Vocational schooling and educational success: comparing apprenticeship to full-time vocational high school*

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Abstract

How to motivate academically struggling students? For those tracked in the vocational stream in France, two alternatives paths are competing: full-time vocational training and apprenticeship. Little research has been done on comparing the effectiveness of these two competing templates as ways to keep students at school and to allow them to graduate and continue further studies.

In this paper, we compare schooling outcomes between apprenticeship and full-time vocational schooling, focusing on dropping-out, graduation and participation in further training. In order to do so, we estimate probit models with two simultaneous equations stating for both apprenticeship and our alternative measures of subsequent academic success. We exploit variations in the local apprenticeship share and in its interaction with the before-tracking pupils' academic achievement to identify whether apprentices experience more educational success than students in full-time vocational schooling.

Our results clearly indicate that endogeneity of the apprenticeship decision need to be taken into account: naïve estimates strongly point in the direction of apprentices being associated with worse educational outcomes. Nevertheless, estimates which deal with the endogeneity issue highlight the opposite: even though following an apprenticeship rather than being enrolled in full-time vocational high school is not associated with any significant effect on the probability to drop-out, apprenticeship training leads to a higher probability of success at the exam and of continuing further education.

Keywords: Apprenticeship, Endogeneity, Treatment Effect, France.
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1 Introduction

In France, around 40% of pupils are selected into the vocational track at the end of 9th grade. Two paths are then available to engage in the vocational stream: these young people can choose either to follow an apprenticeship or to enroll in full-time vocational high school. While the two alternative vocational paths lead to the same qualification, they differ according to the learning process involved: in addition to classroom education, apprenticeship also provides paid, on-the-job training, whereas traditional vocational schooling only provides schooling lectures.[4]

At the end of the 20th century, policy-makers around the world seemed to look up to apprenticeship training programs as this system was developed and extended in many countries such as France, Denmark, the UK, the US and the Netherlands (see Heckman 1993, Steedman, Gospel and Ryan 1998 and Steedman 2005). The underlying idea is that an apprenticeship system may be more successful than a full-time vocational schooling system. But successful in what area? The literature mainly focuses on the school-to work transition and labor market outcomes, which are the initial aims of apprenticeship. Several authors have shown that among youngsters who entered the labor market, those who were enrolled in apprenticeship present lower unemployment rates. Bonnal, Mendès and Sofer (2002) and Winkelmann (1996) both find that apprentices are more likely to experience smoother transition to employment right after graduation. Apprentices are also found to be less hit by unemployment in early work life (see Sollogoub and Ulrich 1999, Winkelmann 1996 and Parey 2009). However, several studies show that there are no significant differences in

[4] A short work experience is also experienced as an internship of only a few weeks for those attending a vocational high school. Those pursuing their studies through apprenticeship will spend a large part of their time in job practice and will be paid a wage, linked to the national minimum wage.

earnings and earnings growth between apprentices and full-time vocational schooling students (see Plug and Groot 1998 and Parrey 2009).

In addition, even though apprenticeship was initially developed as a tool to reduce youth unemployment and facilitate school-to-work transition, apprenticeship may also be a way to motivate pupils who don't thrive in the classroom environment. Indeed, by offering students hands-on training, apprenticeship programs not only connect school coursework to practical, relevant workplace contexts but also increase students' engagement to schooling. The practical experience side of apprenticeship adds relevance to learning, thus increasing struggling students' motivation, which in turn leads to improved educational performances (Ryan 1998, Wagner et al. 2001, Harnish and Wilke-Schnaufer 1998). Our aim in this paper is then to provide information on the extent to which pursuing the "apprenticeship path" versus the "full-time high school path" affects educational outcomes such as the propensity to drop-out, to pass final examination and to continue towards more advanced degrees. To the best of our knowledge, the issue of the effect of apprenticeship on schooling performance has never been studied as such, even though apprenticeship is part of the broad category of work-based learning programs which have often been evaluated in the US (see Neumark and Rothstein 2006 and 2007, Furstenberg and Neumark 2007, Kemple 2004). These programs, regrouped under the terminology School-To-Work (STW) approaches, include a variety of practices such as internships, job shadowing, tech prep programs, mentoring cooperative education, and work in a school-sponsored enterprise (see Stern 1994 for summary descriptions of these program types). One finding that stand out from this literature is that internship/apprenticeship programs appear to boost college enrollment only among those with the lowest test scores.

Nonetheless, it should be noted that apprenticeship and internship are not treated separately and that vocational education is not included in these studies.[5]

However, the issue of the effect of apprenticeship as such on subsequent schooling outcomes is worth addressing, especially as it can help testing one of the possible explanations for the apprentices' better job market outcomes found in the literature. Indeed, it has been suggested that apprenticeship might be a better vehicle to equip young people with vocational skills[6]. This hypothesis can be tested in our database as we are able to compare educational vocational outcomes of full time vocational students with those of apprentices.

In order to investigate the effect of apprenticeship on schooling outcomes, we use data coming from the Secondary Education Pupil Panel 1995, a longitudinal sample of 17,830 students interviewed and followed by the French Ministry of Education. We restrict our attention to students in initial education following the vocational stream and preparing for a CAP (*Certificat d'Aptitudes Professionnelles*, Professional Skills Certificate) or a BEP (*Brevet d'Etudes Professionnelles*, Professional Studies Certificate).

Empirically, a major obstacle in the identification of the causal effect of apprenticeship on academic success arises from the potential endogeneity of apprenticeship. Actually, individuals select themselves into the alternative paths and the choice to pursue the "apprenticeship path" versus the "full-time vocational high school path" may be related to unobserved characteristics that are also likely to affect stay-on rates and schooling performance. For example, students enrolled in apprenticeship may have a lower unobserved

[5] The topic of apprenticeship non-completion has been of increasing interest. Many recent studies (see Laporte and Mueller 2010, Hasluck et al. 2008, Snell and Hart 2008) provide information about the factors which are associated with non-completion of apprenticeship.

[6] Two mechanisms may be at work: apprenticeship may be associated with the implementation of more work-related skills than traditional vocational schooling or apprenticeship may lead to an increased motivation. However, we are not able to distinguish between these two explanations.

ability or motivation for schooling. Then, naive estimates would overestimate the negative effect of apprenticeship.

One worth noting particularity of France is that every region takes responsibility for implementing its own apprenticeship policies which translates into great regional disparities in terms of apprenticeship share at the basic vocational level (cf. table A1 in appendix). We argue that students' decision to enroll in apprenticeship is affected by the local apprenticeship share for secondary vocational level as, in a region where apprenticeship is highly developed, it may be easier for a student to become an apprentice. Nevertheless, we believe that poor performing students are more affected by the regional apprenticeship weight than better performing students when choosing between apprenticeship and full-time vocational schooling. Indeed, apprenticeship is associated with a poor image and is often considered as the alternative for the school rejects. Intuitively, we can then see the apprenticeship share as the degree of competition for full-time vocational schooling and the student's (previous tracking) mark gives us an idea about the ranking of the student among competitors. Indeed, when the apprenticeship share is low, a high proportion of BEP/CAP is proposed by vocational high schools and entrance in these positions is not very selective so that even students with poor achievement can access full-time vocational high school. But when the apprenticeship regional share increases, fewer places are available in vocational high school and competition for these becomes fiercer; this means that academically weaker students are then evicted from full-time vocational training.

In order to circumvent the identification issue highlighted above, we use an instrumental variable strategy in which we exploit interactions between the apprenticeship regional weight and a students' (previous tracking) mark obtained in grade 9. These interaction terms reveal whether the effect of the regional apprenticeship share on the decision to take the work-based

route changes with the schooling achievement of the student, in which case the coefficient of the interaction terms will be significant.

While seeking to estimate the effect of apprenticeship on academic success, we estimate probit models with two simultaneous equations stating for both apprenticeship and our alternative measures of academic success (dropping-out[7], success at the final exam and the decision to enroll in further education), while relying on exclusion restrictions to achieve identification.

Our results clearly indicate that endogeneity of the apprenticeship decision need to be taken into account: naïve estimates which treat apprenticeship as exogenous strongly point in the direction of apprentices being associated with worse educational outcomes. Nevertheless, estimates which deal with the endogeneity issue highlight the opposite: following an apprenticeship rather than being enrolled in full-time vocational high school is not associated with any significant effect on the probability to drop-out and students who participate in apprenticeship training display a higher probability of success at the exam and of undertaking further education.

The rest of the paper is organized as follows. In Section 2, we provide a short review of the French educational system. Section 3 describes the data while Section 4 discusses the specification and identification strategy. Section 5 presents the regression results and finally, Section 6 concludes.

[7] Dropping-out may be understood as not reaching the final year of CAP or BEP; but individuals who leave these basic vocational programs may not be entering the labor market right after they left; they may enter general or technical schooling programs.

