The unexpected effect of subsidies to apprenticeship contracts on firms' training behaviour[*]

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Abstract

This paper offers both a theoretical model and an empirical analysis of firms' behavioural response to variations in the labour cost of apprenticeship contracts. I study two outcomes: (i) firms' propensity to train; (ii) retention of apprentices upon graduation in their training firm. The identification strategy relies on a French reform that entitled regions to change the amount and criteria of a large subsidy targeting employers of apprentices. Before the reform, the subsidy applied homogeneously across regions; after the reform, strong variations in its level and criteria appeared according to firms' location. The data come from 3 administrative databases and from regional regulations that I collected from 16 regional services for apprenticeship training. Using triple-difference techniques, I show that subsidies foster turnover strategies. Thus, I find a limited but significantly negative elasticity of the number of apprentices hired to training costs. The point estimate is -0.22. As hypothesized in a theoretical model, the impact however mostly plays at the intensive margin (training firms taking on more apprentices) rather than at the extensive margin (new firms entering the system). This suggests that training firms may respond to a rise in subsidies by training over their needs in skills. Confirming this interpretation, I find that a drop in the cost of apprenticeships decreases training firms' likelihood to retain apprentices upon graduation.

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Introduction

The yearly unemployment rate among youth aged 15 to 24 years old in France has averaged 22% since 2000. On the same period, the yearly youth-to-adult unemployment ratio has averaged 2.8. Against this backdrop, a policy has gained high levels of consensus: to develop apprenticeship training per the model of Germany. There, a large coverage of apprenticeship training indeed combines with a better access to the labour market for the youth[3].

Yet, reviving training in French firms has proved arduous. 20th century policies have indeed brought a large chunk of vocational training studies into the school realm and the period has been marked by a deteriorating image of apprenticeship training. Illustration of the difficulties to reverse this trend is made clear by the failure to ever attain the objective of 500,000 apprentices in training, although repeatedly stated by different governmental majorities since 1993. Efforts made by the State to develop apprenticeship training are yet important. They are of three main sorts: advertisement aiming at families and their children as well as at firms, enactment of a right to prepare most diploma in higher education via an apprenticeship and large monetary incentives targeting employers. This paper focuses on the latter.

France indeed distinguishes itself by the amount of public expenditures spent on apprenticeships and, among them, by the level of subsidies offered to employers of apprentices. According to Martinot (2015), the yearly cost of an apprentice for the French State in 2010 amounted to 9500 euros; about three times the sum spent by the German government and an amount close to what applies in French standard schooling. Further, 60% of this amount is made of subsidies to employers of apprentices in France against 15% in Germany (ibid). The purpose of this paper is therefore to assess the impact of these subsidies on employers' propensity to take on apprentices. In a second stage, the impact on job mobility upon graduation is estimated.

The main intuitions are the following. The literature has shown that the elasticity of employment to labour cost decreases with the latter (L'Horty et al., 2019). Total labour cost of apprenticeship contracts is grossly made of two

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[3] In Germany, the unemployment rate of the 15-24 indeed averaged 6.8% between 2000 and 2018, 1.5 times the one of adults.

components: (i) the wage; (ii) the cost induced by firm-specific constraints (training facilities, trainer availability, etc.). The former is low, but the latter can reach substantial amounts. Everything else being equal, firms' actual propensity to train is likely to reveal their specific level of induced costs. The total labour cost of an extra apprentice is therefore likely to be lower in firms already training. Thus, in section 2, a structural model predicts that variations in costs have a stronger impact on the number of apprentices hired in training firms (the intensive margin) than on firms' likelihood to train (the extensive margin).

As for retention rates, theory predicts that mobility upon graduation can be largely predicted by the conditions applying at the start of apprenticeship contracts. Intuitively, low training costs urge firms to follow turnover strategies rather than training-to-hire ones. This mechanism plays positively on the size of the elasticity of mobility to training cost. In sections 1 and 2, I therefore build on the literature and on a structural model to hypothesize that the impact of a drop in the cost of apprenticeships on mobility upon graduation is strongly positive.

To test these hypotheses, I use a reform implemented in 2005 which gave regions power to change the amount and criteria of a subsidy targeting employers of apprentices called the *indemnité compensatrice forfaitaire* (ICF hereafter). At the time of the reform, the ICF amounted to a quarter of the 3 billion euros of public money spent on apprenticeship training each year (Carrez, 2002, 2003). Management of the subsidy was taken over again by the State in 2014. I computed a new dataset gathering all regional reforms from 16 of the 22 French metropolitan regions between 2005 and 2014[4]. They show large variations in the criteria and amounts offered.

Three other sources of administrative data are used in the paper: the database Ari@ne, the DADS and FICUS-FARE. The former provides information on more than 80% of the apprenticeship contracts signed in France between 2000 and 2014. The second gives account of working contracts of all wage earners employed in the private sector, to the exception of private

[4] The remaining regions are, on one hand, Picardie and Bourgogne which could not find back the history of regulations since 2005 and, on the other hand, Alsace, Lorraine and Champagne-Ardenne as well as Corsica where specific legislations on training apply.

individuals' employees before 2009. The latter is constructed for fiscal reasons and gives details on active firms each year. Combining these four sources of data makes it possible to compute the hourly labour cost of about 145 000 contracts signed each year.

The main identification strategy uses triple difference techniques that control for the potential relation between regional reforms and the pre-existent structure of apprenticeship training in the regions. It allows me to identify the impact of the labour cost of apprenticeship training on firms' propensity to train as well as on the likelihood for apprentices to be hired (retained) in their training firm upon graduation. The main finding is that subsidies foster turnover strategies. Thus, I measure a limited but significantly negative elasticity of the number of apprentices hired to training costs. The point estimate is -0.22. However, the impact mostly plays at the intensive margin (training firms taking on more apprentices) rather than at the extensive margin (new firms entering the system). This suggests that training firms may respond to subsidies by training over their needs in skills. Confirming this interpretation, I find that a one standard deviation decrease in the cost of apprenticeships decreases the probability of retaining apprentices upon graduation by 88% of a standard deviation on average.

The rest of the paper goes as follows. I first review the literature related to this research. I then build a structural model to clarify the hypotheses to test. Next, I present in more details how apprenticeship training is funded in France and I give information on the institutional setting of the *indemnité compensatrice forfaitaire*. After describing the data, I finally explain the strategy of identification and detail the results. I discuss them and conclude in the last section.

1 The literature

This research relates to two streams of literature. One deals with the impact of labour costs on employment of standard workers and of apprentices. The other analyses why firms train; it gives hints on the impact of training costs on apprentices' mobility upon graduation.

1.1 The elasticity of employment to labour costs

1.1.1 When policies target standard workers

A wide literature has studied the elasticity of employment of standard workers with respect to labour costs. Its main theoretical result is the prediction of a negative correlation between this elasticity and wages (in absolute terms) in countries with a relatively high statutory minimum wage.

There are three main reasons for that (L'Horty et al., 2019). First, across sectors, the share of labour cost in the total production costs and the degree of substitution between capital and labour both decrease with the average level of wages. Labour cost is therefore expected to be a stronger determinant of the level of employment at the bottom of the wage distribution than at the top. Second, a given amount of public money will drop costs more strongly in relative terms if targeting low-wage employment. Even if the elasticity of labour demand to cost were constant across the wage distribution, the impact of a given budget would be maximized if limited to low-wage employment. Third, drops in labour costs can be passed to employees through rising wages which undermines the objective of employment. In countries with a high statutory minimum wage, targeting subsidies to minimum wage workers is expected to limit this side impact. In these countries, the minimum wage is generally considered to exceed the market wage of a large chunk of jobseekers (Cahuc et al., 2014).

The empirical literature has only partly validated these predictions. A large number of articles uses variations in payroll and corporate taxes as a source of identification. I first detail those dealing with the French context before extending to other countries. Kramarz and Philipon (2001), Crépon and Desplatz (2001) and Malgouyres (2019) have evaluated the first employer payroll tax cuts in France which were implemented in the mid-1990s. It applied to workers paid between 1 and 1.3 minimum wages. The three papers find a positive impact of the reform on employment and measure an elasticity of about -1.5. A further range of employer payroll tax cuts have been implemented in France since the late 1990s. With time, they targeted less and less low-wage workers and had a decreasing impact on employment. Bunel et al. (2009) have evaluated one of them which targeted workers up to 1.6

minimum wages. They find a smaller elasticity than in the aforementioned literature: -0.5. Research was finally made on a recent drop in corporate taxes which is granted proportionally to the number of workers earning less than 2.5 minimum wages in the firm. Gilles et al (2017) and Carbonnier et al (2018) find that this measure had nearly no impact on employment. The last reform defers from the previous ones in accounting terms which may reduce its impact on employment (Bozio et al., 2018). Nevertheless, in France overall, it seems that the impact of drops in labour costs on employment is negatively correlated with the wage of targeted workers.

Effects comparable to the French ones are found for general drops in payroll taxes in Belgium (Goos and Konings, 2007), but not in Sweden, (Bohm and Lind, 1993; Bennmarker et al., 2009), Norway (Johansen and Klette, 1997; Gavrilova et al., 2015) nor Finland (Korkeamäki and Uusitalo, 2008). Some have interpreted these results as being compatible with the theoretical prediction that the impact of labour cost on employment depends on the presence of a high statutory minimum wage (Cahuc et al., 2014). This imports for us because the minimum wage applying to apprentices in France is very low which could therefore limit the impact of a drop in the cost of apprenticeships on training. Yet, the statement should be nuanced[5]. In particular, specific analyses of a payroll tax cut targeting the youth in Sweden find negative elasticities[6] while most of the sample is paid much above the sectoral minimum wages (Egebark and Kaunitz, 2014; Saez et al., 2019).

A second stream of research has analysed the impact of hiring credits on employment. In a review, Neumark (2013) shows that hiring credits in the US are not efficient when targeting the disadvantaged. In that case, they stigmatize beneficiaries and foster turnover. Conversely, Neumark and Grijalva (2017) find a limited but positive impact of broader programs enforced in the aftermath of the Great Recession in the US. Cahuc, Carcillo and Le Barbanchon (2014) also focus on a French hiring credit implemented in the

[5] Most of the research led on the Nordic countries uses a variation in payroll taxes applying across all the wage distribution or up to large wage levels. One notable exception can be noted: Huttunen et al (2013) find no impact on employment of a drop in payroll taxes applying to old low-wage workers. This population is however quite specific.

[6] Although they are limited (between -0.20 and -0.30).

wave of the Great Recession. It was targeted at small firms and low-wage employment. They find a strong impact of the policy on employment.

Overall, these results validate the prediction according to which drops in labour cost have a stronger impact on employment when targeting low-wage workers. Whether the drop in costs stems from a hiring credit or a drop in payroll taxes seems only secondary as soon as the treated group remains large enough not to be stigmatized. Conversely, the role of the statutory minimum wage remains to be properly tested.

1.1.2 When policies target apprentices

The aforementioned literature brings several intuitions for our case. The fact that apprentices generally earn small wages in France should positively impact the elasticity of employment (of training) with respect to labour cost. Yet, other elements are likely to counterbalance this effect. First, a specific and very low minimum wage applies to these contracts[7]. Although it remains to be properly tested empirically, the theory on the role of minimum wages persists and suggests that low minimum wages for apprentices should limit the size of the elasticity of interest. Second, the subsidy exploited hereafter depends on very specific parameters. Following Neumark (2013), it is therefore possible that employers show reluctance in hiring the small groups receiving the largest amounts. Third, apprenticeship contracts entail elements likely to negatively affect the size of the elasticity of training to cost: (i) trainees spend part of their time at school, which some employers may consider to be too strong of a constraint; (ii) a tutor (the apprenticeship master) must be nominated and should spend some non-productive time to train the apprentice; (iii) requirements to train apprentices also generally imply to invest into facilities which induced-costs are independent from the 'monetary cost'[8] of trainees.

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[7] In France, the minimum wage of apprentices depends on the age and the seniority. It varies between 25% and 78% of the normal statutory minimum wage.

[8] I define the 'monetary cost' of an apprentice as her gross wage minus the public subsidies and tax credits targeted towards apprentices or received alike all other employees. The gross training cost is obtained by adding the induced cost of training facilities and of masters' time. The net training cost deduces the value of the apprentice's output to the gross cost.

The literature dealing with the impact of apprenticeship costs on employment is tiny and natural experiments are very seldom. It focuses on Germany, Switzerland and Denmark where this form of training is the most developed. Overall, it confirms that the cost elasticity of firms' propensity to train is rather limited. It also suggests that it depends on representatives' power resources.

Three papers have measured the impact of apprenticeship cost on employment in the case of Denmark and Switzerland. Note that the minimum wage applying to apprentices is higher in Denmark. In the early 1980s, in a period of shortage of apprenticeship offers, a subsidy was given to Danish employers for each marginal apprentice they hired on the condition that their stock of trainees would not be lower than two years before. Westergård-Nielsen and Rasmussen (1997) study its impact and find a differentiated effect on firms' propensity to train according to the sector. It is significant (and positive) only in manufacturing, offices and trade. In another paper, Weatherall (2009) evaluates a subsidy conditional on hiring apprentices older than 25. The partial equilibrium impact for this population is limited: positive and significant for male apprentices but non-significant for women. In Switzerland, Muehlemann et al. (2007) have taken advantage of a cost-benefit survey led on training firms to predict training costs for any firm and measure its impact on both the extensive and the intensive margins of training[9]. They find that the elasticity of the probability to train with respect to the cost of apprenticeships is of - 0.45 at the average value of regressors, but find no effect on the intensive margin. Note that there are reasons to think that these measures are over-estimated[10] and should be seen as an upper bound. Overall, it therefore seems that the elasticity of training to labour cost is negative but rather limited in the case of apprenticeship training and that variations in the

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[9] The extensive margin accounts for firms' probability to take on apprentices; the intensive margin measures the number of trainees per firm.

[10] It is likely than firms actually training have some comparative advantage regarding costs or face specific needs for their workforce in comparison with other companies. The authors use a measure of the shortage in skilled labour to take this into account but it is unlikely to be enough. In that case, a negative selection bias would persist and the real value for the estimated elasticity should be closer to zero than the estimated one.

minimum wage for apprentices – which strongly differ between Switzerland and Denmark but remains much lower than the statutory minimum wage applying to ‘normal’ employment – does not seem to play a strong role at first glance.

1.2 The impact of apprenticeship cost on mobility upon graduation

The second independent variable of interest is the likelihood for apprentices to remain in their training firm (retention rates). This variable matters because, on a developed market of apprentices, non-retained graduates can seriously struggle to integrate the labour market (Brébion, 2019). Decision of mobility upon completion of an apprenticeship contract is shared between the apprentice and her employer. Yet, overall, “[f]irms seem to play a more structuring role in the apprentices' immediate mobility” (Lene and Cart, 2018: 22)[11].

Theoretically, training firms are generally said to follow two ideal-typical strategies. Building on Lindley (1975) one can model them as a productive strategy and an investment strategy. In the first case, the firm takes advantage of the low-cost feature of apprenticeships and takes on trainees with no intention of subsequent hiring. In the second case, the firm plans to hire a skilled worker and decide to train in-house rather than to ‘buy’ skilled labour on the external market. Reasons for the latter strategy are many (see Brébion, 2017) and will not be discussed here. What imports for us is to see that retention rates are likely to be much larger in the second case. As such, they are likely to reflect the level of investment firms put into training.

