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DEELTIJDS BEROEPSGERICHT ONDERWIJS EN DE OVERGANG VAN SCHOOL NAAR WERK: EEN DYNAMISCHE ANALYSE

Brecht Neyt, Dieter Verhaest, en Stijn Baert

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Voorwoord

Deze studie meet de impact van het instromen in deeltijds beroepsgericht secundair onderwijs in Vlaanderen met betrekking tot gekwalificeerde uitstroom en eerste arbeidsmarktuitkomsten. Ze draagt bij tot de internationale wetenschappelijke literatuur door een dynamisch econometrisch model te schatten, waarbij opeenvolgende onderwijs- en arbeidsmarktuitkomsten gemodelleerd worden en gecontroleerd wordt voor niet-waarneembare verschillen tussen scholieren die al dan niet instromen in deeltijds beroepsgericht secundair onderwijs. In lijn met de eerdere, internationale literatuur wordt gevonden dat scholieren die instromen in de leertijd sneller werkzaam zijn na het schoolverlaten en sneller een vast contract bemachtigen (in vergelijking met verder gelijkaardige scholieren). Daar staat tegenover dat na het starten in de leertijd er vaker ongekwalificeerde uitstroom is. Beide effecten worden niet teruggevonden voor het instromen in een DBSO-opleiding (deeltijds beroepssecundair onderwijs).

Inhoud

Beleidssamenvatting

Wereldwijd overtreft de werkloosheidsgraad van jongeren die van niet-jongeren, wat een gebrekkige overgang van school naar werk suggereert. Een mogelijke manier om deze transitie te verbeteren, is door school en werk dichter bij elkaar te brengen, bijvoorbeeld door het aanbieden van (deeltijds) beroepsgericht onderwijs. Eerder onderzoek naar beroepsgericht onderwijs toont aan dat dit soort onderwijs, in vergelijking tot (voltijds) algemeen onderwijs, leidt tot meer tewerkstelling en hogere lonen aan het begin van de carrière. Een mogelijke verklaring voor dit voordeel van beroepsgericht onderwijs is dat de afgestudeerde jongere met haar/zijn beroepsspecifieke kennis en vaardigheden meteen kan bijdragen aan de productiviteit van de werkgever. Dit geldt in het bijzonder voor beroepsopleidingen met een sterke werkleerplekcomponent, omdat op die manier gefocust wordt op die vaardigheden die gevraagd worden op de arbeidsmarkt. Bovendien kan deze werkleerplekcomponent dienstdoen als "screeningmechanisme": werkgevers kunnen jongeren in een leercontract "uittesten" om hen nadien vast in dienst te nemen. Echter, het kortetermijnvoordeel van een focus op specifieke kennis en vaardigheden slaat mogelijk om in een nadeel op lange termijn omwille van drie redenen. Ten eerste veroudert, zeker in tijden van snelle technologische vooruitgang, de beroepsspecifieke kennis van jongeren uit beroepsgericht onderwijs snel. Ten tweede is deze beroepsspecifieke kennis sterk gevoelig aan de vraag naar deze specifieke kennis op de arbeidsmarkt. Ten derde komt beroepsgerichte vorming in de plaats van algemene vorming, waar meer gefocust wordt op cognitief, probleemoplossend, en kritisch denken. Deze afname in algemene vorming kan ervoor zorgen dat het vermogen tot levenslang leren voor jongeren uit het (deeltijds) beroepsgericht onderwijs beperkter is, wat hun kansen op de arbeidsmarkt in hun latere carrière hypothekeert.

De uitgevoerde studie onderzoekt specifiek de impact van de beroepsopleidingen uit het stelsel van Leren en Werken in Vlaanderen voorafgaand aan de hervorming van 2008 op de kans op gekwalificeerde uitstroom uit het onderwijs en de tewerkstellingskansen tijdens de eerste vijf jaar na het verlaten van het onderwijs.

De studie draagt ook op drie manieren bij tot eerdere literatuur rond dit onderwerp. Ten eerste vergelijkt deze studie twee types beroepsgericht onderwijs met elkaar binnen hetzelfde institutioneel kader: de leertijd en het DBSO (deeltijds beroepssecundair onderwijs). Het grootste verschil tussen deze twee types onderwijs is dat de leertijd meer aangedreven wordt vanuit de bedrijfswereld, terwijl dat in het DBSO meer door de school (via het Centrum voor Deeltijds Onderwijs) gebeurt. Daarnaast is het belang van de werkleerplekcomponent in de leertijd in principe groter (vier dagen per week in de leertijd in vergijking met drie dagen per week in het DBSO). Onze tweede bijdrage is veeleer methodologisch van aard. Voor de eerste keer in deze literatuur wordt een *dynamisch discretekeuzemodel* aangewend om causale effecten te schatten. Cruciaal hierbij is dat gecorrigeerd wordt voor individuele kenmerken die niet waarneembaar zijn in de longitudinale SONAR-data. Ten derde maakt deze studie een onderscheid tussen het directe en indirecte effect van de beroepsopleidingen uit het stelsel van Leren en Werken op het arbeidsmarktsucces. Het indirecte effect is te wijten aan het effect van de instroom in deze

programma's op de kans om een kwalificatie te behalen in het secundair onderwijs, wat op zijn beurt de arbeidsmarktuitkomsten beïnvloedt. Het directe effect meet de impact van de leertijd en het DBSO los van dit indirecte effect. Dit is een belangrijk onderscheid, gezien deze stelsels een alternatief bieden voor jongeren die niet gemotiveerd zijn om klassiek voltijds onderwijs te volgen en hen toelaten om alsnog een kwalificatie van het secundair onderwijs te behalen.

In deze studie wordt gebruik gemaakt van de SONAR-data, op basis van longitudinale bevragingen van 9000 Vlamingen geboren in 1976, 1978 en 1980. De beschrijvende statistieken van deze data leggen een duidelijk verschil tussen scholieren in het klassieke voltijds onderwijs en de programma's die leren en werken combineren bloot. De latere groep bevat meer jongens, jongeren met een migratieachtergrond en jongeren met minder hoog opgeleide ouders. Bovendien lopen jongeren in deeltijds onderwijs voordien meer vertraging op in zowel het primair als secundair onderwijs en dienen ze vaker hun jaar over te doen, een bevestiging van het belang van het controleren voor observeerbare en niet-observeerbare verschillen tussen jongeren in het stelsel van Leren en Werken en jongeren in voltijds onderwijs.

In lijn met de eerdere, internationale literatuur wordt gevonden dat scholieren die instroomden in de leertijd (voor de hervorming van 2008) sneller werkzaam waren na het schoolverlaten en sneller een vast contract bemachtigden (in vergelijking met verder gelijkaardige scholieren). Dit effect werd gedreven door de mannelijke scholieren in de Vlaamse data. Daar staat tegenover dat na het starten van de leertijd er vaker ongekwalificeerde uitstroom was. Hoewel de resultaten voor jongeren uit het DBSO met werkleerplekervaring in dezelfde richting wijzen, zijn de geschatte effecten minder groot en statistisch niet significant. Een mogelijke verklaring voor deze bevinding is dat het kortetermijnvoordeel van de leertijd toegeschreven kan worden aan de hogere focus op werkplekleren en dus ook op specifieke vaardigheden in dit programma. Vermits jongeren alleen maar in de leertijd kunnen instromen wanneer ze een werkleerplek hebben gevonden, wordt de leertijd mogelijk ook vaker als screeningsinstrument gebruikt.

Wat de impact van de leertijd op de initiële arbeidsmarktkansen betreft, is de evaluatie van de leertijd (voor de hervorming van 2008) dus vrij positief. Ook jongeren die het DBSO combineerden met een werkleerplek scoorden op dit vlak minstens evengoed als jongeren uit het voltijds secundair onderwijs. Wel suggereert het onderzoek dat de programma's in het stelsel van Leren en Werken van voor 2008 niet effectief waren in het reduceren van de ongekwalificeerde uitstroom. Tot slot is het ook belangrijk om te benadrukken dat deze studie geen uitspraken kan doen over de effecten op de arbeidsmarktkansen van de geanalyseerde individuen in de periode na de eerste vijf jaar op de arbeidsmarkt.

Deze beleidsreflecties dienen voorzichtig benaderd te worden. De geanalyseerde data kunnen immers in zekere zin omschreven worden als "historische data". Enerzijds was de hervorming van 2008 van de stelsels substantieel. Bij deze hervorming werd de afstemming tussen beide programma's vergroot en de doelstelling naar voren geschoven om, meer dan vroeger, een beroepsgericht traject op maat van elke jongere aan te bieden en elke jongere een volwaardige kwalificatie aan te reiken. Op basis van deze doelstelling zou dan ook kunnen verwacht worden dat de weergegeven effecten een ondergrens voor de effecten anno 2018 vormen. Anderzijds is ook de sociologische context veranderd sinds de bestudeerde individuen de trajecten doorliepen in de jaren '90. Ongekwalificeerde uitstroom werd sindsdien teruggedrongen en er vond een hogere

doorstroom vanuit het (regulier) technisch secundair onderwijs richting het hoger onderwijs plaats. Het is onduidelijk in welke richting deze veranderde context de gemeten effecten zou beïnvloed hebben. We kijken dan ook uit naar het toepassen van onze methode op meer recentere data – eventueel gerealiseerd door het koppelen van administratieve data – wat ons zou toelaten om ook de oorzakelijke impact van deeltijds onderwijs na de hervorming van 2008 in kaart te brengen.

BIJLAGE: WETENSCHAPPELIJK ARTIKEL

The Impact of Apprenticeship Programs on Early Labour Market Outcomes: A Dynamic Approach

By Brecht Neyt,[i] Dieter Verhaest,[ii] and Stijn Baert[iii]

Abstract

This study examines the impact of inflowing into dual apprenticeship programs in secondary education on six early employment outcomes. Our contribution to the literature is threefold. First, we estimate the effects of two distinct types of dual programs that combine part-time school based instruction with an apprenticeship in a firm within the same, Belgian secondary education framework. Second, these effects are identified by estimating a dynamic model, capturing subsequent educational and labour market outcomes, to control for the dynamic selection of students into dual programs. Third, this approach enables us to distinguish between the programs' direct effects (conditional on educational achievement) and indirect effects (via educational achievement). We find evidence for short-term labour market advantages but only for the program with the most days of in-field training.

Keywords: Vocational education; transitions in youth; dynamic selection; education; labour.

JEL-codes: I21; I26; J21.

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Introduction

Worldwide, youth unemployment rates greatly exceed unemployment rates of non-youth.[1] For example, Figure 1 clearly shows that the youth unemployment rates in the EU-28, Belgium (the country from which we analyse data), and the US are consistently higher compared to the unemployment rates of non-youth. These imbalances indicate a rather poor transition from school to the labour market for youngsters in these economies. Therefore not surprisingly, improving the smoothness of this transition is a key ambition of many OECD countries (van de Werfhorst, 2014).