2 The French educational system

In this section, we provide a brief background on the French educational system. At the end of junior high school, in grade 9, pupils are tracked into several school streams: students may continue on in the general/ technological track or enter the vocational track (cf. Figure 1).

In the general or technological route, pupils work towards a (general or technological) baccalaureate. This track is aimed at the continuation of study in higher education. In the vocational route, pupils work towards a CAP (*Certificat d'Aptitudes Professionnelles*, Professional Skills Certificate) or a BEP (*Brevet d'Etudes Professionnelles*, Professional Studies Certificate) which allow entry into the workplace or further study such as a vocational baccalaureate.

In France, pupils tracked into the vocational stream have two options: they can either enroll in full-time training in a vocational high school or they can take an on-the-job apprenticeship with part-time study at a training centre.

It is worth noting that apprenticeship functions as a direct substitute for full-time vocational education, as both routes prepare for the same nationally recognized diplomas and apprentices sit for the same written examinations in general and technical subjects and the same practical tests as students on the same course in full-time education.

However, two differences between the two paths need to be highlighted, concerning the allocation of training time and the status of the trained youth.

First, in the school-based route, the interaction with the workplace is rather scarce as only a small proportion of time is spent in firms through work placements: their length varies from 12 weeks (for 2-years qualifications) to 22 weeks (for 3-years qualifications). On the contrary, apprenticeship divides the pupils' time between school and work under contract. Most learning takes place inside companies (65-70% of their time is spent in the workplace), and

one or two days per week (a minimum of 400 hours per year) are spent at an apprentice training centre.

The second difference concerns the legal status of the trained youth. Whereas in the school-based route, trained youth are students, in the apprenticeship route, the employer and the apprentice are bound by an apprenticeship contract which is identical to a work contract and subject to French Labor Law as well as industry-wide agreements. The apprentice works for an employer and receives a salary and s/he receives training both at the training centre and in the workplace.

Besides, as the German apprenticeship system is particularly well-known, it seems important to stress the major difference between the French and the German systems: the image of apprentices. In Germany, apprenticeship is the most common and most popular pathway for vocational training, with firms recruiting the best-qualified candidates as apprentices. In France, apprenticeship plays a minor but increasing role in vocational education, while suffering from the perception that this training path is only for the rejects of the school system. To some extent, apprenticeship has been looked down as the low status alternative to full-time vocational schooling, so that mainly the academically weakest students take this route at the BEP/CAP level. However, this image of apprenticeship has been and is still improving thanks to a review of the legislation in 1987 and 1992: in particular, apprenticeships were allowed to be taken at all levels of vocational qualifications up to Masters Degrees, thus inducing a slow improvement in the image of apprentices (Simon, 2001).

A last point worth noting in the French apprenticeship system is that regional governments have much of the responsibility for promoting apprenticeship. Even though laws governing apprenticeship are designed and approved at national levels, implementation of these laws is done at the regional level with great flexibility, so that every region is able to carry out its

own apprenticeship policies. As a result, the geographical distribution of apprenticeship shows great regional disparities (cf. table A1 in appendix). The main reasons for these interregional policy differences are the existence of firms which can receive young persons (i.e. small firms mainly) and the tradition linked to the use of apprenticeship.

3 Data

The analysis in this paper is based on the Secondary Education Pupil Panel 1995 conducted by the French Ministry of Education. This survey follows a sample of 17,830 students enrolled in French junior high schools entering grade 6 in September 1995.

We select all pupils in continental France who enter the vocational track after the end of the first cycle of secondary education and obtain a sample of 4,787 pupils.

We define apprenticeship as a dummy variable taking the value 1 when the student enter the vocational stream by taking an apprenticeship and taking the value 0 when enrolling in full-time vocational high school. The distribution of the type of vocational training in the estimation sample is reported in the first panel of Table 1. Among the 4,787 individuals in the vocational track, 689 are apprentices. Thus only about 14% of all students entering the basic vocational track take the work-based route.

The middle panel of Table 1 considers the links between the type of vocational training and subsequent educational outcomes. The three educational attainment variables we construct from the data are dropping-out, graduation and continuation in further studies. For dropping-out, we take an indicator variable for whether the individuals has quitted basic vocational studies before the last grade. As already stated, dropping-out may be understood as not reaching the final year of CAP or BEP, whatever is their situation afterwards; indeed students who leave these basic vocational programs may enter the labor market right after they left or they may enter general or technical schooling programs. The second outcome we consider is

graduation; we simply look at whether the individual has obtained his basic vocational diploma. And last, we compute a dichotomous variable accounting for whether vocational graduates stay on in education. This variable measures whether students ever attend any type of additional training right after graduation; a wide variety of programs are accounted for, from 1 year complementary program to vocational or even general baccalaureate.

These three measures of educational attainment help us addressing whether apprenticeship impacts a student's engagement and interest in school and effectively smoothes transition to further training. Indeed, it may be the case that apprenticeship program enhances students' knowledge: doing something in the work world with school-derived knowledge makes the student grasps the knowledge in more profound ways ("learning in context"). Apprenticeship may also be associated with motivational effects: apprentices can become more motivated academically because their experiences help them recognize that academic knowledge actually has meaning in the world, thus providing an incentive to study.

Table 1 shows that, at first sight, there are differences between the two groups of vocational students in terms of educational outcomes. The dropping-out rate equals 10.10% for apprentices and 8.77% for students in the traditional vocational path. Moreover, the proportion of students who pass their CAP or BEP is 69.69% for apprentices and 71.57% for students in vocational high school. Only 26.35% of apprentices stay on in education whereas this proportion is 52.52% among full-time vocational high-school students.

The lower panel of Table 1 reports percentage means for the common set of explanatory variables which are used to explain both the apprenticeship probability and the schooling outcomes. Aside for gender, are included family and parental background variables and child's schooling background, all of which are measured prior to placement in apprenticeship programs.

For the family and parental background variables, we include mother's educational level, father's occupation and ethnicity, family structure and sibling size. We also create a dummy variable accounting for the fact that the students lives in a deprived area targeted for special help in education (*ZEP, Zone d'Education Prioritaire*).

Moreover, the pupils' schooling background variables are composed of three kinds of educational information: first, we construct dummy variables which indicate whether the individual has repeated a grade in kindergarten, in primary school and in junior high-school. Second, we have access to average course marks (averaged over grades 8 and 9) in Mathematics, French and Foreign Language. These scores are part of the *Brevet des collèges* national exam. This diploma is awarded on the basis of the pupil's course marks in all the classes taken during grades 8 and 9, as well as in combination with results of end-of-year written national examination in French, Mathematics and History/Geography.[8] We compute the average score for every individual across the three courses and then categorize this score with 3 dummy variables (<7, between 7 and 9, >9) which we label low, medium and high score. Last, we observe whether the individual has been enrolled in vocationally-oriented grades in grade 8 and 9 rather than in traditional grades (*Classes de 4ème et 3ème technologique, agricole ou à projet professionnel*).

4 Specification and Identification

To identify the impact of apprenticeship on educational attainment outcomes, we present regressions in which the potential endogeneity of apprenticeship is accounted for and compare them with specifications where this issue is not dealt with.

[8] Completion of the *Brevet des Collèges* is not a compulsory qualification and continuation of schooling is not dependent on the passing of the examination.

The school outcomes Y we consider in this paper are all represented with probit – either simple or ordered. Suppose that the associated latent variable Y^* depend linearly on a vector of individual characteristics X_Y and on the dummy variable for apprenticeship A:

$$Y^* = A\gamma + X_Y'\beta_Y - \varepsilon_Y \qquad (1)$$

where ε_Y is a random term assumed to follow a standard normal distribution. This error tem potentially includes unobserved determinants of both school performance and of the decision to enter apprenticeship. As already pointed out, naïve estimates of equation (1) may be biased. We take care of the potential endogeneity issue of apprenticeship by using an instrumental variable strategy: we model the decision to follow an apprenticeship with a probit equation. Students in the vocational track are selected in apprenticeship (i.e. $A = 1$) if the latent variable A^* is positive, with:

$$A^* = X_A'\beta_A - \varepsilon_A \qquad (2)$$

This latent variable depends on a set of individual characteristics X_A and on a random term ε_A which is assumed to follow a standard normal distribution.

It is worth noting that, since apprenticeship programs are regulated by regional authorities, we include regional fixed effects in X_Y and X_A to capture any systemic differences between regions. The regional dummies control for all differences between regions that remain constant over time, including differences in individual level factors correlated within regions.

