

ORIGINAL ARTICLE OPEN ACCESS

Meeting the Twin Challenge in Times of Labor Shortage: How Modern Societies Promote Future Skills for the Digital and Green Transitions

Subjective Technology Risk and Education Preferences: VET as a Safe Haven or Dead End?

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ABSTRACT

Education equips individuals with valuable skills to protect them against employment risks associated with the digital transition. As scholars debate whether vocational education and training (VET) or general education better insures against technology-induced employment risk, we ask how this type of risk, as perceived by individuals, shapes their education preferences. Our analyses, based on a survey of over 11,500 respondents across seven European countries, show that VET is regarded as a safe haven by those perceiving heightened risk. This relationship remains robust when controlling for various alternative explanations and is consistent across countries. Subgroup interactions indicate that men, high-income earners, respondents with tertiary education, and those politically on the right more strongly favor VET in response to subjective technology risk. Hence, our study suggests that VET's practical, job-oriented focus is perceived as better protection against the growing uncertainty over skill demands in the twin transition than general education.

1 | Introduction

The rapid technological progress underpinning the twin transition creates fundamental uncertainty for workers by reshaping skill requirements at unprecedented rates. Yet, as Streeck (1989, 92) has argued, undertaking costly investments in skills “presupposes a degree of certainty as to what one is likely to need and value in the future.” The digital and green transitions erode existing certainties about the expected value and security provided by different educational paths, raising the stakes when it comes to educational choices. As fundamental uncertainty complicates objective judgments (Beckert 1996), people's subjective perceptions come into focus. Yet, how technology-induced risk as perceived by individuals shapes their education preferences has received surprisingly little attention.

One of the most consequential choices people face in their educational career is that between different tracks at the upper secondary level. In most European countries, adolescents choose between a vocational and a general track (Giudici et al. 2023;

Shavit and Müller 2000). Later choices, such as whether to go to university or which major to enroll in, have received greater scholarly attention, but the choice of upper secondary track may arguably be even more foundational for later economic outcomes (Hanushek et al. 2017; Korber and Oesch 2019). The climate of heightened uncertainty due to the twin transition is bound to influence people's thinking about which track offers better prospects. Yet, neither the existing literature nor first principles offer an unambiguous answer to this question.

Two contrasting perspectives dominate the existing literature. Scholars influenced by human capital theory have presented vocational education and training (VET) as the risk-averse choice—an educational “safety net” (Shavit and Müller 2000). For example, it lowers the relative cost of acquiring post-compulsory education for working-class youth by offering them a straightforward path to stable employment (Breen and Goldthorpe 1997). This, in turn, reduces the incidence of unskilled work in countries like Germany (Freeman and Schtettkat 2001). Moreover, dual VET promises to align training

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content and labor market needs through the involvement of firms in the definition of training content (Emmenegger and Haslberger 2025). Even if opportunities for wage growth may be more limited (Hanushek et al. 2017), VET therefore presents a favorable risk profile compared to general education (GE) according to this perspective.

However, a contrasting view holds that VET is now a riskier choice. This view, inspired by the varieties of capitalism literature's characterization of vocational skills as highly specific and therefore inherently risky (Estevez-Abe et al. 2001; Streeck 2011), argues that general skills as provided by academic education better prepare people for future skill needs (Iversen and Soskice 2019; Diessner et al. 2022). Durazzi (2021) points out that this may even be true of countries whose growth model relies on advanced manufacturing, where the literature has traditionally assumed a symbiotic relationship with vocational education (Thelen 2014; Wren 2013). Neither strand of literature, however, has investigated people's subjective response to increased uncertainty due to the twin transition.

In this paper, we therefore ask how people's educational preferences at the upper secondary level are shaped by subjective technology risk? We use novel data from a large, representative survey of educational attitudes and preferences in seven European countries (Denmark, England, France, Germany, Portugal, Sweden, Switzerland) with 11,508 respondents. We focus on the choice between vocational and general education at the upper-secondary level because, at this stage, young people sort into tracks in most countries (Giudici et al. 2023). Our main dependent variable is whether respondents personally prefer the vocational or general track. Our respondents are representative of the working-age population in their country and thus have already completed secondary education. They are not facing the decision they are asked about themselves, but are likely to, in their role as parents, relatives, or family friends, influence the sociocultural context in which young people make their decision (Schoon and Parsons 2002)—indeed, they may in practice even make the choice for them.¹ Moreover, unlike adolescents who do not yet have labor market experience, working-age respondents are in a position to link technology risk and educational choices, allowing us to study this important question. Our main independent variable is whether respondents fear losing their job due to a lack of technological skills, capturing subjective technology risk (henceforth STR).

Our analyses show that VET is widely perceived as a safe haven—it appears particularly attractive to individuals who in their own estimation face significant employment risk from technological change. Crucially, this association remains robust and strong when we condition on a range of control variables and the main alternative explanations; that is, educational background to account for status quo bias and potential endogeneity, as well as occupations as a proxy for objective technology risk. Moreover, the relationship is consistent across seven countries with very different education systems. Yet while the relationship is robust, it is not homogeneous. Interaction analyses show that men, high-income, highly educated, and right-leaning individuals increase their favorability towards VET more strongly in response to STR. Our findings point to a hitherto underappreciated implication of the twin transition: as uncertainty over

skill needs grows, people perceive VET to offer an advantage. VET policy may be able to build on this to prepare VET systems for the future and increase their attractiveness for qualified students.

The paper proceeds as follows. The next section situates the role of education in the wider literature on technological change. Section 3 introduces the competing perspectives on VET and argues that high-risk people who experience elevated technology risk are likely to view VET as a safe haven. Section 4 describes our data and analytical approach, and Section 5 presents the results. A final section concludes.

2 | Literature Review

The existing literature on individual educational choices and preferences has generally paid relatively little attention to the role of technology risk. Social stratification research building on established rational choice models of educational decisions (e.g., Breen and Goldthorpe 1997) has at least tried to integrate risk and uncertainty, although without explicit reference to new technologies. Breen et al. (2014) work with Danish register data to show that individuals with high risk aversion and high discount rates on future expected income are less likely to enroll in the academic upper secondary track. Complementary work by Holm et al. (2019) furthermore shows that low-SES individuals are more likely to drop out of academic education if they receive a negative information shock regarding the difficulty of the track, while Cattaneo and Wolter (2022) show that sensitivity to information about drop-out risks may vary geographically. This research highlights the subjective nature of risk perceptions, as individuals often have incomplete information when making educational decisions. Moreover, it indicates that sensitivity to risk may differ between groups of people.

