How vocational training matters for social mobility and why children of immigrants are losing out*

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Abstract

We show that vocational training is a key driver of social mobility for sons of locals, but less so for sons of immigrants in Denmark. To understand why, we examine whether access barriers can explain sons of immigrants' underrepresentation in traditional, high-return vocational fields. We develop a stylized theoretical model in which students choose between two vocational tracks: old traditional and new digital tracks, facing group-specific search frictions. When traditional sectors are harder to access for immigrant youth, our model predicts earlier switching into new digital tracks and potential welfare losses from misallocation. Using population-wide administrative data, we show that sons of immigrants are 30% more likely to graduate from ICT/digital vocational tracks. This difference appears as a skill-neutral parallel shift, suggesting that the inequality is not driven by underlying ability gaps but by access barriers (e.g., discrimination or lack of parental networks) in traditional vocational education. Digital tracks exhibit lower mean earnings but a significantly steeper skill gradient, consistent with digitalisation acting as a compensatory but incomplete substitute for access to traditional vocational sectors. Our findings suggest that access barriers in vocational training may result in suboptimal sorting across educational tracks, limiting the economic mobility of sons of immigrants.

Keywords: vocational training, immigration, digitalisation

JEL classifications: I24, J15, J24, J62

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1 Introduction

Children of immigrants generally face worse economic and educational outcomes in Europe (OECD/EU, 2023). For daughters, differences by parental immigration status tend to be explained by differences in parental characteristics, such as income, whereas for sons, gaps persist in many Continental European countries (Boustan et al., 2025). Group-based inequality raises both normative concerns about fairness and instrumental concerns about efficiency. When certain groups are systematically excluded or disadvantaged, society underutilizes its available talent, resulting in misallocation of human capital and lower overall productivity (Chetty et al., 2020; Hsieh et al., 2019). Group disparities in educational attainment typically widen along the educational ladder. In the case of Denmark, however, vocational education and training (VET) stands out as an exception: sons of Danish-born parents are substantially more likely than sons of immigrants to complete this track, and their over-representation is markedly larger than at any other educational level. In this paper, we ask if access barriers such as structural discrimination or lack of parental network can explain the under-representation of immigrant-background students in traditional VET fields?

VET in Denmark combines school-based instruction with firm-based apprenticeships. Dual VET systems can ease school-to-work transitions and improve early-career job quality (Eichhorst, 2015). Consistent with this, McGuinness et al. (2025) show that stronger dual systems in VET are associated with higher earnings and greater job satisfaction, with returns to VET varying markedly across institutional contexts. These findings highlight how institutional and apprenticeship-quality of VET systems shape not only early labour market outcomes, but also the mechanisms through which individuals sort across educational tracks. Unlike most other parts of the educational system, such as upper-secondary school or university, students in the Danish, dual VET system typically themselves secure an apprenticeship to complete their education. This process is largely informal and decentralized. Reports indicate that students experience difficulties finding apprenticeships due to insufficient support (see e.g., Danmarks Evalueringsinstitut, 2025), and that some sectors face severe shortages of apprenticeship opportunities (see e.g., Gregersen, 2024). Further, research on similar dual VET systems documents both supply-side constraints in apprenticeship availability (Muehlemann et al., 2009) and substantial disparities in apprenticeship enrolment among students with migrant backgrounds (Chadderton & Wischmann, 2014; Imdorf, 2017). Field experiments reveal ethnic discrimination in internship application callbacks (Kaas & Manger, 2012), suggesting that labour market discrimination against migrant-background youth operates not only in standard hiring but also at the stage of securing workplace training opportunities.

The decision to enrol in VET is often made soon after finishing compulsory schooling (age

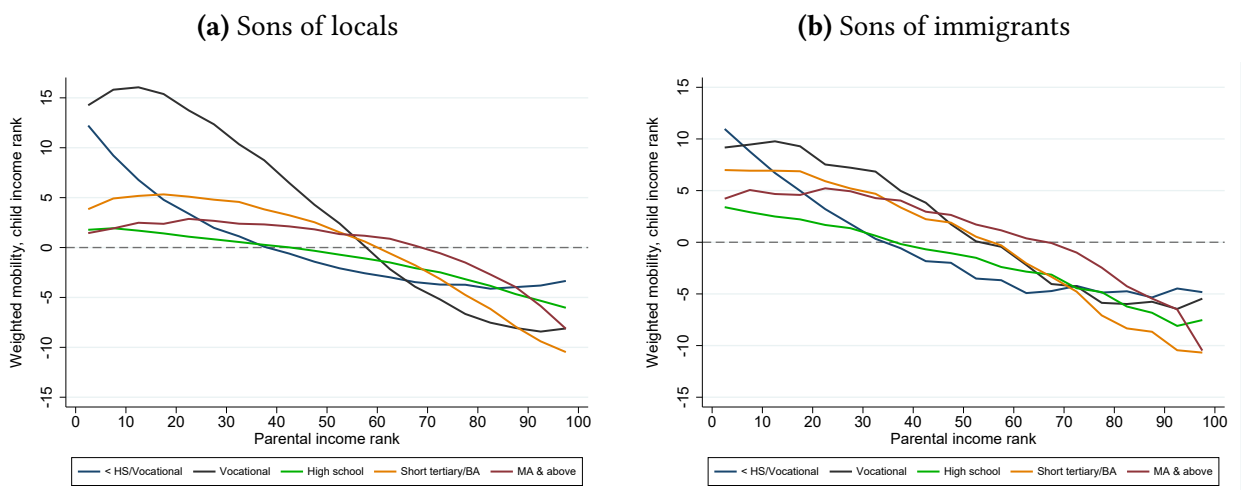
15/16 in Denmark), and parents and parental network are likely to play a substantial role in job/apprenticeship finding at this age (Kramarz & Skans, 2014). Immigrant parents typically have weaker informal networks in the host country (see e.g., Behtoui, 2008). As a result, children of immigrants are likely less able to leverage parental networks to secure apprenticeships in established vocational sectors, where informal referrals often facilitate access (Danmarks Evalueringsinstitut, 2025). In addition, immigrant parents with VET qualifications from their origin country may experience credential devaluation and occupational mismatch (Damelang & Abraham, 2016), preventing them from establishing the sector-specific networks their children would need to access apprenticeships in their own field. Nepotism and ethnic discrimination can therefore elevate barriers for immigrant-background youth in traditional male-dominated trades, where recruitment is more likely to operate through informal channels (Imdorf, 2017; Kaas & Manger, 2012).

In contrast, newer VET fields such as IT, digital media, and software development may function as an equalizer. Arntz et al. (2025) show that access to new occupations in the IT sector can reduce labour market disadvantages for workers with low formal education. Their analysis focuses primarily on within-occupation technological adoption, but they also show that access to new IT-related occupations can reduce labour market disadvantages. Because these sectors are relatively new, few parents, regardless of background, have direct network connections or relevant expertise to pass on to their children (Arntz et al., 2025). As a result, parental networks play a less decisive role and recruitment may be more formalized or meritocratic than in traditional VET sectors where informal ties play a more dominant role. This opens the possibility that digital apprenticeships reduce access gaps for disadvantaged youth by levelling the playing field between locally rooted families and immigrant families. Unlike many VET occupations, where nationally specific certification rules constrain transferability across countries, digital skills are likely to be more standardized and internationally portable, making them less dependent on parental country-specific knowledge. Together, these dynamics suggest why digital pathways may partially mitigate, but not fully close, the opportunity gap faced by children of immigrants.

Recent Danish (e.g., Jensen & Manning, 2025) and international evidence (e.g., Boustan et al., 2025) find that sons of immigrants experience lower rates of upward mobility relative to daughters of immigrants, especially in continental European countries that generally share similar VET systems. Boustan et al. (2025) propose that generally high participation rates and high returns to VET, though low participation of sons of immigrants, in this group of countries could be a key driver of gender differences in rates of mobility. Figure 1 confirms this hypothesis in the case of Denmark, where we decompose experienced mobility by child immigration status and educational outcomes. By multiplying the average experienced income mobility (child rank - parental rank) by the share of children in the education group within each parental income ventile, we

see how different educational paths contribute to overall intergenerational mobility across the parental income distribution. For the group of sons with low-income local-born parents, those undergoing VET account for the largest share of upward mobility. Among sons of immigrants, however, this pattern is much less pronounced, raising the question of why they are less likely to benefit from the same opportunity to break the cycle of disadvantage through VET.

Figure 1: Intergenerational mobility accounted for by child education groups

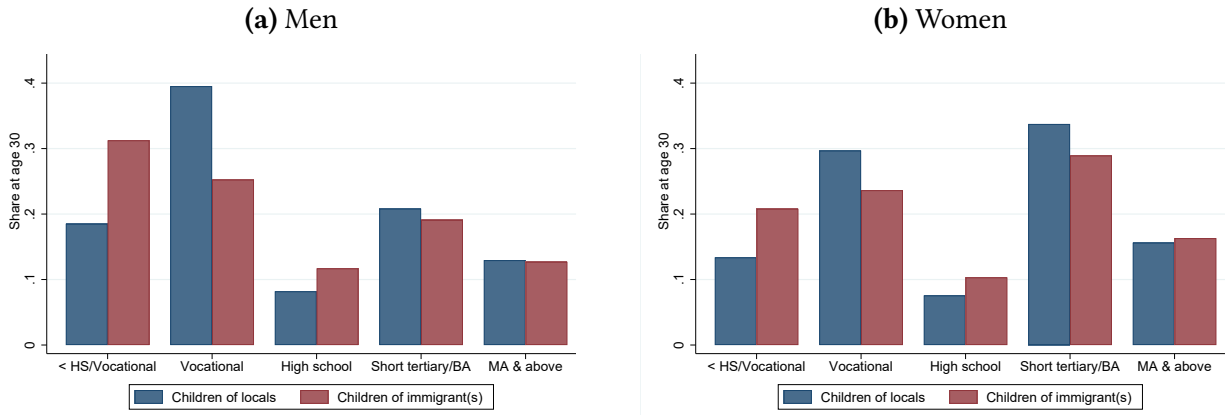


Notes: This figure plots the average experienced income mobility (child rank - parental rank) multiplied by the share of children in the education group within each parental income ventile. This illustrates how much mobility each education group accounts for across the parental income distribution. We see that a large fraction of intergenerational mobility of sons of low-income locals can be accounted for by those who obtain VET. This contrast our finding for sons of immigrants where uptake of VET is particularly low despite high returns to those who complete VET. For daughters, see Appendix Figure A.1. We show the cumulative shares in Figure A.2. Parental income is ranked, 0-100, within child birth cohorts. Child income is ranked within child births cohorts and child gender. Appendix Figures A.3-A.6 provide the underlying components of this analysis: We show the underlying rank-rank relationship between child and parent income in Figure A.3, the difference between children and parental income rank by education level in Figure A.4, the share of children obtaining each level of education in Figure A.5, the distribution of children by across the parental income distribution by parental immigration status in Figure A.6.

Comparing sons in Figure 1 to daughters in Figure A.1, we see that VET matters especially for sons' mobility. This is driven by the fact that men are more likely to choose VET tracks and male-dominated fields yield higher returns (see our Figure B.1). Furthermore, the uptake gap is much larger for sons of locals versus sons of immigrants (about 15 percentage points) than for daughters (about 5 percentage points; see Figure 2). This motivates our focus on the VET choices of immigrant-background sons as a key area where search frictions may generate substantial inequality. Access to VET emerges as a first-order problem if we aim to improve the economic prospects of the growing population of immigrant sons in many OECD countries (OECD/EU, 2023). To study the issue in greater depth, we follow Kirkeboen et al. (2016) and focus on the intensive margin of educational choice, conditioning on individuals who have already selected into VET. Thus, our analysis focuses on the intensive margin of choosing ICT/digital

sectors, recognizing that access frictions at this stage can mirror the structural barriers shaping participation at the extensive margin. Observed within-VET sorting therefore provides a lower-bound estimate of the broader access constraints affecting entry into VET. To further understand barriers to obtaining VET for sons of immigrants, we therefore focus on within-VET sorting, and examine whether: i) differential search costs contribute to the underrepresentation of children of immigrants in VET; ii) ICT/digital VET fields help reduce this gap by offering lower-friction entry routes.

Figure 2: Educational attainment at age 30 by parental immigration status and gender



Notes: The figure shows substantial differences in VET completion between children of locals and children of immigrants, particularly for men. HS is an abbreviation for high school. See Appendix A for a description of the sample used to construct this figure.

We proceed in four steps. First, we develop a stylized model in which students choose between a traditional and a digital vocational sector, facing group-specific access frictions. The model predicts that immigrant-background students will select into the digital sector at lower skill levels than their peers with local-born parents, potentially generating welfare losses due to misallocation. Second, using detailed administrative data from Denmark, we document that children of immigrants are significantly overrepresented in ICT/digital VET programs. Third, we show that this sorting is driven by differential access thresholds rather than comparative advantage: for a given skill level, immigrant-background students are more likely to choose digital fields. Fourth, we document that digital tracks exhibit lower mean earnings but a significantly higher returns to skills.

Although we show that digital VET fields exhibit higher returns to skills, suggesting that digitalization may act as a compensatory mechanism, this compensatory effect does not offset the inefficiencies and societal losses caused by restricted access for students who encounter barriers to accessing established VET pathways. Our results suggest that reducing access barriers in traditional vocational sectors should be a policy priority to ensure equal opportunities independently

of parental origin, while the expansion of digital programs can compensate but not close this gap.

The remainder of the paper is structured as follows: Section 2 discusses related literature. Section 3 provides institutional background. Section 4 develops a theoretical framework of vocational sector choice under group-specific access frictions. Section 5 introduces the administrative data, presents the empirical analysis, tests the model's predictions. Section 6 concludes.

2 Literature

Search costs shape educational decisions: Information interventions have been shown to increase college participation (Hoxby & Turner, 2015), and students facing high search costs tend to "undermatch" by not applying to opportunities for which they are qualified. Moreover, application complexities can themselves act as barriers (Bettinger et al., 2012). Although Hoxby & Turner (2015) and Bettinger et al. (2012) focus on higher education, Figure 1 suggests that such frictions may be even more pronounced in VET, a setting that remains an important type of education both due to its prevalence and high returns, yet underexplored in the literature on educational matching. In VET, students typically face a dual access requirement: they must apply both to a relevant school and separately secure an apprenticeship placement, creating an additional barrier to entry.