We further allow the two residuals to be correlated, and denote the covariance coefficient σ_{AY}. The vector $(\varepsilon_A, \varepsilon_Y)$ then follows a bivariate normal distribution $N\left(\begin{pmatrix}0\\0\end{pmatrix}, \Sigma\right)$ with $\Sigma = \begin{pmatrix}1 & \sigma_{AY}\\ \sigma_{AY} & 1\end{pmatrix}$. If the covariance term σ_{AY} is null, then A is exogenous in the school outcome equation, and consistent estimates of $(\beta_A, \beta_Y, \gamma)$ can be obtained by the maximum likelihood estimation of the single outcome equation. However, if A is endogenous in the outcome

equation, then estimating the school outcome equation separately would yield biased estimates of $(\beta_A, \beta_Y, \gamma)$. We therefore jointly estimate the two equations by maximum likelihood.

Non parametric identification of the simultaneous equation model formed by (1) and (2) requires exclusion restrictions. We need to find at least one variable that is supposed to affect the considered schooling outcomes only through its effect on apprenticeship. Namely, we use the apprenticeship rate in the region at the secondary vocational education level and its interaction with student's prior academic achievement dummy variables.

The local apprenticeship weight was computed as the share of apprentices among all the students in BEP or CAP during the school-year preceding tracking in grade 9, at the level of the region. The regional share of apprenticeship is a sign of the prevalence of this practice in the region where the student studies. Indeed, apprenticeship is widely used in some regions like *Alsace* or *Pays de Loire* where it is a lively tradition, whereas in the North of France, apprenticeship is less represented (cf. Table A1 in appendix). Then, when the local share of apprenticeship is high, the probability to enroll in vocational studies through apprenticeship would be higher. Indeed, Figure 2 reports the relationship in the sample between the deciles of the regional apprenticeship share and the proportion of students in vocational studies who followed an apprenticeship. This figure shows a positive relationship between the local apprenticeship rate and the proportion of individuals enrolled in apprenticeship.

Furthermore, we exploit interactions between the apprenticeship regional share and dummy variables for the students' test score obtained in grade 9. The idea is that students' decision to enroll in apprenticeship may be affected differently by the apprenticeship regional share according to the level of general education they have attained. In other words, we argue that the effect of the regional apprenticeship share on the propensity to become an apprentice

varies with the academic achievement of the student. Our underlying idea is that poor performing students are more affected by the regional apprenticeship weight than better performing students when choosing between apprenticeship and full-time vocational schooling.

Indeed, consider the following simplified framework: as stated in section 2, apprenticeship is mainly perceived as being the low status alternative for basic vocational training and thus every student might prefer to take the full-time schooling path. In this setting, the apprenticeship share can be seen as the degree of competition for full-time vocational schooling and the student's achievement gives us an idea about the ranking of the student among competitors.

As the regional apprenticeship weight increases, the number of places in full-time vocational high school is reduced, there are more applicants than places with the result that entrance becomes more selective. Indeed, vocational high school can now select the best students among applicants and academically weaker students are ruled out from full-time vocational training and end up taking apprenticeship.

The higher the apprenticeship share is, the fiercer the competition for positions in full-time vocational schooling is, and thus the higher the probability is for poor-performing students to be denied access to full time vocational high school and to enter the apprenticeship route. Figure 3 plots the proportion of vocational students in the work-based route according to deciles of the regional apprenticeship share and differentiated by students' achievement obtained in grade 9. This figure indeed suggests that the local apprenticeship rate has different effects according to the academic level of the students, consistently with the kind of mechanism discussed above.

Last, we review the three school outcome variables we use in the next section. First, we model the propensity to drop-out, before graduation of the CAP or BEP level, through a probit model: the latent variable Y^* is positive when the student drops-out before reaching the final year of BEP/CAP (i.e. $Y = 1$) and negative otherwise (i.e. $Y = 0$).

Second, In order to provide information on the effect of apprenticeship on the graduation probability, we build a model which deals with both the propensity to drop-out and the propensity to graduate in CAP or BEP: equation (1) now accounts for both the decision to drop-out from BEP/CAP and for success at the exam. We construct the variable Y which takes three values: $Y = 0$ when the student drops-out before reaching the final year of BEP/CAP, $Y = 1$ when the student stays until the last year but fails the exam and $Y = 2$ when the student stays until the last year and passes the exam.[9] We model the variable Y with an ordered probit model, as follows:

$$Y = k \iff \alpha_k < Y^* = A\gamma + X_Y'\beta_Y - \varepsilon_Y \leq \alpha_{k+1} \quad for\ k \in \{0, 1, 2\}$$

We impose $\alpha_0 = -\infty, \alpha_3 = +\infty$ and $\alpha_1 = 0$.

The third outcome variable we consider is the probability of staying on in education after graduation. Equation (1) is an ordered probit equation: the model jointly accounts for success at the exam and for the decision to stay on in education when successful. The corresponding variable Y takes three values: $Y = 0$ when the student doesn't get his/her diploma (this alternative regroups two possibilities: the student either drops-out before reaching the final year of BEP/CAP, or the student stays until the last year but fails the exam), $Y = 1$ when the

[9] We do not estimate a more complex model with three equations accounting separately for the apprenticeship decision, the dropping-out propensity and the success at the exam, as this specification would require an additional instrumental variable for whom no natural candidate is present in our database.

student passes the exam and does not stay on in education and $Y = 2$ when the student passes the exam and continue towards further schooling.[10]

5 Results

5.1 Local apprenticeship share and individual apprenticeship decision

In this section, we document the effect of the local apprenticeship share on the choice to follow a basic vocational program through apprenticeship instead of through full-time vocational schooling.

To do so, we estimate equation (2) which models the decision to follow an apprenticeship as a probit equation. Results and marginal effects are reported in Table 2. With interaction terms, coefficients of variables that are involved in interactions do not have a straightforward interpretation; and marginal effects of the interacted variables are different from marginal effects of variables that are not interacted. The formulae for the marginal effects of the interacted variables (namely the apprenticeship regional share and the dummy variables for grade 9 schooling achievement) are detailed in appendix, along with the description of the likelihood. To give an intuition, when looking at the effect of one of the interacted terms, we need to take into account both the direct effect of its change and the effect of the change that its change brings to the interaction term.

As expected, our estimates imply that the probability of being apprentice is significantly higher, the larger the share of apprenticeship in the region is. Notice that this effect is higher for low performing students: the lower the attainment in grade 9 is, the higher the sensitivity of the decision of apprenticeship to a variation in the local apprenticeship weight is.

[10] A specification in which the two alternatives imbedded in the case $Y = 0$ are separated has also been implemented: in this case, the ordered probit model experience 4 values. Results can be found in Appendix in Table A5.

In addition, the probability of getting an apprenticeship is lower for female, for students who are academically performing well in grade 9, for students whose father is foreign-born or has a high socio-economic status. Surprisingly, retention does not increase the probability of apprenticeship and the conditioning on the test score in grade 9 might explain the absence of influence. Concerning the effect of the mother's level of education, our results show that having a mother whose higher diploma is a BEP or a CAP increases the probability of being an apprentice; this result may suggest some network effect which facilitates entry into apprenticeship (Ménard et al. 2008).

We also observe that pupils who were already vocationally tracked in grade 8 or 9 have a higher probability of getting an apprenticeship rather than being enrolled in full-time vocational school.

5.2 The impact of apprenticeship on subsequent school outcomes

This section provides information on the extent to which pursuing the "apprenticeship path" versus the "full-time high school path" affects subsequent educational attainment. Both naïve estimates and instrumental variable estimates are presented for each outcome variable so as to compare both specifications and exhibit the cost of ignoring selection. The parameter estimates are used to compute the average treatment effect (ATE) of taking an apprenticeship on subsequent school outcomes. Table 3 presents core estimation results, while the full set of estimates is provided in Tables A2, A3 and A4.

A common pattern emerges from all regressions. For every school outcome we consider, the correlation coefficient between the residuals of the two equations is statistically significant at conventional levels. This result proves that apprenticeship is indeed endogenous in the school performance equations, so that naïve estimates from simple probit are biased. Moreover, when analyzing the sign of this correlation, a negative selection effect associated with

apprenticeship is suggested: on average, pupils selected in apprenticeship are less educationally motivated than pupils enrolled in full-time vocational studies.

Moreover, for every school outcome, the coefficient associated with apprenticeship changes sign when we account for the endogeneity of apprenticeship: in every case, when the decision to take an apprenticeship is treated as exogenous, apprentices are associated with worse outcomes than when the endogeneity is taken into account.

Indeed, as a baseline, we perform simple probit estimations: on average, apprenticeship is found to increase the probability of not reaching the final year of BEP or CAP, while no direct influence can be detected on the propensity to graduate. Finally, when performing naïve estimates, apprentices are found to have a lower probability to stay on in education after graduation than full-time vocational students.

However, when we control for endogeneity, results are completely different. We find no significant evidence of apprentices being more likely to drop-out before reaching the last year of BEP or CAP: the estimated average treatment effect is negative but not statistically significant. Apprenticeship is now found to have a positive and statistically significant at the 5% level effect on the probability of success at the exam for BEP or CAP: on average, apprentices have a probability higher by slightly less than 16 percentage points of graduation from BEP/CAP. Last, apprenticeship is associated with a positive and statistically significant at the 1% level average treatment effect on the probability of staying on in education after graduation: on average, taking an apprenticeship increases the probability of pursuing schooling after graduation by around 42 percentage points.