Other studies in economics zoom in on the role of the social prestige of occupations or cultural differences between natives and immigrants in explaining preferences for vocational or academic education. Abrassart and Wolter (2020) find that in Switzerland, occupations requiring vocational education are perceived as less prestigious, but the expansion of VET at the tertiary level could raise the social prestige of such occupations. Abrassart et al. (2020) show that first-generation immigrants in Switzerland tend to have a stronger preference for academic education over VET, while the preferences of second-generation immigrants are more similar to those of natives. Taken together, research on individual-level educational choices highlights uncertainty over payoffs, concerns over occupational prestige, and cultural influences as factors pushing people to pursue one upper secondary track over the other. However, none of these studies systematically take into account STR, that is, the expectation that one might lose one's job because of technological change. Where risk is considered at all (Breen et al. 2014; Holm et al. 2019), it is as a catch-all category for uncertainty over payoffs to education, and the authors remain agnostic regarding the source of the uncertainty.

By contrast, the political science literature has established subjective technology risk as a distinct concept that merits explicit attention. As Ahrens (2024) and Bicchi et al. (2024) argue,

subjective risk is the theoretical channel through which objective risk filters through to political preferences.² However, education is strangely absent in the growing literature that deals with the effects of automation and digitalization on political behavior (Haslberger et al. 2025). Whereas economists and sociologists have focused on structural changes, documenting upgrading and sometimes polarization in the employment and wage structure (Haslberger 2021; Oesch and Piccitto 2019; Cortes 2016; Autor and Dorn 2013; Acemoglu and Autor 2011), political scientists grapple with the downstream effects of these trends. A growing body of work investigates the effects of technology on social policy preferences and voting behavior (for overviews see, e.g., Gallego and Kurer 2022; Weisstanner 2023; Kurer and Häusermann 2022; Kurer and Van Staaldin 2022), but education preferences have remained a blind spot. Early work focused mostly on “objective” measures of exposure to technology, such as routine intensity scores (Autor et al. 2003; Fernández-Macías and Hurley 2017; Haslberger 2022), and established that risk exposure increases right-wing populist voting and support for some forms of social policy (for examples, see Thewissen and Rueda 2019 and Im et al. 2019).³ As the field matured, people’s subjective risk perceptions have increasingly come into focus. Scholars have pointed out that objective measures of exposure and subjective risk perceptions often do not correspond closely (Ahrens 2024), and the latter tend to have greater explanatory power (Gallego et al. 2022; Bicchi et al. 2024; Busemeyer and Tober 2023). Recently, the literature has begun to incorporate generative AI as a new form of technology risk (for examples, see Magistro et al. 2024 and Haslberger et al. 2024), but it has remained focused on social policy preferences and voting behavior. In summary, sociologists and economists working on educational choices have paid little attention to technology risk, and political scientists working on technological change have largely ignored education preferences. As a result, we know very little about how digitalization and the attendant risks affect education preferences.

Yet, one of the most fundamental impacts of digitalization is on skill formation, requiring new skill sets and tasking education policy with adapting skill formation systems to an environment characterized by rapid change and uncertainty (see introduction to this special issue; Carstensen et al. 2025). Against this backdrop, policy proposals increasingly promote high-quality VET as a means to address emerging skill demands (Lee 2024). National and international actors, including the European Union, have long championed VET reform and expansion (Bonoli and Emmenegger 2022; European Commission 2010, 2016), and recent initiatives such as the European Green Deal and reports on Europe’s (lack of) competitiveness have added a renewed sense of urgency (European Commission 2024). Many advanced economies already face skill shortages in occupations requiring vocational qualifications (Cedefop 2025), underscoring the importance of VET in strategies to address labor market needs.

VET indeed appears attractive for several reasons: it facilitates school-to-work transitions and reduces youth unemployment (Breen 2005), provides substantial labor market returns for individuals without higher education (Bol et al. 2019; Schulz et al. 2023; Hanushek et al. 2017), and is associated with lower wage inequality (Emmenegger and Haslberger 2025). High-quality vocational training has helped countries like Germany

and Switzerland more evenly distribute the economic benefits of technological innovation (Lee 2024). Moreover, VET systems can play an integrative role, offering pathways into the labor market for migrants and less academically inclined individuals (Bonoli and Wilson 2019; Bonoli and Otmani 2023). However, despite these advantages and widespread political support, there remains a disconnect between macro-level evidence on the benefits of VET and the limited research on individuals’ motivations to choose vocational or general education—particularly in light of the fundamental uncertainty associated with the twin transition. In the next section, we outline how two contrasting perspectives rooted in the extant political economy literature would lead people to view VET either as a “dead end” or as a “safe haven” and argue why we ultimately expect the safe haven view to prevail.

3 | Theory: Subjective Technology Risk and Education Preferences Under “Vast Uncertainty”

Autor (2022) argues that current technological change is taking place in a climate of “vast uncertainty” which makes predictions over the future impact difficult. This gives rise to what we may call subjective technology risk (STR): a perception that one may lose one’s job due to an inability to keep up with changing skill requirements.⁴ We expect that STR influences people’s educational preferences. Research shows that people who worry about losing their job due to technological change are more likely to support social protection policies such as unemployment benefits and less likely to support social investment policies (Busemeyer and Tober 2023; Weisstanner 2023). Generalizing from this, almost by definition, people who believe that they face high risks due to technology are likely to be risk averse (see, e.g., Hetschko and Preuss 2020). In the case of upper secondary education, this means that they should favor the track which they expect to provide secure employment and a high degree of adaptability—that is, a track that reduces uncertainty as much as possible.

However, it is not obvious which would be the low-risk alternative in the context of the digital transition—the “safe haven” for those who worry about the consequences of technological change.⁵ We argue that despite a recent literature which portrays VET as an outdated model, and investment in vocational skills as inherently risky, VET still offers promising career prospects; in any case, public perceptions are slow to change. Hence, we expect that STR is nevertheless associated with a preference for vocational upper secondary education. Moreover, we discuss which demographic groups are most likely to experience STR and how the relationship between STR and education preferences may differ between them.

3.1 | VET as a Dead End

Much recent research implies that GE is the safer educational option in the twin transition, while VET risks becoming a dead end (see Emmenegger and Haslberger 2025, for a detailed critical discussion of this view). Building on the work of labor economists who documented an increase in demand for cognitive tasks (Autor and Dorn 2013), political economy scholars have argued that in post-Fordist knowledge

economies, “complementarities in production between skilled and semiskilled workers have been replaced by complementarities between skilled workers and new ICTs” (Hope and Martelli 2019, 243), with the implication that VET skills would be less in demand (see also Iversen and Soskice 2019; Wren 2021). Moreover, Iversen and Soskice (2019) among others explicitly point to the uncertainty about skill demands created by the twin transition to argue that academic education provides more general and transferable skills which increase adaptability.