What impact to expect from a drop in the cost of apprenticeships? Theoretically, the answer is ambiguous. Empirically, the only paper on the matter is a cross-country research based on the ‘firms’ cost and benefit of apprenticeship training’ surveys led in Germany and Switzerland. It shows that both retention rates and labour costs are stronger in Germany (Dionisius

[11] Conversely, deferred mobility would be more often the choice of the graduate (Lene and Cart, 2018).

et al., 2009)[12]. Training firms differ between Germany and Switzerland, but this literature confirms that the decision to retain an apprentice is already – and largely – initiated at the very start of the apprenticeship contract. It further suggests that retention rates are strongly positively correlated with labour cost.

2 A simple theoretical framework

In this section, I develop an illustrative model in discrete time. It allows me to clarify employers' incentives (i) to train; (ii) to hire several apprentices instead of one; (iii) to retain apprentices upon graduation. The model describes employment strategies of a continuum of firms F_k, where $k \in [0,1]$, all willing to fill a vacancy.

Firms can turn to the market of apprentices. They face some firm-specific constraints to adapt the workplace to receive apprentices. Let the induced costs of these constraints be $C(\lambda, n)$, where $\lambda \in [0;1]$ accounts for the technology intensiveness of the sector[13] and n is the number of apprentices trained in the firm.

The function for induced costs is convex in the first parameter. This means that: (i) the more technology incentive a sector is, the larger the cost; (ii) the speed at which induced costs rise as technology intensiveness grows is positive. Further we set $\lim_{\lambda \to 1} C(\lambda, n) = +\infty$: we expect that sectors the most intensive in technology will not train.

As for the second parameter, we have $C_2^{'}(\lambda, n) > 0$. Then, $C_2^{\prime\prime}$, the second derivative with respect to n, is defined by segments which depend on λ. On each interval $[n_{i,\lambda;} n_{i+1,\lambda}[$, we have $C_2^{\prime\prime}(\lambda, n) < 0$. These elements mean that: (i) induced costs increase with the number of trainees; (ii) on each segment $[n_{i,\lambda;} n_{i+1,\lambda}[$ there are positive returns to scale as the number of apprentices

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[12] Interestingly, no difference in training quality is found between the two countries.

[13] λ relates to determinants such as the space required to receive an apprentice or the time spent by the apprentice master on training.

grow; (iii) the cost jumps for all apprentices when the number of trainees goes from $n_{i,\lambda} - 1$ to $n_{i,\lambda}$[14].

There are two types of apprentices available $\{T_0; T_1\}$ in proportion ϕ_0; $1 - \phi_0$. Their respective productivity after training is p_0 and p_1, with $p_0 < p_1$. The employer has a general knowledge of these parameters, but she must pay a cost $\alpha_{app}(\phi_0)$ ex-ante to select candidates of type 1 (with $\alpha'_{app} > 0$). Alternatively, an employer can blindly hire a candidate and observe her type during the apprenticeship.

Training lasts for one period. Independently of their type, apprentices earn a wage w_{app}, have the productivity of an unskilled worker p_{app} and bring their employer a subsidy ψ_{app}. Once trained, their yearly cost grows to w_s which is the one of a junior skilled worker. The relation is not stable over time: in each period, the probability that the match holds is θ_1.

Firms can also turn to the external labour market and hire a senior worker to fill the vacancy. In that case, a matching cost α_2 should be paid to select an appropriate worker (cost to review CVs, lead the interviews, etc.). Senior workers are more productive than junior skilled workers. Their productivity is $p_2 = p_1 + \delta$, with $\delta > 0$. Their yearly cost is $w_2 = w_s + \gamma$ each year, with $\gamma > 0$. γ accounts for the bargaining power senior workers have which allows them to be paid according to their work experience and productivity. Despite the fact that firms pay a matching cost, the match holds at each period with a probability $\theta_2 < 1$.

A few assumptions are taken to simplify the setting:

1) Regarding apprentices:
   - We set $p_0 < w_s$ so that employers will never retain an apprentice of type T_0.

[14] Apprenticeship masters who can only supervise two apprentices at a time in France are a good example to understand the last element. If a firm is willing to take on a third apprentice it must therefore recourse to a second worker entitled to train which is likely to more costly than a standard worker. In the end, the third marginal apprentice has a stronger impact on the induced costs than the second one. Conversely, the impact of the second marginal apprentice is lower than the first one.

- We set the probability for a match to hold over the next period to be the same for senior and junior skilled workers. Namely $\theta_1 = \theta = \theta_2$

2) Regarding the firm:
   - The firm has no risk aversion
3) Regarding contracts:
   - Workers hired on standard contracts remain in the firm until period T.

Firms can take three different routes to fill the vacancy. Different discounted levels of expected profits π_k, where k is the type of firm, are associated to each of them. The discount parameter is β.

1) Select and hire a candidate of type 1 for apprenticeship, train her during one period and offer her a standard contract upon graduation.

$$\pi_k = -\alpha_{app}(\phi_0) + p_{app} - w_{app} + \psi_{app} - C(\lambda_k, 1) + \sum_{t=1}^{T} \beta^t \theta^t (p_1 - w_s)$$

2) Hire n apprentices without selecting them and retain one apprentice of type 1 if available. The type of each apprentice ($type_i$) is randomly and independently selected in $\{T_0; T_1\}$ so that $p\left(T_1 \subset \bigcup_{i=1}^{n} type_i\right) = 1 - {\phi_0}^n$. The expected profit associated to this strategy is:

$$\pi_k = n * (p_{app} - w_{app} + \psi_{app}) - C(\lambda_k, n) + (1 - {\phi_0}^n) * \sum_{t=1}^{T} \beta^t \theta^t (p_1 - w_s)$$

3) Hire a skilled worker from the external market in period 1.

$$\pi_k = -\alpha_2 + \sum_{t=0}^{T} \beta^t \theta^t (p_1 + \delta - w_s - \gamma)$$

In the end, the employer will choose to train if $(*)$ or $(**)$ is larger than $(***)$:

$(*)\quad -\alpha_{app}(\phi_0) + p_{app} - w_{app} + \psi_{app} - C(\lambda_k, 1)$

$(**)\quad \max_{n \geq 1}(n * (p_{app} - w_{app} + \psi_{app}) - C(\lambda_k, n) - {\phi_0}^n * \sum_{t=1}^{T} \beta^t \theta^t (p_1 - w_s))$

$(***) -\alpha_2 + (\delta - \gamma) * \left(\frac{1-(\beta\theta)^{T+1}}{1-\beta\theta}\right) + p_1 - w_s$

In this framework, firms only differ by the induced costs they must pay to adapt the workplace to apprentices. There is a level of technology intensiveness $\tilde{\lambda}$ separating training and non-training firms. Because induced costs are convex in λ and firms are homogeneously distributed in terms of technology, it appears that, at the neighbourhood of a pre-existing equilibrium, a moderate increase in the subsidy is unlikely to bring a large number of new firms to train. In other words, the cost elasticity at the extensive margin is likely to be limited.

Consider now firms F_k which level of tech-intensity, $\lambda_k < \tilde{\lambda}$, ensures that $(*)$ or $(**)$ is larger than $(***)$. The number of apprentices such firms take depends on the relation between $(*)$ and $(**)$. Namely, these firms will take on several trainees if there is a $n > 1$ for which $(\bullet)$ is larger than $(\bullet\bullet)$

$$(\bullet) \qquad (n-1) * (p_{app} - w_{app} + \psi_{app}) - C(\lambda_k, n) - {\phi_0}^n * \sum_{t=1}^{T} \beta^t \theta^t (p_1 - w_s)$$

$$(\bullet\bullet) \qquad -C(\lambda_k, 1) + \max\,(-\alpha_{app}(\phi_0); -\phi_0 * \sum_{t=1}^{T} \beta^t \theta^t (p_1 - w_s))$$

Therefore, firms on support $D_\lambda = [0; \tilde{\lambda}]$ are all the more likely to take on several apprentices rather than one as (i) the concavity of the function C in its second parameter rises; (ii) the share of suitable candidates drops; (iii) the difference between the productivity and subsidized wage $(p_{app} - w_{app} + \psi_{app})$ increases. In low-tech firms, one can expect that once a firm adapts the workplace to host an apprentice, induced marginal costs for taking more trainees are limited. For these firms, suitable candidates are also many: apprenticeship is a rare good in most countries, including France. In the end, the size of the third 'parameter' $(p_{app} - w_{app} + \psi_{app})$ is likely to be decisive. As a result, variations in subsidies are expected to have a stronger impact at the intensive margin of training than at the extensive margin.

Note that positive subsidies could result in a jump in training strategies from one to a large number of apprentices (which exact size depends on the behaviour of induced costs when the number of trainees rises). This is especially the case if the difference between production and the subsidized cost is close to 0.

H1.2: the cost elasticity at the intensive margin is larger than at the extensive margin and reaches a substantial size.

Finally, the relation between cost and mobility is expected to go in the same direction as the impact of costs at the intensive margin of training. This leads us to hypothesis *H2*:

H2: The elasticity of mobility upon graduation to the cost of apprenticeships is negative

3 The ICF and the cost of apprenticeship training

Hypotheses *H1.1*, *H1.2* and *H2* are tested in the case of France on the period 2000-2014. The variation in cost is driven by variations in a subsidy called *Indemnité compensatrice forfaitaire* (ICF) and targeted at employers of apprentices. Before turning to the data and estimations, I bring institutional elements regarding the funding of French apprenticeships.

3.1 National and regional policies affecting the cost of apprenticeship training

Public resources targeting apprenticeship training have three sources in France: specific taxes levied on firms, spending from regions and funds taken from the 'general budget' of the State. At the beginning of the 2000s, the two former were exclusively channelled towards the school part of apprenticeships. Funds from the 'general budget' of the State were directed towards employers. They included two types of spending: (i) an exoneration in payroll taxes for firms with less than 11 workers or with an activity in the craft industry and (ii) a subsidy (the *Indemnité compensatrice forfaitaire*, ICF).

The exoneration in payroll taxes was implemented in 1979 (law 79-13, January 3rd 1979). The only evolution along the period of study 2000-2014 is a law in 2008 which restored a few (and small) payroll taxes for firms exonerated until then. The ICF was created in 1996 to simplify the different financial incentives directed to employers (law 96-376, May 6th 1996). At the time, it included two components: a one-time hiring credit[15] (915€) and a yearly subsidy to cover part of the training expenses (1525€). The latter was topped up for underage apprentices (+305€/year) or if hours of schooling were large enough (+7.62€/hour, maximum of 1524€/year). In 2002, a reform was voted to transfer the payment of the ICF to regions. It applied to contracts signed after January, 1st 2003. By 2005, regions could as well decide upon the criteria of the ICF and the amounts associated, on the condition that a firm would receive between 1,000 and 5,000€ a year for each of its apprentices (decree n° 2004-551, June 15th 2004). The two policies remained active until 2014, year of repealing of the ICF (see section 3.4).

Three other types of public spending were set up between 2000 and 2014 to specifically target apprenticeship training. Their conditions all prevail at the national level. The first one is a tax credit on the pay bill of apprentices, implemented for some firms in 2005, and generalized in 2006. It amounts to 1600€ per year of apprenticeship or 2200€ if the apprentice is disabled. The tax credit was progressively removed from 2013 on. The second is a subsidy granted to firms increasing their stock of apprentices in the aftermath of the crisis, between 2009 and 2011. It roughly sums up to 1800€ for small firms and to 1000€ for larger ones. Finally, a national bonus-malus policy based on the number of apprentices according to the firm size was implemented in 2010. It affects the pay bill of all employees in the firm.

On top of these public expenditures specifically targeting employers of apprentices, other national and general policies have of course impacted the cost of apprentices over the period. They are of three types: (i) changes in the minimum wage, on which apprentices earnings are indexed; (ii) changes in the level of payroll taxes; (iii) a corporate tax credit (CICE) implemented in 2013.

Between 2000 and 2014, the regional laws changing the value and criteria of the ICF from 2005 to 2014 therefore constituted the only source of variation in the 'monetary cost' of apprentices, given their characteristics, the hiring time and the characteristics of the training company.

[15] Limited to apprentices with low levels of diploma in 2001

3.2 The regional regulations

Regions have taken advantage of their entitlement to reform the ICF to different extent. I collected the regional texts of law for 16 of the 22 metropolitan regions between 2005 and 2014. Table 1 shows the date of application of each change in regulation and the total number per region. Regions are classified according to the date of their first regulation.

To cover their expenses, regions received a yearly dotation for this new expenditure. In 2003[16], it equated the actual spending borne by the State in 2002 and updated according to the yearly evolution in the number of apprentices. Then, the yearly amount evolved at the same pace as all endowment funds granted by the State to the regions. The dynamic of the dotation was therefore independent from the evolution in the number of apprentices trained in the region and, more generally, from the evolution in the actual expenditures of each region. For instance, in 2011, the State endowed regions with 801 million euros per the ICF (IGF and IGAS, 2013). This represents an increase of 6.8% with regards to what the State spent in ICF in 2001 while the number of apprentices grew by 11.5% in the meanwhile. Importantly, regions can use their endowment on other purposes than the ICF as long as they provide each employer a minimum of 1000€ per apprentice and per year. In 2011, at a time when all regions had changed the original criteria of the ICF, they spent on average about 75% of their ICF endowment on this purpose (IGF and IGAS, 2013; see Figure A1.1 in Appendix 1).

[Table 1 about here]

3.3 The regional variation in the cost of apprenticeship training

Taking into account all sources of cost and revenues previously mentioned, I can plot the monetary cost of any contract. In this part, for the sake of simplicity, I choose three typical examples of contracts in region Ile-de-France (outside of Paris):

[16] Regions were in charge of expenditures by 2003 but could only change regulations by 2005.

(1) A firm of 8 workers, of which one is an apprentice, hires a new apprentice aged 16, who just graduated from lower secondary education (b*revet des collèges*) and prepares a 2-year c*ertificat d'aptitude professionnelle* (vocational training diploma taken at secondary school) involving 450 hours of class per year.

(2) A firm of 220 workers, of which 2 are apprentices, and which is not part of the craft industry, hires another apprentice aged 24 preparing a 1-year *licence professionnelle* (3rd and last year of short-cycle higher education) involving 600 hours of class per year.

(3) A firm of 270 workers, of which 10 are apprentices, and which is not part of the craft industry, hires another apprentice aged 24 preparing a 1-year *licence professionnelle* (3rd and last year of short-cycle higher education) involving 600 hours of class per year.

I specify other characteristics applying to all types in appendix 2. In particular, the working time of each apprentice is equal to the difference between the normal amount of yearly hours and the number of hours spent at school.

In Figure 1, I display the hourly cost of these contracts according to the year of hiring in region in Ile-de-France. Each of them begins on September, 1st. The cost of a non-fixed term contract of equivalent length paid at the minimum wage is also showed. In all cases, the cost is calculated at the conditions applying at the time of signature. This means that changes in legislation taking place after the beginning of the contract are not taken into consideration in the computation though they actually applied in reality.