Furthermore, I also examine the heterogeneity of effect of apprenticeship by making a distinction by gender and by grade 9 schooling achievement. Table 4 presents the average treatment effects of apprenticeship estimated on these sub-groups of students. Consistently with our findings on the whole sample, apprenticeship has a non significant effect on the

probability to drop-out and is associated with a higher probability of graduation and continue further studies, whatever the gender and the initial academic performance in grade 9.

5.3 Robustness checks

In order to address concern about the interaction terms we use as exclusion restriction , namely interactions between the regional apprenticeship share and the students' grade 9 test score, we provide a simple robustness check by including in the equation accounting for the decision to follow an apprenticeship additional interaction terms between the regional apprenticeship weight and individual characteristics.

Results can be found in Table A6. The first specification is the one we already commented, in which the only interaction terms are between the apprenticeship regional share and the dummies for students' achievement in grade 9. These results clearly indicate that the effect of the regional apprenticeship weight varies according to the student's previous academic performance.

In the second column, we add interaction terms between the apprenticeship regional share and several measures of parental socioeconomic status. In the third column, we additionally control for interactions between the regional apprenticeship weight and other schooling measures; and the last column refers to the specification in which we add interactions with gender and family structure.

Two results are worth noting. First, including additional interaction terms has no effect on the magnitude of the coefficient associated with the apprenticeship weight and its interaction with students' score in grade 9. Second, none of the added interaction term turns out to be highly significant. This implies that the effect of the apprenticeship regional share on the decision to take an apprenticeship does not vary with any individual variable except grade 9 attainment.

Another major concern regarding our estimates is whether our exclusion restrictions, i.e. the apprenticeship regional share and its interaction with students' test score in grade 9, do affect the selection of our sample. Indeed, we have excluded pupils who enrolled in the general or technological track. We want to clarify whether the regional apprenticeship share in addition to affecting the decision to take an apprenticeship when tracked in the vocational path, also affects the tracking into the vocational path itself. To investigate this, we take the whole sample of students who stay in school after grade 9 and estimate a probit model accounting for the decision to select the vocational track. We include the same set of controls as we have used in the study of the vocational route taken by vocational students.

Results are provided in Table A7. As the literature has already suggested, boys and pupils with poor previous achievement have a higher probability of being tracked in the vocational stream. Moreover, students from lower socio-economic homes are less likely to enroll in the general or technological track. It is worth noting that neither the apprenticeship regional share nor its interaction with grade 9 students' score have significant coefficients. This indicates that the selection into the vocational track is not driven by the apprenticeship regional share, unlike the selection into apprenticeship.

6 Conclusion

This paper contributes to the huge literature on the evaluation of school type effects on academic performance by investigating which of the two available vocational paths is more effective as way to keep students in school and give them access to higher education.

Indeed, we provide evidence on the choice to take an apprenticeship rather than enrolling in a full-time vocational schooling, at the basic vocational level; and we compare subsequent schooling outcomes for both types of vocational training.

Our analysis is based on data from the Secondary Education Pupil Panel 1995, a longitudinal sample of 17,830 students interviewed and followed by the French Ministry of Education. We restrict our attention to students in initial education following the vocational stream and preparing for a CAP or a BEP.

The choice of vocational track has relevant effects on subsequent educational outcomes: when compared to full-time vocational schooling, our estimates show that apprenticeship does not encourage early school-leaving and increases the probability that individuals pass their vocational exam and go on to further studies rather than becoming active right after graduation. Moreover, our results clearly indicate the need to take into account the endogeneity of the decision to take an apprenticeship.

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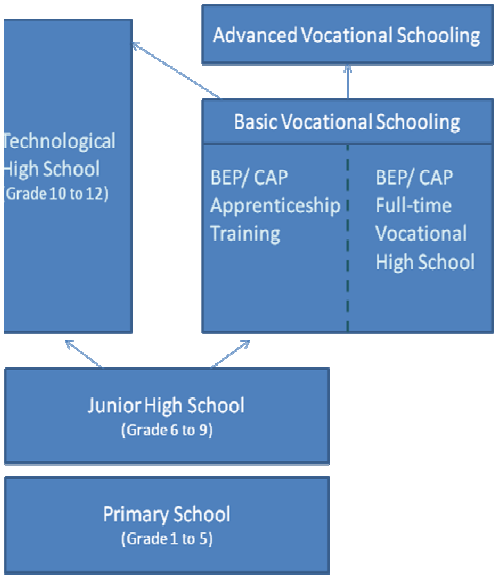
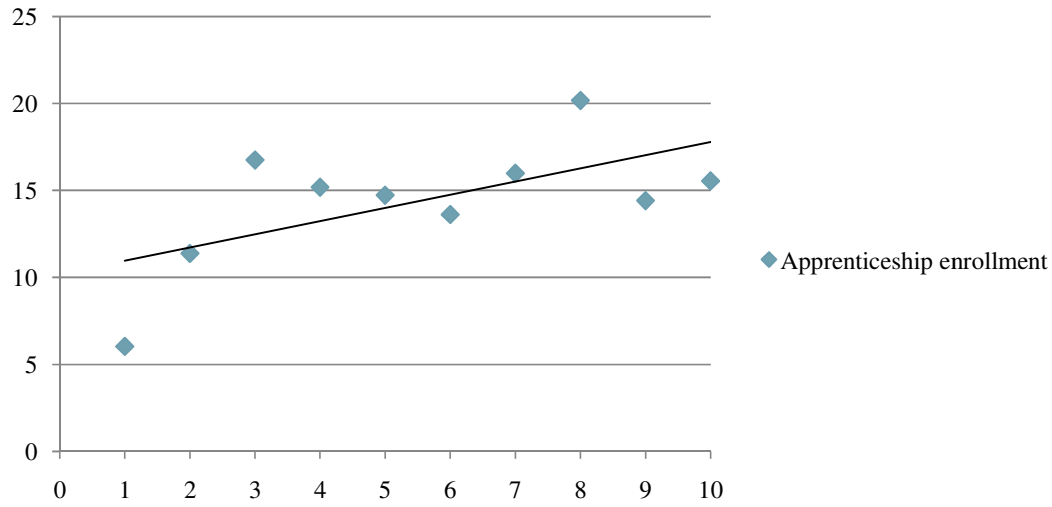
Figure 1: diagram of the French education system up to high school level



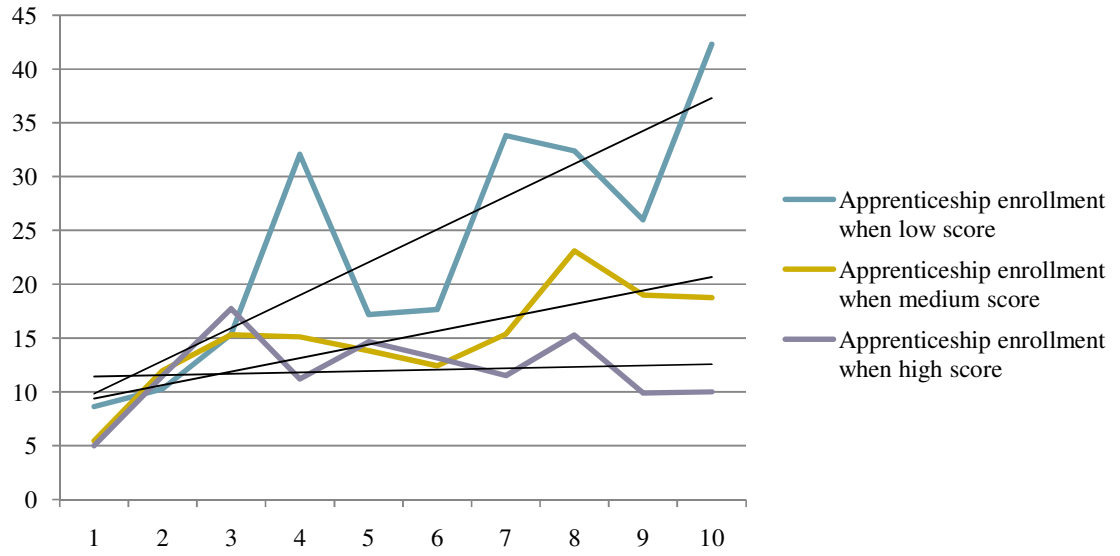
Note: Diagram shows the structure of the French education system up to high school levels. See text for details.