One might therefore expect that years of emphasis on the increasing importance of general and transferable skills, and the equation of these skills with higher education—in rhetoric if not in reality (Streeck 2011)—have created a perception that vocational education leaves people ill-equipped to deal with rapid labor market change due to technology. The very visible (and effective, see OECD 2021) push towards academization in many countries also sends a strong signal that VET is “yesterday’s model” (Emmenegger and Haslberger 2025), not fit for the knowledge economy. Concurrent efforts to promote VET may have been less visible to the general public than the ongoing academization, undermining the salience of arguments in favor of VET. The decline of stereotypical VET occupations such as skilled manufacturing jobs could exacerbate this perception (Autor et al. 2019; Kollmeyer 2009). Following this logic, individuals who experience high STR should be less inclined to look to VET for the skills that are necessary for labor market success in a world of fast-changing technology. Empirically, we would expect this to manifest in a negative relationship between STR and preference for VET.

3.2 | VET as a Safe Haven

However, we contend that the perspective of VET as a dead end has two important flaws which make it unlikely that people with high STR prefer GE. First, it discounts the continuing substantive benefits of VET. Second, even if the pessimistic view of the merits of VET were true, public attitudes likely lag behind. Hence, we expect people with high STR to prefer VET over GE.

There are a number of reasons to reject the view that VET is a dead end in terms of the labor market prospects it provides. As reported by Cedefop (2025), numerous VET occupations face skill shortages across Europe, alleviating fears of a lack of demand. Moreover, VET systems are able to quickly react to changing labor market conditions, especially in countries where employers are involved in the definition of training content (Emmenegger et al. 2023; Haslberger et al. 2025). In practice, this has led to a broadening and upgrading of the skills provided in vocational programs, which in turn has shored up the labor market returns to VET (Schulz et al. 2023; Adda and Dustmann 2023; Emmenegger and Haslberger 2025). In addition, the increasing awareness and availability of lifelong learning and adult education opportunities can assuage fears of skill obsolescence (OECD 2020). For the growing migrant populations across Europe, VET can help reconcile the twin imperatives of labor market integration and skill development (Bonoli and Otmani 2023). Finally, in a world where generative AI is substituting workers in cognitive tasks (Gmyrek et al. 2023; Hui et al. 2024), jobs with a physical component,

which tend to be associated with VET, may be relatively less exposed to technology risk. In the words of Autor (2024, 2), “AI used well can assist with restoring the middle-skill, middle-class heart of the ... labor market that has been hollowed out by automation and globalization.” Hence, VET still provides attractive employment prospects to many individuals in labor markets undergoing the twin transition, owing to the responsiveness and flexibility of VET systems and the potential impact of AI on cognitive jobs requiring tertiary education. These individual-level benefits of VET, along with macro-level benefits such as reduced youth unemployment and lower wage inequality, have been excessively discounted in portrayals of VET as an outdated model (Emmenegger and Haslberger 2025).

However, members of the public are unlikely to be well-informed about the details of such debates. Instead, they are likely to rely on heuristics and basic cues (Althaus 2003; Zaller and Feldman 1992). Hence, it matters that VET has long been and still is viewed as a safe and dependable choice (Cedefop 2017)—absent a highly salient information shock, this perception is unlikely to change. Indeed, influential sociological research has argued that people from non-academic backgrounds prefer the vocational track precisely because it offers secure job prospects and a good salary at a young age, while general and academic education are seen as inherently more risky (Breen and Goldthorpe 1997). More recent survey evidence confirms that this perception is not limited to marginalized individuals and still predominates across Europe (Cedefop 2017). For these reasons, it is easy to see how VET can still be considered an attractive educational path in a digitalizing economy. There are strong substantive reasons to do so, which are aided by the inertia of public opinion. Thus, our central expectation in this study is that *subjective technology risk is associated with a stronger preference for vocational upper secondary education*.⁶

3.3 | Moderating Factors in the Relationship Between Subjective Technology Risk and Educational Preferences

Neither risk exposure nor risk aversion is evenly distributed across the population. We therefore expect the relationship between STR and education preferences to vary between socio-demographic groups. We are not aware of any empirical studies that have investigated such interactions, but the rich literature on risk and social policy preferences suggests several margins that may shape the relationship between technology risk and educational preferences analogously. In this study, we zoom in on gender, income, educational background, and political orientation.

Despite a convergence of the roles of women and men in the labor market (Goldin 2014), there is growing evidence that automation affects women and men in different ways. For example, Gingrich and Kuo (2022) argue that women face higher non-technological labor market risks, limiting the potential impact of technology risk on social policy preferences through a ceiling effect. By the same logic, we might also expect technology risk to affect women’s education preferences less strongly than men’s. On the other hand, women are generally more risk-averse than men (Borghans et al. 2009; Falk

et al. 2018), and there is evidence that women have more negative attitudes towards digital technologies (Borwein et al. 2024; Carvajal et al. 2024; Haslberger et al. 2024), suggesting that they view such technologies as inherently more risky and might show a stronger reaction. Hence, the net effect of these forces is an empirical matter.

Regarding the moderating role of income, the existing literature points to a clear expectation that richer individuals, while generally less likely to prefer VET, should show a stronger shift towards VET with increasing risk. This reasoning mirrors Thewissen and Rueda (2019), who contend that richer individuals are generally opposed to redistribution, but that automation risk has a stronger positive effect on their redistribution preferences since they have more to lose. The negative main effect of income reflects simple self-interest following the Meltzer and Richard (1981) framework, whereas the positive interaction captures increased demand for insurance (Moene and Wallerstein 2001). In our case, lower preference for VET at low risk does not necessarily reflect self-interest, but rather the link between education and income. Insurance is provided by vocational education, which at-risk individuals perceive as providing secure employment. Thus, the expectation of a positive interaction follows from the analogous application of an established theoretical mechanism.

In a similar vein, a person's educational background may affect the relationship between subjective risk and education preferences. We expect individuals who experience high subjective risk and who do not have a VET background to view VET as more appealing, and vice versa, as they are unhappy with the current state of affairs and imagine the alternative to be better. Existing research has mostly looked into how risk and educational background affect preferences for redistribution, but we can again extrapolate from this literature. For example, Häusermann et al. (2015) find that highly skilled individuals are particularly sensitive to labor market risk. Applying this logic to education preferences, tertiary educated individuals with high subjective risk should be particularly prone to think that “the grass is greener on the other side” and increase their preference for VET, while people with a VET background should experience a more moderate preference shift towards GE.

Finally, we expect that right-leaning individuals react more strongly to high subjective risk. They tend to be more favorable toward VET to begin with (Busemeyer et al. 2011), but more importantly, we expect that they are more sensitive to technology risk and disproportionately increase their preference for VET. This follows from psychological research that links fear of loss and uncertainty avoidance to conservative ideology (Jost et al. 2003). If, as we argue, VET is perceived as a safe haven offering attractive job prospects in the twin transition, right-leaning individuals who fear losing their job to technology should therefore favor this educational path particularly strongly.