<Figure 1 about here>

One potential way of pursuing this is by more closely linking education to the labour market, for example by encouraging students to enrol in vocational education and apprenticeship programs (Zimmerman et al., 2013). By completing vocational education and, in particular, participating in work-based learning through apprenticeship training, students gain ready to use skills which immediately increase their employability when they enter the labour market (Hanushek et al., 2017). Moreover, apprenticeships may even provide immediate access to a job if employers use them as a screening device (Wolter and Ryan, 2011). But for three main reasons, this advantage when first entering the labour market might decrease (and even turn into a disadvantage) over time. First, the occupation-specific skills gathered in vocational education may quickly become obsolete ("external depreciation of human capital"; Weber, 2014). This might be especially true today, with automation and

[1] The youth unemployment rate is calculated as the ratio between the unemployed in the age group of 15 to 24 years old and the total labour force (employed and unemployed, i.e. youth in education excluded) for that age group. The non-youth unemployment rate is measured as the ratio between the unemployed in the age group 25 to 74 years old and the total labour force (employed and unemployed) for that age group.

digitalisation leading to rapid technological change (Hampf and Woessman, 2017; Krueger and Kumar, 2004). Second, occupation-specific skills are highly sensitive to changes in the labour demand, so that their premiums might not be robust to these changes (Goldsteyn and Stenberg, 2014). Third, vocational education comes at the cost of less general education, which focuses more on cognitive skills, problem solving, and critical thinking. A lower development of these skills is expected to decrease students' potential for lifelong learning and learning on-the-job, so that students in vocational education are expected to be less capable of adapting to changing labour market conditions, and, therefore, less employable in the long run (Hanushek et al., 2017; Weber, 2014).

Recent research has empirically investigated this trade-off between short-term advantages and long-term disadvantages of vocational education. Several studies have indeed found that the positive short-term effect on the probability of finding a job after leaving school turns into a negative effect over time (Forster et al., 2016; Hampf and Woessman, 2017; Hanushek et al., 2017; Lavrijsen and Nicaise, 2017). Additionally, Brunello and Rocco (2017) find that the short-term advantages in terms of employment of vocational education decrease over time, but their results however do not indicate a negative effect later. Furthermore, the trade-off between short term advantages and long term disadvantages of vocational education has also been found in studies that look at the effect of vocational education on earnings (Cörvers et al., 2011; Goldsteyn and Stenberg, 2014; Laurijssen and Glorieux, 2017; Lavrijsen and Nicaise, 2017) and on the quality of the match in terms of attained and required skills (Verhaest et al., 2018). Finally, some of these studies also concluded that both the initial advantage and the extent to which this advantage diminishes over time is more pronounced in countries like Germany or Denmark, which are characterised by a dual system in which students combine one or two weekly days of school-based learning

with an apprenticeship of three or four weekly days at a firm (Forster et al., 2016; Hampf and Woessman, 2017; Hanushek et al., 2017; Verhaest et al., 2018).

The present study adds to this previous literature examining the trade-off between the short-term advantages and long-term disadvantages of vocational education in three ways. First, in the present study, we directly compare the effectiveness of two distinct VET (Vocational Education and Training) programs that combine part-time school based instruction with an apprenticeship in a firm within the same institutional setting. In most previous studies, a comparison between different vocational education programs was done only by comparing the effect of vocational education between countries with different vocational education systems (Forster et al., 2016; Hampf and Woessman, 2017; Hanushek et al., 2017; Verhaest et al., 2018). As a consequence, it cannot be ruled out that the diverging effects of the programs might be driven by other forms of heterogeneity between these countries.[2] In contrast, in the present study, we compare the effect of two types of apprenticeship programs in terms of obtaining a secondary education qualification and the transition from these programs to the regular labour market. While the first program includes more hours of workplace learning and, as in traditional dual system countries like in Germany, gives a more profound role to employers in the organisation and design of the program, the second program is much more school-led and also allows students to participate as a part-time student in case they do not manage to find a workplace for their apprenticeship. As such, our study also contributes to the discussion on the optimal design of dual programs in general

[2] One other study indirectly evaluated the labour market effects of alternative types of apprenticeship programs. By evaluating a reform of the Italian apprenticeship system, Albanese et al. (2017) recently concluded that bringing the system closer the German system—mainly by increasing the importance of on-the-job training—improved the employment chances and wages in the first few years after the expiration of the apprenticeship contract. However, in contrast with our study, Albanese et al. (2017) did not test whether this new apprenticeship program fares better than other, non-apprenticeship programs.

and dual apprenticeship programs in particular.

Second, we are the first to estimate a dynamic model that corrects for the dynamic selection of students into the dual programs. That is, we estimate a dynamic discrete choice model, in which subsequent educational and early labour market outcomes are explained, based on observed and unobserved characteristics. To this end, unique longitudinal data are exploited.

Third, we are novel in distinguishing between the direct and indirect effect of apprenticeship programs with respect to first labour market outcomes. While the former effect is conditional on students' academic achievement, the latter one goes via the effect of inflowing in dual programs on educational attainment. This distinction is an important one given that the practical focus in vocational programs may motivate certain students that would otherwise have dropped out, to leave school with a secondary education qualification (Bishop and Mane, 2004; Eichhorst et al., 2012; Grubb and Lazerson, 2005; Hanushek et al., 2017).

The remainder of this study is organised as follows. In the next section, we discuss the investigated dual programs within the context of education in Flanders. Next, we discuss the data and econometric model that we use to estimate the relationship between dual programs and first labour market outcomes. In Section 5, the results of our analyses are presented. We end this article with a brief conclusion including policy recommendations and suggestions for future research.

Institutional Setting

In this section, we discuss some crucial characteristics of the education system in Flanders, as this is the region from where we got our data. In Flanders, there is compulsory education starting from September 1st of the year in which the child turns 6, until their 18th birthday or until June 30th of the year in which the child turns 18, whichever comes first. Full-time education is compulsory until the age of 16 or until the age of 15 when they already completed the first two years of secondary education. From that moment on, students are allowed to start dual programs, which consist of learning on a part-time basis at a school or training centre that may be combined with an apprenticeship in a firm or organisation.

There are two types of dual programs and apprenticeships in Flanders. First, students can enrol in part-time vocational education ('Deeltijds Beroepssecundair Onderwijs'), which is organised by Centres for Part-time Education (CPE). In this program, students follow classes in a CPE for two days a week. The remaining three days they are either employed as an apprentice or follow a preliminary phase in a Centre for Part-time Training (PTE) to develop their attitudes and skills before starting employment. The CPE's are often affiliated to a secondary education school and are governed by one of the educational providers that also govern standard schools. Therefore, we will label the programs offered at these institutions as *school-based dual programs*. Based on whether students combine classes with an apprenticeship, we will distinguish between *school-based dual programs with apprenticeship* and *school-based dual programs without apprenticeship*.

Second, students can choose to start the so-called *leertijd* (literally translated "Training Time"), an apprenticeship-based program which is organised by the Flemish Agency for Entrepreneurial Training (SYNTRA) and is recognised by the Flemish government. In these

programs, which we will refer to as *training centre-based dual programs with apprenticeship*, students follow theoretical training in a SYNTRA training centre for one day a week, consisting of four hours of general education and four hours of vocational training. The four remaining days they follow practical training with an employer. Having an employer that is willing to instruct them is therefore a necessary condition that should be met before students can start in the program.

The main differences between students enrolled in school-based and training centre-based dual programs are that in the latter, the practical training is more intensive and employer organisations take relatively more the lead in the organisation and design of the programs. Moreover, unlike with the school-based dual programs, enrolment is only allowed for students who manage to secure an apprenticeship at a firm.

Students who complete full-time education are unconditionally allowed to start tertiary education. In contrast, students who complete dual programs get a secondary education qualification but are not allowed to enrol in tertiary education programs.

Data

Sample

Our analyses are based on the SONAR data, which contain exceptionally rich data on education and labour market outcomes for Flemish youth. More concretely, SONAR includes data on three cohorts of about 3,000 individuals born in 1976, 1978, and 1980. These individuals were interviewed at age 23, age 26, and age 29. In this study, we use data on the last two cohorts, as for these individuals we have uniform information on their school career

and labour market outcomes. To have a sample of pupils with a homogeneous education background, we excluded students who (i) already experienced more than one year of retention at the start of primary education, (ii) needed special help and were therefore in special schools,[3] and (iii) enrolled in a dual program for the first time after the end of compulsory education. Additionally, we excluded students with erroneous or inconsistent data. The final sample consists of 5541 individuals.

Exogenous Variables

In our econometric model, which we discuss in detail in Section 4, we use six strictly exogenous background characteristics of the students. More specifically, we include students' (i) gender, (ii) migration background, (iii) number of siblings, (iv and v) maternal and paternal education level (in years of education after primary education), and (vi) day of birth within the calendar year. The first five variables are standard and have also been included by other researchers (Baert and Cockx, 2013; Cameron and Heckman, 2001; Belzil and Poinas, 2010). The day of birth is included to control for relative age within the birth cohort, which is found to positively affect cognitive and non-cognitive achievements in both the short- and long-term (Angrist and Krueger, 1991; Baert and Cockx, 2013; Bedard and Dhuey, 2006; Fumarco and Baert, 2017). The summary statistics of these variables can be found in Panel A of Table 1. When we compare students with regular full-time education only to students who inflowed in a dual program, we see that boys, students with a migration background, and students with a higher number of siblings are overrepresented within the latter sample.

[3] Due to physical and/or mental disability, serious behavioural and/or emotional problems, or serious learning difficulties.

<Table 1 about here>

Additional to these background characteristics, we include the unemployment rate at the district level, in the year of the modelled outcomes (source: Public Employment Agency of Flanders). This way, we aim to control for time-varying labour market conditions and (to some extent) for the economic differences by region (and, thereby, family wealth).

Endogenous Variables

In our econometric model, we jointly model twelve outcomes. More specifically, we model students' (i) delay at the start of primary education, (ii) delay at the start of secondary education, (iii) track choice in the second year of secondary education (either general track, technical or arts track, or vocational track),[4] and (iv) secondary education experience (in terms of whether they experience study delay and/or downgrade)[5] at the end of compulsory full-time education. Additionally, we model (v) whether students enrolled in a dual program, and (vi-vii) the kind of dual program (training centre-based versus school-based and with or without apprenticeship in case of a school-based dual program). Finally, we also model whether students (viii) obtained a secondary education qualification, (ix) enrolled in tertiary education, and (x-xii) were employed three months, one year, and five years after leaving school. In an alternative approach with respect to the first labour market outcomes, we model

[4] Students have to make their track choice after successful completion of the first year of secondary education.

