefficient (ICC). Subsequently, the regression model is gradually expanded by adding additional predictors, allowing for random slopes of selected predictors at the student level to account for differences in the effects between cantons, and including cross-level interactions to address whether canton-level predictors modify the relationship between student-level predictors and the dependent variable.

The equation of the full regression model is:

$$\begin{aligned} Tutoring_{ij} = \quad & \gamma_{00} + \sum_{p=1}^{P} \gamma_{p0} X_{pij} \quad + \sum_{q=1}^{Q} \gamma_{0q} Z_{qj} \quad + \sum_{p=1}^{P} \sum_{q=1}^{Q} \gamma_{pq} X_{pij} \\ & \times Z_{qj} + \delta_{0j} + \quad \sum_{p=1}^{P} \delta_{pj} X_{pij} + \quad \varepsilon_{ij} \end{aligned}$$

$Tutoring_{ij}$ represents the binary outcome measure of participation in private tutoring of student i within canton j. There are P student-level predictors X_{pij} and Q canton-level predictors Z_{qj}, respectively. The error term comprises the student-level error ε_{ij} and the canton-level errors δ_{0j} and δ_{pj}. All ε_{ij} are assumed to be independent of each other with expectation zero and variance of $\frac{\pi^2}{3}$. The canton-level errors have expectation zero and variance σ^2 and are assumed to be independent of ε_{ij}. Adding a cross-level interaction term $\gamma_{pq} X_{pij} \times Z_{qj}$ additionally re-

[5] The three bilingual cantons are Bern (BE), Fribourg (FR), and Valais (VS). While discrepancies concerning curricula and the structure of lower secondary education exist between the language regions of these cantons, the modalities of entering general education apply to the entire canton.

[6] In both COFO surveys, participation in private tutoring was administered using the question "Did you receive paid tutoring in the [sixth/ninth] year ([eighth/eleventh] year in HarmoS; e.g., individual private tutoring, exam preparation)?".

[7] The grade point average is comprised of self-reported grades in the test language, the first and second foreign language for the primary school sample and the test language, the first foreign language, mathematics and science for the lower secondary school sample. Given the deficiencies of self-reported grades in terms of construct validity (e.g., Kuncel et al., 2005) and the lack of suitable alternatives in the COFO data, caution when interpreting the results is advised.

[8] As the models of lower secondary schooling and, thus, the number of tracks differs between cantons, it is a common practice in research to use a harmonised variable for school types' requirement levels instead (Konsortium ÜGK, 2019, pp. 182–184).

[9] The construction of the composite measure for SES closely follows the ESCS scale used in PISA studies.

Table 2
Sample description.

	End of primary education (COFO 2017)						End of lower secondary education (COFO 2016)					
Variable	N	Mean / Proportion	SD	Min	Max	Proportion Missing	N	Mean / Proportion	SD	Min	Max	Proportion Missing
Private tutoring	18936					0.00	22240					0.00
… No (Ref.)	13801	0.73					14985	0.67				
… Yes	5135	0.27					7255	0.33				
GPA	16294	5.04	0.58	1.00	6.00	0.14	21287	4.7	0.47	1	6	0.04
Academic self-concept	18506	-0.07	0.98	-3.43	1.38	0.02	22212	-0.0016	0.83	-2.69	1.37	0.00
Grade repetition	18818					0.01	22234					0.00
… No grade repetition (Ref.)	16977	0.90					18218	0.82				
… Student repeated a grade	1841	0.10					4016	0.18				
School type							21360					0.04
… Advanced requirements school (Ref.)							8658	0.41				
… Basic requirements school							6965	0.33				
… High requirements school							5737	0.27				
SES	17914	-0.04	0.98	-2.45	1.70	0.05	21932	-0.078	0.98	-2.24	1.7	0.01
Sex	18936					0.00	22240					0.00
… Male (Ref.)	9428	0.50					11372	0.51				
… Female	9508	0.50					10868	0.49				
Migration background	18752					0.01	22081					0.01
… Native (Ref.)	13194	0.70					15827	0.72				
… First generation migrant	1905	0.10					2082	0.094				
… Second generation migrant	3653	0.19					4172	0.19				
Selection method for general education	18936					0.00	22240					0.00
… No entrance exam (Ref.)	16337	0.86					15261	0.69				
… Entrance exam	2599	0.14					6979	0.31				
Inclusiveness^{n}	18936	21.09	5.61	12.47	34.15	0.00	22240	20.66	5.38	12.47	34.15	0.00
Timing of tracking into general education	18936					0.00	22240					0.00
… Early tracking	13316	0.70					14508	0.65				
… Late tracking (Ref.)	5620	0.30					7732	0.35				
Gross cantonal product per capita^{n}	18936	76200.60	24924.89	53347.09	168891.35	0.00	22240	77537.79	26721.34	53347.09	168891.35	0.00
Cantonal graduate population^{n}	18936	25.68	2.72	21.87	32.38	0.00	22240	25.58	2.67	21.87	32.38	0.00

