Competitor or complement? Swiss Training Firms' Perspective on General Education

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Abstract

In knowledge economies, technological advancements have brought about new occupational skill demands. In accommodating these needs, many economies have expanded general education at the cost of vocational education and technical training (VET). This trend also permeates coordination-based economies, wherein firms provide the technical aspect of training (dual VET). Despite rapidly changing skill demands, the well-established collective action among training firms has remained intact. Yet, firms may change their perception of the importance of VET compared to general education, as it reshuffles their dependency on dual VET. In this paper, we explore how the expansion of general education tracks at the upper secondary level, along with firms' academic requirements and use for higher educated workers, influence firms' perception of general education at the upper secondary education level as being a competitor to initial dual VET programs. This perception is important as it may affect firms' motivation to continue providing training and their broader adaptation to institutional change. Combining novel survey data with federal educational statistics, we show that a firm's regional exposure to general education expansion at the upper secondary level has no significant effect on firms' view of general education as a competitor. However, firms' academic requirements and their need and use also for higher (general) educated workers better explain the outcome.

Introduction

Across industrialized advanced economies, the increase in higher education enrolment and the expansion of general education at the upper-secondary education level is advancing (Schofer and Meyer, 2005). A similar progression is happening also in countries with dual vocational education and training (VET) systems, characterised by a strong employer involvement, where part of the youths' training takes place in a company and the rest in school (Durazzi 2023; Baethge and Wolter 2015). This trend is driven by streams of upskilling of education and work (Emmenegger et al., 2023; SOURCE) as well shifting preferences among compulsory school-leavers (and their parents) (Deissinger, 2019; Wolter and Kerst, 2015; Niederbacher & Neuenschwander, 2020). Whereas an expansion of general education at the upper secondary level and an integration of vocational elements also in higher education has been welcomed and promoted by large industrial firms in Germany (Diessner et al., 2021; Durazzi, 2023), a (regional) state-led general education expansion in Switzerland has been largely contested by the collective of small and

medium-sized firms, economic chambers and the professional associations in Switzerland (Emmenegger et al., 2023; Emmenegger and Seitzl, 2020; Economiesuisse, 2021).

To date, few studies have examined the point of view of firms in relation to the changes in educational expansion. Whereas many influential works on the topic of educational choice and preference have focussed on individual students (Bajka et al., 2024; Schulz et al. 2023), families (Meghir and Palme, 2005; Bukodi and Goldthorpe, 2013; Goldthorpe, 1996), or comparing institutional and policy changes within or across countries (van der Velden and Glebbeek, 2024; Graf, 2016; Schofer and Meyer, 2005), scholarship on collective skill formation from firms' perspective are often centred on costs and benefits of training (Muehlemann and Wolter, 2020; Blatter et al., 2016; Dionisius et al., 2009; Schweri et al., 2003) and the diverging preferences across firm-size (Culpepper, 2003; Culpepper and Thelen, 2008; Emmenegger and Seitzl, 2020).

Surveys targeting employers in collective skill formation systems have previously raised the issue of competition from general education to dual VET (SERI, 2022; SKBF, 2023; Bolli et al., 2019), but not addressed the various and nuanced differences between firms' perceptions, given actual levels of general education enrolment change, skill requirements and other important firm-level characteristics. Since firms are central actors in the economy and play a pivotal role as training-providers in collective skill formation systems, their views, expectations and concerns regarding parallel developments in society, such as general education expansion and the shifting educational preferences of youths are critical to understand the micro-foundations of the political economy (Martin and Swank, 2012; Busemeyer, 2012; Culpepper, 2007). Should firms, and in particular training firms in a collective skill formation system, encounter grave difficulties to sustain their skill supply via the dual vocational system without simultaneously reaping the benefits of a higher, general educated workforce, the underpinnings of the system at large could be at risk.

In this paper, we aim to fill this gap in the literature by asking, *what factors associate with training firms' perception of general education as a competitor or a complement to dual VET?*

We focus on Switzerland, a prototypical dual VET country with a high annual enrolment of compulsory school-leavers to dual VET at the upper secondary level compared to general education. Following Ansell and Gingrich's (2013) work on the varieties of higher education and the service economy, positing that Continental European states (including Switzerland) with a

restricted access to higher education refrain workers from moving away from manufacturing and industrial jobs into (higher skilled) service occupations. However, the last decades have seen an overall increase in general education enrolment, and a concomitant decrease in enrolment in initial vocational education and training in collective skill formation systems (Deissinger, 2019; SKBF, 2023; FSO, 2024; Emmenegger et al., 2023). Compared to Germany, the dual VET enrolment is comparatively high in Switzerland coupled with a lower, but increasing, general education enrolment (Emmenegger et al., 2023). In contrast to Switzerland, where mid-skilled industrial and construction sectors have remained stable the past decades (Oesch, 2023), the same occupations have seen a sharp decline in Germany to the benefit of managerial and professional jobs (Emmenegger et all., 2023; Durazzi, 2023). Thus, the labour market demands for mid-skilled occupations are still comparatively high in Switzerland, why increases in general education may pose a problem for firms.

At the same time, across economic sectors, firms report difficulties attracting apprentices to their VET programs and problems of skill gaps and skill shortages are prevalent in Switzerland as well as in other advanced economies (Pusterla et al. 2018; Wilson and Bajka, 2024). Factors such as the declining popularity of certain middle- and low-skilled jobs, notably in blue-collar sectors such as construction, manufacturing, and services, taken together with the upskilling of education and higher requirements on the future workforce in knowledge sectors (Markowitsch and Hefler, 2019), pave way for high concern for the future skill supply in sectors involved in dual VET: especially in combination with an increased interest and enrolment of compulsory school-leavers in general education (Emmenegger et al., 2023).

In the following, we review the literature and develop hypotheses concerning training firms' perception of general education as a competitor to dual VET.

Literature review and theoretical expectations

The global streams of upskilling in education and on the labour market, following technological change and de-industrialization in advanced economies, has gone hand in hand with an academization of labour (Stock et al. 2023; Crouch et al. 1999). This entails higher skill requirements from employers, as well as a stronger emphasis on general skills in education, exerting pressure on educational institutions to furnish the future workforce with skills demanded on the labour market while ensuring a high transition rate also for weaker learners (Bonoli and Emmenegger, 2022; Busemeyer and Trampusch, 2012; Wren, 2021). With growing

interest in among young people (and their parents) general education over vocational education (Deissinger, 2019; Jacob and Solga, 2015; Goldthorpe, 1996), traditionally oriented towards more specific skills, scholars in the field of labour economics as well as policymakers have raised the concern for the viability of the VET system (Fleckenstein et al., 2023; Baethge and Wolter, 2015; Durazzi, 2019). Although upskilling is also taking place in mid-skilled segments of education, vocationally trained workers are still in demand and the level of skill match in dual VET systems remain higher than in non-dual systems (Pusterla et al., 2018). As dual VET hinges on firms' involvement as training providers, and the mutual benefit of equipping future workers with occupational skills, and the high adaptability of VET given the participation of social partners in the organization of VET and the development of VET curricula (to correspond to the needs in the economy), a falling interest in VET in favour of general education may have important repercussions for the labour market and the economy as a whole (Deissinger, 2019).

In the wake of expanding access to higher education and increasing enrolment in general education at the upper secondary level follows concern of 'overeducation' (Di Stasio et al. 2016; Schulz et al. 2023; Wolter and Kerst, 2015), i.e., when workers have a higher skill and qualification level than their jobs require (McGuinness et al., 2018). The consequences of overeducation are poor matching on the labour market, vertical skill mismatches and skill shortages in sectors in which few skilled people are interested in working, and unemployment or lower wages both on the high and mid-level skills end (Bürmann, 2023; Quintini, 2011; Hartog, 2000). This tendency is however stronger in education systems with weakly developed VET systems with lower occupational specificity, where the returns for general skills are higher on the labour market (Di Stasio et al. 2016). In systems where access to higher education is more restricted and wages are more compressed, such as in Continental Europe (including collective skill formation systems such as Germany and Switzerland) (Ansell and Gingrich, 2013), conversely, the returns from a higher education diploma is comparatively lower and restricted to fewer occupations (e.g., doctors, lawyers, engineers) which historically has galvanized a broad share of school-leaving cohorts to select into vocational training.

On the other hand, as the needs for higher skills are rising, the expansion of general education may be a necessary element in advanced economies with well-established VET systems (Oesch, 2023). Dual training programs may well require high requirements in Maths and language, as well as IT skills, chemistry and physics, etc. However, programs that incorporate strong elements of vocational learning produce higher skill specificity than to programs in general upper secondary

higher education (Shavit and Müller 1998). The need for academic (general) skills acquired through a general education is in some case, taking precedence over specific skills acquired through vocational training on the labour market (Iversen and Soskice, 2019), and thus lowers the demand for vocationally trained workers.

Firms and employers in the economy are in this sense the relevant actor to study and inquire with regards to skill demand: what skills do they need to stay relevant and profitable? Cross-country surveys such as the Skill forecast from OECD/CEDEFOP (2022) give us an indication for the current and future skill needs for firms: the highest labour demand projections are found in high-skilled occupations such as business administration, service-oriented occupations such as sales and clerical work, and health and teaching occupations (CEDEFOP, 2022).

In the following sections we theorize and hypothesize the responses from training firms to (expanding) general education options in Switzerland.

