Guess who's there: employment protection legislation and the degree of substitutability between labour contracts^{*}

Preliminary version

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Abstract

Employment protection legislation may affect the degree of substitutability among different types of labour contracts by changing the individuals sorting into jobs and firms screening out jobs. Using administrative data, I document this substitutability in the context of a labour market reform that changed the employment protection legislation and provided incentives to training contracts in Italy in 2012. I present and simulate a model that shows that individual's and firm's behaviour have important implications for the impact of policies that lower firing costs. Inefficiencies of job sorting and screening due to asymmetric information can be reduced by a more flexible employment protection legislation regime combined with incentives to training contracts.

Keywords: Human Capital, Employment Protection Legislation, Asymmetric-information

JEL Codes: J24,J63,J68.

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1 Introduction

Substitutability among different types of labour contracts is crucial for the study of employment protection legislation. When workers are targeted by a policy that alters incentives to use a specific labour contract, changes in job sorting and screening may arise depending on whether how informative layoffs are. Wage offers for both insiders and outsiders can be affected. This in turn impacts on individual careers, firms profit and their choice on how much invest in human capital. When the employment protection legislation is strict, layoffs cannot be informative of workers' characteristics to the secondhand market. On the one hand, the gap in the relative informational advantage of incumbent employer is never filled. On the other hand, the uncertainty of a human capital investment is higher since the job match can be locked in after bearing a costly investment.

In this paper I propose a novel approach that study how the individuals' sorting into jobs and firms' screening out jobs is related to the employment protection legislation regime. A more flexible employment protection legislation combined with other policies that encourage the use of training contracts changes the composition of types of labour contracts (no qualified and likely temporary contracts versus training contracts versus highly qualified and likely permanent contracts) and lower the turnover of workers.

When the decision to whom lay off is left to the firm's discretion, the market infers that adverse selection characterises the pool of laid-off workers. A rich literature documents the labour market impacts that result when the incumbent employer has an informational advantage concerning employees' abilities (see for instance Waldman 1984, Greenwald 1986, Gibbons and Katz 1991, Waldman 2016, Abel, Burger and Piraino 2017, Upward and Wright 2019). Another rich strand of the literature shows how this employer's informational advantage paves the way for firm's sponsored training even when skills provided are general (i.e. these skills increase worker's productivity even at other than the firm providing on-the-job training) (see for instance Acemoglu and Pischke 1998, Acemoglu and Pischke 1999, Autor 2001, Adhvaryu, Kala and Nyshadham 2018, Jahn and Rosholm 2018, Ferreira, de Grip and Van der Velden 2018, Bilanakos, Heywood, Sessions and Theodoropoulos 2018). There is, on the other hand, limited evidence on how firms adjust labor demand and individuals adjust their labour supply sorting into different jobs when employment protection legislation is reformed and incentives to invest in human capital increase. Do firms change their hiring and firing rules? Do these labor demand adjustments affect life cycle earnings profiles of employees? Do workers sort into job differently? Do more individuals sort into training contracts? Does the optimal level of training increase? Answering these questions sheds light on the degree of substitutability of different types of labour contracts and how it is related to employment protection legislation and incentives to on-the-job training.

The extent to which worker's ability level is close to the secondhand wage offer depends on the employment protection legislation, i.e. on the level of the firing costs. This has important implications for the impacts of employment protection legislation policies as well as of other policies that similarly reduce the turnover of workers. Therefore, it is primarily important to assess firm and worker responses to changes in the design of the employment protection legislation. In addition, it is crucial to examine whether and how their behaviour affects the substitutability of types of labour contracts.

To address these questions I exploit the quasi-experimental variation of a unique labour market reform implemented in Italy in 2012 - the Fornero reform - that changed the employment protection legislation and provided incentives to substitute temporary contracts with training contracts (in Italy these training contracts are named vocational apprenticeships).

I use a rich administrative dataset on employer-employee records that covers about the 13% of all job flows in Italy between January 2011 and December 2013. I start by investigating the possible sources of heterogeneous change of labour demand for training contracts in response to the reform. To identify the effect I compare individual before and after the reform just below and just above the threshold of 30 years above which the training contract cannot be signed (1, 279, 730 observations, gathering 105275 individuals aged between 29 or 30 with certainty and turning to 30 or 31 in an unknown month during January 2011-December 2013 who were hired by 99934 firms). The results are informative about the degree of substitutability between different types of labour contracts within and across cohorts when employment protection legislation changes. I then document the worker characteristics that are associated to a higher response to the reform. I conclude by discussing the implications of micro-level substitutability for different types of labour contracts. The higher the worker and firm heterogeneity is, the higher the need for selection into jobs, the more job loss changes face. This phenomenon is observed everywhere. However, the employment protection legislation can influence the informational content of this selection process by changing the number of layoffs and worker turnover rates. I thus improve upon the existing literature that focuses on the behavioral responses of firms and workers. This analysis represents a first step to evaluate the importance of substitutability between different types of labour contracts and workers' sorting into jobs and firms' screening out jobs for the analysis of employment protection legislation policies.

Estimating heterogeneous responses to reforms that reduces employment protection legislation while encouraging the use of a training contract poses two main identification challenges. First, worker sorting into jobs and firm screening out jobs are endogenous. Selection bias makes it hard to isolate heterogeneous responses. Second, this selection bias depends on the workforce age distribution if marginal costs and benefits of worker sorting and firm screening varies over age. The features of the Fornero reform combined with rule (enforced since 2003) that individuals who are aged 30 or more cannot sort into training contracts allow me to address both identification issues. The main hypothesis is that individuals have imprecise control on the age at which the training contract is signed (if it is signed) (see for more details on how the data support this hypothesis Maida and Sonedda 2019). As a result, individuals with similar observable and, hopefully unobservable characteristics (i.e. individuals with similar marginal costs and benefits), experience differential substitutability for types of labour contracts if they are just below and just above the age cutoff. The new law reduced the degree of employment protection legislation and provided incentives to the use of the training contract. The design of the policy generated heterogeneous changes of this differential substitutability for types of labour contracts across otherwise similar cohorts. In other words, the ability distribution between cohorts who reached the threshold age before/after the introduction of the reform is similar. The treatment is then independent to the characteristics of the empirical counterparts of this ability distribution such as for instance the percentile of the distribution of education conditional on age. This is because it leverages small idiosyncratic differences across cohorts of birth in the distribution of education conditional on age within the narrow subset of employees on the cusp of the age cutoff (i.e. the source of variation is randomised). The treatment is also independent of the percentile of the distribution of monthly net job flows (hirings minus separations) since in a given month and year individuals just below and just above the age threshold are exposed to the same business cycle conditions.

I leverage this feature of the reform to address the selection bias problem. In the first part of the paper I document heterogeneous substitutability between types of labour contracts. This finding suggests that the reform changed the worker sorting into jobs and the firm screening out of jobs. To conduct my analysis, I include the treatment into a difference-in-discontinuity reduced form model estimated over the period 2011-2013. I look at one main margin: the training contract probability. For instance, my results show that this probability increased by about one percentage point in the post-reform period at the age threshold for those sitting below the 25th percentile of the distributions of monthly multiple job spells. This probability did not change instead in the post-reform period at the age threshold for those sitting in a percentile higher than the 25th of such distribution. Indeed, training contracts are too costly for some individuals. The effect on the probability of training contract is concentrated on those who are not low educated. I show that in the post-reform period at the age threshold this probability increased more for those who sit above the 25th percentile of the education distribution conditional on age compared to the increase experienced by those who sit below this percentile value. The former is about 1.6% and the latter is about 0.6%. Reporting also the estimated increase of this probability in the post-reform period at the age threshold for those sitting below and above the 75th percentile of the level of the education degree illustrates that this probability increased in the post-reform at the age threshold for those sitting in the interquartile range of this distribution. These findings can be explained by complementarities between former education and on-the-job training. This is, possibly, the observed counterpart of complementarities between individual ability and on-the-job training. This evidence suggests substitutability between different types of labour contracts and different sorting into jobs and screening out jobs caused by a reform of the employment protection legislation combined with incentives to use training contracts.

In the second part of the paper, I study how the reform affected the substitutability between different types of labour contracts due to worker sorting into and firm screening out jobs. I present a simple model of costly human capital investment under a reformed employment protection legislation. I look at changes in firm wage offer of different types of labour contracts (no-qualified jobs, training contracts, highly qualified jobs) caused by a more flexible employment protection legislation. The model builds on Gibbons and Katz (1991) and Autor (2001). How firms induce self-selection and perform subsequent screening of worker ability is similar with these models. As in Autor (2001), the costly human capital investment decision lead workers to sort into it on the basis of their expected ability and firms to improve their screening out jobs. As in both Gibbons and Katz (1991) and Autor (2001) all secondhand pools are a mixture of exogenous and endogenous departures. Hence these pools are characterised by adverse selection. As in Gibbons and Katz (1991) the lay off rule determines the endogenous quits. However, the degree of firm discretion in lay off rules depends on the employment protection legislation. Therefore, substitutability of different types of labour contracts is affected by the degree of employment protection legislation. This analysis and its empirical implications are unique to the current model.

