The Effect of Workplace vs School-Based Vocational Education on Youth Unemployment: Evidence from France*

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Abstract

This article analyzes the impact of increasing workplace-based versus school-based vocational education to promote the employment of low-skilled young people. We combine a field experiment in France with the estimation of a job search and matching model which takes into account the productivity difference of the young people in these two pathways and the choice of employers. We find a positive impact of increased workplace education on youth employment limited by the fact that it stems almost entirely from retention in the training firm without having a significant impact on youth seeking employment in other firms after graduation.

Keywords: Apprenticeship, Vocational education, School-to-work transitions, Field experiment, Search and matching
JEL codes: J24, M53, M51

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I Introduction

Unemployment among low-skilled young people is a social scourge in many countries, and in particular in many European countries. In this context, workplace-based vocational education is often seen as an effective way of reducing unemployment among these young people, especially because empirical studies document that the German-type apprenticeship system is successful in this area.[1] These facts motivate many public policies aiming at boosting workplace-based vocational education to foster youth employment.[2]

However, workplace-based vocational education is organized very differently depending on the country. Three types of schemes can be distinguished in European countries:[3] 1/ Dual systems with an apprenticeship-specific governance and apprenticeship-specific qualification including Austria, Croatia, Germany, Denmark, Ireland, Island, Norway, Poland; 2/ Workplace-based education organized within the formal education system. School-based and workplace-based education, also called 'apprenticeship', yield identical vocational qualifications deliverable in different ways. In this type of organization, vocational schools provide both general education and practical training specific to a profession. This organization is present in Belgium, Finland, France, Hungary, Italy, Luxembourg, the Netherlands, Portugal, Romania, Spain, the United-Kingdom; 3/ Hybrid workplace-based education systems with strong links with social inclusion and employment, present in Belgium, Cyprus, Greece.

Our paper, devoted to the impact of the development of 'apprenticeship' in France, is relevant for the second type of scheme for which empirical studies also find positive effects of workplace-based vocational education on youth employment.[4] This matter is important insofar as the expansion of workplace-based education is on the agenda in European countries where 'apprenticeship'[5] is a type of training delivered within the formal vocational education scheme, in particular in France, where a reform carried out in 2017 increased the number of apprentices by +150% during in four years.[6]

However, little is known about the reasons why former apprentices may perform better than former vocational students at the start of their career in those countries. Apprenticeship is generally more developed in occupations and areas whose labor market is tight, making it

[1] See for instance Fersterer et al. (2008) for Austria and Winkelmann (1996) for Germany.

[2] Kuczerat (2017); CEDEFOP/OECD (2021).

[3] CEDEFOP (2018)

[4] See for instance Bonnal et al. (2002) for France, Noelke and Horn (2014) for Hungary, Picchio and Staffolani (2019) for Italy, Plug and Groot (1998) for the Netherlands, Mcintosh (2004) for the UK. Wolter and Ryan (2011) (p. 553) conclude their survey of the empirical evidence as follows: "The well-documented benefits of apprenticeship for the transition from school to work—once selection into different training options is taken into account—are followed by economic returns in early adulthood that in some countries are similarly favorable but that in others involve smaller pay gains and more unstable employment."

[5] From now on, unless otherwise specified, apprenticeship corresponds to its meaning in the second type of organization within the formal education system.

[6] Les chiffres de l'apprentissage en 2021, Ministère du travail de l'emploi et de l'Insertion. See CEDEFOP/OECD (2021) for other countries.

difficult to disentangle the effects of potential specific skills of apprentices from the demand of firms for these occupations. Potential selection of individuals with specific abilities into apprenticeship implies that estimating the impact of apprenticeship on access to jobs is difficult. Furthermore, the higher employment rate of apprentices may be the consequence of retention in their training firm, without providing any advantage in access to jobs in other firms. Thus, we analyze whether and how the expansion of apprenticeship fosters the integration of youths into employment by addressing two questions:

1. How do employers compare young job seekers with the same qualification obtained either after an apprenticeship or after vocational training at school?

2. Insofar as apprentices not retained in their training firm may be different from those who are retained, it is essential to answer a second question: To what extent the productivity of apprentices not retained in their training firm differs from that of those retained and from that of vocational students?

To answer the first question, we proceed to a field experiment in France in which we measure the chances of getting a callback from employers for unemployed youth who were formerly either apprentices or vocational students. Then to answer the second question, we build and estimate a job search and matching model which models the retention of apprentices in their training firm and the choice of employers between non-retained apprentices and vocational students in line with the results of our field experiment. From this model we estimate productivity differences between vocational students, apprentices retained in their training firm and those non-retained. The model is used to run counterfactual exercises to evaluate the impact of the expansion of apprenticeship on youth employment.

Our field experiment consists in sending résumés, to actual job openings, of unemployed young applicants who are similar except for the pathway through which they got their secondary school diploma.[7] We sent 3,110 applications from January to July 2018 to job offers posted in France for cook and bricklayer positions. The choice of these occupations is motivated by several reasons. First, these occupations attract a significant share of low skill youth, who complete their education at the secondary school level. Second, the shares of apprentices and vocational students are important in both occupations. Third, these occupations belong to different industries, which is relevant for assessing external validity. Fourth, we show that the school-to-work transitions of vocational students and apprentices who intend to work in the hotel and restaurant and construction sectors are similar to those of all students and apprentices.

[7] Apprentices and vocational students get the same diploma, but on average, apprentices typically work three days per week during two years in their training firm while the internships of vocational students last from zero ($\approx$ 16% of students) to four months, generally in different firms.

At the aggregate level, we detect no difference in the callback probability of apprentices and vocational students. This result holds true for both occupations. It also holds true for small and large firms and for temporary and permanent jobs. The only difference, to the advantage of apprentices, arises in commuting zones where the unemployment rate is high. This is consistent with a situation in which employers have a slight preference for apprentices non-retained in their training firm. Nonetheless, this preference has an impact on callback probabilities only if employers can choose among a large pool of applicants.

In order to verify the robustness of the result of our correspondence study, we carried out a second correspondence study from October to December 2018, in which we sent 4,076 spontaneous applications, which led to converging results. In addition, relying on the *Génération* survey, which provides a large representative sample of students leaving education, we generated descriptive evidence showing that the findings of our correspondence study are consistent with the overall school-to-work transitions of apprentices and vocational students in France.

Obviously, former apprentices non-retained in training firms might differ from those who are retained, especially because employers try to keep the best apprentices. To answer our second question: i.e. to what extent the productivity of apprentices not retained in their training firm differs from that of those retained and from that of vocational students, we build and estimate a job search and matching model in which the retention of apprentices in their training firm and the choice of employers between former non-retained apprentices and vocational students are endogenous. In this model, the retention of apprentices depends on their productivity and on non-observable employer-apprentice match specific characteristics. The choice of employers between vocational students and apprentices not retained in their training firm also depends on their productivity. The estimation of this model, using data from the *Génération* survey, indicates that apprentices not retained in the training firms are on average about 10% less productive than those retained, but slightly more productive than vocational students.

Our model accounts for labor market frictions and competition between former vocational students and non-retained apprentices who are looking for jobs. In this framework, the choice of employers between vocational students and non-retained apprentices depends on their respective productivity distributions, on screening costs of applications and on labor market frictions. From this perspective, we verify that the model delivers predictions in line with the results of the correspondence study. We indeed find that the productivity differences between non-retained apprentices and vocational students imply that the callback rates, and the exit rates from unemployment, are very close at the average unemployment rate. Moreover, these differences increase in favor of apprentices when the unemployment rate is higher.

The model is used to run counterfactual exercises to evaluate the impact of the expansion of apprenticeship on youth employment. Expanding apprenticeship has non-trivial effects. It crowds out vocational students facing more competition from more numerous apprentices.

It also increases competition among apprentices. These effects dampen the effectiveness of apprenticeship to improving labor market performance. On the other hand, if apprenticeship raises productivity, its expansion can foster job creation. The expansion of apprenticeship may also attract less effective youth in apprenticeship. This effect is not directly explained by our model in which the productivity distributions of apprentices and students are exogenous. However, to account for the potential impact of the expansion of apprenticeship on the type of youth becoming apprentice, we consider different scenarios relating to the selection of the type of vocational students who become apprentices and to the impact of apprenticeship on productivity. The data indicate that the young people with the best characteristics become apprentices in the current system. Therefore, we consider that the most favorable scenario for apprenticeship is one where young people who become apprentices due to increased apprenticeship become as productive as those who are apprentices in the current system. The least favorable scenario is one where the productivity of vocational students does not improve when they benefit from the apprenticeship. We find that *i*) in all scenarios, the retention rate and the unemployment rate of apprentices are little affected by the increase in apprenticeship insofar as the productivity gap between apprentices and vocation students is small. This means that the youth unemployment rate converges to that of apprentices when apprenticeship increases; *ii*) Since the unemployment rate of apprentices is high, around 20%, an increase in apprenticeship can only reduce the unemployment rate of young people below this level if it is accompanied by an improvement in its efficiency in increasing the productivity and/or the retention of apprentices in their training firm.[8]

These results, whose external validity is discussed more precisely in the conclusion, might have important consequences for public policy. They suggest that the expansion of workplace-based education within the formal education system on youth unemployment may have a limited effectiveness in reducing youth unemployment if it does not include more collaboration with firms and the public employment service to improve the quality of training and matches between young people and the job offers[9] as discussed in our concluding comments, which highlight the apparently very successful German and Japanese experiences in these domains.

Our paper is related to several strands of the literature. Many contributions analyze the features of workplace-based vocational education and school-based (see the surveys of Wolter and Ryan (2011) and Riphahn and Zibrowius (2016)). As far as we are aware, only a few studies aim at identifying the causal impact of workplace-based vocational education on job access or remuneration. Those which do so find higher returns to workplace-based vocational education in terms of remuneration or access to stable jobs both in the dual apprenticeship system (see Fersterer et al. (2008) in Austria, Corseuil et al. (2019) in Brazil) and in countries

[8] Considering worse scenarios than our least favorable scenario in which the productivity of vocational students does not improve when they benefit from the apprenticeship would reinforce this conclusion.

[9] See OECD (2018).

where workplace-based education is organized within the formal education system (Bonnal et al. (2002) in France, Plug and Groot (1998) in the Netherlands, Albanese et al. (2019) in Italy, Neyt et al. (2020) in Belgium). The contributions focused on labor market transitions generally stress the importance of retention of apprentices in their training firms in both systems (Von Wachter and Bender (2006), Fitzenberger et al. (2015), Riphahn and Zibrowius (2016), Léné and Cart (2018), Albanese et al. (2019)). In particular, Von Wachter and Bender (2006) find that wage losses of German apprentices who do not remain in their training firm are initially 15 percent, and then drop to zero within five years. Fitzenberger et al. (2015) find similar results with another methodology. This indicates that retention in training firms does play a key role in the success of apprentices at the outset of their careers. Our analysis, focused on a country where workplace-based education is organized within the formal education system, yields results in line with those of Von Wachter and Bender (2006) and Fitzenberger et al. (2015). We contribute to this literature on three points in the French context, which shares many common characteristics with countries in which workplace-based education is organized within the formal education system. First, we provide information on how employers compare job applicants who are former apprentices or former vocational students. Then, we propose a model which makes it possible to identify the productivity difference between apprentices retained in their training firm and those not retained, and former vocational students. Finally, our model makes it possible to assess the impact of apprenticeship on youth unemployment by considering different empirically plausible scenarios concerning the effect of apprenticeship on productivity and taking into account the reaction of labor demand.

Our analysis contributes to the literature based on correspondence studies devoted to the effect of work experience and education on the likelihood of being invited to an interview. This approach is useful to evaluate the impact of different education or training pathways on school-to-work or training-to-work transitions, leaving aside the analysis of their long run impact.[10] From this perspective, Nunley et al. (2016) find that the internship experience significantly increases the interview rate of college graduates in the US. Gaulke et al. (2019) find that post-baccalaureate business certificates do not improve chances of receiving a callback in the US. Cahuc et al. (2019a) show that, compared to those who have stayed unemployed since leaving school in France, the callback rate of high school dropouts unemployed four years after leaving school is not raised for those with employment experience, whether it is subsidized or non-subsidized, if there is no training accompanied by skill certification. The contribution of Hervelin et al. (2020), also focused on high school dropouts in France, finds that only dropouts with both job related experience and training leading to a qualification manage to

[10]The analysis of the long run impact, which is beyond the scope of this paper, can be useful in identifying the signaling and human capital accumulation components of the returns to education and training as shown by Farber and Gibbons (1996); Altonji and Pierret (2001); Aryal et al. (2019) among others.

catch up with their non-dropout peers. Our paper contributes to this strand of the literature by examining the callback rates of graduates low-skilled in a context where the same diploma can be obtained either through apprenticeship or the vocational school pathway.

Finally, our paper is related to the literature which analyzes the link between callback to interviews and hiring decisions. Jarosch and Pilossoph (2018) show that differences in callbacks of unemployed workers depending on their unemployment spell can have limited consequences for hiring decisions. On the other hand, Quillian et al. (2020) show that there is considerable additional racial discrimination in hiring after the callback. Cahuc et al. (2019b) set out a model showing that the difference in callback rates between two groups of workers at the stage of invitation to interviews can be a poor predictor of eventual hiring differences. We complement this approach by providing and estimating a search and matching model which allows us to infer eventual hiring decisions from the callback to interviews. This approach eventually is useful to relate the results of correspondence studies to the hiring decisions of firms by modeling how employers choose between different applicants. Applying this model to the population of vocational students and apprentices, we show that the higher employment rate of apprentices after leaving school is almost entirely due to the retention rate in the firms where they were trained.

The paper is organized as follows. Section II presents the school system and the features of vocational students and apprentices in France. Section III describes the experimental design. Section IV presents the main findings of the correspondence study and documents their external validity. Section V presents the search and matching model and its estimation. Counterfactual exercises which enable us to explore the consequences on youth unemployment of expanding the share of apprentices are presented in Section VI. Section VII provides concluding comments about the policy implications of our results.

II Background

Since our analysis is focused on youth who completed their vocational education at the upper secondary level, we start by presenting the main features of the upper secondary vocational education system before describing the characteristics of apprentices and vocational students.

II.A The vocational education system

In France, at the end of lower secondary education (ninth grade), students have the choice between two education paths. First, they can choose three-year general education programs to prepare for the high school diploma (*baccalauréat*). About 62% of students choose this path.[11] Second, about 33% choose vocational programs for two or three years either in voca-

[11] See Testas et al. (2018) for data about the paths of students at the end of lower secondary education.

tional schools (*Lycée professionnel*, 28%) or in apprenticeship centers (*Centre de formation des apprentis*, CFA, 5%). The two-year vocational programs, which are chosen by 11% of students, lead to a diploma called *certificat d'aptitude professionnelle* (CAP), with different specializations. The three-year programs, chosen by 22% of students, lead to the *professional baccalauréat*. Our study is focused on young people from the two-year vocational programs because the share of apprentices, which represents about half of these young people, is large relative to the three-year programs, in which there is a tiny fraction of apprentices.[12]

During their ninth grade, students have to list the different specializations for the CAP they want to apply for. These lists are addressed to their school. The schools then send some students files to the targeted vocational schools. While there can be some selection into some specializations due to budgetary constraints or behavioral standards, registration into a vocational school is otherwise automatic. However, students seeking to become apprentices need to find a firm willing to hire them for two years. If the young person is hired, the two parties settle a contract which stipulates the task contents of the occupation, the wage as a percentage of the floor wage in the sector, and the content of the training provided by the employer. Apprentices are registered with an apprenticeship center (known under the acronym CFA, for *Centre de Formation des Apprentis*) which provides general and vocational education. In most cases, apprentices spend between half and two-thirds of their time in the firm each month, and the remainder in the apprenticeship center.

Vocational students who are not apprentices study in vocational high schools. About one fifth study in the classroom exclusively, while the other four fifths combine education in their vocational schools with internships in training firms. According to French labor law, training firms do not have the obligation to pay students if the total number of weeks of internship during a year does not exceed eight weeks. Accordingly, the duration of internships for vocational students is usually no longer than eight weeks. The only obligation training firms face is the commitment to an internship agreement, which describes the task contents and working conditions. This internship agreement has to be signed by the training firm, the student and the vocational school. Since the *circulaire numéro 2015-035 du 26 février 2015* and the *circulaire numéro 2016-055 du 29 mars 2016*, teachers in each specific training program have to create an internship center to reinforce equity among students and to help them find a training firm. Teachers also have to conduct a preparation week before the first period of internship. During this week, students participate in workshops and talks to prepare for their internship.

Whatever the chosen path, students and apprentices have to pass the *same* national exam at the end of the two-year program. Depending on the courses, exams can be written, oral, or both. Some bonus points can be awarded during the two-year program through a system of continuous evaluation, depending on the specialization. The CAP diploma is obtained if the

[12] Vocational education and apprenticeship can also take place at higher education levels.

TABLE I
TRAINING CONTENTS IN VOCATIONAL SCHOOL AND APPRENTICESHIP CENTER

		Vocational school		**Apprenticeship center**	
	Academics				
Courses	Description	1^{st}-year	2^{nd}-year	1^{st}-year	2^{nd}-year
French	Oral (listen, react, express), written (read, analyze, write)				
History	French workforce and republics, world discoveries, world wars	3h30 - 4h	3h30 - 4h	-	-
Geography	Globalization, inequality, agriculture, technological risks				
Morality, Civic education	Rights and duties, citizenship, discrimination, medias	30min	30min	-	-
Art, Culture	Product design, communication design, space design	2h	2h	-	-
Health, Environment	Manage one's health, budget, working and leisure time	1h	1h30	-	-
Foreign language	Objective: A2 level in 1 among 6 languages	2h	2h30	-	-
Sport	3 disciplines among the academic and national lists	2h30	2h30	-	-
Mathematics	Calculus, graphics, proportionality, equations, statistics	3h30 - 4h	3h30	-	-
Sciences	Matter, pH, kinematic, waves, electricity			-	-
Technical, Professional	Lessons, practical work and workshops defined by schools	17h - 18h	17h - 18h	-	-
Total (weekly)		32h - 34h	32h - 34h	-	-
Total (yearly)		**896h - 1,140h**	**812h - 1,026h**	**438h**	**439h**
	Professional				
Type		Internships		Apprenticeship	
Legal document		Internship agreement		Contract of apprenticeship	
Duration		From 12 to 16 weeks		22 months	
Working time		Set by the training firm		35 hours per week	
Salary		None if total duration $\leq$ 8 weeks		€515.15 per month	

Note: This table reports information about the vocational education system in France depending on whether the CAP diploma is obtained in vocational school or in apprenticeship. The information comes from the following sources: *Bulletin officiel spécial numéro 6 du 25 juin 2015*, *Bulletin officiel spécial numéro 8 du 25 février 2010*, *Bulletin officiel spécial numéro 2 du 19 février 2009*, Bull*etin officiel numéro 42 du 12 novembre 2009*, *Circulaire numéro 2015-035 du 26 février 2015*, *Circulaire numéro 2016-055 du 29 mars 2016* for vocational students and *Ari@ne 2015* for apprentices. As indicated in the text, each apprenticeship center can decide the amount of time allocated to each course under the constraint that there is a minimum of 400 hours of lessons per year. There is no available information on the time schedule in apprenticeship centers.

average grade is at least 10/20. The CAP certifies the skills that any worker in the specified occupation must master to be employable.

Table I displays the main features of the two-year education programs of vocational students and apprentices. On average, apprentices spend half as much time in the classroom as vocational students. Conversely, apprentices work 35 hours per week in training firms, during 22 months for a monthly wage of about €515. Academic courses are given by apprenticeship centers at their discretion. The only obligation apprenticeship centers face is to ensure a minimum of 400 hours of lessons per year of training. Apprenticeship centers can decide the amount of time allocated to each course.

Overall, vocational students spend between thirty-two and thirty-four hours per week in the classroom. The number of hours of academic lessons is split evenly between general and vocational education. The exact total number of hours of academic lessons depends on the specialization of students. The higher the total duration of internships, the lower the number of hours of academic education. While the content of general education is common to all specializations, the content of vocational lessons is specialization specific,[13] as is the number of weeks for internships. The manner in which the number of weeks for internships needs to be completed is decided by each vocational school.

II.B Characteristics of apprentices and vocational students

Table II reports the main characteristics of students and apprentices who obtained their CAP in 2000s. We rely on the national surveys *Enquête Génération* run in 2004, 2010, 2013 and 2016,[14], which asks questions to a representative sample of around 25,000 youth who completed school at the end of a specific academic year.[15] About half of youth who obtain their CAP are apprentices. Apprentices are more often males and come from a more favorable environment compared with vocational students: their parents are less often immigrants, are more educated and are more often employed. Moreover, data from the Ministry of education[16] show that apprentices are more skilled in French and mathematics than vocational students. They also have a better subjective self-judgment of their abilities in the social sphere (participation in activities, creation of social relations...). Although apprentices are overall in more favorable situations than vocational students, Table II indicates that their graduation rates

[13] See Tables A.8.1.1 and A.8.2.1 in Appendix A.8 for details regarding the targeted cook and bricklayer occupations respectively in the field experiment.

[14] https://www.cereq.fr/enquetes-et-donnees/insertion-professionnelle-generation.

[15] All young people who went back to school for a specific training within a year after the one they were supposed to finish are excluded from the survey. We also exclude youth who obtained another diploma before their CAP, irrespective of the field of training. Overall, the selected sample is purged of any potential school dropouts or multi-graduated youths, who both constitute specific sub-samples. Finally, we are able to observe at least 10,000 youths followed during 34 months after they ended school whether in 2001, 2007, 2010, or 2013 within the *Génération* surveys 2004, 2010, 2013 and 2016 respectively.

[16] See Testas et al. (2018).