Educational expansion and training firms in Switzerland

Switzerland has a longstanding tradition of dual VET and holds the highest enrolment of initial VET students among all collective skill formation systems (Wettstein et al., 2017; SKBF, 2023). The institutional support from stakeholders and actors involved in the governance and implementation of VET is high, combined with policy efforts made the last years to increase the permeability of VET to higher education (Deissinger and Gonon, 2016; Graf, 2016; Emmenegger et al., 2023). The political will along with motivations from the social partners, in Switzerland notably the 'organizations of the working world' (*Organization der Arbeitswelt,* OdA) encompassing employer as well as trade and occupational interest tasked with organizing VET and updating programme curricula (Wettstein et al., 2017; Emmenegger et al., 2019). The matching between the skills demanded by employers and the skills supplied in the workforce is high in international comparison, a feat that is often attributed to the well-functioning VET system and the production of high-level skills from (technical) universities (Pusterla et al., 2018). The umbrella organisation *Economie Suisse*, representing employers in all economic sectors, have recently warned against a higher access to general education at the upper secondary level, stating that it is "not the solution to higher skill needs in the economy" (Economiesuisse.ch, 08.03.2021). Thereby, the willingness to preserve the high status of VET and to steer clear of an overly high influx of students into general education at the upper secondary level is strong, to maintain a close match of skills with labour market demands (Ansell and Gingrich, 2013). All

while furnishing the future workforce with the combination of general and specific skills that are robust and adaptable to changing needs on the labour market, brought on by technological change (Deissinger and Gonon, 2016; Bonoli and Emmenegger, 2022).

Through these lenses, the expansion of general education at the upper secondary level in (some) cantons appears to be at odds with the strong promotion of dual VET (Trampusch, 2010; Culpepper, 2007; Maurer, 2013). Although the overall enrolment in general education is traditionally lower in German-speaking cantons, and higher in French- and Italian-speaking cantons (see Bonoli and Vorpe, 2022; Gonon and Maurer, 2012), with occupational upskilling, demographic change and the academization of education (Deissinger, 2019; Wolter and Kerst, 2015), the interest in general education is increasing among the young population in (and also in German-speaking parts of) Switzerland (SKBF, 2023). In view of the strong dual VET tradition in Switzerland, and the more recent years' increase in general education enrolment, challenging the importance of dual VET as a cornerstone of the economy (Emmenegger et al., 2023), we may assume that strong general education expansion at the cantonal level is associated with firms' likelihood to view general education as a competitor to dual VET (*H1*).

Firm-level factors affecting the perception of general education

Academic requirements

Whereas upskilling is a fact also in VET, notably in knowledge-intensive, high-skilled, firms that primarily rely on fostering training their own future workers through VET may see general education as competition rather than a complementarity (see Golder et al., 2019; CSRE, 2023). Firms are keen on not only attracting the learners that are able to carry out the training, but to hire those with the most apt profiles, to furnish with their firm-specific skills (Hupka-Brunner et al, 2010; Siegenthaler, 2010; Protsch and Dieckhoff, 2011; Solga and Kohlrausch, 2013). Hiring a highly qualified apprentice may furthermore reduce the training costs for the firm (Kohlrausch and Solga, 2012) and may prevent against the risk of early dropouts from the training (Imdorf, 2009).

Furthermore, training firms often rely on the vocational training program as a 'screening' device, that allows the employer to detect qualified future workers during the training instead of investing in (costly) hiring procedures of skilled workers (Aepli et al., 2024; Blatter et al., 2016). Where general education tracks are attracting highly qualified school-leavers with good grades,

we can expect firms that are especially looking for high-achieving learners to follow their training programs to be concerned about the competition from general education (*H2*).

Firms' need for and use of higher educated workers

There are ways in which firms' reliance on VET and need for high-achieving apprentice candidates, and the hypothesized competition these firms may perceive from general education, may be mediated if firms at the same time have a parallel need for higher educated workers (Durazzi, 2023). Whereas training firms may experience a 'loss of control' over the curricula and the occupation-specific skills learnt through firm-based training with expanding educational options outside of dual VET, either as school-based VET or as general education (Muehlemann and Wolter, 2020) where the firm-specific skills are lost (but the cost of the training is transferred to the state (Busemeyer, 2012)), may be compensated if training firms have a benefit of high educated workers (Durazzi, 2023).

Training firms in Switzerland have the possibility to offer a federal vocational baccalaureate (Berufsmaturität) (FVB) as a part of the in-firm apprenticeship. This federal diploma would, upon completion, provide the graduates with access to a university of applied sciences (Fachhochschule) after an entry exam (Passerelle) and was devised as an alternative to general upper secondary education (Gymnasium) for ambitious students (Gonon, 1994). Almost 60 per cent of entrants into universities of applied sciences had a vocational baccalaureate in 2019 (Emmenegger et al., 2023, and this additional year of studying is supported and offered by many Swiss training firms (Hänni et al., 2022). The decision to support pursuing an FVB is at the discretion of the firms, and given its popularity among apprentices and an important choice to follow a VET program rather than go to general education (Glauser and Becker, 2015), it plausibly increases the attractiveness of a firm from the apprenticeship seekers. Hence, to counter the competition from the general track, firms may choose to offer FVB (see Nikolai and Ebner, 2012).

At the same time, FVB is an educational alternative that increases permeability to higher studies which training firms may ultimately benefit from, if they need vocationally and higher trained workers. Offering FVB comes with the (potential) drawback for the firms, since the enrolled apprentices spend more time in vocational schools than in the firms (Hänni et al., 2022). Therefore, to offer the possibility to pursue an FVB within the realms of the apprenticeship indicates a support for apprentices to possibly enter higher education studies after the

apprenticeship is over (Nikolai and Ebner, 2012), and to shoulder the costs of the apprentice not doing productive work in the firm as much as during the initial VET program.

In sum, interesting job candidates for some firms may have a vocational training background (including obtaining an FVB) or followed higher studies at a university of applied sciences (Oesch, 2023). They may also have followed a general, academic track in upper secondary school (*Gymnasium*, Baccalaureate school), and subsequently pursued a bachelor's or master's degree at a university (Ibid.). In both cases, such job candidates would not directly been a part of the training firms' current 'candidate pool' for initial VET, given the firms' need also for higher educated workers. Firms that not only seek to hire higher education graduates, but that also indirectly support these academic aspirations with their own apprentices by offering FVB possibilities, should be less likely to perceive general education as a competitor to dual VET (*H3*).

Methods

Data

We collected the contact details to 10'632 Swiss training firms that advertised open apprenticeship position on the open recruitment and education guidance platform berufsberatung.ch (orientation.ch) during 2021-2022. The survey project was waived by the UNISG Ethics commission. In November 2022 we reached out to the firms via email, inviting them to participate in the online survey that addressing issues of skill needs and strategies among firms involved in VET. The survey was aimed at staff who were involved in the recruitment and/or training of apprentices. The respondents were guaranteed anonymity and had the possibility to withdraw from the survey and have their responses deleted at any time.

The survey closed in May 2023, and by then 2'738 firms had participated. After removing observations with missing values on our variables of interest, we had a working sample of 1'728 firms[1], representing around 16% of all the firms contacted.

[1] Table A4 in the appendix outlines descriptive data on the main variables of interest for this paper. Other information on the survey process, an analysis of non-respondents by canton and vocational field is available in Table A5 and Figures A2 and A3 in the appendix.

Variables and estimation strategy

We use logistic regression models and calculate average marginal effects of the predictor variables on the outcome (perceiving general education at the upper secondary level as competition), with the inclusion of a set of control variables, following Hosmer and Lemeshow (2013).

We use the survey item "Do you perceive the general education track as a competitor to your main VET program?" as a binary dependent variable in the logit model. We specified to the respondents that we only refer to general education at the upper secondary level, and not to other educational alternatives (such as school-based VET). As predictor variables, we included: the level of increase in general education enrolment between 2010 and 2022; the academic requirements of the vocational field in which firms provide VET-programs, firms' diversity of skill supply strategies aside from dual initial VET, firms' offers of FVB. We used hiring difficulties, reliance on VET for skill supply, firm size, membership in an organization of the working world (OdA), firms' distance to the closest HEI, and main language in the firm as control variables.

We calculated the relative percentual change in general education enrolment at the upper secondary level in all Swiss canton between the school year 2010/2011 and 2021/2022 (FSO, 2024). We chose this time-period for three main reasons: firstly, to allow a few years for the institutionalization of the knowledge economy and increased academization of work, commonly regarded to around the year 2007 (Garritzmann et al., 2022), secondly to capture a relevant time period for the respondents' professional career, and thirdly to allow enough time to pass for (potential) educational expansion to take place in Swiss cantons. Due to the uneven number of observations from each canton, and since almost all cantons have seen an increase in general education since 2010, we then went on to recode these cantonal values into a binary variable where 0 equals a below-average increase in general education enrolment (mean value=13.7% increase), and 1 equals an above-average increase in general education enrolment at the upper secondary level.

For attributing the academic requirements the vocational programs located in the existing vocational fields in the Swiss dual education system, we relied on previous works by the Swiss Union of Arts and Crafts (USAM) and the Swiss Conference of Cantonal Directors of Public

Education (CDIP), co-financed and supported by the Swiss Secretariat of Training, Research and Innovation (SEFRI) establishing skill profiles for vocational programs (profilsdexigence.ch, 2024). At the profilsdexigence.ch index, vocational programs are scored on the level of skill requirements on four school competences: Mathematics, home language, natural sciences, and foreign language. We used the average score of the competences to attribute a value between 1-4 for the vocational programs in our sample. In instances where the academic requirement was in between two scores, we attributed a score with one decimal of 0.5 (for example, 1.5 if the skill requirement in a certain competence was located between 1 and 2). Given that vocational programs are grouped in vocational fields (SBFI, 2022), we grouped the vocational programs in vocational fields and then used weighed averages to calculate the average academic level in the vocational field in our sample. In cases where the exact program name was missing, we imputed the sample average score value within the vocational field. If the vocational program was not scored at profilsdexigence.ch, we used the most similar existing program within the same vocational field. The score index for the vocational fields is presented in table A10 in the appendix. To not lose statistical power but still being able to reflect the nuances in skill requirement differences of the different vocational fields, we divided the fields by academic requirements in tertiles and coded the firms into the following categories: low requiring (=1, reference category), medium requiring (=2), and high requiring (=3).