Descriptive statistics from non-imputed data. Variables denoted with a superscripted n (^{n}) enter the regression models in min-max-normalised form with a range of 0-1. "Ref." indicates the reference category. Data: COFO 2016 and COFO 2017, own calculations.

quires assuming weak exogeneity of Z_{qj}, meaning that Z_{qj} is independent of the error terms.

Regression analyses are conducted on each of the 20 multiply-imputed data sets, and the estimates are combined following Rubin's rules (Rubin, 2018). Nested models are compared using likelihood ratio tests (Chan & Meng, 2022) and pooled pseudo-R^2 statistics (Nakagawa & Schielzeth, 2013; Van Ginkel, 2019).

4. Results

4.1. Descriptive results

Private tutoring is a common phenomenon in Switzerland. On average, 28.7 % (SD: 4.9 Pp.) of students at the end of primary education and 35.6 % (SD: 8.6 Pp.) of students at the end of lower secondary education participate in private tutoring. However, as Fig. 1 shows, participation rates in private tutoring vary considerably between cantons. At the end of lower secondary education, for instance, the share of students participating in private tutoring ranges from 14.8 % in Appenzell Innerrhoden (AI) to 49.3 % in Ticino (TI). According to the data, private tutoring is more prevalent in French- or Italian-speaking cantons (e.g., TI, GE, VD) than in German-speaking Switzerland (e.g., AI, UR, OW). At the same time, private tutoring is most common in cantons with large urban centres (e.g., GE, ZH, BS) and notably less common in predominantly rural cantons (e.g., AI, UR, NW).

On an aggregate level, there is mixed evidence of whether the marked differences in participation rates can be attributed to cantonal education system features. As presented in the left panel of Fig. 2, two-tailed t-tests cannot reject the null hypothesis of no statistically significant differences in participation rates in cantons with or without entrance exams into general education. In contrast, the middle panel of Fig. 2 indicates a positive relationship between the degree of inclusiveness of general education, measured by the baccalaureate rate, and cantonal participation rates in private tutoring. While there is a highly significant bivariate relationship at the end of lower secondary ($ß = 0.010$, $p < 0.001$), the relationship at the end of primary education is less pronounced ($ß = 0.002$, $p > 0.05$). The right panel of Fig. 2 suggests that cantons without early tracking into general education show higher participation rates in private tutoring than cantons entry into general education is possible directly after primary school. This difference is statistically significant ($p < 0.01$) at the end of lower secondary education.

4.2. Multivariate results

Table 3 displays pooled results from mixed-effects logistic regression models on participation in private tutoring at the end of primary education (Models P0-P3) and at the end of lower secondary education (Models LS0-LS3). Coefficient estimates are presented in terms of log odds with standard errors in parentheses. For ease of interpretation, average marginal effects (AME) were computed (see Table S2 in the supplementary materials).

The analyses start with null models (Models P0 and LS0) to gauge the canton- and student-level variance. These models reveal that most variation in the dependent variable is attributable to the student level (P0: ICC = 0.013; LS0: ICC = 0.043). Models P1 and LS1 show the estimates of SES as a measure for the educational motivation and students' GPA as a measure for the investment risk along with control variables at the student level. In line with the conjecture of the SEU model, a higher educational motivation (i.e. a higher SES) is positively related to participation in private tutoring (P1: $ß = 0.047$, $p < 0.05$, AME = 0.008; LS1: $ß = 0.174$, $p < 0.001$, AME = 0.035), whereas a higher investment risk (i.e. a higher GPA) decreases the odds of investing in private tutoring (P1: $ß = -0.630$, $p < 0.001$, AME = −0.107; LS1: $ß = -0.702$, $p < 0.001$, AME = −0.143). According to the interaction term in Models P2 and LS2 (P2: $ß = -0.103$, $p < 0.01$; LS2: $ß = -0.224$, $p < 0.001$), educational motivation and investment risk are in a mutual relationship. As indicated by the predictive margins of this interaction effect in Fig. 3, an SES gap exists among below-average achieving students, with high-SES students showing a substantially higher probability of participating in private tutoring than their mid- and low-SES peers with an identical GPA. Only among high-achieving students the gradient by SES diminishes.