The focus of our discussion on gender, income, educational background, and political orientation reflects the salience of these factors in scientific and political debates over the consequences of technological change (Gallego and Kurer 2022). A

detailed discussion of other potential moderating factors, such as age and migration background, is beyond the scope of this study; although we provide some indicative evidence in the Appendix.

4 | Data and Analytical Strategy

We test our arguments using data from a large online survey with 11,508 working-age respondents aged 18–64 from seven European countries: Denmark, England, France, Germany, Portugal, Sweden, and Switzerland. They are all advanced democracies but represent different welfare state models and varieties of capitalism (Hall and Soskice 2001; Ferrera 1996; Esping-Andersen 1990). This is reflected in differences in the structure and quality of their VET systems. Hence, they face varied institutional challenges while transitioning to knowledge economies and reforming their skill formation systems (Bonoli and Emmenegger 2022). This allows us to posit a high degree of external validity for our findings in a European context. Table B1 provides an overview of the different institutional configurations in the seven countries. To ensure the representativeness of our sample, we used country-specific quotas for gender, age, and education. We fielded our survey in collaboration with the survey company Bilendi in May and June 2024.⁷

Our dependent variable is respondents' educational preference for VET or GE. We asked: “Which upper secondary education track do you personally prefer?” Responses are measured on an 11-point scale, where “1” indicates a strong preference for general education and “11” a strong preference for vocational education. To aid and guide respondents' understanding of the question, we provided country-specific examples of concrete educational tracks. Furthermore, the question followed a detailed explanation of how VET and GE programs at upper secondary level are typically structured, highlighting that we are asking about the preference between two different *types* of education at the same *level* (rather than comparing upper secondary VET with, say, tertiary GE).⁸ It is worth reiterating that the respondents, being of working age, do not face the decision between VET and GE themselves. However, in line with previous research (e.g., Busemeyer et al. 2018; Russo et al. 2019; Abrassart et al. 2020), we study the preferences of adults because in their function as parents, family friends, or peers, they shape the context in which adolescents make their educational choices (Schoon and Parsons 2002; Russo et al. 2019; Fitzenberger et al. 2020). Moreover, only working-age individuals meaningfully experience work-related technology risk. For our research question, it is therefore necessary and appropriate to focus on the preferences of adults.

Our independent variable is subjective technology risk. Our operationalization follows Busemeyer and Tober (2023) and is based on agreement with the statement that over the next 5 years, “I will lose my job because I am not good enough with new technology or because I will be replaced by someone with better technological skills.” Respondents could answer “(very) unlikely,” “can't choose,” or “(very) likely.” In the main analyses, we simplify this into a categorical variable with three levels (low STR/can't choose/high STR), with “low STR” serving as the reference category. Conceptually, we conceive of

STR as a function of three key components that we cannot measure separately: objective risk exposure, risk aversion, and misperceptions (which we assume are random and hence can be treated like an error term). This allows us to derive hypotheses regarding heterogeneous relationships based on established findings on group differences in risk exposure and risk aversion.

Moreover, we collected data on a comprehensive set of controls, including age, gender, educational background (VET or GE), occupation (1-digit codes), personal income (logarithmized 18-category scale), and political orientation (7-point scale, re-coded to 3 categories: left-wing, centrist, right-wing), as well as whether or not the respondent is in paid employment and has children.

Figure 1 shows the pooled distribution of the two main variables.⁹ The left panel shows the distribution of education preferences which, with a mean of 6.12 (SD=3.05), indicates a relatively even split between respondents who prefer VET and those who prefer GE, and a large number of undecided respondents. In the right panel, we see that 24.8% of respondents experience high levels of STR (answered that they will “likely” or “very likely” lose their job due to technology over the next 5 years); a slightly lower share than in Busemeyer and Tober (2023). A glance at the summary statistics for the control variables in Table B2 provides reassurance concerning the socio-economic representativeness of the sample.

To test our argument, we regress individuals' education preference ($Pref_i$) on their subjective technology risk (STR_i) and a vector of individual-level controls (X_i) via ordinary least squares. We include country fixed effects ($v_{country(i)}$) to absorb unobserved country-specific factors, and cluster standard errors at the country level to correct for potential correlation in errors among individuals within the same country. Formally, the core specification is:

$$Pref_i = \alpha + \beta_1 STR_i + \beta'_2 X_i + v_{country(i)} + \varepsilon_i \quad (1)$$

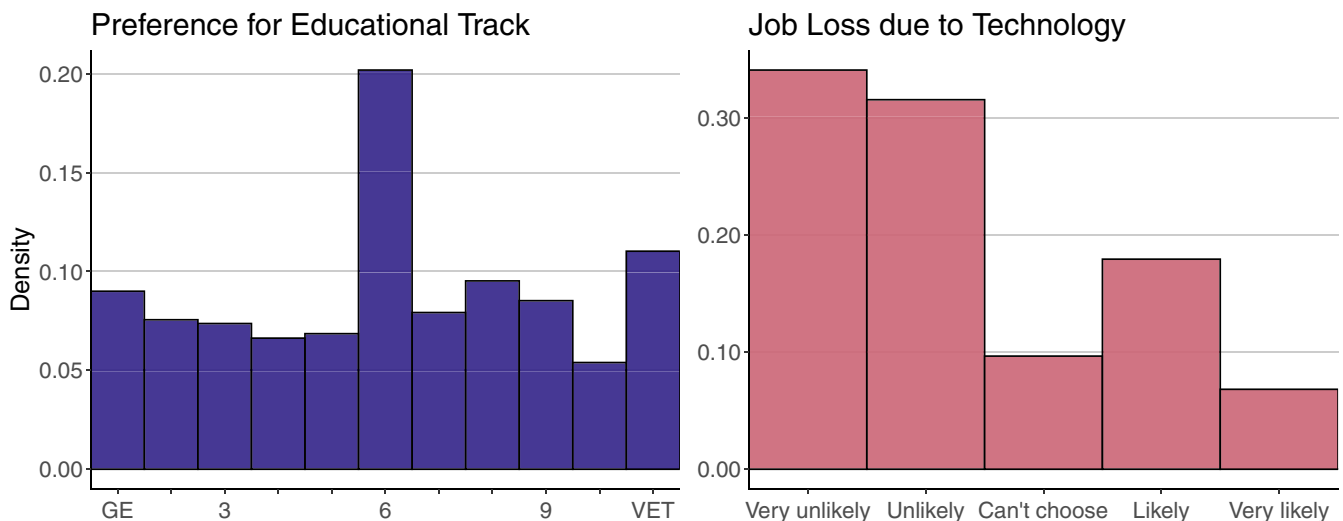


FIGURE 1 | Distribution of educational preferences and subjective technology risk. In our main analyses, we compare the effect of high STR (answered “(very) likely” to the job loss question) to that of low STR (answered “(very) unlikely”). Those who answered “can’t choose” are treated as a separate category. $N = 11,508$.