Then, I simulate this model to endogenise the percentile of the individuals' ability distribution over which workers sort into jobs (no-qualified jobs, training contracts and highly qualified jobs) and firms screen them out. I find that for marginal workers, a more flexible employment protection legislation has a positive effect on sorting into training contracts, but a negative effect on sorting into no-qualified jobs. This is because their lifetime earnings profiles increase when they exchange a lower initial wage for higher future earnings. Hence, the estimated positive effect of the Italian reform reflect a different composition of types of labour contracts. Some individuals would have had a non-qualified job and likely temporary job, absent the reform. Instead, they follow another working career. However, these individuals have higher marginal costs of training. Hence, more flexible criteria for layoffs reduce, the optimal amount of training provided by the firm.

The previous literature has focused on empirical analysis on the effect of employment protection legislation on-the-job training finding mixed results (e.g. Bolli and Kemper 2017, Cabrales, Dolado and Mora Villarrubia 2017). This paper shows that substitutability of different types of labour contracts - caused by a more flexible employment protection legislation - is also very important. Indeed, a more flexible employment protection legislation regime combined with incentives to training contracts can reduce the inefficiencies of job sorting and screening due to asymmetric information. The remainder of the paper proceeds as follows: Section 2 reviews the related literature and illustrates the institutional setting; Section 3 describes the data and present the reduced form analysis; Section 4 presents the model; Section 5 discusses the simulation of the model; Section 6 concludes.

2 Related literature and institutional framework

2.1 Brief overview of the literature

This research is related to at least three strands found in the literature.

First, this paper combines the analysis presented by Autor (2001) with the study by Gibbons and Katz (1991). Hence, it is related to the literature on the role of asymmetric information on firm's training provision. The main economic reasoning is that in presence of asymmetric information firms have ex-post monopsony power (Acemoglu and Pischke 1998, Acemoglu and Pischke 1999). In fact incumbent firms are better informed on employees' abilities relative to other firms. Because of this informational advantage individuals are not paid their marginal product and that this in turn increases the employer's benefit of financing general training. Firms can extract higher profits from workers with higher skill level and workers with more human capital. However, the problem of hiring the *right* employee is quite complicated since employees are privately informed about relevant personal attributes and skills. Employees may have an incentive to misrepresent abilities and overplay experience and qualifications. As firstly suggested by Salop and Salop (1976), firms might induce workers to reveal information prior to the hiring decision. In general, firms could offer compensation packages that are most valuable to the type of employee they wish to attract (Lazear 1990, Lazear 2009, Lazear 2018). Another stream of literature focuses on the role of intermediaries. Autor (2001) argues that free training in general skills provided by temporary agencies both induces worker self-selection and allows these firms to privately screen on worker ability. This paper combined this feature to the literature on the informational content of worker's layoff and how this informational content is related to the firm's hiring policy. Gibbons and Katz (1991) analyse the selection on the part of their employers of workers displaced due to slack work. Human resources management policies give likely preference in retention to more productive workers when

demand declines. In contrast, employers must layoff all employees when a plant closes. On the basis of this argument, workers displaced due to slack work will fare worse when newly hired than employees displaced due to a plant closing. However, the employment protection legislation could influence the informational content of this selection process by restricting the number of layoffs.

Secondly, this study is related to the literature on employment protection legislation. A widely recognised stylised fact is that the share of temporary jobs is higher in countries where permanent jobs have greater protection. Since the eighties restrictions on the use of firing-cost-free temporary contracts were relaxed in some European countries in the name of fighting the high unemployment rates. However, flexibility was introduced only at the margin since strict employment protection legislation governing permanent contracts was not reformed. The rapid expansion of temporary contracts as employment contracts used in new hires led to segmented labour markets while failed to reduce unemployment. This labour market segmentation generated a strong divide between unstable jobs with poor working conditions and stable jobs with better working conditions. Only few papers endogenise the choice between fixed-term and open-ended contracts (Caggese and Cuñat 2008, Berton and Garibaldi 2012, Cahuc, Charlot and Malherbet 2016, Guglielminetti and Nur 2017, Fialho 2017, Tealdi 2019). Temporary job contracts emerge in equilibrium because they provide production opportunities having short expected durations (Cahuc et al. 2016). On the one hand, permanent labor contracts entail probationary periods. On the other hand, temporary jobs cannot be terminated before their ending date. Firms' screening of temporary workers is worthwhile only if the duration of the probationary period of permanent contracts is shorter than the length of fixed-term contracts. In this framework temporary contracts are likely to be more dead-end jobs rather than stepping stone into permanent employment. One stream of the literature suggests that earnings of temporary workers are lower (see for instance Blanchard and Landier 2002), they receive less on-the-job training (see for instance Cabrales et al. 2017) and their career prospects are worse relative to those experienced by workers employed in permanent contracts (García-Pérez, Marinescu and Vall Castello forthcoming).

Thirdly, this research is related to the literature on the relation between employment protection legislation and firm's sponsored training and its developments.

More recent empirical contributions focused on the effect of employment protection legislation on-the-job training by type of contract. One could expect that if a longer working time horizon increases the firm's monopsony rents on workers training, stricter employment protection legislation should increase firm's sponsored training. This effect when estimated is typically either small or statistically insignificant (Almeida and Aterido 2011, Picchio and van Ours 2011, Bolli and Kemper 2017). However, stricter employment protection legislation increases the dualism of the labour market enlarging the gap in training provisions between temporary and permanent workers. The overall impact on the economy should then depend upon the composition of the labour force by type of contract (Cabrales et al. 2017). The composition of the labour force by type of contract is strictly related to the employment protection legislation. For instance, Hijzen, Mondauto and Scarpetta (2017) use a regression discontinuity design to show that stricter employment protection legislation increases worker turnover because of the excessive use of temporary contracts. In what follows I describe a labour market reform in Italy (law no 92/2012) that simultaneously changed the employment protection legislation, enforced the commitment to training provision and the enforcement of the permanent nature of the training contract. In combining these three measures this reform changed the sorting into and screening out of jobs.

2.2 Institutional framework

The Italian employment protection legislation was quite strict comprising, for instance, the reinstatement in the workplace in case of individual dismissals. According to the OECD, employment protection legislation index in 2011 was equal to 2.76 in Italy, 2.68 in Germany, 2.38 in France and 0.26 in the US. Since the end of the nineties, in Italy there have been some reforms increasing flexibility at the margin. Law no. 196/1997 liberalized the use of fixed-term contracts for new hires. However, a very specific list of circumstances under which employers could use those contracts was provided. Decree Law no. 368/2001 eased these restrictions. The segmentation of the Italian labour market has increased since then, limiting the outsiders from having access to the primary labour market of permanent contracts. Over the period of my data, which extends from January 2011 to December 2013, there has been the first main reform of the employment protection legislation (Fornero Reform). The reform aimed to favour more flexibility in hiring by way of open-ended contracts which make the dismissal easier. Severance pay, based on the age of the worker and the years of service substituted the reinstatement in the workplace in case of individual dismissals due to economic hardship. Collective dismissals are allowed under certain reasons such as cutbacks, company changes or termination of activities after complying the information and consultation procedure with trade unions. Irregularities in the procedure can be remedied in the framework of a trade union agreement, without the annulment of dismissals and the reinstatement in the workplace as ruled before the reform. The scope of atypical and temporary work was scaled back, either in salaried and quasisubordinate employment. The combination of this two rules reduced the duality between insiders and outsiders of the Italian labour market. In addition, the reform outlined the central role played by the training contract, named vocational apprenticeships in Italy. This contract shares some characteristics with the permanent labour contract and some characteristics with the temporary labour contract. In fact, this contract is classified as a permanent contract. At the end of the training period it is automatically converted into standard open-ended contract in absence of any notice from the firm. In presence of the firm's notice no firing costs have to be paid. Worker's dismissal at any other time than the end of training period is subject to the same firing costs rules of permanent contracts. The reform quantifies the potential number of apprentices that can be recruited by the employer, which is determined by the number of qualified workers in employment. The reform enforced the open-ended nature of the contract by limiting the number of newly hired apprentices if the employer had not recruited at least 50% of apprentices whose contract ended in the past 36 months.¹ In sum, this reform changed the substitutability of different labour contracts while reducing the employment protection legislation. In 2013 the OECD employment protection legislation index, was then equal to 2.68 in Italy as in Germany, 2.38 in France and 0.26 in the US.

 $^{^{1}}$ This percentage has been reduced to 30% in relation to the 36 months subsequent to the enforcement of the reform.

3 Data and Reduced-form analysis on the relationship between changes in employment protection legislation and substitutability between different types of labour contracts.

3.1 Data

In estimation of reduced-form analysis on the relationship between changes in employment protection legislation and substitutability between different types of labour contract I make use of a very rich administrative dataset by the Ministry of Labour and Social Policies, CICO. All individuals who activate, transform and dismiss a labour contract in all sectors including the Agricultural sector and Public Administration between 2009 and second quarter of 2017 remain in the panel from first job episode recorded then onwards. The relevant dates (day, month, year) of each event are available in the database together with the type of labour contract, the sector, the region of work and the type of benefit associated to the contract (if applicable). The units of observation are all individuals born on the 1st, the 9th, the 10th and the 11th of each month for each cohort of birth whose gender, year of birth, region of birth, citizenship, and education are recorded.² Each worker is associated to his/her employers through an anonymous identifier. Using the worker's anonymous identification code I link information recorded in two databases on self-employment activities and independent job episodes in the professional orders. This merge is meant to let the non-employment status to be due to either unemployment or being out of the labour force status. My full data set is made of 1, 279, 730 observations gathering 99934 firms and 105275 individuals aged between 29 or 30 with certainty and turning to 30 or 31 in an unknown month during January 2011-December 2013 (± 18 months around June 2012 when the labour market reform was issued). Balancing-out of covariates at the age threshold before and after the Fornero reform is presented in Table 1.