There are multiple potential causes of immigrant disadvantage in the search for apprenticeships. One cause is network effects and nepotism. Kramarz & Skans (2014) show that youth are far more likely to work for their parent's employer, which especially benefits those with weaker qualifications, since family connections can substitute for formal signals of ability. Discrimination against immigrants can be another source of immigrant disadvantage in search for apprenticeships. Numerous correspondence studies on adult hiring have shown lower callback rates for applicants with non-majority sounding names (e.g., Bertrand & Mullainathan, 2004). In a correspondence study specifically examining student internship applications in Germany, Kaas & Manger (2012) similarly find a 14% callback advantage for German names, particularly in smaller firms with less formal hiring processes. Furthermore, navigating apprenticeship systems requires insider knowledge. While Dustmann et al. (2016) documents how social ties influence access to traditional employment, we examine how emerging ICT/digital sectors, where such legacy networks are less relevant, may help youth from immigrant families bypass ethnic networks and institutional barriers.

There exists no integrated framework connecting the dynamics of search costs and potential discrimination in VET access, which this paper develops and investigates. Research on VET track choice that jointly considers education and employer matching is very limited. The potential of ICT/digital pathways as an equalizing mechanism remains largely unexplored, and there is a clear

need to quantify the impact of search costs on immigrant outcomes.

Denmark's dual VET system is institutionally closest to those of Germany, Austria, and the Netherlands, where access likewise depends on securing an apprenticeship contract (Cedefop; University College Copenhagen, 2022). Similar contract-driven frictions are present in Czechia, Slovakia, and Slovenia, while more school-based Nordic systems (e.g. Sweden and Finland) rely less on firm placement (Cedefop; University College Copenhagen, 2022). The dynamics in our setting generalize most directly to dual systems; although its strength may vary in mixed or predominantly school-based models. Beyond the VET context, evidence suggests that immigrants face structural barriers rather than underlying ability gaps, extending across fields and countries, consistent with a broader international literature on labour market discrimination and unequal access to opportunities (Bertrand & Mullainathan, 2004; Heath & Cheung, 2007).

Educational choice models: The theoretical model presented in this paper takes an offset in theory of educational choice which provides a natural framework for disentangling how skill distributions, search frictions, and institutional constraints shape the allocation of talent across sectors. The model developed by Roy (1951) has long served as a workhorse framework in labour economics to analyze self-selection into sectors or occupations based on comparative advantage. Building on Roy's insight, a large literature, most notably Borjas (1987) and Heckman & Honore (1990), has formalized and extended the model to estimate the role of heterogeneity in returns, preferences, and constraints in shaping individual choices. This structural approach lends itself naturally to counterfactual analysis, allowing researchers to simulate how changes in frictions or incentives affect selection patterns.

A growing number of studies have applied Roy-type models to educational settings, where students choose between fields of study or education tracks based on anticipated payoffs and individual skills (e.g., Kirkeboen et al., 2016; Keane & Wolpin, 1997). These models typically emphasize expected earnings, preferences, and ability sorting in explaining observed choices across general and VET. We apply a Roy-style framework to the education context, allowing for frictions that vary across groups and sectors, tailored to highlight the societal costs of group-specific search barriers.

Our setting has close parallels to the growing literature in mechanism design that studies allocation under asymmetric information and unequal constraints. Classic work on school choice mechanisms highlights how decentralization, informal access, or lack of transparency can disadvantage specific groups, particularly when participants differ in their information or ability to strategise (Abdulkadiroğlu & Sönmez, 2003; Pathak & Sönmez, 2008).

Further, the large empirical literature on labour-market matching (see e.g. Petrongolo & Pis-

sarides, 2001, for an overview) shows that individuals not only must choose an education track, but also later compete on the labour market – often via search, network-effects, and with matching frictions. In our context, the dual requirement of securing both a VET school admission and an apprenticeship contract mirrors these broader matching challenges in the labour market.

In our context, traditional VET tracks operate under decentralized search and opaque access routes, creating allocative inefficiencies for disadvantaged students. We extend the literature by studying how emerging ICT/digital tracks, characterized by greater transparency and weaker reliance on parental networks, may act as an implicit mechanism that reduces access frictions and levels the playing field. This paper builds on both strands of models by integrating search frictions into a Roy-style educational choice model, with a specific focus on how parental networks, and the absence thereof, shape access to VET pathways.

3 Context: The Danish Setting

The Danish context functions as a natural laboratory for identifying mechanisms that are also relevant in other countries with similar institutions. First, Denmark offers exceptionally rich administrative register data, enabling population-wide analysis at the individual level with precise information on education, family background, and labour market outcomes. Second, the Danish educational system features a clear division between VET and academic tracks, supported by a strong apprenticeship tradition, which makes it particularly well suited for studying sorting into different pathways. Moreover, although admission rules diverge across type of post-compulsory education, they are largely uniform across regions and across schools in Denmark, ensuring comparable access conditions nationwide. Third, Denmark has experienced rapid digitalization, becoming one of the world's most digitalized economies (Eurostat, 2025). Finally, the population of children of immigrants has grown substantially in recent decades, making questions of education and labour market integration both academically important and of clear policy relevance (OECD/EU, 2023).

The Danish educational system comprises ten years of compulsory education (from approximately age 5/6 to 15/16), after which students encounter a pivotal decision between three primary pathways: VET, general upper secondary education (which prepares students for university), or a cessation of further education.

Denmark operates a dual VET system that distinguishes itself from the academic track through its integration of school-based instruction with firm-based apprenticeships.[1] Students typically enter VET directly after completing compulsory schooling, beginning with a short basic course before progressing to the main programme. More than 100 VET programmes exist across di-

[1]For detailed descriptions of the VET programmes in Denmark, see e.g. Groes et al. (2025, 2021).

verse sectors including construction, technology, health care, and services. Governance is highly decentralised, with trade committees and social partners closely involved in curriculum design and workplace approval, whilst the Ministry of Education provides overall regulatory oversight (Cedefop; University College Copenhagen, 2022).

Crucially, completing the main VET programme requires students to secure a training contract with an approved employer. This institutional structure creates a dual access requirement: students must not only apply and be admitted to a relevant school, but also obtain an apprenticeship placement. Students are generally responsible for finding their own apprenticeships by reaching out to potential employers – a process in which parental networks and informal connections often prove decisive, particularly given students' young age at entry (Danmarks Evalueringsinstitut, 2025). Apprenticeship places are frequently in short supply, and existing evidence identifies the difficulty of securing such placements as one of the primary drivers of high VET discontinuation rates (Groes et al., 2021). This dependence on student-led apprenticeship search creates potential barriers for those lacking established networks, making access contingent not solely on ability but also on social capital.

4 Theory

4.1 Theoretical Model

Group-specific search costs (such as those faced by children of immigrants in traditional vocational sectors) act as participation constraints that bind unequally across types. Even if individual sector choices are incentive-compatible, these constraints reduce the set of feasible allocations. To fix ideas consider a continuum of individuals who differ in their absolute skill level $\theta \in \Theta$, which we interpret as academic ability or rank. Similarly to Roy (1951), each individual chooses between two (educational) sectors:

I) **Old Traditional Sector**: Traditional VET tracks (e.g., plumbing, carpentry)

II) **New Digital Sector**: Digital or IT-oriented tracks, which the younger generation is among the first to enter

Each individual selects the sector that maximizes their expected utility. For sector $j \in \{\text{Old}, \text{New}\}$, utility is defined as:

$$u_j(\theta, g) = R_j(\theta) - C_j(\theta, g) \tag{4.1}$$

where $R_j(\theta)$ is the return to skill in sector j, and $C_j(\theta, g)$ is the cost of accessing sector j for an individual of type $g \in \{CL, CI\}$, representing Children of Locals (CL) and Children of Immigrants (CI), respectively.

To focus on structural access frictions, we assume discrimination enters only through a fixed component of the access cost, while returns are group-invariant and weakly increasing:

$$R_j(\theta, g) = R_j(\theta), \qquad R_j'(\theta) \geq 0.$$

The observed gap is best interpreted as reflecting uniform structural access barriers across the skill distribution, rather than differences in ability. We assume that skills are drawn from the same underlying distribution across groups. This assumption is made for simplicity, yet it is not essential for our main results:

$$\theta \sim F_g(\theta), \quad \text{with } F_{CL} = F_{CI},$$

so sorting differences arise solely from unequal costs in the Old sector:

$$C_{\text{New}}(\theta, CL) = C_{\text{New}}(\theta, CI), \qquad C_{\text{Old}}(\theta, CI) > C_{\text{Old}}(\theta, CL). \tag{4.2}$$

Empirically (see results in Section 5), the immigrant–native gap appears as a skill-neutral parallel shift across the grade distribution, consistent with this fixed-cost wedge rather than a skill-dependent one.

The higher costs faced by CI in the Old Traditional Sector may reflect search frictions, reduced access to informal networks, or anticipated discrimination. Importantly, we abstract from group differences in preferences or productivity and focus exclusively on access costs.

This implies a decision rule, where individuals choose the Old Traditional Sector if: [2]

$$u_{\text{Old}}(\theta, g) \geq u_{\text{New}}(\theta, g) \tag{4.3}$$

Because CI face higher costs in the Old Traditional Sector, they require a higher skill level to make the switch. This implies that even when equally skilled, CI are disproportionately less likely to enter the Old Traditional Sector and instead sort into the New Digital Sector, where access costs are equal. Hence, the cut-off point for choosing one sector over the other, θ_g^*, is different between

[2] One could introduce a stochastic component into sectoral choice, to reflect preferences. Hence, let ε_j denote an i.i.d. Type I Extreme Value shock for sector j, independent across individuals and sectors. Utility then becomes $U_j(\theta, g) = u_j(\theta, g) + \varepsilon_j$, and the probability of choosing the Old Traditional Sector is given by a standard logit expression:

$$P_{\text{Old}}(\theta, g) = \frac{\exp(u_{\text{Old}}(\theta, g))}{\exp(u_{\text{Old}}(\theta, g)) + \exp(u_{\text{New}}(\theta, g))}.$$

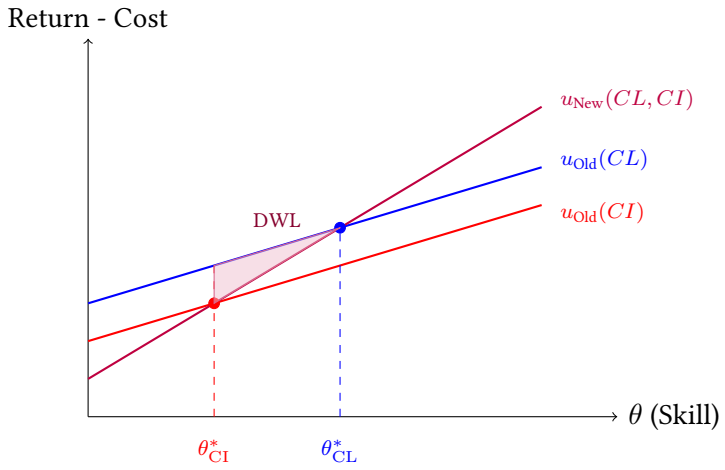
This extension yields a smooth, continuous choice pattern rather than a strict cutoff. The deterministic model presented in the main text can thus be viewed as the limiting case of this stochastic specification, however does not have significant implications for the underlying factors of differentiated search costs.

the two groups:

$$\theta^*_{CL} \neq \theta^*_{CI} \tag{4.4}$$

The model thus predicts that skill differences alone cannot explain the observed sorting patterns across sectors: group-specific frictions play a central role.

Figure 3: DWL between u_{New} and $u_{\text{Old}}(\text{CL})$ on $[\theta^*_{\text{CI}}, \theta^*_{\text{CL}}]$



Notes: The figure illustrates sorting with group-specific search costs. Both groups face identical returns to skill, but children of immigrants (CI) faces an additional fixed access cost in the Old sector, shifting their cutoff threshold relative to children of locals (CL): $\theta^*_{CI} > \theta^*_{CL}$. As a result, in the interval $[\theta^*_{CI}, \theta^*_{CL}]$, equally skilled individuals are sorted into different sectors: CL students enter the Old sector, while CI students are diverted into the New sector where access costs are equal. The shaded area highlights the deadweight loss (DWL) generated by this misallocation. In this region, CI students select into New even though Old would yield higher net returns under equal access, so talent that would be more productively allocated in Old is inefficiently shifted to New, producing both individual utility losses and aggregate inefficiency

This simple framework captures how institutional or structural frictions can distort educational pathways and lead to misallocation of talent. The presence of group-specific cutoff thresholds will be central to our welfare analysis in the next section.

4.2 Counterfactual Deadweight Losses from Group-Based Frictions

The societal Deadweight Losses, $\mathcal{L}$, from misallocation can be expressed as follows: among individuals with skill levels between θ^*_{CI} and θ^*_{CL}, children of immigrants select into the digital sector even though the traditional sector would offer a higher net return under equal access. This diversion generates a partial-equilibrium welfare loss, as these students are allocated to the digital rather than the traditional sector despite higher potential returns in the latter.

These frictions not only distort sectoral sorting but may also generate welfare losses at both

the individual and societal level. Let $j^*(\theta, g) \in \{\text{Old}, \text{New}\}$ denote the sector chosen by an individual of type g with skill θ under the current, group-specific access costs. Let $\tilde{j}^*(\theta, g)$ denote the counterfactual choice that would arise if both groups faced the same access costs as CL. That is, the counterfactual removes the frictions uniquely affecting CI and evaluates how choices would change under equal access:

$$\tilde{j}^*(\theta, g) = \underset{j \in \{\text{Old,New}\}}{\arg\max} \{R_j(\theta) - C_j(\theta, CL)\} \tag{4.5}$$

Then, the individual-level welfare loss for a CI with skill θ is:

$$\Delta u(\theta, CI) = u_{\tilde{j}^*(\theta,CI)}(\theta, CI) - u_{j^*(\theta,CI)}(\theta, CI) \tag{4.6}$$

where $\Delta u(\theta, CI) > 0$ if and only if the individual would have chosen differently in the absence of group-specific costs.

The total welfare loss attributable to these frictions is:

$$\mathcal{L}_{CI} = \int_{\Theta} \mathbf{1}\left\{j^*(\theta, CI) \neq \tilde{j}^*(\theta, CI)\right\} \cdot \Delta u(\theta, CI)\, dF(\theta) \tag{4.7}$$

This loss captures the extent to which high-skilled CI are inefficiently diverted from the Old Traditional Sector. In a broader social context, this may translate into lower overall productivity, poorer job matches, and weakened mobility, not because of differences in ability, but due to unequal access to opportunity structures. Consequences of differentiated search costs in a two-dimensional setting can be found in Appendix C.

Our model deliberately holds preferences and skill distributions constant across groups to isolate the impact of search frictions. This focus allows us to derive clear predictions about how access costs alone can generate systematic sorting differences and welfare losses. While real-world differences may extend beyond access, the model provides a clean benchmark for identifying the consequences of this one key mechanism.