The student-level controls further support the argument that investments in shadow education are driven by subjective expected utility. Replicating findings from previous research (C. Buchmann et al., 2010; Entrich & Lauterbach, 2020), elevated participation in private tutoring is found among females and students with a migration background. Students with a stronger academic self-concept are significantly less likely to participate in private tutoring, whereas participation rates are

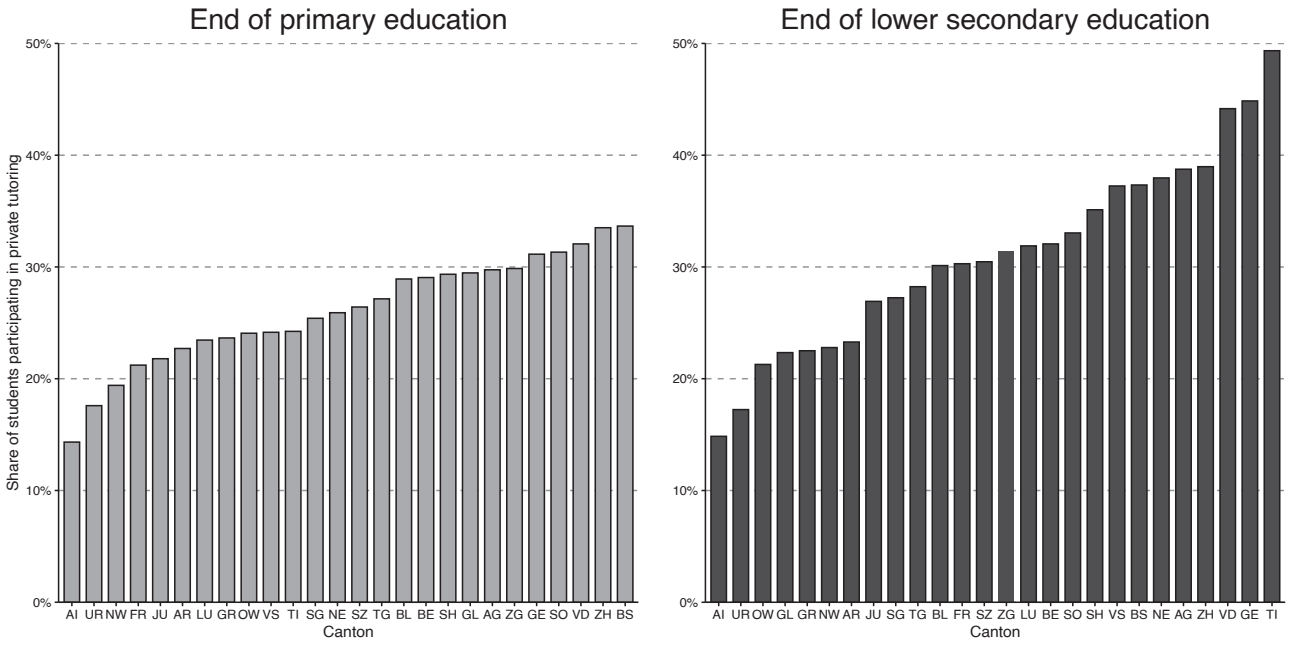

Fig. 1. Proportion of students participating in private tutoring by canton.