To examine heterogeneous relationships, we add an interaction term with the moderating variable M_i (e.g., gender). Formally:

$$Pref_i = \alpha + \beta_1 STR_i + \beta_2 M_i + \beta_3 STR_i \times M_i + \beta'_4 X_i + v_{country(i)} + \varepsilon_i \quad (2)$$

The observational nature of our data does not allow us to interpret significant relationships as evidence of a causal effect. In particular, despite a comprehensive set of controls, there remains a residual risk of endogeneity. ChatGPT was used to assist in the development of R code for the figures displaying the results.

5 | Results

5.1 | Subjective Technology Risk Is Associated With a Preference for VET

Do individuals who experience high technology risk prefer vocational or general education? In Figure 2, we build up our models in four steps. The base model controls only for country fixed effects. High STR is positively and significantly associated with a preference for VET ($\beta_1 = 0.60$; $p < 0.001$). Respondents

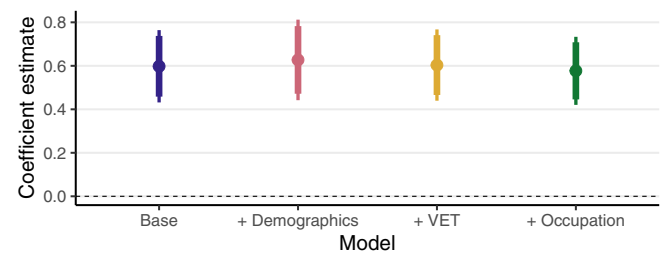


FIGURE 2 | High subjective technology risk is associated with a preference for VET. Estimated effect of high STR on preferences for VET (reference category: low STR), with 90% and 95% confidence intervals (thick and thin lines). All models include country fixed effects and standard errors clustered by country. Full output in Table A1.

who provided no substantive answer to the STR question (“can’t choose”) also lean towards VET, but less so than individuals with high STR (see Table A1 for full output). As we successively add more controls in models 2–4, β_1 remains consistently significant and essentially unchanged in size. In model 2, we add our main demographic controls, which largely behave as expected (see Table A1). However, this still leaves our analysis vulnerable to three obvious alternative explanations: status-quo bias, endogeneity, and objective replacement risk.

To account for status-quo bias and potential endogeneity with regard to respondents’ own education, in model 3 we additionally control for whether the respondent has a VET background. Unsurprisingly, the coefficient is positive and large, indicating that status-quo bias is indeed present and respondents tend to prefer the educational track they have completed themselves (Di Stasio 2017). Nevertheless, this leaves the coefficient on STR unaffected. Thus, our main finding is not simply a result of education preferences and risk perceptions being endogenous to educational background, or of status-quo bias operating through educational achievement.

In model 4, our main model throughout the remainder of the paper, we moreover account for the possibility that STR is a function of objective automation risk by including occupation dummies. In the absence of more detailed occupational information which would allow us to use routine intensity scores, 1-digit occupation dummies nevertheless capture a large portion of the variation in substitutability as commonly understood in the labor economics literature (Acemoglu and Autor 2011). Again, however, the estimated effect of STR remains unaffected. Thus, in line with Ahrens (2024), we find evidence for significant divergence between objective and subjective labor market risks. These results indicate that individuals who are concerned about losing their job due to technological change are more likely to prefer vocational over general education than those who view such job loss as unlikely. The estimated effect size is substantial, amounting to approximately 1 / 5 of a standard deviation (see Table B2).

We find substantively identical results across a range of alternative specifications. In Table C1, we employ alternative measures of STR.¹⁰ Moreover, in Table C2 we use continuous versions of the STR measures (excluding respondents who answered “can’t choose” from the analysis) and in Table C3, we show results obtained from using the first component from a principal component analysis with the three variables as the STR measure (for details, see Appendix E). In all cases, we obtain consistent results. In Table C4, we use an ordinal version of the dependent variable (prefer GE/undecided/prefer VET) and estimate an ordered logit model, again with identical results. Finally, in Table C5, we add a battery of additional controls to alleviate remaining concerns about endogeneity. Again, the coefficient on STR remains highly robust.

With the inclusion of country fixed effects, we abstract from differences between countries and identify β_1 purely from within-country variation in individual characteristics. To be sure about the generalizability of the results, we must therefore consider the possibility that the relationship differs qualitatively between different groups of countries.¹¹ In Figure 3, we estimate our main model for each country individually. The coefficient

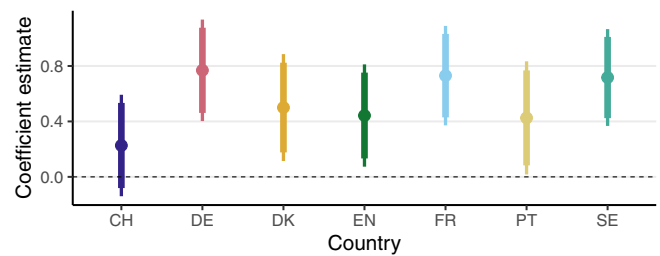


FIGURE 3 | Subjective technology risk and educational preferences by country. Estimated effect of high STR on preferences for VET (reference category: low STR), by country, with 90% and 95% confidence intervals (thick and thin lines). Full output in Table A2.

is positive everywhere and statistically significant everywhere but in Switzerland. Hence, our findings suggest that individuals perceiving higher automation risk tend to favor vocational education, though the strength of this relationship varies across countries.

This variation highlights the importance of national contexts, but there is no obvious pattern corresponding to differences in welfare state models or varieties of capitalism (Esping-Andersen 1990; Ferrera 1996; Hall and Soskice 2001), which constitutes *prima facie* evidence against a straightforward institutional explanation (see Table B1 for an overview of the institutional configurations in our sample). There is also no indication that the relationship differs systematically between countries where VET is predominantly dual (Denmark, Germany, Switzerland) and countries with school-based VET systems (England, France, Portugal, Sweden). Moreover, labor shortages in VET occupations might drive differential perceptions of VET as a safe haven. However, using data from Cedefop (2025), we find no consistent evidence that people in countries with more pronounced labor shortages in VET occupations have a stronger perception of VET as a safe haven (see Figure D1). Thus, the main takeaway is that people who experience high STR tend to favor VET across a range of countries, but further qualitative or large-N research is necessary to determine the precise role of contextual factors. Given the lack of an obvious institutional or labor-market explanation, differences may be linked to the content and salience of narratives about VET (Martin 2018).