For measuring firms' recruitment of workers with a tertiary degree, we used the answer category 'Hire graduates from VET schools at the upper secondary level' to the survey item 'Which approaches does your firm use to secure the skill supply?', where the respondents could indicate which skill supply approaches they currently were employing. The variable is binary where 0 equals 'do not recruit tertiary educated workers', and 1 equals 'recruit tertiary educated workers'.

For firms' FVB offers, we used the item "Does your firm offer apprentices to pursue a federal vocational baccalaureate?" and coded "No" as 0 and "Yes" as 1.

We also included a control variable for the closest distance (in travel duration via public transport) between the responding firm and a higher education institute (HEI). We wanted to account for the actual competition from general (higher) education alternatives for young people in the area, who might stand to choose between a dual apprenticeship or academic studies (albeit on the upper secondary level) (see Glauser and Becker, 2025, for the effect of regional opportunity structures on educational choice).

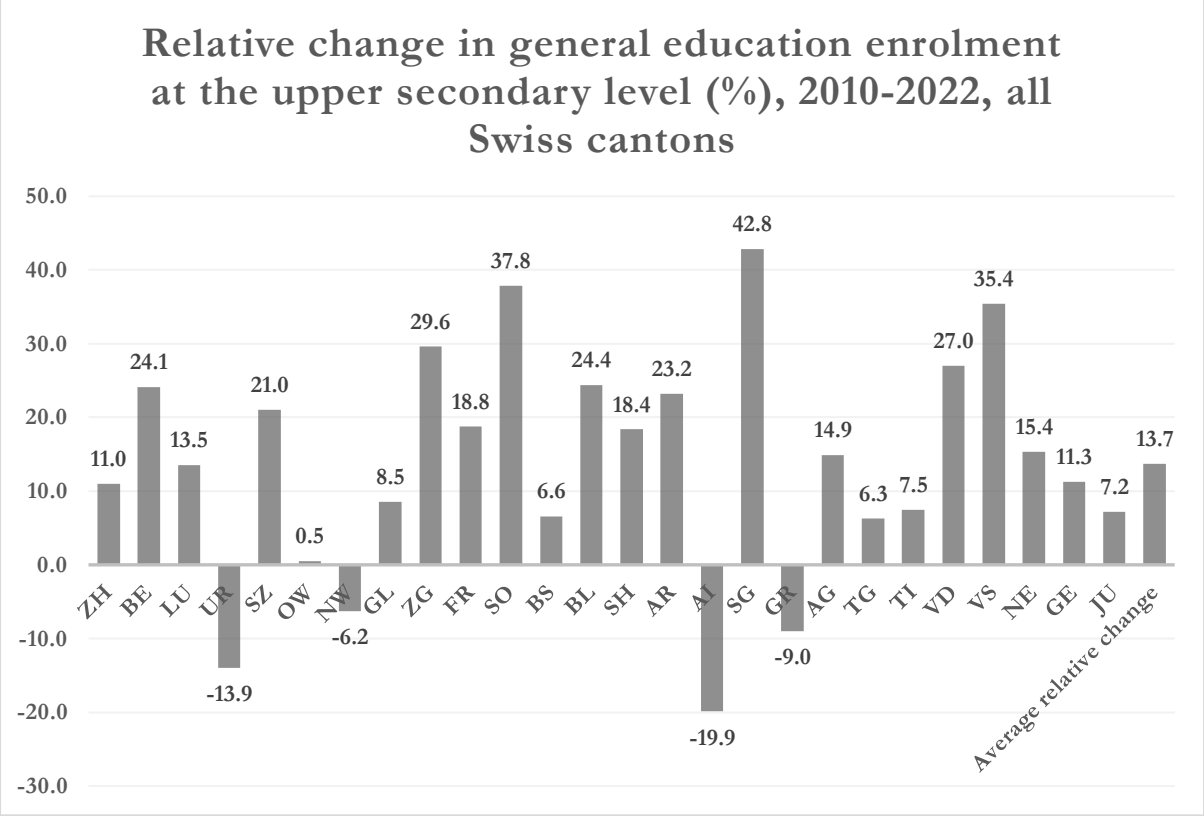
The remaining variables were directly taken from the survey answers and coded into binary variables (the firms' reliance on VET for skill supply, firms' hiring difficulties of apprentices, OdA-membership, professional VET experience, language), and an ordinal scale variable for firm size (1-9 employees=1, reference category; 10-49 employees=2; 50-249 employees=3; More than 250 employees=4). A description of the distribution of the answers categories of the different survey items used in the analysis is available in table A4 in the appendix.

We ran post-estimation tests for multicollinearity between the predictor variables, calculating Variance Inflation Factors (VIF) (Kohler & Kreuter, 2012). We did not detect any multicollinearity (see figures A2 and A3 in the appendix). We used Hosmer-Lemeshow 'goodness of fit' post-estimation tests for all our models (Hosmer and Lemeshow, 2013). The p-values were all substantially higher than 0.05 (see Figure A1 in the appendix), which indicates no reasons to believe the model does not fit the data well.

Main findings

Descriptive analysis

Figure 1. Overview of educational change in all Swiss cantons



Source: FSO (2024), authors' calculations.

Figure 1 gives an overview of the Swiss cantons and the change in general education enrolment at the upper secondary level (limited to the dual VET and the general education tracks) in the academic year 2021/2022. We see that, compared to the Swiss average change, some cantons stand out with their strong general education expansion. These are, for example, St. Gallen, Solothurn and Valais.

Looking at the distribution of answers to our survey item "Do you think that the general education track at the upper secondary education level is a competitor to your firm's main VET program?" (Table 1), in our sample, around 33% of the firms agree.

Table 1. Descriptive statistics on dependent variable

Competition from general education track to firm's main VET programs	**Freq.**	**Percent**
No	1155	66.84
Yes	573	33.16
	1728	100

Looking closer at the distribution of answers to the question by cantons, we choose to focus on the cantons with over 75 respondents in our sample, since the others had too few observations for statistical analysis[2]. The relationship between the change in general education enrolment at the upper secondary level and the perception of general education as a competitor to VET in these cantons is ambiguous (Table 2).

Table 2. Change in general education enrolment 2010-2022 by nine most frequent cantons in the sample.

Canton	**Freq. in sample**	**Relative change in GE enrolment (2010-2022) (Swiss average 13.7%)**	**Type of change**	**Share of firms perceiving GE as a competitor to VET (sample average 33%)**

[2] A full list of the change in general education enrolment between 2010-2022 in all cantons is available in table A9 in the appendix.

ZH	244	+11.16%	Around average expansion	31.2%
BE	132	+23.9%	Strong expansion	34.1%
LU	112	+13.3%	Around average expansion	33%
FR	79	+18.9%	Expansion	32.9%
SG	198	+43%	Strong expansion	28.8%
AG	166	+15.3%	Around average expansion	39.8%
TG	79	+6.5%	Small expansion	34.2%
VD	142	+27%	Strong expansion	31%
VS	92	+35.6%	Strong expansion	30.4%

Source: FSO (2024) and own survey data.

Multivariate logistic regression analysis

In a first step of the multivariate logistic regression analysis, we included predictor variables on the firm-level (i.e., skill supply diversity, level required in the VET programs, hiring difficulties, reliance on VET as skill supply approach, firm size, OdA-membership, distance to the closest higher education institute (HEI)), and on the cantonal level (language region binary variable and the relative change in general education enrolment 2010-2022, recoded into a binary variable where 0 equals a below-average increase in general education enrolment and 1 equals an above average increase in general education enrolment).

Table 3. Multivariate logistic linear regression models on outcome "General education is a competitor to VET program"

	Model 1		Model 2	
GE increased above average since 2010	0.101	(0.110)		
Rely on VET for skill supply (ref. No)	0.223°	(0.115)	0.218°	(0.116)
Medium academic requirements (Ref. Low)	-0.044	(0.129)	-0.051	(0.129)
High academic requirements	0.762***	(0.140)	0.766***	(0.141)
Hire graduates from (technical) universities	0.411*	(0.170)	0.422*	(0.171)
Hiring difficulty (ref. Not difficult)	0.481***	(0.119)	0.472***	(0.119)
10-49 employees (ref. 1-9)	-0.135	(0.146)	-0.132	(0.147)
50-249 employees	-0.202	(0.158)	-0.196	(0.159)
More than 250 employees	-0.069	(0.204)	-0.053	(0.205)
OdA-member (ref. No)	0.135	(0.120)	0.129	(0.121)
Language dummy (ref. French/Italian)	0.377*	(0.152)	0.381*	(0.152)
Respondents' experience in VET (ref. Less than 5 years)	-0.393**	(0.142)	-0.398**	(0.143)
Shortest travel duration to HEI	-0.000	(0.000)	-0.000	(0.000)
Offer FVB	0.492***	(0.118)	0.505***	(0.118)
Relative GE change Zürich			-0.015	(0.016)
Relative GE change Bern			-0.004	(0.009)
Relative GE change Luzern			0.001	(0.018)
Relative GE change Fribourg			0.003	(0.014)
Relative GE change Solothurn			-0.005	(0.008)
Relative GE change St. Gallen			-0.006	(0.005)
Relative GE change Aargau			0.023°	(0.013)
Relative GE change Thurgau			0.041	(0.043)
Relative GE change Vaud			-0.001	(0.008)
Relative GE change Valais			-0.005	(0.007)
Constant	-1.980***	(0.239)	-1.892***	(0.245)
N	1728		1728	
Log-Likelihood	-1041.174		-1036.518	
AIC	2112.347		2121.036	
BIC	2194.168		2251.949	
Pseudo-R2	0.052		0.056	

Standard errors in parentheses $^{\circ}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Reviewing the results of the average marginal effects analysis, following the logistic regression analysis, we do not find an effect of changes in enrolment in general education between 2010 and 2022 on the likelihood to perceive general education as a competitor to dual initial VET at the upper secondary level (Table 3, model 1). However, the direction of the effect is in the expected direction, but it does reach a significant level.