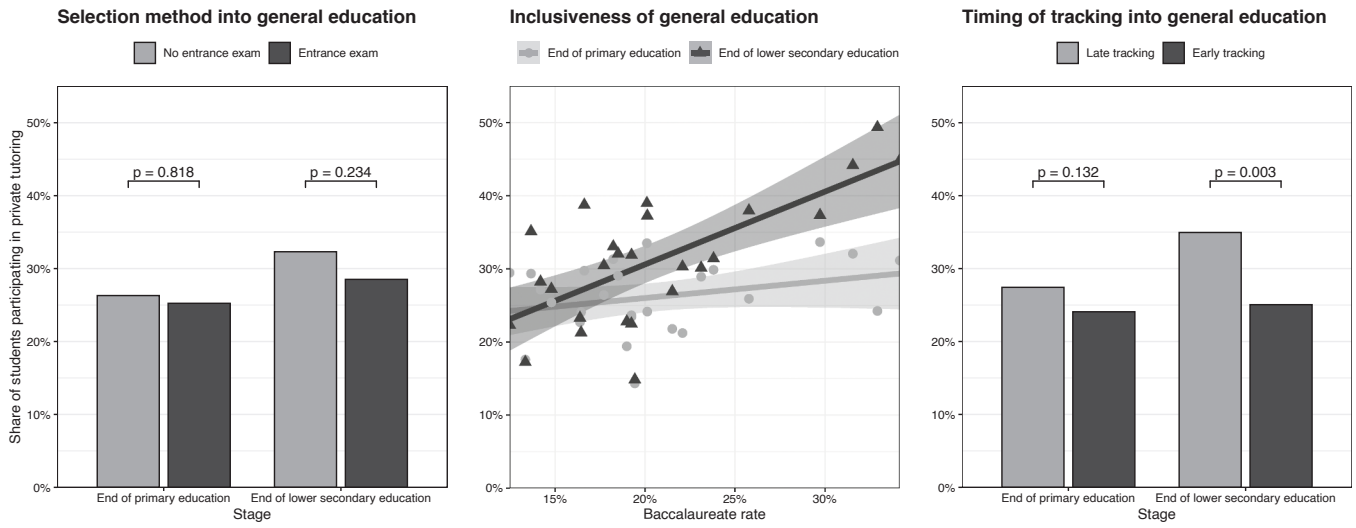

Fig. 2. Participation in private tutoring by education system feature.

Table 3
Mixed-effects logistic regression models on participation in private tutoring.

	P0	P1	P2	P3	LS0	LS1	LS2	LS3
GPA		-0.630 * **	-0.652 * **	-0.655 * **		-0.702 * **	-0.725 * **	-0.722 * **
		(0.039)	(0.039)	(0.039)		(0.039)	(0.039)	(0.039)
Academic self-concept		-0.512 * **	-0.508 * **	-0.504 * **		-0.235 * **	-0.228 * **	-0.227 * **
		(0.022)	(0.022)	(0.022)		(0.021)	(0.021)	(0.021)
Grade repetition		0.592 * **	0.596 * **	0.602 * **		0.363 * **	0.365 * **	0.365 * **
(Ref. No grade repetition)		(0.055)	(0.055)	(0.055)		(0.040)	(0.040)	(0.040)
Basic requirements school						0.011	0.020	0.022
(Ref. Advanced requirements school)						(0.040)	(0.040)	(0.040)
High requirements school						-0.249 * **	-0.248 * **	-0.252 * **
(Ref. Advanced requirements school)						(0.040)	(0.040)	(0.040)
SES		0.047 *	0.552 * *	0.556 * *		0.174 * **	1.213 * **	1.220 * **
		(0.020)	(0.175)	(0.175)		(0.019)	(0.170)	(0.170)
Female		0.130 * **	0.131 * **	0.131 * **		0.294 * **	0.300 * **	0.300 * **
(Ref. Male)		(0.036)	(0.036)	(0.036)		(0.030)	(0.030)	(0.030)
First generation migrant		0.466	0.474 * **	0.469 * **		0.270 * **	0.280 * **	0.277 * **
(Ref. Native)		(0.057)	(0.057)	(0.057)		(0.053)	(0.053)	(0.053)
Second generation migrant		0.387	0.391 * **	0.388 * **		0.131 * *	0.132 * *	0.128 * *
(Ref. Native)		(0.046)	(0.046)	(0.045)		(0.042)	(0.042)	(0.042)
GPA x SES			-0.103 * *	-0.104 * *			-0.224 * **	-0.225 * **
			(0.035)	(0.035)			(0.036)	(0.036)
Entrance exam				0.227 *				0.068
(Ref. No entrance exam)				(0.099)				(0.101)
Inclusiveness[n]				0.096				1.080 * **
				(0.144)				(0.214)
Early tracking				-0.186 *				-0.212 *
(*Ref. Late tracking*)				(0.078)				(0.091)
Gross cantonal product per capita[n]				0.413 * *				-0.047
				(0.144)				(0.198)
Cantonal graduate population[n]				-0.384 * *				-0.615 * **
				(0.123)				(0.174)
Intercept	-1.033 * **	1.703 * **	1.825 * **	1.906 * **	-0.824 * **	2.270 * **	2.386 * **	2.288 * **
	(0.045)	(0.197)	(0.200)	(0.205)	(0.078)	(0.199)	(0.201)	(0.218)
SD(Intercept)	0.043	0.035	0.036	0.010	0.150	0.131	0.135	0.030
Observations	18936	18936	18936	18936	22240	22240	22240	22240
Cantons	26	26	26	26	26	26	26	26
AIC	21872.570	19458.360	19449.462	19438.698	27333.171	26163.930	26121.443	26096.898
Marginal R2	0.000	0.183	0.185	0.192	0.000	0.075	0.077	0.103
Conditional R2	0.013	0.191	0.194	0.194	0.043	0.110	0.113	0.111