In summary, STR is a significant factor in explaining educational preferences, independent of educational background, objective automation risk, and other individual characteristics, as well as across countries. This finding offers valuable insights into the dynamics of educational preferences in advanced economies. It suggests that the attractiveness of VET is bolstered by automation anxiety, creating a potential dilemma for policymakers seeking to reduce automation anxiety while strengthening VET.

5.2 | Heterogeneous Effects of Subjective Technology Risk

We have argued that risk exposure and risk aversion are unevenly distributed across the population. Since STR can be understood as a function of objective risk exposure and underlying risk aversion, we expect significant differences between socio-demographic subgroups. We therefore investigate the

interactions between STR and (1) gender, (2) income, (3) educational background, and (4) political orientation.

First, Figure 4 provides descriptive insights into the density distributions of subjective risk and education preferences by subgroup. Gender differences are small, with men expressing a stronger preference for VET and slightly higher technology risk. Lower-income groups display higher concerns about automation and more variability in preferences, highlighting the complex relationship between economic vulnerability, education, and technological change.¹² We can see that individuals who themselves have a VET background prefer the vocational path and experience intermediate levels of STR, compared to

respondents with non-tertiary GE on the one hand and tertiary GE on the other. Right-wing individuals tend to favor VET and perceive higher automation risks than their centrist and left-wing counterparts.¹³

Next, we estimate a set of models where we interact STR with the respective socio-demographic indicators. Our analyses in Figure 5 (full output in Table A3) reveal that not only do social groups differ in how much technology risk they experience, but also in the extent to which this shapes their education preferences.¹⁴ In the case of gender, at low levels of subjective risk there is no gender difference in education preferences, but among women the perception of VET as a safe haven is less

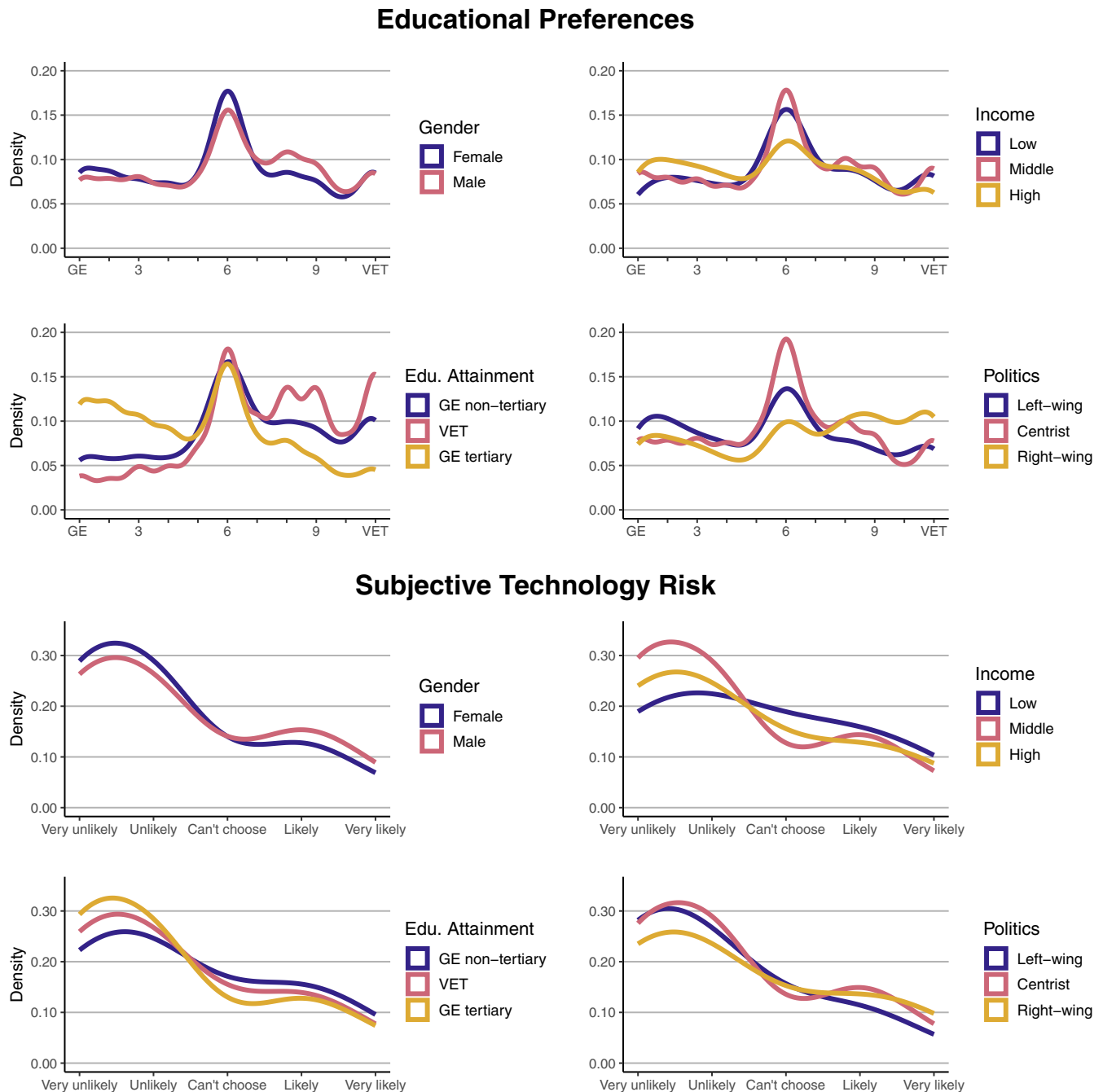


FIGURE 4 | Educational preferences and subjective technology risk across subgroups. Kernel density estimates of educational preferences and STR by subgroups.