Figure 2: Apprenticeship enrollment according to the regional apprenticeship share



Note: The figure reports the proportion of individuals following an apprenticeship by deciles of regional apprenticeship share.
Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Figure 3: Apprenticeship enrollment according to the regional apprenticeship share, by type of students' achievement in grade 9



Note: The figure reports the proportion of individuals following an apprenticeship by deciles of regional apprenticeship share, according to their test score in grade 9.
Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Table 1: Descriptive statistics, dependent variables and explanatory variables

	Apprentices (N=689)	Vocational high-school students (N=4,098)	Total (N=4,787)
	(A) Distribution of vocational training type		
Proportion	14.33%	85.67%	100%
	(B) Vocational training type and academic performance		
Drop-out	10.10%	8.77%	8.96%
BEP/CAP Graduation	69.69%	71.57%	71.30%
Stay on to further education after graduation	26.35%	52.52%	48.77%
	(C) Vocational training type and control variables		
Gender:			
Female	30.16%	47.18%	44.75%
Male	69.84%	52.82%	55.25%
Mother's diploma :			
No qualification	47.87%	54.99%	53.97%
High school dropouts	10.98%	10.40%	10.49%
High school vocational graduate	31.92%	23.68%	24.86%
College	9.23%	10.93%	10.68%
Father's occupation :			
Farmer or craftman	15.95%	11.23%	11.91%
White collar/ Blue collar	61.64%	62.68%	62.55%
Middle manager/ Executive	12.59%	13.67%	13.51%
Missing	9.82%	12.42%	12.04%
Father's ethnicity :			
French	88.73%	76.38%	78.15%
Foreign	8.34%	17.89%	16.53%
Missing	2.93%	5.73%	5.32%
Parental structure :			
Lone parent family	18.89%	21.14%	20.81%
Couple	81.11%	78.86%	79.19%
Sibship size :			
Only child	10.24%	9.79%	9.85%
2 children	40.27%	36.46%	37.02%
3 or more children	49.49%	53.75%	53.13%
Retention			
in kindergarten	8.20%	10.33%	10.03%
in primary school	20.94%	19.59%	19.78%
in secondary school	51.24%	51.89%	51.79%
Test score in grade 9 :			
<7	22.40%	14.13%	15.31%
7 - 9	32.21%	30.83%	31.02%
> 9	45.39%	55.04%	53.67%
ZEP	6.44%	14.94%	13.72%
Vocationally-oriented grade 8 or 9	22.40%	17.07%	17.83%

Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Note: The table reports percentage means both for the whole sample and by type of vocational students. The first column refers to those who follow an apprenticeship, the second column to those who enrolled in full-time vocational high school and the last column to the pooled sample. See text for details.

Table 2: Simple probit model: the determinants of the decision to enter apprenticeship

	Apprenticeship		
Covariates	**Estimates**	**Std. Errors**	**Marginal Effects**
Intercept	-1.677	1.533	
Test score in grade 9 :			
Low (<7)	-0.495*	0.300	0.1198
Medium (7 – 9)	-0.330	0.265	0.0378
High (> 9)	Ref.	Ref.	Ref.
Apprenticeship regional share	0.036	0.102	Total ME: 0.0096 ME for low score students: 0.0184 ME for medium score students: 0.0112 ME for high score students: 0.0066
Apprenticeship regional share × low score in grade 9	0.034***	0.009	
Apprenticeship regional share × medium score in grade 9	0.017**	0.008	
Female	-0.352***	0.049	-0.0702
Parental structure :			
Lone parent family	Ref.	Ref.	Ref.
Couple	-0.064	0.066	-0.0134
Mother's diploma :			
No qualification	Ref.	Ref.	Ref.
High school dropouts	0.055	0.079	0.0115
High school vocational graduate	0.150***	0.057	0.0320
College	-0.114	0.086	-0.0221
Father's ethnicity :			
French	Ref.	Ref.	Ref.
Foreign	-0.542***	0.084	-0.0887
Missing	-0.396***	0.123	-0.0649
Father's job :			
Farmer or craftman	Ref.	Ref.	Ref.
White collar/ Blue collar	-0.160**	0.071	-0.0333
Middle manager/ Executive	-0.266***	0.092	-0.0481
Missing	-0.134	0.105	-0.0257
Sibship size :			
Only child	Ref.	Ref.	Ref.
2 children	0.003	0.084	0.0007
3 or more children	0.006	0.082	0.0012
Retention in kindergarten	-0.112	0.084	-0.0216
Retention in primary school	-0.015	0.063	-0.0030
Retention in secondary school	-0.071	0.067	-0.0145
ZEP	-0.360***	0.085	-0.0626
Vocationally-oriented grade 8 or 9	0.232***	0.063	0.0515

Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Note: Significativity levels: *** (1%), ** (5%) and * (10%). Regional dummies are included. The coefficients associated with the regional dummies are not reported. Marginal effects are evaluated at sample means of explanatory variables, except for the interacted variables which are taken not at the mean value but at the interaction of the mean values. For the interacted variables, i.e. the apprenticeship regional share and the dummies for test score in grade 9, marginal effects are different from marginal effects of variables that are not interacted. The formulae for the marginal effects of the interacted variables are detailed in appendix . Predicted probability is 12%. See text for details.

Table 3: Results from estimation of academic performance models

	Drop-out		Graduation		Stay on	
	Simple Probit	**Bivariate Probit**	**Simple Probit**	**Bivariate Probit**	**Simple Probit**	**Bivariate Probit**
Apprenticeship:						
ATE	0.0196*	-0.0675	-0.0203	0.1565***	-0.1310***	0.4149***
(Std. Dev.)	(0.0118)	(0.0469)	(0.0180)	(0.0737)	(0.0174)	(0.0115)
σ_{AY}:						
Coeff.		0.403*		-0.374**		-0.927***
(Std. Dev.)		(0.278)		(0.164)		(0.022)

Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Note: The table reports average treatment effects and standard deviations from regressions of several ordinal educational outcomes on a dummy for apprenticeship and control variables with two specification: the first specification is called "Simple Probit" and does not account for the endogeneity of apprenticeship. The second specification reports the IV estimates of the effect of apprenticeship, where apprenticeship is instrumented by the regional apprenticeship share and its interaction with score dummies. Each column refers to a different outcome variable. In Column 1, we model the propensity to drop-out, before graduation of the CAP or BEP level, through a probit model: $Y = 1$ when the student drops-out before reaching the final year of BEP/CAP and $Y = 0$ otherwise. In Column 2, we use construct the variable Y which takes three values: $Y = 0$ when the student drops-out before reaching the final year of BEP/CAP, $Y = 1$ when the student stays until the last year but fails the exam and $Y = 2$ when the student stays until the last year and passes the exam. The Average Treatment Effect we compute is then the ATE on $P(Y = 2)$. In Column 3, we model an ordered probit equation: the variable Y takes three values: $Y = 0$ when the student doesn't get his/her diploma (this alternative regroups two possibilities: the student either drops-out before reaching the final year of BEP/CAP, or the student stays until the last year but fails the exam), $Y = 1$ when the student passes the exam and does not stay on in education and $Y = 2$ when the student passes the exam and continue towards further schooling. Again, the Average Treatment Effect we compute is the ATE on $P(Y = 2)$.

All specifications include dummies for gender, mother's education, father's occupation and ethnicity, family structure, sibling size, location in ZEP, previous grade retention, test score in grade 9, a dummy for early vocational track and regional fixed effects. Predicted probabilities are 8%, 72% and 49% respectively for Dropping-out, Graduation and Staying on in education. Significativity levels: *** (1%), ** (5%) and * (10%). See text for details.

Table 4: Results from estimation of academic performance models

	Effect of Apprenticeship on Drop-out	**Effect of Apprenticeship on Graduation**	**Effect of Apprenticeship on Stay on**
Sample:	ATE (Std. dev.)	ATE (Std. dev.)	ATE (Std. dev.)
All	-0.0675 (0.0469)	0.1565*** (0.0737)	0.4149*** (0.0115)
Gender :			
Male	-0.0711 (0.0518)	0.1615** (0.0780)	0.4301*** (0.0129)
Female	-0.0631 (0.0412)	0.1503** (0.0684)	0.3961*** (0.0107)
Test score in grade 9 :			
Low (<7)	-0.1043 (0.0764)	0.1971** (0.0995)	0.4703*** (0.0159)
Medium (7 – 9)	-0.0669 (0.0467)	0.1607** (0.0759)	0.4266*** (0.0124)
High (> 9)	-0.0574 (0.0389)	0.1424** (0.0651)	0.3923*** (0.0108)

Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Note: The table reports average treatment effects and standard deviations from regressions of several ordinal educational outcomes on a dummy for apprenticeship and control variables with account for the endogeneity of apprenticeship. Each column refers to a different outcome variable. In Column 1, we model the propensity to drop-out, before graduation of the CAP or BEP level, through a probit model: $Y = 1$ when the student drops-out before reaching the final year of BEP/CAP and $Y = 0$ otherwise. In Column 2, we use construct the variable Y which takes three values: $Y = 0$ when the student drops-out before reaching the final year of BEP/CAP, $Y = 1$ when the student stays until the last year but fails the exam and $Y = 2$ when the student stays until the last year and passes the exam. The Average Treatment Effect we compute is then the ATE on $P(Y = 2)$. In Column 3, we model an ordered probit equation: the variable Y takes three values: $Y = 0$ when the student doesn't get his/her diploma (this alternative regroups two possibilities: the student either drops-out before reaching the final year of BEP/CAP, or the student stays until the last year but fails the exam), $Y = 1$ when the student passes the exam and does not stay on in education and $Y = 2$ when the student passes the exam and continue towards further schooling. Again, the Average Treatment Effect we compute is the ATE on $P(Y = 2)$.