[5] At the end of each academic year during secondary education, students receive an A, B, or C evaluation. Those getting an A are promoted to the next education year. However, if they wish, they can downgrade the track. In the present article, we define a downgrade as a transition from general secondary education to another track or from technical or arts secondary education to vocational secondary education. Transitions in the opposite direction are hardly observed. Students obtaining a C must repeat the education year and, if they wish, can downgrade the track. Students with a B evaluation are forced to downgrade in case they want to be promoted to the next education year (Cockx et al., in press).

whether students secured a permanent contract after leaving school (in comparison to be either not employed or employed without permanent contract).

The descriptive statistics of these endogenous variables are given in Panel B of Table 1. Comparing students in regular full-time education with students in a dual program, we see indications that students in the latter group performed worse in school by the end of compulsory full-time education. Indeed, they more often had a delay at the start of primary and secondary education, were more delayed, and downgraded more.

Among the 5541 students observed in our full sample, 332 left regular full-time secondary education for a dual program. Of the latter group, 37.7% (i.e. 125/332) opted for a training centre-based dual program, while the remaining 62.3% opted for the school-based dual program. These students in dual programs less often obtained a secondary education qualification. When we look at transition to work success, students in dual programs more often had a job three months after leaving school. Contrarily, they were less often employed one year or five years after leaving school. This pattern is also observed when looking at the alternative labour market outcome 'permanent contract after leaving school'. These observations are in line with the theoretical arguments outlined in Section 1 for dual programs offering short-term advantages, at the cost of long-term disadvantages (Hanushek et al., 2017).

Endogeneity Problem

By simply comparing the descriptive statistics for students in and out of dual programs, we are, however, unable to deduce the causal impact of these programs on first labour market outcomes. Indeed, the observed association may also be driven by observable or unobservables differences between students in and out of dual programs.

The biggest barrier to estimating the causal relationship between dual programs and transition to work success, is the presence of unobservable differences between students in and out of dual programs (Ryan, 2001). Indeed—and in line with our discussion of Panel B.1. of Table 1—several studies report that these programs are mostly attended by students with lower ability and motivation (Altonji et al., 2012; Eichhorst et al., 2012; Malamud and Pop-Eleches, 2010). This unobserved heterogeneity may yield a classic omitted variable problem: as they may also impact labour market outcomes, naively estimated effects are unable to distinguish between the effect of these unobservables and the effect of dual programs. In addition, bias may be introduced by the dynamic sorting that takes place in the educational progression. Cameron and Heckman (1998) show this formally. Intuitively, the latter bias is brought about by the progressively growing negative correlation between observed characteristics such as parental educational attainment and unobserved characteristics because students with adverse observables realise successful outcomes only if their unobserved endowments are sufficiently favourable. This biases the coefficients of observables negatively and more so as one proceeds to higher grades (Baert and Cockx, 2013; Cockx et al., in press).

In this study, we simultaneously model schooling outcomes up to the end of compulsory full-time education, inflow into dual programs, and first labour market outcomes and control for the unobservable differences between students. We outline this approach in more detail in the next section.

Method

In this section, we present the econometric model used to estimate the causal impact of leaving regular full-time secondary education for one of the two discussed dual programs on later transition from school to work success. The added value of this approach is twofold. First, it enables us to control for unobservable factors that influence both the enrolment of students in dual programs and later employment outcomes. Second, this model allows us to make a distinction between the direct effect of these dual programs (conditional on their effect on the probability of obtaining a secondary education qualification, tertiary education enrolment, and earlier labour market outcomes) and their indirect effect (through these earlier outcomes).

Dynamic Discrete Choice Model

We build on dynamic discrete choice models that were used in the past (Baert and Cockx, 2013; Baert et al., 2017; Cameron and Heckman, 1998, 2001; Cockx et al., in press). In line with this literature, our model is a sequence of binary and multinomial probabilities. More concretely, in our benchmark model, we jointly explain the twelve outcomes mentioned in Section 3.3: (i) delay at the start of primary education, (ii) delay at the start of secondary education, (iii) track choice at the start of the second year of secondary education, (iv) secondary education experience at the end of full-time compulsory education, (v-vii) type of dual program (if any), (viii) secondary education qualification, (ix) tertiary education enrolment, and (x-xii) employment three months, one year, and five years after leaving school. See Figure 2 for a schematic overview of this model. In an alternative model, the impact of dual programs on the chances of securing a permanent contract is investigated. The

outcomes (x-xii) then become whether or not students had a permanent contract three months, one year, and five years after leaving school.

<Figure 2 about here>

The choice set for a specific outcome, denoted by C^O, is a set of multinomial numbers: $C^O = \{0,1,...,n^O\}$, where n^O defines the number of choices that can be made for outcome *O* minus 1. With respect to outcome (iii), three outcome values are possible: general track (outcome value 0), technical or arts track (outcome value 1), and vocational track (outcome value 2). With respect to outcome (iv), four outcome values are possible: no retention and no downgrade (outcome value 0), retention but no downgrade (outcome value 1), no retention but downgrade (outcome value 2), and retention and downgrade (outcome value 3). All other outcomes are binary in nature.

The optimal choice $\hat{c}_i^O$ of an individual *i* with respect to outcome *O* is the following:

$$\hat{c}_i^O = c \in C^O \quad if \quad \omega_c^O < U_{i,c}^O \leq \omega_{c+1}^O \tag{1},$$

where $U_{i,c}^O$ is the latent utility of choice *c* for outcome *O,* and ω_c^O and ω_{c+1}^O are threshold utilities ('cut-off values') that determine the ordered choice ($\omega_0^O \equiv -\infty$ and $\omega_{n^O+1}^O \equiv +\infty$). In line with the literature, we approximate this $U_{i,c}^O$ by a linear index:

$$U_{i,c}^O = Z_i \alpha^O + R_i^O \beta^O + V_i^O \gamma^O + \nu_{i,c}^O \tag{2}.$$

In this equation, Z_i is a vector representing the exogenous variables as observed for individual *i*, and R_i^O captures the unemployment rate at the district level at the moment of outcome *O*, both of which are described in Section 3.2. V_i^O is the vector of endogenous outcomes that are realised before outcome *O*, which are described in Section 3.3. α^O, β^O, and γ^O are the

vectors of associated parameters and $\nu_{i,c}^{O}$ is unobservable from the researcher's point of view.

We follow Cameron and Heckman (2001) by assuming that $\nu_{i,c}^{O}$ is characterised by a factor structure. However, in line with the more recent literature (Carneiro et al., 2003; Cockx et al., 2018; Fruehwirth et al., 2016; Heckman and Navarro, 2007), we generalise by allowing that the factor "loadings" depend on our main treatment status (whether or not students enrolled in a dual program) P_i:

$$\nu_{i,c}^{O} = \delta^{O}\eta + \varphi^{O}P_i\,\eta + \varepsilon_{i,c}^{O} \qquad (3),$$

in which η is a random effect, independent of $\varepsilon_{i,c}^{O}$, and independent across people, which captures unobserved determinants of the outcomes in the model. The outcome-specific coefficients δ^{O} and φ^{O} are normalised to 1 for the first modelled outcome. $\varepsilon_{i,c}^{O}$ is the i.i.d. error term, which is assumed to be logistically distributed.

As a consequence, we can write the probability of a particular outcome value as:

$$\Pr(\hat{c}_i^{O} = c \,|\, \mathrm{Z}_i, R_i^{O}, V_i^{O}, \eta; \vartheta) = \frac{\exp(\omega_{c+1}^{O} - \mathrm{Z}_i\alpha^{\mathrm{O}} - R_i^{O}\beta^{\mathrm{O}} - V_i^{O}\gamma^{O} - \delta^{O}\eta - \varphi^{O}P_i\,\eta - \varepsilon_{i,c}^{O})}{1+\exp(\omega_{c+1}^{O} - \mathrm{Z}_i\alpha^{\mathrm{O}} - R_i^{O}\beta^{\mathrm{O}} - V_i^{O}\gamma^{O} - \delta^{O}\eta - \varepsilon_{i,c}^{O})} - \frac{\exp(\omega_{c}^{O} - \mathrm{Z}_i\alpha^{\mathrm{O}} - R_i^{O}\beta^{\mathrm{O}} - V_i^{O}\gamma^{O} - \delta^{O}\eta - \varphi^{O}P_i\,\eta - \varepsilon_{i,c}^{O})}{1+\exp(\omega_{c}^{O} - \mathrm{Z}_i\alpha^{\mathrm{O}} - R_i^{O}\beta^{\mathrm{O}} - V_i^{O}\gamma^{O} - \delta^{O}\eta - \varepsilon_{i,c}^{O})} \qquad (4),$$

in which we denote the vector of unknown parameters by ϑ. The likelihood contribution $\ell_i(Z_i, R_i^{O}, V_i^{O}, \eta; \vartheta)$ for any sampled individual, conditional on the unobservable η, is then constructed by the product of the probabilities of the choices realised in the data for the twelve modelled outcomes.

Following the literature, we adopt a non-parametric discrete distribution for the unobserved random variable η. We assume that this distribution is characterised by an *a*

priori unknown number of *K* points of support η_k to which are assigned probabilities $p_k(q)$ specified as logistic transforms:

$$p_k(q) = \frac{exp(q_k)}{\sum_{j=1}^{K} exp(q_j)} \quad with \quad k = 1,2,...K; q \equiv [q_1, q_2, ..., q_K]' \; and \; q_1 = 0 \tag{5}.$$

Hence, the unconditional individual likelihood contribution for individual *i* is:

$$\ell_i(Z_i, R_i^O, V_i^O; \vartheta, q) = \sum_{k=1}^{K} p_k(q) \ell_i(Z_i, R_i^O, V_i^O, \eta_k; \vartheta) \tag{6}.$$

As Cameron and Heckman (1998; 2001) show, identification of the random effect is proven if our initial condition, i.e. delay at the start of primary education, is free of selection. This means that η should be independent of Z_i and R_i^O.

Model Selection

We estimated the coefficients for the model presented in the previous subsection with a maximum likelihood estimation following Gaure et al. (2007). Heterogeneity types were gradually added until the log-likelihood value of the model failed to increase.

Table A–1 in Appendix A reports the number of parameters, the log-likelihood, and the Akaike Information Criterion (AIC)[6] values of the model according to the number of heterogeneity types *K* included. The lowest AIC is obtained for *K = 6*. The coefficient estimates for this model are displayed in Table A–2. Unless otherwise stated, the simulations below are based on these parameter estimates.