Regardless of the actual change in general education enrolment, German-speaking firms are more likely to have a view of general education as competition rather than a complement to dual initial VET, also when controlling for firm-level characteristics. In model 2 (Table 3) we controlled for the change in general education enrolment in the nine largest cantons in our sample, where none of the canton effects were statistically significant on the $p<0.05$ level (regardless of the type or size of change). Thus, we do not find support for H1.

Instead, we find that firms that offer VET programs requiring high academic skills are significantly more likely to perceive general education at the upper secondary level as a competitor to dual initial VET (H2), with a substantial average marginal effect (Figure 1). This is in line with the expectation that candidates who would qualify to a highly demanding program would likely also qualify for a general education track at the upper secondary level (SKBF 2023, p. 116; SERI transition barometer 2022), and that firms in the concerned vocational fields are aware of this.

Figure 2. Marginal effects on perceiving general education as competition (main independent variables)

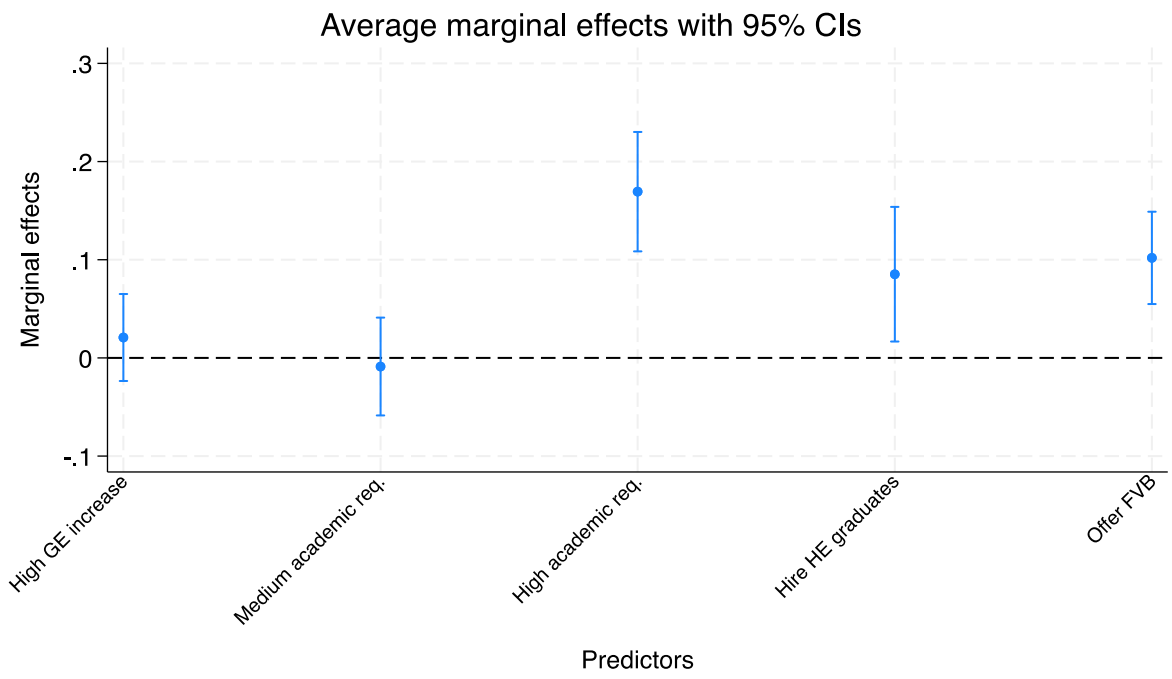
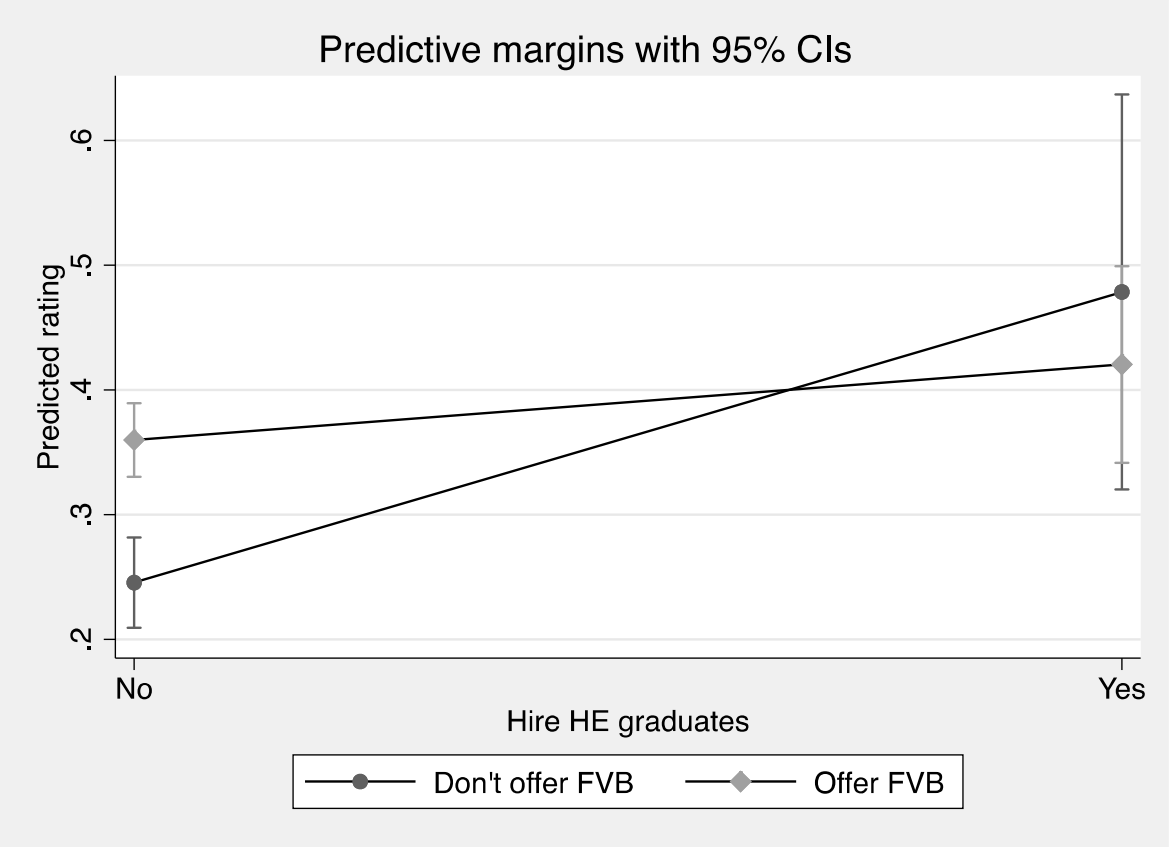


Figure 3. Interaction effects FVB offers##Hire higher educated graduates


Predictive margins with 95% CIs
Predicted rating
.2
.3
.4
.5
.6
No
Yes
Hire HE graduates
Don't offer FVB
Offer FVB

In Table 3 and Figure 2, we see that the direct effect of hiring higher education graduates is *positively* correlated with a concern for general education as a VET competitor. Hence, as independent variables, offering FVB and hiring higher educated graduates do not have a negative effect on firms' likelihood to perceive general education as competition: it is rather the opposite.

With H3, however, we set out to test whether firms that both offer FVB *and* that seek to hire higher educated graduates are rather agnostic or even supportive of general education expansion since they ultimately support and need higher educated workers. We test this by interacting the variables for offering FVB and hiring higher educated graduates. In Figure 3, we find a negative interaction effect between these two variables, including the same controls as in Model 1 Table 3 in the equation. From Figure 3, we see that hiring higher educated graduates mediates the positive effect of offering FVB on firms' likelihood to perceive general education as competition.

Discussion

Using data from FSO for the enrolment in upper secondary education (school year 2021/2022), we calculated the change in general education enrolment in the nine largest cantons in our sample since 2010 (Table 2). Examining the actual change in enrolment in these cantons and the tendency to perceive general education as competitor, we did not find convincing support for a relationship between the two factors. Furthermore, in a multivariate logistic regression analysis, the binary variable for general education change between 2010 and 2022 did not have a significant direct effect on the outcome: however, the coefficient is in the expected direction.