Regression includes dummies for gender, mother's education, father's occupation and ethnicity, family structure, sibling size, location in ZEP, previous grade retention, test score in grade 9, a dummy for early vocational track and regional fixed effects. Predicted probabilities are 8%, 72% and 49% respectively for Dropping-out, Graduation and Staying on in education. Significativity levels: *** (1%), ** (5%) and * (10%). See text for details.

Data appendix

The analysis in this paper is based on the Secondary Education Pupil Panel 1995 conducted by the French Ministry of Education. This survey follows a sample of 17,830 students enrolled in French junior high schools entering grade 6 in September 1995. Their progression is recorded annually up to 2006: are reported information about the institution and grade attended in each year, the type of exam the student sat for, whether the student passed or failed that examination and, only for the school years 1998, 1999 and 2000, average course marks (averaged over grade 8 and 9) in Mathematics, French and Foreign Language. These scores are part of the *Brevet des collèges* national exam. This diploma is awarded on the basis of the pupil's course marks in all the classes taken during grades 8 and 9, as well as in combination with results of end-of-year written national examination in French, Mathematics and History/Geography. The data also include detailed demographics and family background which were recorded twice in 1995 and 1998.

We then define our sample of interest as all the pupils in continental France who enter the vocational track after the end of the first cycle of secondary education. We exclude overseas *départements* and territories, as the information concerning our instrumental variable is not available and we have too few observations in these regions. Moreover, not only do we select pupils entering the vocational track directly after grade 9, but we also select pupils who enter the vocational track later but with no previous diploma. We obtain a sample of 4,787 pupils.

Since we observe the full schooling history of each sampled individual, it is straightforward to establish whether an individual has been an apprentice. We define apprenticeship as a dummy variable taking the value 1 when the student enter the vocational stream by taking an apprenticeship and taking the value 0 when enrolling in full-time vocational high school.

We construct three educational outcome variables from the data: dropping-out, graduation and continuation in further studies. For dropping-out, we compute an indicator variable for whether the individuals have quitted basic vocational studies before the last grade. For graduation, we simply look at whether the individual has been successful at completing his vocational program. And last, we compute an index variable accounting for whether vocational graduates stay on in education.

The apprenticeship rate in the region at the secondary vocational education level was computed as the share of apprentices among all the students in BEP or CAP during the school-year preceding tracking in grade 9 at the level of the region. The French Ministry of Education provides us with all the data necessary to compute the apprenticeship weight for every region.

Appendix

A1: Simple probit model for apprenticeship: likelihood function and marginal effects of the interacted terms

We model the decision to follow an apprenticeship with a probit equation. Student i in the vocational track is selected in apprenticeship if $A_i = 1$, and:

$$A_i = \mathbb{I}\{A_i^* = X_{Ai}'\beta_A - \varepsilon_{Ai} \geq 0\}$$

The random term ε_A is assumed to follow a standard normal distribution. The vector X_A can be decomposed into the vector X of all control variables except the score dummies, the score dummies I_1 and I_2, the local share of apprenticeship W and the interaction terms between this share and the test score dummies WI_1 and WI_2. With these notations, the probit model can be rewritten as follows:

$$A_i = \mathbb{I}\{X_i'\beta^A + W_i\beta_W^A + I_{1i}\beta_1^A + I_{2i}\beta_2^A + W_iI_{1i}\beta_{W1}^A + W_iI_{2i}\beta_{W2}^A - \varepsilon_{Ai} \geq 0\}$$

- Likelihood contributions:

$$P(A_i = 1) = \Phi(X_i'\beta^A + W_i\beta_W^A + I_{1i}\beta_1^A + I_{2i}\beta_2^A + W_iI_{1i}\beta_{W1}^A + W_iI_{2i}\beta_{W2}^A)$$

$$P(A_i = 0) = 1 - \Phi(X_i'\beta^A + W_i\beta_W^A + I_{1i}\beta_1^A + I_{2i}\beta_2^A + W_iI_{1i}\beta_{W1}^A + W_iI_{2i}\beta_{W2}^A)$$

with $\Phi(.)$ the cdf of a standard Gaussian variable.

The log-likelihood function is then: $lnL = \sum_{i=1}^{n}[A_i lnP(A_i = 1) + (1 - A_i)lnP(A_i = 0)]$

with n the sample size.

- Marginal effects of the regional apprenticeship weight W[11]:

To obtain the correct marginal effect of W, the following formula must be estimated:

$$\frac{\partial P(A=1)}{\partial W} = \varphi(X'\beta^A + W\beta_W^A + I_1\beta_1^A + I_2\beta_2^A + WI_1\beta_{W1}^A + WI_2\beta_{W2}^A).(\beta_W^A + I_1\beta_{W1}^A + I_2\beta_{W2}^A)$$

with $\varphi(.)$ the density function of a standard Gaussian variable.

[11] The individual subscript i is omitted hereafter in order to alleviate the notational burden.

The marginal effect of W may be nonzero even if its coefficient is zero. This arises because the marginal effect of W depends not only on W but also on the combined effects of W and I_1 and W and I_2.

Moreover, we are interested in how the effect of W varies according to the academic level of the students. We then compute the marginal effect of W on three subsamples and evaluated then at mean values in each subsample:

$$\frac{\partial P(A=1|I_1=0,I_2=0)}{\partial W} = \varphi(X'\beta^A + W\beta_W^A).(\beta_W^A)$$

$$\frac{\partial P(A=1|I_1=1)}{\partial W} = \varphi(X'\beta^A + W\beta_W^A + \beta_1^A + W\beta_{W1}^A).(\beta_W^A + \beta_{W1}^A)$$

$$\frac{\partial P(A=1|I_2=1)}{\partial W} = \varphi(X'\beta^A + W\beta_W^A + \beta_2^A + W\beta_{W2}^A).(\beta_W^A + \beta_{W2}^A)$$

- Marginal effects of the test score dummies I_1, I_2:

Similarly, we need to pay attention to the marginal effects of the test score dummies as they are interacted with the variable W. For $j = 1,2$:

$$P(A = 1|I_j = 1) - P(A = 1|I_1 = 0, I_2 = 0)$$
$$= \Phi(X'\beta^A + W\beta_W^A + \beta_j^A + W\beta_{Wj}^A) - \Phi(X'\beta^A + W\beta_W^A)$$

Table A1: apprenticeship rate at the level of the region for BEP and CAP

Region	**1997**	**1998**	**1999**	**Region**	**1997**	**1998**	**1999**
Picardie	24.08	24.78	25.55	Pays de la Loire	38.61	39.46	40.46
Franche-Comté	29.44	30.05	31.07	Centre	36.99	37.52	37.93
Aquitaine	33.34	34.24	34.67	Poitou-Charentes	41.10	41.52	41.78
Basse-Normandie	35.00	35.24	36.07	Champagne-Ardenne	27.20	27.22	27.70
Auvergne	35.22	35.63	36.28	Bretagne	30.70	31.87	32.22
Corse	39.10	40.14	39.60	Haute-Normandie	30.98	32.16	32.49
Bourgogne	37.31	37.89	38.64	Alsace	37.47	37.71	38.30
Nord-Pas-de-Calais	14.96	15.08	15.50	Midi-Pyrénées	33.78	34.39	33.53
Limousin	29.34	29.88	30.15	Rhône-Alpes	26.18	26.82	27.05
Languedoc-Roussillon	33.20	33.21	32.27	Provence-Alpes-Côte-d'Azur	36.24	36.61	37.06
Lorraine	27.41	27.95	28.17	Ile de France	25.09	25.05	25.78

Source: French Ministry of Education. The apprenticeship weight is computed as the share of apprentices among all the students in BEP or CAP during the school-years 1997-1998, 1998-1999 and 1999-2000 at the level of the region.