4.3 Testable Predictions

In our framework, "skill" refers to the underlying ability that shapes educational selection, with primary school grades providing the main observable proxy available to schools and employers at the time of admission. The framework allows immigrant disadvantages to appear in two different ways: either as a skill-dependent wedge, where access costs vary with ability, or as a skill-neutral wedge, where children of immigrants face a fixed barrier that shifts their effective

cut-off independently of skill. As we will show in Section 5, our empirical evidence points strongly to the latter. Across the grade distribution, the immigrant-native gap manifests itself as a nearly parallel upward shift in the probability of entering Digital, consistent with a fixed displacement rather than a slope effect. We therefore model discrimination as operating primarily through a skill-neutral wedge, consistent with fixed access costs such as weaker parental networks, reliance on informal recruitment channels, or general bias against immigrant-background youth. This assumption is guided by the data, though the opposite pattern could in principle emerge under a skill-dependent wedge. Aggregated probabilities can also appear as parallel shifts due to noise and unobserved heterogeneity. The dominant empirical signal is that structural, skill-independent discrimination drives the observed differences in sorting. Our framework then delivers the following predictions that guide our empirical analysis:

1. **Over-representation in digital:** Children of immigrants (CI) are more likely than children of locals (CL) to enter New Digital VET tracks because they face relatively higher access costs in traditional fields (see Eq. 4.2 and Fig. 3).
2. **Selection pattern:** The precise sorting mechanism follows from the cutoff rule in Eq. 4.3-4.4.
    - If the wedge is *skill-dependent*, CI switch into New Digital tracks at lower levels of θ, generating a *cutoff shift* relative to CL.
    - If the differential is instead *constant*, independent of skill, the cut-off simply shifts outward for CI by a fixed amount. In the data, this will manifest as a nearly *parallel increase* in the probability of choosing New Digital tracks across the skill distribution.

    This distinction allows us to test whether immigrant disadvantages manifest as a skill-dependent cut-off effect or as a skill-neutral displacement.

We will evaluate these predictions empirically by estimating sorting patterns across the skill distribution and comparing earnings gradients across fields.

5 Empirical Analysis

5.1 Data Sources

The rich, population-wide Danish administrative data allows us to track individuals from their compulsory schooling through their educational choices and into the labour market, enabling analysis of both selection into different VET tracks and subsequent labour market outcomes. We provide a description of the data used for our motivational intergenerational mobility figures in Appendix A. Below, we detail the data utilised in our main analyses, where we examine the outcomes of individuals who have completed VET. For our main analyses, we limit our sample to those who have completed VET between 2008-2015, so that we can observe their compul-

sory schooling grades (available from 2003) and observe their earnings five years after completed training (income data are available till 2020).

Demograhics: The population register (BEF 1986-2020) includes parent-child links. After identifying the parents of each child, we can extract information on parental country of birth (defining "child of immigrant" as having at least one foreign-born parent. We include all children of immigrants either born in Denmark or if immigrated to Denmark before age 10, so that we observe compulsory schooling outcomes and educational choices).

School grades: Compulsory schooling in Denmark spans 10 years from age 5/6 to age 15/16. The UDFK-register includes school grades for those finishing school from 2003 onward. We focus on grades from exams in the 9th school grade (measured at age 15/16) and calculate the average grade across the relevant exams.[3] To account for grade inflation and changes in grading scales, we rank children's average grades within school cohorts to obtain percentile school grade ranks.

Educational outcomes: The registers on educational attainment (UDSF and UDDA registers) allow for detailed tracking of education, including VET. We identify all individuals who complete VET and observe their fields of study.[4] We categorize each VET program into study fields based on ISCED-field codes provided by Statistics Denmark.[5] For most analyses, we use a binary classification of fields: ICT/digital versus other programs.

Labour market outcomes: The income register (IND 2013-2020) allows us to determine earnings (including income from self-employment) 5 years after completing VET. We inflation-adjust all measures of earnings to 2020-levels. In our main analyses, we focus on the natural logarithm of earnings; however, in robustness checks in Appendix B, we also provide results using alternative definitions of earnings that allow for the inclusion of zeros (non-transformed income and income ranks).

5.2 Educational Outcomes

Figure 2 illustrates educational attainment by age 30, disaggregated by parental immigration status and gender. For men in particular, there is a notable gap in VET completion, with sons of immigrants significantly less likely to complete VET qualifications than sons of locals. This

[3]When finishing compulsory schooling in Denmark, exams in certain subjects are sat in all schools, others are randomly drawn and vary across school and pupils. To be able to consistently compare exams outcomes across students, we focus on the grades from the non-randomly drawn exams. If we do not observe a grade in the relevant compulsory exam by the end of the calendar year in which an individual turns 17, we assign them the lowest possible grade.

[4]If an individual completes multiple VET programmes, we focus on first programme.

[5]In addition, we manually go through each VET programme title and correct any misclassifications.

disparity in VET uptake is markedly larger than at any other educational level and substantially exceeds the corresponding gap amongst daughters (approximately 15 percentage points for sons versus 5 percentage points for daughters). These patterns establish VET as the educational pathway where children of immigrants, particularly sons, are most underrepresented relative to their peers with locally born parents. Given VET's demonstrated importance for upward mobility amongst sons of low-income locals (Figure 1), this underrepresentation raises the question of what mechanisms might constrain access to VET for immigrant-background youth.

Figure B.1 complements this by showing that fields with a higher share of women are associated with lower earnings, which makes it natural to focus on sons: if high-return VET fields are particularly male-dominated, understanding why immigrant-background boys do not access these pathways is central to explaining mobility gaps. ICT/digital stands out as both a high-earning and male-dominated field, making a comparison between sons of locals and sons of immigrants in choosing this VET field particularly salient.

Figure 4 demonstrates the increasing importance of ICT/digital VET in Denmark, showing a steadily growing share of VET male graduates from ICT/digital tracks. This trend creates an opportunity to study whether these emerging sectors provide different opportunities for sons of immigrants compared to traditional VET paths.

Figure 4: ICT/digital share of VET graduates over time by gender

Notes: The figure shows the growing importance of ICT/digital VET, with an increasing share of graduates coming from ICT/digital tracks. We consider all completed VET programs from 1999-2022 observed in the UDSF-register.

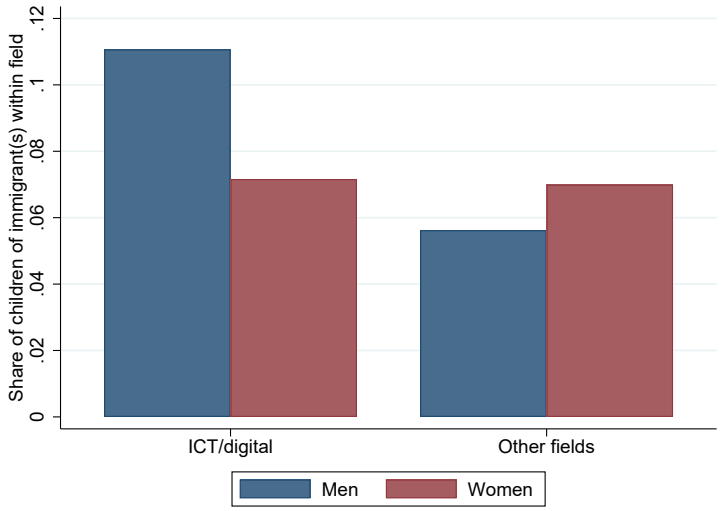
5.3 Selection into ICT/digital VET Pathways

We next examine patterns of selection into ICT/digital VET tracks. We first document whether children of immigrants are overrepresented in ICT/digital programmes. Then, guided by our the-

oretical framework where groups face unequal access costs in traditional sectors, we test whether this sorting reflects differential skill-based selection thresholds or a skill-neutral parallel shift.

5.3.1 VET Track Choice

Figure 5: Share of children of immigrants within VET fields by gender



Notes: The figure shows that sons of immigrants are relatively more likely to complete VET in ICT/digital fields compared to other VET tracks. We test this difference statistically in Table 1, Columns 1 and 2. The sample includes individuals who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

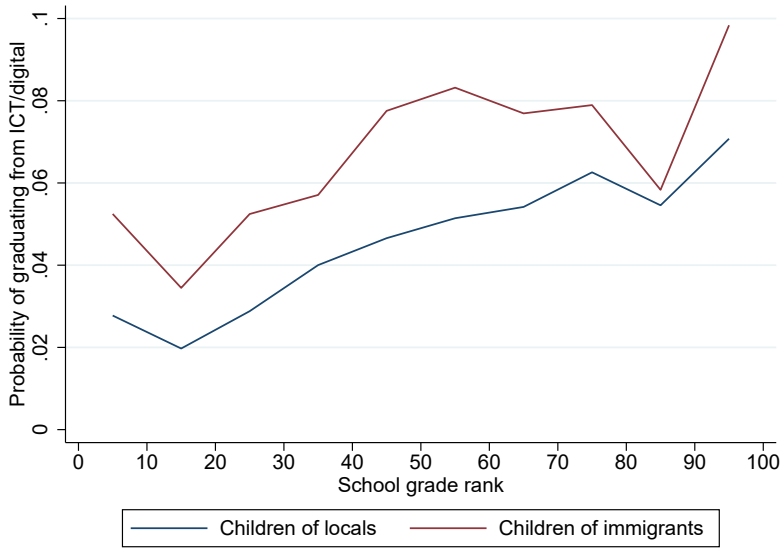
Figure 5 shows the share of children of immigrants within different VET fields, separated by gender. Strikingly, sons of immigrants are much more likely to choose ICT/digital tracks compared to other VET fields. Figure B.2 demonstrates that this overrepresentation persists across *all* parental regions of origin, including Asia, the Middle East, and Europe. These patterns are consistent with our theoretical prediction that children of immigrants will be overrepresented in New Digital Sector vocations where search frictions may be lower.

The documented overrepresentation of sons of immigrants in ICT/digital programmes could be attributed to either: i) lower barriers to entry in the digital sector, or ii) higher earnings potential within the digital sector. The first explanation aligns with our theoretical prediction that children of immigrants will favour sectors with lower access frictions. The second suggests that immigrant-background students sort into ICT/digital fields due to higher returns in terms of earnings, rather than differential access costs. We examine both possibilities in subsequent analyses.

5.3.2 Selection by Skill Level

To further understand whether the overrepresentation of sons of immigrants in ICT/digital programmes reflects differential access barriers, we examine how the probability of choosing

Figure 6: ICT/digital track completion by school grade rank and immigrant status



Notes: The figure shows that the probability of choosing and completing ICT/digital VET tracks increases with skill level (school grade rank) for both sons of immigrants and sons of locals, and that sons of immigrants are more likely to choose ICT/digital tracks at all skill levels. We test these differences statistically in Table 1, Columns 3 and 4. The sample includes individuals who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

ICT/digital tracks varies with skill level (measured by compulsory school grades) for sons of immigrants versus sons of locals. If access barriers in traditional sectors drive the overrepresentation in ICT/digital fields, we should observe sons of immigrants selecting into ICT/digital tracks at higher rates than sons of locals even after controlling for skill – a pattern that could manifest either as a parallel shift across the skill distribution (skill-neutral access costs) or as differential slopes (skill-dependent access costs).

Figure 6 shows that the probability of choosing ICT/digital tracks increases with skill level for both groups. Further, we see that sons of immigrants are more likely to choose ICT/digital tracks at all skill levels compared to sons of locals. This pattern supports our initial prediction regarding participation but indicates that the relationship between skills and sector choice is comparable across groups, rather than varying across the skill distribution as our basic model suggested.

Table 1 presents regression results estimating the following model, confirming the patterns from Figure 6:

$$\begin{aligned}\Pr(\text{ICT/digital}_i = 1) =& \beta_0 + \beta_1 \cdot \text{ChildOfImmigrant}_i + \beta_2 \cdot \text{SchoolGradeRank}_i \\ &+ \beta_3 \cdot (\text{ChildOfImmigrant}_i \times \text{SchoolGradeRank}_i) + \varepsilon_i\end{aligned} \tag{5.1}$$

where ICT/digital_i is an indicator equal to one if individual i completes an ICT/digital VET pro-

Table 1: Regression of probability of choosing ICT/digital track on skills

	(1)	(2)	(3)	(4)
Child of immigrant(s)=1	0.0167***	0.0111***	0.0179***	0.0128**
	[0.00279]	[0.00293]	[0.00480]	[0.00512]
School grade rank			0.000593***	0.000573***
			[0.0000374]	[0.0000377]
Child of immigrant(s)=1 × School grade rank			0.0000774	0.0000413
			[0.000146]	[0.000148]
Constant	0.0387***	0.0369***	0.0168***	0.0156***
	[0.000747]	[0.000761]	[0.00136]	[0.00140]
R^2	0.00247	0.0264	0.00666	0.0306
N	73894	66856	73894	66856
Baseline ICT/digital share if local-born parents	3.86%	3.64%	3.86%	3.64%
Year FEs	Yes	Yes	Yes	Yes
Age FEs	No	Yes	No	Yes
Region at age 14 FEs	No	Yes	No	Yes

Notes: This table reports estimates of Equation 5.1, showing how the probability of completing the a ICT/digital VET program vary with school grade levels and across immigrant groups. In Columns 2 and 4, we add additional controls through age FEs and region at age 14 FEs. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables. Robust standard errors in brackets, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

gramme, $\text{ChildOfImmigrant}_i$ is an indicator equal to one if at least one parent was born outside Denmark, and SchoolGradeRank_i is the individual's percentile rank in the compulsory school grade distribution (ranging from 0 to 100).

Table 1, Column 1 presents the baseline specification, regressing ICT/digital completion on immigrant background alone, controlling only for year fixed effects. We find that sons of immigrants are 1.67 percentage points more likely to complete ICT/digital tracks, a 43% difference relative to baseline mean of those with local-born parents. Column 2 adds age and region fixed effects to this baseline specification, yielding a slightly smaller but still highly significant coefficient of 1.11 percentage points – a substantial 30% difference relative to the baseline mean of 3.64% of male VET graduates with local-born parents who complete ICT/digital programmes during this period. These results confirm those from Figure 5.

Table 1, Columns 3 and 4 introduce school grade rank and its interaction with immigrant status to test whether sorting patterns vary across the skill distribution. Across both specifications – with Column 3 controlling only for year fixed effects and Column 3 adding age and region

fixed effects – the results are qualitatively consistent. The main effect of ChildOfImmigrant$_i$ remains positive and statistically significant, indicating that sons of immigrants are approximately 1.3–1.8 percentage points more likely to choose ICT/digital tracks even at the lowest skill levels. The coefficient on SchoolGradeRank$_i$ is positive and highly significant, confirming that higher-skilled students are more likely to select into ICT/digital fields. Crucially, the interaction term between immigration background and school grade rank is small and statistically insignificant in both specifications, indicating that the relationship between skill and ICT/digital track choice does not differ meaningfully between sons of immigrants and sons of locals.

The positive main effect on ChildOfImmigrant$_i$ combined with the negligible interaction term suggests that sons of immigrants face a fixed disadvantage in accessing traditional VET sectors, leading them to sort into ICT/digital fields at uniformly higher rates regardless of skill level.