When replacing the binary variable for educational expansion with nine cantonal variables in the model, to further examine whether firms in any specific canton where more likely to perceive general education at the upper secondary level as a competitor to dual VET, none of the cantonal variables had a significant effect (in any direction) (Table 3, Model 2). We can therefore not confirm H1, but however note that German-speaking firms are still more likely than French- and Italian-speaking firms to see general education as competition to dual VET. This likely speaks to the strong cultural and educational traditions of vocational training in the Germanic cantons compared to the Romance cantons (Wettstein et al., 2017; Glauser and Becker, 2015).

Although enrolment in the general education track has increased in Switzerland overall over the past long decade, and in some cantons has expanded quite strongly, the perception of employers

in our sample overall remains insular to this relative change. In view of the determination of Swiss economic actors to caution against a drastic expansion in general education to preserve and valorise VET (Emmenegger et al., 2023; Hippach-Schneider and Schneider, 2018; Schweizerischer Arbeitgeberverband, 2023; Schweizerischer Wissenschafts- und Innovationsrat, 2014), and despite the actual late increase, this does not seem to affect firms' view of general education as a VET competitor. With central actors' devotion to upskilling through VET rather than in parallel with VET through hybridisation of higher education and dual VET programs at university (Emmenegger et al., 2023; Baethge and Wolter, 2015; Graf, 2016), it is reasonable to assume that even individual firms in regions where the general education enrolment is notoriously high (such as in Vaud, Valais and Fribourg) (FSO, 2024), or where it has expanded lately (such as in St. Gallen, Bern and Zurich) (Table 2) are not overall affected by the expansion *per se*.

Instead, the explained variation in the outcome, perceiving general education as a competitor to VET, likely has other causes than the actual expansion, or retraction, of general education enrolment at the upper secondary level. It is possible, if not even likely, that firms rather quickly adapt to changes on the supply side, or simply do not notice relative changes of 20 % or even 40 % on a medium-term basis, but rely more on their own individual experiences with advertising and hiring youths for their apprenticeships. In other words, if the firms themselves have not experienced a slump in new talents in the last years, they may not be likely to have given much thought to the general education track and its last (long) decade's (gradual) expansion or retraction. This notion brings us to H2.

We found positive marginal effects of VET programs with medium-high and high academic requirements (supporting H2). In these segments of surveyed firms, the higher academic requirements that the programs entail, make general education a de facto competitor for high-achieving students (see Durazzi, 2023; CSRE; 2023). It also tells us something important about these firms' skill needs and preferences for workers: had they in fact better use for workers with a general education background, as opposed to those with a vocational background, they would likely not have indicated general education as a competitor but rather perceived it as a welcome complement to the skilled workers they would already foster themselves within the organization (see Oesch, 2023).

Their preference however seems to lie with the vocationally trained workers (see Aerne and Bonoli, 2022), and general education track as educational pathway for strong learners could stand in the way for a continued balanced skill supply in the firm, or even for their future involvement in VET. This notion also corroborates the findings of Di Stasio et al. (2016), underscoring the high positional value of VET diplomas compared to general education diplomas in countries with the dual VET system.

However, highly qualified candidates are undoubtedly in demand among the medium-high and higher-skilled VET occupations, and it is also in these strata that the general education alternative poses the largest problem for the firms (CSRE 2023). Interestingly, the medium-high and high academic requirement categories in our study comprise a broad range of different vocations in various sectors, such as electricity and energy, commercial business, ICT, and arts and crafts. These vocational fields cut right across the type of work offered (blue-collar and white-collar jobs, Gibson and Papa (2000)), catering to various types of candidates: boys and girls (Bajka et al., 2024; Combet, 2023) and things-versus-people oriented skills (Kuhn and Wolter, 2022). This highlights the edge of the higher skilled vocational programs in the Swiss dual VET system, and their high level of intellectual requirements, clearly catering to all ambitious and high-achieving lower secondary school pupils.

Notwithstanding the academic requirements that certain VET programs have for their future apprentices, certain firms may both encourage their learners to pursue higher (vocational) studies through offering a federal vocational baccalaureate with access to universities of applied sciences and seek to hire higher educated workers into their firms as a skill supply strategy in parallel with dual vocational training (H3). At first glance, these two independent variables each had a positive effect on the outcome (Table 3), which is less surprising than it might seem. First, FVB-offering firms may be soliciting to a broad share of applicants, not only higher education-bound, and therefore count on it more as a signal of attractiveness than an actual encouragement and need for higher educated workers in the end (Geser, 2001; Gonon, 2001; Culpepper, 2007). Similarly, firms that in parallel with providing dual VET (in low to high-skilled occupational fields) also hire higher education graduates as regular employees may still worry about general education competing with dual VET because the higher educated workers are carrying out separate tasks and have different roles in the company. Therefore, assuming that hire higher educated graduates as a remedy for the perception of general education as a VET-competitor would be wrong, since firms have different needs and jobs in the firm may be occupied both by (higher) vocationally

and general educated workers. By interacting these two variables in our data, however, we target firms that i) likely offer FVB out of interest in vocationally higher educated workers since ii) they are also actively seeking to hire higher educated workers from universities and universities of applied sciences. Doing this, we indeed found a negative interaction effect (Figure 3).

Conclusion

The question of educational expansion and academization of work in the transition to the knowledge economy has over the last years gained a lot of traction in the scholarly debate (Schofer and Meyer, 2005; Baethge and Wolter, 2015; Benassi and Durazzi, 2018; Haasler, 2020; Damelang and Ruf, 2023; Deissinger, 2019). Collective skill formation systems have been known to better counter the nefarious effects of overeducation, by providing vocational students with portable occupational skills that are well-matched with labour market needs (Bonoli and Emmenegger, 2022; Busemeyer and Trampusch, 2012) and held in high esteem by employers (Di Stasio et al., 2016). However, considering recent educational expansion also in dual VET systems, where training-providing firms are key actors, little attention in the literature has been given to the perspective of firms in the face of general education expansion. This paper has aimed to close this gap by investigating the relationship between the expansion of general education at the upper secondary level, firm-level characteristics and strategies, and the perception of general education as a competitor to dual VET programs in Switzerland.

Among around one third of firms in our sample, the general education track is seen as a competitor for the VET program. Despite the reported lack of skilled workers in many sectors (CEDEFOP, 2022), our findings indicate that it is not the *expansion* of general education enrolment at the upper secondary level *per se* that may be the culprit in Switzerland. Previous literature has highlighted the increased need for high-skilled workers in knowledge-intensive sectors also in the dual VET stronghold Switzerland, and an occupational upgrading blurring the line between vocational and theoretical skills and skill needs on the labour market (Oesch, 2023; Markowitsch and Hefler, 2019). However, firms that themselves train for high-skilled occupations in ICT, electronics and automation, and commercial business work, to mention a few, are comparatively more preoccupied with general education as a competitor to VET than viewing it as a potential complement to dual VET, notwithstanding its actual level of expansion the last (long) decade.

Controlling for the relative expansion, the academic requirements in the firm, along with another large set of controls (see table A1 in the appendix), we find that an interaction between offering a federal vocational baccalaureate and hiring higher educated workers can turn things around. Firms with this combination of offers and skill supply strategies are significantly less likely to perceive general education as a competitor to VET. This insight aligns well with previous literature highlighting the favourable position of firms with high skill-ratio in the transition to the knowledge economy (Bratti and Matteuci, 2004), and similarly for firms with needs for high vocational and general skills (Durazzi, 2023). Thus, they underscore previous literature addressing the intertwined challenges of technological change and upskilling in VET and the expansion of general education with regards to sustaining interest in VET as an education track among compulsory school leavers (Baethge and Wolter, 2015; Oesch and Piccitto, 2019; Fleckenstein et al., 2023; Durazzi, 2019).

Our study of Switzerland, a country where the political consensus to maintain a high status of VET and to improve its permeability to higher education rather than expanding academic education at its expense (Emmenegger et al., 2023), has provided a critical case for testing the notion of the potential 'threat' of general education expansion at the upper secondary level. Our findings concur with previous studies underscoring the relatively high level of satisfaction with VET and contributing with a firm-level perspective spanning across language regions and industries (KOF, 2024). Despite the overall increase in general education enrolment in the country, this effect is not statistically related to firms' view of general education as a competitor when controlling for academic requirements of VET programs, as well as other firm-level characteristics (Figure 2). Heterogeneity within and between the cantons and among the firms that have not been accounted for in this study are many, limiting the explanatory potential of this paper but providing avenues for future research. These include political processes and interests to either strengthen VET or general education (or both) on the cantonal level, accounts on cantonal educational history and specific industrial relations, specific demographic change and challenges, as well as educational and occupational preferences and aspirations of the young generations which make cause *within-VET* competition rather than general education-VET competition.

Furthermore, out of around 60'000 Swiss firms that train apprentices (Gonon, 2014; KOF 2024), we have only reached a sub-sample which unmistakeably limits our possibilities for nuancing the analysis and capture and explaining variation across firms and their contextual setting. To

address the critical issue of the survival of relevance of VET in the time of academization, upskilling and technological change, we also recommend cross-country comparisons delineating the complementarities or competition of general education and dual VET in different institutional contexts.