The coefficient estimates in Table A–2 provide further evidence that controlling for

[6] Following the argument in Gaure et al. (2007), we believe that the AIC is the preferable criterion for our sample size.

unobserved heterogeneity is important. First, the proportions of multiple heterogeneity types are substantial (p_1 = 40.1%, p_2 = 6.0%, p_3 = 35.4%, p_4 = 16.5%, p_5 = 0.9%, and p_6 = 1.2%).[7] Second, almost all (other) parameters of the unobserved heterogeneity distribution (i.e. all η_k's and most δ^O's) are highly significantly different from 0.

Simulation Strategy

Based on the estimated parameters for our preferred model, we simulate students' schooling career (among which their enrolment in dual programs) and early labour market outcomes. To answer our research questions, we run these simulations under different scenarios with respect to students' enrolment in dual programs.

For each analysis, we randomly draw 999 vectors from the asymptotic normal distribution of the preferred model's parameters. Subsequently, in each of the 999 draws, the parameters are used to calculate the probabilities associated with each heterogeneity type. These probabilities are then used to randomly assign a heterogeneity type to each pupil in the sample.[8] Thereafter, based on these randomly drawn parameters and the assignment of individuals to a heterogeneity type, the full sequence of schooling and labour market outcomes is simulated for each student in the sample (for each draw).

More concretely, each outcome is simulated sequentially based on its (multinomial) logit specification reported in Section 4.1. These specifications yield, for each individual in each draw, a probability for each potential outcome value. These probabilities are then translated

[7] For instance, following equation (5), p_2 = *exp(-1.899) / (exp(0) + exp(-1.899) + exp(-0.124) + exp(-0.887) + exp(-3.787) + exp(-3.538))*.

[8] As we assume that observables and unobservables are orthogonal at the start of our model (supra, Section 4.1), we have no way of knowing which individual belongs to a specific heterogeneity type.

to segments on the unit interval. To determine the particular outcome value for each individual in each draw, a random number is generated from the standard uniform distribution. The outcome value assigned to the individual depends on the segment in which this random number falls. Once an outcome is assigned, it is saved and conditioned upon for the subsequent outcomes.

In the sequel, the model prediction of a particular outcome refers to the average of these 999 replications. The 95% confidence intervals are constructed by choosing the appropriate percentiles of the 999 simulated probabilities.

Goodness of Fit

To determine the benchmark model's goodness of fit, for each endogenous variable we compared the actual probability (as observed in our data) with the simulated probability (as estimated by our model). As can be seen from Table A–3 and Figure 3, the simulated probabilities are closely distributed around the actual probabilities. Only for the outcome 'Employed five years after leaving school', the simulated probability deviates significantly (on the 5% confidence level) from the actual probability. Nonetheless, also for this outcome the simulated probability approaches the actual probability quite well in economic terms (i.e. the probabilities are 0.923 and 0.906, respectively).

<Figure 3 about here>

Average Treatment Effects

To answer our research questions, we simulated, following the strategy presented in the former subsection, two series of Average Treatment Effects (ATEs): one for the treatment

'training centre-based dual program' and one for the treatment 'school-based dual program with apprenticeship'. As in a school-based dual program without apprenticeship there is no real work component (supra, Section 2), we do not report the ATEs for this program. These results for this treatment are available on request.

The ATEs are a combination of Average Treatment effects on the Treated (ATTs) and Average Treatment effects on the Non-Treated (ATNTs). ATTs were based on the simulated outcomes of individuals who were assigned to the treatment of a certain dual program given a particular parameter draw. Similarly, for individuals who were assigned to no treatment, we calculated the ATNTs. First, the ATT for a certain treatment is calculated for each outcome of interest (and for each of the 999 parameter draws) as follows:

$$\frac{average\ outcome\ across\ treated\ individuals}{average\ outcome\ across\ treated\ individuals, in\ the\ counterfacutal\ of\ no\ treatment} \quad (7).$$

The counterfactual outcomes were realised by forcing all indicator variables for treatment (i.e. participation in dual program, school-based dual program, and apprenticeship during school-based dual program) to 0 for each treated individual. Second, the ATNT is calculated for each outcome of interest as follows:

$$\frac{average\ outcome\ across\ untreated\ individuals, in\ the\ counterfacutal\ of\ treatment}{average\ outcome\ across\ untreated\ individuals} \quad (8).$$

In this case, the counterfactual outcomes in case of treatment were realised by forcing the indicator variables for treatment to the appropriate status. More concretely, in the counterfactual situation of a training centre-based dual program only variable 'participation in dual program' was forced to 1, while in the counterfactual situation of a school-based dual program with apprenticeship also 'school-based dual program' and 'apprenticeship during school-based dual program' were forced to 1, for each untreated individual. Third, the ATE is realised by combining both strategies and calculated as follows:

$$\frac{average\ outcome\ across\ treated\ individuals}{average\ outcome\ across\ untreated\ individuals} \quad (9).$$

For each parameter draw, the numerator is the average outcome in case of treatment for all individuals (so the factual simulated outcome for the individuals assigned to the treatment or the counterfactual outcome in case of no such assignment) while the denominator is the average outcome in case of no treatment for all the individuals (so the counterfactual outcome for the individuals assigned to the treatment or the factual simulated outcome in case of no such assignment). If the ATE is above (below) 1, this means there is a positive (negative) effect of the treatment on the outcome of interest. Below, we discuss the distribution of this ATE, i.e. its average over the 999 draws and its 95% confidence intervals.

Total and Direct Effects

For outcomes realised after the decision (not) to enrol in a dual program, we make a distinction between total effects and direct effects. For the total effects, we do not condition equation (9) on earlier outcomes. Consequently, the treatment impacts these outcomes both directly (via the model's coefficients capturing the direct effect of a dual program) and indirectly (via the model's coefficients capturing the effects of earlier outcomes, which in turn were (potentially) affected by inflowing into a dual program). In contrast, for the direct effects, we condition equation (9) on earlier outcomes as realised in the factual situation. Consequently, the treatment impacts the analysed outcomes only directly (via the model's coefficients capturing the direct effect of a dual program on these outcomes).

Results

In this section we present the results of our analyses. We start with a brief discussion of the coefficient estimates of our benchmark model and three alternative models (to inspect whether the effect of the dual programs is heterogeneous by observed early labour market outcome and by gender). Next, we discuss our ATEs and contrast the total effects of inflowing into a dual program with its direct effects. All these analyses are based on our preferred model, i.e. the model with six heterogeneity types.

Table 2 shows the main coefficient estimates for several specifications of our model—the full estimation results of our benchmark model are presented in Table A–2. The models of which the main results are presented in the first two columns of Table 2 use 'employed after leaving school' as the labour market outcome, while the other models use 'permanent contract after leaving school'. Column (1) and (3) show the results for models without an interaction effect between participation in a dual program and female gender while column (2) and (4) provide the estimation results for an extended version of the model in which this interaction is added. The coefficients should be interpreted relative to 0. If the coefficients are above (below) 0, there is a positive (negative) effect of inflowing into a dual program compared to regular full-time education. The effect of inflowing into a training centre-based dual program is measured by the coefficient of 'participation in dual program'. For students in a school-based dual program without apprenticeship (with apprenticeship), this coefficient should be increased with the coefficient of 'school-based dual program' (with the coefficients of 'school-based dual program' and 'apprenticeship during school-based dual program').

<Table 2 about here>

We first focus on the results in column (1) and (3). Panel A of Table 2 clearly shows a

highly significantly negative effect of enrolling in a dual program on the probability of obtaining a secondary education qualification. We cannot reject that this effect is homogeneous by whether one inflows into a training centre-based or school-based dual program (i.e. 'school-based dual program' is not significant) or by whether one is employed during one's school-based dual program (i.e. 'apprenticeship during school-based dual program' is not significant).

Regarding the work status (employment and having a permanent contract after leaving school) of students three months after leaving school (Panel B), we observe a highly significantly positive effect for students doing a training centre-based dual program (conditional on the included education outcomes). For students with an experience of a school-based dual program, we cannot reject the null hypothesis of a 0 effect (i.e. the sum of the coefficients of 'participation in dual program' and 'school-based dual program' is never statistically significantly different from 0). Further, no significant effects of the dual programs are found with respect to the later labour market outcomes (conditional on earlier education and labour market outcomes).

Concerning heterogeneous effects by gender, we find a negative effect of the interaction term 'participation in a dual program × female gender' on the probability of being employed three months after leaving school but not on the probability of having a permanent contract then. So, the premium of a dual program is found to be lower for females, *ceteris paribus*.

The mentioned results based on parameter estimates are direct effects, i.e. they are conditional on all earlier outcomes. Moreover, their magnitude is difficult to interpret. Therefore, in Table 3 and 4, we present various ATEs of the dual programs. The treatment is a particular dual program. The counterfactual is the scenario where the same individuals do

not follow any dual program (i.e. they are enrolled in regular full-time regular education).[9] The ATEs should be interpreted relative to 1. If the ratio is above (below) 1, there is a positive (negative) effect of the dual program compared to regular full-time education.

Column (1) of Table 3 shows the total effects of dual programs on secondary education qualification and employment three months, one year and five years after leaving school. In line with our discussion of Panel A of Table 2, we find that students doing a training centre-based dual program (Panel A of Table 3) are 5.5% less likely to obtain a secondary education qualification compared to students in regular full-time education. Next, students in a school-based dual program with apprenticeship (Panel B), are 3.9% less likely to obtain this qualification (compared to students without in inflow in a dual program). However, the latter effect is not statistically significantly different from 0. Concerning the labour market outcomes, we find that students in training centre-based dual programs are 29.7% more likely to have a job three months after leaving school, but that this effect fades out over time. That is, there is no effect on the probability of having a job one year and five years after leaving school. For students doing a school-based dual program with apprenticeship, we see the same pattern, although we do not find a statistically significant effect. Also in economic terms, the ATEs are lower (compared with those for a training centre-based dual program).

<Table 3 about here>

Column (2) of Table 3 presents the direct effects of the two dual programs.[10] These effects capture the same empirical pattern as that presented in column (2) of Table 2, since the coefficient estimates also measure direct effects. For students doing a training centre-based

[9] Results do not substantially differ when estimating ATTs or ATNTs (see Table A–4 in Appendix A).

[10] Given that for the outcome 'secondary education qualification obtained', we do not condition on prior endogenous outcome variables, the direct effects equal the total effects and are therefore not reported.

dual program, the direct effect on finding a job three months after leaving school (30.6%), is slightly bigger than the total effect (29.7%). This means that the direct effect overcompensates a very small negative indirect effect, via the negative effect of doing a training centre-based dual program on obtaining a secondary education qualification, which in turn has a positive effect on finding work (Panel M of Table A–2).[11]

Table 4 compares the total effects on the labour market outcome 'employed after leaving school' with the alternative labour market outcome 'permanent contract after leaving school'. For this alternative outcome the results are somewhat more pronounced. Students doing a training centre-based dual program have a 78.9% higher probability of having a permanent contract three months after leaving school and a 26.7% higher probability of having a permanent contract one year after leaving school. The fact that a significant total effect on having a permanent contract one year after leaving school is found while column (3) of Table 2 points in the direction of no direct effect, can be explained by the significant effect of having a contract three months after leaving school on having such a contract one year after leaving school. Again, for students in the school-based dual program with apprenticeship (Panel B), no statistically significant treatment effects are found.