Connection to Theory: In Column 4, Table 1, the predicted probability at $\theta = 0$ is $p_{CL}(0) = 0.0156$ for locals and $p_{IM}(0) = 0.0156 + 0.0128 = 0.0284$ for immigrants, i.e. a level gap of 0.0128 ($\approx$1.28 pp). This is exactly the kind of level difference implied by a skill-neutral (parallel) shift. If the gap is a pure parallel shift, slopes should be the same across the skill-distribution. In Column 4, the slope for locals is 0.000573, while the immigrant slope is $0.000573 + 0.0000413 = 0.0006143$. The interaction 0.0000413 is small and statistically insignificant, which is consistent with parallel slopes and thus a skill-neutral displacement. Hence, immigrants reach a 50% probability of entering Digital at a *lower* skill level by about $845.4 - 767.7 \approx \mathbf{77.7}$ points, i.e. roughly **9.2%** lower ($767.7/845.4 \approx 0.91$).[6] ICT/digital programs account for approximately 4-5% of all male VET completions during this period, making the 50% probability threshold calculation illustrative of the differences between groups rather than descriptive of typical pathways.

Taken together, these findings confirm that ICT/digital programs attract a disproportionately large share of sons of immigrants, consistent with our theoretical prediction that lower access barriers induce sorting into new fields. The pattern is not confined to a particular part of the skill distribution, and Table 1 shows that even conditional on school rank, children of immigrants remain significantly more likely to choose ICT/digital. This provides strong evidence that differential access costs, rather than comparative advantage alone, drive the overrepresentation of immigrant-background students in ICT/digital VET pathways.

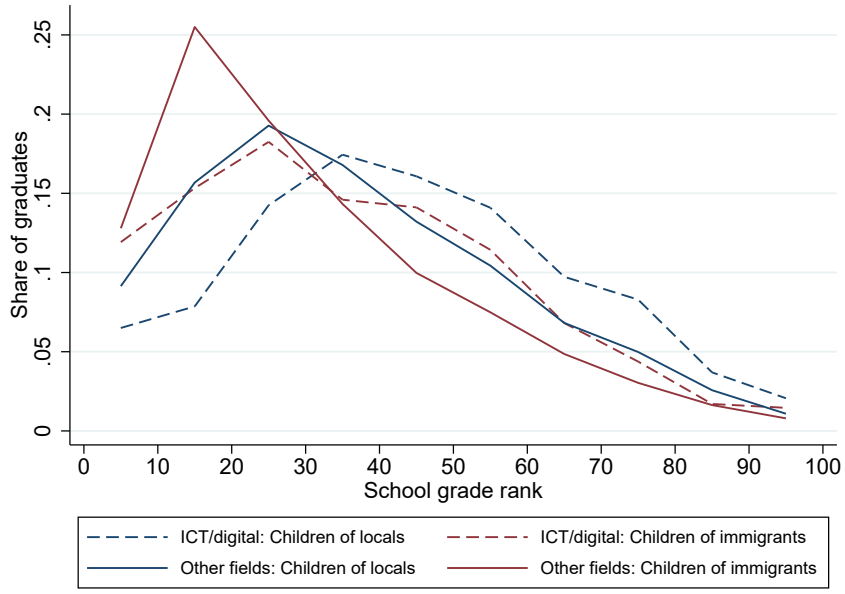
[6] Using column (4) coefficients, we have that:

$$p_{CL}(\theta) = 0.0156 + 0.000573\,\theta, \qquad p_{IM}(\theta) = 0.0284 + 0.0006143\,\theta.$$

Solving $p_g(\theta) = 0.5$ gives:

$$\theta^{CL}_{0.5} = \frac{0.5 - 0.0156}{0.000573} \approx \mathbf{845.4}, \qquad \theta^{IM}_{0.5} = \frac{0.5 - 0.0284}{0.0006143} \approx \mathbf{767.7}.$$

Figure 7: Share of graduates within track by school grade rank and immigrant status



Notes: The figure shows that individuals who complete VET are concentrate in lower half of the overall school grade distributation. Further, those who complete ICT/digital tracks have grade distributions shifted to the right (higher grades) compared to other fields for both children of locals and children of immigrants. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

5.3.3 Skill Distribution within Tracks

Having documented sectoral sorting across skill levels, we now turn to the composition of each VET track to assess how selection shapes the skill distribution within fields. Comparing the skill distributions within tracks allows us to rule out ability-based selection as the main driver of immigrant overrepresentation in ICT/digital fields, consistent with the interpretation that this pattern reflects differential access costs.

Figure 7 examines the distribution of skills within each VET track by immigrant background. We find that ICT/digital tracks have a skill distribution shifted to the right (higher skills) compared to other fields for both groups, contrary to our model's prediction of differential selection. The skill distributions within each track differ between children of locals and children of immigrants, with children of immigrants being less skilled in both tracks. Figure B.3 confirm that average school grade ranks are higher in ICT/digital tracks compared to other fields for both groups. This suggests that ICT/digital VET attract higher-skilled students on average, but not through the differential selection mechanism proposed in our basic model.

Figures 7 and B.3 demonstrate that ICT/digital programs attract the highest-performing students among both children of locals and children of immigrants, as measured by school rank. At

the same time, children of immigrants consistently display lower average grades than their native peers within both ICT/digital and other VET fields. This implies that the overrepresentation of immigrant-background students in ICT/digital cannot be explained by comparative advantage based on higher academic ability. Rather, the evidence rules out the alternative explanation that children of immigrants disproportionately select into ICT/digital because they are relatively more skilled, thereby reinforcing the interpretation that differential access costs are the primary driver of this sorting pattern.

Our measure of skill is unidimensional, considering only school grade rank. Sons of immigrants possess other unobserved skills – such as cultural familiarity with technology or language abilities – that complement ICT/digital work but are not captured by compulsory school grades. If such group-specific comparative advantages drove the observed sorting, we would expect heterogeneity across parental origin regions: sons of immigrants from some cultural backgrounds might be overrepresented in ICT/digital fields whilst those from others are not. However, Figure B.2 shows that sons of immigrants from *all* parental origin regions, including Asia, the Middle East, and Europe, are more likely to choose ICT/digital VET fields. This universal pattern argues against explanations based on culturally specific skills, and instead supports our interpretation that structural access barriers in traditional sectors uniformly push immigrant-background students toward ICT/digital pathways.

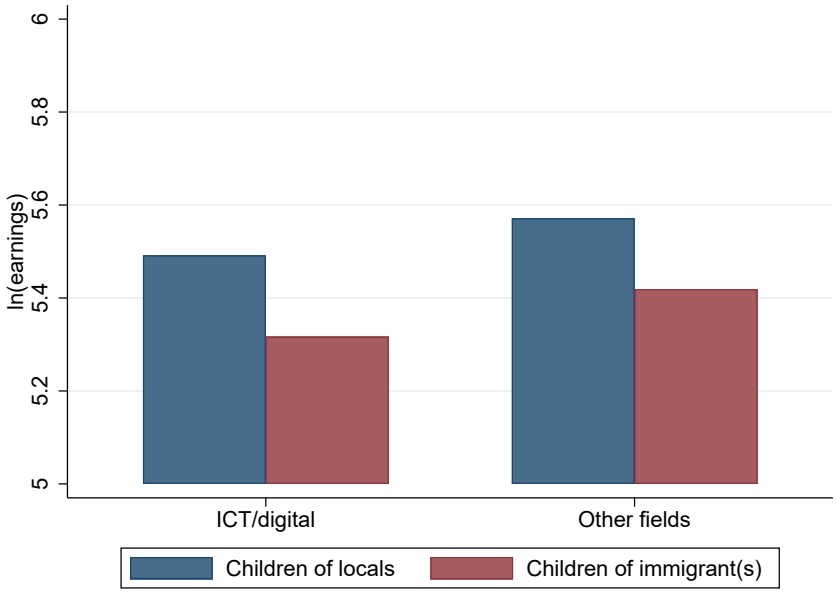
5.4 Earnings in ICT/digital VET Pathways

To assess whether ICT/digital fields compensate for access frictions, we estimate returns to skill across sectors and compare the steepness of earnings gradients across skill level. While our theory predicts that frictions distort sectoral sorting, the returns to each track will affect the size of the deadweight loss from sectoral mismatch. We now examine whether the observed sorting patterns map onto differential earnings outcomes.

5.4.1 Overall Earnings Gaps

Figure 8 shows average ln(earnings) by field and immigrant background. Contrary to what one might expect given the higher skill levels in ICT/digital tracks, we find that earnings are lower in ICT/digital tracks compared to other fields for both groups. Further, children of immigrants earn less than children of locals within each track. This creates a seeming paradox: ICT/digital tracks attract higher-skilled students but offer lower returns on average. This pattern suggests that factors beyond immediate earnings must be driving the selection into ICT/digital VET. In particular, the fact that ICT/digital fields yield lower average earnings than traditional male-dominated VET tracks confirms that immigrant-background students are not choosing ICT/digital because of higher wages. Instead, it supports our theoretical prediction that higher search costs

Figure 8: ln(earnings) by field and immigrant status



Notes: The figure reports means of ln(earnings) by education fields. We see that earnings are lower in ICT/digital tracks compared to other fields for both children of locals and children of immigrants, despite the higher average skill levels in ICT/digital tracks. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables. See Appendix B for results using alternative earnings definitions.

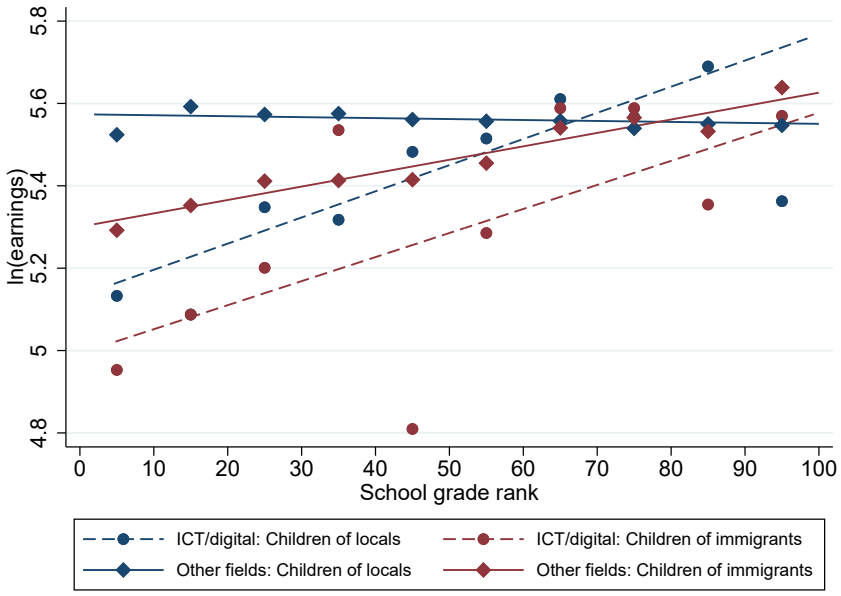
in traditional sectors divert children of immigrants toward ICT/digital, underlining the central role of access frictions in shaping VET choices.

5.4.2 Returns to Skills across Tracks

If ICT/digital fields offer higher returns to skill – as our stylized model allows via steeper slope of u_{New} – we should expect to see this reflected in empirical earnings gradients by skill and field.

Figure 9 examines how earnings vary with skill level across tracks and immigrant groups. We find that the earnings gradient with respect to skills is relatively flat for children of locals in non-digital fields, while ICT/digital graduates show a much steeper gradient across both immigrant and native groups. Moreover, children of immigrants exhibit a steeper gradient than children of locals in both sectors. These patterns suggest that while ICT/digital tracks have lower average returns, they offer greater rewards for skill, which may be particularly valuable for high-skilled children of immigrants. In other words, although the average earnings in ICT/digital are lower than in traditional male-dominated VET tracks, the marginal return to skill is higher. This helps explain why high-skilled children of immigrants still choose ICT: despite lower mean earnings, the steeper gradient implies greater gains at the top, supporting our model's prediction that ICT/digital fields can partially compensate for access barriers in traditional sectors.

Figure 9: ln(earnings) by school grade rank, field, and immigrant status



Notes: The figure illustrates how earnings five years after completing VET vary with skill level across tracks and immigrant groups, showing steeper returns to skills in ICT/digital tracks and among children of immigrants within VET. We test these differences statistically in Table 2, Columns 3 and 4. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables. See Appendix B for results using alternative earnings definitions.

5.4.3 Regression Analysis of Earnings

To test our findings from Figure 9 statistically, Table 2 presents the regression results estimating the following model:

$$\begin{aligned}\ln(\text{Earnings}_i) =& \beta_0 + \beta_1 \cdot \text{SchoolGradeRank}_i + \beta_2 \cdot \text{ICT/digital}_i \\ &+ \beta_3 \cdot (\text{ICT/digital}_i \times \text{SchoolGradeRank}_i) \\ &+ \beta_4 \cdot \text{ChildOfImmigrant}_i + \beta_5 \cdot (\text{ChildOfImmigrant}_i \times \text{SchoolGradeRank}_i) \\ &+ \beta_6 \cdot (\text{ICT/digital}_i \times \text{ChildOfImmigrant}_i) \\ &+ \beta_7 \cdot (\text{ICT/digital}_i \times \text{ChildOfImmigrant}_i \times \text{SchoolGradeRank}_i) + \varepsilon_i \end{aligned} \tag{5.2}$$

where $\ln(\text{Earnings}_i)$ denotes the natural logarithm of individual i's labour income five years after completing VET (inflation-adjusted to 2020 levels), and all other variables follow from Equation 5.1.

Table 2, Columns 1 and 2 estimate our baseline specification excluding indicators for immigrant background. Column 1, controlling only for year fixed effects (FEs), shows that ICT/digital

tracks are associated with 45% lower baseline earnings, but exhibit significantly steeper returns to skill (with a coefficient on interaction between school grade rank and ICT/digital of 0.00639). Column 2 adds age and region fixed effects, yielding qualitatively similar results: a -38.6% baseline penalty and a steeper skill gradient in ICT/digital of 0.00649. These findings confirm that whilst ICT/digital fields offer lower mean earnings, they offer higher returns to skill – consistent with our theoretical framework.