The main take-away points are the following. The monetary interest in hiring an apprentice instead of a 'standard' worker appears clearly, including in the case when the apprentice has already graduated from a two-year diploma in higher education (types 2 and 3). The value of apprentices of type 1 oscillates between 1.15€/hr and 2.85€/hr. This seems to be small enough to ensure that, taking into account the cost of training facilities, the master's time and the apprentice output, the net training cost is negative (see note 8).

Finally, three year-to-year changes in cost for a given type stand out. The drop between 2004 and 2005 results from the instauration of the national tax credit for hiring an apprentice. The drop between 2009 and 2010 for type 3 stems from the fact that hiring a new apprentice brings the firm above one of the thresholds set up in the bonus-malus law. This brings a drop in the payroll taxes for the whole wage bill of the firm. I integrate the gain for the employer into the apprenticeship cost. Last, the sharp increase in cost taking place for all types between 2011 and 2013 is explained by a combination of factors: the end of the post-crisis specific subsidies, a change in the regional regulation of the ICF in Île-de-France and the end of the national tax credit received for hiring an apprentice.

[Figure 1 about here]

In Figure 2, I focus more specifically on the regional dispersion in the apprenticeship cost stemming from the variation in the ICF. The figure focuses on types 1 and 2. Type 3 is indeed very particular, few are the apprentices allowing firms to reach one of the thresholds set in the bonus-malus law. Comparing them at the regional level therefore brings little information. The two lines of Figure 2 are built according to the same principle as Figure 1 with the exception that the value of ICF granted to each contract is computed using the national regulation applying before any regional reform. This means that the amount of ICF used to compute the hourly cost displayed in the two lines is constant for each type over time. For each type and year, I then compute the actual distribution of the hourly cost across regions. In each region, this is computed using the pre-reform amount of ICF only until enactment of the first regional regulation. Afterwards, levels of ICF are computed according to the regional rule applicable. The shaded area of Figure 2 displays the spread between the 'placebo' value +/- one standard deviation of the actual distribution of regional apprenticeship costs. Since regions could implement regulations by 2005, this standard deviation is null before then and the shaded area empty.

[Figure 2 about here]

3.4 The repealing of the ICF

Announcement of the suppression of the ICF took place on July, 17th 2013. It was fully unexpected and the reactions opposing it were so strong that, the following day, the government announced the creation of a new subsidy directed towards small firms. Both changes were enacted in 2014 and applied to contracts signed after January, 1st 2014. Contracts signed before benefitted from a transitory plan. Because the change in legislation was not smooth and took place in the middle of the main period of hiring for apprentices (July-September), the analysis will focus on the introduction rather than the suppression of the ICF.

3.5 Other considerations

It should be said that the subsidy is not granted if the contract is broken before the end of the trial period. Moreover, until 2009 the part of the ICF which is offered yearly was conditional on the fact that the contract would not be broken before the end of the school year. Afterwards, this part got distributed to the prorata of the year spent under contract. Given these conditions, no specific action is needed from the firm to receive the ICF: registration of a contract before the administration is a necessary and sufficient condition to be entitled to and to receive the subsidy.

4 Data

The paper relies on four sources of data: the regional regulations of the ICF, an administrative database bringing information on apprenticeship contracts (Ari@ne) and two general administrative databases with information on employment spells (DADS) and on fiscal characteristics of firms (FICUS FARE).

4.1 Regional regulations

Information on regional regulations has been collected from regional services for apprenticeship training. Requests and reminders were sent by phone and electronic mails over about a year. In many cases, contacts with the regional archive services were needed and, in a few instances, my demands were transmitted to retired workers as a last resort to find the required documents. To ensure that all reforms were covered in the documentation sent by each region, extensive reading of proceedings of regional meetings on the matter of apprenticeship training was made. When documentation on a reform proved inexistent in regional archives, I searched the website webarchive.org to find relevant documentation around the expected timing of missing reforms. In the end, for 2 regions out of the 18 I contacted, the regional services could not find the whole history of regulations for the ICF (Picardie and Bourgogne) and I could not recover it vita webarchive. Champagne-Ardenne, Lorraine and Alsace were left aside because specific conditions for apprenticeship training and payroll taxes apply there. Corsica is also not considered here.

In the 16 remaining regions[17], each text of regulation provides information on: (i) the date of application; (ii) the value of the different subsidies composing the ICF and their conditions in terms of firms' and apprentices' characteristics; (iii) requirements in terms of school attendance and minimal duration of the contract; (iv) the potential exclusion of contracts signed as an extension of a previous one. Appendix 3 shows a summary of the regulation applying in Ile-de-France for contracts signed between July, 1st 2006 and June, 1st 2011. The national regulation applying before is also given for information.

4.2 Ari@ne, the administrative database of apprenticeship contracts

Information on apprenticeship contracts is taken from an administrative database called Ari@ne. The data comes from the paperwork signed at the

[17] They are: Rhône-Alpes, Pays de la Loire, Haute-Normandie, Poitou-Charente, Centre, Bretagne, Île-de-France, Languedoc-Roussillon, Nord-Pas-de-Calais, Limousin, Basse-Normandie, Provence-Alpes-Côte d'Azur, Franche-Comté, Acquitaine, Midi-Pyrénées, Auvergne.

time of the contract. It provides information on the apprentice (including both his stock of diploma and some socio-demographic characteristics), on the firm (including an identifying number, its size and sector) and on the contract itself (length, date of signature...). Note that subsequent events are not registered[18].

The database therefore offers most of the information necessary to compute the value of the ICF for each contract between 2000 and 2014. Among the information lacking to evaluate it precisely, the most redundant include: (i) whether the share of girls (resp. boys) engaged in the track at the regional level is low enough to give entitlement to gender diversity bonuses when applicable; (ii) whether the master responsible for the apprentice has followed the training courses offered by the region when applicable. Note that the latter generally last for very short time and require little involvement. Following a rule of thumb, I therefore impute the value of subsidies for masters to all contracts but the value of gender diversity bonuses to none.

The database is not exhaustive. Coverage goes from 80% in 2000 to 96% in 2014 and the DARES – who produces the data – has only used the data to evaluate the yearly number of new apprentices in the country since 2012. Data collection goes as follows: after signing a contract, the employer has 5 weekdays to get it stamped by the school where its apprentice is registered and send it to the appropriate consular chamber (based on the sector of occupation, number of workers and place of work). Consular chambers then transmit contracts to the regional government via an online system of information. The database Ari@ne is constructed with this information. It appears that Chambers were not ready to use the computer system when it was first set up. For this reason, it took time for some of them to organize a routine to send the paperwork to regional governments.

The lack of exhaustiveness of the data is an issue for the first-stage estimation – namely, the analysis of the impact of apprenticeship cost on firms' propensity to train. Identifier for Chambers are only available from 2012 on, but circumvolution of the problem is still possible using the geographic condition linking firms to consular Chambers. They are of 4 main types in

[18] In the last years, information on contract termination is given, but, according to the DARES who produces the database, this should be handled cautiously since all breaks are not reported.

France. For each of them, and within each city (postcode), I consider that contracts were correctly sent to the regional government if at least one contract per year was registered by a firm of its scope. City × type groups which do not respect this rule are dropped. This procedure is only used to build the sample of the first-stage analysis. As for the second stage – namely the impact of cost on mobility upon graduation – there is no reason why the time variation in registration by consular chambers would be systematically correlated with the variation in the level of retention.

Further selection is led to focus on contracts planned over at least two consecutive years, for at least 6 months and for less than 4 years, in the private sector and involving apprentices younger than 28. I drop contracts extended because of a failure at an exam or taking over a first contract broken between the apprentice and another employer. At that point the database is composed on average of a bit more than 200,000 contracts signed each year between 2000 and 2012. Of these, I can compute the average hourly monetary cost applying over the time of the contract for about 150,000 apprentices starting each year between 2000 and 2012[19]. As previously mentioned, the difference stems mainly from the fact that legislations relative to the ICF are available for only 16 regions.

4.3 DADS, the administrative database for social contributions

The database Ari@ne has three main limitations for this research. First, firm size is self-declared. Yet this is one of the main criteria ruling the level of ICF offered to each firm and its computation is not straight-forward: some workers should not be included in the count (apprentices for instance) and, for multi-plant firms, manpower in all plants should be taken into consideration. It is therefore likely to be noisy. I could not obtain clear information on whether regional services use this measure anyway or rather the real value computed from another administrative database. Second, the identification strategy I follow in section 6.1 necessitates information on firms in years when

[19] The minimum national conditions are applied. In particular, this means that branch-level minimum wages for apprentices are not taken into account.

they do not take on apprentices – namely whether the firm is still active and its size if so. These are not available in Ari@ane. Third, the database does not provide information on the labour outcomes of trainees after their contract. In particular, it is unknown whether the training firm offers its apprentice a regular contract upon graduation which constitutes the dependent variable in the second-stage analysis.

For these two reasons, I first recourse to the DADS, which is a database used by the administration to compute social contributions. It covers all wage earners in France since 2009. Before that, employees working in the public sector or for private individuals were not covered. The database is constructed at the individual × plant × year level. This means that all contracts between a worker and an establishment in a given year are gathered together, including in cases when a break took place between two contracts. Yearly information on the nature of the main contract of an individual in an establishment is available in the DADS – the main contract being defined as the one which brought the largest earnings to the worker. In particular, while apprenticeship contracts are not identified directly by employers in the paperwork, the producer of the database provides the information by word-search in the job title. Though noisy, the measure is good enough to be used in our case.

I also use the database FICUS FARE, computed by the administration for fiscal reasons. It is constructed at the year × firm level and provides information on sales among other things. This is used to recover firms in years when they are active but have no worker.

4.4 Merging the databases

Two types of merge are led according to the dependent variable. The analysis of the impact of the training cost on firms' propensity to train only requires yearly data at the firm level from the DADS and FICUS FARE. I therefore match the two databases with Ari@ne on the unique firm identifier, available in the three sources of information. About 6% of the selected sample in Ari@ne is not found back in the DADS or in FICUS FARE. Training cost can be measured for an average of about 145 000 contracts starting each year when firm size is computed from these databases. These contracts constitute the basis of the sample for the first-stage analysis – hereafter called sample A. It will be panelised at the plant level in section 6.1 and then called sample A'.

Second, in the analysis of second stage, I study the impact of training cost on the probability for an apprentice to be hired in her training firm upon graduation. It is therefore necessary to identify each trainee in the DADS upon completion of apprenticeships between 2002 and 2012[20]. The merging procedure between Ari@ne and the database of contracts retrieved as apprenticeships by the INSEE in the DADS is led on the following variables: firm identifier, region of employment, trainees' sex and age, termination date of the contract, first day of training the year preceding contract termination.

Matching is done approximately for the two latter variables. Regarding the former, graduation often takes place before contractual termination[21] and it is known that many apprentices break their contract upon completion of studies if not offered further employment in their training firm. By law, trainees even benefit from particular facilities to do so. These observations must not be lost. I therefore keep matches if the contractual termination date in Ari@ne does not exceed the real termination date in the DADS by more than 93 days. An apprentice will be considered as retained if, in the DADS, it is observed in the same establishment 2 months after contractual termination of the apprenticeship (see section 6.2). As for the starting date, I allow a maximum differential of 31 days between the two databases to limit the impact of mismeasurement. Finally, it should be added that plant identifiers (NIC5) are also available, but they cannot be used because of their poor quality in Ari@ne.

Table A4.1 in appendix 4 shows how well the second matching procedure does. About 45% of the contracts selected in Ari@ne (see section 4.2) with contractual termination between 2002 and 2012 are not found back in the DADS. Yet, it is known that about a third of apprenticeship contracts are broken before their term. I therefore fail to identify only about 15p.p. of real contract terminations. For the rest, about 45% of the contracts selected in

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[20] The database Ari@ne includes contracts beginning after January, 1st, 2000. The first significant yearly sample of contract terminations is therefore 2002.

[21] While graduation takes place between May and July in most cases, about 90% of sample A have a contractual termination between July and September.

Ari@ne are matched to only one DADS position while about 10% are merged with several DADS positions[22]. The latter case is overrepresented among large firms. The second-stage analysis will therefore only be led on the 1 to 1 matches – skimmed of some observations, see section 6.2. This represents a sample of about 55 000 contracts completed each year between 2002 and 2012 – hereafter named sample B.

5 Descriptive statistics

In this part, I present a few descriptive statistics on samples A and B. Columns (1) and (3) of table 2 describe the average number of apprentices per region and their average cost in sample A. The respective standard errors are given in columns (2) and (4). Column (5) gives information on the average retention rate of apprentices according to the termination year in sample B. Its standard error is available in column (6). Each of these values are computed yearly.

The upward trend in the number of apprentices (see column (1)) is both due to the development of apprenticeship training over the years (see Brébion, 2019) and to the increasing coverage of contracts in Ari@ne. The main variations in training cost over years have already been discussed in section 3; variation across regions are due both to differences in cost and in composition. As for the retention rate, it is equivalent to what was found in Brébion (2019) using the surveys *Génération* (about 40%). Yet, the latter focused only on apprentices who left school for at least a year after graduation while part of those in sample B are going back to school upon graduation while others do not graduate. The figure estimated here therefore slightly overestimate the real value.

[Table 2 about here]

[22] For the 1-to-n matches, n strongly rises in 2009 at the time when the scope of the DADS grows.

In what follows, I use the fact that four regions[23] ("regions of control" hereafter) implemented their first law relative to the ICF in 2009 to graphically evaluate the relation between training costs and recourse to apprenticeships in the other regions ("treated regions" hereafter) between 2000 to 2008. The idea is to compare the evolution in the number of contracts which cost increased (or decreased / remained stable) in a treated region which legislated on the ICF, with similar contracts in the regions of control.

Giving a practical example before formalizing the process may be useful. Consider a contract of type 1 (such as defined in section 2.3) and signed in Île-de-France on September, 1st 2005. The employer is entitled to 3,965€ of ICF over the time of the contract resulting in a total monetary cost for the apprenticeship of 2,273€. Region Île-de-France legislated over the ICF for contracts beginning after July, 1st 2006. It appears that a contract of type 1 signed on September, 2006 would only bring 3,000€ to the same firm. Everything else equal, its cost would therefore sum to 3,238€ (= 2,273 + 3,965 - 3000) over the time of the contract. This represents a yearly rise of 42%. I then compare the evolution in the number of contracts of type 1 signed between July, 1st and June, 30th every year in region Île-de-France and in the four regions of control where the ICF remains equal to 3,965€ until 2009[24]. For a given contract, the ICF is the only source of variation in cost across regions. The evolution in this difference therefore gives hints on the impact of a rise in labour cost on firms' propensity to train.

To gain in generality, the process is not led on the sole contracts of type 1. Thus, I group contract types according to their evolution in each treated region: (i) drop larger than 10%; (ii) limited change in price ([−10%; 10%]); (iii) rise larger than 10%. A few steps are finally taken to ease presentation of the difference of evolution in the number of contracts in each of these groups between Île-de-France on one side and Franche-Comté, Aquitaine, Midi-Pyrénées, Auvergne on the other side.