TABLE II

STATISTICAL PORTRAIT OF STUDENTS AND APPRENTICES

Component	Information	Students	Apprentices
		57.55%	**42.45%**
Individual	Sex (male)	54.62%	72.17%
	Age	20 y.o.	20 y.o.
	Handicap	1.79%	2.36%
	Driving license	33.49%	55.40%
Family	District area		
	Downtown	33.71%	26.25%
	Suburb	31.61%	32.98%
	Small city	10.93%	11.54%
	Village	23.75%	29.22%
	Siblings	92.72%	90.32%
	French language	92.62%	96.07%
	Birthplace of father		
	France	74.32%	84.17%
	European countries	4.53%	5.10%
	Arabic countries	15.39%	8.36%
	African countries	4.31%	1.49%
	Rest of the world	1.44%	0.88%
	Birthplace of mother		
	France	76.85%	87.09%
	European countries	4.72%	4.18%
	Arabic countries	13.12%	6.49%
	African countries	4.16%	1.57%
	Rest of the world	1.15%	0.67%
	School level of father		
	No diploma	45.53%	33.46%
	Cap/Bep	40.43%	47.31%
	Bac	8.94%	12.63%
	Bac+	5.09%	6.60%
	School level of mother		
	No diploma	43.77%	34.69%
	Cap/Bep	38.32%	39.00%
	Bac	13.41%	17.97%
	Bac+	4.49%	8.34%
	Father works	80.46%	86.28%
	Mother works	61.65%	72.46%
Education	Repeat year before 6th grade	37.87%	38.48%
	Normal middle school program	59.24%	59.75%
	Would have preferred apprenticeship	47.03%	-
	Reason of non-apprenticeship		
	No CFA	4.80%	-
	No employer	31.50%	-
	Neither CFA, nor employer	29.60%	-
	Other	34.09%	-
	Internships / Apprenticeship Tutor	83.83%	87.96%
	Number of internships		
	1	24.55%	-
	2	28.91%	-
	3 or more	46.54%	-
	Contact with the (last) training firm		
	Self	41.90%	46.40%
	Family and friends	27.58%	35.17%
	School / Apprenticeship center	21.46%	10.62%
	Other Public Structure	0.16%	5.73%
	Other	8.89%	2.07%
	Graduated	93.02%	91.47%

Note: This table reports descriptive statistics for both apprentices and vocational students. Shares of students who made interships and the mode of contact with the last training firm are computed from the *Génération 2010* survey only, while the respective shares for apprentices are computed from the *Génération 2001* survey, because of variation in the specific questions. The share of graduated students and apprentices are computed with both the *Génération 2010-2013* surveys because of changes in the content of the level V diploma in 2009 in France.

Source: pooled *Génération 2001-2007-2010-2013* surveys, CEREQ ($N = 10,947$ individuals)

are almost identical.

Table II reports that almost half of vocational students declare that they would have preferred apprenticeship. 66% of those who would have preferred apprenticeship either did not find any apprenticeship center (CFA), or employer, or found neither. In addition, about 20% of vocational students did not do an internship during their training in a vocational school. For the others, about half of them had to do at least three internships to meet the legal duration of internships during the vocational program. We are not able to see from the data whether these different internships had been done within the same training firm or not. Around 66% of vocational students declared that their last training firm was found thanks to their private network (self, family or friends), and 22% thanks to a public network (teacher or a school service). On the contrary, these proportions rose to 81% and declined to 15% respectively for apprentices.

All in all, according to observable characteristics, it seems that apprentices are more employable than vocational students: they get the same diploma, but they come from more favorable backgrounds, they were better students in lower secondary schools, they have better subjective self-judgments of their social abilities and their acquired more work experience. The next section presents an experimental design which allows us to analyze how employers compare former apprentices and vocational students with identical characteristics usually reported in résumés.

III Experimental design

The experiment aims at comparing the probability of callback to job applications of otherwise identical apprentices and vocational students. We start by presenting the applicants before describing the applications.

III.A The applicants

The applicants, who are all unemployed at the time of their response to job offers, are identical in all points, with the exception of their education path while they were in upper-secondary vocational education. The characteristics of the fictitious applicants were chosen so as to match those of real apprentices and vocational students when they leave school.

Applicants are young males aged 18 at the date of graduation. We focus on males because it is much less common for women to be apprentices, especially in construction, where almost all apprentices are males. Their names have been chosen among those most commonly encountered in the French population. According to the *Fichier des prénoms* (INSEE), the two first names used in the experiment, Alexis and Théo, were respectively ranked 13 and 9 in

the most given first names in 1999.[17] And according to the *Fichier patronymique* (INSEE), the surnames, Dubois and Petit, were respectively ranked 7 and 6.[18]

Given financial and organizational constraints, two occupations were selected. The choice of occupations relies on the following criteria: belonging to different industries, existence of an official state certification for the diploma that is normally a prerequisite to be hired, having sufficient shares of former upper-secondary vocational students and apprentices, having a sufficiently large number of job offers, being present in both market and non-market sectors to enlarge the potential number of job offers, having school-to-work transitions similar to those of the overall apprentices and vocational students displayed in the previous section.[19] This led us to select cook (ROME G1602) and bricklayer (ROME F1703) occupations. The features of the young people belonging to these two occupations and of their school-to-work transitions are documented in Tables A.8.1.2 and A.8.2.2 for cooks and bricklayers in Appendix A.8. Although there are more males and the share of apprentices is much larger in construction (69.7% versus 49.5% for all occupations and 50.7% for food services), CAP graduates from construction and food services share important common features with all apprentices and vocational students, for our purpose. For both occupations, the employment rate of apprentices is higher than that of vocational students from the date of school completion. Moreover, the employment rate difference between apprentices and vocational students vanishes when individual characteristics and retention in the training firms are taken into account.

The profiles of applicants were then designed for these two occupations. They obtained the *CAP cuisine* for cook and the *CAP maçon* for bricklayer occupations in June 2017. Since then, they have been unemployed without any work experience from the date of graduation to the dates of job applications, which are sent from 22 January 2018 to 23 July 2018. They have a mix of soft skills (the ones expected in a firm) and hard skills (the ones expected in the occupation).[20]

III.B The applications

All applications included a résumé and a cover letter. They were accompanied by a short email message. Two templates have been created to ensure that callbacks do not depend on employers' preferences for a given presentation.[21] The templates have been inspired by

[17] The first names have been chosen randomly among the top 20.

[18] The same has been done for surnames.

[19] We used various sources, including the Labor Force Survey (*Enquête emploi, INSEE)* and the *Répertoire National des Certifications Professionelles* (RNCP), to verify the existence of national diploma, the *Pôle emploi* database to evaluate the number of job offers.

[20] These skills have been taken from the *fiches métiers Pôle emploi*. Occupation related hobbies are cuisine, pastry, international cuisine for cook and DIY, for bricklayer. Other hobbies are: cinema, sport, handball, music. More details here for cooks and here for bricklayers.

[21] See Appendix A.1 for examples of résumés and cover letters.

different samples taken from the *Pôle emploi CVthèque*,[22] a youth center sample, and Google searches. The cover letters contained five paragraphs each. Sentences were written in a similar way so there was no apparent literacy difference among the two templates.[23]

Since applications were sent to job offers in all French *départements*, applicants' addresses were chosen to be in the center of whatever city serves as the administrative capital (préfecture) of the department in which the job was posted, in order to ensure that candidates live sufficiently close to their potential future job.[24] Since the diploma is national, there is no information about the school, which is common in résumés for this type of application. The address of training firms where students and apprentices worked during their studies is not provided, to avoid detection of fictitious applications. These training firms are large well known firms (Flunch, Hyppopotamus for cooks and Bouygues Construction and Lafarge for construction) for which it is unusual to mention the address of the establishment in which one has been employed.

Job offers for both occupations were identified using mainly the website of *Pôle emploi*, the French public employment agency.[25] Applications were sent only when it was possible to contact the recruiter directly by email, hence job offers issued by temporary work agencies or other intermediaries were not considered. Moreover, the same recruiter could never be contacted more than once, even if he posted different job positions in different areas of France throughout the entire experiment period. The same goes for offers providing only a *Pôle emploi* counselor email address. If a job vacancy met these criteria, one (and only one) application was sent from one of the two fictitious candidates. The name of the applicant, the applicant profile (apprentice or student), and the layout type were all selected at random.

Replies from recruiters were collected up to the last recorded phone call and email message on 10 October 2018. When recruiters provided a positive answer to an application by inviting the applicant to an interview or requesting additional information about the application, an email was sent in order to thank the recruiter and inform him that the applicant had signed an open-ended contract with a different employer.

In total, 3,110 applications were sent from 22 January 2018 to 13 July 2018. As shown in Table III, there are 2,542 applications from cooks and 568 from bricklayers. The relatively low number of applications for positions as bricklayers stems from the large share of job ads posted by temporary work agencies in the construction industry. Since our fictitious candidates could not apply to these job offers without a high probability of being detected,

[22] This public databank is available to help recruiters in selecting different available profiles. More details at https://www.pole-emploi.fr/employeur/consultez-librement-des-cv-de-candidats.

[23] We check that the callback rates are not correlated with the layout types to avoid the potential issues of "template bias", addressed in Lahey and Beasley (2009).

[24] Addresses have been collected and verified via *Google maps*.

[25] A few private job search websites, such as *Le Bon Coin* or *Indeed* were also used when the number of offers available on the *Pôle emploi* platform was too low on a given day.

the number of applications for this occupation was limited.[26] Table A.2.1 in Appendix A.2 provides randomization tests. Due to the randomized design of the field experiment, this table confirms that the covariates characterizing the job vacancies are balanced between apprentices and vocational students.

IV Results

We start by presenting the callback rates to all applications before analyzing whether the results obtained at the aggregate level depend on the local unemployment rate. We then document the external validity of these results for apprentices and students in occupations other than bricklayers and cooks.

IV.A Callbacks to all applications

A reply from a recruiter who stated that he did not select the application for the job vacancy is classified as a negative callback, like the absence of callback. Any other reply is considered as positive callback, but we distinguish two grade of positivity. "Positive callbacks" show some interest in the application, ranging from the vague request "please call me back" to more precise inquiries about the training or experience of the applicant, or his means of transportation if the worksite is located more than a few kilometers away from where he (supposedly) lives. We regard these requests as positive because they are likely motivated by genuine interest in the application on the part of the recruiter, and indeed some replies we classify as positive may not only request information, but may suggest an interview or even a hire. "Propositions" are more positive in that they straightforwardly propose an interview or a hire. Accordingly, we consider two categories of positive callbacks: *i)* "positive callbacks", which include propositions for interview, for hiring or a demand for complementary information; *ii)* "proposition" for callbacks which propose an interview or hiring.

The mean callback rates by category of callback and by profile of applicant are displayed in Table III. Callback rates are relatively high, about 28% for "positive callbacks" and 23% for "propositions", despite the relatively low level of education of applicants. Actually, like in all occupations where apprenticeship is well developed, the market of cooks and bricklayers is quite tight, which provides good employment opportunities to applicants.[27] Indeed, appren-

[26] The sample size has been chosen to detect a difference of 0.05 at 5% significance level and power of 80% between the baseline callback rate of vocational students and that of apprentices. It appeared quickly that the baseline callback rate was around 25% for both occupations. In this context, the minimum sample size is equal to 1,251 per group, which is reached for the whole sample and also for cooks as shown by Table III. This target was clearly unreachable for bricklayers, given the availability of job offers to which it was possible to apply.

[27] Challe et al. (2020) find callback rates around 25% in the restaurant industry for applications of waiters with profiles similar to our cooks in 2018-2019, a period in which the situation of the French labor market was similar to that covered by our experiment. Petit et al. (2016) find an average callback rate between 19.3% and 26.2% - depending on the location - for cook in France in 2011-2012. Fremigacci et al. (2015) find an

TABLE III
CALLBACK RATES DESCRIPTIVE STATISTICS BY PROFILE

	Students	Apprentices	Difference (2)−(1)	p-value
	(1)	(2)	(3)	(4)
All				
# Observations	1,541	1,569		
Positive callback	.2745	.2830	.0085	.5979
	(.0114)	(.0114)	(.0161)	
Proposition	.2284	.2390	.0106	.4858
	(.0107)	(.0108)	(.0152)	
Cook				
# Observations	1,278	1,264		
Positive callback	.2793	.2975	.0181	.3133
	(.0126)	(.0129)	(.0180)	
Proposition	.2316	.2532	.0216	.2050
	(.0118)	(.0122)	(.0170)	
Bricklayer				
# Observations	263	305		
Positive callback	.2510	.2230	-.0280	.4341
	(.0268)	(.0239)	(.0358)	
Proposition	.2129	.1803	-.0326	.3294
	(.0253)	(.0221)	(.0334)	

Note: This table reports the number of observations per profile and the mean value of the primary dependent variables. A positive callback is equal to one if the fictitious candidate received a demand for complementary information, sometimes with a suggestion for interview or hiring. Proposition corresponds to callbacks which straightforwardly propose an interview or hiring. Standard error of the mean is reported in parentheses below the mean. Column (3) reports the difference between column (2) and column (1) and column (4) displays the p-value for the test $H_0 : \{\Delta =$ callback[apprentices] - callback[students] $= 0\}$ vs $H_1 : \{\Delta \neq 0\}$.

ticeship, which is partly funded by employers, is more developed in sectors where employers face hiring difficulties.

It is clear from Table III that there are no statistically significant callback rate differences between apprentices and students. There is a tiny non-statistically significant positive difference in favor of apprentices taken as a whole and for cooks, of about 1 percentage point. Compared with the baseline callback rate, which is above 25% for "positive callbacks", this difference would be economically negligible if it were statistically significant.[28]

average callback rate of 19.3% for young bricklayer candidates aged 21 year-old in France in 2011 when the unemployment rate was increasing, after the shock of the great 2008-2009 recession.

[28] Detection of such small difference is beyond the reach of this paper. Two-sample proportion tests imply that the sample size of each group must be equal to more that 29,800 to detect a difference of 0.01 at 5% significance level and power of 80% between the baseline callback rate of vocational students equal to 25% and

TABLE IV
EFFECTS OF APPRENTICESHIP ON CALLBACK PROBABILITY

	All applicants			Cook	Bricklayer
	(1)	(2)	(3)	(4)	(5)
Dep var: Positive callback					
Apprenticeship	0.00849	0.00766	0.00903	0.0172	-0.0309
	(0.0170)	(0.0168)	(0.0172)	(0.0196)	(0.0444)
Student mean	0.2745***	0.2745***	0.2745***	0.2793***	0.2510***
	(0.0114)	(0.0114)	(0.0114)	(0.0126)	(0.0268)
Observations	3,110	3,110	3,110	2,542	568
R-squared	0.000	0.003	0.043	0.050	0.197
Dep var: Proposition					
Apprenticeship	0.0106	0.00993	0.0119	0.0223	-0.0330
	(0.0146)	(0.0145)	(0.0147)	(0.0169)	(0.0411)
Student mean	0.2284***	0.2284***	0.2284***	0.2316***	0.2129***
	(0.0107)	(0.0107)	(0.0107)	(0.0118)	(0.0253)
Observations	3,110	3,110	3,110	2,542	568
R-squared	0.000	0.003	0.043	0.050	0.184
Month FE	No	Yes	Yes	Yes	Yes
Department FE	No	No	Yes	Yes	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

To analyze the data more extensively, we estimate the following linear probability model:

$$y_{ij} = \alpha + \beta \cdot Apprenticeship_i + x_j'\gamma + \varepsilon_{ij}$$

where y_{ij} is an indicator variable equal to one if applicant i gets called back for job j, 0 otherwise. *Apprenticeship* is an indicator variable equal to one if applicant i is a former apprentice, 0 if it is a former vocational student. β measures the callback rate difference between apprentices and vocational students. x_j is a vector of department and month fixed effects.[29] ε_{ij} is a residual term.

The OLS estimates of β are reported in Table IV. The three first columns report the estimates for occupations pooled together, for different specifications including department and month fixed effects, and for the two categories of callbacks: "positive callbacks" and "propositions". The results, which are very stable across specifications and callback categories,

that of apprentices. However, we provide further evidence from a correspondence study relying on unsolicited applications in Section A.6.

[29] A department is an administrative territorial unit. There are 95 departments in Metropolitan France.

confirm the absence of statistically significant callback rates differences between apprentices and vocational students. Columns (4) displays the results for cooks and column (5) for bricklayers. Once again, the estimates of the β parameter are not statistically different from zero.[30]

We then analyze whether the estimates of β vary according to the type of firm or contract for which we sent our applications. Table A.4.1 in Appendix A.4 shows the results with the same specifications as above by splitting the callbacks from small and large firms and indicates that former apprentices are not considered differently than students in either case. The same applies when we consider callbacks from permanent or temporary jobs as shown by Table A.5.1 in Appendix A.5.

IV.B The impact of local labor market conditions

On tight labor markets, employers face hiring difficulties which imply that they tend not to be choosy when they select their workers. Since the callback rates of our applicants are quite high, about 25%, we can consider that our experiment concerns relatively tight labor markets. This may imply that we do not observe callback rate differences between apprentices and vocational students because employers have little choice. But it might be that callback rate differences show up on less tight labor markets.[31]

To deal with this issue, we analyze how the callback rate difference between apprentices and vocational students varies according to the local unemployment rate. We estimate the difference in callback rate between apprentices and vocational students for each tercile of the unemployment rate at the commuting zone level.[32] The youth unemployment rate varies from 9.6% in the bottom tercile to 39.7% in the top tercile. The callback rate of students goes from 36.0% in the top tercile of unemployment rate to 22.6% in the bottom tercile. Table V shows that the callback rate of apprentices is not different from that of students, except in the top tercile of local unemployment rate. It is about 5 percentage points higher for positive callbacks and 4 percentage points higher (and significant at 10% confidence level only) for callbacks with a proposition for interview or hiring. This result holds when firms and job characteristics are controlled for. This indicates that apprentices have a comparative advantage which arises only when the local unemployment rate is very high, so that employers can be choosy because they have access to abundant job offers.[33]

[30] To address concerns about non-linear effects, we report the results of Table IV replacing the linear probability model with a Probit model in Appendix A.3. The Probit results in Table A.3.1 show that the estimated marginal effects are very similar to the OLS results. This similarity holds for all the results in the paper.

[31] Several audit studies find that callback rates are related to labor market tightness (Kroft et al. (2013),Baert et al. (2015), Carlsson et al. (2018), Button and Walker (2020).

[32] We use the "zones d'emploi" from "INSEE". There are 304 "zones d'emploi" in metropolitan France.

[33] Similar results are displayed in Table A.8.1.5 for cooks but not for bricklayers in A.8.2.5, probably due to the low number of available observations.

TABLE V
EFFECTS OF APPRENTICESHIP ON CALLBACK PROBABILITY GIVEN DIFFERENT LABOR MARKETS

	All	T1 (7.2%)	T2 (8.5%)	T3 (10.8%)
	(1)	(2)	(3)	(4)
Youth unemployment rate	0.2500	0.0964	0.2050	0.3973
Dep var: Positive callback				
Apprenticeship	0.0184	-0.00668	-0.00178	0.0545**
	(0.0201)	(0.0423)	(0.0346)	(0.0270)
Student mean	0.2966***	0.3600***	0.3013***	0.2259***
	(0.0136)	(0.0248)	(0.0231)	(0.0220)
Observations	2,281	763	759	759
R-squared	0.079	0.103	0.091	0.091
Dep var: Proposition				
Apprenticeship	0.0152	-0.0133	0.0188	0.0399*
	(0.0169)	(0.0379)	(0.0283)	(0.0226)
Student mean	0.2524***	0.3147***	0.2456***	0.1956***
	(0.0129)	(0.0240)	(0.0217)	(0.0209)
Observations	2,281	763	759	759
R-squared	0.069	0.085	0.090	0.091
Month & Department FE	Yes	Yes	Yes	Yes
Firm & Job Characteristics	Yes	Yes	Yes	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. TX corresponds to the Xth tercile of the unemployment rate at the commuting zone level. Youth unemployment rates are computed from the French labor force survey, for youth aged 16 to 25, with secondary school vocational diploma, over 2014-2018 to get a sufficient number of observations at the commuting zone level. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

All in all, our correspondence study indicates that the callback rates of apprentices and students who apply for jobs as cooks and bricklayers are identical at the aggregate level. A difference arises only when the local unemployment rate is high. To evaluate the robustness of these findings we present the results of a correspondence study relying on unsolicited applications of cooks and bricklayers which allows us to get a larger number of observations in Appendix A.6. This correspondence study confirms that there is almost no difference between the probability of getting a callback from employers for unemployed youth formerly either apprentices or vocational students.

IV.C External validity

To interpret our results and explore whether the absence of comparative advantage for apprentices in our correspondence study may apply to other professions, we turn to the school-to-work

and labor market transitions of vocational secondary school graduates using the *Génération* survey.[34]

Figure 1 displays the evolution of the employment rates of apprentices and vocational students who graduated in June-July of the year they left school.[35] The employment rates are displayed from October (month one) to September three years later. Apprentices perform much better: their employment rate is about 15 percentage points higher than that of vocational students over the whole period. The time profiles of employment rates are similar: they increase steadily during the first year and are approximately stable the two following years. The employment rate difference between apprentices and vocational students is approximately stable over the three years after graduation. The difference originates mostly from the start of the period, i.e. just after graduation. We find that the employment difference coincides with the difference between the share of apprentices who remain in their training firm and the share of vocational students who remain in the firm where they were interns before leaving school. 33.6% of apprentices have been hired by their training firm while 8.5% of vocational students have been hired after graduation in a firm where they were interns. Figure 1 shows that the profile of unemployment rates follows the same pattern. The unemployment rate of apprentices is lower than that of students just after graduation and the difference remains stable over three years.

Table A.7.1 in Appendix A.7 shows that the employment rate difference between apprentices and vocational students drops by half when observable characteristics, including gender, family background, industry and past school performance are accounted for. This is the consequence of the selection of the most advantaged students into apprenticeship as described in section II.B. This table shows that the employment rate difference between apprentices and vocational students is no longer significantly different from zero over the three-year post-school period when observable characteristics *and* the retention rate in the training firms are accounted for. The positive effect of apprenticeship even vanishes as soon as observable characteristics are taken into account when looking only three years after graduation. An exact similar pattern arises for the unemployment rates.

Figure A.7.1 in Appendix A.7 displays the survival functions of apprentices in their training firms and in employment for those who remained in their training firm after graduation. 30 months after graduation, about 50% of the apprentices who remained in their training firm are still employed in the same firm and 90% have always remained in employment. This high survival rate in employment implies that differences in retention rates in training firms after graduation between apprentices and students may have long-lasting effects on their employment rate differential.

[34] The external validity of our findings outside the French context is discussed in the conclusion of the paper.

[35] Figures A.8.1.1 and A.8.2.1 in Appendix A.8.1 and A.8.2 display similar graphs for youths in the food sector and construction sector respectively with a similar interpretation.