I consider the following covariates as potential mechanisms that could help explaining the reduced form relationship between changes in the employment protection legislation and substitutability between different types of labour contracts: education, past-

 $^{^{2}}$ Missing information on the educational level are included using an indicator function that controls for this status.

	Main Sample			
	Raw data Polynomial f			omial fit
	[-1,1]	[-2,2]	[-1,1]	[-2,2]
	DiD	DiD	DiD	DiD
	(Std. Dev.)	(Std. Dev.)	(Std. Err.)	(Std. Err.)
Gender	-0.005^{***}	-0.005^{***}	-0.005	0.001
	0.001	0.001	0.056	0.095
Region of birth	-0.193^{***}	-0.152^{***}	-0.193	-1.075
	0.074	0.052	27.011	46.041
Education	-0.323^{***}	-0.301^{***}	-0.323	-0.263
	0.041	0.029	7.357	12.685
Missing education	0.001	0.003^{***}	0.001	-0.006
	0.001	0.001	0.137	0.235
Past experience	-16.086^{***}	-110.236^{***}	-16.086	151.320
	1.290	0.892	79.416	126.001
Missing past exp.	-0.006^{***}	0.007^{***}	-0.006	-0.025
	0.001	0.001	0.023	0.039
Region of work	0.002	-0.015^{**}	0.002	0.032
	0.010	0.007	0.950	1.659
Changing sector	0.002^{**}	-0.001^{**}	0.002	0.007
	0.001	0.001	0.024	0.042
Regional mobility	-0.006^{***}	-0.006^{***}	-0.006	-0.014
	0.001	0.001	0.233	0.398
Higher 25 per. monthly job spells	-0.005^{***}	-0.003^{***}	-0.005	-0.006
	0.001	0.001	0.033	0.056
Higher 25 per. monthly sep. flows	-0.001	-0.001^{**}	-0.001	0.001
	0.001	0.000	0.008	0.014
Higher 25 per. monthly net job flows	-0.001	-0.003^{***}	-0.001	0.002
	0.001	0.000	0.009	0.015
Higher than 25 perc. costs reduction	0.001^{***}	-0.000	0.001	0.003
	0.000	0.000	0.011	0.020
Higher than 25 perc. soc. insurance benefits	0.001^{***}	-0.000^{***}	0.001	0.001
	0.000	0.000	0.001	0.001

Table 1: Difference-in-discontinuity on covariates generated by the Fornero reform at the age threshold

Notes: The independent samples t-test compares the difference in the means from the two groups (treated and untreated cohorts) around the age threshold, to zero. The polynomial fit corresponds to a zero (first) order polynomial in age when the age range is $\pm 1(2)$. Each variable, defined as higher than the 25th percentile, is a dummy variable which is equal to 1 if the job episode sits in a percentile higher than the 25th of the age specific distribution of each covariate in a given month and year.

experience, a dummy equal to 1 for switching sector of activity; a dummy equal to 1 for switching region of work; a dummy equal to 1 if the worker's number of monthly multiple job spells is higher than the 25th percentile of the corresponding distribution conditional on age; a dummy equal to 1 if the job episode is associated to a number of monthly job separations higher than the 25th percentile of the corresponding distribution conditional on age and region of birth; a dummy equal to 1 if the job episode is associated to a number of monthly net flows (hirings minus separations) higher than the 25th percentile of the corresponding distribution conditional on age and region of birth; a dummy if the job episode benefits from a labour costs reduction higher than the 25th percentile of the corresponding distribution conditional on age, and finally a dummy if the job episode is covered by subsidies higher than the 25th percentile of the corresponding distribution conditional on age. I also include as covariates gender, worker's region of birth, a dummy for missing information on education, a dummy for missing information on past-experience, worker's region of work.

Table 1 clearly shows that there is not any statistical difference in each covariate at the age threshold generated by the Fornero Reform as estimated by a polynomial of degree zero in age. The table also indicates that this polynomial of degree zero perfectly matches the difference of the mean values of the covariates before/after at the age threshold in raw data.³ For instance, this implies that at the age cutoff of 30 years above which vocational apprenticeship contracts cannot be signed there is no difference between treated and untreated individuals in the propensity of sitting in a percentile higher than the 25th in the number of monthly multiple job spells. Hence, the unconditional independence assumption holds. This is expected because at the age threshold the labour market reform generated a randomised source of variation.

Figure 1 displays some observed facts on the vocational apprenticeship probability at the age threshold distinguishing between treated and untreated cohorts. It ranks the vocational apprenticeship probability in raw data on the basis of the covariates. The ranking is very similar across treated and untreated cohorts allowing to establish some two stylised facts. First, vocational apprenticeship probability is zero when the number of monthly job separations is high or the weakness of firms take the form of a high number of labour contracts that were publicly subsidized. In Italy apprenticeships are classified as open-ended contract committed to a training period. Hence, this fact is consistent with the argument made by Cahuc et al. (2016). When firm expected production opportunities are short-term (even very short ones) only temporary contracts are used to fill them.

³Information on the worker's birth date limited to the year impose some restrictions on the functional form of the regression model. See Maida and Sonedda (2019) for further details.

Second, those who work in the region of birth, switch sector of activity, have an education level higher than the 25th (the 75th) percentile of the age specific distribution and sit at the lowest 25 percentile of the monthly number of multiple job spell distribution have the highest probability to be vocational apprentices at the age threshold. Figure 1 clearly shows that there is a monotonic increase in the vocational apprenticeship probability distribution generated by the Fornero reform whose heterogeneous impact at the threshold is illustrated in what follows. Further details that set the premises of this reduced-form analysis are provided in the Appendix A1.

3.2 Reduced-form analysis on the relationship between changes in employment protection legislation and job flows into job training contracts.

The Fornero reform increased the enforcement of the permanent contract nature of vocational apprenticeships through the introduction of a future punishment on those firms that did not accomplished with it. It also set out an adequate mentoring scheme to the apprentices to raise the firm's commitment to the training provision. It thus improved the incentives for workers to be hired as apprentices modifying exogenously the individuals' sorting into vocational apprenticeships. The reform also changed the employment protection legislation by allowing individual dismissals for all firms independently of their size. In fact, before the reform only firms with less than 15 employees could dismiss workers without risking their reinstatement by a court. Hence, the reform changed the firm discretion in layoffs and the informative content of dismissals to the secondhand market changed. The combination of all these measures might have affected the screening out process of the employers. As a result the degree of substitutability of different types of labour contracts changed.

I use the unchanged discontinuity rules in job entry as vocational training apprentices to find out the candidate mechanisms that could explain the effect of the Fornero reform on the apprenticeship probability in a difference-in-discontinuity framework, an approach used to estimate the stepping stone into permanent employment hypothesis of vocational apprenticeship by Maida and Sonedda (2019). Bratti, Conti and Sulis (2019) use a similar,



Figure 1: Some facts on vocational apprenticeship probability at the age threshold.

Notes: H25sep stands for sitting at a percentile higher than the 25th of the age and region of birth distribution of the number of monthly job separations; H25llc stands for sitting at a percentile higher than the 25th of the age distribution of benefits from labour costs reduction; H25mjs stands for sitting at a percentile higher than the 25th of the age distribution of the monthly number of multiple job spells; L25e stands for sitting at a percentile lower than the 25th of the age distribution of education; YRM stands for working in a region different from the region of birth; L75exp stands for sitting at a percentile lower than the 75th of the age distribution of past experience; NCS stands for no switching sector of activity; L75e stands for sitting at a percentile lower than the 75th of the age distribution of education; L25njf stands for sitting at a percentile lower than the 25th of the age and region of birth distribution of the number of monthly net job flows; L25hs stands for sitting at a percentile higher than the 25th of the age and region of birth distribution of social insurance benefits; L25llc stands for sitting at a percentile lower than the 25th of the age distribution of benefits from labour costs reduction; L25sep stands for sitting at a percentile lower than the 25th of the age and region of birth distribution of the number of monthly job separations; H25njf stands for sitting at a percentile higher than the 25th of the age and region of birth distribution of the number of monthly net job flows; NRM stands for working in the region of birth; H75exp stands for sitting at a percentile higher than the 75th of the age distribution of past experience; YCS stands for switching sector of activity; H25e stands for sitting at a percentile higher than the 25th of the age distribution of education; H75e stands for sitting at a percentile higher than the 75th of the age distribution of education and L25mjs stands for sitting at a percentile lower than the 25th of the age distribution of the monthly number of multiple job spells.

albeit not identical approach⁴ to estimate the effect of the reduced firing restrictions for firms with more than 15 employees set out by the Fornero reform on the number of trained

 $^{^{4}}$ This is because the difference-in-discontinuities aims at controlling for a confounding policy at the same threshold of 15 employees, rather than exploiting the difference in the same discontinuity policy rule (at the age threshold of 30 years) as in Maida and Sonedda (2019).