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Unstandardised regression coefficients with robust standard errors in parentheses. Models P0-P3 show estimates for students at end of primary education, whereas estimates for students at the end of lower secondary education are provided in Models LS0-LS3. Variables denoted with a superscripted n (^{n}) enter the regression models in min-max-normalised form with a range of 0-1. "Ref." indicates the reference category. Models with non-imputed data are provided in Table S1 in the supplementary materials. Alternative model specifications are presented in Table S7 in the supplementary materials. Results in terms of average marginal effects (AME) are provided in Table S2 in the supplementary materials. Models considering each education system feature separately are presented in Table S3 and Table S4 in the supplementary materials. Data: COFO 2016 and COFO 2017, own calculations.

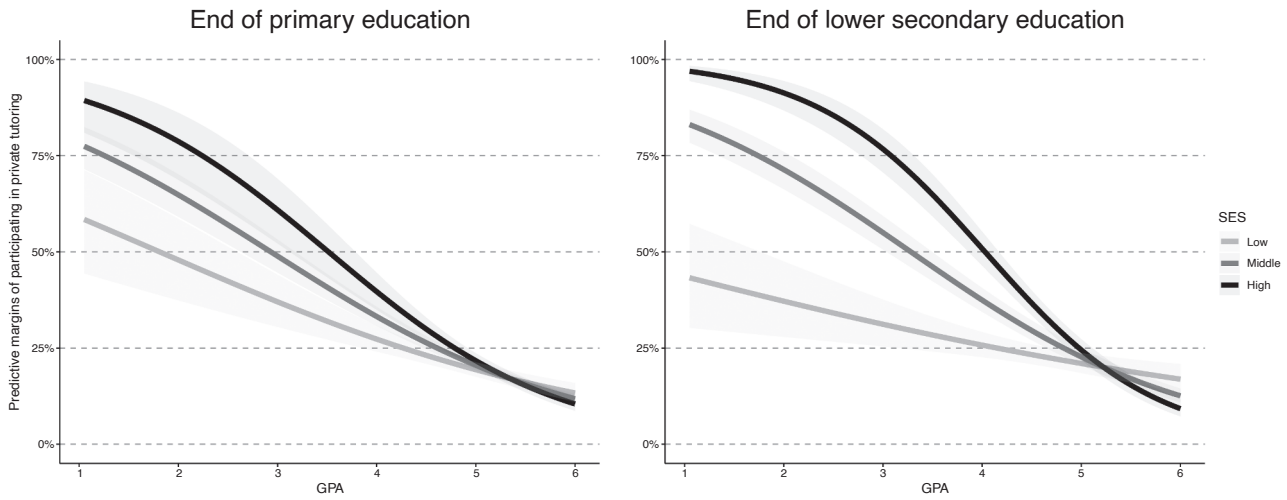

Fig. 3. Predictive margins of interaction between SES and GPA.

higher among those who have experienced a grade repetition throughout their educational career. Notably, in Model LS2, students who entered the high requirement track in lower secondary education are significantly less likely (ß = −0.248, $p < 0.001$, AME = −0.049) to participate in private tutoring than their counterparts in the advanced requirement track.

The inclusion of cantonal-level predictors in Models P3 and LS3 indicates that institutional features of cantonal education systems are related to participation in private tutoring. The regression models predict higher propensities of investing in private tutoring in cantons with high-stakes entrance exams into general education. However, this relationship is only statistically distinguishable from zero at the end of primary education (ß = 0.227, $p < 0.05$, AME = 0.040) but not at the end of lower secondary education (ß = 0.068, $p > 0.05$, AME = 0.014). One-shot entrance exams seem to lower the investment risk and increase the probability of status demotion when no investments in shadow education are made.