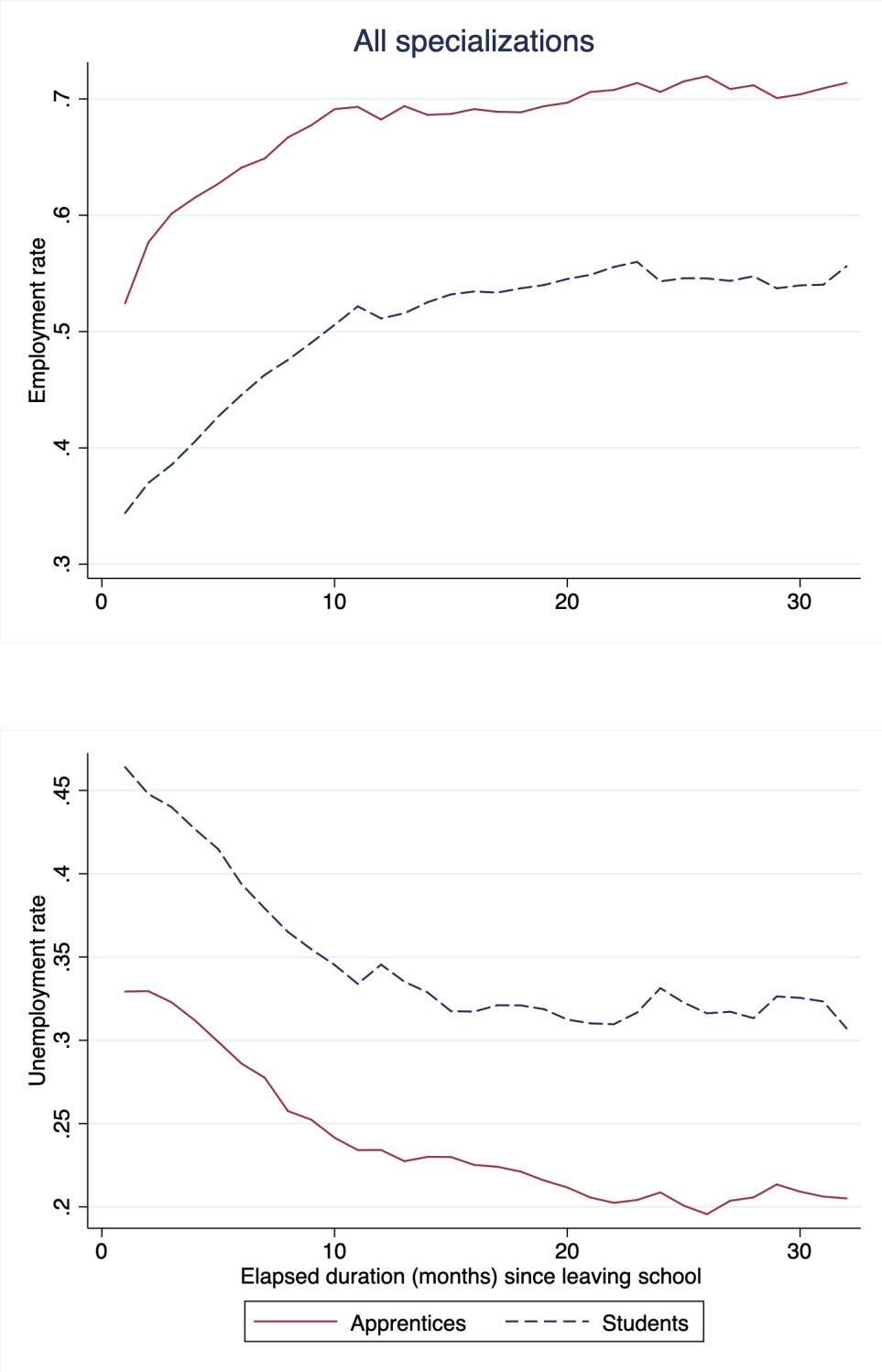


FIGURE 1: EVOLUTION OF THE SHARE OF STUDENTS AND APPRENTICES IN EMPLOYMENT OR UNEMPLOYMENT AFTER LEAVING SCHOOL.
Note: Students got their CAP diploma in June-July. Month zero stands for September.
Source: pooled *Génération 2001-2007-2010-2013* surveys, CEREQ.

Table VI
Cox Regressions

Transitions	Non-Employment → Employment		Unemployment → Employment	
	(1)	(2)	(3)	(4)
Apprenticeship	1.3065***	1.0345	1.3375***	0.9344
	(0.1104)	(0.1316)	(0.1362)	(0.1653)
Male		1.1615		1.1036
		(0.1525)		(0.2044)
Driving license		1.5218***		2.0566***
		(0.1999)		(0.3811)
Graduated		1.8919***		2.3843**
		(0.4653)		(0.8244)
Observations	7,593	7,593	5,795	5,795
Other Control Variables	No	Yes	No	Yes

Note: This table reports probability ratio estimates from a proportional hazards model estimated with Cox regressions, where the dependent variable is a dummy variable equal to one if the individual has undergone a transition from a non-employment situation to an employment situation. "Apprenticeship" is a dummy variable equal to one if the individual has followed his vocational education as an apprentice. Columns (1) to (2) consider any situations of non-employment from employment situations. While columns (3) to (4) yield estimates from unemployment to employment situations. We control for additional covariates in columns (2) and (4). All of the control variables are fixed over time. Unreported control variables include dummies for the age at school leaving, being disabled, school level of father, school level of mother, father in employment, mother in employment, birthplace of father, birthplace of mother, department of residency, region of the training establishment, speciality of training. Robust standard errors are clustered at the individual level and presented in parentheses below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.
Source: pooled *Génération 2001-2007-2010-2013* surveys, CEREQ

These facts are consistent with the findings of our correspondence study: the higher employment rate of apprentices after leaving school arises from their high retention rate in training firms compared with that of vocational students. Once they have been unemployed, apprentices do not get jobs at higher rate than vocational students. Table VI, which reports the estimation of proportional hazard models shows that the unemployment to employment and the non-employment to employment transitions of apprentices and vocational students are not statistically different once observable individual characteristics are controlled for.

All in all, this section shows that the results of our correspondence study, according to which there is almost no difference between the probability of getting a callback from employers for unemployed young cooks and bricklayers, formerly either apprentice or vocational student, is consistent with the school-to-work and labor market transitions of overall low skilled youth. The next section presents a model for interpreting all these results, taking into account in particular the selection of apprentices who were not retained in their training firm and the choice of recruiting unemployed vocational students and apprentices in a labor market with frictions.

V The model

This section sets out and estimates a search and matching model which allows us to explain the retention of apprentices in their training firms and to reproduce the main stylized facts of the

French youth labor market of vocational students and apprentices who have just graduated. Then, the model is used to simulate the impact of the expansion of apprenticeship on the youth unemployment rate.

V.A Conceptual framework

We consider a population of N young individuals who complete their initial education. There are N_a apprentices and N_s students (i.e. individuals who studied without being apprentices):

$$N = N_a + N_s \tag{1}$$

This is a static, one period model. Insofar as we focus on school-to-work transitions and the data displayed above show that the employment rate difference between apprentices and students remains almost constant over the three year period that we analyze, there is no obvious gain to considering a dynamic multi-period model.

Individuals are risk neutral and derive utility from consumption only. They are heterogeneous with respect to their productivity, y. The timing of events, which start just after graduation, is as follows.

1. Youth draw their productivity. This productivity is drawn in different distributions for apprentices and students. The cumulative distribution of y is denoted by G_s for students and by G_a for apprentices;

2. Firms that employ apprentices decide whether they keep their apprentices. There is a specific separation cost for each apprentice. The separation cost is independently drawn by each employer for each apprentice in a distribution the properties of which are described below. Employers retain their apprentices whose associated expected profits is larger than the separation cost. Each apprentice accepts the job offer with exogenous probability χ. This determines, for each productivity level y, an endogenous share of apprentices who remain in their training firm and the complementary share who look for jobs;

3. Firms create job vacancies;

4. Students and apprentices looking for jobs send applications to job vacancies;

5. Employers select the workers they want to hire;

6. Wages are bargained over and production takes place.

The model is solved backward. Accordingly, we start by focusing on wage formation.

Wage formation

The productivity of apprentices is known by firms in which apprentices trained. The productivity can be observed by firms only after the job interview in all other cases. Productivity distributions are common knowledge.

A job with productivity y yields profits

$$J(y) = y - w(y) \tag{2}$$

where $w(y)$ stands for the wage whose value is determined by bargaining. The bargaining implies that workers get the share β of job surplus. In case of agreement, workers get utility $w(y)$ and firms profits $y-w(y)$. In case of disagreement, worker get the unemployment income z and firms get zero profits. Therefore, the surplus of a job with productivity y is equal to $y - z$.

Labor costs have a lower bound induced by the minimum wage $w_{\min}$, which is larger than z, the income of unemployed individuals. Therefore, wages are set by bargaining subject to the minimum wage constraint:

$$w(y) = \begin{cases} z + \beta(y - z) & \text{if } y \geq \bar{y} \\ w_{\min} & \text{if } w_{\min} \leq y < \bar{y} \end{cases} \tag{3}$$

where $\bar{y} = [w_{\min} - (1 - \beta)z] / \beta$. This equation indicates that the wage is equal to $z + \beta(y - z)$ if the productivity is larger than $\bar{y}$ and to the minimum wage if it belongs to the interval $[w_{min}, \bar{y}]$. The job is not filled if the productivity is smaller than $w_{\min}$, which corresponds to the reservation productivity.

Students and apprentices who did not remain in their training firm look for jobs. To do so, they send applications to job offers. It is assumed that matches between job openings and applications are determined by an urn-ball matching process[36] where job openings are assimilated to urns, and job applications to balls tossed at the urns by job seekers. In this framework, a match occurs when a ball goes into an urn. As job seekers simultaneously apply for jobs not knowing where other job seekers are sending their applications, some vacancies get no application, while others may get one or more applications. For the sake of simplicity, it is assumed that each applicant sends one application.

Hiring decisions

Since the matching between job applications and job openings is determined by the urn-ball model where each job seeker sends one application, the probability that a vacant job gets n_a applications from apprentices is defined by the binomial probability function with parameters $(1 - \rho)N_a$ (the number of trials) and $1/v$ (the probability of success of each trial),

[36] Hall (1979), Pissarides (1979), Blanchard and Diamond (1994).

denoted by $b(n_a, (1-\rho)N_a, 1/v)$. Similarly, the probability to receive n_s applications from students is defined by the binomial probability function $b(n_s, N_s, 1/v)$.

Firms do not observe the number of applications they receive. They prefer to interview an apprentice, whose expected productivity is higher than that of a vocational student. However, when they find out about a vocational school student's application, they must decide whether to call him back immediately or pay an additional cost to try to screen more applications and have the opportunity to select an apprentice.

Firms draw the screening costs in the distribution whose cumulative distribution function is denoted by F assumed to be continuous on the interval $[c_{\min}, c_{\max}]$. c is interpreted as the costs to draw and screen an application in the pool of applications of the vacant job. The heterogeneity in screening costs arises from the heterogeneity in opportunity costs of time and resources devoted to find and screen applications.

At the screening stage, firms can observe, from the applications that have been drawn, whether an applicant is an apprentice or a student and decide which applicant is called back for interview. Firms discover the productivity of the applicant after the hiring interview. If the productivity is above its reservation level $w_{\min}$, the applicant is hired. If the productivity is below the reservation level, the applicant is not hired and the firm does not make profit in the period.[37] Therefore, the expected profit from calling back an apprentice or a vocational student is, respectively:

$$\begin{aligned} \pi_a &= \int_{w_{\min}}^{y_{\sup}} J(y) \mathrm{d}G_{an}(y) \\ \pi_s &= \int_{w_{\min}}^{y_{\sup}} J(y) \mathrm{d}G_s(y) \end{aligned}$$

where G_{an} is the cumulative distribution function of apprentices not retained in their training firm. The productivity distribution of apprentices who do not stay in their training firm depends on the distribution of productivity of all apprentices (G_a) and on the probability to stay in the training firm which will be determined below.

It is shown in Appendix A.9, that firms with screening costs c call back an apprentice with probability

$$q_a(c) = \sum_{i=1}^{m(c)} p_a(i) \prod_{j=0}^{i-1} \left[1 - p_a(j)\right], \text{ with } p_a(0) \equiv 0$$

where $p_a(n)$ is the probability of getting an apprentice at the n^{th} application and $m(c)$ is the maximum number of applications screened by firms with screening costs c. Firms with

[37] It is assumed that firms can interview one applicant only. Assuming that employers can interview several applicants complicates the analysis without allowing us to better account for the substitutability between apprentices and students at the hiring stage insofar as there are no available data which disentangle the callback stage and the hiring stage of the hiring process.

screening costs c call back a student with probability

$$q_s(c) = [1 - q_a(c)] \Pr(n_s > 0)$$

where

$$\Pr(n_s > 0) = 1 - b(0, N_s, 1/v)$$

is the probability that there is at least one application of student.

For firms with screening costs c, the total expected screening costs of applications is equal to c times the expected number of screened applications, defined in Appendix A.10:

$$C(c) = c \sum_{i=1}^{m(c)} \left(i p_a(i) \prod_{j=1}^{i-1} [1 - p_a(j)] \right)$$

Job creation

Once the probability to hire an apprentice and a student and the total screening costs are determined, one can compute the expected profit of a vacant job posted by firms with screening costs c:

$$\Pi(c) = q_a(c)\pi_a + q_s(c)\pi_s - C(c)$$

Free entry implies that firms create jobs until the value of vacant jobs is equal to zero. Let h denote the creation cost of a vacancy. The free entry condition is:

$$h = \int_{c_{\min}}^{c_{\max}} \Pi(c) \mathrm{d}F(c) \tag{4}$$

Retention choice

At the end of their apprenticeship, employers keep the youth only if it is profitable to do so. It is assumed that there is a cost ε to terminate the job of the apprentice. ε has a normal distribution with mean μ_ε and variance σ_ε^2. This cost can be due to administrative constraints or to other events like the loss of reputation when an apprentice is not retained. Remark that ε can be negative, meaning that the employer can have a gain to retain the apprentice beside the profits that will be induded by the work of the apprentice, for example if it is costly to hire another apprentice or if offering the apprentice to keep his job has a positive impact on the firm's reputation. In this framework, the gain of the employer is either equal to $-\varepsilon$ if the

apprentice is not retained or to $J(y)$ if he is retained. Thus, an apprentice can remain in his training firm if and only if

$$J(y) \geq -\varepsilon$$

where

$$J(y) = \begin{cases} (1-\beta)(y-z) & \text{if } y \geq \bar{y} = \frac{w_{\min}-(1-\beta)z}{\beta} \\ y - w_{\min} & \text{if } y < \bar{y} \end{cases}$$

For each value of y the share of apprentices who are not retained by their employer is equal to

$$\begin{cases} \Pr\left[\varepsilon < (1-\beta)\left(z-y\right)\right] = \Phi\left[(1-\beta)(z-y)\right] & \text{if } y \geq \bar{y} = \frac{w_{\min}-(1-\beta)z}{\beta} \\ \Pr\left[\varepsilon < w_{\min} - y\right] = \Phi(w_{\min} - y) & \text{if } y < \bar{y} \end{cases}$$

where Φ is the cumulative density function of the normal distribution with mean μ_ε and variance σ_ε^2. It is clear that more productive apprentices have a higher probability to be retained in their training firm since function Φ is necessarily increasing. If they are retained and they accept the job offer, apprentices bargain their wage like the other youth. If they leave the firm, they look for a job as described above.

The share of apprentices who are proposed to be retained in their training firm is equal to

$$\gamma = \int_0^{\bar{y}} \left[1 - \Phi(w_{\min} - y)\right] g_a(y) \mathrm{d}y + \int_{\bar{y}}^{+\infty} \left[1 - \Phi\left[(1-\beta)(z-y)\right]\right] g_a(y) \mathrm{d}y$$

From the previous equations, one gets the probability distribution function of productivity y of apprentices not retained in their training firm:

$$g_{an}(y) = \begin{cases} \frac{1}{1-\gamma}\Phi\left[(1-\beta)(z-y)\right] g_a(y) & \text{if } y \geq \bar{y} = \frac{w_{\min}-(1-\beta)z}{\beta} \\ \frac{1}{1-\gamma}\Phi(w_{\min} - y) g_a(y) & \text{if } y < \bar{y} \end{cases} \tag{5}$$

Since apprentices accept the job offers with probability χ, the share of apprentices retained in their training firm is equal to

$$\rho = \gamma\chi$$

Labor market equilibrium

The equilibrium value of the number of vacant jobs is determined by equation (4). This value is unique (assuming its existence), since the binomial probability function necessarily decreases with v, the number of vacant jobs. Once v has been determined, one can compute the number of jobs won by apprentices who have not been retained in their firm and the

number of jobs won by students:

$$\begin{aligned} L_a &= v\left[1 - G_{an}(w_{\min})\right] \int_{c_{\min}}^{c_{\max}} q_a(c) \mathrm{d}F(c) \\ L_s &= v\left[1 - G_s(w_{\min})\right] \int_{c_{\min}}^{c_{\max}} q_s(c) \mathrm{d}F(c) \end{aligned}$$

From these two equations we can determine the hiring probability of apprentices and students, equal to $L_a/(1-\rho)N_a$ and L_s/N_s respectively. Then, the unemployment rates of apprentices and students follow

$$u_a = 1 - \rho - \frac{L_a}{\alpha N} \tag{6}$$

$$u_s = 1 - \frac{L_s}{(1-\alpha)N} \tag{7}$$

which yield the youth unemployment rate:

$$u = \frac{N - \rho\alpha N - L_a - L_s}{N} = \alpha u_a + (1-\alpha) u_s \tag{8}$$

and the unemployment rate of individuals who are looking for a job, i.e. those who do not remain in their training firm:

$$\tilde{u} = \frac{N - \rho\alpha N - L_a - L_s}{N - \rho\alpha N} = 1 - \frac{L_a + L_s}{(1-\rho\alpha)N}$$

The callback probabilities are computed in Appendix A.12.

V.B Estimation and calibration

To bring the model to the data and to consider a population similar to that of our correspondence study, we rely on the *Generation* surveys conducted in 2013 and 2016 that we harmonized and pooled together. In line with our correspondence study, the analysis is restricted to young males who enrolled in a CAP-equivalent program after middle school and work in construction and restaurant sectors to get a sufficient number of observations (see Appendix A.13).

One needs to determine the value of six parameters, α, z, β, χ, c_{max}, h, plus the parameters of the Normal distribution Φ of separation costs ϵ of apprentices from their training firms and the parameters of the Log-normal productivity distributions of apprentices and students, G_a and G_s. We proceed as follows:

1. The share of apprentices, α, is set to 0.5 to match the observed share in our population;

2. The income of unemployed workers, z, is set to €904. This corresponds to the mean value of unemployment benefits for a male unemployed worker aged below 25 years receiving unemployment benefits in 2016;[38]

3. The bargaining power parameter, β, is set to 0.5 in the benchmark version (Appendix A.15 shows that our conclusions remain qualitatively unchanged for different values);

4. The productivity distributions of apprentices and vocational students, $G_j(y),\ j = a, s$ and of separation costs of apprentices from their training firm $\Phi(\epsilon)$ are estimated with maximum likelihood assuming that wages are determined by the wage bargaining solution described in equation (3). We estimate the productivity distribution of students from their wage distribution. The productivity distribution of apprentices and the distribution of separation costs ϵ are jointly estimated from the wage distributions of non-retained and retained apprentices in the training firms. The distribution of ϵ is identified thanks to the differences between the wages of retained and non-retained apprentices. Appendix A.13 provides details about the estimation of these distributions;

5. The share χ of apprentices who accept the offer to remain in their training firm, is set to match the observed retention rate ρ, equal to 0.3, once the share of apprentices retained by their training firm has been computed from the estimation of distributions G_a, G_s and Φ;

6. The cost of creation of vacant jobs, h, and the upper bound of the distribution of screening costs, c_{max}, assumed to be uniform on the interval $[0, c_{max}]$, are jointly determined to match the unemployment rates of apprentices and students.

The values of parameters are summarized in Table VII together with the firts moments of the productivity distributions of apprentices and vocational students. The productivity distributions of apprentices and students are displayed on Figure 2. It is clear that the productivity distribution of retained apprentices first-order stochastically dominates the productivity distribution of non-retained apprentices which first-order stochastically dominates that of students. The average productivity of apprentices is about 5% higher than that of students. The average productivity of retained apprentices is about 10% higher than that of non-retained apprentices.

The distributions of non-retained apprentices and students are very close, which is consistent with the absence of statistically significant difference between the exit rate from unemployment of apprentices and students. Nevertheless, these distributions imply that employers prefer to invite apprentices for interview if selecting applicants is not costly, because the average productivity (conditional on being larger than the reservation productivity) of apprentices

[38] More details here.

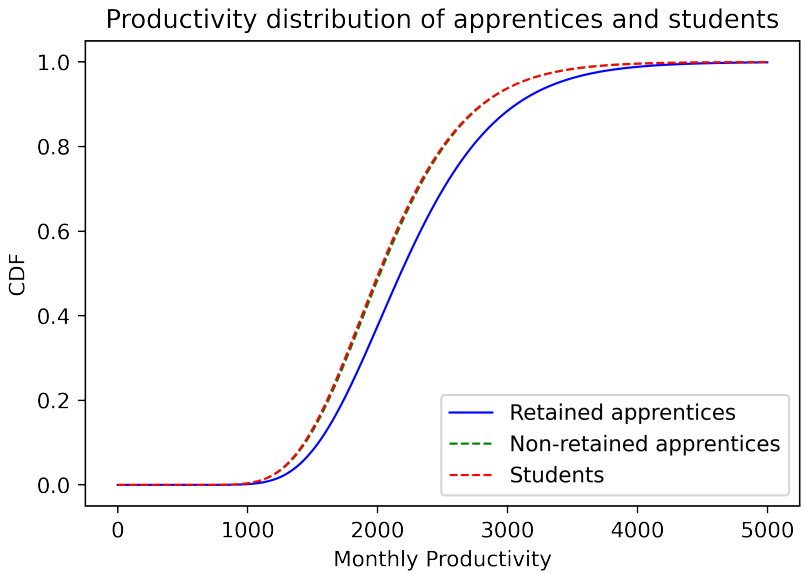


FIGURE 2: CUMULATIVE DISTRIBUTIONS OF PRODUCTIVITY OF STUDENTS AND APPRENTICES
Note: The vertical dotted line indicates the level of the net minimum wage.
Source: pooled *Génération 2010-2013* surveys, CEREQ.

is slightly larger than that of students, as shown in Table VII. The effects of this preference for apprentices on the callback and hiring probabilities of apprentices and students depend on the number of applicants received by each firm. If this number is small, which is the case when the unemployment rate is low, the preference for interviewing apprentices first has almost no impact on the hiring probability difference between students and apprentices, to the extent that firms have small pools of applicants. However, if the number of applicants is large, the preference for interviewing apprentices first may induce significant callback and hiring rates differences.