<Table 4 about here>

Conclusion

In this study we examined the effect of training centre-based and school-based dual programs

[11] When using the outcome 'permanent contract after leaving school', the differences between total effects and direct effects are similar. These additional results are available on request.

within the context of the Belgian secondary education system on educational achievement and labour market outcomes. We found that students doing a training centre-based dual program less often obtain a secondary education qualification compared to students in regular full-time education, whereas this effect was not significant for students in a school-based dual program. In addition, students doing a training centre-based dual program had an increased probability of finding a job when entering the labour market and this impact diminished over time. This advantage was not found for students in the school-based dual program, suggesting that the positive effect of doing a training centre-based dual program is due to its closer ties to the labour market. The finding that the advantage of training centre-based dual programs in the short run fades out over time, is consistent with previous literature that also found evidence for a positive effect of vocational education on employment outcomes only in the short run (Brunello and Rocco, 2017; Forster et al., 2016; Hampf and Woessman, 2017; Hanushek et al., 2017; Lavrijsen and Nicaise, 2017).

Our results have several implications for policy makers. First, overall, our evaluation of the Flemish dual programs in secondary education is rather positive. Although students inflowing into this system face a slightly higher unqualified drop-out, they have a substantially higher probability of a smooth transition to work (especially with respect to getting a permanent contract) compared with students with the same endowments who did not inflow in a dual program. Second, and in line with Albanese et al. (2017), our results suggest that this advantage may be enforced by increasing the importance of in-field training. Third, our results also suggest that policy makers face a trade-off when designing dual programs since programs with more in-field training also seem to result in more unqualified drop-out, with potential negative effects beyond early labour market outcomes (Hanushek et al., 2017; Weber, 2014).

Finally, we recommend several directions for future research. First, we suggest to

investigate the effect of dual programs (in Belgium and abroad) on other labour market outcomes than those considered in this study. In particular, it would be interesting to see what the direct and indirect causal effects of the studied programs on later wages are. Second, due to data constraints, we were unable to investigate the mechanisms underlying the smoother transition from school to work after a (training centre-based) dual program in secondary education. In particular, our data did not allow us to examine the extent to which students enrolled in such a program start to work with the employer who they worked for during these programs. Finding evidence for this screening channel could support the idea that programs with more in-field training are more effective due to the realised stronger ties with the labour market. Third, as Verhaest and Baert (2018) already examined for vocational education in higher studies, it would be interesting to see what the effect of vocational education programs in secondary education is on school leavers' job match. In particular, it would be interesting to examine whether there also exists a decline in the short-term advantages of dual programs with respect to this outcome. Fourth, since we only observed the first five years after labour market entry, we were not able to assess whether the declining advantage of dual programs in terms of labour market outcomes ultimately turns into a disadvantage, as found in some former contributions. Relying on a similar type of modelling to investigate whether this is the case is a final interesting avenue for further research.

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Appendix A

<Table A–1 about here>

<Table A–2 about here>

<Table A–3 about here>

<Table A–4 about here>

Table 1. Summary statistics.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	I. Whole sample (N = 5541)		II. Sample with regular full-time education only (N = 5209)		III. Sample with dual program (N = 332)		IV. Sample with training centre-based dual program (N = 125)		V. Sample with school-based dual program without apprenticeship (N = 97)		VI. Sample with school-based dual program with apprenticeship (N = 110)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
A. Exogenous variables												
Female gender	0.495	-	0.506	-	0.331	-	0.317	-	0.485	-	0.211	-
Migration background	0.062	-	0.057	-	0.142	-	0.071	-	0.247	-	0.128	-
Number of siblings	1.642	1.403	1.606	1.351	2.208	1.966	1.706	1.345	2.763	2.482	2.294	1.921
Mother's education after primary education (years)	5.441	3.209	5.585	3.164	3.181	3.058	3.508	2.950	2.742	3.046	3.193	3.170
Father's education after primary education (years)	5.869	3.472	6.016	3.442	3.563	3.103	3.659	2.860	3.134	3.319	3.835	3.164
Day of birth within calendar year	180.316	103.336	180.358	103.334	179.654	103.517	165.365	104.101	207.536	105.434	171.358	97.016
B. Endogenous variables												
B.1. Educational outcomes before potential selection in dual program												
Delay at start PE	0.017	-	0.016	-	0.033	-	0.032	-	0.021	-	0.046	-
Delay at start SE	0.106	-	0.096	-	0.268	-	0.246	-	0.278	-	0.284	-
Track choice at start second year of SE												
General track	0.605	-	0.634	-	0.157	-	0.206	-	0.124	-	0.128	-
Technical or arts track	0.260	-	0.257	-	0.307	-	0.246	-	0.351	-	0.339	-
Vocational track	0.135	-	0.109	-	0.536	-	0.548	-	0.526	-	0.532	-
SE experience at end of compulsory FT education												
No retention and no downgrade	0.812	-	0.820	-	0.681	-	0.738	-	0.670	-	0.624	-
Retention and no downgrade	0.074	-	0.069	-	0.160	-	0.103	-	0.175	-	0.211	-
No retention and downgrade	0.104	-	0.102	-	0.139	-	0.127	-	0.134	-	0.156	-
Retention and downgrade	0.010	-	0.009	-	0.021	-	0.032	-	0.021	-	0.009	-
B.2. Choice related to dual program												
Participation in dual program	0.060	-	0.000	-	1.000	-	1.000	-	1.000	-	1.000	-
Training centre-based dual program	0.023	-	0.000	-	0.377	-	1.000	-	0.000	-	0.000	-
School-based dual program	0.037	-	0.000	-	0.623	-	0.000	-	1.000	-	1.000	-
Apprenticeship during school-based dual program	0.020	-	0.000	-	0.328	-	0.000	-	0.000	-	1.000	-

B.3. Later schooling and labour market outcomes												
SE qualification obtained	0.924	-	0.942	-	0.633	-	0.770	-	0.546	-	0.550	-
TE enrolment	0.636	-	0.677	-	0.000	-	0.000	-	0.000	-	0.000	-
Employed three months after leaving school	0.615	-	0.613	-	0.646	-	0.795	-	0.495	-	0.619	-
Employed one year after leaving school	0.834	-	0.842	-	0.723	-	0.819	-	0.608	-	0.724	-
Employed five years after leaving school	0.906	-	0.920	-	0.780	-	0.900	-	0.627	-	0.788	-
Permanent contract three months after leaving school	0.311	-	0.305	-	0.407	-	0.569	-	0.258	-	0.365	-
Permanent contract one year after leaving school	0.504	-	0.505	-	0.497	-	0.637	-	0.371	-	0.462	-
Permanent contract five years after leaving school	0.768	-	0.780	-	0.643	-	0.758	-	0.494	-	0.655	-

Notes. See Section 3 for a description of the mentioned variables. The following abbreviations are used: FT (full-time), PE (primary education), SE (secondary education), and TE (tertiary education). For binary variables no standard deviations are presented.

Table 2. Main estimation results.

	(1)	(2)	(3)	(4)
	Model			
	Labour market outcome: employed after leaving school		Labour market outcome: permanent contract after leaving school	
	Dual program effect homogeneous by gender (benchmark model)	Dual program effect heterogeneous by gender	Dual program effect homogeneous by gender	Dual program effect heterogeneous by gender
A. Outcome: SE qualification obtained				
Participation in dual program	−1.941*** (0.729)	−1.996*** (0.754)	−2.333*** (0.794)	−2.387*** (0.837)
Participation in dual program × female gender		0.293 (0.923)		0.871 (0.971)
School-based dual program	−0.271 (0.941)	−0.207 (1.028)	−0.045 (0.975)	−0.083 (1.118)
Apprenticeship during school-based dual program	0.840 (1.128)	0.981 (1.272)	0.875 (1.217)	1.167 (1.393)
B. Outcome: work status three months after leaving school				
Participation in dual program	0.930*** (0.312)	1.194*** (0.343)	1.111*** (0.261)	1.269*** (0.281)
Participation in dual program × female gender		−0.641** (0.323)		−0.471 (0.347)
School-based dual program	−1.055*** (0.389)	−0.995** (0.392)	−1.118*** (0.383)	−1.082*** (0.388)
Apprenticeship during school-based dual program	0.448 (0.358)	0.272 (0.368)	0.363 (0.371)	0.255 (0.390)
C. Outcome: work status one year after leaving school				
Participation in dual program	−0.382 (0.381)	−0.153 (0.430)	−0.048 (0.416)	−0.042 (0.441)
Participation in dual program × female gender		−0.489 (0.440)		−0.010 (0.460)
School-based dual program	−0.048 (0.439)	0.023 (0.452)	−0.134 (0.518)	−0.120 (0.530)
Apprenticeship during school-based dual program	0.335 (0.460)	0.222 (0.492)	0.045 (0.532)	0.055 (0.556)
D. Outcome: work status five years after leaving school				
Participation in dual program	0.174 (0.471)	0.387 (0.537)	−0.370 (0.303)	−0.233 (0.346)
Participation in dual program × female gender		−0.393 (0.438)		−0.311 (0.359)
School-based dual program	−0.939* (0.528)	−0.941* (0.530)	−0.586 (0.431)	−0.566 (0.432)
Apprenticeship during school-based dual program	0.608 (0.502)	0.522 (0.506)	0.447 (0.431)	0.360 (0.438)
N	5541	5541	5541	5541
# heterogeneity types (K)	6	6[a]	6	6
# parameters	239	243	239	243
Log-likelihood	−19,441.101	−19,436.983	−20,562.977	−20,561.153
Akaike Information Criterion (AIC)	39,360.203	39,359.965	41,603.953	41,608.305

Notes. The presented statistics are estimated coefficients and standard errors between parentheses. * (**) ((***)) indicates significance at the 10% (5%) ((1%)) significance level.

[a] The AIC is slightly lower for the model with seven heterogeneity types (AIC is 39,358.177 then). However, for consistency, we used the model with six heterogeneity types throughout all our analyses. Using a model with seven heterogeneity types for this specification does not substantially change our results.

Table 3. ATEs on schooling and labour market outcomes: participation in dual program versus regular full-time education.