Formally, the process comes down to the following steps in each of the twelve treated regions:

[23] Franche-Comté, Aquitaine, Midi-Pyrénées, Auvergne

[24] The second regional reform in Île-de-France took place in 2011.

(1) I focus on the impact of the first regional regulation on the matter of the ICF (in year $t_{0,r}$) and drop contracts signed after the second regional regulation.

(2) In year $t_{0,r} - 1$, I group contracts according to the impact the first regulation would have on their cost, were they signed the subsequent year. Three groups are constructed as follows:

   (i) Contracts signed in $t_{0,r} - 1$ which cost would decrease by more than 10% if receiving the level of subsidies applying to their case after the new regulation.
   (ii) Contracts signed in $t_{0,r} - 1$ which cost would remain stable (within the interval $[-10\%;\ 10\%]$).
   (iii) Contracts signed in $t_{0,r} - 1$ which cost would increase by more than 10%.

(3) In the remaining years, I identify contracts which characteristics are the same as at least one contract signed in $t_{0,r} - 1$.

(4) I assign these contracts to the group where contracts signed in $t_{0,r} - 1$ with similar characteristics were allocated.

(5) Similarly to steps (3) and (4), I allocate all contracts from the four regions of control to the three groups according to their characteristics

(6) I separately normalize to 1 the number of apprentices in each group in the treated region as well as in the four regions of control in $t_{0,r} - 1$.

(7) Each year, I finally compute the group-specific difference between the normalized number of apprentices in the treated region and the normalized number of apprentices in the regions of control. I then detrend this difference based on the group-specific trends estimated before $t_{0,r}$.

The resulting group-specific variables are plotted over time for each treated region in appendix 5. The date of regional enactments over the ICF is standardized to 0. To ease presentation, I then average the results from the eight treated regions for which the most common window $[t_{0,r} - 5; t_{0,r} + 2]$ is observable. Figure 3 shows that, given their respective trend before each regional regulation, the number of apprentices in all groups of contracts evolve slower in the treated regions after a regional regulation than at the same time in the regions of control. Yet, contracts which costs decreased thanks to regional regulation of the ICF are less affected than those which cost remained stable or increased. Figure 3 therefore brings a first hint towards validation of hypothesis *H1* since it suggests that the elasticity of training to costs is negative.

Note that, to the exception of the year preceding the reform, all values in the figure are below 0. This means that, on average in the treated regions, the number of apprentices increased more in the pre-reform year than in the preceding years in comparison with the regions of control. This suggests that regional reforms may have been implemented to respond to regional specific paths in apprenticeship training. It would be a threat to be treated in our identification strategy (see section 6) if the difference plotted in Figure 3 and applying in each group followed different trajectories before the implementation of each regional reform. At first glance, it does not seem to be the case.

[Figure 3 about here]

Some heterogeneity in this elasticity should be emphasized. Figure 4 plots similar lines but this time limiting the sample to firms with at least 20 workers while Figure 5 uses its complementary. The former is noisier because of the lesser number of contracts in each regional group. It still clearly appears that small firms respond more strongly to the stimulus. It is however not possible to disentangle whether this comes from a difference in responsiveness of firms given the type of apprentice or whether this is driven by a difference in the composition of trainees between firms. Large firms indeed hire older apprentices who prepare more advanced diploma and cost more. Thus, figures A6.1 and A6.2 in appendix 6 show that training cost and recourse to apprenticeship seem uncorrelated for apprentices older than 18 to the contrary of underage trainees.

[Figures 4 and 5 about here]

6 The results

6.1 The impact of apprenticeship cost on firms' propensity to train

6.1.1 Calculation of the main independent variable

To analyse the impact of the hourly cost of apprenticeship training on firms' propensity to train, dataset A is panelised in a dataset A' at the level of plants. In the regressions, this allows me to take into account their unobserved characteristics if constant over time. The impact of interest is therefore identified through the variation of cost applying over time to each plant. Note that plants can be followed over time in FICUS-FARE and the DADS[25] as long as they exhibit positive values of sales and that their identifier does not change.

To be able to control for pre-trends, only the first legislation relative to the ICF is studied in each region (more details hereafter). The time window therefore depends on the region: it goes from 2000 to the year preceding the second law in each region (i.e. to 2012 for the last regions). This includes the four regions which waited 2009 to enact their first regulation and were used as controls in section 0. In fine, the unbalanced panel A' is composed of about 260 000 firms which signed at least one of the contracts identified in sample A (see section 4.4) over the selected years. Each firm is observed on average over 8.5 years. Results are stable to dropping years 2011 and 2012 where firms in regions Aquitaine and Midi-Pyrénées only are covered (see table 1).

[25] Firms employing no worker a given year are not covered in the DADS. Yet they can be identified as such if found in FICUS-FARE the same year with a positive value of sales.

To introduce the identification strategy, it should be recalled that apprenticeship costs depend on a wide range of firm-specific and trainee-specific characteristics. The intersection of all legislative conditions over the period 2000-2012 therefore constitutes tens of thousands of groups[26]. This fact as well as the interrelation between the preference of a firm for a type of apprentice and the cost of other types make it difficult to estimate an equation at the level of each type of potential contract. In other words, it is necessary to work at an aggregate level where, for each firm in a given year, the potential matches and their cost would be taken into consideration in a sole observation.

To do so, I compute a variable measuring the cost that, each year from 2001 on, firms should pay to hire the average apprentice fitting their 'preferences'. 'Preferences' are estimated per subgroup of firms at the national level in 2000. They are proxied by the relative weight that each type of apprentice represents in the total number of apprentices hired by the subgroup of firms in 2000. Computed as such, 'preferences' are exogenous to regional regulations taking place at least 5 years later. The probability for a firm to take an apprentice a subsequent year is then regressed on the updated weighted cost computed as mentioned (+ controls and fixed effects). In details, I stick to the following procedure:

[26] This large number comes from the variety of variables used in regional and national legislations as well as from the variety of thresholds for each variable. Thus, to evaluate the cost of an apprenticeship starting in a firm between 2000 and 2012 and taken randomly, one needs to know :
(1) about the trainee: (i) whether she is disabled; (ii) her age; (iii) her 'stock' of diploma; (iv) the diploma she prepares; (v) her professional/schooling situation before the apprenticeship.
(2) about the firm: (vi) the region of employment; (vii) whether it belongs to the craft industry; (viii) its size when training begins; (ix) its monthly size in the last 3 years; (x) whether it took trainees in the last 3 years.
(3) about the contract itself: (xi) the starting month; (xi) its length in years; (xii) the number of schooling hours.
As mentioned, different thresholds can be used for the same variable. For instance, in their ICF criteria between 2005 and 2013, regions set up 6 different thresholds relative to trainees' age.

(1) Each year, firms are separated into groups[27] according to all criteria relative to firms' characteristics found in the legislations relative to apprenticeship cost between 2000 and 2012. 42 groups are constituted. Within a region and a group and given the time of hiring, the cost of a given trainee is therefore invariable across firms: it depends only on its own characteristics and on the characteristics of her school track.

(2) Firms with less than 10 workers being over-dominant, I further separate them into three groups so that firms with no employee, firms with 1 to 5 employees and firms with 6 to 10 employees are treated separately. Note however that everything else equal, a given trainee will cost firms of these 3 groups the same amount if working in the same region and hired at the same time.

To ensure that results in the following regressions are not driven by small groups of firms, those with less than 1000 apprentices over the period are dropped. Hereafter, subscript f accounts for the 24 remaining groups of firms.

(3) I evaluate the structure of apprenticeship contracts in each group of firms at the national level in 2000 (i.e. firms' preferences). Specifically, I compute the share W_{gf} that each group of apprentices g accounts for in the total number of apprentices hired in 2000 in firms of group f. Groups of apprentices g are defined according to the intersection of the national and regional legislative criteria based on the characteristics of apprentices and of their school track. There are G = 4501 groups[28]. At a given time of hiring and in a given region, all apprentices of a group g would therefore cost the same to all firms of a group f.

By construction, $\sum_{g=1}^{G} W_{gf}$ = 1 for any f.

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[27] The criteria are (i) whether it belongs to the craft industry; (ii) its size when training begins sorted in 5 categories – [0; 10[, [10; 20[, [20; 50[, [50; 250[, [250; ...[; (iii) whether its size was larger than a threshold during 12 months in the last three years – thersholds are 20 and 250. Note that the intersection of these categories is often empty, hence the only 42 resulting groups.

[28] Note that the 4501 groups all include an apprentice hired in 2000. Relaxing this constraint would strongly inflate the number of groups.

(4) Each of the following years, I compute a weighted cost WCO_{frt} by applying each weight W_{gf} derived in (3) to the cost C_{gfrt} of a 'fictive' contract signed on September, 1st of year t between an apprentice of group g and a firm of group f in the region r.

i.e. $WCO_{frt} = \sum_{g=1}^{G} W_{gf} * C_{gfrt}$.

The bottom and top 1% of the weighted cost is dropped in all regression samples.

The yearly average and standard deviation of WCO_{frt} are given in table 3. The construction of the independent variable of interest implies two main assumptions. First, preferences in terms of types of apprentices g are assumed to be homogenous within each group of firms f[29]. Second, they should be stable over time within each group f at the national level.

[Table 3 about here]

6.1.2 The impact of costs on firms' likelihood to train

If enactments of regional laws are independent of the pre-existent training behaviour of each firm group (sequential exogeneity), the impact of apprenticeship cost on firms' likelihood to train can be estimated with no bias. The impact is measured by β in the following equation:

$$P_{ifrt} = \alpha_i + c_t + \zeta_f + \mathrm{T}X_{it} + \beta WCO_{frt} + \epsilon_{ifrt} \tag{1}$$

where, in each region, t goes from 2001 to the year preceding the second regional law on the ICF. The dependent variable P_{ifrt} is a dummy taking the value 1 if firm i from the group of firms f located in region r hired an

[29] One could be willing to relax a bit this assumption by creating smaller f groups. For instance, one could be tempted to separate between sectors more systematically than done here (craft-industry v.s. the rest). Yet, this reduces the final sample size in the estimations because I drop contracts of type $f \times g$ signed after 2000 if no contract of the same type was signed in the country in 2000.

apprentice in t. X_{it} is a matrix of time dependent characteristics of the firm (size and number of apprentices in the workforce in t-1, t-2 and t-3). Because one would expect yearly shocks to differently affect regions, equation (2) may be preferred:

$$P_{ifrt} = \alpha_i + \rho_{rt} + \zeta_f + \mathrm{T}X_{it} + \beta WCO_{frt} + \epsilon_{ifrt} \tag{2}$$

Whether the error term and the main independent variable are sequentially exogenous should of course be questioned. There are many reasons why the average behaviour of firms in a group $f \times r$ in $t-1$ could affect regional decisions, and thereby costs applying to this group in t. Among other things, if, in a region r, employment of apprentices in a group of firms $f_1 \times r$ has been steadily rising before 2005 to the contrary of firms of group $f_2 \times r$, the regional government may decide to shift subsidies towards $f_2 \times r$ when entitled to do so in 2005. Conversely, the regional government could also put money on the group of apprentices g the most hired in firms of $f_1 \times r$ per the reasoning that these are the most employable students in the region. The first regional behaviour would upwardly bias β while the second would generate a downward bias.

To test the assumption of sequential exogeneity, I estimate whether the trend in the dependent variable P_{ifrt} between 2000 and the year T_r of the first regional law applying in region r is significantly associated with the evolution in cost applying to the firm afterwards (i.e. $WCO_{frT} - WCO_{frT-1}$). This comes down to estimating the following equations:

$$P_{ifrt} = \alpha_i + \rho_{rt} + \zeta_f + \mathrm{T}X_{it} + \delta_{fr} * t + \nu_{ifrt} \ , \qquad t < T_r \tag{3}$$

$$WCO_{frT_r\_}WCO_{fr(T_r-1)} = \kappa_r + \mu_{fr} \tag{4}$$

$$\widehat{\mu_{fr}} = \theta.\widehat{\delta_{fr}} + \lambda_{fr} \tag{5}$$

In these equations, $\widehat{\delta_{fr}}$ gives us the trend in firms' likelihood to train in group $f \times r$ before the implementation of a regional regulation relative to the ICF. In each region, $\widehat{\mu_{fr}}$ gives us the variation in cost, specific to each firm group, implied by a change in regional regulation, once taken out the average evolution in cost in each region. There is sequential endogeneity if the two variables are correlated; i.e. if θ is significantly different from 0. In that case, the following equation should be preferred to equations (1) and (2):

$$P_{ifrt} = \alpha_i + \rho_{rt} + \zeta_f + \delta_{fr} * t + \mathrm{T}X_{it} + \beta WCO_{frt} + e_{ifrt} \tag{6}$$

Estimation of equations (1), (2), and (6) are provided in table 4. They are computed with clustered standard error at the level of the group of firm in a region (i.e. $f \times r$). They show that, when trend is not taken into consideration, the relation between cost and recourse to apprenticeship training appears positive against hypotheses *H1.1*. Yet, as displayed in table 5 estimation of equation (5) rejects the test for sequential exogeneity. Thus, when updating the law relative to the ICF, regions target subsidies toward groups of firms which are decreasingly hiring – which implies targeting the types of apprentices they hire the most. Coefficient β in equation (2) is therefore biased upwards. When taking this trend into account, it appears that the impact of training cost on the likelihood that a firm trains is non-significantly different from 0. The point estimate corresponds to an elasticity of training to cost of -0.08[30]. The 95% confidence interval (CI) of this elasticity is $[-0.24; 0.08]$. Hypothesis *H1.1* is therefore validated.

A specific element of the method should be mentioned here. The model incorporates a plant fixed effect in order to capture plants' unobservable characteristics. This setting brings a lot to the analysis but it evacuates firms who never train out of the sample. By definition, the variation in costs observed over the period had no impact on the training behaviour of these firms. This means that the elasticity of cost to firms' likelihood to train is even more centred on 0 than the one estimated.

Finally, given the graphical evidence from section 0, one would expect to find a positive relation between the size of the elasticity of interest and the size of firms. The method however lacks power to validate this conclusion. It does point towards such relation[31] but estimates are not statistically significant. The standard errors indeed increase too sharply when sample A' is

[30] Average values of WCO_{frt} and P_{ifrt} are respectively 2.77 and 0.27.

[31] The point estimate for firms with less than 20 workers corresponds to an elasticity of training likelihood to cost of -0.18

separated between large and small firms. Results are displayed in tables A7.1 and A7.2 in appendix 7.

[Tables 4 and 5 about here]

What is therefore the cost to bring a firm into training *via* regional hiring credits in our sample A'? Let's consider the hypothetical case where, in its 2006 reform, region Île-de-France (IDF) would decide to offer an extra 1000€ per contract on top of the changes which actually occurred. The top-up would equate to an average drop of about 0.55 units of $\overline{WCO_{IDF,2007}}$ according to the structure of firms in sample A'. This can be read as a drop of 0.55€/h in the cost of the average apprentice that firms of sample A' are willing to hire in the region in 2007. The sample gathers 47,344 plants in IDF. The number of plants in sample A' hiring apprentices in IDF in 2007 because of the top-up ("compliers" hereafter) would be 208 – which is the centre of the following 95% CI: [−208 ; +624][32].