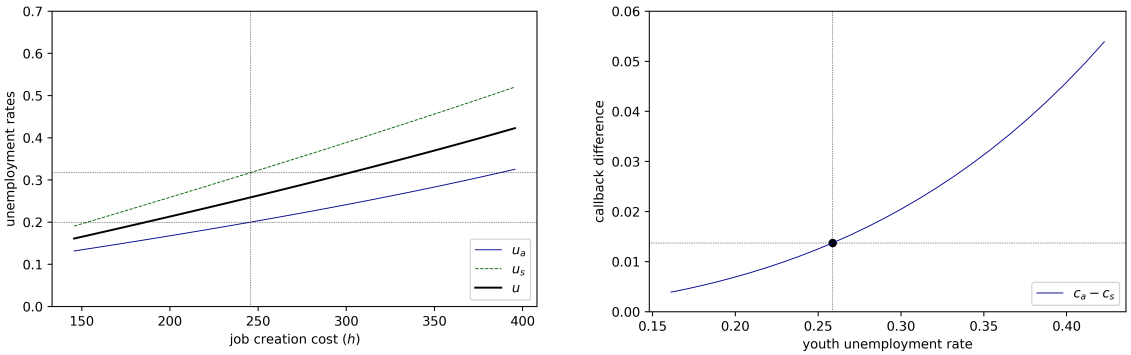
All in all, the model reproduces an unemployment rate difference between apprentices and students that is compatible with their empirical wage distributions. The callback rate difference between apprentices and students predicted by the model, which is equal to 1.4 percentage points (as displayed in Figure 3b), is in line with the 95% interval confidence of our correspondence study, as shown in Table IV. The model is also able to reproduce the finding of our correspondence study that the callback rate difference between apprentices and students increases with the local unemployment rate. This is shown on Figure 3 which displays the effects of changes in h, the costs of job creation. Increases in job creation costs, which decrease job creation, raise unemployment for apprentices and students. This is accompanied by a rise in the apprentice/student callback rate difference consistent with the results of our correspondence study. As reported in Table V, which displays the results of the correspondence study, the callback rate for the interview difference between apprentices and

TABLE VII
VALUES RELATED TO THE MODEL

Description	Notation	Value
Panel A: Parameters of the model		
Share of apprentices	α	0.5
Share of the job surplus going to workers	β	0.5
Share of apprentices retained in their training firm	ρ	0.3
Share of apprentices who agreed to stay in their training firm	χ	0.6
Separation cost of apprentices		
mean	μ_ϵ	-613.371 (24.715)
standard deviation	σ_ϵ	1,613.571 (74.155)
Productivity of apprentices		
mean	μ_a	7.647 (0.003)
standard deviation	σ_a	0.266 (0.002)
Productivity of students		
mean	μ_s	7.604 (0.008)
standard deviation	σ_s	0.261 (0.006)
Level of net minimum wage	w_{min}	€1,129.30
Level of unemployment benefits	z	€904
Cost of job creation	h	€247.52
Cost of screening applications	$[c_{min}; c_{max}]$	[€0.0; €0.3]
Panel B: First-order moment of the productivity distributions		
Average productivity of students	$\mathbb{E}[y\|G_s]$	€2,076.59
Average productivity of apprentices	$\mathbb{E}[y\|G_a]$	€2,171.64
Average productivity of retained apprentices	$\mathbb{E}[y_r\|G_a]$	€2,256.36
Average productivity of non-retained apprentices	$\mathbb{E}[y_{nr}\|G_a]$	€2,085.60

Note: This table reports the values associated with the exogenous parameters of the model. α and ρ are estimated from the pooled *Génération 2010-2013* surveys. w_{min} and z come from official sources of Insee and Pôle emploi respectively. The parameters related to the separation cost of apprentices (μ_ϵ; σ_ϵ) and productivity of both apprentices (μ_a; σ_a) and students (μ_a; σ_a) are estimated with maximum likelihood as shown in Appendix A.13. The standard errors of these parameters, computed from the Fisher information matrix, are shown in parentheses beside the estimated values. c and h are jointly determined to match the equilibrium values of the unemployment rates of apprentices and students with their empirical values, taken also from the pooled *Génération 2010-2013* surveys ($u_a = 0.2, u_s = 0.3$).

students belong to the 95 percent confidence interval $[0.0, 0.8]$ when the unemployment rate is very high, about 40%, meaning that the callback difference *slightly* increases with the unemployment rate. The model reproduces well the fact that the apprentice/student callback rate difference varies little with the unemployment rate. According to Figure 3a, this difference reaches 0.45 pp when the unemployment rate amounts to 40%, which is consistent with the results reported in Table V.



(A) Unemployment Rates

(B) Callback Difference

FIGURE 3: Relation between cost of job creation, unemployment rates and callback difference between apprentices and students
Note: The dotted lines indicates the initial value of the variables.

VI Counterfactual exercises

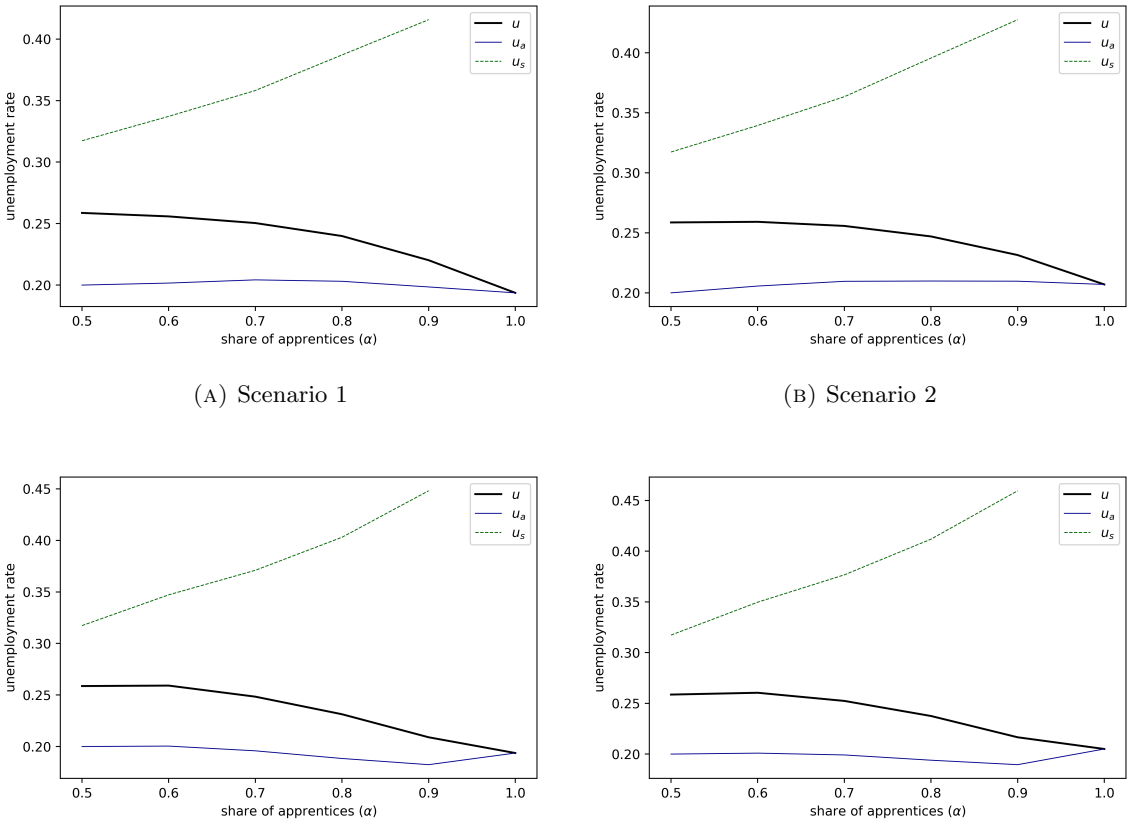
The model is used to analyze the consequences of increases in the share of apprentices. The results will depend on the impact of apprenticeship on productivity and on the selection of young people who become apprentice. These two mechanisms are exogenous in the model. To deal with this issue, we consider different scenarios having in mind that apprentices come from more favorable social environment, were better students in lower secondary schools, have better subjective self-judgments of their social abilities than vocational students as shown above, in Section II.B.

Concerning the impact of apprenticeship on productivity, we assume that the most favorable scenario to apprenticeship is the case in which a student with rank $r \in [0, 1]$ in the productivity distribution of students achieves the same expected productivity as an apprentice with the same rank in the productivity distribution of apprentices. We also consider an opposing scenario in which apprenticeship does not raise the productivity of vocational students.

The results also depend on the type of students who become apprentice when apprenticeship is expanded. We consider two cases. In the first case, the best students become apprentices and in the second students who become apprentices are drawn at random.

Hence, we end up with four scenarios when the share of apprentices is increased from α to $\alpha + \Delta$. The counterfactual productivity distributions are defined in Appendix A.14.

1. The share of students who become apprentice is selected at random in distribution G_s and their new productivity is drawn in distribution G_a.



(A) Scenario 1

(B) Scenario 2

(C) Scenario 3

(D) Scenario 4

FIGURE 4: Youth unemployment rate and share of apprentices.
Note: u is the youth unemployment rate, u_a the unemployment rate of all apprentices and u_s the unemployment rate of vocational students.

2. The share of students who become apprentice is selected at random in distribution G_s and their new productivity is drawn in distribution G_s.

3. The share of students who become apprentice is selected in the top of distribution G_s and their new productivity is drawn in the top part of distribution G_a.

4. The share of students who become apprentice is selected in the top of distribution G_s and their new productivity, which remains the same, is drawn in the top part of distribution G_s.

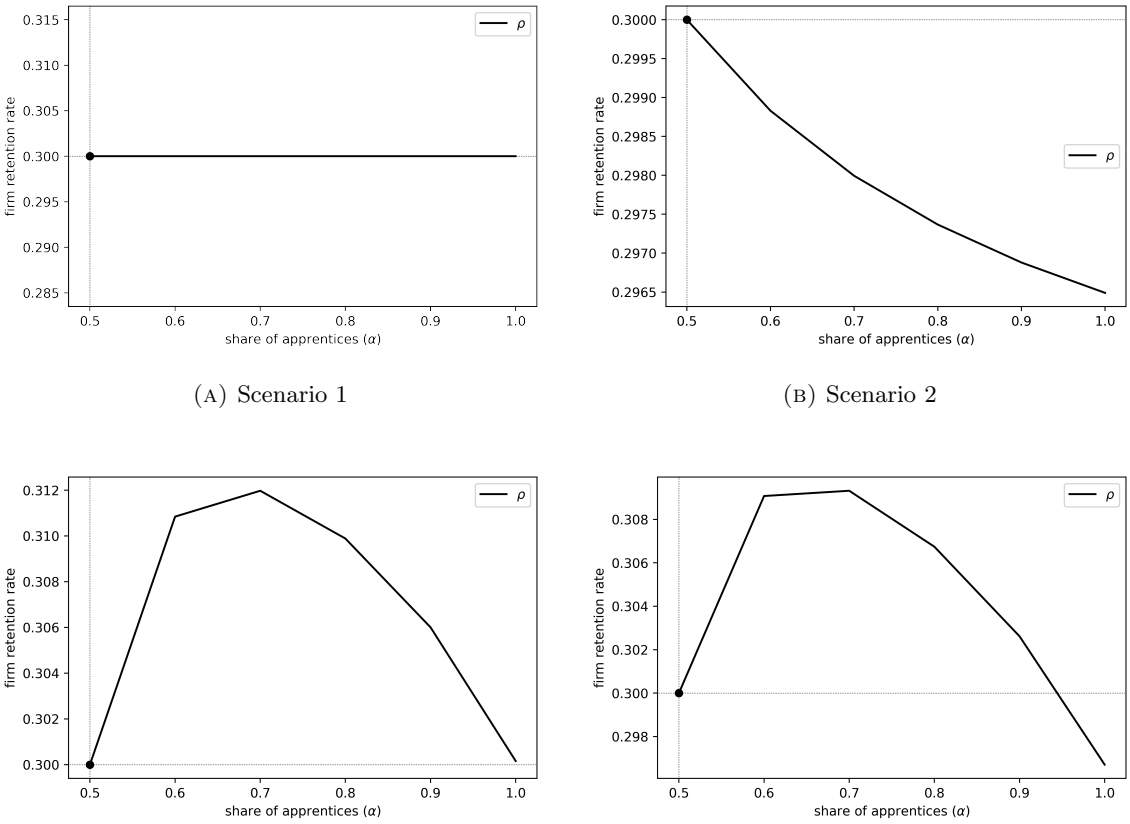
Figure 4 shows that the expansion of apprenticeship decreases youth unemployment in all scenarios, whether or not apprenticeship improves productivity and regardless of the type of student who becomes an apprentice. Moreover, the youth unemployment rate roughly converges to the initial (i.e. when the share of apprentices $\alpha = 0.5$) unemployment rate when all young people are apprentices. This result is the consequence of the limited productivity gap between vocational students and apprentices. Thus, the retention of apprentices in training

firms, which is a key determinant of better access to employment for apprentices compared to that of vocational students, varies little when the share of apprentices increases, as shown by Figure 5. The retention of apprentices is unchanged when the share of students who become apprentice is selected at random in distribution G_s and their new productivity is drawn in distribution G_a – Scenario 1. In this case, the retention rate is unchanged because the development of apprenticeship does not change the productivity distribution of apprentices. In Scenario 2, where students who become apprentices are selected at random in distribution G_s and do not improve their productivity thanks to apprenticeship, the retention rate decreases because the average productivity of apprentices diminishes. In Scenarios 3 and 4, in which students who become apprentice are selected in the top of distribution G_s, the increase in apprenticeship has a non-monotonous impact on the retention rate. First, it increases, because selected students who become apprentices are more productive on average than those already apprentice. Then, it decreases because the productivity of students who become apprentices drops as their share raises. Nevertheless, in all scenarios, the retention rate varies very little, because the average productivity of apprentices changes very little when apprenticeship is expanded due to the small difference in productivity between students and apprentices.

The small productivity gap between apprentices and vocational students also implies that the expansion of apprenticeship does not sufficiently foster job creation to bring unemployment down sharply. Indeed, the number of job vacancies drops when apprenticeship is expanded because there are fewer jobs seekers, and the raise in their productivity does not compensate for the drop in their number, even in the most favorable scenario. This drop in the number of job vacancies is detrimental to all job seekers. Apprentices who are not retained in their training firm face greater difficulties in finding a job. Vocational students have less opportunities to get job offers and face more intense competition from apprentices. Therefore, the unemployment rate of vocational students increases sharply as apprenticeship increases – see Figure 4.

All in all, in our context, the positive impact of the development of apprenticeship on employment is based on the retention rate of apprentices in their training firms. The relatively low retention rate of apprentices in their training firms implies that the expansion of apprenticeship has a limited impact on reducing unemployment among low-skilled youth. In addition, the small difference in productivity between apprentices and vocational students greatly reduces the impact of increased apprenticeship on employment, which leads to reduced employment opportunities for young people seeking a job.

Our results lead to the conclusion that increasing apprenticeship is of limited effectiveness in reducing youth unemployment beyond the retention of apprentices in their training firms. This conclusion rests on conservative assumptions, rather favorable to apprenticeship. Indeed, our estimate of the impact of the expansion of apprenticeship on the apprentice retention rate is based on the behavior of firms that train apprentices in the current system. It is likely



(A) Scenario 1

(B) Scenario 2

(C) Scenario 3

(D) Scenario 4

FIGURE 5: Retention rate of apprentices in training firms and share of apprentices

that the increase in apprenticeship attracts firms which have less interest in retaining their apprentices at the end of their training.

VII Conclusion

This paper finds that increasing workplace-based vocational education in construction and food services is of limited effectiveness in reducing youth unemployment in France beyond the consequences of the retention rate of apprentices in their training firm because the productivity difference between apprentices and vocational students is limited. Although external validity is always a contentious issue, we provide information indicating that the average school-to-work transitions of apprentices and vocational students is similar to those of cooks and bricklayers, suggesting that our results might be more widely relevant, for other professions in France. These results might also be relevant for countries in which apprenticeship is a type of training delivered within the formal vocational education scheme, with identical

vocational qualifications deliverable in different ways.[39] Indeed, economic theory shows that employers may have limited incentives to transmit to apprentices knowledge of value outside the training firm (Becker, 1964; Acemoglu and Pischke, 1998; Malcomson et al., 2003; Garicano and Rayo, 2017; Fudenberg and Rayo, 2019). When apprentices obtain the same diploma as vocational students and can leave their training firm after graduation, employers may have limited incentives to transmit more knowledge to their apprentices than that acquired by vocational students in the classroom. Otherwise, apprentices could easily benefit from a competitive advantage that would allow them to bargain wage increases after graduation. Hence, economic theory suggests that the absence of significant competitive advantage of apprentices with respect to vocational students observed in the French context might be true in other contexts where apprenticeship is a type of training delivered within the formal vocational education scheme.

Empirical evidence suggests that apprentices are selected and trained differently in firms in countries where apprenticeship is integrated in a dual system.[40] Hence, specific institutional features might explain the small comparative advantage for apprentices in France (Cahuc et al., 2014). Dustmann and Schönberg (2012) argue that the well-structured regulatory framework and monitoring institutions that exist in Germany entail that apprenticeship training schemes are more successful in countries like Germany rather than in Anglo-Saxon countries like the United Kingdom, because more firms are able to commit to training provision. Ryan (2000) stresses that the involvement of trade unions and employers' associations, which is different in these two types of country, may also play a role.[41]

Another key aspect of the success of the dual system is the existence of strong links between schools and firms, with the involvement of public employment services. This collaboration, which is almost non-existent in many OECD countries, is well developed in Japan and in Germany, which share important common attributes in this respect (Ryan (2001), p. 59) and which are very successful at integrating youths into employment. In Japan, where apprenticeship is very rare, high schools provide career support for their students.[42] Counselling and job search training are often part of senior high school curricula from the first year. In the second year of high school, many schools have specific career preparation classes for students

[39] Let us remind the reader that this system is in place in the following European countries: Belgium Finland, France, Hungary, Italy, Luxembourg, the Netherlands, Portugal, Romania, Spain, United-Kingdom.

[40] The involvement of employers who have strong interest in providing training specific to their sector may also explain the fact that individuals with a vocational qualification have a higher employment probability than those with a general qualification at the start of their career in OECD countries, but that this pattern can reverse in later life, as stressed by Forster et al. (2016) and Hanushek et al. (2017), although Brunello and Rocco (2017) show that empirical evidence on this issue is mixed.

[41] Available empirical evidence show cases where a large share of apprentices do not remain in their training firm in countries in which apprenticeship is a type of training delivered within the formal vocational education scheme. This share, which is around 65% in France, is around 80% in Spain (Bentolila et al. (2020)) and in Italy (Albanese et al. (2019)). It is lower in Germany, around 45% (Brébion (2017), OECD (2018)), where there is a dual-system with an apprenticeship-specific governance and apprenticeships-specific qualification.

[42] See OECD (2017), pp. 134 ss.

who do not intend to pursue higher education. In the third year of high school, aspiring labor market entrants undergo a regulated job placement process at school in which the teachers responsible for career guidance match students to the available positions based on vacancy lists provided by public employment agencies. The application process follows a strict schedule to promote equal opportunities among graduates and to ensure that students focus on completing their studies. Students are not allowed to seek work independently, and employers are expected to cooperate with public employment agencies when hiring future graduates. The job placement of high school graduates is remarkably effective, about 90%, and there is little evidence that it comes at the cost of lower job stability. In Germany, the Federal Employment Office recommends secondary school applicants to sponsoring employers. As in Japan, there are important interactions between schools and public employment agencies. The effectiveness of this strategy is also stressed by Noelke and Horn (2014) who argue that economic liberalization in post-socialist countries like Hungary has made the transition from vocational education to work more difficult by breaking linkages from schools to employers that performed a critical matching function.

Our findings suggest that the German-Japanese strategy targets an important cause of youth unemployment: the difficulty for job market entrants in finding jobs to which they are suited. Hence, improving the job placement of school leavers thanks to the involvement of public employment services in schools may be an important lever to boost youth employment whether in connection or in complement to the development of apprenticeship. More research is needed to better know the effectiveness of this lever.

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A Appendix

A.1 Examples of documents for applications

Application email messages (by layout)

For type 1 applications, the email message was the following:

Object: Application job offer n°XXX
Attached files: Curriculum_Vitae.pdf, Lettre_Motivation.pdf

Dear Madam, Sir,

With reference to your advertisement XXX for the position of YYY, I wish to submit my application.
Please find enclosed my cover letter and my resume. May I assure you, Madam, Sir, of my sincere gratitude.

First name, Last name
Phone number

For type 2 applications, the email message was the following:

Object: Application (job ads XXX)
Attached files: CV.pdf, LM.pdf

Dear Madam, Sir,

I am pleased to submit my application for the position of YYY following your advertisement XXX published on the website Pôle Emploi.
I am sending you in the attachment my resume and my cover letter.
May I assure you, Madam, Sir, that I remain faithfully yours.

First name, Last name
Phone number

Application reply email messages (by candidate)

For Alexis Dubois application reply, the email message was the following:

Greetings,

Thank you for your consideration of my application. However, I am unable to respond favourably. Indeed, I have accepted another offer.