Figure 2: Candidate mechanisms of the difference in discontinuity impacts.

Notes: H25sep stands for sitting at a percentile higher than the 25th of the age and region of birth distribution of the number of monthly job separations; H25llc stands for sitting at a percentile higher than the 25th of the age distribution of benefits from labour costs reduction; H25mjs stands for sitting at a percentile higher than the 25th of the age distribution of the monthly number of multiple job spells; L25e stands for sitting at a percentile lower than the 25th of the age distribution of education; YRM stands for working in a region different from the region of birth; L75exp stands for sitting at a percentile lower than the 75th of the age distribution of past experience; NCS stands for no switching sector of activity; L75e stands for sitting at a percentile lower than the 75th of the age distribution of education; L25njf stands for sitting at a percentile lower than the 25th of the age and region of birth distribution of the number of monthly net job flows: L25hs stands for sitting at a percentile higher than the 25th of the age and region of birth distribution of social insurance benefits; L25llc stands for sitting at a percentile lower than the 25th of the age distribution of benefits from labour costs reduction; L25sep stands for sitting at a percentile lower than the 25th of the age and region of birth distribution of the number of monthly job separations; H25njf stands for sitting at a percentile higher than the 25th of the age and region of birth distribution of the number of monthly net job flows; NRM stands for working in the region of birth; H75exp stands for sitting at a percentile higher than the 75th of the age distribution of past experience; YCS stands for switching sector of activity; H25e stands for sitting at a percentile higher than the 25th of the age distribution of education; H75e stands for sitting at a percentile higher than the 75th of the age distribution of education and L25mjs stands for sitting at a percentile lower than the 25th of the age distribution of the monthly number of multiple job spells. The reported coefficient is the interaction of being below the age cutoff with a post-reform dummy and with a group dummy for each candidate mechanism keeping fixed all the other mechanisms and (month and year) fixed effect, sector fixed effect, region of birth fixed effect, region of work fixed effects, firm fixed effect (polynomial of degree 1 in the firm identification code).

workers.

In Figure 2, I show results of a difference-in-discontinuity estimator for vocational apprenticeship probability, comparing the pre-reform January 2011-June 2012 data to the post-reform period between July 2012 and December 2013 in a ± 1 year range around the threshold of 30 years separately for each group defined by a candidate mechanism, for instance sitting above the lowest 25th percentile of the past-experience distribution

conditional on age in a given month and year.⁵ This is a linear probability model with vocational apprenticeship as a dependent variable. The reported coefficient is the interaction of being below the age cutoff with a post-reform dummy and with a group dummy for each candidate mechanism keeping fixed all the other mechanisms. For instance, the regression, that estimates whether the difference in discontinuity impact of the Fornero reform at the age threshold differs across groups defined by being above 25th percentile of the past-experience distribution, also includes all the other mechanisms as covariates and time (month and year) fixed effect, sector fixed effect, region of birth fixed effect, region of work fixed effects, and the firm identification code. The results indicate that the relative position of the individual past-experience does not matter: independently of being below or above the 25th percentile of the distribution, the vocational apprenticeship probability of individuals treated by the labour market reform at the age cutoff increased by about one percentage point above the vocational apprenticeship rates of similar untreated individuals; these effects are highly significant. For those who sit below (above) the 25th percentile of the distributions of monthly job separations, monthly number of net job flows and of publicly provided subsidies the difference-in-discontinuity impact is (not) significantly different from zero. This is expected, because typically only firms with long-term production opportunities use an open-ended contract initially committed to the provision of on-the-job training. The vocational apprenticeship probability at the age threshold of those treated by the 2012 reform and sitting below (above) the 25th percentile of the distributions of monthly multiple job spells increased by about 1% (is not statistically different from zero) compared to the apprenticeship probability of similar untreated individuals. This might indicate that the vocational apprenticeship labour contract could be too costly for some individuals to benefit from it. It is costly not only because of the additional effort associated to the on-the-job training provision but also because of the initial lower wage. The difference in discontinuity impact on the vocational apprenticeship probability of those who sit above the 25th percentile of the education distribution conditional on age is about 1% higher than the difference-in-discontinuity impact for those who sit below the 25th percentile (1.6% versus 0.6%). The difference in discontinuity impact

⁵The interaction of being below the age cutoff with a post-reform dummy measures the impact for those sitting below this percentile.

on the vocational apprenticeship probability of those who sit above the 75th percentile of the education distribution conditional on age is in the same order of magnitude of the difference in discontinuity impact for those who sit above the 25th (about 1.6%). Since the impact for those who sit below the 75% is about 1% also those who sit in the interquartile range of the education distribution have increased their apprenticeship probability at the age threshold in the post reform period compared to similar untreated individuals.

As a first robustness check, I then use data centered in ± 24 months around June 2012, which allows me to estimate how the difference-in-discontinuity impact on vocational apprenticeship probability varies across the candidate mechanisms using a different month interval. I use the same linear probability model for vocational apprenticeship, controlling for potential mechanisms by adding one by one an interaction of being in this category with the difference-in-discontinuity interaction term. The results are in panel (b) of Figure 2. Estimates are very robust.

To further validate the approach, I also implemented a set of placebo estimates on pairs of month intervals from the pre-reform period of 2009 to 2011. Two of these placebo tests are carried-out on data either centered ± 6 months or ± 8 months⁶ around September 2011 when legislative decree no.167 was introduced. This legislative decree established common nation-wide rules for the apprenticeship contract rather than regional regulations as ruled before the reform. I also centered data either ± 12 or ± 18 months around a placebo reform that took place in June 2010. Estimates for the various pairs of months intervals are presented in Figure 3: they are all very small and insignificant (with some few exceptions).

Finally, Appendix A1 presents for each candidate mechanism a graphical comparison of vocational apprenticeship probability flows of individuals just below the age cutoff to individuals just above the age cutoff before and after the labour market reform. For presentational purposes, I measure age as deviation from 30.

These graphs demonstrate visually that for all groups defined by each candidate mechanisms, individuals treated by the labour market reform have a higher vocational apprenticeship probability than similar untreated individuals. But the difference (before/after)in-discontinuity (i.e. the difference in vocational apprenticeship between those aged 29 with certainty and turning 30 and those aged 30 with certainty and turning 31 measured

⁶It is not possible to extend further the month interval without overlapping with the Fornero reform.



Figure 3: Placebo estimates on candidate mechanisms of the difference in discontinuity impacts.

(c) Centered 9 months around September 2011. (d) Centered 18 months around June 2010.

Notes: H25sep stands for sitting at a percentile higher than the 25th of the age and region of birth distribution of the number of monthly job separations; H25llc stands for sitting at a percentile higher than the 25th of the age distribution of benefits from labour costs reduction; H25mjs stands for sitting at a percentile higher than the 25th of the age distribution of the monthly number of multiple job spells; L25e stands for sitting at a percentile lower than the 25th of the age distribution of education; YRM stands for working in a region different from the region of birth; L75exp stands for sitting at a percentile lower than the 75th of the age distribution of past experience; NCS stands for no switching sector of activity; L75e stands for sitting at a percentile lower than the 75th of the age distribution of education; L25njf stands for sitting at a percentile lower than the 25th of the age and region of birth distribution of the number of monthly net job flows; L25hs stands for sitting at a percentile higher than the 25th of the age and region of birth distribution of social insurance benefits; L25llc stands for sitting at a percentile lower than the 25th of the age distribution of benefits from labour costs reduction; L25sep stands for sitting at a percentile lower than the 25th of the age and region of birth distribution of the number of monthly job separations; H25njf stands for sitting at a percentile higher than the 25th of the age and region of birth distribution of the number of monthly net job flows; NRM stands for working in the region of birth; H75exp stands for sitting at a percentile higher than the 75th of the age distribution of past experience; YCS stands for switching sector of activity; H25e stands for sitting at a percentile higher than the 25th of the age distribution of education; H75e stands for sitting at a percentile higher than the 75th of the age distribution of education and L25mjs stands for sitting at a percentile lower than the 25th of the age distribution of the monthly number of multiple job spells. The reported coefficient is the interaction of being below the age cutoff with a post-reform dummy and with a group dummy for each candidate mechanism keeping fixed all the other mechanisms and (month and year) fixed effect, sector fixed effect, region of birth fixed effect, region of work fixed effects, firm fixed effect (polynomial of degree 1 in the firm identification code).

by the jump of the vocational apprenticeship probability at 29 years of age to zero) diverges across groups. The reform is most relevant for the two higher education groups, with an increase in the vocational apprenticeship probability of those who have higher education relative to the increase experienced by those who are less-educated. The reform enhanced the commitment of training provision of vocational apprenticeships, enforced the permanent nature of the contract and lessened the employment protection legislation. As expected, the apprenticeship probability of those who either have a high number of monthly job episodes or started a new job in a month characterised by high job separations or in a month characterised by high net job flows or of those whose job was publicly subsidized looks unaffected by the reform at the age cutoff. For these groups the vocational apprenticeship probability is always roughly zero. While the difference-in-discontinuity impact on vocational apprenticeship is specific to this institutional context, this exercise serves to show that the combined features of the reform did indeed change the sorting into and screening out of jobs, mechanisms that I can expect my model to replicate. Since this change in the sorting into and screening out of jobs is strictly related to a less strict employment protection legislation, the implications of the model can be generalised to all countries which differ in terms of their employment protection legislation. Vocational apprenticeship is henceforth a training contract.