Table 2: Regression of ln(earnings) on skills and VET track

	(1)	(2)	(3)	(4)
School grade rank	0.000310*	0.000358*	-0.000191	-0.000115
	[0.000187]	[0.000196]	[0.000194]	[0.000203]
ICT/digital=1	-0.452***	-0.386***	-0.453***	-0.402***
	[0.0581]	[0.0611]	[0.0621]	[0.0651]
ICT/digital=1 × School grade rank	0.00639***	0.00649***	0.00661***	0.00686***
	[0.00117]	[0.00122]	[0.00125]	[0.00129]
Child of immigrant(s)=1			-0.281***	-0.291***
			[0.0286]	[0.0317]
Child of immigrant(s)=1 × School grade rank			0.00356***	0.00390***
			[0.000716]	[0.000759]
ICT/digital=1 × Child of immigrant(s)=1			0.140	0.215
			[0.166]	[0.180]
ICT/digital=1 × Child of immigrant(s)=1 × School grade rank			-0.00413	-0.00458
			[0.00359]	[0.00390]
Constant	5.539***	5.532***	5.573***	5.564***
	[0.00783]	[0.00832]	[0.00807]	[0.00858]
R^2	0.00401	0.00602	0.00676	0.00851
N	70256	63587	70256	63587
Year FEs	Yes	Yes	Yes	Yes
Age FEs	No	Yes	No	Yes
Region at age 14 FEs	No	Yes	No	Yes

Notes: This table reports estimates of Equation 5.2, showing how earnings five years after completing VET vary with school grade rank across tracks and immigrant groups. In columns 2 and 4, we add additional controls through age FEs and region at age 14 FEs. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables. See Appendix B for results using alternative earnings definitions. Robust standard errors in brackets, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2, Columns 3 and 4 introduce immigrant status and its interactions to test whether returns to skill differ by group. Column 4 adds controls for age and region as FEs. Across both specifications, the results are consistent. The main effect of $\text{ChildOfImmigrant}_i$ is negative and statistically significant (approximately -28 to -29 percentage points), indicating lower baseline

earnings for sons of immigrants in traditional VET fields. However, the interaction between immigrant status and school grade rank is positive and highly significant (approximately 0.0036 to 0.0039), demonstrating that sons of immigrants face significantly steeper earnings returns to skill across all VET tracks. The baseline ICT/digital effect remains large and negative, whereas its interaction with skill remains positive and significant, replicating the pattern from Columns 1 and 2. The coefficient on the interaction between ICT/digital and immigration status is positive but statistically insignificant, indicating that the baseline earnings gap between ICT/digital and traditional fields does not differ significantly by immigrant status. Finally, the three-way interaction term between ICT/digital, immigration status, and school grade rank, is negative but also statistically insignificant, suggesting that the steeper skill gradient in ICT/digital fields does not differ substantially between sons of immigrants and sons of locals.

These findings validate our model's assumptions about sectoral earnings structures. ICT/digital fields exhibit lower mean earnings but higher marginal returns to skill, a pattern that holds for both groups of children. Similarly, sons of immigrants face lower baseline earnings but steeper skill gradients across tracks. This combination helps explain why high-skilled immigrant-background students sort disproportionately into ICT/digital pathways: despite lower mean payoffs, the steeper returns to skill in ICT/digital fields make them relatively more attractive for those with higher abilities, particularly if access to higher-paying traditional sectors is constrained by search frictions.

6 Conclusion

Children of immigrants are substantially more likely than their native peers to enter ICT/digital VET tracks. Using population-wide Danish register data, we document that immigrant-background student are 30% more likely to graduate from ICT/digital VET tracks (Table 1). This difference persists at all skill levels, consistent with skill-neutral search-cost differentials in traditional sectors. Conditional-on-choice regressions confirm that the main immigrant effect is positive and significant, while the interaction with school performance is small and insignificant (Table 1), indicating a parallel upward shift. ICT/digital fields, meanwhile, display lower baseline earnings but steeper returns to skill (Table 2), matching the model's prediction that ICT/digital educational routes provide partial compensation, but not a complete substitute for restricted access to traditional sectors.

Our theoretical framework rationalises these patterns. When children of immigrants face higher access costs in Old Traditional fields but equal costs in New Digital ones, the cutoff threshold for CI shifts relative to a setting without these frictions. As a result, some individuals with ability in $[\theta^*_{CL}, \theta^*_{CI}]$ are diverted into ICT/digital, despite the traditional old being the efficient

match under equal access. The model thus predicts both the observed immigrant overrepresentation in New Digital fields and the parallel structure of the choice gap. The difference appears as a skill-neutral parallel shift, suggesting that the inequality is not driven by underlying ability differences but by structural access barriers such as information barriers and discriminatory behaviours in VET.

These results have both practical and theoretical implications. The immigrant –native gap appears as a skill-neutral shift, pointing to structural access barriers rather than ability differences. This mechanism generalizes to dual VET systems with firm-based apprenticeships (Germany, Austria, Netherlands, Switzerland), where access depends on securing training contracts, and resonates with broader evidence of discrimination across sectors and countries. Our findings resonate with evidence from the UK, where Cavaglia et al. (2020) show that the expansion of apprenticeships has not translated into equal gains. Instead, they document unequal returns across demographic groups and sectors, consistent with our findings that differential access and sorting, rather than ability, shape outcomes. These findings speak to two complementary policy levers. First, the expanding *friction-light* ICT/digital pathways can improve opportunities for disadvantaged groups. Digitalisation has created sectors where entry barriers are less unequal and returns to skill are high, offering immigrant-background students a valuable alternative route into skilled employment. Second, and crucially, barriers in traditional sectors must be reduced to prevent inefficient sorting.

Thus, we cannot distinguish whether the documented under-utilization of talent within traditional VET fields among sons of immigrants reflects structural discrimination or limited parental networks. However, the following policy interventions address both potential sources: (i) increasing transparency in apprenticeship matching through centralized or audited matching systems (cf. Abdulkadiroğlu & Sönmez, 2003; Pathak & Sönmez, 2008); (ii) strengthening counselling and information support to substitute for missing parental networks (cf. Hoxby & Turner, 2015; Bettinger et al., 2012); (iii) encouraging firms to diversify recruitment channels and reduce discrimination (cf. Bertrand & Mullainathan, 2004; Kaas & Manger, 2012); and (iv) expanding apprenticeship opportunities and reducing reliance on informal referrals (cf. Kramarz & Skans, 2014). Together, such reforms could both *level the playing field* and *raise aggregate productivity* by aligning sectoral choices more closely with underlying skills (cf. Kirkeboen et al., 2016; Hsieh et al., 2019).

Our analysis conditions on VET completion and cannot speak to barriers in initial access or dropout before graduation, suggesting our estimates are a lower bound of overall frictions in access to VET. Future research should examine whether these patterns persist as ICT/digital sectors mature and develop their own informal access barriers, explore variation by parental ori-

gin country, and develop identification strategies that exploit policy variation in apprenticeship allocation.

In summary, our model and empirical findings suggest that digitalisation can mitigate, but not eliminate on its own, the inequities that arise from informal and decentralised access to apprenticeships in traditional VET tracks. Addressing the *sources* of access frictions in traditional vocational sectors while scaling effective alternatives in ICT/digital sectors is, therefore, central to reducing the misallocation of immigrant talent and realising the potential productivity gains from a more equitable allocation of skills.

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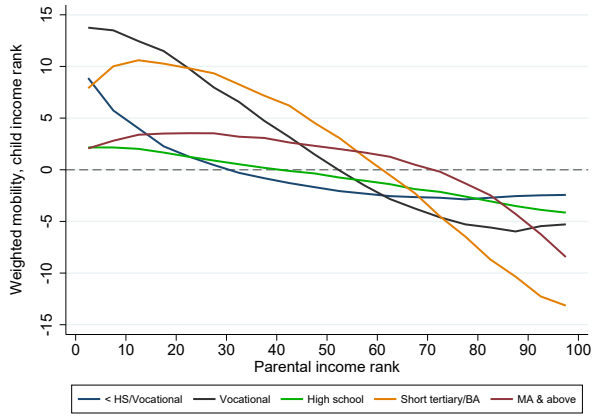
Appendix A Additional Results: Intergenerational Mobility by Education Level

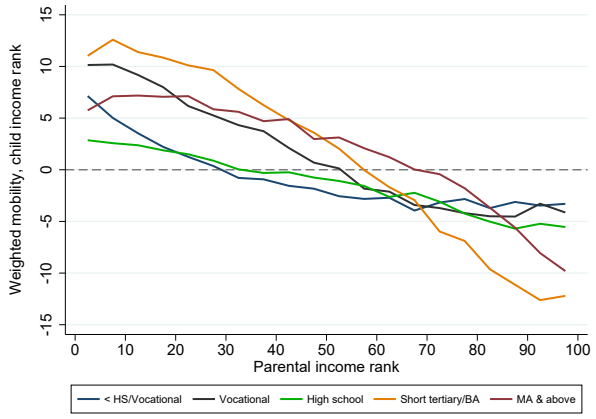
To measure intergenerational income mobility by parental immigration status and child education level, we construct a dataset similar to Chetty et al. (2014) and Jensen & Manning (2025). To be able to include the "1.5 generation", that is children of immigrants born abroad, but who immigrated to Denmark as children, we focus on the sum of inflation-adjusted parental labour market income from child age 10 to 14. This allows us to include all children who are either born in Denmark or who immigrated to Denmark before age 10 in our sample. Next, we rank parental income within birth cohorts. We consider child education level and labour income at age 30. To account for gender differences in earnings (which we want to abstract from in this analysis), we rank child income with gender and birth cohort, so that the median child income rank in our gender-specific analysis is 50, similar to the median parental income rank. We limit our sample to children born in 1973 to 1990, so that we observe them at age 30 from 2003 to 2020 for whom we observe that parental country of birth for both parents and who are observed in the education registers (also including those with non-completed education).

Figure A.1: Intergenerational mobility accounted for by child education groups

(a) Daughters of locals



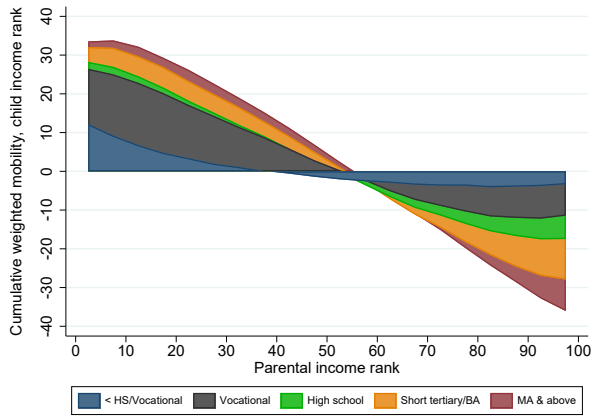
(b) Daughters of immigrants



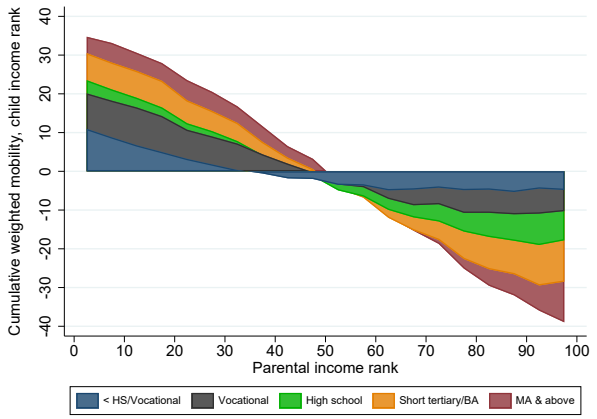
Notes: This figure shows the average level of intergenerational mobility (child income rank - parental income rank) by child education group within each parental income ventile multiplied by the share of children each education group accounts for within the given parental income ventile. This illustrates how much mobility each education group accounts for across the parental income distribution. We show the underlying rank-rank relationship between child and parent income in Figure A.3, the difference between children and parental income rank by education level in Figure A.4, the share of children obtaining each level of education in Figure A.5, the distribution of children by across the parental income distribution by parental immigration status in Figure A.6.