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Appendix

Figure A1. Goodness of fit test

```
Goodness-of-fit test after logistic model
Variable: compacdtr_dummy

      Number of observations =   1,728
Number of covariate patterns =   1,724
          Pearson chi2(1701) = 1727.85
                 Prob > chi2 =  0.3194
```

Figure A2. Correlation matrix

	~0_dummy	skill_~c	appsk~ni	diffic~y	mainap~l	size	oda_du~y	langua~y	exp5ye~s	shorte~n
change_ge1~y	1.0000									
skill_spec	0.0529	1.0000								
appskills~ni	0.0138	0.1974	1.0000							
difficult_~y	-0.0305	-0.0963	-0.0533	1.0000						
mainapproa~l	-0.0459	-0.1076	-0.0890	0.0579	1.0000					
size	0.0211	0.1817	0.2089	-0.0646	-0.0514	1.0000				
oda_dummy	-0.0127	-0.1010	-0.0651	0.0586	0.0710	0.0410	1.0000			
language_d~y	0.0096	-0.0184	-0.0924	0.1182	0.0236	0.0372	0.2702	1.0000		
exp5years	0.0132	0.0913	0.0412	-0.0205	-0.0923	0.0608	-0.0708	0.0736	1.0000	
shortest_d~n	-0.0218	-0.0105	0.0681	0.0179	0.0494	0.0227	-0.0057	0.0117	0.0118	1.0000

Table A3. Collinearity Diagnostics

Variable	VIF	SQRT VIF	Tolerance	R-Squared
change_ge10_dummy	1.01	1.00	0.9943	0.0057
skill_spec	1.09	1.05	0.9138	0.0862
appskillsupply_hiretechuniuni	1.10	1.05	0.9112	0.0888
difficult_dummy	1.03	1.01	0.9710	0.0290
mainapproach_full	1.03	1.02	0.9679	0.0321
size	1.08	1.04	0.9250	0.0750
oda_dummy	1.11	1.05	0.9046	0.0954
language_dummy	1.11	1.05	0.8994	0.1006
exp5years	1.03	1.02	0.9698	0.0302
shortest_duration	1.01	1.00	0.9905	0.0095
Mean VIF	1.06			

Eigenval	Cond Index

1	**7.2853**	**1.0000**
2	**0.9133**	**2.8244**
3	**0.7957**	**3.0259**
4	**0.4594**	**3.9822**
5	**0.3915**	**4.3139**
6	**0.3188**	**4.7805**
7	**0.3061**	**4.8783**
8	**0.2381**	**5.5314**
9	**0.1434**	**7.1269**
10	**0.1135**	**8.0117**
11	**0.0349**	**14.4507**

Condition Number 14.4507

Eigenvalues & Cond Index computed from scaled raw sscp (w/ intercept)

Det(correlation matrix) 0.7395

Figure A4. Marginal effects of firms' likelihood to perceive GE as a competitor to dual VET (including cantonal variables for relative change in GE enrolment 2010-2022)

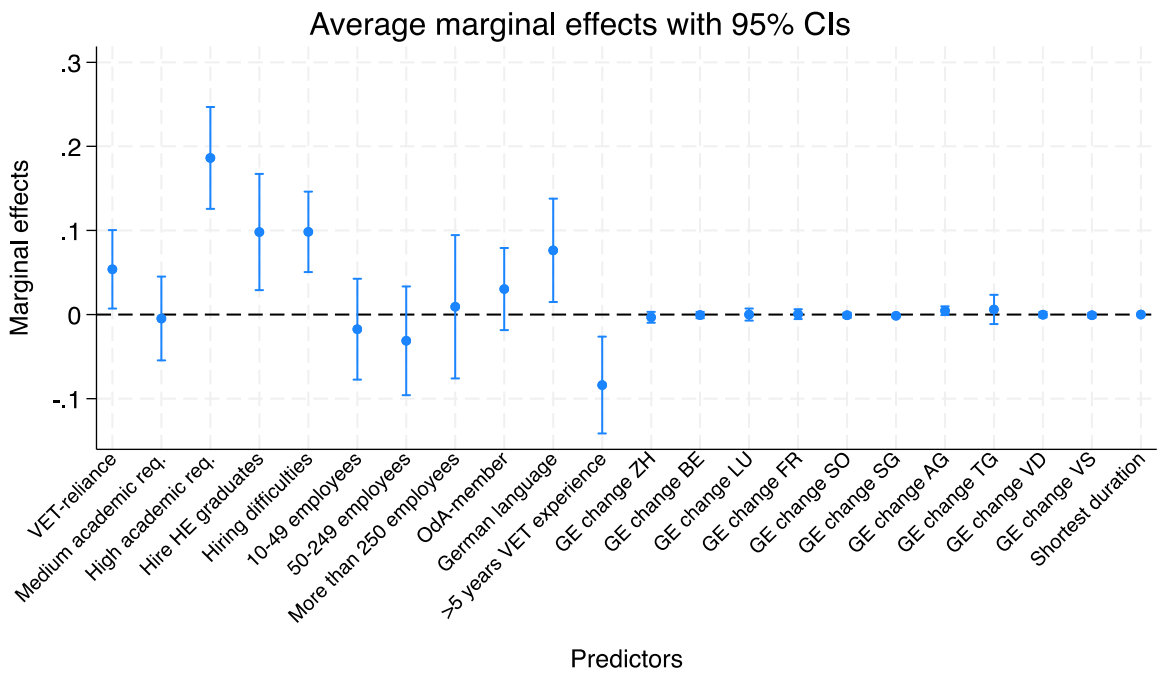
Average marginal effects with 95% CIs
Marginal effects
.3
.2
.1
0
-.1
VET-reliance
Medium academic req.
High academic req.
Hire HE graduates
Hiring difficulties
10-49 employees
50-249 employees
More than 250 employees
OdA-member
German language
>5 years VET experience
GE change ZH
GE change BE
GE change LU
GE change FR
GE change SO
GE change SG
GE change AG
GE change TG
GE change VD
GE change VS
Shortest duration
Predictors

Table A2. Logistic regression models on firms' likelihood to perceive general education as a competitor to VET (with interaction term VET-reliant*Hire HE graduates and Academic requirements*Hire HE graduates)

	Model 1		**Model 2**	
	General education competitor to VET program (ref. No)		**General education competitor to VET program (ref. No)**	
GE increased over average since 2010 (ref. No)	**0.115**	**(0.109)**	**0.104**	**(0.109)**
Rely on VET for skill supply (ref. No)	**0.257***	**(0.114)**		
Hiring difficulty (ref. Not difficult)	**0.478*****	**(0.118)**	**0.479*****	**(0.119)**
Firm size	**-0.042**	**(0.060)**	**-0.018**	**(0.061)**
OdA-member (ref. No)	**0.165**	**(0.120)**	**0.163**	**(0.120)**
Language dummy (ref. French/Italian)	**0.341***	**(0.151)**	**0.340***	**(0.151)**
Respondents' experience in VET (ref. Less than 5 years)	**-0.411****	**(0.142)**	**-0.417****	**(0.142)**
High academic requirements	**0.943*****	**(0.135)**		
Hire graduates from (technical) universities	**0.611****	**(0.229)**	**0.938*****	**(0.247)**
High academic requirements # Hire graduates from (technical) universities	**-0.325**	**(0.329)**		

Shortest travel duration to HEI	**-0.000**	**(0.000)**	**-0.000**	**(0.000)**
Medium academic requirements			**-0.020**	**(0.127)**
High academic requirements			**0.810*****	**(0.139)**
VET-reliant			**0.372****	**(0.124)**
VET-reliant # Hire graduates from (technical) universities			**-0.832***	**(0.327)**
Constant	**-1.750*****	**(0.241)**	**-1.844*****	**(0.247)**
N	**1727**		**1728**	
Log-Likelihood	**-1047.317**		**-1047.570**	
AIC	**2118.635**		**2121.141**	
BIC	**2184.084**		**2192.052**	
Pseudo-R2	**0.046**		**0.046**	

Standard errors in parentheses

$^{¬^{\infty}}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A3 Variables

General track competitor to VET track: We asked the respondents: In your opinion, does the baccalaureate school track at the upper secondary level compete for the same youths as the vocational program in which you are mainly involved? The respondents could indicate "Yes", "No" and "Don't know". We removed the "Don't know" answers and recoded the other values to 0 (=No, reference category) and 1 (=Yes).

Hiring difficulty: We asked the respondents to indicate the extent to which they had had difficulties hiring adequate candidate(s) to their main vocational program the last 12 months. The response categories ranged from "Very easy", "Easy", "Neither easy not difficult" to "Difficult" and "Very difficult", and "Don't know". We removed the "Don't know" answers and transformed the other responses to a binary variable where "Difficult" "Very difficult" were collapsed into one category (=1), and the "Very easy", "Easy" and "Neither" into the reference category (=0).

Rely on VET for skill supply: We asked the respondents to indicate the extent to which VET is their main skill supply approach (fully agree, rather agree, neither, rather disagree, fully disagree) or "Don't know". We removed the "Don't know" answers and recoded the other answer categories to a binary variable with "fully agree" and "rather agree" answers were collapsed into one category (=1), and the remaining into the reference category (=0).

Diversity of skill supply approaches: We used the eight answer categories to the survey item "Which approaches does your firm use to secure the skill supply?" to create a continuous variable (values 1-8). The categories were "Train foreign apprentices", "Hire graduates from VET schools at the upper secondary level", "Provide continued training for employees", "Hire skilled workers", "Hire skilled workers from related fields", "Hire graduates from technical universities and/or universities", "Outsource recruitment to external firms", and "Investing in R&D". We recoded these answers into a continuous variable ranging from values 1-8, to indicate the diversity of the skill supply approaches in the firm. Due to the fewer observations in firms that employed 6 or more skill supply approaches, we collapsed the observations with 5, 6, 7 or 8 to one category, and retained an ordinal scale variable with 5 values: 1= low skill supply diversity (reference category), 2 = medium-low skill supply diversity, 3 = medium skill supply diversity, 4= medium-high skill supply diversity, 5= high skill supply diversity.