For which cost? Given that 14,209 apprentices started a contract in the private sector that year in sample A', the cost of the measure would reach about 14.4M€. Therefore, the amount of ICF spent to bring one more firm into training in sample A' is about 70,000€[33].

6.1.3 The impact of training costs on the yearly number of apprentices hired in each plant

The previous development focused on the extensive margin, namely: the impact of training cost on firms' likelihood to train (at least one apprentice). As modelled in section 2, training cost can also play a role at the intensive margin of training: firms who plan to train a given year can adjust the number

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[32] The centre of the confidence interval (C.I.) is computed as follows: 47344*-0.008*-0.55. The first figure accounts for the number of plants, the second for the point estimate from equation (6) and the last from the average variation in cost $\overline{WCO_{IDF,2007}}$ stemming from the top-up. The bounds of the C.I. are computing using bounds of the CI of estimation of equation 6 (i.e. [-0.024;0.008]) rather than the point estimate.

[33] This equates $\big((14209 + 208) * 1000\big)$ € / 208.

of trainees they actually hire according to their cost. In this part, I estimate the elasticity of firms' propensity to train to costs taking into account both the intensive and the extensive margins. The sample remains the same (i.e. A') to the exception that I drop firms who hired more than 50 apprentices a given year. This is the top 99.999% of the distribution among firms taking on apprentices. The decision is taken to avoid results to be driven by outliers. Results are however stable if the whole sample A' is used. Equation (7) to estimate is similar to equation (6):

$$N_{ifrt} = \alpha_i + \rho_{rt} + \zeta_f + \delta_{fr} * t + \mathrm{T}X_{it} + \beta WCO_{frt} + e_{ifrt} \tag{7}$$

In particular, independent variables are the same and the setting takes into account the fact that sequential endogeneity applies in our case. The independent variable is a count variable accounting for the number of apprentices hired by firm i from the group of firms f located in region r in year t. Its distribution is given in Figure A8.1 of appendix 8. Standard errors are still clustered at the level $f \times r$.

The equation is estimated via a method of Poisson pseudo maximum likelihood (PPML). This model is well suited in the case of nonnegative data with many zeros (Correia et al., 2019a: 2). It has however a major constraint: the existence of maximum likelihood estimates is not always guaranteed – though standard softwares sometimes still compute them and provide wrong results in these cases (Santos Silva and Tenreyro, 2010; Correia et al., 2019b: 5). Note that the risk increases with the share of zeros – which is fairly large in our case, see Figure A8.1 in appendix 8. A new command giving the possibility to estimate a PPML model with high dimensional fixed effects and taking into account the aforementioned risk was recently made available on Stata (Correia et al., 2019a). This is the one I use to compute results which are displayed in table 6. Note that the number of observations has dropped. This is because singletons created by the intersection of control variables and fixed effects are automatically removed from estimation by the command.

[Table 6 about here]

Estimates in table 6 tell us that a one standard deviation decrease in the cost of apprenticeships increases the number of apprentices in training firms by 3.2%[34] of a standard deviation. The elasticity of the number of contracts to training cost is negative and equates -0.22 with a 95% CI of [-0.37;-0.07].

As in the previous section, I focus now on a practical example. Here as well, I assume that region Île-de-France (IDF) increased the ICF for each contract by an extra 1000€ on top of all changes implemented in the 2006 reform. Although the sample has evolved a bit, on average, this still equates to a drop of 0.55€ in $\overline{WCO_{IDF,2007}}$. The sample used in table 6 gathers 41,544 firms from region IDF. Therefore, the aforementioned reform would result in the creation of 773 new apprenticeships (95% CI: [236; 1311])[35].

Here as well, a cost-benefit analysis can be provided. 13,851 apprentices actually signed a contract in 2007 in one of the firms of table 6 situated in region IDF. The overall cost of the top-up would therefore reach about 14.6€[36]. This is equivalent to about 18,900€ per contract generated. Importantly, this should not be read as the public cost for these contracts. It is rather the surplus in cost that region IDF would bear on top of all other public expenditures normally budgeted per apprenticeship contract. These include subsidies but also tax credits or schooling expenditures. The CNEFOP estimates that the State and regions have spent about 3,300M€ on apprenticeship matters in 2007 which amounts to about 7,800€ per apprentice and per year[37]. The average length of an apprenticeship contract is 1.8 years in the sample of interest. In the end the total amount of public expenditures spent each year on each of the contracts generated by the rise in ICF therefore equates 18,300€. If one applies similar calculations for each bound of the 95% CI of the estimate of interest of equation (7), this amount varies between [14,200; 41,000].

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[34] The standard deviation of the weighted cost is 0.87 while the standard deviation of the number of apprentices taken on per firm is 0.92 in the sample of table 6.

[35] The calculation is the following: -0.55*-0.034*41,554

[36] (13,851+773)*1000€

[37] The stock of apprentices equated 425,000 in 2007. The sum obviously significantly varies across regions. I use the average number for simplification.

Combining results of sections 6.1.2 and 6.1.3, we can now conclude on the impact of monetary training costs on firms' propensity to train. It appears that the cost elasticity at the extensive margin (i.e. whether firms train or not) is non-significantly different from 0. It is precisely estimated: the lower bound of the 95% CI is only -0.24. Conversely, the elasticity of the number of apprenticeship contracts to training costs is significantly negative. But its size remains limited: the 95% CI is [-0.37;-0.07]. Monetary training costs therefore have no impact on the extensive margin of training with a significant but very limited impact on the intensive margin of training. Hypotheses *H1.1* and *H1.2* are therefore mostly validated.

It is interesting to compare these results with those found by Muelhemann et al. (2007) for Switzerland. The point estimate of the cost elasticity at the extensive margin exhibited in this paper equates 17.5% of theirs. Several elements can explain the difference. First, as mentioned is section 1.1.2, the elasticity computed in Muelhmann et al. is probably overestimated given the difficulty to take into account firms' selection into training. Second, Muelhmann et al. use the net training cost rather than the monetary cost[38] and the former may be relatively inelastic to the latter. If they are low enough, monetary costs can weight little in the net cost on apprentices. In particular, costs for training facilities and for masters' time could rise to infinite if the firm has no worker or space available. In these cases, our model predicts that variations in these induced costs are more likely to foster training than variations in monetary costs. Firms may also compensate variations in subsidies via the productive work of apprentices. Particular focus on the induced costs to adapt the workplace and on apprentices' productivity during training should therefore be taken in future research.

As for the cost elasticity at the intensive margin, it is non-significant in Muelhemann et al. (2007) while the combination of results from sections 6.1.2 and 6.1.3 suggest that it is negatively significant in mine. Precision of estimations in Muelhemann et al. (2007) is however weaker than in my estimations.

[38] As mentioned in note 8, to compute the net training cost, one takes into consideration the monetary cost but also the value of the apprentice's output, the cost of training facilities and the cost of the master's time.

6.2 The impact of cost on retention rates

The previous section suggests that firms who plan to train may partly decide on the number of apprentices to take on according to their price. The theoretical model set up in section 2 predicts that trainees taken on because of their low cost may not be retained upon graduation. I test this hypothesis in this section.

Mobility upon graduation is measured as not being working in the training firm 2 months after the contractual term of the apprenticeship contract. Note that for data reasons[39], contracts finishing after October, 1st each year cannot be used. They account for 8% of the total number of contracts of sample B – which was selected according to the procedure described in section 4.4. Once removed, the sample of interest includes about 50,000 yearly contracts termination between 2002 and 2012.

The main difficulty in estimating the impact of training cost on mobility is the risk of reverse causality: firms who 'train to retain' are more likely to hire costly apprentices. The estimation strategy therefore consists in aggregating data at the level of firm groups f and to use as a main independent variable the weighted costs WCO_{frt} previously computed. The analysis thereby comes down to evaluating the impact of the cost of the average apprentice on the average retention rate within each group of firm between 2003[40] and 2012. The equation to estimate is therefore the following:

$$\overline{RE_{frt}} = \rho_{rt} + \xi_{fr} + \beta WCO_{frt} + u_{frt} \qquad (8)$$

where $\overline{RE_{frt}}$ is the average retention rate of contracts signed in t by firms of group f in region r. This equation is demanding in terms of fixed effects and could be relaxed using equation (9)

[39] Many firms in France pay earnings accounting for the month of December N in January N+1 ("*décalage de paie*"). In wave N of the DADS, workers affected will therefore appear as quitting the establishment at the end of November N. It is not possible to get information back on the transition between years N and N+1 if variables from year N-1 are also needed – which is the case in this paper.

[40] As in section 6.1, the weighted cost is computed using the structure of hiring in 2000. I then drop contracts starting that year. Most of them end in 2002. This constrains me to estimate equations (7) to (9) using the remaining contracts ending after 2002.

$$\overline{RE_{frt}} = \rho_{rt} + \omega_f + \beta WCO_{frt} + u_{frt} \quad (9)$$

These equations are estimated via weighted least squares where weights are group size rather than via ordinary least squares (Angrist and Pischke, 2008). Results are displayed in table 7. The impact of cost on retention rates is significantly positive. The impact according to equation (8) is the following: a one standard deviation decrease in the (weighted) cost of apprenticeships decreases the probability of retaining apprentices upon graduation by 88% of a standard deviation on average[41]. The elasticity of retention rates to cost is about 0.40.

These results are in line with hypothesis *H2*. As suggested in the comparative literature on the Swiss and German case, it appears that the impact of training cost on mobility is large.

[Table 7 about here]

Conclusion

In this paper, I analysed the impact of variations in the labour cost of apprenticeship contracts on firms' propensity to train and on employment mobility of apprentices upon graduation in France. This research is motivated by the difficulties experienced in the country to develop apprenticeship training despite strong public investments to revive it. The strategy of identification takes advantage of the regionalization of a subsidy targeting employers of apprentices, the *indemnité compensatrice forfaitaire* (ICF). The ICF was set up at the national level in 1996. Between 2005 and 2014, regions could change its criteria and the amounts offered, which generated large variations in the cost of apprenticeship contracts according to firms' location.

Using triple difference techniques, I find that the elasticity of the number of apprentices to the cost of apprenticeships is significantly negative and equals -0.22. As predicted in a structural model that I built, this fairly limited

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[41] The standard deviation of the weighted cost is 0.87 while the standard deviation of the retention rates is 0.061 in the sample of table 6.

effect mostly plays via the intensive margin (i.e. the number of apprentices in training firms): the cost elasticity at the extensive margin is indeed zero. Still in line with the predictions of the model, I then find that the impact of training costs on mobility upon graduation is negative. Thus, a one standard deviation decrease in the cost of apprenticeships decreases the probability of retaining apprentices upon graduation by 88% of a standard deviation on average.

These results therefore suggest that firms can be gathered into two groups. In the first case, non-monetary costs are binding and firms are not able to train no matter the size of the subsidy. For instance, in some environments, the value of investments in training facilities or the trainer's teaching time can be much larger than firm's expected returns to training. The extreme case takes place when no working space or training master is available to host the trainee. In the second case, non-monetary costs are low enough for the firm to engage into training. In this situation, the firm has a given number of standard jobs to fill – which can be zero – upon graduation of her apprentices. She can however decide to take on a larger number of students if their cost is low enough. In that case, the extra trainees are taken to bring profits during their apprenticeship with no goal of retention upon graduation.

Whether subsidies targeting employers of apprentices should ultimately be encouraged depends on the result of a cost-benefit analysis. In the paper, I take the example of region Île-de-France in 2007 and show that the total cost to create a new apprenticeship contract *via* the ICF rises up to 18,300€ per year of contract. In another paper, I showed that taking an apprenticeship track rather than a standard school track at secondary level in France decreases unemployment likelihood by about 2 months in the 12 first months following school exit (Brébion, 2019). Since non-retained students tend to do less well than the average apprentice (ibid), overall, it seems that subsidies to employers of apprentices are rather costly tools to help the youth better integrate the labour market.

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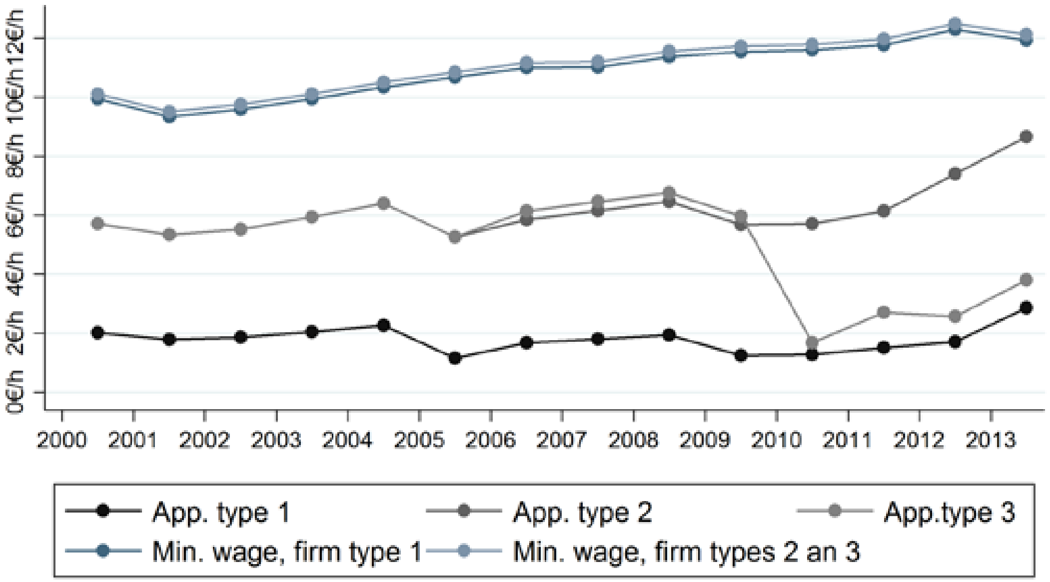
Main tables and figures

Table 1 – Timing and number of changes in regulations relative to the ICF according to the region

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total number of changes
Rhône-Alpes	01/06			01/06					01/06	3
Pays de la Loire	01/07	01/07	01/07				01/07	01/07		5
Haute-Normandie		01/01						01/11		2
Poitou-Charente		01/06			01/06	01/06	01/06	01/07		5
Centre		01/06				01/06				2
Bretagne		01/07			01/07					2
Île-de-France		01/07					01/06			2
Languedoc-Roussillon			01/06		01/06					2
Nord-Pas-de-Calais			01/06				01/06			2
Limousin			01/06				01/06			2
Basse-Normandie				01/06			01/06			2
Provence-Alpes-Côte d'Azur				01/07				01/07		2
Franche-Comté					01/01		01/01	01/06		3
Aquitaine					01/01					1
Midi-Pyrénées					01/06					1
Auvergne					01/09			01/07		2

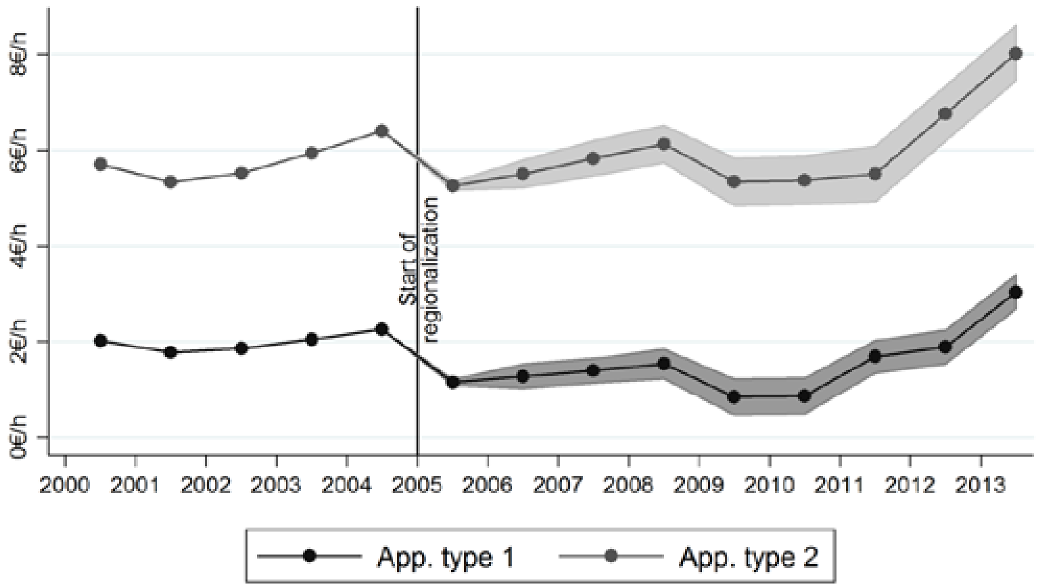
Source: own treatment of regional regulations.
Dates are formatted as DD/MM.