	(1)	(2)
	Total effect	**Direct effect**
A. Treatment: training centre-based dual program		
SE qualification obtained	0.945*** [0.893, 0.989]	
Employed three months after leaving school	1.297*** [1.117, 1.449]	1.306*** [1.129, 1.456]
Employed one year after leaving school	1.011 [0.914, 1.093]	0.943 [0.826, 1.044]
Employed five years after leaving school	1.009 [0.943, 1.051]	1.007 [0.943, 1.050]
B. Treatment: school-based dual program with apprenticeship		
SE qualification obtained	0.961 [0.891, 1.009]	
Employed three months after leaving school	1.129 [0.872, 1.344]	1.136 [0.885, 1.349]
Employed one year after leaving school	1.003 [0.859, 1.111]	0.980 [0.847, 1.084]
Employed five years after leaving school	0.985 [0.884, 1.047]	0.984 [0.890, 1.044]

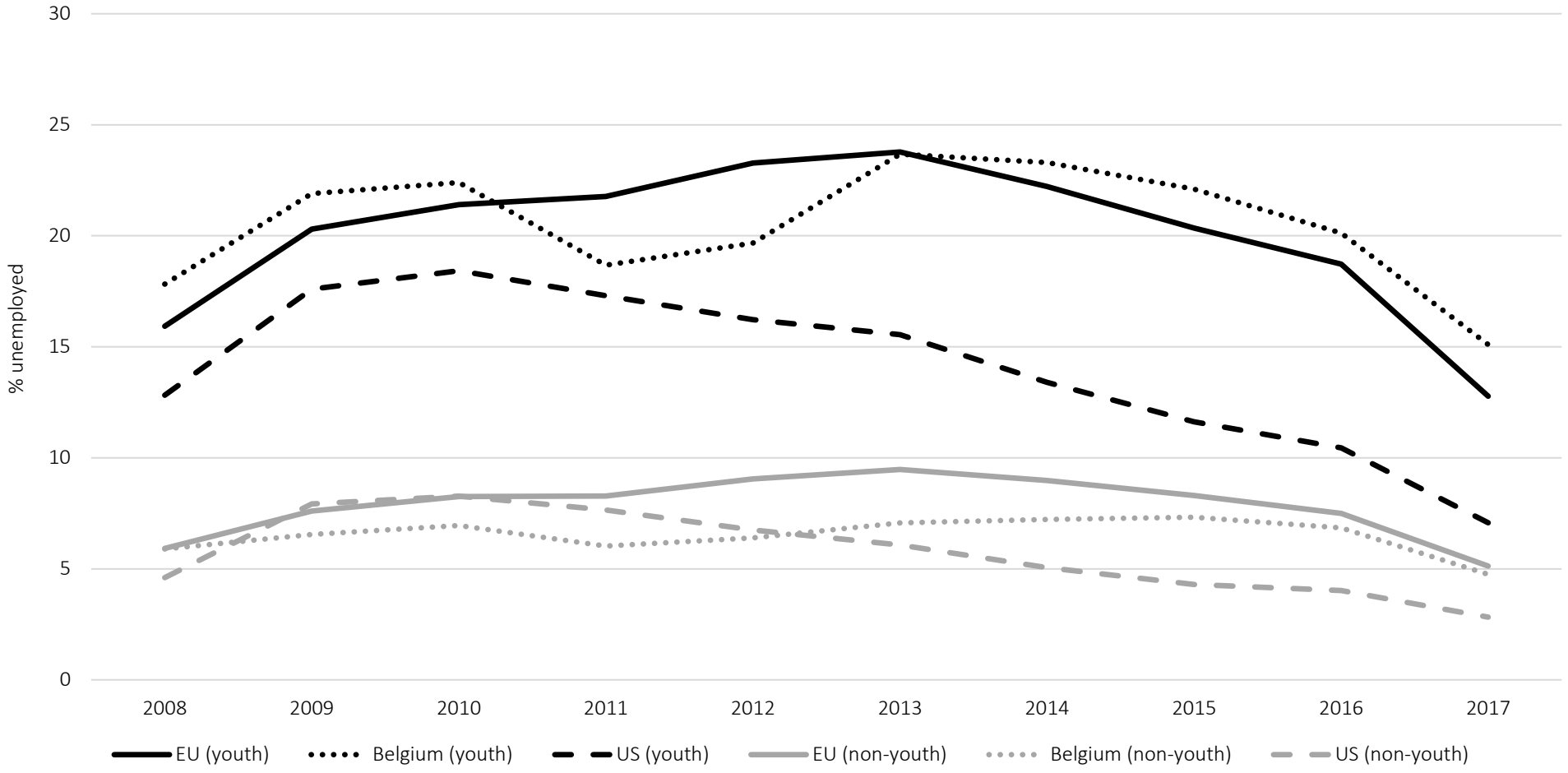
Notes. The presented statistics are simulated Average Treatment Effects (ATEs) and 95% confidence intervals are given between brackets. The following abbreviation is used: SE (secondary education). * (**) ((***)) indicates significance at the 10% (5%) ((1%)) significance level.

Table 4. ATEs on labour market outcomes: the two dual programs versus regular full-time education.

	(1)	(2)
	Total effect	
	Employed	Permanent contract
A. Treatment: training centre-based dual program		
Work status three months after leaving school	1.297*** [1.117, 1.449]	1.789*** [1.383, 2.216]
Work status one year after leaving school	1.011 [0.914, 1.093]	1.267** [1.038, 1.482]
Work status five years after leaving school	1.009 [0.943, 1.051]	0.979 [0.847, 1.090]
B. Treatment: school-based dual program with apprenticeship		
Work status three months after leaving school	1.129 [0.872, 1.344]	1.248 [0.811, 1.726]
Work status one year after leaving school	1.003 [0.859, 1.111]	1.046 [0.749, 1.343]
Work status five years after leaving school	0.985 [0.884, 1.047]	0.905 [0.693, 1.078]

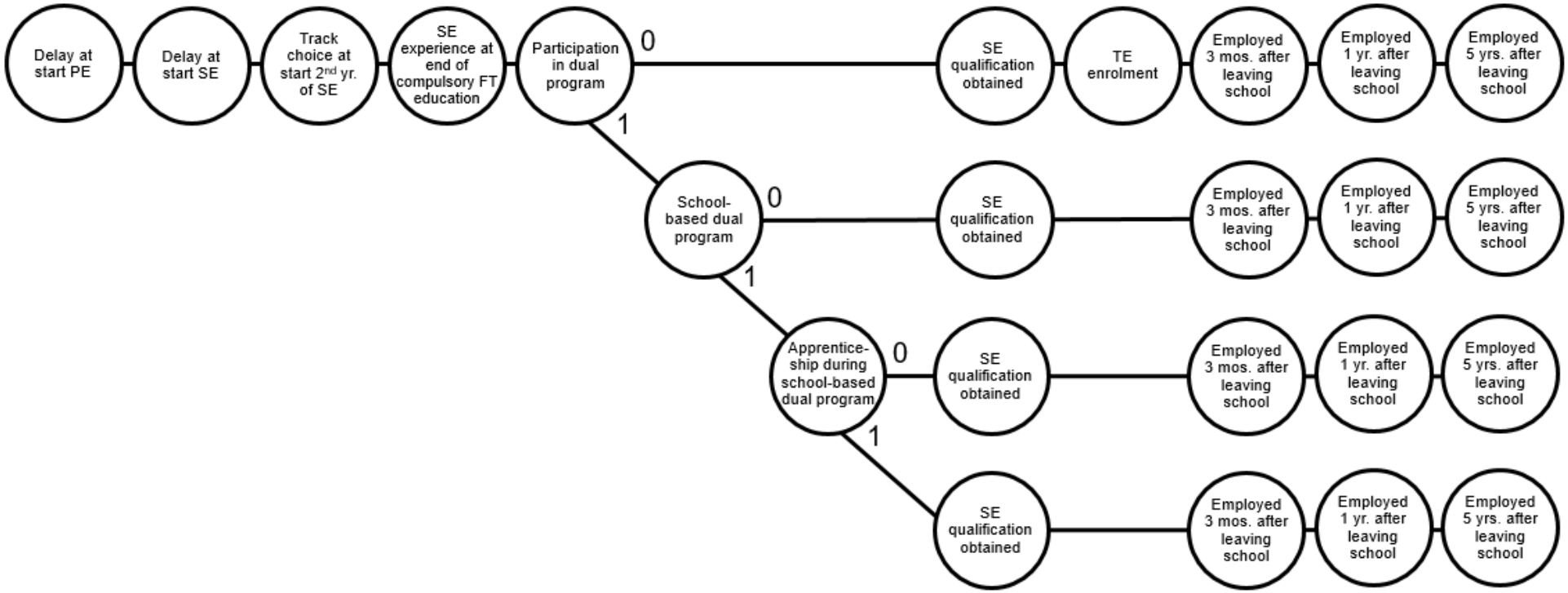
Notes. The presented statistics are simulated Average Treatment Effects (ATEs) and 95% confidence intervals are given between brackets. * (**) ((***)) indicates significance at the 10% (5%) ((1%)) significance level. The effects are not presented with respect to the outcome 'SE qualification obtained', as these effects are equal for both models.

Figure 1. Youth and non-youth unemployment rates.