Predicted Education Preferences by Moderating Factors

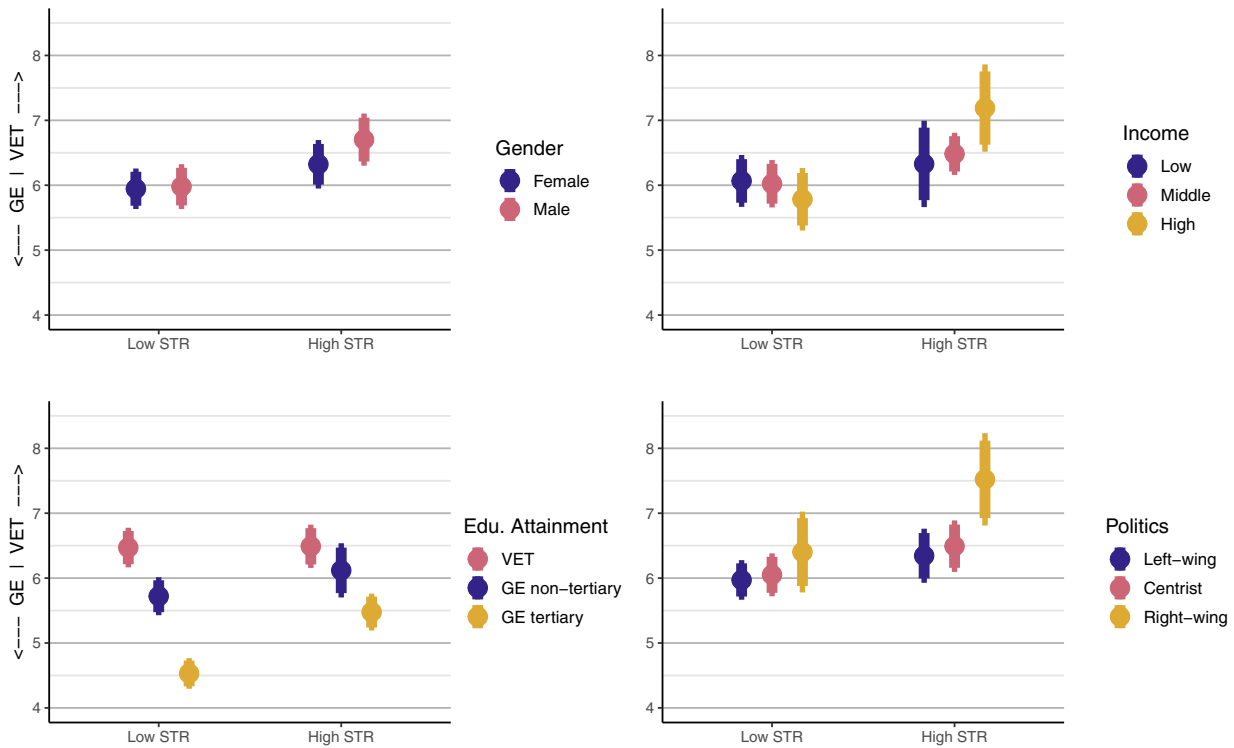


FIGURE 5 | Predicted education preferences, by STR and moderating variable, with 90% and 95% confidence intervals (thick and thin lines). Full results in Table A3.

pronounced. The size of the coefficients implies that the estimated effect of subjective risk is 92% larger for men.¹⁵ This finding aligns with Gingrich and Kuo (2022), who argue that since women face higher non-technological labor market risks, there is a ceiling to the potential effect of technology risk on social policy preferences. We show that this logic extends to education preferences as well.

With regard to income, we find no difference between the three groups at low levels of STR. All groups express a stronger preference for VET at high levels of subjective risk, but the estimated interaction coefficient is statistically significant only for high-earners. This implies that high-income individuals in particular regard VET as a safe haven when they experience technology risk. Our finding for education preferences thus conforms to what Thewissen and Rueda (2019) have established for redistribution preferences: rich individuals' demand for insurance is more sensitive to risk because they have more to lose. In the case of education, insurance comes from vocational education, which is perceived to better prepare people for the labor market in uncertain times.

Educational background likewise significantly shapes the relationship between STR and education preferences. Distinguishing between VET and GE with and without a tertiary qualification, we see a clear gradient. At low levels of risk, people with tertiary GE are almost 2 points less likely to choose VET than VET graduates (amounting to approximately 2/3 of a standard deviation on the 11-point scale), with GE graduates without a tertiary qualification in between. The estimated effect of high STR is

positive but not statistically significant for VET and non-tertiary GE graduates, but highly significant for tertiary GE graduates, reducing the difference between the predicted preferences of VET and tertiary GE graduates by almost half.¹⁶ Thus, as we argued with reference to the findings of Häusermann et al. (2015) for high-skilled labor market outsiders, the most educated individuals appear to be most sensitive to STR and increase their preference for what they perceive to be an educational safe haven. However, since VET graduates do not significantly move towards GE, there is no general “the grass is greener on the other side”-effect when it comes to education and STR.

Finally, the analysis by political orientation indicates that right-wing individuals are marginally more likely to choose VET to begin with, compared to people who identify as politically left-wing. In line with our expectation, right-wingers' preference for VET increases more strongly when they perceive high levels of technology risk. From an elevated baseline, the estimated increase is twice as strong as for left-wing individuals.¹⁷ Centrists resemble left-wing individuals in both the low and high STR conditions. The significant interaction effect is consistent with conservatism being linked to psychological traits such as uncertainty avoidance (Jost et al. 2003).

These analyses show that the relationship between STR and education preferences is not homogeneous. In line with arguments about risk exposure and risk aversion that have been made in the literature on social policy preferences, we show that men, high-income and highly educated individuals, as well as politically right-leaning people all react more strongly to STR by

increasing their preference for VET.¹⁸ Thus, VET appears to be perceived as a safe haven in times of heightened uncertainty due to the twin transition, but not to the same extent by everyone.

6 | Conclusion

Based on the observation that rapid technological change associated with the twin transition is increasing uncertainty over future skill requirements, this article argues that individuals today make educational choices in a context of heightened risk. One of the most consequential choices people face in their educational careers is that between vocational and general education at the upper secondary level (Shavit and Müller 2000; Hanushek et al. 2017). However, research so far has little to say about how people's appraisal of the technology-induced risks they face shapes their preference between these alternatives. Sociological and economic research relies on rational choice arguments to explain education preferences, but has largely neglected the increased uncertainty precipitated by the twin transition. Concurrently, political science research emphasizes the effect of subjective risk on social policy and voting preferences, but not education. Our study links these literatures and helps us understand how macro-level trends interact with micro-level decision-making.

We contrast two extant perspectives. On the one hand, recent literature argues that VET increasingly constitutes a risky choice, as the specificity of vocational skills may quickly render them obsolete during times of rapid change (Iversen and Soskice 2019). On the other hand, some scholars object that VET remains an attractive option during the twin transition, as VET systems are highly adaptable and inculcate skills that are in high demand (Emmenegger and Haslberger 2025). Against the background of this unresolved debate, our study aims to establish how subjective technology risk shapes individuals' preference between vocational and general upper secondary education. Drawing on the literature linking automation risk to demand for social insurance, we posit that STR is associated with a preference for an educational "safe haven." We further argue that the public is likely to consider VET a safe haven because it continues to provide substantive benefits and because public opinion lags behind expert debates questioning the viability of VET. We test this argument using data from a large, representative survey in seven European countries (Denmark, England, France, Germany, Portugal, Sweden, Switzerland).