Figure 1 – Hourly cost of an apprenticeship contract in Île-de-France according to the type of contract



Note : The hourly monetary cost of a non-fixed term contract paid at the minimum wage in the same firm is given for information. It does not differ between types 2 and 3.
The date of signature is September, 1st for each year.

Figure 2 – Hourly cost of typical apprenticeship contracts computed with the national value of the ICF prevailing in 2000 and actual dispersion of costs over regions



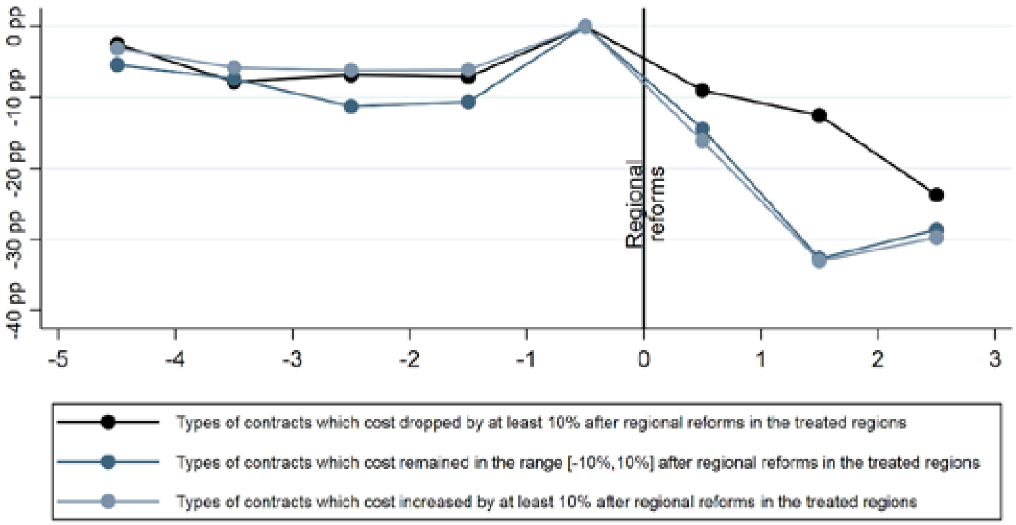
Note : Shaded areas show the spread between the cost of a placebo contract bringing a value of ICF defined by the reform national regulations +/- 1 standard deviation of the distribution in the actual cost applying over regions.
The vertical line shows the timing of the reform.
The date of signature is September, 1st for each year.

Table 2 - Descriptive statistics across region × year cells

	(1) Average number of new contracts per region	(2) Standard deviation of col. (1)	(3) Average cost of contracts beginning in...	(4) Standard deviation of col. (3)	(5) Average retention rate upon graduation per region	(6) Standard deviation of col. (5)
	Sample A				Sample B	
2000	7,641	5,163	3.16	0.19		
2001	7,812	5,435	2.84	0.20		
2002	7,752	5,399	2.96	0.21	0.44	0.03
2003	7,356	5,015	3.18	0.21	0.45	0.02
2004	8,271	5,686	3.51	0.22	0.46	0.03
2005	8,563	6,004	2.43	0.22	0.45	0.02
2006	9,079	6,504	2.91	0.45	0.44	0.03
2007	8,829	5,648	3.06	0.40	0.42	0.02
2008	10,484	9,888	3.58	0.63	0.42	0.02
2009	10,091	8,658	3.28	0.61	0.41	0.02
2010	11,453	10,509	3.47	0.68	0.40	0.02
2011	11,990	11,085	4.10	0.58	0.40	0.02
2012	12,102	11,391	4.50	0.54	0.39	0.02

Sources: Ari@ne and DADS, own calculations

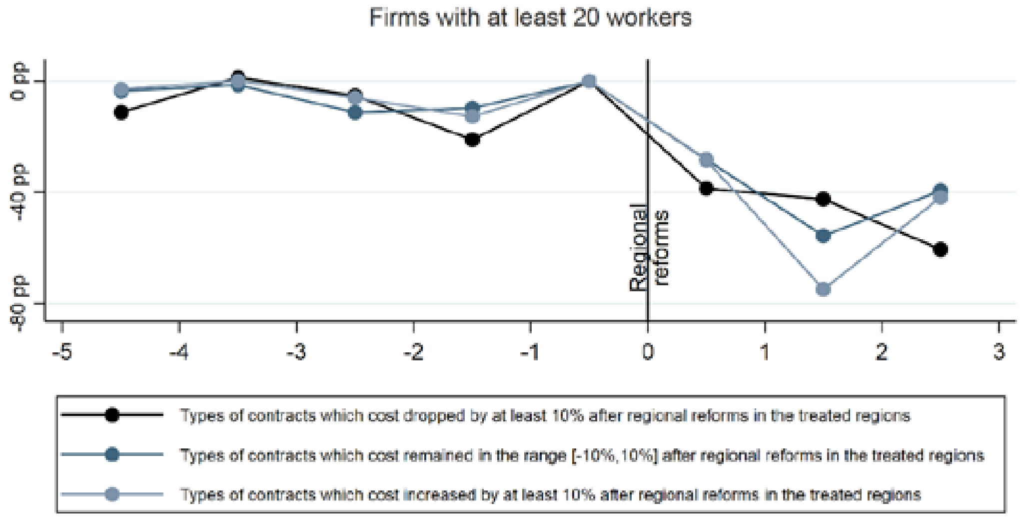
Figure 3 – Detrended difference in the normalized number of contracts signed each year in the treated regions and the regions of control



Note: The graph maps the normalized difference between (i) the number of yearly conctracts grouped according to changes in their cost implied by regulations on ICF in eight treated regions and (ii) the number of similar matches in four control regions.
Groups are constituted according to the evolution in cost the year before regional reforms and the year after in the treated regions.
The treated group includes regions who implemented their first regulation between 2005 and 2007 with no second regulation in the following two years;
The control group includes regions who did not enact any regulation on ICF before 2009. See text for details.

Reading: The year following implementation of regional regulation on ICF (t=0), the number of contracts which saw their cost decrease by more than 10% increased by .pp quicker in the treated regions than in the regions of control in comparison with their respective stock a year before. As for the contracts which saw their cost increase by more than 10% in the treated regions, the path was .pp quicker than in the regions of control.

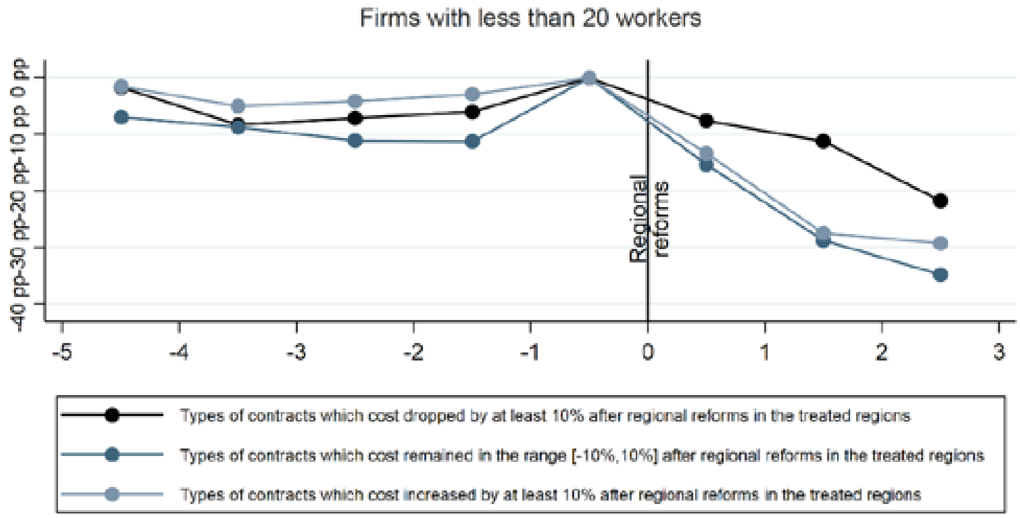
Figure 4 – Detrended difference in the normalized number of contracts signed each year in the treated regions and the regions of control



Note: The graph maps the normalized difference between (i) the number of yearly conctracts grouped according to changes in their cost implied by regulations on ICF in eight treated regions and (ii) the number of similar matches in four control regions.
Groups are constituted according to the evolution in cost the year before regional reforms and the year after in the treated regions.
The treated group includes regions who implemented their first regulation between 2005 and 2007 with no second regulation in the following two years;
The control group includes regions who did not enact any regulation on ICF before 2009. See text for details.

Reading: The year following implementation of regional regulation on ICF (t=0), the number of contracts which saw their cost decrease by more than 10% increased by .pp quicker in the treated regions than in the regions of control in comparision with their respective stock a year before. As for the contracts which saw their cost increase by more than 10% in the treated regions, the path was .pp quicker than in the regions of control.

Figure 5 – Detrended difference in the normalized number of contracts signed each year in the treated regions and the regions of control



Note: The graph maps the normalized difference between (i) the number of yearly conctracts grouped according to changes in their cost implied by regulations on ICF in eight treated regions and (ii) the number of similar matches in four control regions.
Groups are constituted according to the evolution in cost the year before regional reforms and the year after in the treated regions.
The treated group includes regions who implemented their first regulation between 2005 and 2007 with no second regulation in the following two years;
The control group includes regions who did not enact any regulation on ICF before 2009. See text for details.

Reading: The year following implementation of regional regulation on ICF (t=0), the number of contracts which saw their cost decrease by more than 10% increased by .pp quicker in the treated regions than in the regions of control in comparision with their respective stock a year before. As for the contracts which saw their cost increase by more than 10% in the treated regions, the path was .pp quicker than in the regions of control.

Table 3 - Summary table of weighted costs W_{frt}

	Average value of weighted costs W_{frt} (€/h)	Standard deviation	Number of observations
2000	3.05	0.61	167,075
2001	2.73	0.60	180,598
2002	2.84	0.62	193,637
2003	3.09	0.66	207,231
2004	3.38	0.70	222,434
2005	2.21	0.67	238,846
2006	2.54	0.79	226,641
2007	2.82	0.86	225,663
2008	3.04	0.92	189,196
2009	2.27	1.00	151,927
2010	2.33	1.00	131,362
2011	3.27	0.81	59,807
2012	3.38	0.77	23,719

Sources: Ari@ne and DADS, own calculations

Table 4 - Effect of apprenticeship cost on firms' likelihood to train

	(1)	(2)	(3)
	Equation (1)	Equation (2)	Equation (6)
Weighted Cost WCO_{frt}	0.021*	0.069***	-0.008
	(0.012)	(0.014)	(0.008)
Firm Fixed Effects	Yes	Yes	Yes
Group of Firms Fixed Effects	Yes	Yes	Yes
Time * Region Fixed Effects	No	Yes	Yes
Specific Trend per Firm Group * Region	No	No	Yes
Observations	2,045,420	2,045,420	2,045,420
Adjusted R-squared	0.167	0.169	0.170

Note: The average probability to train P_{ifrt} in the sample is 0.27
Model: OLS
Clustered standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source : Ari@ne, DADS and Ficus Fare, own calculations

Table 5 - Responsiveness of regional policies to pre-trends in region*firms group's training behaviour

	(1)
	Equation (5)
θ	5.152***
	(1.042)
Observations	359
R-squared	0.064

Model: OLS
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source : Ari@ne, DADS and Ficus Fare, own calculations

Table 6 - Marginal impact of apprenticeship cost on the yearly number of apprentices hired by each firm

	(1)
	Equation (7)
Weighted Cost WCO_{frt}	-0.034***
	(0.012)
Firm Fixed Effects	Yes
Group of Firms Fixed Effects	Yes
Time * Region Fixed Effects	Yes
Specific Trend per Firm Group * Region	Yes
Observations	1,813,269
Pseudo R-squared	0.242

The average number of apprentices N_{ifrt} in the sample is 0.43
Model: Poisson pseudo maximum likelihood
Clustered standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source : Ari@ne, DADS and Ficus Fare, own calculations

Table 7 - Effect of apprenticeship cost on retention of apprentices

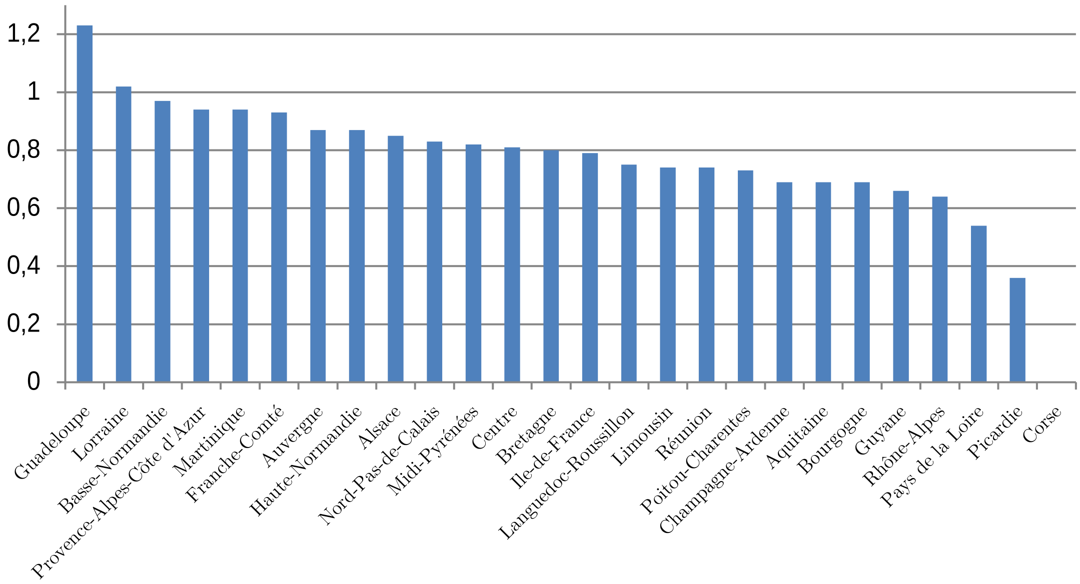
	(1)	(2)
	Equation (8)	Equation (9)
Weighted Cost WCO_{frt}	0.061***	0.062***
	(0.013)	(0.013)
Time * Region Fixed Effects	Yes	Yes
Firm Group * Region Fixed Effects	Yes	No
Firm Group * Time Fixed Effects	No	No
Firm Group Fixed Effect	No	Yes
Observations	2,666	2,674
Adjusted R-squared	0.650	0.614

The average value of retention rates $\overline{RE_{frt}}$ in the sample is 0.44
Model: Weighted least square where weights are group size.
Standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$
Source : Ari@ne, DADS and Ficus Fare, own calculations

Appendix – additional tables and figures

Appendix 1 – Regional expenditures on the matter of the ICF relatively to their endowments

Figure A1.1 - Ratio between the regional endowments and expenditures relative to the ICF in 2011



Source: IGF and IGAS, 2013

Reading: In 2011, region Ile-de-France spent in ICF about 80% of its endowment on this matter

Appendix 2 – Complementary information on the three types of contracts on which figures 1 and 2 are based

The three types of contracts used in Figure 1 and Figure 2 are the following.