In comparison, the degree of inclusiveness is not related to participation in private tutoring at the end of primary education (ß = 0.096, $p > 0.05$, AME = 0.016). Conversely, Model LS3 estimates a positive and highly significant effect for students at the end of lower secondary education. This effect is sizable, with students in the canton with the highest baccalaureate rate showing a 21.9 % (ß = 1.080, $p < 0.001$) higher likelihood of participating in private tutoring than students in the canton with the lowest baccalaureate rate. Contrary to the expectations, this finding implies that lower inclusiveness is not indicative of fierce competition for places in general education, which would incentivise investments in private tutoring.

Contrary to the expectations based on the SEU model, early tracking into general education is negatively and significantly associated with participation in private tutoring before both educational transitions. Early tracking into general education might dissuade families from investing in private tutoring at the end of primary school (ß = −0.186, $p < 0.05$, AME = −0.031) because there is another entry point into this track further down the educational pathway. Conversely, lower participation rates at the end of lower secondary education in cantons with early tracking into general education (ß = −0.212, $p < 0.05$, AME = −0.043) might exist because high-achievers from high-SES families – the main clientele for private tutoring – have already entered general education.[10]

To examine whether the effects of investment risk and educational motivation differ by education system features, separate cross-level interaction terms are estimated, which are presented in Table 4.[11]

In cantons where students need to pass an entrance exam to enter general education after primary school (Model P4), the cross-level interaction term (ß = 0.677, $p < 0.001$) nearly neutralises the raw effect of investment risk (ß = −0.764, $p < 0.001$). While students in primary education in cantons without entrance exams are less likely to participate in private tutoring with increasing grades, this effect is much less pronounced in cantons with entrance exams into general education. To put this into perspective, the estimated probability of participating in private tutoring in absence of entrance exams amounts to 53.8 % (± 5.5 Pp.) for students with a GPA of 3.0 % and 20.3 % (± 1.3 Pp.) for students with a GPA of 5.0. In contrast, the respective probabilities are 29.2 % (± 9.9 Pp.) and 26.0 % (± 4.0 Pp.) for students living in cantons with entrance exams into general education. Entrance exams at the end of primary education are furthermore related to systematic differences in the effect of educational motivation, measured by students' SES. In cantons with entrance exams into general education, students with higher SES are more likely to participate in private tutoring (P5: ß = 0.199, $p < 0.05$). While the predicted probability of participating in private tutoring amounts to about 20 % for both members of the 20th and 80th percentile of the SES distribution in cantons without entrance exams, there is a significant participation gap in cantons with entrance

[10] There is a concern that cantonal education systems resemble regimes where institutional characteristics are systematically aligned to one another. Although there are no empirical indications of multicollinearity for any of the models in Table 3, models considering each education system feature separately are available in the supplementary materials in Tables S3 and S4. While the results at the end of lower secondary education prove robust, estimates for entrance exams and early tracking at the end of primary education are indistinguishable from zero when estimated separately. This is unsurprising since entrance exams can only exist if early tracking into general education is possible. Given that the effects of entrance exams and early tracking are in opposite direction, it is likely that they cancel each other out when not considered jointly.

[11] Complete regression tables are available in the supplementary materials in Tables S5 and S6.

Table 4
Cross-level interactions from mixed-effects logistic regression models on participation in private tutoring.