4 The model

4.1 The set up

This section presents a simple model on the relationship between the degree of substitutability of different types of labour contracts and employment protection legislation. The objective is to show how firms change their offer of training contracts to induce selfselection and perform subsequent screening of worker ability in presence of a more flexible employment protection legislation. The model builds on Gibbons and Katz (1991) and Autor (2001). I discuss the similarities with these models below. The analysis on how the human capital provision is affected by the employment protection legislation and its empirical implications, that are derived, tested and simulated are unique to the current model. The model has three periods. Figure B1 in Appendix describes the timing of the events among the three periods. At the start of the first period, workers form beliefs b = H, Labout their ability based on an observed signal (i.e. the educational degree) and on a signal that they privately receive. Beliefs can be high H or low L. There are a large number of firms, some of which hire workers using training contracts, and some of which do not. Each firm offers a first-period wage. Since output is unobservable to prospective employers and so plausibly also to a court, labour contract contingent on output cannot be enforced. Each worker then select to apply either at a highly qualified or non-highly qualified job. In the latter case the workers select to a labour contract as either trainee or to other labour contracts. A training contract is committed to provide on-the job training, partly financed by the firm during the first period. Firms and workers matched by other labour contracts are not committed to invest in human capital.⁷ At this point, firms do not know the ability of any worker they have hired.

At the end of the first period, a fraction λ of the workers at highly qualified jobs quits for exogenous reasons to enter the second-hand market. In addition, a fraction of these workers μ quit their first period firms voluntarily to enter the second-hand market. In fact, after observing a given worker's first-period output, the current employer let these workers quit by making a wage offer that is lower than wage offers from prospective employers. Another possible interpretation is that the first period labour contract was temporary and the current employer does not renew it or does not convert it into a permanent contract. Once the second period arrives, firms which employ workers in non-highly qualified jobs make layoff decisions that depend on individuals' ability, as described below. Therefore some workers could enter the second-hand market after being laid-off, some will be retained by the incumbent firm and others will quit. While a fraction of workers quit for exogenous reasons, the remaining fraction quits endogenously on the basis of the following wagesetting game. First, prospective employers observe that the worker was not laid-off by the first-period employer and make a second-period wage offer. The current employer observes these offers from prospective employers and then makes its own second-period wage offer to the worker. The worker accepts the highest of the wages offered (choosing the incumbent

⁷For simplicity sake, I assume that, at job entry, firms provide general skills training only to workers hired using training contracts.

employer's offer in case of a tie). At the beginning of the third period, all workers are hired into the permanent sector and are paid their productivity.

The first-period output of a worker of productive ability η is $y_1 = \eta$. If the worker is not hired as trainee, the second and third period output of a worker of ability η is $y_2(\eta) = \eta + s$ (where $s = s_1 + s_2$ and $s_1 > 0$, $s_2 > 0$) if the worker remains with the first-period employer but is $y_2(\eta) = \eta$ if the worker changes employer. If, instead, the individual is hired as trainee, the second and third period output of a worker of ability η is $y_2(\eta|\tau) = \eta(1+\tau) + s_1 + s_2$ if the worker remains with the first-period employer but is $y_2(\eta|\tau) = \eta(1+\tau) + s_1 + s_2$ if the worker remains with the first-period employer but is $y_2(\eta|\tau) = \eta(1+\tau)$ if the worker changes employer. The parameter s_1 can be interpreted as firm-specific human capital embedded by work experience, while s_2 measures a firing cost incurred by the first-period employer.⁸ As in Autor (2001) the multiplicative specification of the production function conditioned on-the job training implies that ability and general skills training (inside and outside the firm) are complements.

The cost for each trainee is $c(\tau)$, which is incurred by the firm. This cost function is assumed to be everywhere strictly increasing, convex and differentiable. Each trainee pays a fixed cost equal to K.

As in Gibbons and Katz (1991), at the beginning of the first period, information is symmetric but imperfect. Based on the observable characteristics of a given worker, the distribution from which worker ability is drawn is common knowledge, but neither firms nor workers know the ability of any individual in the first period. The worker's productive ability is distributed according to the probability distribution $F(\eta)$ on (η_{MIN}, η_{MAX}) with density $f(\eta)$. I assume further that the density function is log concave which implies that $\frac{d(E(\eta|\eta\geq x))}{dx} < 1$. At the start of the first period, however, each worker and firm receive an observable imperfectly informative signal of his or her ability, the education degree. Since the worker's productive ability and general skills and competencies acquired at school are complements, the worker's productive ability of the fraction β_h of individuals with the highest educational degree is distributed according to $F(\eta)$ on $(\eta_{minh}, \eta_{MAX})$ while the remaining fraction $1 - \beta_h$ is distributed on $(\eta_{MIN}, \eta_{maxl})$, where $\eta_{minh} < \eta_{maxl}$.⁹

⁸I follow Gibbons and Katz (1991) in the interpretation of the parameters s_1 and s_2 . However, differently from them, I distinguish the role played by the firing cost and the firm-specific human capital.

⁹Further details on the ability distributions are provided in Appendix B2.

fraction β_h , δ_{hh} is the portion of individuals with high beliefs, while within the fraction $1 - \beta_h$, δ_{ll} is the portion of individuals with low beliefs. These signals are (imperfectly) informative. A worker belonging to the β_h category with high beliefs δ_{hh} is more likely than the average worker in this category to be of ability η_h , required for a highly qualified job, and vice versa for low belief workers in this category. A worker belonging to the $1 - \beta_h$ category with low beliefs δ_{ll} is less likely than the average worker in this category to be of ability η_{τ} , required for a training contract, and vice versa for high belief workers in this category. At the end of the first period, the worker's current employer observes the worker's first-period output and so infers the worker's ability. The training provision strengthen further the screening process of the firm that relies on the observed first period output. Prospective employers instead do not observe output and so do not (yet) update their beliefs about the worker's ability except when a worker is laid-off. The amount of training given to each trainee is public knowledge. Therefore, secondhand wage may depend upon training received. In the third period, each worker's ability is common knowledge.

Depending on parameter values, the model has a continuum of equilibria. The equilibrium of empirical relevance, analysed below, is a separating equilibrium in which firms screen worker on the basis of their ability and workers with intermediate levels of ability self-select to be hired as trainees. After deriving the conditions for a separating equilibrium, I explore how a change in the employment protection legislation modifies the process of screening out and sorting into the human capital investment. This separating equilibrium formalises the intuition given at the introduction: a reduction of firing costs increases the range of ability of individuals who are hired as trainees. As a consequence, a reform of the employment protection legislation that encourages the usage of a training contract changes the worker sorting into jobs and the firm screening out jobs.

4.2 Separating equilibrium

I use the following notation to describe the players' (pure) strategies. Let D(i) represent the observational signal of an individual of ability η : $D(\eta) = 1$ if the worker has an high educational degree (i.e. a university degree); $D(\eta) = 0$ if the worker has not such degree. As discussed above, the proportion of those who have $D(\eta) = 1$ is observed and equal to β_h . Let $w_1(D, b, Q)$ denote the wage offer made by the firm to the worker who according to his/her beliefs, b, and educational degree, D, apply for either a highly qualified (Q = 1)or non-highly qualified jobs (Q = 0, either as trainee or not). Let A(i) represent the worker's decision to enter into the labour market as trainee given the package offered by the firm, his/her ability η and his/her beliefs b: $A(\eta, b)=1$ if the worker is hired as trainee; $A(\eta,b)=0$ if he/she is not. Following Gibbons and Katz (1991), let L(η) represent the firm's layoff decision for a worker of ability η : $L(\eta)=1$ if the current employer lays off a worker with ability η ; $L(\eta)=0$ if the firm does not lay off such a worker. Let $w_2(L, A)$ denote the wage offer made by the secondhand market if the current employer lays off a worker who was hired with labour contract A; let $w_2(R, A)$ denote the analogous offer in the event that the firm does not lay off the worker. To construct the necessary conditions for a separating equilibrium in the model, I work backward from the third (final) period. Since worker ability and training provided by the training contract are common knowledge in the third period, third period wages are set competitively:

$$w_3 = \eta_i (1 + \alpha \tau_i) \tag{1}$$

where α is less than one if the trainee has been laid-off in the first period and $\tau = 0$ if the worker was not hired as trainee.

In general, to retain workers in the second period, incumbent firms must pay them at least what they can earn in the secondhand market. Therefore, I first compute the firm's optimal wage offer to a worker it did not lay off, given the worker's ability, the offers made by prospective employers and worker's job (Q_i, A_i) . I then determine the market's optimal wage offer to a worker who was not laid-off, given that the firm's subsequent offer will be the best response just derived and given the market's conjecture about the layoff rule used by the firm. (i.e. period 2 wages are set by wages offered to separators who were not laid-off). Finally, I assess the firm's optimal layoff rule, given that the subsequent wage offers will be the best responses just derived. I also assess the worker's optimal sorting rule into job entry, given that the subsequent wage offers will be the best responses just derived. In equilibrium, the market's conjecture must be identical to the corresponding decision taken by firms (layoff rule) and workers (sorting into highly qualified jobs, training contracts or other job qualifications.) For the sake of clarity, I will discuss separately the nodes related to highly and non-highly qualified jobs leaving to the end the final discussion that the worker's sorting rule into job entry is the best response given the subsequent wage offers derived in the following sub-sections.