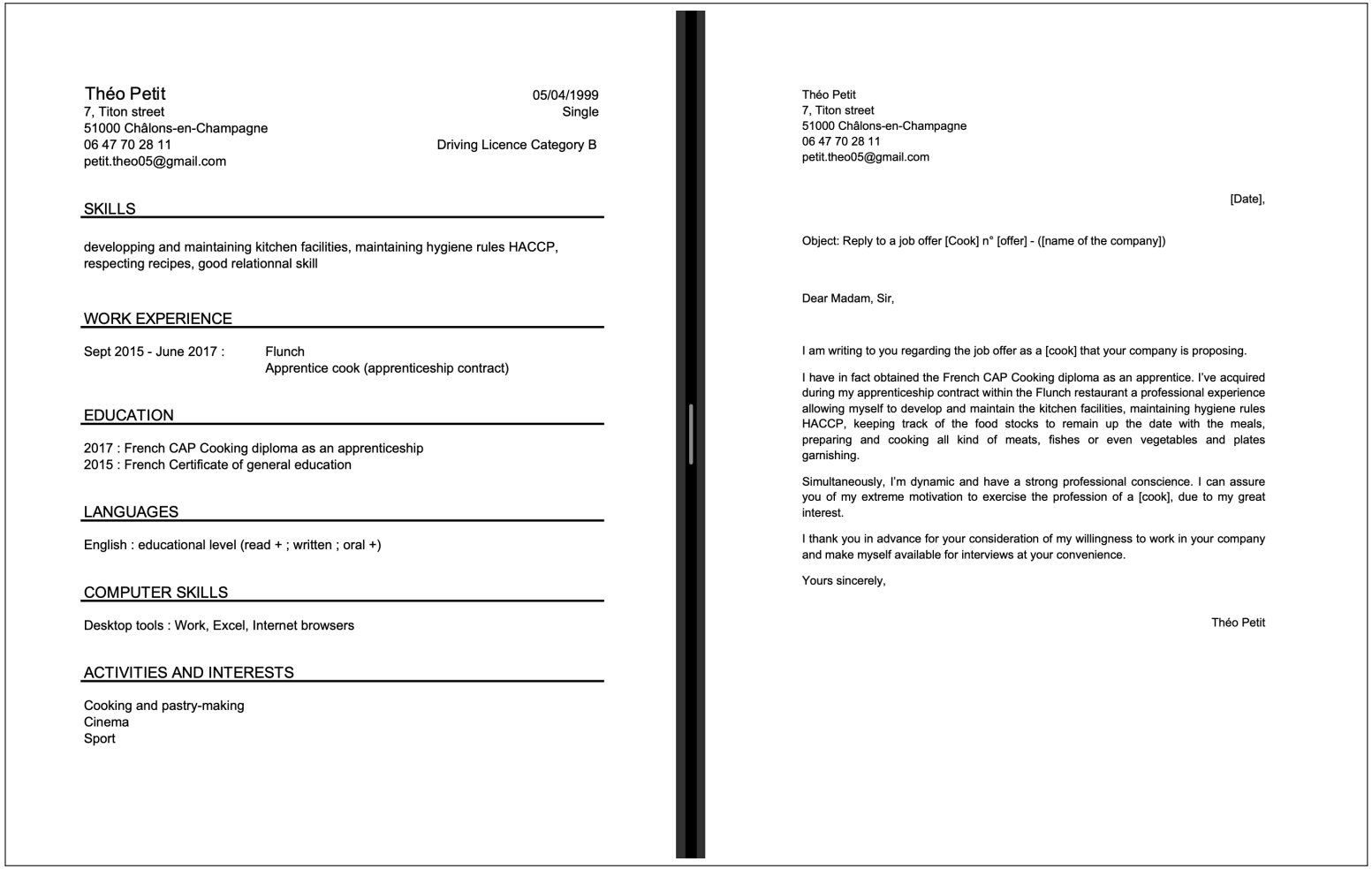
With kind regards,
Alexis Dubois

For Théo Petit application reply, the email message was the following:

Good morning,

I thank you for your answer regarding my application. Nevertheless, I have just accepted another offer.

Sincerely,
Théo Petit



Théo Petit
7, Titon street
51000 Châlons-en-Champagne
06 47 70 28 11
petit.theo05@gmail.com

05/04/1999
Single

Driving Licence Category B

SKILLS

developping and maintaining kitchen facilities, maintaining hygiene rules HACCP, respecting recipes, good relationnal skill

WORK EXPERIENCE

Sept 2015 - June 2017 : Flunch
Apprentice cook (apprenticeship contract)

EDUCATION

2017 : French CAP Cooking diploma as an apprenticeship
2015 : French Certificate of general education

LANGUAGES

English : educational level (read + ; written ; oral +)

COMPUTER SKILLS

Desktop tools : Work, Excel, Internet browsers

ACTIVITIES AND INTERESTS

Cooking and pastry-making
Cinema
Sport

Théo Petit
7, Titon street
51000 Châlons-en-Champagne
06 47 70 28 11
petit.theo05@gmail.com

[Date],

Object: Reply to a job offer [Cook] n° [offer] - ([name of the company])

Dear Madam, Sir,

I am writing to you regarding the job offer as a [cook] that your company is proposing.

I have in fact obtained the French CAP Cooking diploma as an apprentice. I've acquired during my apprenticeship contract within the Flunch restaurant a professional experience allowing myself to develop and maintain the kitchen facilities, maintaining hygiene rules HACCP, keeping track of the food stocks to remain up the date with the meals, preparing and cooking all kind of meats, fishes or even vegetables and plates garnishing.

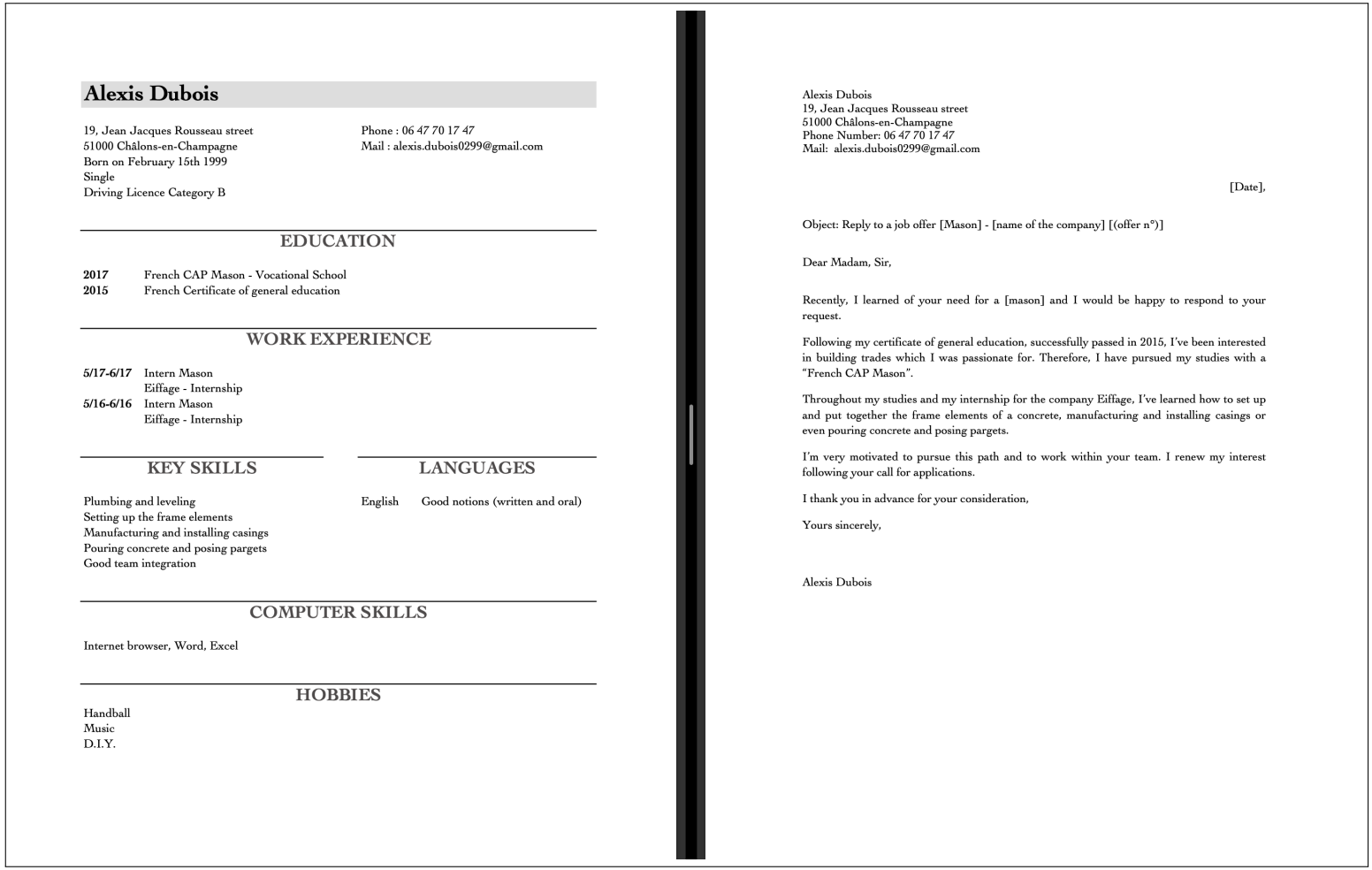
Simultaneously, I'm dynamic and have a strong professional conscience. I can assure you of my extreme motivation to exercise the profession of a [cook], due to my great interest.

I thank you in advance for your consideration of my willingness to work in your company and make myself available for interviews at your convenience.

Yours sincerely,

Théo Petit

FIGURE A.1.1: EXAMPLE OF CV AND COVER LETTER (COOK APPRENTICES - LAYOUT 1)



Alexis Dubois

19, Jean Jacques Rousseau street
51000 Châlons-en-Champagne
Born on February 15th 1999
Single
Driving Licence Category B

Phone : 06 47 70 17 47
Mail : alexis.dubois0299@gmail.com

EDUCATION

2017 French CAP Mason - Vocational School
2015 French Certificate of general education

WORK EXPERIENCE

5/17-6/17 Intern Mason
Eiffage - Internship
5/16-6/16 Intern Mason
Eiffage - Internship

KEY SKILLS

Plumbing and leveling
Setting up the frame elements
Manufacturing and installing casings
Pouring concrete and posing pargets
Good team integration

LANGUAGES

English Good notions (written and oral)

COMPUTER SKILLS

Internet browser, Word, Excel

HOBBIES

Handball
Music
D.I.Y.

Alexis Dubois
19, Jean Jacques Rousseau street
51000 Châlons-en-Champagne
Phone Number: 06 47 70 17 47
Mail: alexis.dubois0299@gmail.com

[Date],

Object: Reply to a job offer [Mason] - [name of the company] [(offer n°)]

Dear Madam, Sir,

Recently, I learned of your need for a [mason] and I would be happy to respond to your request.

Following my certificate of general education, successfully passed in 2015, I've been interested in building trades which I was passionate for. Therefore, I have pursued my studies with a "French CAP Mason".

Throughout my studies and my internship for the company Eiffage, I've learned how to set up and put together the frame elements of a concrete, manufacturing and installing casings or even pouring concrete and posing pargets.

I'm very motivated to pursue this path and to work within your team. I renew my interest following your call for applications.

I thank you in advance for your consideration,

Yours sincerely,

Alexis Dubois

Figure A.1.2: Example of CV and Cover Letter (Cook Students - layout 2)

A.2 Balancing table

Table A.2.1
Randomization tests

	Students (1)	Apprentices (2)	(3)
	Sample mean	Sample mean	p-value (2)-(1)
For-profit	.9489	.9505	.8407
Not-for-profit	.0510	.0494	.8407
Primary sector	.0006	.0006	.9940
Secondary sector	.0006	.0000	.3148
Tertiary sector	.8477	.8320	.2422
Construction sector	.1509	.1673	.2212
Small firm (vs large firm)	.6146	.6141	.9781
Permanent contract (vs temporary)	.4051	.4227	.3213
Full-time job	.9395	.9342	.5406
Part-time job	.0604	.0657	.4060
No diploma required	.0468	.0602	.2239
Cap required	.9261	.9084	.1872
Bac required	.0269	.0313	.5949
Male recruiter (vs female recruiter)	.6229	.6120	.5398

Note: This Table reports means across subsamples of the experimental sample and presents randomization tests based on comparing the means across subsamples. Column (3) displays the p-value for the test $H_0 : \{\Delta = \text{mean\_callback[apprentices] - mean\_callback[students]} = 0\}$ vs $H_1 : \{\Delta \neq 0\}$.

A.3 Probit model

Table A.3.1
Marginal Effects of Apprenticeship on the Probability of Callback

	All applicants			Cook	Bricklayer
	(1)	(2)	(3)	(4)	(5)
Dep var: Positive callback					
Apprenticeship	0.00849	0.00809	0.0102	0.0195	-0.0367
	(0.0170)	(0.0167)	(0.0172)	(0.0198)	(0.0536)
Dep var: Proposition					
Apprenticeship	0.0106	0.0102	0.0123	0.0242	-0.0501
	(0.0146)	(0.0144)	(0.0145)	(0.0168)	(0.0537)
Observations	3,110	3,105	3,105	2,531	447
Month FE	No	Yes	Yes	Yes	Yes
Department FE	No	No	Yes	Yes	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. Reported estimates are marginal effects from a Probit model. Robust standard errors are clustered at the department level and reported below the coefficients.

A.4 Callbacks to applications from large and small firms

Employers in small and large firms might have different preferences for apprentices versus vocational students, implying that the similarity of callback rates for apprentices and vocational students observed at the aggregate level could be the consequence of composition effects, stemming from relatively high callback rates for apprentices in small firms and relatively low callback rates for apprentices in large firms. Indeed, apprentices might be more valuable in small firms, which need workers who are immediately productive and have less possibility to provide complementary on-the-job training. It is also likely that vocational students, whose education is more classroom-oriented than that of apprentices, have more transferable skills, which could be more valuable for large firms which can offer more varieties of jobs.

Table A.4.1 shows that there is no difference in the callback rates of apprentices and vocational students between large and small firms. Therefore, the absence of difference between callback rates of apprentices and vocational students observed at the aggregate level is not the consequence of composition effects in the population of firms stemming from different behaviors of small and large firms.[43]

[43] Similar results are displayed in Tables A.8.1.3 and A.8.2.3 for cooks and bricklayers respectively.

TABLE A.4.1

EFFECTS OF APPRENTICESHIP ON CALLBACK PROBABILITY GIVEN DIFFERENT FIRM SIZES

	Small Firms			Large Firms		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep var: Positive callback						
Apprenticeship	0.0316	0.0252	0.0294	0.00396	0.00223	-0.00428
	(0.0293)	(0.0307)	(0.0328)	(0.0212)	(0.0211)	(0.0223)
Student mean	0.2984***	0.2984***	0.2984***	0.2652***	0.2652***	0.2652***
	(0.0204)	(0.0204)	(0.0204)	(0.0156)	(0.0156)	(0.0156)
Observations	1,015	1,015	1,015	1,617	1,617	1,617
R-squared	0.001	0.009	0.116	0.000	0.003	0.071
Dep var: Proposition						
Apprenticeship	0.0201	0.0139	0.0183	0.00534	0.00484	-0.000404
	(0.0268)	(0.0276)	(0.0306)	(0.0195)	(0.0197)	(0.0205)
Student mean	0.2549***	0.2549***	0.2549***	0.2243***	0.2243***	0.2243***
	(0.0194)	(0.0194)	(0.0194)	(0.0147)	(0.0147)	(0.0147)
Observations	1,015	1,015	1,015	1,617	1,617	1,617
R-squared	0.001	0.009	0.122	0.000	0.003	0.059
Month FE	No	Yes	Yes	No	Yes	Yes
Department FE	No	No	Yes	No	No	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. Small firms have less than 10 employees and large firms have at least 10 employees. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

A.5 Callbacks to applications for temporary and permanent jobs

It is possible that temporary jobs, which need employees immediately operational, are more suited for apprentices than for vocational students, whose abilities are less operational inasmuch they have much less work experience. On the other hand, permanent jobs, often associated with career perspectives within the firm, could be more suited for vocational students, whose spectrum of competencies might be wider than that of apprentices. Hence, one could expect that employers favor apprentices relative to vocational students for temporary jobs and make the opposite choice for permanent jobs.

Table A.5.1 reports the callback rates for temporary and permanent jobs. The similarity of callback rates for apprentices and vocational students observed at the aggregate level is also observed for temporary jobs and permanent jobs.[44]

[44]Similar results are displayed in Tables A.8.1.4 and A.8.2.4 for cooks and bricklayers respectively.

TABLE A.5.1

EFFECTS OF APPRENTICESHIP ON CALLBACK PROBABILITY GIVEN DIFFERENT CONTRACTS

	Temporary Jobs			Permanent Jobs		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep var: Positive callback						
Apprenticeship	0.0237	0.0227	0.0259	-0.0117	-0.0131	-0.00694
	(0.0198)	(0.0194)	(0.0198)	(0.0255)	(0.0259)	(0.0274)
Student mean	0.2871***	0.2871***	0.2871***	0.2564***	0.2564***	0.2464***
	(0.0150)	(0.0150)	(0.0150)	(0.0175)	(0.0175)	(0.0175)
Observations	1,820	1,820	1,820	1,286	1,286	1,286
R-squared	0.001	0.006	0.065	0.000	0.004	0.083
Dep var: Proposition						
Apprenticeship	0.0208	0.0205	0.0238	-0.00363	-0.00544	0.00293
	(0.0174)	(0.0175)	(0.0181)	(0.0245)	(0.0246)	(0.0261)
Student mean	0.2336***	0.2336***	0.2336***	0.2212***	0.2212***	0.2212***
	(0.0140)	(0.0140)	(0.0140)	(0.0166)	(0.0166)	(0.0166)
Observations	1,820	1,820	1,820	1,286	1,286	1,286
R-squared	0.001	0.004	0.061	0.000	0.004	0.091
Month FE	No	Yes	Yes	No	Yes	Yes
Department FE	No	No	Yes	No	No	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. Temporary jobs comprise all offers for a seasonal contract or a determined duration contract. Permanent jobs are the complement. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

A.6 Spontaneous applications

A.6.1 Examples of documents for spontaneous applications

Application email messages (by name)

The email message was the following:

Object: Application for a position of [cook/bricklayer]
Attached files: Curriculum_Vitae.pdf/CV.pdf, Lettre_Motivation.pdf/LM.pdf

Dear Madam, Sir,

I saw on the Internet that you have some personnel working as [cook/bricklayer]. I am interested by such position in your firm.
Please find enclosed my cover letter and my resume. May I assure you, Madam, Sir, of my sincere gratitude.

First name, Last name
Phone number

Application reply email messages (by name)

The email message was the following:

Good morning,

I thank you for your answer regarding my application. Nevertheless, I have just accepted another offer.

Sincerely,
First name, Last name

Alexis Dubois
19, rue Jean Jacques Rousseau
51000 Châlons-en-Champagne
06 86 03 99 06
dubois.alexis1502@gmail.com

15/02/1999
Single
Driving Licence Category B

SKILLS

developping and maintaining kitchen facilities, maintaining hygiene rules HACCP, respecting recipes, good relationnal skill

WORK EXPERIENCE

Sept 2016 - June 2018 : Flunch
Apprentice Cook (apprenticeship contract)

EDUCATION

2018 : French CAP Cooking diploma as an apprenticeship
2016 : French Certificate of general education

LANGUAGES

English : education level (read + ; written ; oral +)

COMPUTER SKILLS

Desktop tools: Work, Excel, Internet browsers

ACTIVITIES AND INTERESTS

Cooking and pastry-making
Cinema
Sport

Alexis Dubois
19, rue Jean Jacques Rousseau
51000 Châlons-en-Champagne
06 86 03 99 06
dubois.alexis1502@gmail.com

Object: Spontaneous application for a cook position.

Dear Madam, Sir,

I am writing to you regarding a potential position of cook within your company.

I have in fact obtained the French CAP Cooking diploma as an apprentice. I've acquired during my apprenticeship contract within the Flunch restaurant a professional experience allowing myself to develop and maintain the kitchen facilities, maintaining the hygiene rules HACCP, keeping track of the food stocks to remain up the date with the meals, preparing and cooking all kind of meats, fishes or even vegetables and plates garnishing.

Simultaneously, I'm dynamic and have a strong professional conscience. I can assure you of my extreme motivation to exercise the professional of a cook, due to my great interest.

I thank you in advance for your consideration of my willingness to work in your company and make myself available for interviews at your convenience.

Alexis Dubois

FIGURE A.6.1: EXAMPLE OF CV AND COVER LETTER (COOK APPRENTICES - LAYOUT 1)

Théo Petit

7, rue Titon
51000 Châlons-en-Champagne
Né le 5 avril 1999
Single
Driving Licence Category B

Tel : 06 86 07 05 33
Email : theo.petit0504@gmail.com

EDUCATION

2018 French CAP Mason - Vocational School
2016 French Certificate of general education

WORK EXPERIENCE

5/18-6/18 Intern Mason
Eiffage - Internship
5/17-6/17 Intern Mason
Eiffage - Internship

KEY SKILLS

Plumbing and leveling
Setting up the frame elements
Manufacturing and installing casings
Pouring concrete and posing pargets
Good team integration

LANGUAGES

English Good notions (written and oral)

COMPUTER SKILLS

Internet browser, Word, Excel

HOBBIES

Handball
Music
D.I.Y

Théo Petit
7, rue Titon
51000 Châlons-en-Champagne
Phone Number: 06 86 07 05 33
Mail: theo.petit0504@gmail.com

Object : Spontaneous application to a bricklayer position

Dear Madam, Sir,

I am sending, by this letter, my application to a position of mason within your company.

Following my certificate of general education, successfully passed in 2015, I've been interested in building trades which I was passionate for. Therefore, I have pursued my studies with a "French CAP Mason".

Throughout my studies and my internship for the company Eiffage, I've learned how to set up and put together the frame elements of a concrete, manufacturing and installing casings or even pouring concrete and posing pargets.

I'm very motivated to pursue this path and to work within your team. I renew my interest following your call for applications.

I thank you in advance for your consideration.

Yours sincerely,

Théo Petit

FIGURE A.6.2: EXAMPLE OF CV AND COVER LETTER (COOK STUDENTS - LAYOUT 2)

A.6.2 Econometric analyses

This appendix presents the results of a correspondence study relying on unsolicited applications which allows us to get a larger number of observations. As stated in Section III.B, the relatively low number of applications for bricklayers comes from the management of job vacancies by temporary work agencies. Another concern related to our experiment would be about the type of firms targeted by our applications. We sent applications only to firms that posted job vacancies online. This rules out firms that hire workers through other channels. Accordingly, we considered spontaneous applications as a second channel of application. We sent our fictitious profiles to firms operating in the same two occupations (cook and bricklayer) without answering to any job ads.