Skill level of VET program: We used the on the skills profiles of vocational programs described at profilsdexigence.ch/anforderung.ch, developed by USAM and CDIP (co-financed and supported by SEFRI), and attributed the average score between 1-4 (in the subjects Math, home language, natural science, and foreign language) to the different programs. Then we used a weighted average, by the share of respondents per vocational programs, to attribute an average skill level score to the vocational field. In the cases where the vocational program was not specified by the respondents, we used the average score among the existing training programs in the vocational field and imputed this value to these "Other" categories. In the cases where the vocational program's skill profile was not available at profilsdexigence.ch, we used the closest existing vocational program's skill average and attributed this to the vocational program in question. The index we used to score the vocational programs and fields is available in Table A10. We divided the sample in tertiles and created a three-level variable, where 1 equals low, 2 equals medium, and 3 equals high skill requirements.

Firm size: We asked the respondents to indicate how many employees the firm has along the following categories: 1-9 employees, 10-49 employees, 50-249 employees, or 250 and more employees. The answers were recoded into an ordinal scale variable with the codes 0 (= 1-9

employees, reference category), 1 (=10-49 employees), 2 (=50-249 employees) and 3 (=250 or more employees). We removed the "Don't know" answers.

OdA-membership: We asked the respondents to indicate whether their establishment was member of an Organisation of the working world (OdA / Ortra). The respondents could indicate "Yes", "No", or "Don't know". We removed the Don't know answers and recoded the remaining categories to a binary variable (0= No, 1= Yes).

General education relative change in cantons 2010-2022: We obtained statistical data from the BFS of general education offers in the 26 cantons from the year 2010/11 and the year 2021/22 (BFS, 2020, 2024). We calculated the relative change in general education enrolment (%) in all the cantons between the two points in time. We recoded the values from the continuous general education change variable into a binary where cantons that had a below average (i.e. 19.4%) increase were coded 0, and cantons where the general education enrolment increased over the average were coded 1.

German-speaking firm: We used the language in which the respondents had taken the survey to approximate the common language spoken in the firm (German, French or Italian). Given the tradition of dual VET in Switzerland being stronger in the German-speaking regions compared to both French- and Italian-speaking regions (Wettstein et al. 2017; Gonon and Maurer, 2012), we recoded the variables into a binary, where French- and Italian-speaking firms were merged (=0) into one reference category and the German-speaking firms got a category of their own (=1).

Experience in VET: We asked the respondents to indicate how many years of experience working with dual VET-related tasks at work they had. We recoded the answers to a binary variable where 0 equals less than 5 years of experience, and 1 equals more than 5 years of experience.

Shortest travel duration between firm and HEI: We estimate the distances training firms travel to HEI along public transport routes, as it has been (frequently) done in the geographical transport literature (Costa et al. 2021).
Since VET candidates are not allowed to drive and usual live in proximity of their future employers, we measured public transport journeys durations between firms and HEI. To calculate routes distances, we used the application programming interfaces (API) for Google Maps. The API for Google Maps enabled a query based on firm coordinates we had collected with our survey and manually collected HEI coordinates to be sent to Google's online servers, which then returned a calculated route in a standardised format.
The Google API has daily search limits and is computational demanding, therefore, we split up our inquiries across three workdays (Wednesday to Friday) between 07.30 and 09.30. The calls made were within the bounds of the daily inquiry limits. Yet, at various occasions, this approach would fail to return a result. The reasons for these failures were not clear, in certain cases it had to the firm location were so far away (probably due to respondents using a VPN connection or being on holiday) to that no public transport rote could be calculated. Thus, distances could be extracted from Google providing a reasonable solution for calculating routes.

Table A4 Descriptive statistics of main variables

Variables	**Freq.**	**Percent**
Hiring difficulties		

No	566	32.18
Yes	1172	67.82
Total	1728	100
Rely on VET for skill supply		
No	596	34.49
Yes	1132	65.51
Total	1728	100
Hire tertiary educated workers		
No	1534	88.77
Yes	194	11.23
Total	1728	100
Academic level required in vocational fields		
Low	658	38.08
Medium	644	37.27
High	426	24.65
Total	1728	100
Firm size		
1 to 9 employees	352	20.37
10 to 49 employees	690	39.93
50-249 employees	497	28.76
More than 250 employees	189	10.94
Total	1728	100
OdA-membership		
No	556	32.18
Yes	1172	67.82
Total	1728	100
GE increased over average since 2010		
No	665	38.48
Yes	1063	61.52
Total	1728	100
Language spoken in firm		
French/Italian	309	17.88
German	1419	82.12
Total	1728	100

Experience in VET		
Less than 5 years	331	19.16
More than 5 years	1397	80.84
Total	1728	100

Table A5 Participation of firms in various vocational fields, compared to the most popular VET programs during 2022

Vocational fields	**n firms**	**Most popular occupations in Switzerland 2022**	**Nr of apprenticeships**
Construction	316	Commercial employee (Secretary and office work)	12768
Human health care and social work	289	Healthcare worker (Human healthcare and social work)	4979
Secretary and office work	175	Retail clerk (Wholesale and retail)	4196
Machines and metal industry	141	Social care worker (Human healthcare and social work)	3951
Wholesale and retail	136	IT technician (ICT)	2237
Hospitality	118	Electrician (Electricity and energy)	1946
Electricity and energy	106	Logistician (Transport)	1771
Vehicles, ships and airplanes	74	Draughtsman (Architecture and urban planning)	1504
Food production	61	Cook (Hospitality)	1487
Architecture and urban planning	54	Farmer (Crop production and animal breeding)	1420
Transport services	42		
Materials	47		
Hairdressing and beauty	30		
Electronics and automation	28		
Dentistry	31		
Domestic services	23		
Crop production and animal breeding	35		
Gardening	32		
ICT	37		
Forestry	21		
Arts and crafts	13		

Chemistry	13
Audio-visual technique	8
Textile production	9
Fashion and industrial design	7
Veterinary medicine	4
Library services	1
Recycling	2
Sum	1854

Note: Data on most popular occupations obtained from SBFI (2022). The cells highlighted in grey indicate an overlap between the most popular VET programs and the highest participation of firms in different vocational fields in this survey.

Table A6 Survey protocol

Date	Steps taken
January 2021-October 2022	Collection of training firm contact details from open recruitment platform berufsberatung.ch
June-July 2022	Exploratory interviews and adaptation of survey questionnaire
08.11.22	Pre-registration of PAP and hypotheses on OFS (Wilson and Bajka, 2022)
10.11.22	Exemption for survey from UNISG Ethics Commission obtained
22.11.22	Launch of survey to contacts
06.12.23	First reminder
17.01.23	Second reminder
16.05.23	Survey closed, 2738 responses (25% response rate).
20.06.23	Results reported to respondents who had indicated interest.

Table A7 Interview protocol

Function	Sector	VET program	Location	Date	Length	Interviewer

HR personnel, VET responsible	Commerce and administration	Employé de commerce	Lausanne (online interview)	21.06.22	0.26	Anna
Apprentice unit manager	Public administration	Employé de commerce, ICT, Technical support, Parks and maintenance, Customer relations, etc.	Lausanne (online interview)	07.07.22	0.37	Anna
HR personnel, VET responsible	Commerce and administration	Employé de commerce, Logisticien	Lausanne (online interview)	13.07.22	0.35	Anna
HR personnel	Machines and metal industry	Industrial manufacturer, EFZ	Lausanne (written questionnaire)	15.07.22	0.20	.
Management team	Construction	Plumbing fitter, EFZ	Lonay (written questionnaire)	13.07.22	0.19	.
HR personnel	Electricity and energy	Electric installer, EFZ	Lausanne (written questionnaire)	26.07.22	0.23	.
Software developer / VET trainer	ICT	ICT-Kauffrau/Kauffman	St. Gallen (online interview)	12.07.2022	Ca 1h	Scherwin
HR personnel, involved in VET training	ICT	ICT-Kauffrau/Kauffman	St. Gallen (online interview)	12.07.2022	Ca 1h	Scherwin
Head of VET program in IT	ICT	ICT-Kauffrau/Kauffman	St. Gallen (online interview)	14.07.2022	Ca 1h	Scherwin
HR personnel, involved in VET training	ICT	ICT-Kauffrau/Kauffman	St. Gallen (online interview)	09.08.2022	Ca 1h	Scherwin