4.2.1 Non-highly qualified jobs.

Consider a worker who was not laid-off after entering into the labour market in a nonhighly qualified job and who was not a trainee. Let $w_{2,m}(R = 1, A = 0)$ denote the wage offer from the market. If the worker's ability satisfies $\eta + s \ge w_{2,m}$ the firm's best response is to offer the market wage to retain the worker for the second period. At the end of period 1, however, a fraction λ of firm's workers are exogenously constrained to move. If, instead, the worker's ability satisfies $\eta + s < w_{2,m,A=0}$, the firm's best response is to offer less than the market wage, in which case the worker will also separate endogenously to pool with the exogenous departures. Let define ψ the fraction of endogenous quitters. In equilibrium, prospective employers anticipate that the firm will play the best response just determined. In order to calculate their optimal wage offers, prospective employers must also have a conjecture about the layoff rule used by the firm and the sorting rule used by the workers. In fact, at the separating equilibrium, the worker pool is composed exclusively of workers with ability level equal to or less than $\eta_{\tau m}$ (i.e. for higher ability levels workers sort into training contracts) who have not got the highest educational degree. Moreover, prospective employers believe that the firm lays off a worker if and only if the worker's ability is less than some cutoff, η_R . Accordingly, each worker receives the second-hand market wage offer that is equal to the expected productivity of the entire pool:

$$w_{2,m,A=0,L=0} = \frac{\lambda}{\lambda+\psi} E(\eta|\eta_R \le \eta_i < \eta_{\tau m}) + \frac{\psi}{\lambda+\psi} E(\eta|\eta_R \le \eta_i < w_{2,m,A=0} - s)$$
(2)

where ψ corresponds to $prob[\eta_i + s < w_{2,m,A=0} | \eta_R \le \eta_i]$

At the separating equilibrium, the firm anticipates that the subsequent market wage offer will correspond to equation 2 and it will find it unprofitable to retain a worker of ability satisfying $\eta_i + s < w_{2,m,A=0,L=0}$. As a result it offers the worker less than the market wage to let him/her quit. Thus, the firm's optimal layoff rules is to layoff individuals with ability level less than η_R and to induce the worker to quit if $\eta_R \leq \eta_i < w_{2,m,A=0,L=0} - s$. If the firm adopts this rule, then the market's conjecture is correct.

As in Gibbons and Katz (1991), a necessary condition to construct this separating equilibrium is $\eta_R + s < w_{2,m,A=0,L=0}$. This is because otherwise the incumbent firm will retain also workers with ability level η_R . Following Gibbons and Katz (1991), this condition holds provided that $\eta_R \leq \eta_1^*$ where η_1^* is the unique solution to $\eta_1^* + s = E(\eta | \eta_1^* \leq \eta_i \leq \eta_{\tau m})$

Moreover, incumbent firm's informational advantage about worker ability depresses outside wages, (Gibbons and Katz 1991, Autor 2001). This occurs because the secondhand pool is characterised by adverse selection. If workers could not be laid-off, outside buyers cannot distinguish individual ability and individual workers cannot credibly signal to be exogenous separators. As a result, this informational advantage generates firm's limited monopsony power over retained workers who are paid strictly below their actual productivity. In fact, the expected productivity of workers in the secondhand market is strictly below the expected productivity of the average worker with ability in the range of η_R and $\eta_{\tau m}$. This is the ability range of retained workers in a non-highly qualified job determined by the firm's layoff rule and the minimum ability level required to be hired as trainee.

At the separating equilibrium, the pool of workers who do not enter into the labour market as trainees is composed exclusively of workers, among those without the highest educational level with low beliefs, whom ability level ranges from η_{min} to $\eta_{\tau m}$. In fact, it is too costly in terms of both effort and wage losses for them to enter into the labour market as trainees. Firms anticipate this individuals' selection process and consequently the first period wage in non-highly qualified jobs is equal to the expected productivity:

$$w_{1,m,A=0} = (1 - \beta_h) \delta_{ll} E(\eta | \eta_i < \eta_{\tau m})$$
(3)

If a firm lays off a worker who was not hired as trainee and if market correctly conjectures that this firm lays off a worker if and only if the worker's ability is less than η_R , then second period reemployment wage of a laid-off worker will be:

$$w_{2,m,A=0,L=1} = E(\eta | \eta_i < \eta_R)$$
 (4)

4.2.2 Training contracts

Similar behavioural responses are assumed when the worker is hired as trainee and he/she is not laid-off. Then, at the end of period 1, if the worker's ability satisfies $\eta + s \ge w_{2,m,A=1,L=0}$ the firm's best response is to offer the market wage, $w_{2,m,A=1,L=0}$, to employ the worker for the second period. All the other hired trainees who have an ability level that do not satisfied this condition are induced to endogenously quit. Let define ϕ the fraction of these quitters. As above, however, a fraction λ of firm's workers separates for exogenous reasons. Then, the second hand market wage offer amounts to the expected productivity of the worker pool who sorts into training contracts:

$$w_{2,m,A=1,L=0} = (1+\tau) \left(\frac{\lambda}{\lambda+\phi} E(\eta | \eta_{\tau m} \le \eta_i < \eta_h) + \frac{\phi}{\lambda+\phi} E(\eta | \eta_{\tau m} \le \eta_i < w_{m2} - s) \right)$$
(5)

where ϕ corresponds to $prob[\eta_i + s < w_{2,m,A=1,L=0} | \eta_{\tau m} \leq \eta_i]$

At the separating equilibrium the pool of workers who enter as trainees is made of individuals whom ability level is higher than $\eta_{\tau m}$. At the beginning of period 1, individuals do not observe their own ability but form expectation on this based on the signals privately received (beliefs) and publicly observed (the education degree). Those who sort into training contracts have high beliefs among the pool of individuals with less than the highest education degree $(1-\beta_h)(1-\delta_{ll})$ and low beliefs among the pool of individuals with the highest education degree $\beta_h(1-\delta_{hh})$. Therefore, the individual's ability level could be below the cut-off η_{τ} required by the firm to invest in the worker's human capital. This is because training costs $c(\tau)$ are incurred by the firm. The cost function is assumed to be everywhere strictly increasing, convex and differentiable with c(0) = 0, c' > 0 and c'' > 0. As in Autor (2001), this cost structure ensures that some training is socially optimal for high ability workers.

Thus, the firm's lay-off rule for trainees is to lay-off a worker if her/his ability level is below η_{τ} . Then, if prospective employers correctly guess the firm's layoff rule, the second period reemployment wage of a laid-off trainee is:

$$w_{2,m,A=1,L=1} = (1 + \alpha \tau) E(\eta | \eta_{\tau m} \le \eta_i < \eta_\tau) \tag{6}$$

where α is strictly below 1 and corresponds to the share of training received by the workers before being laid-off. The amount of training $\alpha \tau$ given to each worker is public knowledge.

Finally, since firms anticipate the individuals' sorting into training contracts, the first period wage for those hired as trainees is equal to the expected ability of trainees less the implicit cost of this labour contract K:

$$w_{1,m,A=1} = (1 - \beta_h)(1 - \delta_{ll})E(\eta | \eta_{\tau m} < \eta_i \le \eta_{maxl}) + \beta_h(1 - \delta_{hh})E(\eta | \eta_i \ge \eta_{minh}) - K$$
(7)

4.2.3 Highly qualified jobs

Both public and private observable signals are informative. As a consequence, the ability level of those who sort into a highly qualified job is higher than the ability level η_{τ} below which the firm would laid-off the worker. Then, in this portion of the labour market workers are not laid-off. Nevertheless, among the high belief individuals who self-select themselves into these jobs there is a fraction μ for whom $prob[\eta_i + s < w_{2,m,Q=1}]$. This fraction μ is composed of those who are endogenously induced to quit at the beginning of the second period while a fraction λ separates for exogenous reasons.

$$w_{2,m,Q=1} = \frac{\lambda}{\lambda+\mu} E(\eta|\eta_i \ge \eta_h) + \frac{\mu}{\lambda+\mu} E(\eta|\eta_{minh} \le \eta_i < \eta_h)$$
(8)

where η_h is the minimum level of ability for which is profitable for the incumbent firm to retain a worker in a highly qualified job. There exists an η_h^* that is the solution to $\eta_h^* + s = E(\eta | \eta_h^* \ge \eta_i \ge \eta_h)$. Finally, market conjectures on workers' sorting are correct only if $\eta_{maxl} \le \eta_h$ otherwise it would be profitable to hire in a highly qualified job position also those who have not got the highest education qualification but have the highest ability levels.¹⁰ Then, if the highest educational degree is an informative signal

¹⁰For simplicity sake in the simulation exercise I will assume $\eta_{maxl} = \eta_h$.

individuals who sort into the highly qualified jobs belong to the pool of those with high belief and the highest educational degree. Therefore, first period wage for those hired in a highly qualified jobs is equal to the expected ability of those who belong to this pool:

$$w_{2,m,Q=1} = \beta_h \delta_{hh} E(\eta | \eta_i \ge \eta_{minh}) \tag{9}$$

4.2.4 Main implications of the model

As in Autor (2001), this model has several implications in terms of the sorting in and screening out of workers in the labour market and in the human capital investment decision. First, all secondhand pools, who are not laid-off, are characterised by adverse selection. This is because these pools are a mixture of exogenous and endogenous departures. For instance this amounts to saying that the expected productivity of trainees in the secondhand market is strictly below the expected productivity of the average trainee. Since the outside buyers cannot distinguish individual ability and individual workers cannot credibly communicate the reason they separated from their first period firm, the secondhand market offer each worker the expected productivity of the entire adverse selected pool.