(1) A firm of 8 workers, of which one is an apprentice, hires a new apprentice aged 16, who just graduated from lower secondary education (*brevet des collèges*) and prepares a 2-year *certificat d'aptitude professionnelle* (CAP – vocational training diploma taken at secondary school) involving 450 hours of class per year.

(2) A firm of 220 workers, of which 2 are apprentices, and which is not part of the craft industry, hires another apprentice aged 24 preparing a 1-year *licence professionnelle* (3^{rd} and last year of short-cycle higher education) involving 600 hours of class per year.

(3) A firm of 270 workers, of which 10 are apprentices, and which is not part of the craft industry, hires another apprentice aged 24 preparing a 1-year *licence professionnelle* (3^{rd} and last year of short-cycle higher education) involving 600 hours of class per year.

On top of these characteristics, all firms: (i) are from a private sector (excl. professionals) where boys and girls are both well represented among apprentices; (ii) do not pay any extra contribution on top of the compulsory ones; (iii) are subject to the VAT (and therefore do not pay the *taxe sur les salaires*); (iv) have not signed any agreement reducing working time per the plan Aubry before 2002; (v) pay their workers twice the minimum wage on average; (vi) are not subject to a branch-specific minimum wage for apprentices; (vii) pay contributions for transportation applying in the department Essonne; (viii) close their accounts for the financial year on March, 31^{st}; (ix) have already hired an apprentice in the three previous years; (x) have had the same number of employees in the last 3 years and the same number of apprentices in the last 2 years.

Furthermore, the person in charge of the apprentice in the firm (the apprenticeship master) takes part in training set up by the region if applicable[42]. The apprentice is not disable and was at school the year before starting her apprenticeship.

[42] These are generally very short and require little involvement.

Appendix 3 – Summary of the ICF regulation applying nationally before the reform and of the first regional regulation in Ile-de-France.

Table A3.1: Criteria and amounts of the ICF prevailing before the first regulation in each region and after the first regulation in Île-de-France

	Contracts …		Conditions on firms		Conditions relative to the apprentice at the time of signature	Condition on the diploma prepared	Condition on the contract	Condition on school assiduity	Amount	Frequency	Parts of the ICF not taken into account in the graphs and regressions
	… signed after	… signed before	F1	F2	G1	D1	C1	S1			
National values applying before the reform	/	the first regional regulation	It should not be part of the non-industrial or commercial public sector					Some conditions on school assiduity apply	1 525 €	Yearly	
					Older than 18				305 €	Yearly	
							> 600 hours of classes per year		7,62 € max 1524	Per hour of class	
				Monthly size has not exceeded 20 workers in 12 months of the last 3 years	No diploma higher than grade 9		The contract exceeds the trial period & the contract is not extending after failure at the exam		915 €	Once	
Île-de-France	July, 1st 2006	June, 1st 2011	It should not be part of the non-industrial or commercial public sector					The ICF is capped at 1000€ if assiduity at school is insufficient	1 200 €	Yearly	
				250 workers max					300 €	Yearly	
					Older than 18	Professional diploma from higher secondary education			500 €	Yearly	
					Older than 20	"Baccalauréat" (grade 12)			500 €	Yearly	
					Older than 22	Professional diploma from higher education			500 €	Yearly	
					Girl	Less than 25% of girls engaged in this track			500 €	Yearly	X
					Disable				600 €	Yearly	
						Part of the track is followed abroad			40 €, max 1200 €	Per day spent abroad	X

Source: own treatment of the national and regional regulations provided by the regional services for apprenticeship
Reading: a large firm (say 1000 workers) signing a 2-year apprenticeship contract with an overage apprentice who spends 750 hours at school each year before July, 1st 2006 in Île-de-France will receive 5946 euros in ICF (=1525*2+305*2+min(1524;7,62*150)*2) over the time of the contract, if the apprentice attends school and if the contract is not broken before its end.

Appendix 4 - Quality of the merging procedure led to obtain sample B

Table A4.1 - Quality of the merging procedure between Ari@ne and the DADS, according to the year of contractual termination

	(1)	(2)	(3)	(4)	(5)
	Total number of selected contracts for which cost can be computed	Share of contracts not found in the DADS (1 to 0 matches)	Share of contracts merged to only one DADS position (1 to 1 matches)	Share of contracts merged to several DADS positions (1 to n matches)	Average number of DADS positions merged to in '1 to n matches'
	(sample A)		(sample B)		
2002	117302	51%	43%	6%	3
2003	124516	53%	41%	6%	4
2004	123317	53%	41%	6%	4
2005	124893	50%	43%	7%	4
2006	134168	46%	46%	8%	4
2007	141462	42%	49%	9%	4
2008	142686	42%	48%	10%	4
2009	151876	36%	51%	13%	6
2010	165033	36%	51%	13%	7
2011	162115	39%	48%	13%	8
2012	185990	40%	47%	13%	8

Note: the merging variables are: the firm identifier, the region of employment, the sex and age of the apprentice, the ending date of contracts (+/- 93 days) and the first day of work in the preceding year (+/-31 days). About a third of all contracts are broken before termination and cannot be found in the DADS per the merging variables. By construction, they are included in the count of '1-0 matches'.

Figures displayed here include contracts in the 16 regions for which information regarding the ICF is available.

Reading: of the 185,990 apprenticeship contracts with contractual termination year in 2012 for which cost could be computed, 40% were not retrieved in the DADS by the merging procedure (including contracts broken before completion), 47% were matched to only one contract in the DADS and 13% were matched to several DADS positions (8 on average).

Appendix 5 – Relation between regional training costs and recourse to apprenticeships across regions