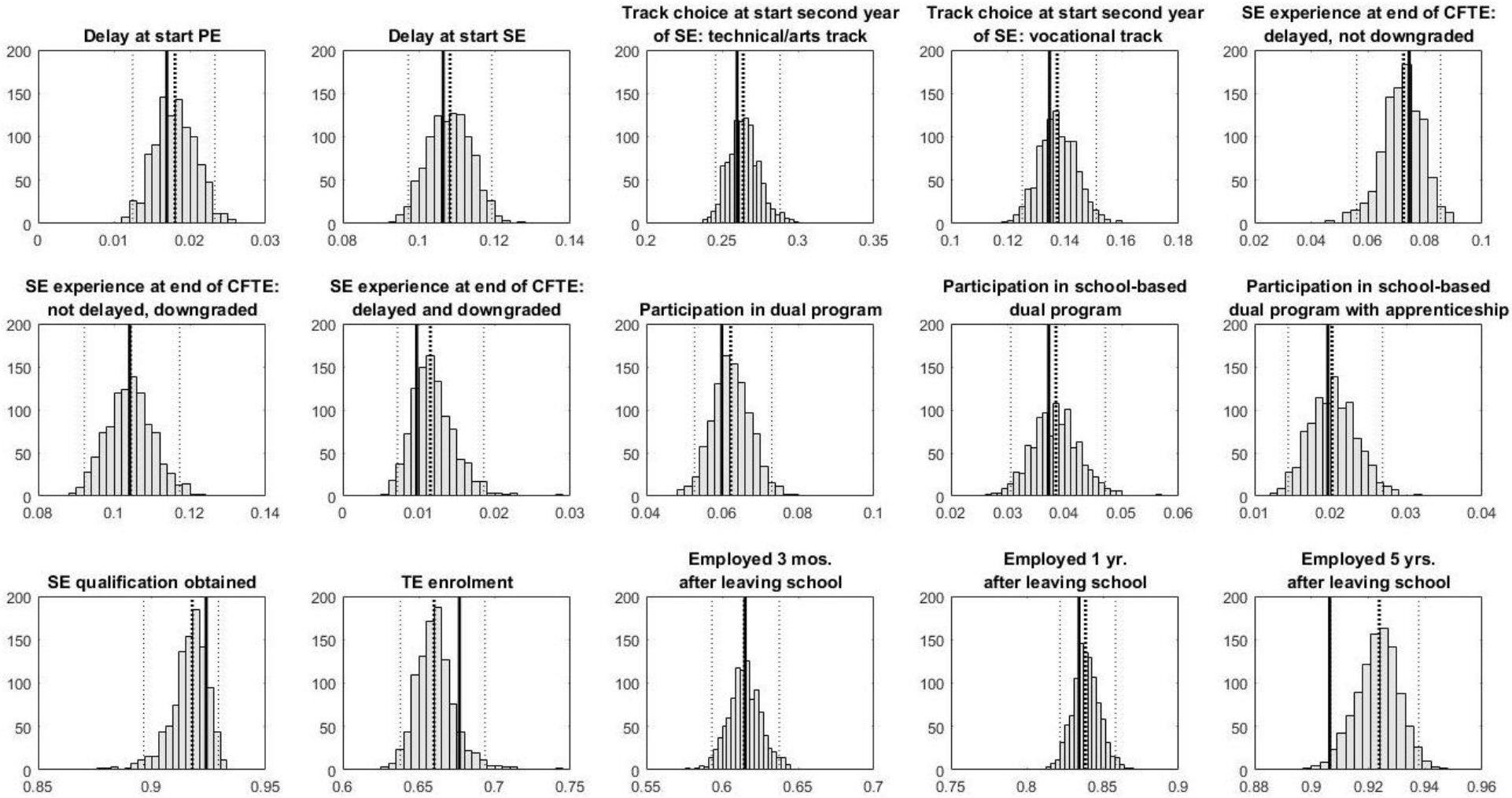
Source: Eurostat. Youth: between 15 and 24 years old. Non-youth: between 25 and 74 years old.

Figure 2. Schematic overview of the econometric model.



Notes. The following abbreviations are used: FT (full-time), PE (primary education), SE (secondary education), TE (tertiary education), mos. (months), yr. (year), and yrs. (years).

Figure 3. Goodness of fit.



Notes. The y-axis indicates how many times (on a total of 999) a particular probability (x-axis) was simulated. The full line indicates the actual probability, the dotted lines indicate the median and the 95% confidence interval of the simulated probabilities. The following abbreviations are used: CFTE (compulsory full-time education), PE (primary education), SE (secondary education), TE (tertiary education), mos. (months), yr. (year), and yrs. (years).

Table A–1. Benchmark model: model selection.

(1)	(2)	(3)	(4)
# heterogeneity types (K)	**# parameters**	**Log-likelihood**	**Akaike Information Criterion**
1	212	−19,602.013	39,628.027
2	231	−19,501.459	39,464.917
3	233	−19,455.369	39,376.737
4	235	−19,452.384	39,374.768
5	237	−19,447.588	39,369.175
6	**239**	**−19,441.101**	**39,360.203**
7	241	−19,439.929	39,361.859
8	243	−19,439.051	39,364.103

Table A–2. Benchmark model: full estimation results.

A. Outcome: Delay at start primary orientation	
Female gender	−0.048 (0.243)
Migration background	1.281*** (0.390)
Number of siblings	0.019 (0.089)
Mother's education after PE (years)	−0.031 (0.050)
Father's education after PE (years)	0.032 (0.046)
Day of birth within calendar year	0.005*** (0.001)
Unemployment rate	0.017 (0.056)
Intercept	−5.854*** (0.990)
B. Outcome: Delay at start SE	
Female gender	−0.285*** (0.099)
Migration background	0.525*** (0.162)
Number of siblings	0.096*** (0.032)
Mother's education after PE (years)	−0.139*** (0.019)
Father's education after PE (years)	−0.081*** (0.018)
Day of birth within calendar year	0.003*** (0.000)
Unemployment rate	0.011 (0.017)
Delay at start primary orientation	3.473*** (0.283)
Intercept	−1.828*** (0.292)
C. Outcome: Track choice at start second year of SE: technical or arts track	
Female gender	−0.628*** (0.089)
Migration background	−0.352* (0.195)
Number of siblings	0.080** (0.035)
Mother's education after PE (years)	−0.194*** (0,020)
Father's education after PE (years)	−0.187*** (0.018)
Day of birth within calendar year	0.001*** (0,000)
Unemployment rate	0.043*** (0,014)
Delay at start primary orientation	−0.252 (0.365)
Delay at start secondary orientation	1.857*** (0.202)
Intercept	1.603*** (0.321)
D. Outcome: Track choice at start second year of SE: vocational track	
Female gender	−0.704*** (0.138)
Migration background	−0.375 (0.269)
Number of siblings	0.238*** (0.048)
Mother's education after PE (years)	−0.355*** (0.031)
Father's education after PE (years)	−0.295*** (0.028)
Day of birth within calendar year	0.002*** (0.001)
Unemployment rate	0.096*** (0.021)
Delay at start primary orientation	−0.176 (0.555)
Delay at start secondary orientation	3.252*** (0.263)
Intercept	1.071** (0.446)
E. Outcome: SE experience at end of compulsory FT education: delayed, not downgraded	
Female gender	−0.434*** (0.135)
Migration background	0.493** (0.240)
Number of siblings	0.055 (0.043)
Mother's education after PE (years)	0.009 (0.027)
Father's education after PE (years)	0.061*** (0.024)
Day of birth within calendar year	0.000 (0.001)

Unemployment rate	−0.012 (0.022)
Delay at start primary orientation	−0.624 (0.638)
Delay at start secondary orientation	−1.113*** (0.238)
Track choice at start second year of SE: technical or arts track	2.973*** (0.383)
Track choice at start second year of SE: vocational track	3.691*** (0.530)
Intercept	−6.115*** (0.652)
F. Outcome: SE experience at end of compulsory FT education: not delayed, downgraded	
Female gender	−0.113 (0.094)
Migration background	−0.365 (0.251)
Number of siblings	0.021 (0.038)
Mother's education after PE (years)	−0.095*** (0.020)
Father's education after PE (years)	−0.078*** (0.019)
Day of birth within calendar year	0.000 (0.000)
Unemployment rate	0.027* (0.015)
Delay at start primary orientation	−1.309 (1.143)
Delay at start secondary orientation	−4.053*** (1.124)
Track choice at start second year of SE: technical or arts track	−0.155 (0.169)
Track choice at start second year of SE: vocational track	−50[a]
Intercept	−1.333*** (0.352)
G. Outcome: SE experience at end of compulsory FT education: delayed and downgraded	
Female gender	−0.414 (0.347)
Migration background	−0.454 (0.884)
Number of siblings	0.094 (0.122)
Mother's education after PE (years)	−0.052 (0.066)
Father's education after PE (years)	−0.158*** (0.059)
Day of birth within calendar year	−0.001 (0.002)
Unemployment rate	0.015 (0.054)
Delay at start primary orientation	0.345 (1.821)
Delay at start secondary orientation	−0.388 (1.162)
Track choice at start second year of SE: technical or arts track	−1.206* (0.710)
Track choice at start second year of SE: vocational track	−50[a]
Intercept	−2.785*** (1.030)
H. Outcome: Participation in dual program	
Female gender	−0.716*** (0.148)
Migration background	0.058 (0.231)
Number of siblings	0.071 (0.043)
Mother's education after PE (years)	−0.039 (0.029)
Father's education after PE (years)	−0.031 (0.027)
Day of birth within calendar year	−0.001 (0.001)
Unemployment rate	−0.11*** (0.023)
Delay at start primary orientation	0.258 (0.482)
Delay at start secondary orientation	0.026 (0.185)
Track choice at start second year of SE: technical or arts track	2.244*** (0.373)
Track choice at start second year of SE: vocational track	4.304*** (0.526)
SE experience at end of compulsory FT education: delayed, not downgraded	0.157 (0.274)
SE experience at end of compulsory FT education: not delayed, downgraded	1.416*** (0.236)
SE experience at end of compulsory FT education: delayed and downgraded	2.270*** (0.560)
Intercept	−3.665*** (0.617)

I. Outcome: School-based dual program	
Female gender	−0.115 (0.320)
Migration background	0.828 (0.552)
Number of siblings	0.221** (0.108)
Mother's education after PE (years)	−0.007 (0.058)
Father's education after PE (years)	0.044 (0.058)
Day of birth within calendar year	0.002* (0.001)
Unemployment rate	−0.006 (0.044)
Delay at start primary orientation	0.051 (0.903)
Delay at start secondary orientation	−0.207 (0.374)
Track choice at start second year of SE: technical or arts track	2.560*** (0.890)
Track choice at start second year of SE: vocational track	2.859** (1.120)
SE experience at end of compulsory FT education: delayed, not downgraded	0.112 (0.555)
SE experience at end of compulsory FT education: not delayed, downgraded	0.518 (0.531)
SE experience at end of compulsory FT education: delayed and downgraded	0.410 (1.705)
Intercept	−3.750*** (1.323)
J. Outcome: Apprenticeship during school-based dual program	
Female gender	−1.179*** (0.392)
Migration background	−0.460 (0.519)
Number of siblings	−0.021 (0.097)
Mother's education after PE (years)	0.002 (0.074)
Father's education after PE (years)	0.029 (0.064)
Day of birth within calendar year	−0.003* (0.002)
Unemployment rate	−0.009 (0.057)
Delay at start primary orientation	0.902 (1.214)
Delay at start secondary orientation	0.199 (0.458)
Track choice at start second year of SE: technical or arts track	0.091 (0.961)
Track choice at start second year of SE: vocational track	0.607 (1.260)
SE experience at end of compulsory FT education: delayed, not downgraded	0.235 (0.595)
SE experience at end of compulsory FT education: not delayed, downgraded	0.557 (0.596)
SE experience at end of compulsory FT education: delayed and downgraded	−0.887 (2.210)
Intercept	0.602 (1.592)
K. Outcome: SE qualification obtained	
Female gender	1.687*** (0.448)
Migration background	−2.279*** (0.597)
Number of siblings	−0.075 (0.092)
Mother's education after PE (years)	−0.163** (0.068)
Father's education after PE (years)	−0.007 (0.055)
Day of birth within calendar year	0.005*** (0.002)
Unemployment rate	0.150** (0.064)
Delay at start primary orientation	0.080 (1.475)
Delay at start secondary orientation	0.430 (0.561)
Track choice at start second year of SE: technical or arts track	−12.245*** (2.479)
Track choice at start second year of SE: vocational track	−20.440*** (3.995)
SE experience at end of compulsory FT education: delayed, not downgraded	2.786*** (0.984)
SE experience at end of compulsory FT education: not delayed, downgraded	−1.047 (0.805)
SE experience at end of compulsory FT education: delayed and downgraded	−6.914* (3.661)
Participation in dual program	−1.941*** (0.729)
School-based dual program	−0.271 (0.941)
Apprenticeship during school-based dual program	0.840 (1.128)