However, the main new result of this paper is that a reform of the employment protection legislation affects the sorting in and screening out process of a human capital investment. In doing so, it changes the type of labour contracts composition of the workforce. This is because the employment protection legislation, through the parameter s_2 that measures the firing costs, differently impact on the informative content of the lay off rule (i.e. it affects the wage offers). It directly impact on the threshold ability level, for instance η_1^* , that determines who is screened out (i.e. letting him/her endogeneously quit) by the incumbent firm. I turn next to a simulation of the model that displays this result.

5 Simulation of the model

I start by assuming that individuals' ability follows a gamma distribution, i.e. $\eta \sim \Gamma(\xi)$ whose probability density function is equal to:

$$f(\eta) = \frac{\left(\frac{\eta-\theta}{\chi}\right)^{\gamma-1} exp\left(-\frac{\eta-\theta}{\chi}\right)}{\chi\Gamma(\xi))} \tag{10}$$

where θ is the location parameter and $\eta \ge \theta$; $\xi > 0$ is the shape parameter and $\chi > 0$ is the scale parameter.

As benchmark I generate the gamma distribution of 1000000 individuals' ability by setting $\xi = 50$, $\chi = 0.1$ and $\theta = 6$. Table 2 displays how the relevant parameters of the model are fixed at the baseline:

Table 2: Baseline parameters and endogenous percentiles of the ability distribution

	Percentiles of the ability distribution						Parameters					
	η_R	$\eta_{ au m}$	$\eta_{ au}$	η_{minh}	η_h	δ_{ll}	δ_{hh}	β_h	Κ	α	γ	λ
Fixed at	p_5	p_{10}	p_{16}	p_{65}	p_{87}	0.129	0.86	0.3	9.3	0.2	0.04	0.15

Notes: p_j means the jth percentiles of the ability distribution.

5.1 Endogenising the percentiles of the ability distribution

As a first simulation exercise I endogenise the percentile of the individuals' ability distribution over which workers sort into jobs and firms screen them out. It is possible to separate the values of $\eta_{\tau m}$ from η_{τ} if and only if firing costs are quite low. In general, if firing costs increase the likelihood to have a parameter configuration associated to a separating equilibrium reduces. I consider then all the parameters reported above to which I add the lowest value of s = 0.1.¹¹ I fix a convergence criterion (0.0001) to the difference between the earning histories under the two main alternatives that the individual faces on the basis of the employment-earnings package offered him/her by the firms. This amounts to say that the lowest ability individual, who enters into the labour market as trainee, (i.e. $\eta_{\tau m}$) earns over his/her life-time at least as much as the highest ability worker ($\eta_{\tau m}$ - ϵ with $\epsilon \to 0$) who enters into the labour market in a non-qualified occupation. Here, earnings are calculated as life-time earnings (i.e. the sum of earnings in the three periods) This is a stronger condition than stating that workers, with ability higher or equal $\eta_{\tau m}$, on average earns more if enter into the labour market as trainee rather than working in a non-qualified job. This condition implies that it is consistent with market beliefs that those with ability lower than $\eta_{\tau m}$ do not sort into the labour market as trainees.

Similarly, the percentile η_{τ} (i.e. the minimum level of ability required by the firm to train a worker that guarantees the optimal amount of training τ) is determined by

¹¹For the sake of simplicity I assume $s = s_2$ (i.e. $s_1 = 0$).

equalising the earnings histories of the highest ability individual, who started as trainee, (i.e. η_h - ϵ with $\epsilon \to 0$) to the earnings histories in a highly-qualified occupation of an individual with ability level (η_h) which, in this simulation exercise, corresponds to the 87th percentile. A natural interpretation of this percentile is that it is equal to (or higher than) the maximum ability level of those without the highest level of education η_{maxl} . Table 3 summarises the results.

Table 3: Endogenous percentiles of the ability distribution, firing costs and optimal amount of training

Ende	ogenous	percentiles	Optimal training			
s	$\eta_{ au m}$	$\eta_{ au}$	au			
0.1	p_{11}	p_{23}	0.197			
0.2	p_{16}	p_{16}	0.193			
0.3	p_{23}	p_{23}	0.198			
0.4	p_{32}	p_{32}	0.210			

Notes: p_j means the jth percentiles of the ability distribution.

As in Gibbons and Katz (1991) is that the ability distribution is determined endogenously by the firm's layoff decision. It depends on the employment protection legislation that fixes the firing cost s_2 and then contributes to determine s. Even if λ is arbitrarily small there exist equilibria in which turnover does not vanish. The maximal quit rate occurs when the layoff rate is zero. This may occur when the employment protection legislation is strict. In other words, a more flexible employment protection legislation reduces firm turn-over.

A change in the employment protection legislation impacts on the firms' screening out process by modifying the firm's layoff rule and the proportion of those who are induced to quit. In fact η_1^* and η_h^* decrease with s.¹². When firing costs raise it not longer possible to determine with the same rate of convergence the marginal values of the percentiles of the ability distribution implying that the informational content of the sorting and screening process is sensibly weaken. In fact as firing costs increase the difference between $\eta_{\tau m}$ and η_{τ} converges to zero. However, as long as higher ability individuals sort into training contracts

¹²As shown by Gibbons and Katz (1991) this results from implicit differentiation of $\eta_1^* + s = E(\eta | \eta_1^* \le \eta_i \le \eta_{\tau m})$ using the assumption of log concavity of the ability distribution function. In the limits, η_1^* approaches the upper limit $\eta_{\tau m}$ as s approaches zero. As in any lemons problem, the productivity in the incumbent firm of the marginal retained worker equals the productivity in the prospective firm of the average retained worker only if s > 0. Even if firing cost would be zero the two levels of productivity could differ because of the presence of firm specific human capital.

the optimal amount of training that equalises firms' marginal costs and benefits increases. This relationship is not strictly monotone.¹³ In sum, when firing costs are higher, the job flows into training contracts are smaller but the average ability in the pool of trainees is higher, overall the firm turnover is higher.

The ability distribution is determined by other parameters such as the marginal cost of training, γ , the implicit cost of the training contract K and the share of graduates β in the population. Figure 4 displays how these parameters affect the screening and the sorting into training contracts. An increase in both the implicit cost of the contract and in the marginal cost of training reduces the range of individual's abilities that drives individuals sorting into training contracts. In fact the minimum percentile $\eta_{\tau m}$ increases linearly with both costs. However, the mechanisms differ. When the implicit costs increase it is too costly to sort into training contracts for a larger fraction of low ability individuals. Marginal costs of training are burdened, instead, on the employer. When they increase the firm reacts by increasing in the second period the layoff rate of trainees. Since individuals sorts into training contracts on the basis of their expected life-cycle earnings a higher fraction of low ability individuals enters into the labour market in non-qualified jobs. An increase in the share of graduates in the population has two counterbalancing effects on the expected life-cycle earnings of trainees. On one hand, it reduces the expected earnings since increases the fraction of high skilled who enter into the labour market in high-qualified job positions. On the other hand, it increases the fraction of low belief graduates who enter as trainees leading to a raise in individuals' abilities in the pool of trainees. Figure 4 shows that when the share of graduates starts increasing from the baseline value, this latter effect dominates the former. Then the two effects balance out when a threshold value of the share of graduates is reached. In such a cases, the $\eta_{\tau m}$ percentile is constant and independent of the share of graduates.

5.2 Human capital investment and employment protection legislation

Starting from the baseline scenario, I now simulate how the ability range $(\eta_{\tau m} - \eta_{maxl}$ $(\eta_h))$, that drives individuals sorting, changes over different levels of firing costs. Since

¹³When the parameter s increase from 0.1 to 0.2, the lock-in effect has a very small negative impact on the optimal amount of training. This is because η_{τ} , the ability level required by the incumbent firm to retain the worker, is lower.



(a) Marginal cost of training.(b) Implicit cost of the contract.(c) Share of graduate students.Notes: .

Figure 4: Sorting into training contracts and model parameters

 η_{maxl} is exogenously given, this exercise amounts to analyse how the minimum ability level to enter into a training contract, $\eta_{\tau m}$, varies with the level of firing costs. I set the lowest level of *s* equal to 0.1 to which I add 0.01 at each iteration of the model simulation. Figure 5 illustrates the main result of the model.