Our study makes two contributions to understanding the micro-foundations of education preferences in times of heightened uncertainty. First, we show that individuals who experience high STR indeed view VET as a safe haven that provides attractive employment prospects and insurance against uncertainty over future skill demands. Second, we demonstrate that the relationship between STR and education preferences is not uniform across socio-demographic groups. We find that STR matters more for male, high-income, highly educated, and right-leaning respondents. Our results thus mirror prominent findings from the literature on automation risk and social policy preferences (Thewissen and Rueda 2019; Häusermann et al. 2015; Gingrich and Kuo 2022). While our findings are not causal, they are highly robust across different empirical specifications and generalizable across advanced European democracies covering

different welfare state types and varieties of capitalism (Esping-Andersen 1990; Hall and Soskice 2001).

These findings offer important insights which can help policy-makers craft effective skills policies for the twin transition. The predictability and security that citizens seek may remain elusive. How, then, can public policy promote adaptability without fanning anxiety? First, it is necessary to recognize that the fundamental uncertainty accompanying the twin transition imposes risks on people. Skills policies should aim to alleviate these risks by putting people in a position where they can adapt to changing circumstances and requirements. As argued in the introduction to this special issue, this "is not to be confused with an emphasis on general skills because skill requirements during the twin transition might still be highly specific, but individuals need to be empowered to adapt to rapidly changing skill requirements by gaining immediate access to affordable high-quality training that prepares them for the next phase of their labor market career." VET systems are well placed to provide initial training that inculcates up-to-date specific skills, but additional efforts are needed to make access to high-quality training throughout the labor market career a reality. Such efforts can build on existing VET infrastructure to identify emerging skill needs and offer suitable training formats in coordination with employers. For this to succeed, it is crucial to cultivate healthy industrial relations and especially employer buy-in (Emmenegger et al. 2023).

Second, our findings highlight the political dimension of uncertainty over skill needs. Framing efforts to strengthen VET and lifelong learning as a way of enabling people to deal with the requirements of the twin transition may prove electorally popular with a broad and unlikely coalition. This is because rising macro-level uncertainty unites knowledge economy winners who are otherwise less positively disposed towards VET, such as high-income and highly educated individuals, and knowledge economy losers, such as men and those on the political right, in strengthening preferences for VET. This may open a window of opportunity for substantive and sustainable reform. However, policymakers should resist the temptation to fan anxiety over technological change to drive up support for VET. Such a policy could invite a host of unintended consequences, such as strengthening radical parties or backlash against the twin transition as such (Kurer and Häusermann 2022; Kurer 2020). Ultimately, how well individuals feel able to respond to uncertainty over skill requirements is partially shaped by the education and training opportunities open to them. But policymakers will only be able to build institutions providing these opportunities if they remain attuned to people's anxieties and preferences.

As we seek to chart a new line of research that takes seriously the role of subjective risk perceptions in shaping education preferences, we suggest four avenues for future research to further expand on our findings. First of all, future work should investigate the preferences and choices of adolescents themselves. While they lack labor market experience, as the workforce of the future, their perspective on technology risk and education is particularly relevant. Second, such studies should include an experimental component that manipulates information about the level or type of technology risk and returns to different

educational tracks. This will provide important causal insights into the mechanisms through which STR affects education preferences. Third, other heterogeneous relationships between STR and education preferences, for example, with regard to age and immigration background, are beyond the scope of this study but merit a dedicated analysis. Finally, future research should jointly analyze STR and related subjective concerns such as “technostress” (Bicchi et al. 2024), as well as the degree of correspondence between objective and subjective risks, which will allow for a more nuanced understanding of how individuals’ labor market experience shapes their views on technology risk and education. We hope that our paper will serve as a starting point for further efforts to understand how citizens think about education during the twin transition.

Acknowledgments

We thank the participants of the special issue workshop as well as the special issue editors and three anonymous reviewers for their helpful feedback. All remaining errors are our own. Open access publishing facilitated by University of St Gallen, as part of the Wiley - University of St Gallen agreement via the Consortium Of Swiss Academic Libraries.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Endnotes

- ¹ Surveying adult education preferences is in line with previous research (see, e.g., Busemeyer et al. 2018; Russo et al. 2019; Abrassart et al. 2020), but actual choices of adolescents may differ.
- ² Bicchi et al. (2024) furthermore point out that substitution risk is not the only relevant dimension of subjective risk, as concerns over the need to continually adapt (“technostress”) and the impact of technological change on job autonomy and satisfaction may affect people’s preferences.
- ³ Scholars generally distinguish between investment, compensation, and steering policies (Bürgisser 2023). The evidence is not conclusive, but on balance, risk appears to increase support for compensation and steering policies, but not investment policies.
- ⁴ This perception should at least to some extent be rooted in objective risks such as membership in occupational groups susceptible to replacement, although the degree to which this is the case is debated (Ahrens 2024). Misperceptions of the risks people face have been linked, besides lack of information, to deep-seated factors such as socialization (Wehl 2019; O’Grady 2019).
- ⁵ While we focus on the relationship between STR and education preferences in the context of the ongoing digital transition, it is important to note that people may react differently to other types of technological change.
- ⁶ Readers unconvinced by our substantive argument might object that people who hold this view are misinformed. This is possible, but it would not change our empirical expectation. However, if our substantive argument is correct, it would be more accurate to say that while the recent literature fails to fully appreciate the benefits of VET in the twin transition, the general public does.

- ⁷ Some components of the survey were pre-registered, see here. Before being fielded, the survey received the approval of the University of St. Gallen Ethics Board.
- ⁸ Screenshots from the England version of the survey are included in Figure B1.
- ⁹ Figure B2 shows the distributions by country.
- ¹⁰ Agreement with the statements “My job will be replaced by a person providing a similar service on an internet platform” and “My job will be replaced by a robot, computer software, an algorithm, or artificial intelligence.”
- ¹¹ While the share of people reporting high STR is very similar across countries, differences in education preferences are more pronounced, see Figure B2.
- ¹² For simplicity, we recoded the income variable into three country-specific categories: low ($< \text{Mean} - 1\text{SD}$), middle ($\text{Mean} \pm 1\text{SD}$), and high ($> \text{Mean} + 1\text{SD}$).
- ¹³ Pairwise t-tests reveal that 18 out of 20 mean differences are statistically significant, see Table D1.
- ¹⁴ For the predicted values in Figure 5, we set the control variables to the following levels: gender: male; income: sample mean; VET background: yes; politics: centrist; has children: yes; employed: yes; age: sample mean; occupation: professional and technical occupations; country: Germany. Choosing different values changes the absolute levels of preferences, but not the relative differences that are of interest for our study.
- ¹⁵ $(0.3769 + 0.3477) / 0.3769 = 1.9225$.
- ¹⁶ $(0.0192 + 0.9271) / -1.940 = -0.4878$.
- ¹⁷ $0.7476 / 0.3726 = 2.0064$.
- ¹⁸ We explored additional heterogeneous relationships by age and migrant background but did not find significant interaction effects, see Figure D2.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** Supporting Information.