Table A2: simple and bivariate probit models: the effect of apprenticeship on the probability of dropping-out

	Simple probit Drop-out			Bivariate probit Drop-out		
Covariates	**Estimates**	**Std. Errors**	**Marginal Effect**	**Estimates**	**Std. Errors**	**Marginal Effect**
Intercept	-1.527***	0.162		-1.403***	0.192	
Apprenticeship	0.120*	0.065	0.0189	-0.576	0.431	-0.0640
Test score in grade 9 :						
Low (<7)	0.330***	0.074	0.0554	0.407***	0.087	0.0737
Medium (7 – 9)	0.080	0.062	0.0112	0.114***	0.065	0.0160
High (> 9)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
female	-0.001	0.054	-0.0001	-0.065	0.070	-0.0096
Parental structure :						
Lone parent family	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Couple	-0.181***	0.069	-0.0288	-0.186***	0.068	-0.0316
Mother's diploma :						
No qualification	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
High school dropouts	-0.316***	0.100	-0.0391	-0.294***	0.101	-0.0391
High school vocational graduate	-0.206***	0.069	-0.0283	-0.167**	0.075	-0.0255
College	-0.310***	0.105	-0.0385	-0.313***	0.102	-0.0415
Father's ethnicity :						
French	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Foreign	-0.014	0.078	-0.0020	-0.099	0.100	-0.0140
Missing	-0.054	0.121	-0.0078	-0.123	0.128	-0.0177
Father's job :						
Farmer or craftman	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
White collar/ Blue collar	0.111	0.092	0.0161	0.071	0.094	0.0132
Middle manager/ Executive	0.166	0.116	0.0267	0.101	0.123	0.0199
Missing	0.269**	0.117	0.0457	0.227*	0.119	0.0430
Sibship size :						
Only child	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
2 children	0.111	0.101	0.0168	0.108	0.098	0.0176
3 or more children	0.207**	0.098	0.0304	0.202**	0.096	0.0315
Retention in:						
kindergarten	-0.041	0.088	-0.0060	-0.057	0.086	-0.0088
primary school	0.027	0.067	0.0041	0.023	0.066	0.0040
secondary school	0.118**	0.055	0.0174	0.102*	0.055	0.0161
ZEP	0.069	0.075	0.0106	0.015	0.086	0.0026
Vocationally-oriented grade 8 or 9	0.300***	0.067	0.0506	0.333***	0.067	0.0594
σ_{AY}	0			0.403*	0.278	

Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Note: Significativity levels: *** (1%), ** (5%) and * (10%). The outcome variable Y takes two values: $Y = 0$ when the student drops-out before reaching the final year of BEP/CAP, $Y = 1$ when the student stays until the last year. Regional dummies are included. The coefficients associated with the regional dummies are not reported. Marginal effects are computed at the mean values. For the bivariate probit specification, the first equation corresponds to the decision to take an apprenticeship rather than to enroll in full-time vocational schooling. Estimates of the first equation are not reported and variables which are excluded from the second equation are the apprenticeship regional share and its interaction with dummies for grade 9 test score. See text for details.

Table A3: simple and bivariate probit models: the effect of apprenticeship on the probability of graduation

	Simple probit Graduation			Bivariate probit Graduation		
Covariates	**Estimates**	**Std. Errors**	**Marginal effect on $P(Y=2)$**	**Estimates**	**Std. Errors**	**Marginal effect on $P(Y=2)$**
Intercept	1.594***	0.117		1.476***	0.135	
Apprenticeship	-0.062	0.054	-0.0212	0.593**	0.283	0.1607
Test score in grade 9 :						
Low (<7)	-0.436***	0.054	-0.1539	-0.504***	0.060	-0.1778
Medium (7 – 9)	-0.129***	0.044	-0.0421	-0.158***	0.045	-0.0507
High (> 9)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
female	0.017	0.038	0.0058	0.072	0.046	0.0231
Parental structure :						
Lone parent family	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Couple	0.202***	0.051	0.0700	0.205***	0.050	0.0720
Mother's diploma :						
No qualification	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
High school dropouts	0.251**	0.067	0.0785	0.235***	0.067	0.0745
High school vocational graduate	0.245***	0.049	0.0786	0.211***	0.052	0.0695
College	0.163**	0.068	0.0524	0.176***	0.068	0.0555
Father's ethnicity :						
French	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Foreign	-0.119**	0.056	-0.0409	-0.044	0.067	-0.0166
Missing	-0.023	0.084	-0.0079	0.035	0.088	0.0099
Father's job :						
Farmer or craftman	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
White collar/ Blue collar	-0.044	0.062	-0.0148	-0.015	0.062	-0.0053
Middle manager/ Executive	-0.034	0.079	-0.0115	0.013	0.081	0.0039
Missing	-0.062	0.083	-0.0212	-0.036	0.084	-0.0120
Sibship size :						
Only child	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
2 children	-0.085	0.069	-0.0287	-0.080	0.068	-0.0289
3 or more children	-0.105	0.067	-0.0351	-0.100	0.066	-0.0351
Retention in:						
kindergarten	-0.004	0.062	-0.0015	0.013	0.062	0.0026
primary school	-0.050	0.048	-0.0170	-0.047	0.048	-0.0160
secondary school	-0.140***	0.039	-0.0468	-0.128***	0.039	-0.0432
ZEP	-0.111*	0.055	-0.0382	-0.062	0.060	-0.0234
Vocationally-oriented grade 8 or 9	-0.389***	0.049	-0.1384	-0.417***	0.049	-0.1483
α_2	0.825***	0.024		0.800***	0.033	
σ_{AY}	0			-0.374**	0.164	

Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Note: Significativity levels: *** (1%), ** (5%) and * (10%). The outcome variable Y takes three values: $Y = 0$ when the student drops-out before reaching the final year of BEP/CAP, $Y = 1$ when the student stays until the last year but fails the exam, $Y = 2$ when the student stays until the last year and passes the exam. Regional dummies are included. The coefficients associated with the regional dummies are not reported. Marginal effects are computed at the mean values. For the bivariate probit specification, the first equation corresponds to the decision to take an apprenticeship rather than to enroll in full-time vocational schooling. Estimates of the first equation are not reported and variables which are excluded from the second equation are the apprenticeship regional share and its interaction with dummies for grade 9 test score. See text for details.

Table A4: simple and bivariate probit models: the effect of apprenticeship on the probability of staying on in further education

	Simple probit Stay on in Education			Bivariate probit Stay on in Education		
Covariates	**Estimates**	**Std. Errors**	**Marginal effect on $P(Y=2)$**	**Estimates**	**Std. Errors**	**Marginal effect on $P(Y=2)$**
Intercept	0.943***	0.106		0.582***	0.101	
Apprenticeship	-0.356***	0.048	-0.1398	1.312***	0.046	0.4349
Test score in grade 9 :						
Low (<7)	-0.514**	0.051	-0.2004	-0.600***	0.049	-0.2354
Medium (7 – 9)	-0.144***	0.040	-0.0577	-0.193***	0.038	-0.0750
High (> 9)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
female	0.040	0.035	0.0161	0.178***	0.033	0.0696
Parental structure :						
Lone parent family	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Couple	0.245***	0.047	0.0972	0.220***	0.045	0.0882
Mother's diploma :						
No qualification	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
High school dropouts	0.213***	0.059	0.0849	0.143**	0.056	0.0581
High school vocational graduate	0.224***	0.043	0.0893	0.103**	0.041	0.0428
College	0.134**	0.061	0.0536	0.155***	0.059	0.0612
Father's ethnicity :						
French	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Foreign	-0.114**	0.054	-0.0455	0.072	0.052	0.0286
Missing	0.022	0.079	0.0088	0.171**	0.076	0.0664
Father's job :						
Farmer or craftman	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
White collar/ Blue collar	-0.057	0.055	-0.0230	0.043	0.052	0.0168
Middle manager/ Executive	0.082	0.070	0.0330	0.204***	0.067	0.0799
Missing	0.005	0.077	0.0021	0.094	0.073	0.0381
Sibship size :						
Only child	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
2 children	-0.066	0.062	-0.0265	-0.062	0.059	-0.0244
3 or more children	-0.104*	0.060	-0.0415	-0.089	0.058	-0.0348
Retention in:						
kindergarten	-0.039	0.057	-0.0157	0.000	0.055	-0.0004
primary school	-0.115**	0.045	-0.0460	-0.080*	0.043	-0.0341
secondary school	-0.185***	0.035	-0.0736	-0.124***	0.034	-0.0507
ZEP	-0.119**	0.052	-0.0473	0.009	0.050	0.0007
Vocationally-oriented grade 8 or 9	-0.498***	0.046	-0.1932	-0.486***	0.044	-0.1914
α_2	0.641***	0.017		0.499***	0.016	
σ_{AY}	0			-0.927***	0.022	

Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Note: Significativity levels: *** (1%), ** (5%) and * (10%). The outcome variable Y takes three values: $Y = 0$ when the student doesn't get his/her diploma (this alternative regroups two possibilities: the student either drops-out before reaching the final year of BEP/CAP or the student stays until the last year but fails the exam), $Y = 1$ when the student passes the exam and does not stay on in education and $Y = 2$ when the student passes the exam and continue towards further schooling. Regional dummies are included. The coefficients associated with the regional dummies are not reported. Marginal effects are computed at the mean values. For the bivariate probit specification, the first equation corresponds to the decision to take an apprenticeship rather than to enroll in full-time vocational schooling. Estimates of the first equation are not reported and variables which are excluded from the second equation are the apprenticeship regional share and its interaction with dummies for grade 9 test score. See text for details.