Figure A.2: Intergenerational mobility by education groups, cumulative

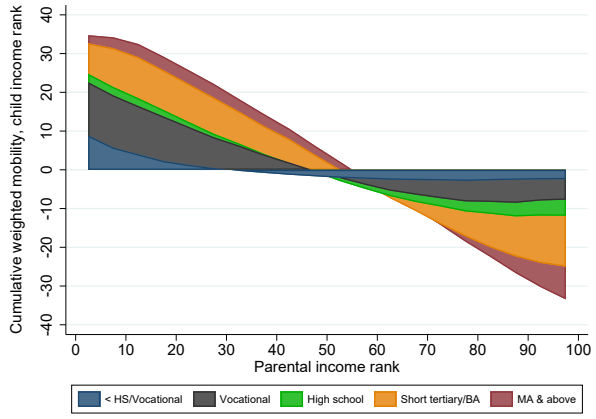
(a) Sons of locals



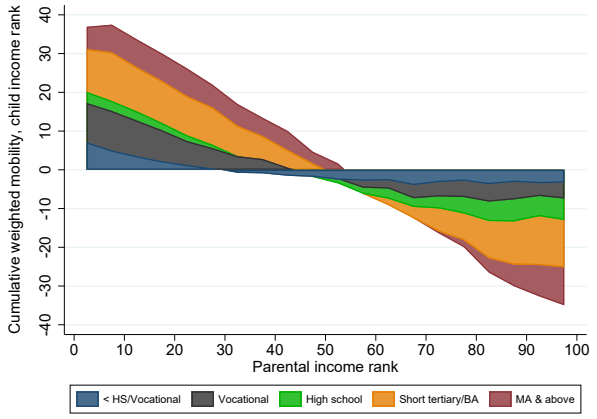
(b) Sons of immigrants



(c) Daughters of locals

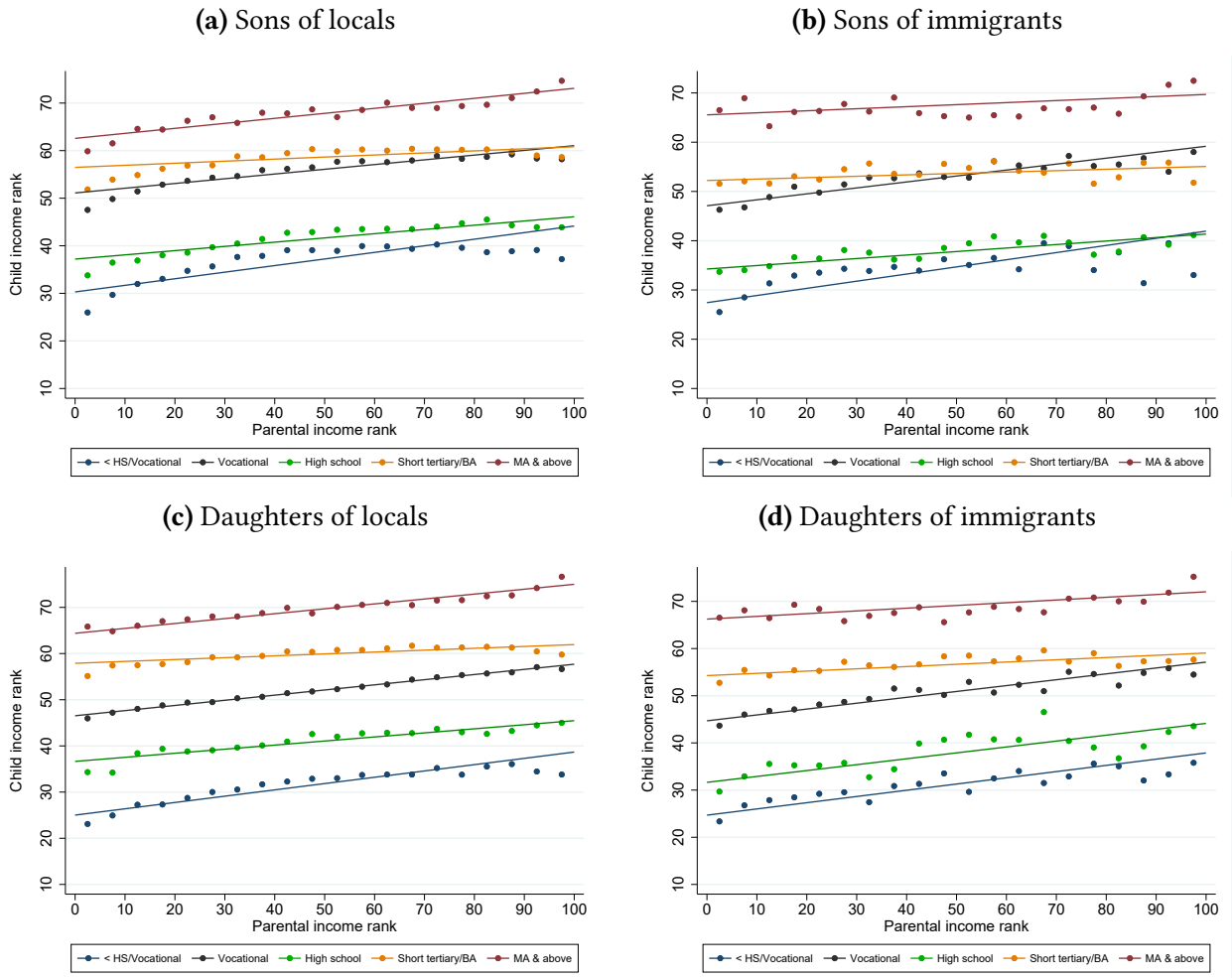


(d) Daughters of immigrants



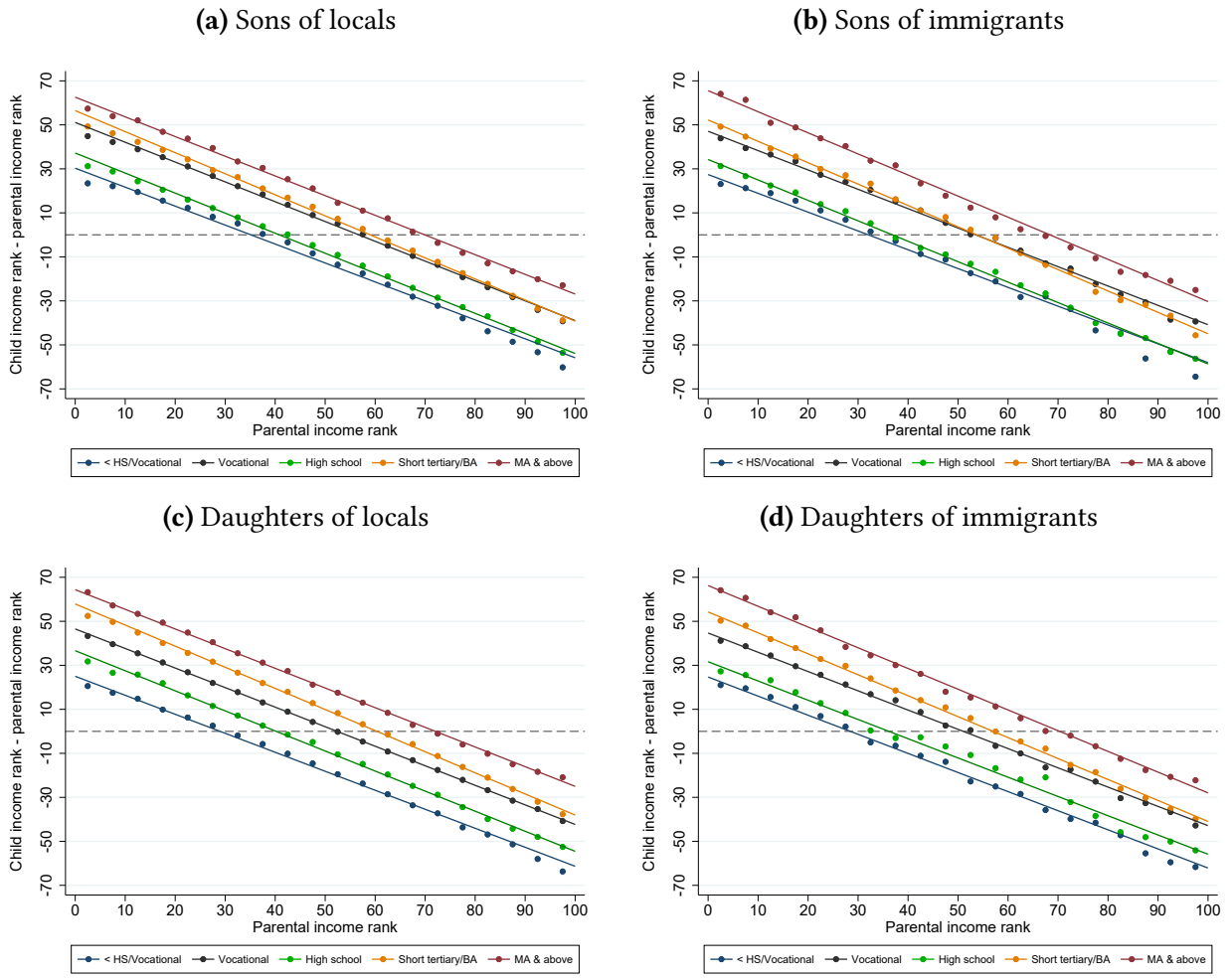
Notes: This figure shows the average level of intergenerational mobility (child income rank - parental income rank) by child education group within each parental income ventile multiplied by the share of children accounted for by education group within the given parental income ventile. This shows how much mobility each education group accounts for across the parental income distribution. Unlike Figure 1, in this figure, we add the shares together to show the aggregate levels of mobility across the parental income distribution. Parental income is ranked, 0-100, within child birth cohorts. Child income is ranked within child births cohorts and child gender. We show the underlying rank-rank relationship between child and parent income in Figure A.3, the difference between children and parental income rank by education level in Figure A.4, the share of children obtaining each level of education in Figure A.5, the distribution of children by across the parental income distribution by parental immigration status in Figure A.6.

Figure A.3: Rank-rank relationship by education groups



Notes: This figure shows the rank-rank relationship between child and parent income by education level for daughters. Parental income is ranked, 0-100, within child birth cohorts. Child income is ranked within child births cohorts and child gender. We show the underlying rank-rank relationship between child and parent income in Figure A.3, the difference between children and parental income rank by education level in Figure A.4, the share of children obtaining each level of education in Figure A.5, the distribution of children by across the parental income distribution by parental immigration status in Figure A.6.

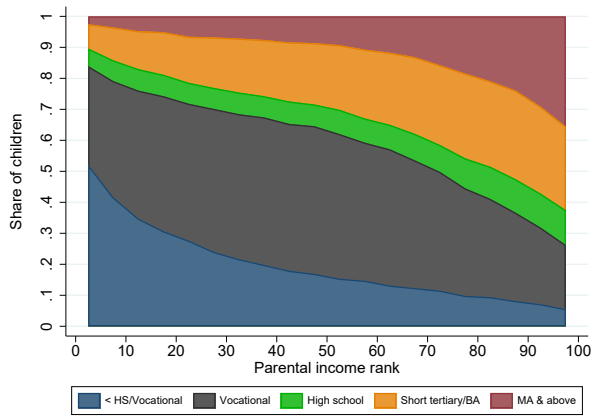
Figure A.4: Difference between parent and child ranks by education groups



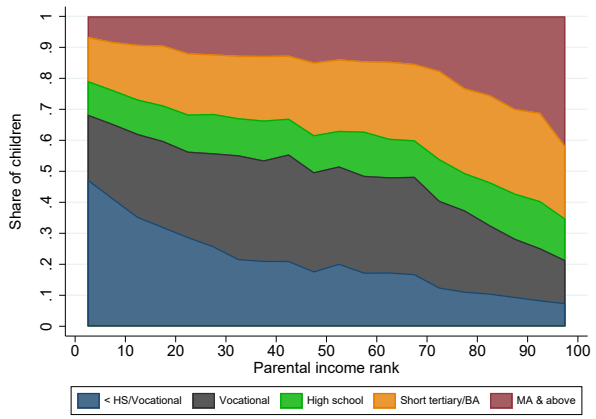
Notes: This figure shows intergenerational mobility as the difference between children and parental income rank (child income rank - parental income rank) by child education group. Parental income is ranked, 0-100, within child birth cohorts. Child income is ranked within child births cohorts and child gender. We show the underlying rank-rank relationship between child and parent income in Figure A.3, the share of children obtaining each level of education in Figure A.5, the distribution of children by across the parental income distribution by parental immigration status in Figure A.6.

Figure A.5: Educational level at age 30 by parental income rank

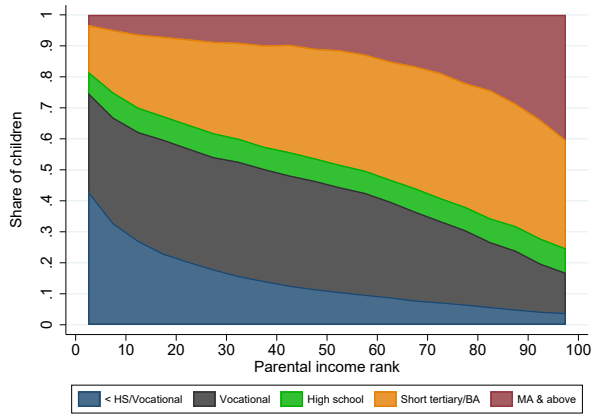
(a) Sons of locals



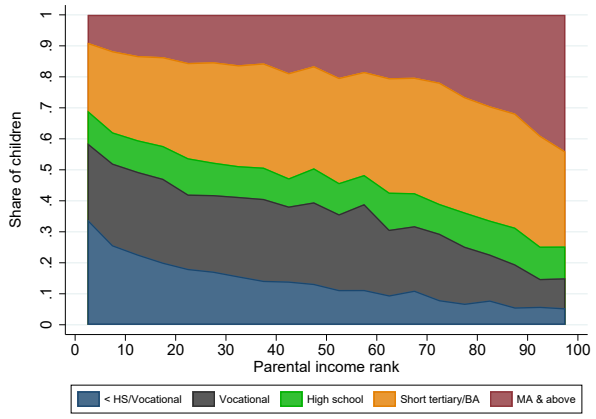
(b) Sons of immigrants



(c) Daughters of locals

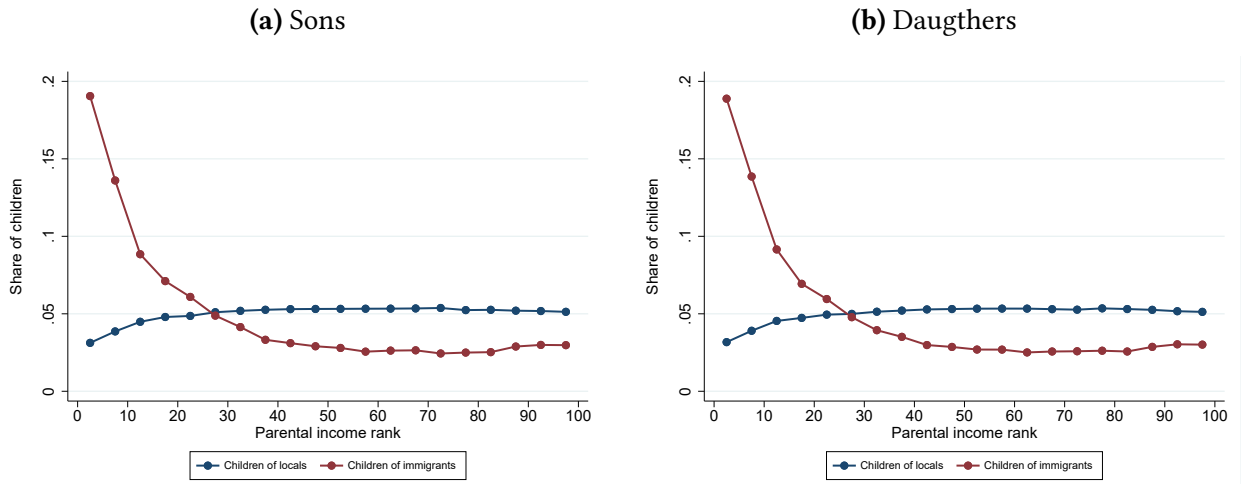


(d) Daughters of immigrants



Notes: This figure shows child education levels at age 30 by parental income rank. Parental income is ranked, 0-100, within child birth cohorts. We show the distribution of children by across the parental income distribution by parental immigration status in Figure A.6.

Figure A.6: Distribution of children by parental income and parental immigration status



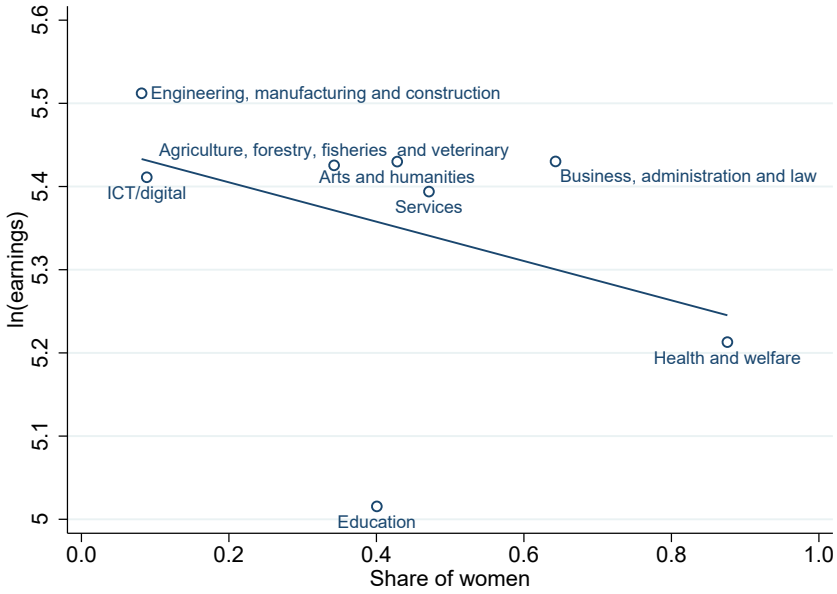
Notes: This figure shows the distribution of children across the parental income distribution by parental immigration status. We plot the fraction of children in each ventile point across the parental income distribution. Parental income is ranked, 0-100, within child birth cohorts.