Figure 5: Sorting into an investment in human and employment protection legislation.

By inducing sorting of workers with an ability level higher than a certain threshold, training contracts improve the firm's worker pool. By revealing private information about worker ability, training contracts then allow the firm to profit from this pool. These two roles interact with the employment protection legislation regime. Panel (a) of Figure 5 shows a positive relationship between firing costs and the percentile of the ability distribution that sets the threshold above which workers sort into training contracts. A firing costs reduction lowers the corresponding ability threshold level and hence increases the ability range over which individuals enter into a job position as trainees. However, a reduction of the degree of the employment protection legislation also increases the ex-post monopsony power of the firm. Although employers incur training costs up front in the first period, in the second period they retain workers whose ability is equal or strictly higher than the ability threshold required to equalised marginal costs and benefits of the training during the first period. Hence incumbent firms capitalise on their informational advantage about ability developed through training and need only pay workers a wage strictly below their actual productivity. While training employers recognise worker's ability, firms in the secondhand market do not. Firm's discretion on dismissals creates the Greenwald (1986) and Gibbons and Katz (1991)'s insight framework that incumbent firms' informational advantage about worker ability generates adverse selection in the second-hand market, thereby depressing outside wages. Only if firms have discretion over layoffs a separating equilibrium occurs. Panel (b) of Figure 5 displays the cumulated earnings profile over the ability distribution simulated using the lowest value of s, 0.1. A key result of the information structure visible from Figure 5 is that only workers with ability levels between $\eta_{\tau m}$ (min) and η_h (max) would sort into training contracts. At a separating equilibrium, the expected period 3 wage gain for trainees with ability level between $\eta_{\tau m}$ (min) and η_h offsets at a minimum their training wage penalty in period 2 and 1, while for lower and higher ability workers it does not. In fact, although all workers with ability lower than η_h would forgo some earnings to receive training, workers with ability level higher than $\eta_{\tau m}$ will forgo proportionally more because their expected period 3 gains are larger. Hence, they would self-select to receive training because of the complementarity between training and ability. If training and ability were not complements, a separating equilibrium would be infeasible. If, however, firms did not acquire private information about trainee ability, as Becker (1962) argued, employers would not hire trainees because each trainee would receive his marginal product after training in the first period. In fact, the on-the-job training provided during the first period increases trainees' productivity by more than it increases their period 2 wages. This result follows from the fact that in period 2 it is not productivity that sets wages at training firms but rather the degree of adverse selection in the outside market. The extent to which the degree of adverse selection in the outside market influence second period wage depends on the employment protection regime. The separating equilibrium is not satisfied at all parameter values. The lower the firm's discretion on layoffs (i.e.

the higher the degree of employment protection legislation) the lower the influence of the adverse selection on second period wages. To the best of my knowledge this feature of the model is new to the literature. A reform of the employment protection legislation that increases the firm's discretion on layoffs increases the ability range over which individuals would sort into training contracts and reinforces the screening-out process of the firms that lead to firms sponsored training even if the skills provided are general.

6 Conclusions

Employment protection legislation that affects employment decisions may change individual careers by affecting the accumulation of human capital as well as wage offers. How and if employment protection legislation impact on individuals' sorting into jobs and firms' screening out jobs requires to take these features into account. In this paper, I use a reform implemented in Italy in 2012 - the Fornero reform - that caused sudden and heterogeneous change in the degree of substitutability between permanent versus training contracts (vocational apprenticeships) versus temporary contracts. I leverage on quasi-experimental variation generated by this reform to argue that it changes both the individual's sorting into jobs and firms' screening out jobs. In part this is because of the more flexible employment protection legislation regime that increases the informative content of individuals' layoffs. In part this is because this reform combines more flexible employment protection legislation with incentives to use training contracts rather than temporary contracts to screen out workers. In Italy, vocational apprenticeships are training contracts subject to firing costs as permanent labour contracts except if the individual is laid-off when the training period terminates. In absence of firm's notice at the end of the training period, this contract is automatically converted into a standard permanent contract. Hence, vocational apprenticeship has a longer probation period than permanent contracts. This longer probationary period coincide with the training period. However, because of the commitment of training provision it is more costly to both firms and individuals.

I then develop a simple model on the relationship between the degree of substitutability of different types of labour contracts and employment protection legislation. The model shows how firms change their offer of a training contract to induce self-selection and perform subsequent screening of worker ability in presence of a more flexible employment protection legislation. As a result of individual's sorting and firms' screening, the degree of substitutability between different types of labour contracts (no qualified jobs versus training contracts versus highly qualified jobs) changes.

I simulate this model to endogenise the percentile of the individuals' ability distribution over which workers sort into jobs and firms screen them out. The results are informative about the degree of substitutability between different types of labour contracts within and across firms. In fact, although the endogenous creation of temporary contracts is not explicitly modelled, the endogenous quitting of the individuals can be interpreted as the end of a temporary contract that is not renewed. A more flexible employment protection legislation encourages individuals' sorting into training contracts. This is because it lowers the percentile of the ability distribution for which is convenient to sort into these jobs. Lifetime earnings profiles of these individuals are higher if they exchange a lower initial wage, to partly finance the human capital investment, for higher future earnings. Hence, the reform has induced some individuals, who in absence of it would have had a non-qualified job and likely temporary job, to follow instead another working career. However, all in all, when firing costs are reduced, the optimal amount of training provided by the firm is lower since more less able individuals, whose marginal training costs are higher, sort into training contracts rather than opting out for a non-qualified job. This paper shows that a more flexible employment protection legislation regime combined with training contracts can reduce the inefficiencies of job sorting and screening due to asymmetric information.

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Additional Figures of the Reduced Form analysis **A1**

Figure A1: Difference-in-discontinuity across contiguous cohorts generated by Law No. 92/2012 across different groups



centiles: past experience.

-3 -2

(a) Above/below the 75th per-(b) Above/below the 25th per-(c) Above/below the 75th percentiles: education. centiles: education.



-5 -4 -3 -5 -4 -3 -2

(g) Above/below the 25th per-(h) Above/below the 25th per-(i) Above/below the 25th percentiles: number monthly job sep-centiles: number monthly net jobcentiles benefitting of lower labour arations. flows. costs.

Age c

-3 -2

Notes: The dots are averaged raw data points while the line and the gray area refer to the parametric fit (third order polynomial in age) and its 99% confidence intervals. Heteroskedasticity robust standard errors.



B2 Ability distributions

Ability of individuals without a higher education degree



Ability of individuals with a higher education degree



B3 The wage setting game



B4 Characterization of the model

This appendix provides the details of the characterisation of the separating equilibrium. These characterisations follow Gibbons and Katz (1991). I start showing that exists a unique η_1^* satisfying $\eta_1^* + s = E(\eta | \eta_1^* \leq \eta_i \leq \eta_{\tau m})$. At $\eta_1^* = \eta_R$, $E(\eta | \eta_1^* \leq \eta_i \leq \eta_{\tau m})$ exceeds $\eta_1^* + s$; at $\eta_1^* = \eta_{\tau m}$, $\eta_1^* + s$ exceeds $E(\eta | \eta_1^* \leq \eta_i \leq \eta_{\tau m})$ and the derivative of the lefthand side with respect to η_1^* is one, which exceeds the derivative of the right-hand side because $f(\eta)$ is log concave. The same monotonicity argument implies that, if $\eta_R < \eta_1^*$, then $\eta_R + s < E(\eta | \eta_i \geq \eta_R)$. Given a value of $\eta_R < \eta_1^*$, there exists a unique solution to equation 2.

At $w_{2,m,A=0,L=0} = \eta_{MIN}$, the right-hand side of equation 2 is higher than the lefthand side because $\frac{\lambda}{\lambda+\psi}E(\eta|\eta_R \leq \eta_i < \eta_{\tau m}) \geq w_{2,m,A=0,L=0} = \eta_{MIN}$ and the probability term ψ in the second term is zero. At $w_{2,m,A=0,L=0} = \eta_{\tau m}$, the right-hand side is smaller than the lefthand side negative because $\frac{\lambda}{\lambda+\psi}E(\eta|\eta_R \leq \eta_i < \eta_{\tau m}) \leq w_{2,m,A=0,L=0} = \eta_{MIN}$ and the second term is either smaller than $w_{2,m,A=0,L=0}$ or zero (depending on whether the probability term is positive or zero). After rewriting equation 2 as a first order condition and taking the derivative of the right-hand side with respect to $w_{2,m,A=0,L=0}$, this derivative is negative for every x. Thus, given η_R , equation 2 has a unique solution in the interval $\eta_{MIN} - \eta_{\tau m}$. This is the optimal wage offer for prospective employers when incumbent firms lay off workers if and only if their ability is less than η_R . This is because no workers would accept a lower wage. All workers would accept a higher wage even the lowestability workers whose productivity is lower than the wage offered. Hence, firms would earn negative profits if offer a wage higher than 2. The same proof, by contradiction provided by Gibbons and Katz (1991), shows that if $\eta_R < \eta_1^*$ then $\eta_R + s_1 + s_2 \leq w_{2,m,A=0,L=0}$ where $w_{2,m,A=0,L=0}$ is the solution to equation 2.

Similar arguments can be applied all the other wage offer conditions that characterise the separating equilibrium.