	P4	LS4	P5	LS5	P6	LS6	P7	LS7	P8	LS8	P9	LS9
GPA	-0.764 * **	-0.716 * **	-0.657 * **	-0.728 * **	-0.731 * **	-0.793 * **	-0.659 * **	-0.729 * **	-0.748 * **	-0.688 * **	-0.659 * **	-0.728 * **
	(0.056)	(0.060)	(0.039)	(0.040)	(0.124)	(0.089)	(0.039)	(0.040)	(0.080)	(0.060)	(0.039)	(0.040)
SES	0.587 * *	1.218 * **	0.493 * *	1.211 * **	0.624 * **	1.221 * **	0.486 * *	1.155 * **	0.612 * **	1.221 * **	0.505 * *	1.228 * **
	(0.177)	(0.171)	(0.177)	(0.172)	(0.177)	(0.171)	(0.181)	(0.176)	(0.177)	(0.171)	(0.179)	(0.172)
Entrance exam	-3.069 * **	0.307	0.247 *	0.084	0.162	0.036	0.164	0.074	0.167	0.045	0.169	0.081
(Ref. No entrance exam)	(0.706)	(0.527)	(0.101)	(0.101)	(0.140)	(0.094)	(0.116)	(0.096)	(0.139)	(0.095)	(0.116)	(0.097)
Inclusiveness[n]	0.097	1.067 * **	0.063	1.074 * **	-0.441	0.305	0.070	0.990 * **	0.086	1.071 * **	0.045	1.080 * **
	(0.149)	(0.197)	(0.160)	(0.196)	(1.193)	(0.894)	(0.151)	(0.209)	(0.148)	(0.200)	(0.160)	(0.198)
Early tracking	-0.197 *	-0.251 * *	-0.193 *	-0.261 * *	-0.200 *	-0.255 * *	-0.198 * *	-0.266 * *	-1.118	0.406	-0.180 *	-0.225 *
(Ref. Late tracking)	(0.080)	(0.086)	(0.076)	(0.088)	(0.080)	(0.086)	(0.076)	(0.089)	(0.685)	(0.505)	(0.079)	(0.091)
GPA x Entrance exam	0.677 * **	-0.054										
	(0.145)	(0.104)										
SES x Entrance exam			0.199 *	-0.015								
			(0.080)	(0.052)								
GPA x Inclusiveness[n]					0.110	0.152						
					(0.248)	(0.176)						
SES x Inclusiveness[n]							0.112	0.120				
							(0.109)	(0.086)				
GPA x Early tracking									0.192	-0.132		
									(0.142)	(0.101)		
SES x Early tracking											0.049	-0.061
											(0.066)	(0.051)
Intercept	2.444 * **	2.292 * **	1.900 * **	2.300 * **	2.299 * **	2.680 * **	1.903 * **	2.340 * **	2.380 * **	2.149 * **	1.909 * **	2.287 * **
	(0.282)	(0.316)	(0.205)	(0.215)	(0.597)	(0.454)	(0.206)	(0.217)	(0.393)	(0.318)	(0.205)	(0.216)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SD(Intercept)	0.606	0.719	0.009	0.032	1.795	0.711	0.011	0.032	1.552	0.653	0.010	0.032
SD(GPA)	0.026	0.024			0.080	0.023			0.069	0.021		
SD(SES)			0.007	0.008			0.012	0.007			0.011	0.007
Cov(Intercept|GPA)	-0.125	-0.129			-0.378	-0.128			-0.326	-0.117		
Cov(Intercept|SES)			0.002	-0.010			0.005	-0.009			0.005	-0.009
Observations	18936	22240	18936	22240	18936	22240	18936	22240	18936	22240	18936	22240
Cantons	26	26	26	26	26	26	26	26	26	26	26	26
AIC	19365.602	26091.520	19410.037	26084.849	19380.779	26090.996	19414.100	26083.023	19379.047	26090.012	19414.614	26083.477
Marginal R2	0.200	0.107	0.196	0.107	0.197	0.106	0.195	0.104	0.198	0.106	0.195	0.105
Conditional R2	0.205	0.116	0.199	0.118	0.207	0.115	0.201	0.115	0.208	0.115	0.200	0.116

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Unstandardised regression coefficients with robust standard errors in parentheses. Models P4-P9 show estimates for students at end of primary education, whereas estimates for students at the end of lower secondary education are provided in Models LS4-LS9. Variables denoted with a superscripted n ([n]) enter the regression models in min-max-normalised form with a range of 0-1. "Ref." indicates the reference category. Complete models are provided in Table S5 and Table S6 in the supplementary materials. Data: COFO 2016 and COFO 2017, own calculations.

exams that amounts to 7.8 % points (± 4.1 Pp.) in favour of those belonging to the 80th percentile. The effects of investment risk (GPA) and educational motivation (SES) do not systematically vary depending on the degree of inclusiveness of general education. Although all cross-level interaction terms in Models P6-P7 and LS6-LS7 in Table 4 have a positive sign, none of these effects are statistically distinguishable from zero. In cantons where entry into general education is possible directly after primary school, neither the effects of investment risk nor educational motivation on participation in private tutoring systematically differ (Models P8-P9 and LS9-LS9). Overall, with the exception of entrance exams at the end of primary education, there is no evidence that cantonal education system features contribute to achievement- and SES-related disparities in take-up of private tutoring.

5. Discussion

The worldwide expansion of shadow education encouraged many scholars to determine what drives its demand. While there is solid evidence that families seek investments in private tutoring to enhance their children's educational advancement (Luo & Chan, 2022; Park et al., 2016; Zhang & Bray, 2020), there is still much to learn about the moderating role of education system features. This gap in research may stem from the level of analysis the bulk of previous research has opted for. On the one hand, analyses on the country-level neglect potential within-country variation. On the other hand, cross-country studies may run the risk of comparing countries with divergent institutional arrangements and where shadow education might be of fundamentally different significance (Bray et al., 2020; Bray & Kobakhidze, 2014). The present study aims to strike a novel path by exploiting the federalist structure of Switzerland's education system to study the implications of education system features for participation in private tutoring.