Intercept	21.674*** (4.035)
L. Outcome: TE enrolment	
Female gender	1.304*** (0.328)
Migration background	−0.636 (0.528)
Number of siblings	0.152 (0.101)
Mother's education after PE (years)	−0.056 (0.052)
Father's education after PE (years)	0.132*** (0.050)
Day of birth within calendar year	0.006*** (0.002)
Unemployment rate	0.461*** (0.079)
Delay at start primary orientation	3.195*** (1.003)
Delay at start secondary orientation	−0.031 (0.524)
Track choice at start second year of SE: technical or arts track	−12.044*** (1.730)
Track choice at start second year of SE: vocational track	−18.462*** (2.537)
SE experience at end of compulsory FT education: delayed, not downgraded	3.666*** (0.737)
SE experience at end of compulsory FT education: not delayed, downgraded	−4.901*** (0.750)
SE experience at end of compulsory FT education: delayed and downgraded	−8.170*** (2.179)
Intercept	7.716*** (1.319)
M. Outcome: Employed three months after leaving school	
Female gender	−0.225*** (0.061)
Migration background	−0.744*** (0.140)
Number of siblings	−0.048** (0.023)
Mother's education after PE (years)	−0.008 (0.013)
Father's education after PE (years)	−0.026** (0.011)
Day of birth within calendar year	0.000 (0.000)
Unemployment rate	−0.105*** (0.015)
Delay at start primary orientation	−0.196 (0.264)
Delay at start secondary orientation	−0.061 (0.114)
Track choice at start second year of SE: technical or arts track	0.073 (0.195)
Track choice at start second year of SE: vocational track	0.069 (0.344)
SE experience at end of compulsory FT education: delayed, not downgraded	−0.077 (0.151)
SE experience at end of compulsory FT education: not delayed, downgraded	0.147 (0.110)
SE experience at end of compulsory FT education: delayed and downgraded	0.205 (0.355)
Participation in dual program	0.930*** (0.312)
School-based dual program	−1.055*** (0.389)
Apprenticeship during school-based dual program	0.448 (0.358)
SE qualification obtained	0.577*** (0.178)
TE enrolment	−0.175 (0.174)
Intercept	1.436*** (0.458)
N. Outcome: Employed one year after leaving school	
Female gender	−0.379*** (0.098)
Migration background	−0.570*** (0.196)
Number of siblings	−0.060* (0.032)
Mother's education after PE (years)	−0.024 (0.020)
Father's education after PE (years)	−0.017 (0.018)
Day of birth within calendar year	−0.001* (0.000)
Unemployment rate	−0.111*** (0.021)
Delay at start primary orientation	−0.549 (0.376)
Delay at start secondary orientation	0.075 (0.160)
Track choice at start second year of SE: technical or arts track	−0.910** (0.353)

Track choice at start second year of SE: vocational track	−1.657*** (0.605)
SE experience at end of compulsory FT education: delayed, not downgraded	0.382* (0.231)
SE experience at end of compulsory FT education: not delayed, downgraded	−0.263 (0.184)
SE experience at end of compulsory FT education: delayed and downgraded	−0.791 (0.568)
Participation in dual program	−0.382 (0.381)
School-based dual program	−0.048 (0.439)
Apprenticeship during school-based dual program	0.335 (0.460)
SE qualification obtained	0.338 (0.258)
TE enrolment	−0.178 (0.284)
Employed three months after leaving school	2.319*** (0.109)
Intercept	3.226*** (0.778)
O. Outcome: Employed five years after leaving school	
Female gender	−0.669*** (0.168)
Migration background	−0.618** (0.271)
Number of siblings	−0.138*** (0.041)
Mother's education after PE (years)	0.021 (0.033)
Father's education after PE (years)	−0.007 (0.030)
Day of birth within calendar year	0.001 (0.001)
Unemployment rate	−0.038 (0.047)
Delay at start primary orientation	0.145 (0.655)
Delay at start secondary orientation	0.010 (0.225)
Track choice at start second year of SE: technical or arts track	−0.936 (0.672)
Track choice at start second year of SE: vocational track	−2.386** (1.082)
SE experience at end of compulsory FT education: delayed, not downgraded	0.339 (0.356)
SE experience at end of compulsory FT education: not delayed, downgraded	−0.192 (0.304)
SE experience at end of compulsory FT education: delayed and downgraded	−1.580** (0.729)
Participation in dual program	0.174 (0.471)
School-based dual program	−0.939* (0.528)
Apprenticeship during school-based dual program	0.608 (0.502)
SE qualification obtained	0.064 (0.395)
TE enrolment	−0.188 (0.501)
Employed three months after leaving school	0.153 (0.182)
Employed one year after leaving school	1.197*** (0.187)
Intercept	3.988*** (1.415)
P. Unobserved heterogeneity distribution	
q_2	−1.899*** (0.124)
q_3	−0.124 (0.113)
q_4	−0.887*** (0.194)
q_5	−3.787*** (0.313)
q_6	−3.538*** (0.552)
η_2	1.115*** (0.203)
η_3	0.387*** (0.074)
η_4	0.693*** (0.128)
η_5	1.425*** (0.255)
η_6	−0.411*** (0.115)
δ: delay at start SE	−0.564** (0.254)
δ: track choice at start second year of SE: technical or arts track	3.722*** (0.865)
δ: track choice at start second year of SE: vocational track	7.823*** (1.654)
δ: SE experience at end of compulsory FT education: delayed, not downgraded	−4.555*** (1.095)

δ: SE experience at end of compulsory FT education: not delayed, downgraded	−0.558 (0.405)
δ: SE experience at end of compulsory FT education: delayed and downgraded	−0.173 (0.921)
δ: participation in dual program	2.212*** (0.710)
δ: school-based dual program	3.167** (1.414)
δ: apprenticeship during school-based dual program	0.353 (1.269)
δ: SE qualification obtained	−20[b]
δ: TE enrolment	−16.348*** (3.744)
δ: employed three months after leaving school	−0.185 (0.374)
δ: employed one year after leaving school	−1.755** (0.706)
δ: employed five years after leaving school	−2.056* (1.137)
η_i × participation in dual program × SE qualification obtained	0.675 (1.130)
η_i × participation in dual program × employed three months after leaving school	0.059 (0.543)
η_i × participation in dual program × employed one year after leaving school	0.148 (0.665)
η_i × participation in dual program × employed five years after leaving school	−0.062 (0.678)
N	5541
# heterogeneity types (K)	6
# parameters	239
Log-likelihood	−19,441.101
Akaike Information Criterion	39,360.203

Notes. The presented statistics are estimated coefficients and standard errors between parentheses. * (**) ((***)) indicates significance at the 10% (5%) ((1%)) significance level. The following abbreviations are used: FT (full-time), PE (primary education), SE (secondary education), and TE (tertiary education).

[a] As the outcome 'downgraded' is not possible for students in the vocational track (the lowest track), these parameters were estimated with a large negative number (−50), causing a 0 probability with respect to this outcome for students in the vocational track. [b] One parameter of the unobserved heterogeneity distribution is estimated as a very large negative number causing a 0 or 1 probability with respect to secondary education qualification for some heterogeneity types. This is numerically problematic, so that, in the spirit of Gaure et al. (2007), we stack it to −20, and kept it out of further estimation.

Table A–3. Goodness of fit.

	(1) Actual probability	(2) Simulated probability [95% CI]
Delay at start PE	0.017	0.018 [0.013, 0.023]
Delay at start SE	0.106	0.108 [0.097, 0.119]
Study choice in second year SE		
General track (reference)	0.605	0.598
Technical or arts track	0.260	0.264 [0.246, 0.288]
Vocational track	0.135	0.138 [0.125, 0.151]
Education experience		
No retention and no downgrade (reference)	0.812	0.812
Retention and no downgrade	0.074	0.072 [0.056, 0.085]
No retention and downgrade	0.104	0.104 [0.092, 0.117]
Retention and downgrade	0.010	0.012 [0.007, 0.019]
Dual program	0.060	0.063 [0.053, 0.073]
School-based dual program	0.037	0.038 [0.031, 0.047]
Apprenticeship during school-based dual program	0.020	0.020 [0.014, 0.027]
SE qualification obtained	0.924	0.916 [0.896, 0.929]
TE enrolment	0.636	0.661 [0.638, 0.694]
Employed three months after leaving school	0.615	0.615 [0.593, 0.638]
Employed one year after leaving school	0.834	0.839 [0.822, 0.859]
Employed five years after leaving school	0.906	0.923** [0.907, 0.938]

Notes. We do not provide confidence intervals for the two reference categories, as these probabilities are not simulated. The probabilities here are calculated by subtracting the simulated probabilities of the non-reference categories from 1. The following abbreviations are used: PE (primary education), SE (secondary education), and TE (tertiary education). * (**) ((***)) indicates a significant difference between the actual and simulated probabilities at the 10% (5%) ((1%)) significance level.

Table A–4. ATTs and ATNTs on labour market outcomes: the two dual program programs versus regular full-time education.

	Total effect	
	ATTs	ATNTs
A. Treatment: Training centre-based dual program		
SE qualification obtained	0.870** [0.744, 0.980]	0.949*** [0.900, 0.987]
Employed three months after leaving school	1.198* [0.991, 1.434]	1.300*** [1.128, 1.454]
Employed one year after leaving school	1.001 [0.864, 1.150]	1.008 [0.904, 1.087]
Employed five years after leaving school	1.015 [0.899, 1.131]	1.008 [0.950, 1.048]
B. Treatment: School-based dual program		
SE qualification obtained	0.855 [0.591, 1.098]	0.965 [0.898, 1.009]
Employed three months after leaving school	1.052 [0.747, 1.361]	1.123 [0.883, 1.327]
Employed one year after leaving school	0.987 [0.775, 1.226]	1.003 [0.876, 1.105]
Employed five years after leaving school	0.970 [0.750, 1.174]	0.985 [0.889, 1.044]

Notes. The presented statistics are simulated Average Treatment effects on the Treated (ATTs) and Average Treatment effects on the Non-Treated (ATNTs) and 95% confidence intervals are given between brackets. The following abbreviation is used: SE (secondary education). * (**) ((***)) indicates significance at the 10% (5%) ((1%)) significance level.