Figure A5.1 – Region Île-de-France – All apprentices

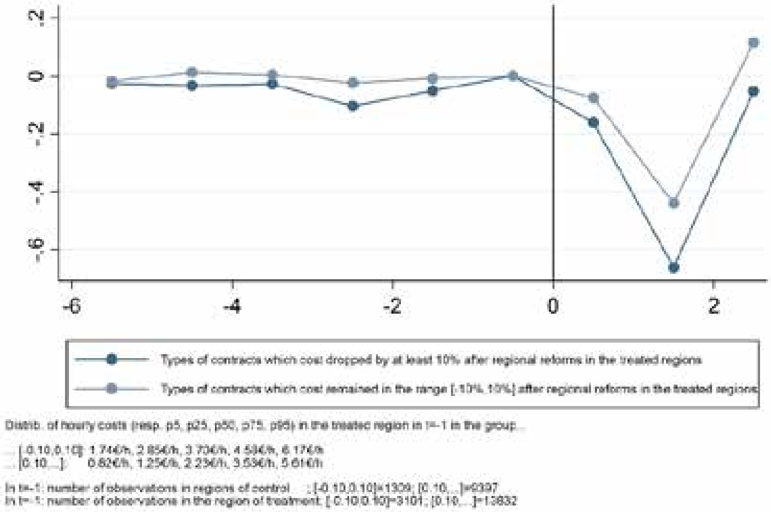


Figure A5.2 – Region Haute-Normandie – All apprentices

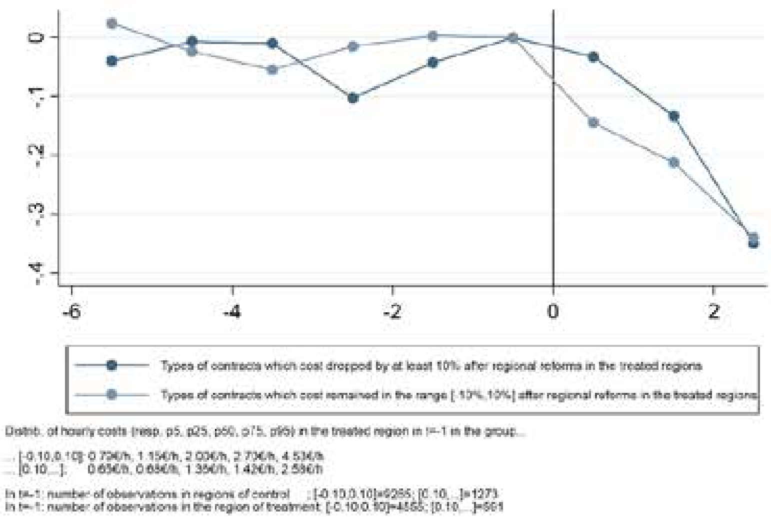


Figure A5.3 – Region Centre – All apprentices

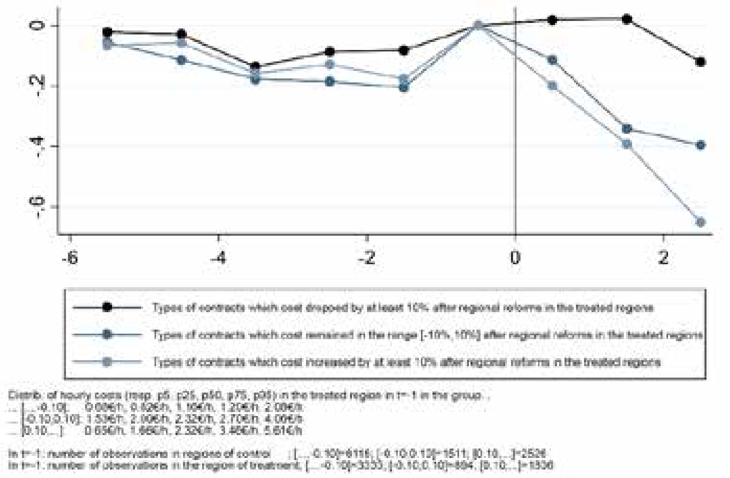


Figure A5.4 – Region Basse-Normandie – All apprentices

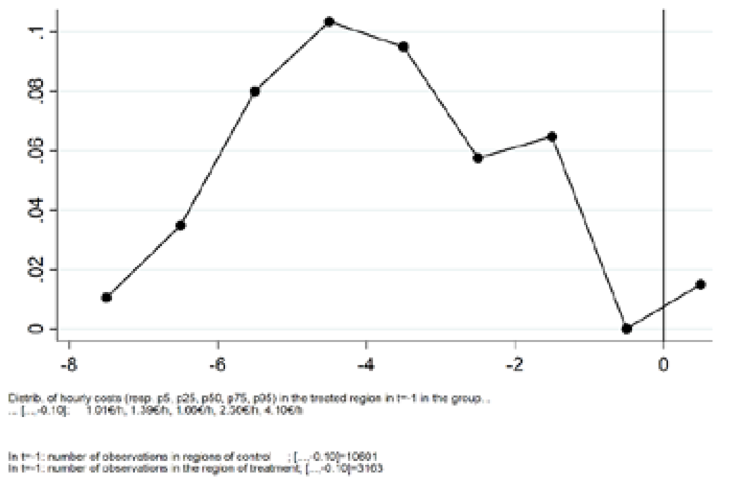


Figure A5.5 – Region NPDC – All apprentices

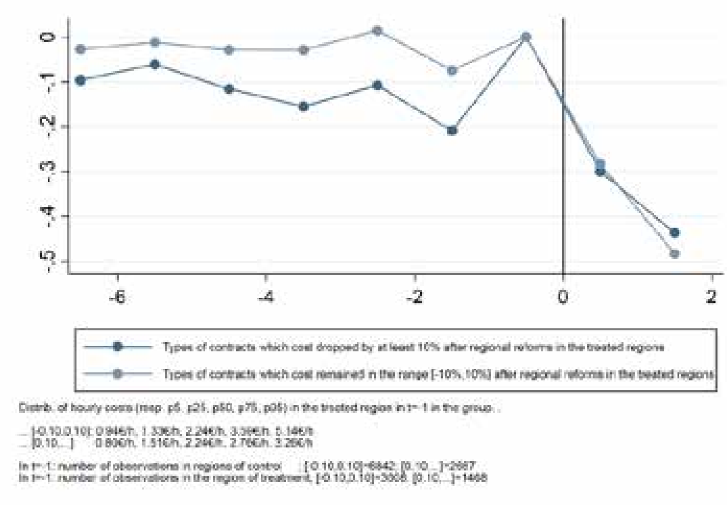


Figure A5.6 – Region Pays de la Loire – All apprentices

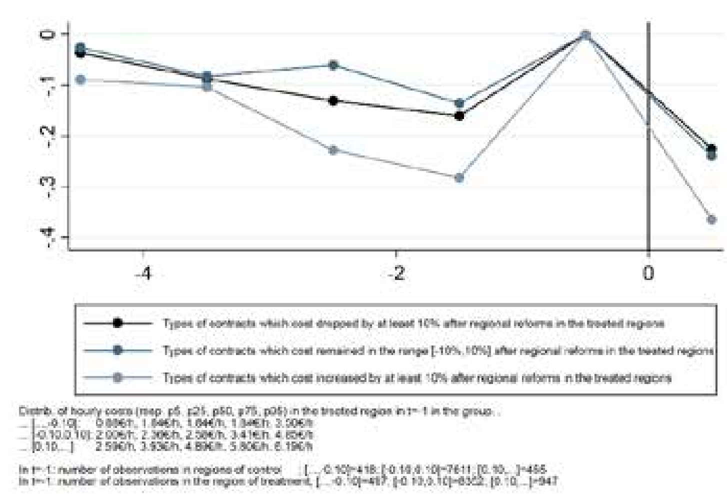


Figure A5.7 – Region Bretagne – All apprentices

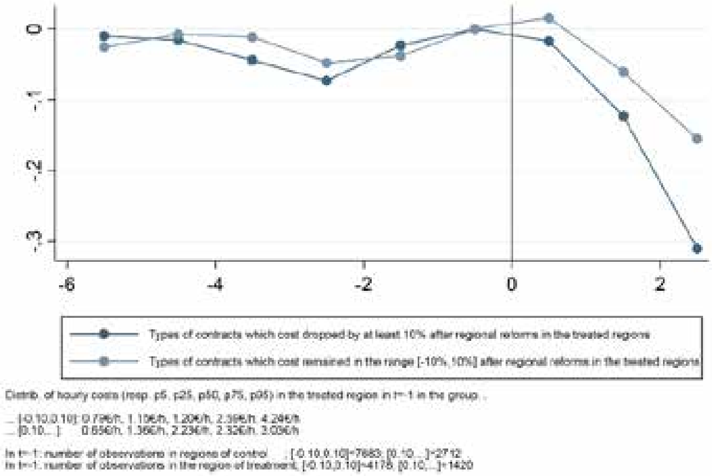


Figure A5.8 – Region Poitou-Charentes– All apprentices

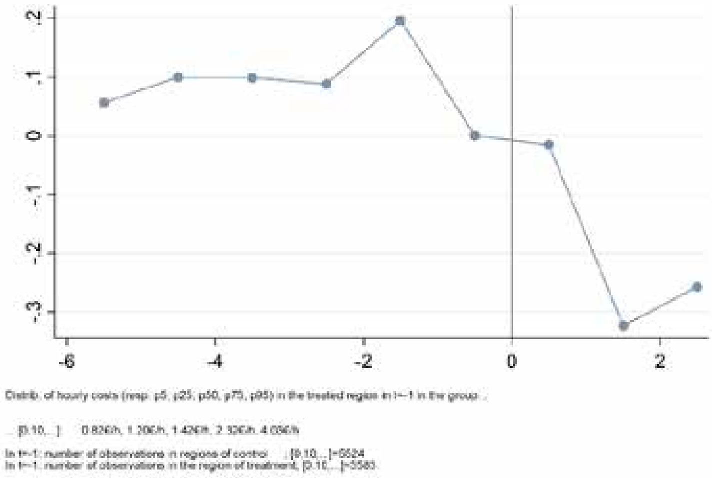


Figure A5.9 – Region Limousin – All apprentices

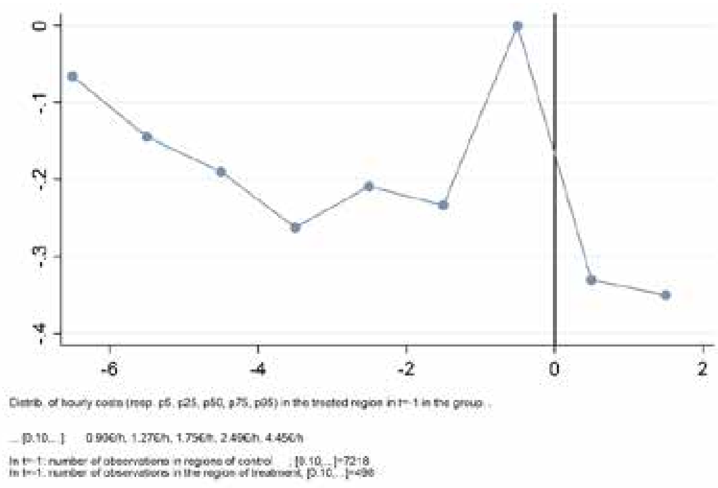


Figure A5.10 – Region Rhône-Alpes – All apprentices

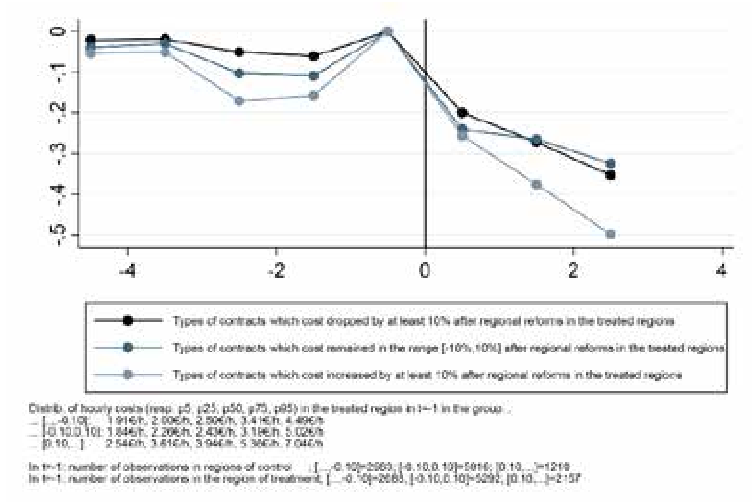


Figure A5.11 – Region Languedoc-Roussillon – All apprentices

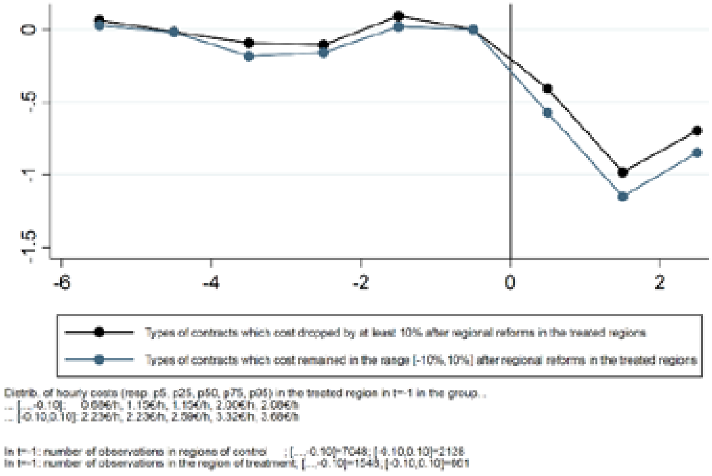
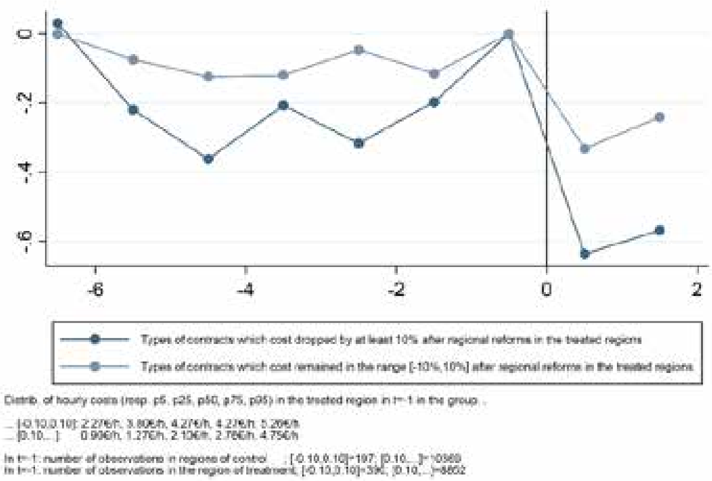
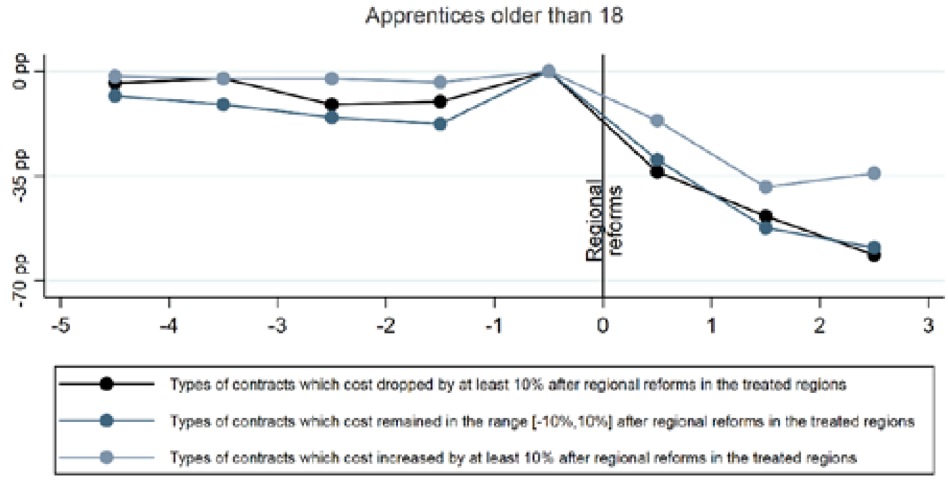


Figure A5.12 – Region Provence-Alpes-Côte d'Azur – All apprentices



Appendix 6 – Relation between regional training costs and recourse to apprenticeships according to the age of apprentices

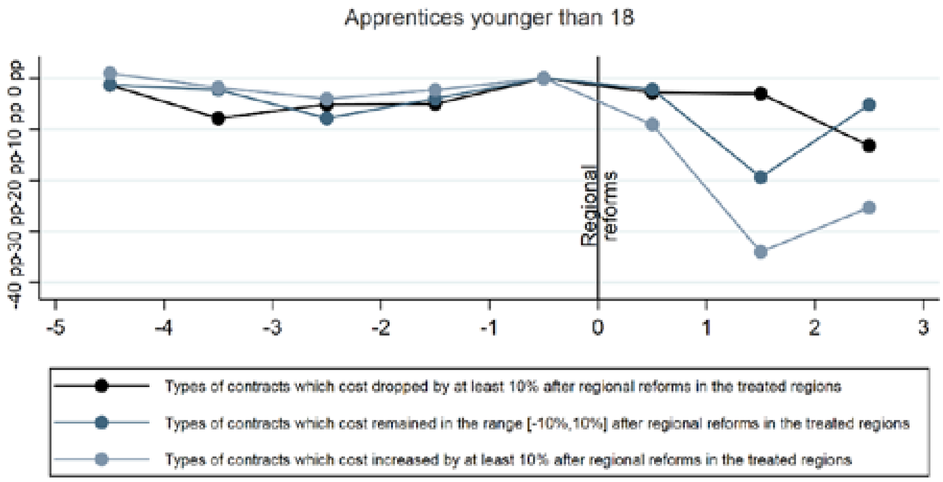
Figure A6.1 – Detrended difference in the normalized number of contracts signed each year in the treated regions and the regions of control



Note: The graph maps the normalized difference between (i) the number of yearly conctracts grouped according to changes in their cost implied by regulations on ICF in eight treated regions and (ii) the number of similar matches in four control regions.
Groups are constituted according to the evolution in cost the year before regional reforms and the year after in the treated regions.
The treated group includes regions who implemented their first regulation between 2005 and 2007 with no second regulation in the following two years;
The control group includes regions who did not enact any regulation on ICF before 2009. See text for details.

Reading: The year following implementation of regional regulation on ICF (t=0), the number of contracts which saw their cost decrease by more than 10% increased by .pp quicker in the treated regions than in the regions of control in comparison with their respective stock a year before. As for the contracts which saw their cost increase by more than 10% in the treated regions, the path was .pp quicker than in the regions of control.

Figure A6.2 – Detrended difference in the normalized number of contracts signed each year in the treated regions and the regions of control



Note: The graph maps the normalized difference between (i) the number of yearly conctracts grouped according to changes in their cost implied by regulations on ICF in eight treated regions and (ii) the number of similar matches in four control regions.
Groups are constituted according to the evolution in cost the year before regional reforms and the year after in the treated regions.
The treated group includes regions who implemented their first regulation between 2005 and 2007 with no second regulation in the following two years;
The control group includes regions who did not enact any regulation on ICF before 2009. See text for details.

Reading: The year following implementation of regional regulation on ICF (t=0), the number of contracts which saw their cost decrease by more than 10% increased by .pp quicker in the treated regions than in the regions of control in comparison with their respective stock a year before. As for the contracts which saw their cost increase by more than 10% in the treated regions, the path was .pp quicker than in the regions of control.

Appendix 7 – Differentiation of the size of the elasticity of firm’s propensity to train to training costs according to the size of firms

Table A7.1 - Effect of apprenticeship cost on firms' likelihood to train - according to the size of firms

	(1)	(2)	(3)	(4)	(5)	(6)
	Small Firms			Large Firms		
	Equation (1)	Equation (2)	Equation (6)	Equation (1)	Equation (2)	Equation (6)
Weighted Cost WCO_{frt}	-0.016*	-0.023	-0.019	0.040***	0.061***	0.008
	(0.008)	(0.024)	(0.018)	(0.017)	(0.011)	(0.010)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Group of Firms Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time * Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Specific Trend per Firm Group * Region	No	No	Yes	No	No	Yes
Observations	1,700,781	1,700,781	1,700,781	185,179	185,179	185,179
Adjusted R-squared	0.153	0.154	0.155	0.273	0.280	0.282

Model: OLS

Clustered standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source : Ari@ne, DADS and Ficus Fare, own calculations

Table A7.2 - Responsiveness of regional policies to pre-trends in region*firms group's training behaviour - according to the size of firms

	(1)	(2)
	Small Firms	Large Firms
	Equation (5)	Equation (5)
θ	2.345*	0.975
	(1.243)	(1.057)
Observations	112	153
R-squared	0.031	0.006

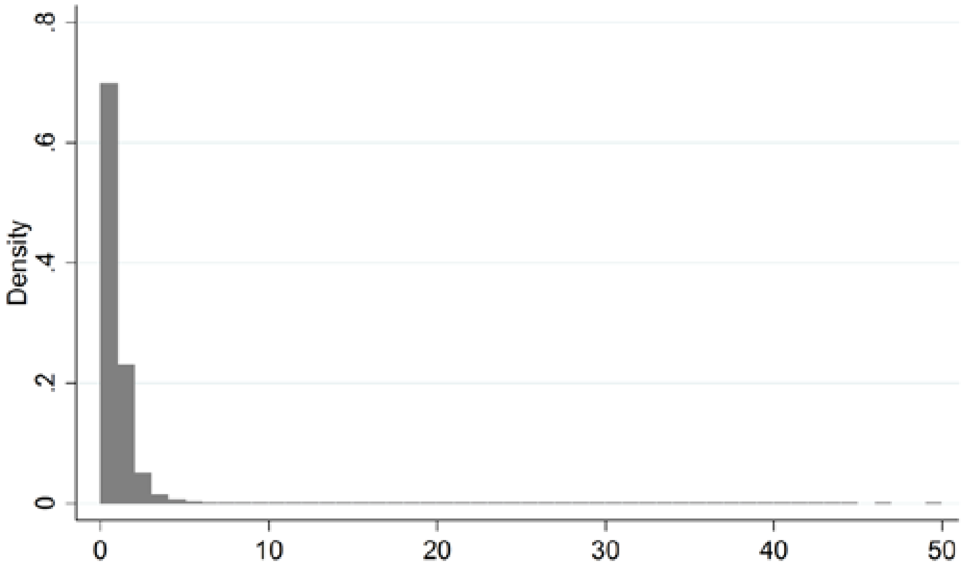
Model : OLS

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source : Ari@ne, DADS and Ficus Fare, own calculations

Appendix 8 – Distribution of firms' likelihood to train and of the number of apprentices hired in each firm.

Figure A8.1 – Distribution of the yearly number of apprentices hired in each plant of sample A'



Reading: in 70% of the yearly observations, plants of sample A' did not train.
In 23% of the yearly observations, they hired only one apprentice.
Source: Ari@ne, DADS and Ficus Fare, own calculations