Table A5: simple and bivariate probit models: the effect of apprenticeship on the probability of staying on in further education - another specification

	Simple probit Stay on in Education			Bivariate probit Stay on in Education		
Covariates	**Estimates**	**Std. Errors**	**Marginal effect on $P(Y=3)$**	**Estimates**	**Std. Errors**	**Marginal effect on $P(Y=3)$**
Intercept	1.739***	0.104		1.200***	0.106	
Apprenticeship	-0.345***	0.046	-0.1354	1.260***	0.056	0.4233
Test score in grade 9 :						
Low (<7)	-0.475***	0.049	-0.1858	-0.586***	0.047	-0.2241
Medium (7 – 9)	-0.133***	0.038	-0.0531	-0.191***	0.037	-0.0752
High (> 9)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
female	0.032	0.034	0.0128	0.173***	0.033	0.0684
Parental structure :						
Lone parent family	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Couple	0.237***	0.045	0.0940	0.219***	0.044	0.0877
Mother's diploma :						
No qualification	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
High school dropouts	0.227***	0.057	0.0904	0.151***	0.056	0.0641
High school vocational graduate	0.216***	0.042	0.0863	0.103**	0.041	0.0421
College	0.159***	0.060	0.0634	0.173***	0.058	0.0695
Father's ethnicity :						
French	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Foreign	-0.079	0.051	-0.0317	0.116**	0.050	0.0450
Missing	0.041	0.076	0.0166	0.177**	0.074	0.0725
Father's job :						
Farmer or craftman	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
White collar/ Blue collar	-0.072	0.053	-0.0287	0.025	0.051	0.0124
Middle manager/ Executive	0.051	0.068	0.0205	0.173***	0.066	0.0715
Missing	-0.046	0.074	-0.0186	0.040	0.072	0.0218
Sibship size :						
Only child	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
2 children	-0.073	0.060	-0.0294	-0.059	0.058	-0.0257
3 or more children	-0.124**	0.058	-0.0495	-0.097*	0.057	-0.0391
Retention in:						
kindergarten	-0.023	0.054	-0.0094	0.018	0.053	0.0062
primary school	-0.110**	0.043	-0.0440	-0.078*	0.042	-0.0337
secondary school	-0.179***	0.034	-0.0714	-0.116***	0.033	-0.0493
ZEP	-0.111**	0.049	-0.0442	0.025	0.049	0.0038
Vocationally-oriented grade 8 or 9	-0.468***	0.044	-0.1823	-0.473***	0.043	-0.1830
α_2	0.823***	0.024		0.606***	0.028	
α_3	1.463***	0.027		1.116***	0.039	
σ_{AY}	0			-0.898***	0.028	

Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Note: Significativity levels: *** (1%), ** (5%) and * (10%). The coefficients associated with the regional dummies are not reported. Marginal effects are computed at the mean values. For the bivariate probit specification, the first equation corresponds to the decision to take an apprenticeship rather than to enroll in full-time vocational schooling. Estimates of the first equation are not reported and variables which are excluded from the second equation are the apprenticeship regional share and its interaction with dummies for grade 9 test score. The second equation is an ordered probit equation: the corresponding variable Y takes four values: $Y=0$ when the student drops-out before reaching the final year of BEP/CAP, $Y=1$ when the student stays until the last year but fails the exam, $Y=2$ when the student passes the exam and does not stay on in education and $Y=3$ when the student passes the exam and continue towards further schooling. See text for details.

Table A6: Simple probit models with additional interaction terms: the determinants of the decision to enter apprenticeship

	Apprenticeship			
Covariates	**Estimates (Std. Errors)**	**Estimates (Std. Errors)**	**Estimates (Std. Errors)**	**Estimates (Std. Errors)**
Apprenticeship regional share	0.036 (0.102)	0.038 (0.104)	0.039 (0.110)	0.039 (0.112)
Interacted with low score in grade 9	0.034*** (0.009)	0.033*** (0.009)	0.032*** (0.010)	0.032*** (0.010)
Interacted with medium score in grade 9	0.017** (0.008)	0.018** (0.008)	0.017** (0.008)	0.018** (0.008)
Interacted with mother's diploma :				
High school dropouts		-0.003 (0.013)	-0.002 (0.013)	-0.003 (0.013)
High school vocational graduate		-0.021* (0.011)	-0.022* (0.012)	-0.022* (0.012)
College		-0.007 (0.014)	-0.008 (0.014)	-0.010 (0.014)
Interacted with father's ethnicity :				
Foreign		0.002 (0.014)	0.001 (0.014)	0.001 (0.014)
Missing		-0.001 (0.020)	-0.001 (0.021)	-0.001 (0.021)
Interacted with father's job :				
White collar/ Blue collar		0.006 (0.012)	0.007 (0.012)	0.007 (0.012)
Middle manager/ Executive		0.012 (0.015)	0.011 (0.015)	0.011 (0.015)
Missing		0.015 (0.017)	0.015 (0.017)	0.015 (0.017)
Interacted with retention:				
in kindergarten			0.026* (0.015)	0.027* (0.015)
in primary school			-0.001 (0.010)	-0.003 (0.010)
in secondary school			0.001 (0.008)	0.002 (0.008)
Interacted with ZEP			-0.013 (0.013)	-0.014 (0.013)
Interacted with vocationally-oriented grade 8 or 9			-0.005 (0.009)	-0.007 (0.010)
Interacted with female				0.002 (0.008)
Interacted with parental structure : Couple				-0.005 (0.011)
Interacted with sibship size :				
2 children				-0.015 (0.013)
3 or more children				-0.012 (0.013)

Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Note: The table reports estimated coefficients and standard deviations from probit regressions of the decision to take an apprenticeship. Each column refers to a different specification. All specifications include dummies for gender, mother's education, father's occupation and ethnicity, family structure, sibling size, location in ZEP, previous grade retention, test score in grade 9, a dummy for early vocational track and regional fixed effects. Significativity levels: *** (1%), ** (5%) and * (10%). See text for details.

Table A7: The selection in the vocational track: simple probit model

	Apprenticeship		
Covariates	**Estimates**	**Std. Errors**	**Marginal Effects**
Intercept	-1.540	1.137	
Test score in grade 9 :			
Low (<7)	1.881***	0.407	0.707
Medium (7 – 9)	1.257***	0.182	0.474
High (> 9)	Ref.	Ref.	Ref.
Apprenticeship regional share	0.055	0.076	Total ME: 0.021 ME for low score students: 0.001 ME for medium score students: 0.011 ME for high score students: 0.016
Apprenticeship regional share × low score in grade 9	0.020	0.014	
Apprenticeship regional share × medium score in grade 9	0.001	0.006	
Female	-0.135***	0.029	-0.052
Parental structure :			
Lone parent family	Ref.	Ref.	Ref.
Couple	-0.192***	0.042	-0.074
Mother's diploma :			
No qualification	Ref.	Ref.	Ref.
High school dropouts	-0.156***	0.049	-0.058
High school vocational graduate	-0.167***	0.038	-0.062
College	-0.721***	0.042	-0.254
Father's ethnicity :			
French	Ref.	Ref.	Ref.
Foreign	-0.176***	0.049	-0.065
Missing	-0.128*	0.067	-0.047
Father's job :			
Farmer or craftman	Ref.	Ref.	Ref.
White collar/ Blue collar	0.101**	0.045	0.038
Middle manager/ Executive	-0.391***	0.051	-0.143
Missing	-0.282***	0.062	-0.102
Sibship size :			
Only child	Ref.	Ref.	Ref.
2 children	0.165***	0.050	0.063
3 or more children	0.204***	0.049	0.077
Retention in kindergarten	0.051	0.055	0.019
Retention in primary school	0.772***	0.057	0.300
Retention in secondary school	0.836***	0.047	0.321
ZEP	0.065	0.048	0.025
Vocationally-oriented grade 8 or 9	2.019***	0.095	0.618

Source: Panel 1995 (DEP, French Ministry of Education). Number of observations=4,787.

Note: Significativity levels: *** (1%), ** (5%) and * (10%). Regional dummies are included. The coefficients associated with the regional dummies are not reported. Marginal effects are evaluated at sample means of explanatory variables, except for the interacted variables which are taken not at the mean value but at the interaction of the mean values. For the interacted variables, i.e. the apprenticeship regional share and the dummies for test score in grade 9, marginal effects are different from marginal effects of variables that are not interacted. The formulae for the marginal effects of the interacted variables are detailed in appendix.