Appendix B Additional Results: VET

In Section 5.4, we consider ln(earnings) five years after completing VET. To verify that our results are robust to including zeros and alternative transformations of earnings, in Section B.2 we consider non-transformed earnings in 1000 DKK inflation-adjusted to 2020-levels. Further, in Section B.3 we consider earnings ranks five years after graduation. As vocationally trained typically enters the labour market before those with tertiary education, ranking within birth cohorts is less informative for this exercise. Instead, we rank labour market income within the total adult population, age 18-64, and calendar year. As such, these results show where in the aggregate earnings distribution VET graduates place five years after graduation.

B.1 Additional Main Results

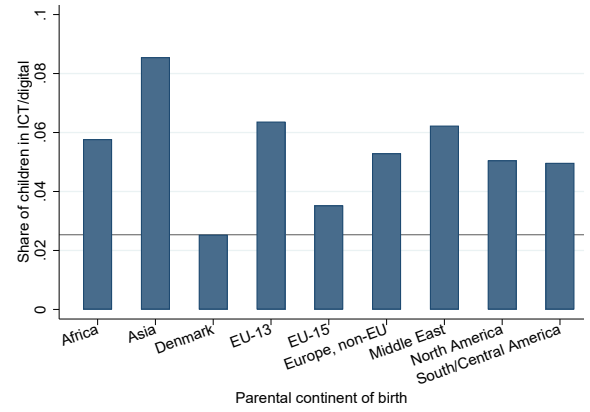
Figure B.1: Mean ln(earnings) and female shares within VET fields



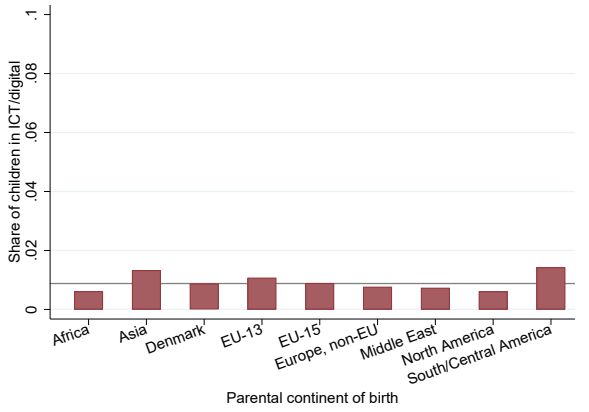
Notes: The figure reports means of ln(earnings) and the share of female graduates by VET fields. We see that earnings are lower in fields with a higher proportion of women. The sample includes individuals who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

Figure B.2: Share of children of immigrants within fields

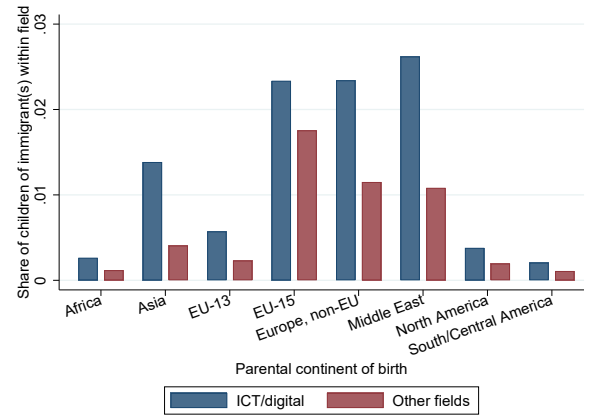
(a) Men: Share of VET graduates in ICT/digital



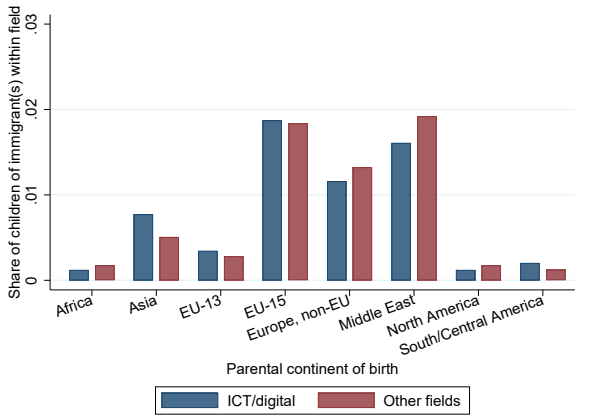
(b) Women: Share of VET graduates in ICT/digital



(c) Men: Share of sons of immigrants within each field

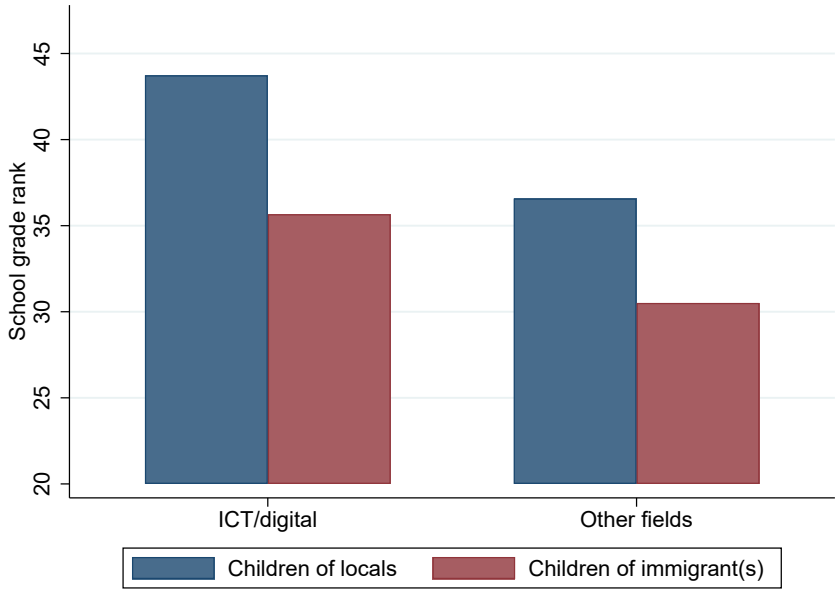


(d) Women: Share of daughters of immigrants within each field



Notes: Panel (a) of this figure shows that sons of immigrants with parents from all regions are relatively more likely to complete VET in ICT/digital fields compared to other VET tracks. Panel (b) shows that differences are much smaller for daughters. Panel (c) and (d) show the representation of children of immigrants from each parental origin in each VET field. The sample includes individuals who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

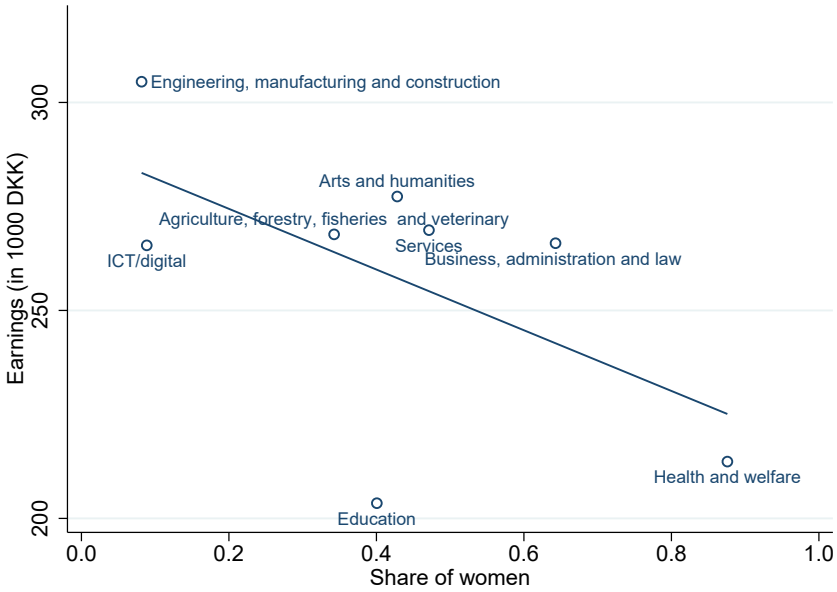
Figure B.3: Mean school grade rank by field and immigrant status



Notes: The figure confirms that average school grade ranks are higher in ICT/digital tracks compared to other fields for both children of locals and children of immigrants. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

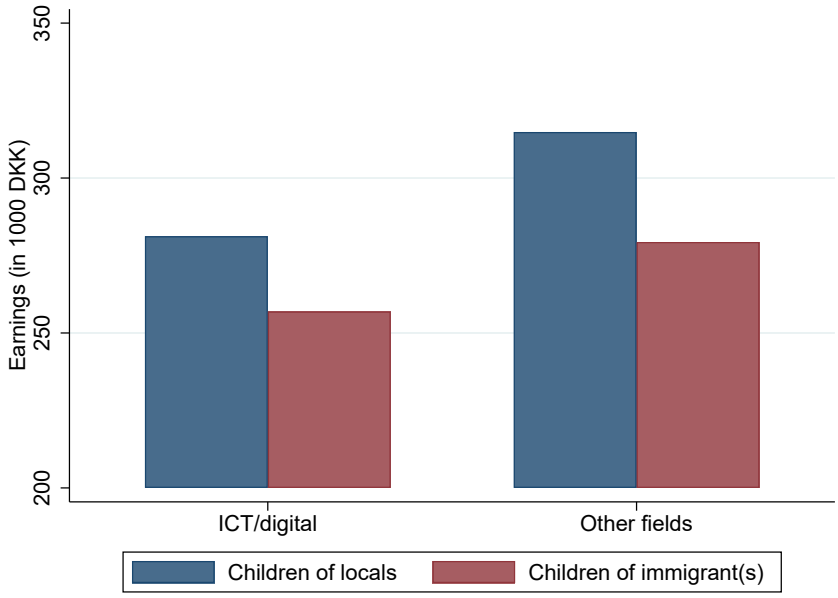
B.2 Earnings in 1000 DKKs

Figure B.4: Mean earnings in 1000 DKK and female shares within VET fields



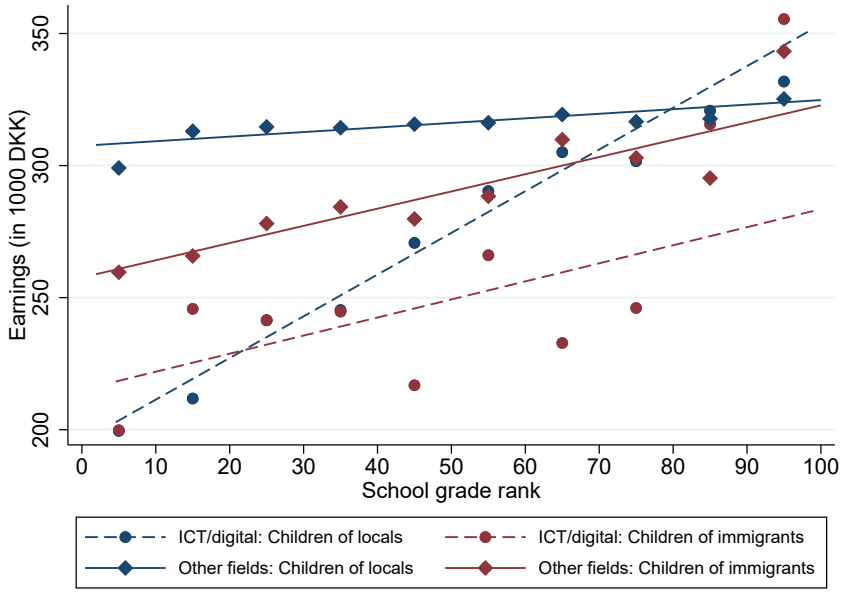
Notes: The figure reports the means of earnings in 1000 DKK inflation-adjusted to 2020-level and the share of female graduates by VET fields. We see that earnings are lower in fields with a higher proportion of women. The sample includes individuals who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

Figure B.5: Earnings by field and immigrant status



Notes: The figure reports means of earnings in 1000 DKK inflation-adjusted to 2020-level by education fields. We see that earnings are lower in ICT/digital tracks compared to other fields for both children of locals and children of immigrants, despite the higher average skill levels in ICT/digital tracks. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

Figure B.6: Earnings by school grade rank, field, and immigrant status



Notes: The figure illustrates how earnings in 1000 DKK inflation-adjusted to 2020-level five years after completing VET vary with skill level across tracks and immigrant groups, showing steeper returns to skills in ICT/digital tracks and among children of immigrants. We test these differences statistically in Table B.1, Columns 3 and 4. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

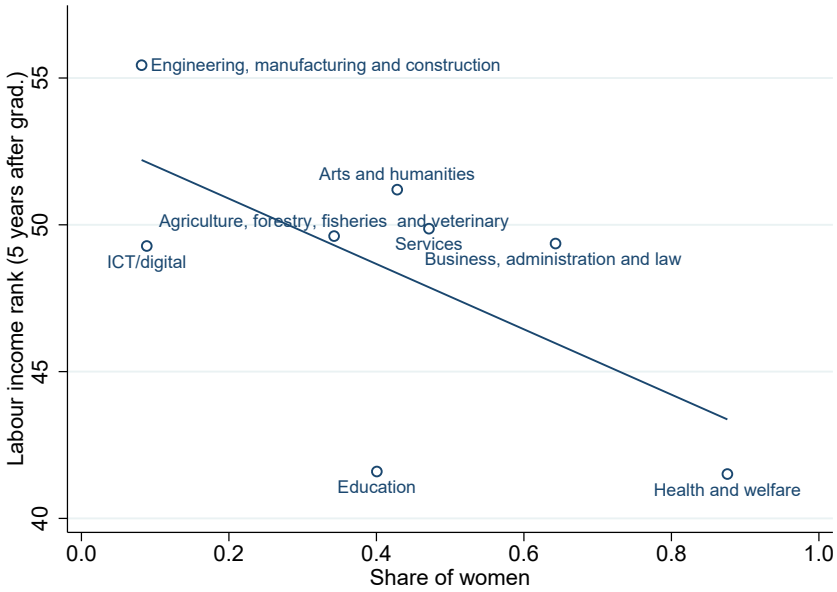
Table B.1: Regression of earnings on skills and VET track