Figure A5 Participation and non-participation in survey by vocational field

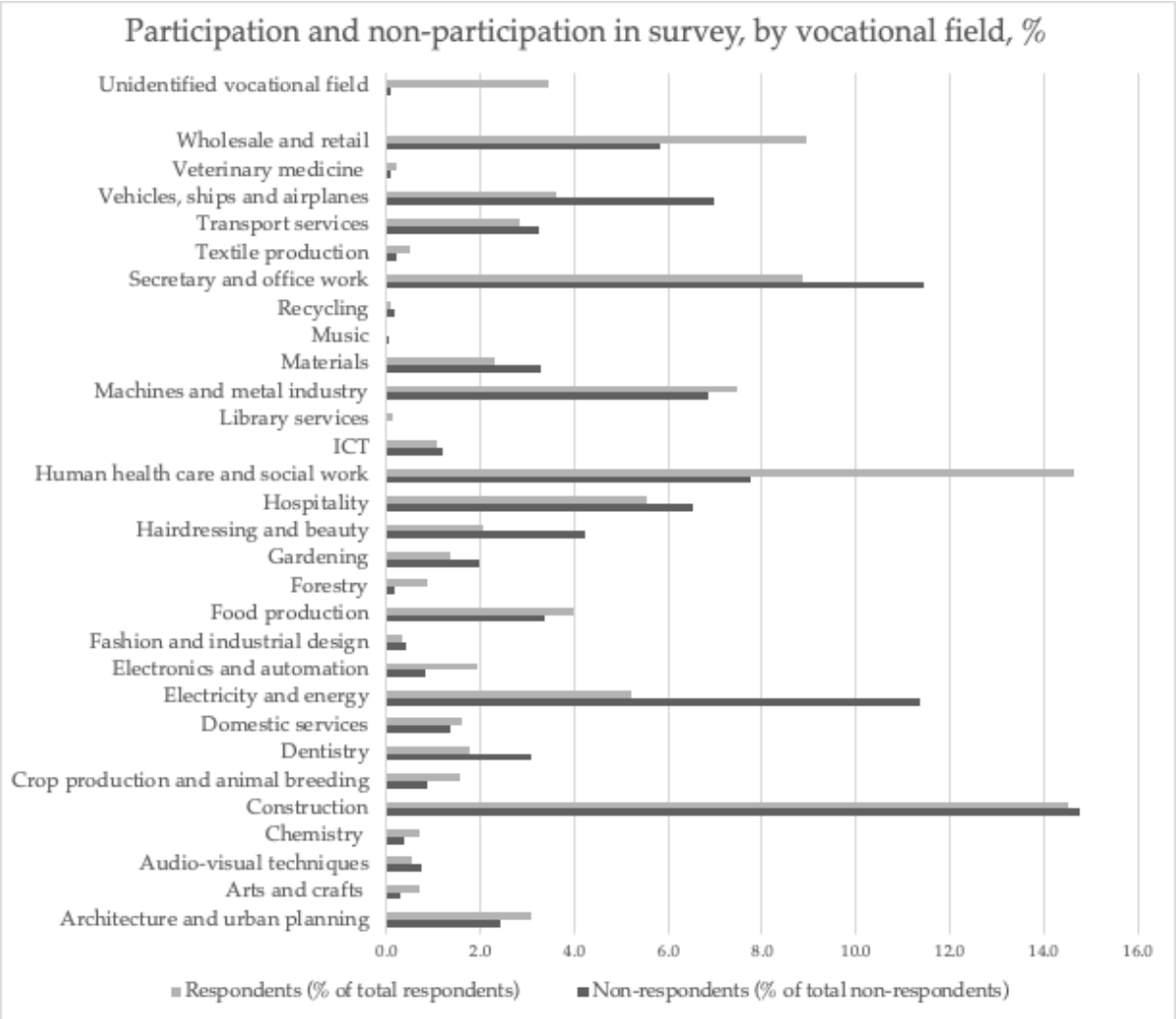

Figure A6 Respondents and non-respondents, by canton, %

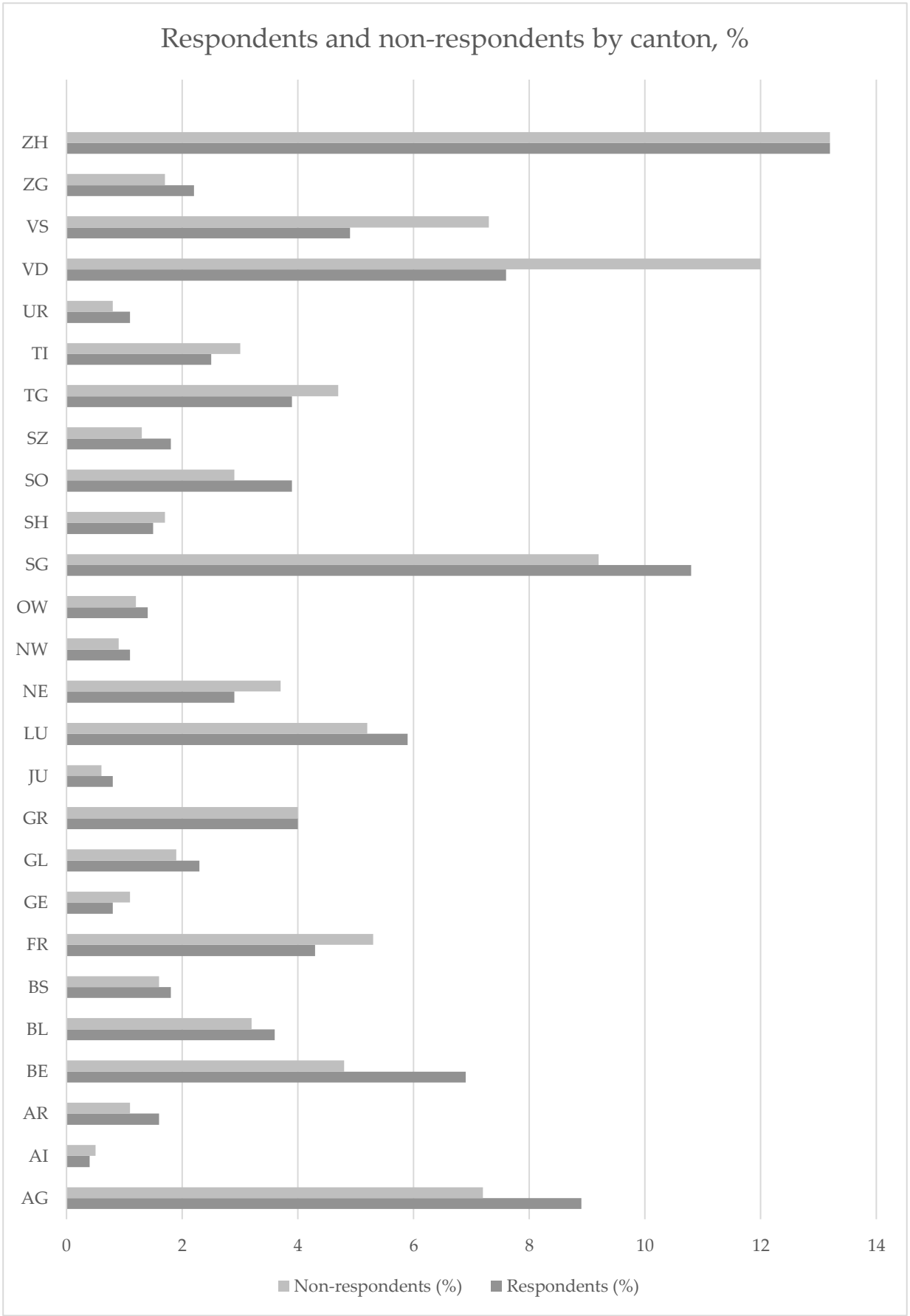

Table A8. Coding of skill level variable

Vocational field	Skill requirement average (profilsdexigence.ch / anforderung.ch) (1-4)	3 skill-level categories
Domestic services	2.0	Low
Forestry	2.0	Low
Hair and beauty	2.0	Low
Dentistry	2.0	Low
Recycling	2.0	Low
Transport	2.1	Low
Hospitality	2.2	Low
Gardening	2.2	Low
Crop and animal breeding	2.2	Low
Food production	2.2	Low
Construction	2.2	Low
Retail and wholsale	2.3	Low
Textile production	2.3	Low
Audiovisual technique and media	2.4	Medium
Material production	2.4	Medium
Vehicles	2.5	Medium
Machine and metal industry	2.5	Medium
Healthcare and social work	2.5	Medium
Electricity and energy	2.6	Medium
Veterinary medicine	2.7	Medium
Fashion and industrial design	2.7	Medium
Office work	2.7	Medium
Arts and craft	2.9	High
Electronics and automation	3.0	High
ICT	3.0	High
Chemistry	3.2	High
Architecture and urban planning	3.3	High
Library and information services	3.3	High

Table A9 Relative change in general education enrolment in Swiss cantons, 2010-2022

Canton	GE enrolment 2010	Ge enrolment 2022	Relative change
Zürich	23.3	25.9	11.2
Bern	22.2	27.5	23.9
Luzern	22.5	25.5	13.3
Uri	22	19	-13.6
Schwyz	20.5	24.8	21.0
Oberwalden	19.8	19.9	0.5
Niederwalden	25.1	23.6	-6.0
Glarus	19.6	21.2	8.2

Zug	29.1	37.7	29.6
Fribourg	37.1	44.1	18.9
Solothurn	19.7	27.2	38.1
Basel-stadt	46.6	49.6	6.4
Basel-landt	32.2	40.1	24.5
Schaffhausen	18.4	21.7	17.9
Appenzeller-ausserrhoden	19.7	24.3	23.4
Appenzeller-innerrhoden	24.3	19.5	-19.8
St. Gallen	15.8	22.6	43.0
Grisons	25.3	23	-9.1
Aargau	20.9	24.1	15.3
Thurgau	18.5	19.7	6.5
Ticino	39.7	42.7	7.6
Vaud	44.7	56.8	27.1
Valais	27.8	37.7	35.6
Neuchatel	34.3	39.6	15.5
Geneve	58.8	65.4	11.2
Jura	29.7	31.8	7.1
Mean value			**13.7**

Source: FSO (2024)

Table A10 Chi2-test VET-reliance and academic requirements

Rely on VET for skill supply (ref. No)	Skill level in vocational fields			Total
	Low skill	Medium sk	High skil	
Not VET-reliant	**199**	**209**	**188**	**596**
VET-reliant	**459**	**435**	**238**	**1,132**
Total	**658**	**644**	**426**	**1,728**

Pearson chi2(**2**) = **23.9608** Pr = **0.000**