We scrapped a list of firms that have workers in these occupations from the Internet.[45] Then, we cleaned this list to ensure that firms did not receive a previous application from our initial testing. Once this list was completed, we changed some sentences in the cover letter and the email of the application to match a spontaneous testing.[46] We still randomized the profile, the template and the name of fictitious applicant sent to a firm. In addition to the initial testing, we additionally picked a random date and time of sending.[47] Each firm received also one application to avoid detection. We ended up sending 4,076 spontaneous applications to firms from October to December 2018.

We consider the same outcome variables and specifications as in Section IV.A, where we analyze the overall callback differences between apprentices and students. Results reported in Table A.6.1 show that the average callback rate for a vocational student is about 8%, which is lower than when applying to a job vacancy. Here again, there is no statistical difference between the positive callback rates of apprentices and students. The situation is even worse for apprentices when restricting the outcome variable to proposition for job interviews only. Apprentices have a lower callback rate by 1.5 percentage points on average than students. This does not necessarily imply differences in the probability of hiring as it is likely that employers want to know before proposing an interview the reasons why apprentices, who are supposed to have better job opportunities than students, send unsolicited applications . From this point of view, callback rates are more relevant than propositions for job interview to compare the hiring probability of apprentices and students when applications are spontaneous. Table A.6.2 reports the results for the sample including the observations from the initial testing and from the spontaneous applications. Like in the initial testing, no significant difference between apprentices and students arises for positive callback and proposition for interview.

Tables A.6.3 and A.6.4 in Appendix A.6.2 replicate results of Table V about the impact of local market conditions for spontaneous applications. Like in the initial testing, point estimates indicate that the relative situation of apprentices is better when the local unemployment rate is higher, but the differences between labor markets with high and low unemployment rates are not statistically significant. This result is consistent with the prediction of our model according to which firms decide to interview students when they do not get applications of apprentices. Unsolicited applications, unlike applications that respond to job offers, are not necessarily addressed to firms that receive a large number of applications from which they can select the candidates for which they have a slight

[45] We extracted information including the zip code, the phone number and the contact email address from *Qualibat* and *La Bonne Boite* websites.

[46] See Appendix A.6.1 for examples of unsolicited emails and cover letters.

[47] The date was randomly drawn from Monday to Friday and the time was randomly drawn from 8 am to 9 pm, as this was the rule in the initial correspondence study.

Table A.6.1

Effects of apprenticeship on callback probability for spontaneous applications

	All applicants			Cook	Bricklayer
	(1)	(2)	(3)	(4)	(5)
Dep var: Positive callback					
Apprenticeship	-0.0112	-0.0110	-0.0105	-0.0135	-0.0099
	(0.0080)	(0.0079)	(0.0081)	(0.0130)	(0.0111)
Student mean	0.0804***	0.0804***	0.0804***	0.0850***	0.0760***
	(0.0060)	(0.0060)	(0.0060)	(0.0088)	(0.0082)
Observations	4,076	4,076	4,076	1,990	2,086
R-squared	0.000	0.001	0.030	0.054	0.057
Dep var: Proposition					
Apprenticeship	-0.0148**	-0.0147**	-0.0144**	-0.0190	-0.0122
	(0.0065)	(0.0065)	(0.0065)	(0.0114)	(0.0097)
Student mean	0.0711***	0.0711***	0.0711***	0.0741***	0.0683***
	(0.0057)	(0.0057)	(0.0057)	(0.0082)	(0.0078)
Observations	4,076	4,076	4,076	1,990	2,086
R-squared	0.001	0.002	0.034	0.064	0.061
Month FE	No	Yes	Yes	Yes	Yes
Department FE	No	No	Yes	Yes	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition when it was sent spontaneously to a firm. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

preference, even when the local unemployment rate is high.

All in all, these results confirm those of the initial testing according to which there is almost no difference between the probability of getting a callback from employers for unemployed youth formerly either apprentices or vocational students.

Table A.6.2
Effects of apprenticeship on callback probability for all applications

	All applicants			Cook	Bricklayer
	(1)	(2)	(3)	(4)	(5)
Dep var: Positive callback					
Apprenticeship	-0.0027	-0.0029	-0.0021	0.0036	-0.0120
	(0.0093)	(0.0093)	(0.0094)	(0.0125)	(0.0114)
Spontaneous	-0.2040***	-0.1944***	-0.1939***	-0.1629***	-0.1950***
	(0.0105)	(0.0525)	(0.0543)	(0.0320)	(0.0543)
Constant	0.2801***	0.2748***	0.2741***	0.2960***	0.2551***
	(0.0124)	(0.0295)	(0.0309)	(0.0622)	(0.0315)
Observations	7,186	7,186	7,186	4,532	2,654
R-squared	0.0748	0.0772	0.0957	0.0980	0.0942
Dep var: Proposition					
Apprenticeship	-0.0038	-0.0041	-0.0028	0.0043	-0.0145
	(0.0080)	(0.0080)	(0.0080)	(0.0109)	(0.0104)
Spontaneous	-0.1700***	-0.1037**	-0.1022**	-0.1360***	-0.0922**
	(0.0104)	(0.0455)	(0.0467)	(0.0315)	(0.0459)
Constant	0.2357***	0.1982***	0.1967***	0.2612***	0.1799***
	(0.0114)	(0.0265)	(0.0269)	(0.0609)	(0.0274)
Observations	7,186	7,186	7,186	4,532	2,654
R-squared	0.0599	0.0622	0.0825	0.0872	0.0826
Month FE	No	Yes	Yes	Yes	Yes
Department FE	No	No	Yes	Yes	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition when it was sent spontaneously to a firm. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

TABLE A.6.3
EFFECTS OF APPRENTICESHIP FOR SPONTANEOUS APPLICATIONS IN DIFFERENT LABOR MARKETS

	All	T1 (7.3%)	T2 (8.5%)	T3 (10.6%)
	(1)	(2)	(3)	(4)
Dep var: Positive callback				
Apprenticeship	-0.0133	-0.0316	-0.0123	0.0008
	(0.0097)	(0.0200)	(0.0205)	(0.0130)
Student mean	0.0819***	0.1064***	0.0949***	0.0454***
	(0.0072)	(0.0142)	(0.0133)	(0.0095)
Observations	2,859	953	953	953
R-squared	0.038	0.050	0.101	0.078
Dep var: Proposition				
Apprenticeship	-0.0163*	-0.0329*	-0.0156	-0.0008
	(0.0084)	(0.0197)	(0.0163)	(0.0110)
Student mean	0.0722***	0.0958***	0.0825***	0.0392***
	(0.0068)	(0.0136)	(0.0125)	(0.0088)
Observations	2,859	953	953	953
R-squared	0.042	0.053	0.124	0.069
Month & Department FE	Yes	Yes	Yes	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. TX corresponds to the Xth tercile of the unemployment rate at the commuting zone level. Youth unemployment rates are computed from the French labor force survey, for youth aged 16 to 25, with secondary school vocational diploma, over 2014-2018 to get a sufficient number of observations at the commuting zone level. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

Table A.6.4
Effects of apprenticeship for all applications in different labor markets

	All	T1 (7.2%)	T2 (8.4%)	T3 (10.5%)
	(1)	(2)	(3)	(4)
Dep var: Positive callback				
Apprenticeship	-0.0027	-0.0026	-0.0187	0.0147
	(0.0116)	(0.0230)	(0.0181)	(0.0151)
Spontaneous	-0.1950***	-0.1286	-0.2775**	-0.1166
	(0.0572)	(0.1285)	(0.1153)	(0.0782)
Constant	0.2839***	0.2393***	0.2951***	0.1838***
	(0.0329)	(0.0769)	(0.0664)	(0.0458)
Observations	5,672	1,913	1,872	1,887
R-squared	0.1049	0.1330	0.1209	0.1106
Dep var: Proposition				
Apprenticeship	-0.0024	-0.0054	-0.0130	0.0138
	(0.0097)	(0.0215)	(0.0151)	(0.0126)
Spontaneous	-0.1152**	-0.1317	-0.2043**	0.0179
	(0.0510)	(0.1270)	(0.0968)	(0.0526)
Constant	0.2110***	0.2298***	0.2356***	0.0886***
	(0.0297)	(0.0756)	(0.0560)	(0.0308)
Observations	5,672	1,913	1,872	1,887
R-squared	0.0910	0.1199	0.1111	0.0999
Month & Department FE	Yes	Yes	Yes	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. TX corresponds to the Xth tercile of the unemployment rate at the commuting zone level. Youth unemployment rates are computed from the French labor force survey, for youth aged 16 to 25, with secondary school vocational diploma, over 2014-2018 to get a sufficient number of observations at the commuting zone level. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

A.7 External validity of the results of the correspondence study

Table A.7.1
OLS Regressions

Situations	All Years			3 Years After		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep var: Employment						
Apprenticeship	0.145***	0.0789***	0.0336	0.118***	0.0459	0.0211
	(0.0224)	(0.0240)	(0.0238)	(0.0279)	(0.0303)	(0.0307)
Male		0.0908***	0.0756***		0.0635*	0.0552*
		(0.0261)	(0.0249)		(0.0330)	(0.0323)
Driving license		0.0931***	0.101***		0.121***	0.125***
		(0.0230)	(0.0216)		(0.0291)	(0.0288)
Graduated		0.0852**	0.0676*		0.0803	0.0709
		(0.0419)	(0.0391)		(0.0532)	(0.0521)
Firm retention			0.259***			0.142***
			(0.0236)			(0.0338)
Constant	0.551***	0.549***	0.572***	0.602***	0.621***	0.632***
	(0.0159)	(0.0241)	(0.0231)	(0.0203)	(0.0197)	(0.0196)
Observations	42,318	42,318	42,318	8,771	8,771	8,771
R-squared	0.022	0.172	0.204	0.016	0.214	0.224
Dep var: Unemployment						
Apprenticeship	-0.0888***	-0.0574***	-0.0210	-0.0776***	-0.0413	-0.0246
	(0.0206)	(0.0218)	(0.0217)	(0.0250)	(0.0274)	(0.0276)
Male		-0.0424*	-0.0303		-0.0190	-0.0134
		(0.0244)	(0.0237)		(0.0302)	(0.0300)
Driving license		-0.0813***	-0.0877***		-0.111***	-0.114***
		(0.0211)	(0.0203)		(0.0264)	(0.0263)
Graduated		-0.0728*	-0.0586		-0.0385	-0.0321
		(0.0397)	(0.0380)		(0.0516)	(0.0509)
Firm retention			-0.208***			-0.0959***
			(0.0208)			(0.0284)
Constant	0.328***	0.338***	0.319***	0.281***	0.283***	0.275***
	(0.0148)	(0.0248)	(0.0240)	(0.0184)	(0.0184)	(0.0182)
Observations	42,318	42,318	42,318	8,771	8,771	8,771
R-squared	0.010	0.147	0.171	0.008	0.183	0.189
Other control Variables	No	Yes	Yes	No	Yes	Yes

Note: This table reports OLS estimates, where the dependent variable is a dummy variable equal to one if the individual is in employment, zero otherwise. "Apprenticeship" is a dummy variable equal to one if the individual has followed his vocational education as an apprentice. Columns (1) to (3) include all available years after leaving school, while columns (4) to (6) yield results three years after leaving school. We control for additional covariates in columns (2), (3), (5), and (6). Unreported control variables include demeaned dummies for the age at school end, being disabled, school level of father, school level of mother, father in employment, mother in employment, birthplace of father, birthplace of mother, department of residency, region of the training establishment, speciality of training, date. Firm retention is a demeaned dummy variable equal to one if the individual has been retained by his training firm after ending school. Robust standard errors are clustered at the individual level and presented in parentheses below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Source: pooled *Génération 2001-2007-2010-2013* surveys, CEREQ

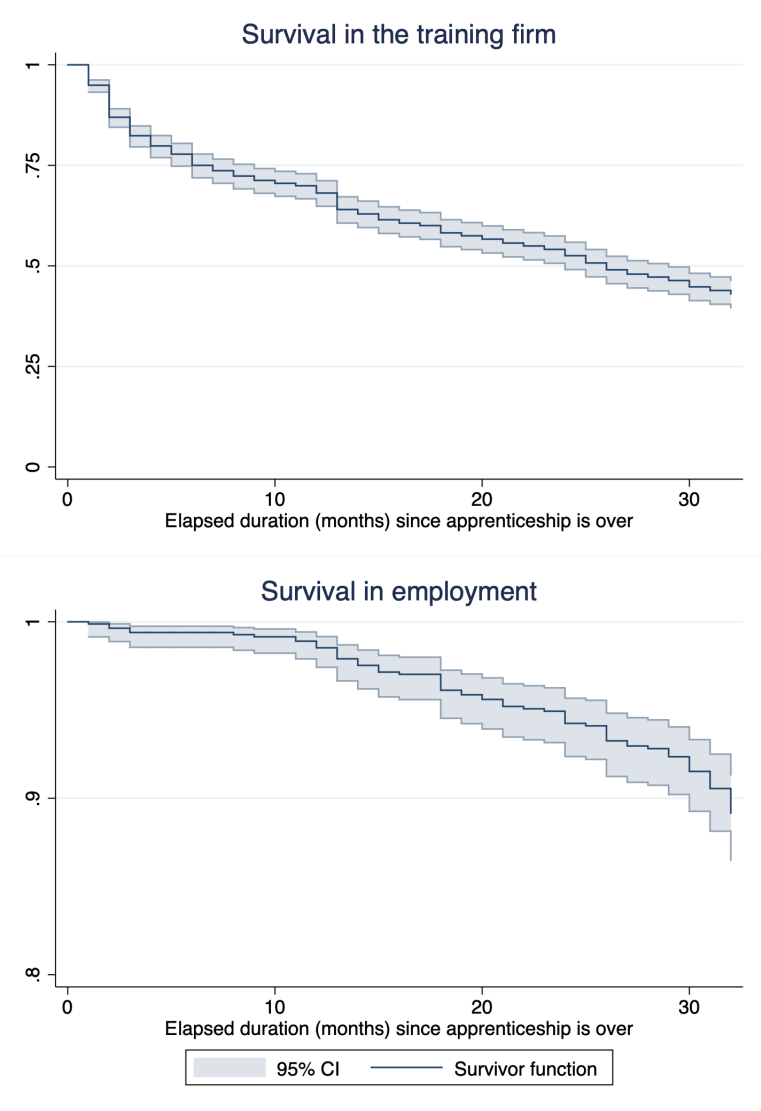


FIGURE A.7.1: EVOLUTION OF THE SHARE OF APPRENTICES IN EMPLOYMENT WITHIN THEIR TRAINING FIRM (TOP) OR IN ANY FIRM (BOTTOM) OVER TIME.
Note: the sample is composed of apprentices retained by their training right after their apprenticeship training.
Source: pooled *Génération 2001-2007-2010-2013* surveys, CEREQ.

A.8 Replicates of tables by selected occupation

A.8.1 Cook

Table A.8.1.1
Description of the cook occupation

Occupation	**Cook**				
Diploma	CAP Cuisine				
Definition	The owner of the diploma can work in any kind of cuisine under the authority of a chef				
Uniting	**Activities**	**Skills**	**Exams**		
			Modality	**Tests**	**Coeff.**
Organization of the production in the cuisine	Participating in supply operations	Accept, control, and store the supplies	Continuous evaluation	4 case studies as written exams + 1 interview in the 2nd year	4
	Contributing to organize food preparation	Collect all the information for the recipe			
Preparation and delivery of the cuisine production	Organizing the kitchen quarters	Prepare, organize and manage the kitchen quarters all along the recipe	Continuous evaluation	1 real situation in the training center + 1 interview in the training firm	14
	Applying basic food skills	Master food techniques to realize the production			
	Engaging in food production	Analyze, control the quality of the food production and send it			
	Communicating in a professional environment	Respect the usage of the profession			
Health, environment			Continuous evaluation	1 written exam + 1 practical exam	1
French, History, Geography, and Moral			Continuous evaluation	1 written exam in French + 1 oral exam in History, Geography, and Moral	3
Mathematics, Physics, and Chemistry			Continuous evaluation	1 written exam in Maths + 2 practical exams in Physics & Chemistry	2
Sport			Continuous evaluation	3 evaluations	1
Foreign language			Continuous evaluation	1 written exam + 1 oral exam + 1 restitution exam	1

Source: *Arrêté du 17 mars 2016 portant création de la spécialité cuisine du certificat d'aptitude professionnelle et fixant ses modalités de délivrance.*

Table A.8.1.2

Statistical portrait of students and apprentices in food services

Component	Information	Students	Apprentices
		31.43%	**68.57%**
Individual	Sex (male)	43.52%	54.47%
	Age	18.5 y.o.	20 y.o.
	Handicap	7.17%	9.82%
	Driving license	16.23%	30.96%
Family	District area		
	Downtown	32.52%	28.22%
	Suburb	31.99%	36.19%
	Small city	9.70%	13.77%
	Village	25.79%	21.82%
	Siblings	89.89%	95.17%
	French language	89.93%	96.41%
	Birthplace of father		
	France	76.43%	85.32%
	European countries	5.59%	3.94%
	Arabic countries	8.54%	8.72%
	African countries	4.40%	0.73%
	Rest of the world	5.05%	1.29%
	Birthplace of mother		
	France	78.35%	89.23%
	Europe	6.42%	2.02%
	Arabic countries	6.59%	7.93%
	African countries	4.33%	0.82%
	Rest of the world	4.31%	0.00%
	School level of father		
	No diploma	28.96%	43.76%
	Cap/Bep	54.79%	36.23%
	Bac	10.46%	14.76%
	Bac+	5.78%	5.24%
	School level of mother		
	No diploma	45.17%	33.18%
	Cap/Bep	37.95%	45.30%
	Bac	13.83%	15.21%
	Bac+	3.04%	6.30%
	Father works	85.75%	82.64%
	Mother works	63.91%	72.02%
Education	Repeater year before 6th grade	51.46%	46.90%
	Normal middle school program	34.24%	67.01%
	Would have preferred apprenticeship	52.84%	-
	Reason of non-apprenticeship		
	No CFA	0.00%	-
	No employer	28.16%	-
	Neither CFA, nor employer	32.70%	-
	Other	39.14%	-
	Internships / Apprenticeship Tutor	72.50%	-
	Number of internships		
	1	12.57%	-
	2	34.73%	-
	3 or more	52.70%	-
	Contact with the (last) training firm		
	Self	29.29%	-
	Family and friends	13.28%	-
	School / Apprenticeship center	46.90%	-
	Other Public Structure	0.95%	-
	Other	9.59%	-
	Graduated	93.66%	85.85%

Note: This table reports descriptive statistics for both apprentices and vocational students in the food services. Shares of students who made interships and the mode of contact with the last training firm are computed from the *Génération 2010* survey only because of the specific questions. The share of graduated students and apprentices are computed with both the *Génération 2010-2013* surveys because of changes in the content of the level V diploma in 2009 in France.

Source: pooled *Génération 2001-2007-2010-2013* surveys, CEREQ ($N = 445$ individuals)

Table A.8.1.3

Effects of apprenticeship on the probability of getting a callback given the size of firms for cook

	Small Firms			Large Firms		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep var: Positive callback						
Apprenticeship	0.0322	0.0258	0.0257	0.0220	0.0208	0.0155
	(0.0314)	(0.0328)	(0.0352)	(0.0247)	(0.0245)	(0.0258)
Student mean	0.3141***	0.3141***	0.3141***	0.2644***	0.2644***	0.2644***
	(0.0223)	(0.0223)	(0.0223)	(0.0174)	(0.0174)	(0.0174)
Observations	872	872	872	1,268	1,268	1,268
R-squared	0.001	0.013	0.139	0.001	0.003	0.078
Dep var: Proposition						
Apprenticeship	0.0191	0.0126	0.0119	0.0272	0.0263	0.0235
	(0.0285)	(0.0291)	(0.0329)	(0.0225)	(0.0224)	(0.0231)
Student mean	0.2679***	0.2679***	0.2679***	0.2208***	0.2208***	0.2208***
	(0.0213)	(0.0213)	(0.0213)	(0.0164)	(0.0164)	(0.0164)
Observations	872	872	872	1,268	1,268	1,268
R-squared	0.000	0.014	0.147	0.001	0.002	0.062
Month FE	No	Yes	Yes	No	Yes	Yes
Department FE	No	No	Yes	No	No	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. Small firms have less than 10 employees and large firms have at least 10 employees. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

Table A.8.1.4

Effects of apprenticeship on the probability of getting a callback for temporary and permanent jobs for cook

	Temporary Jobs			Permanent Jobs		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep var: Positive callback						
Apprenticeship	0.0218	0.0190	0.0190	0.0128	0.0130	0.0176
	(0.0226)	(0.0222)	(0.0231)	(0.0281)	(0.0284)	(0.0294)
Student mean	0.2949***	0.2949***	0.2949***	0.2542***	0.2542***	0.2542***
	(0.0162)	(0.0162)	(0.0162)	(0.0199)	(0.0199)	(0.0199)
Observations	1,558	1,558	1,558	982	982	982
R-squared	0.001	0.007	0.076	0.000	0.004	0.117
Dep var: Proposition						
Apprenticeship	0.0193	0.0170	0.0199	0.0244	0.0245	0.0313
	(0.0204)	(0.0203)	(0.0214)	(0.0267)	(0.0266)	(0.0275)
Student mean	0.2409***	0.2409***	0.2409***	0.2167***	0.2167***	0.2167***
	(0.0152)	(0.0152)	(0.0152)	(0.0188)	(0.0188)	(0.0188)
Observations	1,558	1,558	1,558	982	982	982
R-squared	0.000	0.006	0.081	0.001	0.004	0.122
Month FE	No	Yes	Yes	No	Yes	Yes
Department FE	No	No	Yes	No	No	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. Temporary jobs comprise all offers for a seasonal contract or a determined duration contract. Permanent jobs are the complement. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

Table A.8.1.5

Effects of apprenticeship on callback probability given different unemployment rates at the commuting zone level for cook