The assumption that institutional features incentivise take-up of private tutoring seems plausible given the substantial variability of participation rates across Swiss cantons. The case of Switzerland clearly illustrates that countries should not – by default – be regarded as monoliths regarding the pervasiveness of shadow education. Future research is called for considering within-country variation when studying shadow education. Multilevel regression models confirm findings from previous studies that stress the importance of students' and their families' resources for explaining the demand for shadow education. The SEU model employed in this study, which characterises investment in private tutoring as a result of rational weighing of educational motivation and investment risk, proves a viable frame of reference. By incorporating education system features into families' incentive structures, the SEU model provides grounds for why the prevalence of private tutoring differs between contexts – be it regions or entire countries. Taken together, this study's results underline the characterisation of shadow education as a means of status maintenance, which has been argued for in previous research (Entrich & Lauterbach, 2020; Lorenz & Stubbe, 2020).

The results further indicate that education system features incentivise families' investments in private tutoring. Yet, an intricate picture emerges when focusing on the modalities of entry into general education. The degree inclusiveness of general education only takes effect at the end of lower secondary education. In light of the long-lasting implications of upper secondary track placement, the perception that access to general education is possible not only for elites seems to mobilise investments in private tutoring beyond the typical clientele of low-performing or high-SES students. Furthermore, there is evidence backing findings from Zwier and colleagues (2020) and Guill and Lintorf (2019) that the existence of high-stakes entrance exams into general education is associated with a higher propensity of participating in private tutoring. While this association is only present at the end of primary education, high-stakes entrance exams are related to an increased SES gap in participation and a decreased importance of educational achievement. Thus, as entrance exams entail an increased risk of failing to enter general education, even high-performing students – particularly those from high-SES families – are incentivised to pay for private supplemental education. At both points of measurement, and contradicting what previously has been found (e.g., Entrich, 2020), the results suggest that earlier tracking into general education deters investments in private tutoring. In cantons where direct entry into general education is possible after primary school already, students may try entering general education without help from private tutoring providers at first, as there is an additional chance to enter general education after lower secondary education. At the same time, as many children from high-SES families enter general education directly after primary schools in cantons where this is possible (M. Buchmann et al., 2016; Leemann et al., 2022), a considerable target group may not require private tutoring anymore at the end of lower secondary education.

Overall, the present study provides grounds for considering regional variation in shadow education and argues that institutional structures matter in families' considerations of investing in private tutoring. Although the findings prove generally robust over different specifications, some limitations sound a note of caution. First, due to data limitations, it is not possible to differentiate participation in private tutoring by its intensity, quality or underlying purposes. As, for instance, Takashiro (2021) suggest, shedding light on the mode of participation in private tutoring may reveal a more nuanced picture. Similarly, while education system features are characterised as factors affecting families' incentives to invest in private tutoring, the complex interrelations of these features cannot be uncovered due to sample size and data restrictions. It would be insightful to further investigate how high-stakes testing and curricular differentiation interact (Bol et al., 2014). Moreover, particularly for the case of Switzerland, how vocational and general education are coordinated within the cantons deserves closer attention. Second, the present application of the SEU model must rely on assumptions that cannot be fully resolved. While this data does not provide information on families' financial standing, there is further no option to quantify the actual costs of private tutoring due to the sheer diversity of the supply of private tutoring. Moreover, additional measures are needed to be able to account for disparate perceptions of the benefits and costs associated to investments in private tutoring between social groups. Third, the critique brought forward regarding the appropriate level of analysis can also be used against the present study. As some previous research indicates, it is reasonable to assume that not only regional circumstances matter but also that local opportunity structures and peer dynamics are decisive in families' decision to invest in private tutoring (e.g., Matsuoka, 2018; Pan et al., 2022). In light of its increasing prevalence, shadow education is a phenomenon that deserves continuous attention in research. The present study opens up a further level of complexity and encourages scholars to pursue research on the regional variability of shadow education and the role of institutional features.

CRediT authorship contribution statement

Robin Benz: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The author has no relevant interest(s) to disclose.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.rssm.2024.100958.

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