	(1)	(2)	(3)	(4)
School grade rank	0.274***	0.276***	0.186***	0.197***
	[0.0286]	[0.0297]	[0.0299]	[0.0309]
ICT/digital=1	-106.2***	-94.97***	-115.2***	-106.5***
	[7.323]	[7.847]	[8.089]	[8.606]
ICT/digital=1 × School grade rank	1.234***	1.349***	1.416***	1.551***
	[0.160]	[0.167]	[0.173]	[0.180]
Child of immigrant(s)=1			-51.82***	-52.10***
			[3.817]	[4.143]
Child of immigrant(s)=1 × School grade rank			0.499***	0.535***
			[0.105]	[0.112]
ICT/digital=1 × Child of immigrant(s)=1			70.95***	86.05***
			[19.37]	[21.19]
ICT/digital=1 × Child of immigrant(s)=1 × School grade rank			-1.399***	-1.540***
			[0.478]	[0.520]
Constant	300.6***	298.9***	307.3***	305.0***
	[1.150]	[1.203]	[1.207]	[1.259]
R^2	0.0131	0.0168	0.0180	0.0211
N	73894	66856	73894	66856
Year FEs	Yes	Yes	Yes	Yes
Age FEs	No	Yes	No	Yes
Region at age 14 FEs	No	Yes	No	Yes

Notes: This table reports estimates of Equation 5.2, showing how earnings in 1000 DKK inflation-adjusted to 2020-level five years after completing VET vary with school grade rank across tracks and immigrant groups. In columns 2 and 4, we add additional controls through age FEs and region at age 14 FEs. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables. Robust standard errors in brackets, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

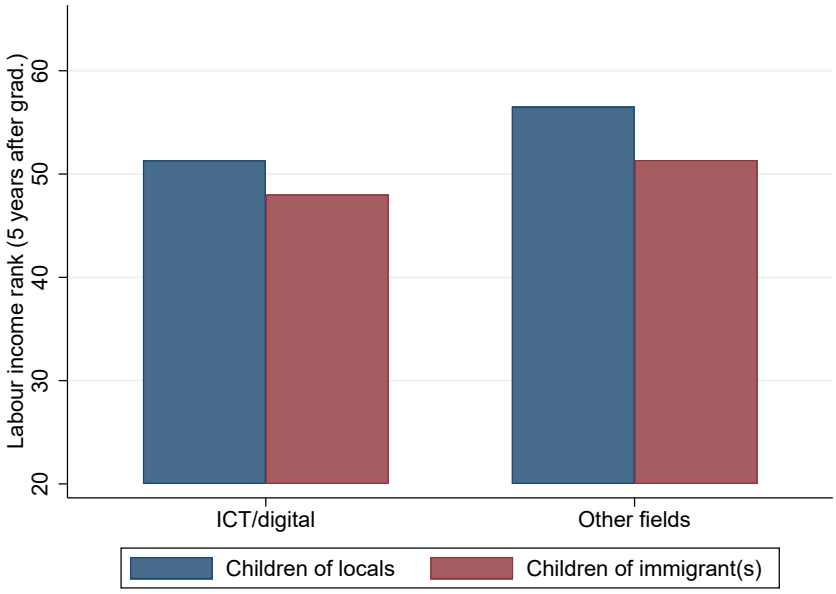
B.3 Earnings Rank

Figure B.7: Mean earnings rank and female shares within VET fields



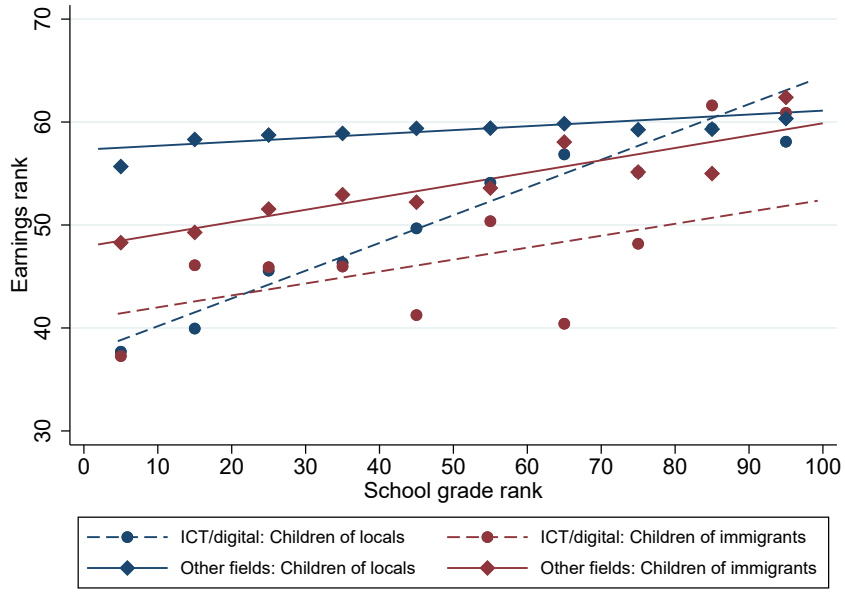
Notes: The figure reports the mean earnings rank and the share of female graduates by VET fields. We see that earnings are lower in fields with a higher proportion of women. The sample includes individuals who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

Figure B.8: Earnings by field and immigrant status



Notes: The figure reports mean earnings rank by education fields. We see that earnings are lower in ICT/digital tracks compared to other fields for both children of locals and children of immigrants, despite the higher average skill levels in ICT/digital tracks. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

Figure B.9: Earnings rank by school grade rank, field, and immigrant status



Notes: The figure illustrates how earnings rank five years after completing VET vary with skill level across tracks and immigrant groups, showing steeper returns to skills in ICT/digital tracks and among children of immigrants. We test these differences statistically in Table B.2, Columns 3 and 4. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables.

Table B.2: Regression of earnings rank on skills and VET track

	(1)	(2)	(3)	(4)
School grade rank	0.0440***	0.0439***	0.0326***	0.0338***
	[0.00387]	[0.00403]	[0.00403]	[0.00419]
ICT/digital=1	-14.29***	-12.88***	-15.60***	-14.56***
	[0.999]	[1.077]	[1.108]	[1.185]
ICT/digital=1 × School grade rank	0.156***	0.175***	0.181***	0.204***
	[0.0216]	[0.0227]	[0.0235]	[0.0245]
Child of immigrant(s)=1			-6.933***	-6.963***
			[0.519]	[0.566]
Child of immigrant(s)=1 × School grade rank			0.0607***	0.0648***
			[0.0142]	[0.0151]
ICT/digital=1 × Child of immigrant(s)=1			10.04***	12.32***
			[2.607]	[2.864]
ICT/digital=1 × Child of immigrant(s)=1 × School grade rank			-0.192***	-0.216***
			[0.0643]	[0.0700]
Constant	53.94***	54.00***	54.85***	54.82***
	[0.157]	[0.165]	[0.164]	[0.172]
R^2	0.00878	0.0130	0.0138	0.0175
N	73893	66855	73893	66855
Year FEs	Yes	Yes	Yes	Yes
Age FEs	No	Yes	No	Yes
Region at age 14 FEs	No	Yes	No	Yes

Notes: This table reports estimates of Equation 5.2, showing how earnings rank five years after completing VET vary with school grade rank across tracks and immigrant groups. In columns 2 and 4, we add additional controls through age FEs and region at age 14 FEs. The sample includes men who have completed VET between 2008-2015 born in or by age 10 immigrated to Denmark. See Section 5.1 for further descriptions of the sample and variables. Robust standard errors in brackets, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix C Comparative Advantage and Search Frictions in Two Dimensions

To further illustrate how group-specific frictions distort sorting, we extend the baseline model to a two-dimensional framework that captures selection based on comparative advantage. This extension highlights how, even when groups are equally skilled in expectation, differentiated access costs can shift individuals away from their comparative advantage, resulting in inefficiencies.

Similarly to the baseline model, we consider a continuum of prospective students of two types: Children of Locals (CL) and Children of Immigrants (CI). Each individual chooses between two educational sectors: an Old Traditional Sector (e.g., traditional VET tracks) and a New Digital Sector (e.g., digital or IT-oriented tracks).

Each individual is endowed with a two-dimensional, sector-specific skill vector $(\theta_O, \theta_N) \sim F_g(\cdot)$, where θ_O denotes skill relevant to the Old Traditional Sector and θ_N denotes skill relevant to the New Digital Sector. The distribution F_g may vary by group, but we assume symmetry across groups: $F_{CL}(\cdot) = F_{CI}(\cdot)$. Thus, any differences in outcomes between groups arise solely from differences in access costs, not differences in underlying skill endowments.

The expected utility from entering sector $j \in \{\text{Old}, \text{New}\}$ is given by

$$u_j(\theta_j, g) = R_j(\theta_j) - C_j(g), \quad \text{where} \quad R_j(\theta_j) = A_j \cdot \theta_j.$$

Here, $A_j > 0$ denotes the sector-specific return to skill, and $C_j(g)$ is a group-specific fixed cost of accessing sector j. For tractability, we assume returns are linear in skill and that costs are fixed within group-sector pairs (i.e., independent of skill).

Each individual chooses the sector that maximizes expected utility:

$$j^*(\theta_O, \theta_N, g) = \underset{j \in \{\text{Old,New}\}}{\arg\max} \left\{ A_j \cdot \theta_j - C_j(g) \right\}.$$

As in the main model, we assume that group-specific frictions are concentrated in the Old Traditional Sector. Specifically, CI face strictly higher access costs in the Old Traditional Sector than CL, while access costs in the New Digital Sector are equal across groups:

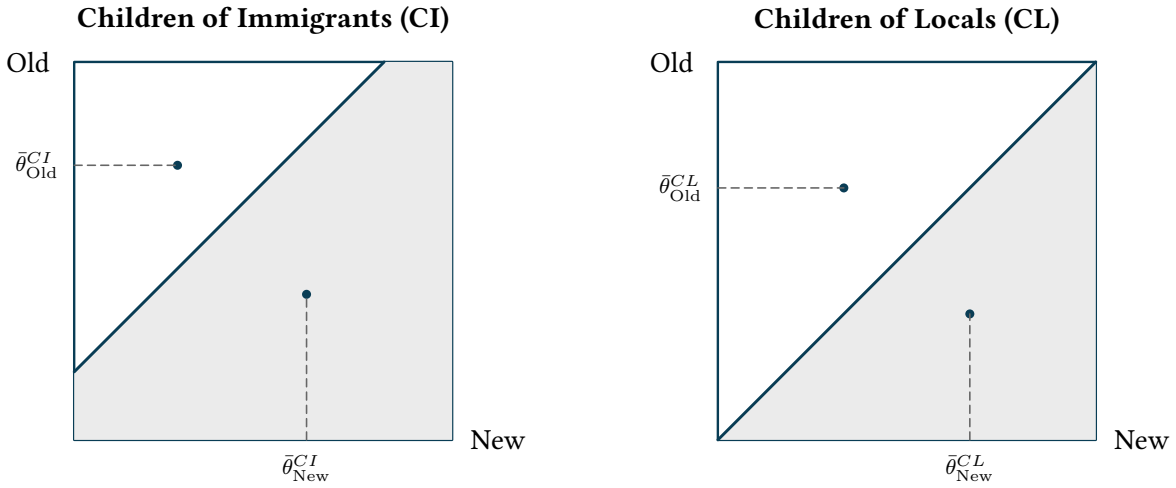
$$C_{\text{Old}}(CI) > C_{\text{Old}}(CL), \quad C_{\text{New}}(CI) = C_{\text{New}}(CL).$$

This formulation implies that even when a CI individual would have a comparative advantage in the Old Traditional Sector under equal access costs, he may still choose the New Digital Sector

because of higher access costs. In this way, frictions distort not only absolute sorting but also the realization of comparative advantage. As in the one-dimensional setting, such misallocation leads to potential losses in both individual welfare and aggregate output, despite the absence of any differences in skill distributions across groups.

C.1 Welfare Losses from Unequal Access

Figure C.1: Cutoff geometry in Old vs. New sectors by group (same style as main paper)



Notes: Each panel shows the assignment boundary between *Old* and *New* sectors as a diagonal line inside a unit square. The shaded region is allocated to *New*, the unshaded to *Old*. In the CL panel the boundary is $y = x$; in the CI panel it is a parallel upward shift $y = x +$ (fixed cost), reflecting a higher fixed access cost in *Old* for children of immigrants. The dots mark the *centroids* of the respective regions: $\bar{\theta}^{g}_{\text{New}}$ (shaded) and $\bar{\theta}^{g}_{\text{Old}}$ (unshaded), with dashed guides to the axes. For uniform distributions, the centroid-points reflects the average skill levels of the ones entering each sector. The shift shrinks the feasible *Old* region for CI and expands *New*, implying that, holding skills and returns fixed, CI are more likely to be allocated to *New*. In our model this generates misallocation on the range where CL would choose *Old* but CI are diverted to *New*, creating deadweight loss: talent that would yield higher net returns in *Old* under equal access is instead allocated to *New*, lowering individual utility and aggregate efficiency.

Group-specific frictions distort sectoral allocation by pushing some individuals away from their comparative advantage. In particular, Children of Immigrants (CI) may face elevated fixed search costs in the Old Traditional Sector due to weaker parental networks or lack of informal access to apprenticeships. As a result, some individuals with high θ_O/θ_N ratios, who would be better matched to the Old Traditional Sector, end up selecting into the New Digital Sector instead. This misallocation generates not only looses for the individuals being pushed out of the Old Traditional Sector, but also have societal consequences, being:

I) A higher share of CI students sorts into the New Digital Sector relative to CL:

$$\int_{i \in S_{\text{New}} \cap CI} di > \int_{i \in S_{\text{New}} \cap CL} di,$$

where S_j is the set of individuals choosing sector j.

II) Conversely, a higher share of CL students selects into the Old Traditional Sector:

$$\int_{i \in S_{\text{Old}} \cap CL} di > \int_{i \in S_{\text{Old}} \cap CI} di.$$

III) Conditional on choosing the New Digital Sector, the average skill level is higher among CL than CI, compared to what would occur in a frictionless setting:

$$\overline{\theta}^{CL}_{\text{New}} > \overline{\theta}^{CI}_{\text{New}}, \quad \text{where} \quad \overline{\theta}^{g}_{\text{New}} = \frac{1}{\mu(S_{\text{New}} \cap g)} \int_{i \in S_{\text{New}} \cap g} \theta_i \, di,$$

where $\mu(\cdot)$ is the size of the set.

IV) Conditional on choosing the Old Traditional Sector, the average skill level is higher among CI than CL, compared to what would occur in a frictionless setting:

$$\overline{\theta}^{CI}_{\text{Old}} > \overline{\theta}^{CL}_{\text{Old}}, \quad \text{where} \quad \overline{\theta}^{g}_{\text{Old}} = \frac{1}{\mu(S_{\text{Old}} \cap g)} \int_{i \in S_{\text{Old}} \cap g} \theta_i \, di.$$

V) Ultimately aggregate productivity is reduced, as high-θ_O individuals are diverted from the sector where their skills are most valuable. This loss is not offset elsewhere in the economy, as lower-θ_O individuals remain in the New Digital Sector. These welfare losses arise purely from differences in access, not differences in underlying ability or preferences, highlighting the importance of reducing frictions.