	All	T1 (7.2%)	T2 (8.5%)	T3 (10.8%)
	(1)	(2)	(3)	(4)
Dep var: Positive callback				
Apprenticeship	0.0293	0.0411	-0.0119	0.0508*
	(0.0217)	(0.0472)	(0.0406)	(0.0270)
Student mean	0.3029***	0.3576***	0.3127***	0.2386***
	(0.0151)	(0.0276)	(0.0258)	(0.0244)
Observations	1,869	621	616	632
R-squared	0.083	0.105	0.104	0.097
Dep var: Proposition				
Apprenticeship	0.0259	0.0200	0.0179	0.0339
	(0.0185)	(0.0410)	(0.0361)	(0.0220)
Student mean	0.2567***	0.3113***	0.2508***	0.2092***
	(0.0143)	(0.0267)	(0.0242)	(0.0233)
Observations	1,869	621	616	632
R-squared	0.078	0.087	0.103	0.099
Month & Department FE	Yes	Yes	Yes	Yes
Firm & Job Characteristics FE	Yes	Yes	Yes	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. TX corresponds to the Xth tercile of the unemployment rate at the commuting zone level. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

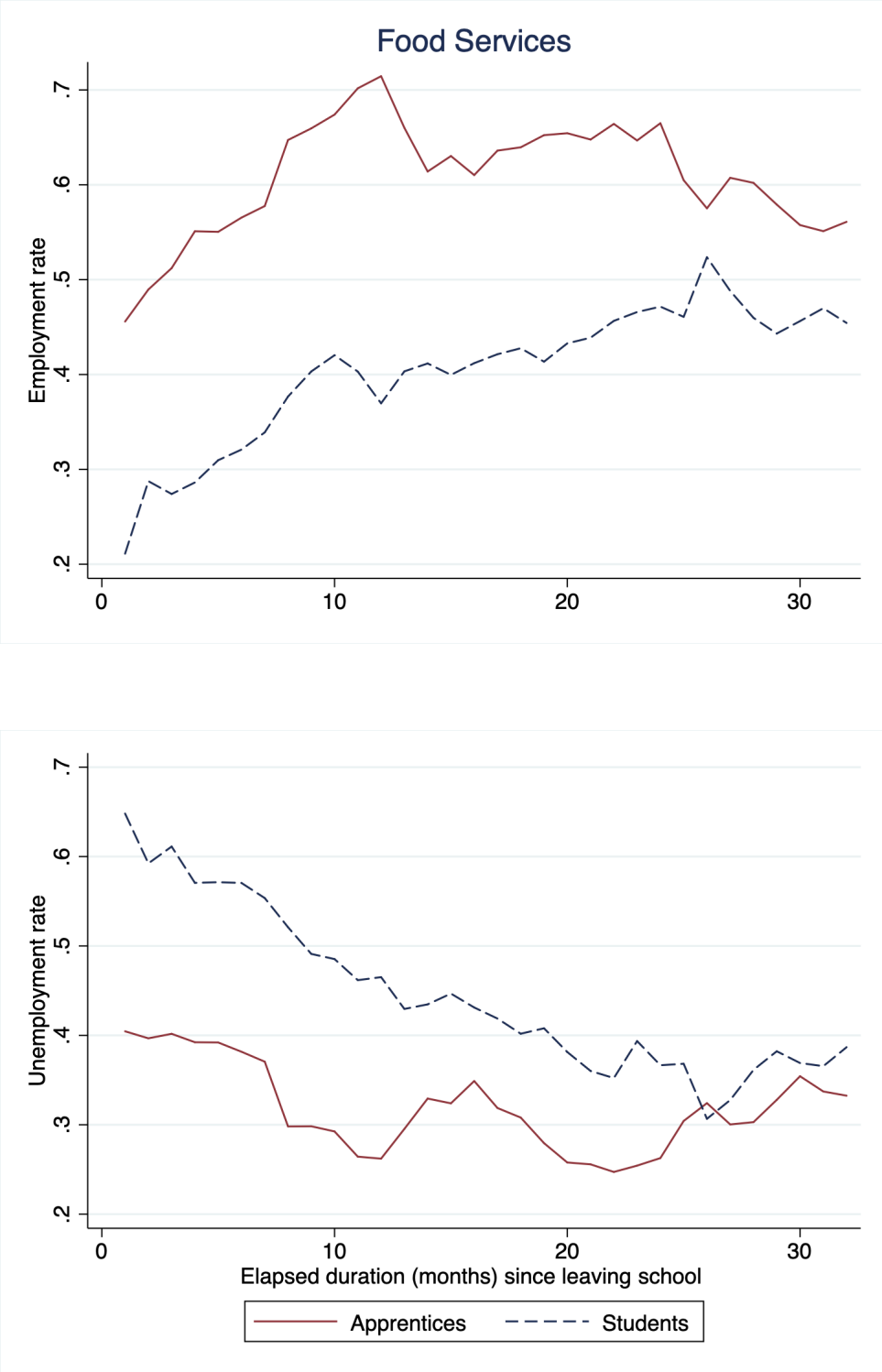


FIGURE A.8.1.1: EVOLUTION OF THE SHARE OF STUDENTS AND APPRENTICES IN EMPLOYMENT OR UNEMPLOYMENT AFTER LEAVING SCHOOL IN FOOD SERVICES.
Note: Students got their CAP diploma in June-July of a given year. Month zero stands for September of this year.
Source: pooled *Génération 2001-2007-2010-2013* surveys, CEREQ.

A.8.2 Bricklayer

Table A.8.2.1
Description of the bricklayer occupation

Occupation	**Bricklayer**
Diploma	CAP Maçon
Definition	The owner of the diploma can work in any kind of building firm with structural work tasks

Uniting	**Activities**	**Skills**	**Exams**		
			Modality	**Tests**	**Coeff.**
Analysis of a professional situation	Preparing its materials on the construction site Explaining the realizations to colleagues or supervisors	Mastering rules in a building site Speak and listen in a professional context	Continuous evaluation	2 oral examinations in the training center	4
Normal working tasks	Reading and applying instructions for normal working tasks	Lay composite materials for construction	Continuous evaluation + practical exam	1 practical session in the training center + 1 practical session in the training firm	8
Additional working tasks	Reading and applying instructions for additional working tasks	Lay composite materials for construction	Continuous evaluation	1 practical session in the training center + 1 practical session in the training firm	4
French language			Written exam	text comprehension and short essay	3
Mathematics, Physics, and Chemistry			Written exam	Several exercises	2
Social and Working Life			Written exam	Real life questions	1
Sport			Continuous evaluation	3 evaluations	1

Source: *Arrêté du 17 août 2004 modifiant l'arêté du 21 août 2002 modifié, portant création du certificat d'aptitude professionnelle maçon.*

Table A.8.2.2
Statistical portrait of students and apprentices in Construction

Component	Information	Students	Apprentices
		22.35%	**77.65%**
Individual	Sex (male)	90.53%	99.95%
	Age	19 y.o.	21 y.o.
	Handicap	7.98%	6.70%
	Driving license	37.86%	49.16%
Family	District area		
	Downtown	30.84%	22.32%
	Suburb	27.59%	32.58%
	Small city	13.41%	15.98%
	Village	28.16%	29.12%
	Siblings	86.70%	84.32%
	French language	89.01%	95.07%
	Birthplace of father		
	France	83.95%	88.67%
	European countries	6.00%	3.11%
	Arabic countries	6.13%	7.73%
	African countries	2.96%	0.32%
	Rest of the world	0.96%	0.18%
	Birthplace of mother		
	France	85.33%	88.92%
	Europe	4.72%	3.52%
	Arabic countries	7.23%	6.95%
	African countries	1.78%	0.42%
	Rest of the world	0.95%	0.18%
	School level of father		
	No diploma	44.29%	29.49%
	Cap/Bep	43.94%	48.08%
	Bac	4.20%	12.90%
	Bac+	7.57%	9.53%
	School level of mother		
	No diploma	31.70%	36.13%
	Cap/Bep	29.20%	42.43%
	Bac	34.03%	16.29%
	Bac+	5.07%	5.15%
	Father works	82.86%	88.14%
	Mother works	70.13%	72.25%
Education	Repeater year before 6th grade	50.03%	44.34%
	Normal middle school program	52.60%	62.67%
	Would have preferred apprenticeship	60.46%	-
	Reason of non-apprenticeship		
	No CFA	3.51%	-
	No employer	20.79%	-
	Neither CFA, nor employer	22.92%	-
	Other	52.78%	-
	Internships / Apprenticeship Tutor	75.05%	-
	Number of internships		
	1	15.46%	-
	2	33.41%	-
	3 or more	51.13%	-
	Contact with the (last) training firm		
	Self	35.64%	-
	Family and friends	45.40%	-
	School / Apprenticeship center	7.70%	-
	Other Public Structure	0.62%	-
	Other	10.64%	-
	Graduated	71.90%	93.27%

Note: This table reports descriptive statistics for both apprentices and vocational students in the construction sector. Shares of students who did interships and the mode of contact with the last training firm are computed from the *Génération 2010* survey only because of the specific questions. The share of graduated students and apprentices are computed with both the *Génération 2010-2013* surveys because of changes in the content of the level V diploma in 2009 in France.
Source: pooled *Génération 2001-2007-2010-2013* surveys, CEREQ ($N = 418$ individuals)

Table A.8.2.3

Effects of apprenticeship on the probability of getting a callback given the size of firms for bricklayer

	Small Firms			Large Firms		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep var: Positive callback						
Apprenticeship	0.0159	0.0314	0.0839	-0.0567	-0.0609	-0.0805
	(0.0673)	(0.0693)	(0.143)	(0.0497)	(0.0501)	(0.0727)
Student mean	0.2029***	0.2029***	0.2029***	0.2739***	0.2739***	0.2739***
	(0.0488)	(0.0488)	(0.0488)	(0.0357)	(0.0357)	(0.0357)
Observations	133	133	133	332	332	332
R-squared	0.000	0.030	0.581	0.004	0.017	0.294
Dep var: Proposition						
Apprenticeship	0.0136	0.0268	0.0894	-0.0649	-0.0665	-0.0727
	(0.0642)	(0.0633)	(0.141)	(0.0437)	(0.0442)	(0.0631)
Student mean	0.1739***	0.1739***	0.1739***	0.2420***	0.2420***	0.2420***
	(0.0460)	(0.0460)	(0.0460)	(0.0341)	(0.0341)	(0.0341)
Observations	133	133	133	332	332	332
R-squared	0.000	0.034	0.563	0.006	0.023	0.283
Month FE	No	Yes	Yes	No	Yes	Yes
Department FE	No	No	Yes	No	No	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. Small firms have at most 10 employees and large firms have more than 10 employees. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

Table A.8.2.4

Effects of apprenticeship on the probability of getting a callback for temporary and permanent jobs for bricklayer

	Temporary Jobs			Permanent Jobs		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep var: Positive callback						
Apprenticeship	0.0286	0.0328	0.0377	-0.0856	-0.0879	-0.0835
	(0.0632)	(0.0623)	(0.0953)	(0.0525)	(0.0529)	(0.0861)
Student mean	0.2424***	0.2424***	0.2424***	0.2598***	0.2598***	0.2598***
	(0.0431)	(0.0431)	(0.0431)	(0.0391)	(0.0391)	(0.0391)
Observations	206	206	206	259	259	259
R-squared	0.001	0.026	0.478	0.011	0.037	0.328
Dep var: Proposition						
Apprenticeship	0.00359	0.00692	0.0223	-0.0771	-0.0791	-0.0827
	(0.0547)	(0.0545)	(0.0835)	(0.0490)	(0.0499)	(0.0817)
Student mean	0.2020***	0.2020***	0.2020***	0.2362***	0.2362***	0.2362***
	(0.0406)	(0.0406)	(0.0406)	(0.0378)	(0.0378)	(0.0378)
Observations	206	206	206	259	259	259
R-squared	0.000	0.032	0.475	0.009	0.035	0.345
Month FE	No	Yes	Yes	No	Yes	Yes
Department FE	No	No	Yes	No	No	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. Temporary jobs comprise all offers for a seasonal contract or a determined duration contract. Permanent jobs are the complement. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

Table A.8.2.5

Effects of apprenticeship on callback probability given different unemployment rates at the commuting zone level for bricklayer

	All	T1	T2	T3
	(1)	(2)	(3)	(4)
Dep var: Positive callback				
Apprenticeship	-0.0578	-0.308***	0.0501	0.0392
	(0.0561)	(0.0988)	(0.114)	(0.106)
Student mean	0.2673***	0.3699***	0.2500***	0.1579***
	(0.0312)	(0.0569)	(0.0514)	(0.0487)
Observations	412	142	143	127
R-squared	0.291	0.419	0.339	0.302
Dep var: Proposition				
Apprenticeship	-0.0564	-0.275**	0.0384	0.0203
	(0.0515)	(0.107)	(0.111)	(0.0874)
Student mean	0.2327***	0.3288***	0.2222***	0.1228***
	(0.0298)	(0.0554)	(0.0493)	(0.0439)
Observations	412	142	143	127
R-squared	0.260	0.382	0.326	0.254
Month & Department FE	Yes	Yes	Yes	Yes
Firm & Job Characteristics FE	Yes	Yes	Yes	Yes

Note: The dependent variable is a dummy variable equal to one if the application gets a positive callback or a proposition. Positive callback corresponds to cases in which the fictitious candidate received a request for complementary information or a suggestion for interview or hiring. Proposition corresponds to callbacks with interview or hiring proposition. Apprenticeship is a dummy variable equal to one if the application was from an apprentice. TX corresponds to the Xth tercile of the unemployment rate at the commuting zone level. Robust standard errors are clustered at the department level and reported below the coefficients. * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent.

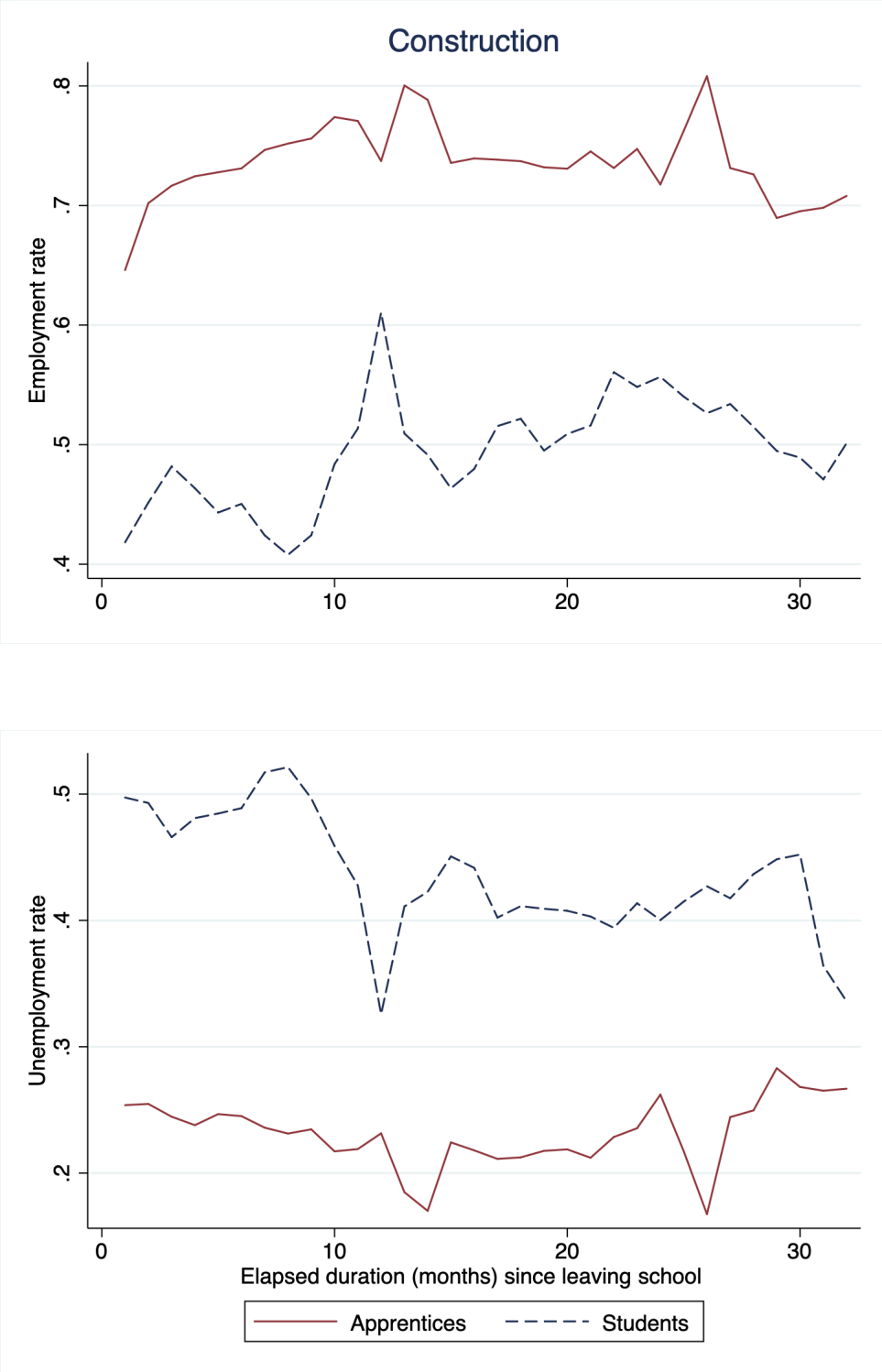


FIGURE A.8.2.1: EVOLUTION OF THE SHARE OF STUDENTS AND APPRENTICES IN EMPLOYMENT OR UNEMPLOYMENT AFTER LEAVING SCHOOL IN CONSTRUCTION.
Note: Students got their CAP diploma in June-July of a given year. Month zero stands for September of this year.
Source: pooled *Génération 2001-2007-2010-2013* surveys, CEREQ.

A.9 Selection of applications and hiring decisions

This appendix describes the selection of applications by employers and the hiring decisions.

– If the first applicant is an apprentice, he is called back. The expected profit is

$$\pi_a = \int_{w_{\min}}^{y_{\sup}} J(y) \mathrm{d}G_{an}(y)$$

where G_{an} is the cumulative distribution function of apprentices not retained in their training firm. The productivity distribution of apprentices who do not stay in their training firm depends on the distribution of productivity of all apprentices and on the probability to stay in the training firm which will be determined below. The first applicant is an apprentice with probability

$$p_a(1) = \sum_{n_a=0}^{(1-\rho)N_a} b(n_a, (1-\rho)N_a, 1/v) \sum_{n_s=0}^{N_s} b(n_s, N_s, 1/v) \frac{n_a}{\max(n_a + n_s, 1)}$$

– If the first applicant is a student, which occurs with probability

$$p_s(1) = \sum_{n_a=0}^{(1-\rho)N_a} b(n_a, (1-\rho)N_a, 1/v) \sum_{n_s=0}^{N_s} b(n_s, N_s, 1/v) \frac{n_s}{\max(n_a + n_s, 1)}$$

the expected profit of calling back the applicant is

$$\pi_s = \int_{w_{\min}}^{y_{\sup}} J(y) \mathrm{d}G_s(y)$$

If the firm decides to continue drawing applicants instead of interviewing the student, it keeps the application of the student who can be recalled later and makes another draw. The firm pays the cost c to find and screen the second application. If the application comes from an apprentice, which occurs with probability $p_a(2)$ at this second draw, the apprentice is called back. If the application comes from a student, the firm has to decide whether to continue screening or to call back the student. If there is no more application, the firm calls back the student of the previous application. Therefore, the expected profit from screening a second application is:[48]

$$\pi(2, c) = p_a(2)\pi_a + [1 - p_a(2)] \max[\pi(3, c), \pi_s] - c$$

where $\pi(3, c)$ is the expected profit from screening the third application. Hence, the expected profit from screening the n^{th} application, denoted by $\pi(n, c)$, $n \in \mathbb{N}, n > 1$, can be written:

$$\pi(n, c) = p_a(n)\pi_a + [1 - p_a(n)] \max[\pi(n+1, c), \pi_s] - c \tag{A.9}$$

[48] It can be assumed that the cost c is made up of an application search cost c_0 and a processing cost, c_1. In this case, the cost c is equal to $c_0 + c_1 [p_s(2) + p_a(2)]$. We do not distinguish between search costs and application processing costs and assume that the cost c is paid whether the firm finds a candidate of not for the sake of simplicity to the extent that we have no information that could identify these cost components. Our assumption is consistent with a situation where search costs, which include the time to wait for the arrival of applications, are large with respect to the cost of reading applications.

where the probability to draw an apprentice from the n^{th} application (which occurs only if $n-1$ students have already been drawn) is, for $n=2$

$$\Pr(\text{apprentice } n=2) = p_s(1) \sum_{n_a=0}^{(1-\rho)N_a} b(n_a,(1-\rho)N_a,1/v) \sum_{n_s=1}^{N_s} b(n_s,N_s,1/v) \frac{n_a}{\max(n_a+n_s,1)}$$

and for $n=3$

$$\Pr(\text{apprentice } n=3) = p_s(1)p_s(2) \sum_{n_a=0}^{(1-\rho)N_a} b(n_a,(1-\rho)N_a,1/v) \sum_{n_s=2}^{N_s} b(n_s,N_s,1/v) \frac{n_a}{\max(n_a+n_s,1)}$$

where

$$p_s(2) = \sum_{n_a=0}^{(1-\rho)N_a} b(n_a,(1-\rho)N_a,1/v) \sum_{n_s=1}^{N_s} b(n_s,N_s,1/v) \frac{n_s}{\max(n_a+n_s,1)}$$

Therefore, we get

$$p_a(n) = \begin{cases} \sum_{n_a=0}^{(1-\rho)N_a} b(n_a,(1-\rho)N_a,1/v) \sum_{n_s=0}^{N_s} b(n_s,N_s,1/v) \frac{n_a}{\max(n_a+n_s,1)} & \text{if } n=1 \\ \prod_{i=1}^{n-1} p_s(i) \sum_{n_a=0}^{(1-\rho)N_a} b(n_a,(1-\rho)N_a,1/v) \sum_{n_s=n-1}^{N_s} b(n_s,N_s,1/v) \frac{n_a}{\max(n_a+n_s,1)} & \text{if } n>1 \end{cases} \tag{A.10}$$

with

$$p_s(i) = \sum_{n_a=0}^{(1-\rho)N_a} b(n_a,(1-\rho)N_a,1/v) \sum_{n_s=i-1}^{N_s} b(n_s,N_s,1/v) \frac{n_s}{\max(n_a+n_s,1)}$$

Since $\pi(n,c)$ decreases with n, a firm stops screening application when the expected profit from the inspection of one more application becomes smaller than its cost. This means that firms with screening costs c screen at most $m(c)$ applications, where

$$m(c) = \{\text{floor of } \zeta | \pi(\zeta,c) = \pi_s\} \tag{A.11}$$

Equation (A.11) determines a unique value of $m(c)$, the expected maximum number of screened applications for firms with screening costs c. It is clear from the definition (A.10) of $p_a(n)$ that $p_a(n)$ increases with the number of apprentices looking for jobs. Since $\pi(n,c)$ increases with $p_a(n)$, the expected gains from screening further applications when the applications already screened come from students raise with the number of apprentices looking for jobs.

A.10 Expected number of screened applications

This appendix computes the expected number of screened applications. Firms with screening costs c screen at most $m(c)$ applications and stop screening when they draw an apprentice. Thus, the probability that they screen only one application is equal to $s(1) = p_a(1)$. The probability that they screen exactly two applications is $s(2) = p_a(2)\left[1 - p_a(1)\right]$. The probability that they screen exactly 3 applications is the probability that they draw an application at the third draw if they have not drawn an application in the first and the second draw:

$$s(3) = p_a(3)\left[1 - p_a(1)\right]\left[1 - p_a(2)\right]$$

By recurrence, one gets that the probability that they screen exactly n applications is

$$s(n) = p_a(n)\prod_{i=1}^{n-1}\left[1 - p_a(i)\right]$$

The expected number of screened applications is

$$\sum_{i=1}^{m(c)} i s(i)$$

A.11 Profit expectations from interviews with students and non-retained apprentices

The profit expectation from an interview with a student is

$$\int_{w_{\min}}^{\bar{y}} (y - w_{\min}) \mathrm{d}G_s(y) + \int_{\bar{y}}^{\infty} (1-\beta)(y-z) \mathrm{d}G_s(y)$$

The profit expectation from an interview with an apprentice is

$$\frac{1}{1-\rho} \left(\int_{w_{\min}}^{\bar{y}} (y - w_{\min}) \Phi(w_{\min} - y) g_a(y) \mathrm{d}y + \int_{\bar{y}}^{\infty} (1-\beta)(y-z) \Phi\left[(1-\beta)(z-y)\right] g_a(y) \mathrm{d}y \right)$$

A.12 Callback probabilities

This appendix presents the computation of the callback probability of apprentices and students respectively.

Callback probability of apprentices

Let us consider an apprentice who applies to a job with $n_a + n_s > 1$ applicants. The firm draws a maximum number of applications equal to $m(c)$ defined equation (A.11).

For this apprentice, the probability to be called back in the first draw is equal to

$$p_0 = \frac{1}{n_a + n_s}$$

The probability to be called back in the second draw is equal to the probability that an apprentice has not been called back in the first draw, equal to

$$1 - \frac{n_a}{n_a + n_s} = \frac{n_s}{n_a + n_s}$$

times the probability to be called back in the second draw, which yields (remark that there are necessarily $n_s - 1$ students in the second draw otherwise an apprentice has been drawn in the first draw implying that the employer stops screening applications):

$$\left(1 - \frac{n_a}{n_a + n_s}\right) \frac{1}{n_a + (n_s - 1)} = \frac{n_s}{n_a + n_s} \frac{1}{n_a + (n_s - 1)}$$

Thus, if $m = 2$, the probability to be called back is equal to the probability to be called back in the first draw plus the probability to be called back in the second raw, or

$$\frac{1}{n_a + n_s} + \left(1 - \frac{n_a}{n_a + n_s}\right) \frac{1}{n_a + (n_s - 1)} = \frac{1}{n_a + n_s} + \frac{n_s}{n_a + n_s} \frac{1}{n_a + (n_s - 1)}$$

If $m = 3$, the probability to be called back at the third draw if the apprentice has not been called back at draws 1 and 2 is:

$$\frac{1}{n_a + (n_s - 2)}$$

The probability that there is a third draw is the probability that an apprentice has not been drawn in draws 1 and 2:

$$\left(1 - \frac{n_a}{n_a + n_s}\right) \left(1 - \frac{n_a}{n_a + n_s - 1}\right) = \left(\frac{n_s}{n_a + n_s}\right) \left(\frac{n_s - 1}{n_a + n_s - 1}\right)$$

Therefore, the probability that the apprentice is recalled at the third draw is:

$$\frac{1}{n_a + (n_s - 2)} \left(1 - \frac{n_a}{n_a + n_s}\right) \left(1 - \frac{n_a}{n_a + n_s - 1}\right)$$

The probability to be recalled if $m(c) = 3$ is equal to the sum of callback in the third three draws,

or

$$\frac{1}{n_a+n_s}+\frac{1}{n_a+n_s-1}\left(1-\frac{n_a}{n_a+n_s}\right)+\frac{1}{n_a+n_s-2}\left(1-\frac{n_a}{n_a+n_s}\right)\left(1-\frac{n_a}{n_a+n_s-1}\right)$$
$$\frac{1}{n_a+n_s}+\frac{1}{n_a+n_s-1}\left(\frac{n_s}{n_a+n_s}\right)+\frac{1}{n_a+n_s-2}\left(\frac{n_s}{n_a+n_s}\right)\left(\frac{n_s-1}{n_a+n_s-1}\right)$$

Following the same reasoning, one can compute the probability to be called back for any value of (n_a, n_s) by a firm that screens at most $m(c)$ applicants:

$$\psi_a\left(n_a,n_s,c\right)=\frac{1}{n_a+n_s}+\mathbf{1}\left[m\left(c\right)>1\right]\sum_{j=1}^{m(c)-1}\frac{1}{n_a+n_s-j}\prod_{i=0}^{j-1}\frac{n_s-i}{n_a+n_s-i}$$

Therefore, the callback probability of an apprentice, who competes with $(1-\rho)N_a-1$ other apprentices on all vacancies, is equal to

$$\sum_{n_a=0}^{(1-\rho)N_a-1}\sum_{n_s=0}^{N_s}b(n_a,(1-\rho)N_a-1,1/v)b(n_s,N_s,1/v)\int_{c_{\min}}^{c_{\max}}\psi_a\left(n_a+1,n_s,c\right)\mathrm{d}F(c)$$

Callback probability of students

Now, let us compute the probability that a student is called back on a job with (n_a, n_s) applicants, which screens at most $m(c)$ applications. The probability that each apprentice is called back is equal to $\psi_a\left(n_a,n_s\right)$, implying that the probability that an apprentice an apprentice is called back is equal to

$$n_a\psi_a\left(n_a,n_s,c\right)$$

Therefore, the probability that a student is called back is equal to $1-n_ac_a\left(n_a,n_s\right)$ and the probability of being called back for a given student is

$$\psi_s\left(n_a,n_s,c\right)=\frac{1-n_a\psi_a\left(n_a,n_s,c\right)}{n_s}$$

Eventually, the callback probability of a vocational student who competes with $(1-\rho)N_a$ apprentices and N_s-1 other students on all vacancies, is equal to

$$\sum_{n_a=0}^{(1-\rho)N_a}\sum_{n_s=0}^{N_s-1}b(n_a,(1-\rho)N_a,1/v)b(n_s,N_s-1,1/v)\int_{c_{\min}}^{c_{\max}}\psi_s\left(n_a,n_s+1,c\right)\mathrm{d}F(c)$$

A.13 Wage and productivity distributions of apprentices and students

This appendix presents the estimation of the distributions of productivity of apprentices and vocational students, conditional on experience, region of residence, family situation and work environment. As explained in the main text, the productivity distributions of apprentices and vocational students, $G^j(y),\ j = a, s$, are estimated assuming that wages are determined by the wage bargaining solution, so that we start by estimating the wage distributions to retrieve the productivity distributions relying on equation (3).

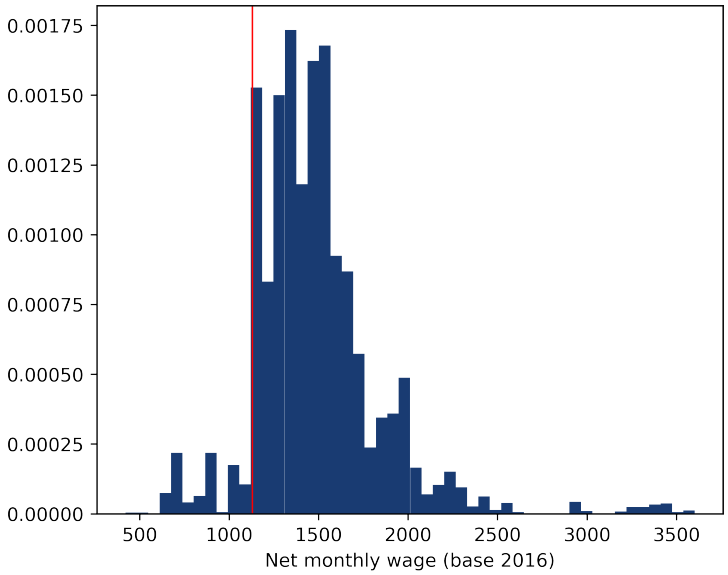


FIGURE A.13.0.1: Histogram of the net monthly wages earned by apprentices and students.
Source: pooled *Génération 2010-2013* surveys, CEREQ.

In line with our correspondence study, the analysis is restricted to young males with French origin who enrolled in a CAP-equivalent program after middle school and are working in the construction industry, hotel and restaurants. The analysis is focused on the monthly wage of full-time workers to avoid important measurement errors. Figure A.13.0.1 displays the histogram of wages. To account for the presence of the minimum wage, the wage distribution is left-truncated at the minimum wage level and log-wages are estimated with the maximum likelihood method. Another strategy could be to assume that wages are contaminated by measurement errors. However, the main source of measurement errors below the minimum wage is likely due to the fact that there are several subsidized jobs the status of which allows the employers to circumvent the minimum wage regulation, especially in the case of young workers. Insofar as the status of these jobs is not well reported in the *Génération* survey, there are some observations below the minimum wage. We hence discard these observations and truncate the wage distribution at the minimum wage to infer the productivity distributions from the wage distributions.

We assume that productivity is log-normally distributed, i.e. the distribution of y is $\log -\mathcal{N}(\mu_j, \sigma_j),\ j = a, s$. As explained in Section V, the distribution of separation costs of apprentices for their training

firms is normally distributed with parameters μ_ϵ and σ_ϵ. The parameters of these distributions are estimated with maximum likelihood. The likelihood functions consistent with the theoretical model are derived below.

A.13.1 Likelihood of the productivity distribution of students

The cumulative distribution function of the productivity of students is denoted by $G_s(y)$ and its derivative by $g_s(y)$. The wage equation (3) implies that the probability of observing the wage $w(y) > w_{\min}$ is equal to

$$g_s(y) = g_s\left(\frac{w(y) - (1-\beta)z}{\beta}\right), \text{if } w(y) > w_{\min}$$

and the probability of observing the wage $w_{\min}$ is equal to $G_s(\bar{y}) - G_s(w_{\min})$ or

$$G_s\left(\frac{w_{\min} - (1-\beta)z}{\beta}\right) - G_s(w_{\min}) \text{ if } w = w_{\min}$$

Therefore, the log likelihood is

$$\sum_i \log\left[g_s\left(\frac{w_i - (1-\beta)z}{\beta}\right)\right]\mathbf{1}(w_i > w_{\min}) + \sum_i \log\left[G_s\left(\frac{w_{\min} - (1-\beta)z}{\beta}\right) - G_s(w_{\min})\right]\mathbf{1}(w_i = w_{\min})$$

or

$$\sum_i \log\left[g_s\left(y_i\right)\right]\mathbf{1}(w_i > w_{\min}) + \sum_i \log\left[G_s\left(\bar{y}\right) - G_s(w_{\min})\right]\mathbf{1}(w_i = w_{\min})$$

with

$$y_i = \frac{w_i - (1-\beta)z}{\beta}; \bar{y} = \frac{w_{\min} - (1-\beta)z}{\beta}$$

A.13.2 Likelihood of the productivity distribution of apprentices

We write the likelihood of the productivity distribution of apprentices using the information on wages of employed apprentices retained and non-retained in their training firm. Since non-retained apprentices are matched with vacant jobs at random, independently of their type y, we can use the likelihood of the productivity distributions of all employed apprentices, whether retained or non-retained in their training firm, to identify the parameters of the productivity distributions of retained and non-retained apprentices, G_{an} and G_{an}. Since the couple of productivity distributions G_{an} and G_a uniquely defines the distribution Φ of separation costs ϵ of apprentices from their training firms as shown by equation (5), we can identify the parameters of distributions G_a and Φ from the maximization of the likelihood of the wage distributions of retained and non-retained apprentices. Then, the parameters of G_{an} are deduced from those of G_a and Φ.

We have shown that for each value of y the share of apprentices who are not retained by their employer is equal to

$$\begin{cases} \Pr\left[\varepsilon < (1-\beta)\left(z-y\right)\right] = \Phi\left[(1-\beta)(z-y)\right] & \text{if } y \geq \bar{y} = \frac{w_{\min}-(1-\beta)z}{\beta} \\ \Pr\left[\varepsilon < w_{\min} - y\right] = \Phi(w_{\min} - y) & \text{if } y < \bar{y} \end{cases}$$

Thus, the probability to observe an apprentice with productivity y among those who remained in

their training firm is

$$p_r(y) = \begin{cases} \left[1 - \Phi\left[(1-\beta)(z-y)\right]\right] g_a(y) & \text{if } y > \bar{y} = \frac{w_{\min} - (1-\beta)z}{\beta} \\ \left[1 - \Phi(w_{\min} - y)\right] g_a(y) & \text{if } y \leq \bar{y} \end{cases} \tag{A.12}$$

The probability to observe an apprentice with productivity y among employed apprentices non-retained by their training firm is

$$p_n(y) = \begin{cases} \Phi\left[(1-\beta)(z-y)\right] g_a(y) & \text{if } y > \bar{y} = \frac{w_{\min} - (1-\beta)z}{\beta} \\ \Phi(w_{\min} - y) g_a(y) & \text{if } y \leq \bar{y} \end{cases} \tag{A.13}$$

The likelihood of the productivity distribution of all employed apprentices is

$$\prod_i \left(\left[1 - \Phi\left[(1-\beta)(z-y_i)\right]\right] g_a(y_i)\right)^{\mathbf{1}(y_i > \bar{y}, r_i = 1)} \left(\int_{-\infty}^{\bar{y}} \left[1 - \Phi(w_{\min} - y)\right] g_a(y) \mathrm{d}y\right)^{\mathbf{1}(y_i \leq \bar{y}, r_i = 1)}$$
$$\left[\Phi\left[(1-\beta)(z-y_i)\right] g_a(y_i)\right]^{\mathbf{1}(y_i > \bar{y}, r_i = 0)} \left(\int_{-\infty}^{\bar{y}} \left[\Phi(w_{\min} - y)\right] g_a(y) \mathrm{d}y\right)^{\mathbf{1}(y_i \leq \bar{y}, r_i = 0)}$$

where $r_i \in \{0, 1\}$ equals 1 if the apprentice works in his training firm.

The productivity of an apprentice with wage $w(y)$ is

$$\begin{cases} y = z + \frac{w(y) - z}{\beta} & \text{if } w(y) > w_{\min} \\ y \leq \frac{w_{\min} - (1-\beta)z}{\beta} & \text{if } w(y) = w_{\min} \end{cases}$$

Therefore, the log likelihood of the wage distribution of apprentices is

$$\begin{aligned} \mathcal{L} = \sum_i \log \left(\left[1 - \Phi\left[\frac{(1-\beta)}{\beta}(z - w_i)\right]\right] g_a\left(z + \frac{w_i - z}{\beta}\right)\right) \mathbf{1}(w_i > w_{\min}, r_i = 1) \\ + \sum_i \log \left(\int_{-\infty}^{\bar{y}} \left[1 - \Phi(w_{\min} - y)\right] g_a(y) \mathrm{d}y\right) \mathbf{1}(w_i = w_{\min}, r_i = 1) \\ + \sum_i \log \left(\Phi\left[\frac{(1-\beta)}{\beta}(z - w_i)\right] g_a\left(z + \frac{w_i - z}{\beta}\right)\right) \mathbf{1}(w_i > w_{\min}, r_i = 0) \\ + \sum_i \log \left(\int_{-\infty}^{\bar{y}} \Phi(w_{\min} - y) g_a(y) \mathrm{d}y\right) \mathbf{1}(w_i = w_{\min}, r_i = 0) \end{aligned}$$

where $r_i \in \{0, 1\}$ equals 1 if the apprentice is retained in his training firm.

A.14 Counterfactual productivity distributions

This appendix defines the counterfactual productivity distributions arising in the four scenarios analyzed in our counterfactual exercises when the share of apprentices is increased from α to $\alpha + \Delta$.

1. The share of students who become apprentice is selected at random in distribution G_s and their productivity is drawn in distribution G_a. The productivity distribution of apprentices and students are unchanged.

2. The share of students who become apprentice is selected at random in distribution G_s and their productivity is drawn in distribution G_s. The productivity distribution of students is unchanged. The number of apprentices increases by ΔN. The share of youth who were students before the expansion of apprenticeship and who are apprentices among the total number of apprentices after the expansion of apprenticeship (equal to $(\alpha + \Delta))N$) is equal to $\Delta/(\alpha + \Delta)$. Thus, the cumulative distribution function of the productivity of apprentices becomes

$$\tilde{G}_a(y) = \frac{1}{\alpha + \Delta} \left[\alpha G_a(y) + \Delta G_s(y)\right]$$

3. The share of students who become apprentice is selected in the top part of distribution G_s and their productivity is drawn in the top part of distribution G_a. Since the share of students before the expansion of apprenticeship is equal to $1-\alpha$, the share of students who become apprentice is equal to $\Delta/(1-\alpha)$. The cumulative distribution function of the productivity of students becomes

$$\tilde{G}_s(y) = \begin{cases} 1 & \text{if } y \geq \tilde{y}_s \\ \frac{(1-\alpha)G_s(y)}{1-\alpha-\Delta} & \text{if } y \leq \tilde{y}_s \end{cases}$$

where $\tilde{y}_s = \left\{y | \frac{\Delta}{1-\alpha} = 1 - G_s(y)\right\}$ and that of apprentices becomes

$$\tilde{G}_a(y) = \begin{cases} \frac{1}{\alpha+\Delta}\left[\alpha G_a(y) + \Delta \frac{G_a(y)-G_a(\tilde{y}_a)}{1-G_a(\tilde{y}_a)}\right] & \text{if } y \geq \tilde{y}_a \\ \frac{\alpha G_a(y)}{\alpha+\Delta} & \text{if } y \leq \tilde{y}_a \end{cases}$$

where $\tilde{y}_a = \left\{y | \frac{\Delta}{\alpha+\Delta} = 1 - G_a(y)\right\}$

4. The share of students who become apprentice is selected in the top part of distribution G_s and their productivity, which remains the same, is drawn in the top part of distribution G_s. The cumulative distribution function of the productivity distribution of students is

$$\tilde{G}_s(y) = \begin{cases} 1 & \text{if } y \geq \tilde{y}_s \\ \frac{(1-\alpha)G_s(y)}{1-\alpha-\Delta} & \text{if } y \leq \tilde{y}_s \end{cases}$$

where $\tilde{y}_s = \left\{y | \frac{\Delta}{1-\alpha} = 1 - G_s(y)\right\}$ and that of apprentices becomes

$$\tilde{G}_a(y) = \begin{cases} \frac{1}{\alpha+\Delta}\left[\alpha G_a(y) + \Delta \frac{G_s(y)-G_s(\tilde{y}_s)}{1-G_s(\tilde{y}_s)}\right] & \text{if } y \geq \tilde{y}_s \\ \frac{\alpha G_a(y)}{\alpha+\Delta} & \text{if } y \leq \tilde{y}_s \end{cases}$$

A.15 Robustness: model

TABLE A.15.0.1
ROBUSTNESS OF THE MODEL SIMULATIONS ACCORDING TO DIFFERENT VALUES OF β

	Values of parameters and variables				
	(1)	(2)	(3)	(4)	(5)
β	0.3	0.4	0.5	0.6	0.7
μ_s	7.9080	7.7296	7.6043	7.5106	7.4377
σ_s	0.3134	0.2848	0.2613	0.2417	0.2249
μ_a	7.9609	7.7773	7.6477	7.5506	7.4746
σ_a	0.3174	0.2894	0.2662	0.2468	0.2302
μ_ϵ	-1431.3480	-920.1222	-613.3706	-408.8749	-262.8191
σ_ϵ	3771.3843	2423.0836	1613.5712	1074.1463	689.3574
π_s	€1363.2	€875.6	€583.0	€388.0	€248.9
π_a	€1376.2	€883.4	€587.6	€390.4	€249.8
Benchmark ($\alpha = 0.5$)					
c	[€0.0, €0.3]	[€0.0, €0.3]	[€0.0, €0.3]	[€0.0, €0.3]	[€0.0, €0.3]
h	€559.02	€351.66	€229.47	€149.64	€93.86
ρ	.3	.3	.3	.3	.3
$c_a - c_s$	.0112	.0112	.0112	.0112	.0112
u_a	.2000	.2000	.2000	.2000	.2000
u_s	.2951	.2920	.2912	.2923	.2948
u	.2475	.2460	.2456	.2461	.2474
Counterfactual – Scenario 1 ($\alpha = 0.6$)					
ρ	.3	.3	.3	.3	.3
u_a	.1825	.1868	.1867	.1867	.1866
u_s	.3163	.3124	.3111	.3117	.3137
u	.2360	.2370	.2365	.2367	.2374
Counterfactual – Scenario 2 ($\alpha = 0.6$)					
ρ	.2988	.2988	.2988	.2988	.2987
u_a	.1864	.1907	.1907	.1907	.1907
u_s	.3185	.3145	.3132	.3137	.3157
u	.2392	.2402	.2397	.2399	.2407
Counterfactual – Scenario 3 ($\alpha = 0.6$)					
ρ	.3108	.3108	.3108	.3109	.3110
u_a	.1968	.2008	.2002	.1995	.1988
u_s	.3234	.3202	.3199	.3220	.3259
u	.2474	.2486	.2481	.2485	.2497
Counterfactual – Scenario 4 ($\alpha = 0.6$)					
ρ	.3091	.3091	.3091	.3091	.3092
u_a	.1996	.2036	.2029	.2022	.2014
u_s	.3258	.3225	.3222	.3242	.3280
u	.2501	.2512	.2506	.2510	.2521

Note: This table reports the indicators simulated by the model with different values of β both in the benchmark and counterfactual situations. We ran the simulations with N=50 observations to speed up the process. The estimates are in line with those discussed in the core paper when comparing to column (3) with $\beta = 0.5$.