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An econometric evaluation on panel data

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Did the 2005 French Disabled workers Act increase the employment rate of people with disabilities? An econometric evaluation on panel data¹

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Abstract

This paper presents the first evaluation of the 2005 French disability Act enacted to promote the employment of disabled people. We apply panel data methods, which account for individual and time fixed effects, to the SIP (Health and Labour Market Histories) survey. They are equivalent to double and triple difference methods. In a first step, we estimate the effect of a disability on the employment rate. We find a strong negative effect of disability, which reaches its maximum for men and the oldest workers. However, we also find that the characteristics (age, gender, education) of disabled workers are different in pre-reform (1991-2004) and post-reform (2005-2009) periods. Therefore, we extend our model to control for the variation in the disabled workers characteristics over time, in order to isolate the causal effect of the reform on the employment rate of disabled workers. We find that the 2005 Law seems to meet its initial ambition, with a positive effect on the employment rate of the disabled workers, especially in the private sector. The reform would have compensated about one-half of the effect of the disabilities on the employment rate. We also find that the effect of the reform has been stronger for the workers with a secondary education, corresponding to the vocational training certificates.

Keywords: policy evaluation, disability, employment, panel data, triple difference, France.

JEL: C33, C52, I10, J20, J31.

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1. Introduction

In France, the employment rate of the disabled people has increased regularly since the implementation of both Disabled workers acts of 1987 and 2005 (AGEFIPH, 2017). Yet, in 2019, the global employment rate in full-time equivalent for disabled people, equal to 4.3%, remains under the legal target of 6% of firm's total workforce (Ministry of Labor, 2019).

In France, the expression "disabled workers" appeared for the first time in the Law of November 23th 1957 with the following meaning: "any person whose opportunities to obtain or maintain employment are effectively reduced as a result of inadequate or impaired physical or mental abilities". Institutions in charge of giving an official recognition of disability were created at the local level. A "sheltered sector" appeared at the same time and was regulated by the Law of June 30th 1975 which also acknowledged fundamental rights to disabled people (specifically the right to work in priority in the standard job market and to have access to every institutions like every citizens) and extends the employment obligation of disabled workers to the public sector ("reserved employment"). But this law, although proclaiming the willingness to integrate disabled person in all the spheres of the society, did not contain enforcing properties (such as financial penalties) and failed to reach its goals.

In this context, the French Disabled Workers Act of July 10th 1987, which first introduced what we called today the "Employment Obligation of Disabled Workers" (OETH in French), is tailored to raise the incentives of employers to hire disabled workers, in the private sector and in a small part of the public sector. The OETH concerns all establishments employing at least 20 workers for more than three years, both in the public and the private sectors. It concerns both part-time and full-time jobs. It imposes a legal quota of 3% of the total workforce, progressively raised to 4% in 1989 and 6% in 1991. The compliance control was different for the public and the private sectors. The private sector employers had to report the composition of their workforce, and to pay a financial penalty in case of non-compliance. The public sector had no obligation to report and no penalty in case of non-compliance. This first law failed in increasing the employment rate for disabled workers. Indeed, Barnay et al. (2019) find that eligible firms preferred to pay a financial compensation rather than hiring disabled workers.

The law of the 11th of February 2005 has completed it by extending the eligibility of disabled workers, generalizing the legal quota of disabled workers to public organizations employing 20 people and over², encouraging firms to implement support measures to help disabled people keeping their job or getting one, and finally raising the level of financial compensations for non-compliance with the legal quota³.

This law gave the opportunity to employers to comply with the legal quota by different ways: by hiring directly disabled workers or by hiring them indirectly through outsourcing contracts with the "sheltered sector", which provides either jobs or training placements for disabled workers. Outsourcing is restricted to one-half of the quota. In case of non-compliance, the firms pay financial penalties to the AGEFIPH⁴. To determine the penalty, a theoretical number of missing disabled workers is first computed⁵. It accounts for the disability severity, the age and the type of labour contract of the disabled workers already hired by the firm. The financial penalties then depend on the establishment's

² The financial penalties for non-compliant employers in the public sector were progressively implemented between 2005 and 2010. The effect of the reform on the employment in the public sector could be delayed.

³ The financial penalty in case of non-compliance strongly increased (from 20% to 33% depending on firm size) and, from 2009, a huge additional penalty was implemented for employers that did not employ people with disabilities, directly or indirectly, during the last three years. Yet, the total amount of levies can be lowered for three main reasons: if public or private employers hire some workers with low employability (long-term unemployed people, people severely disabled, and so on), if the share of jobs that cannot be proposed to disabled people due to specific skills not compatible with disability is high, if the employers financed workplace accommodations to keep disabled people in employment.

⁴ Association pour la gestion du fonds pour l'insertion professionnelle des personnes handicapées

⁵ For a more comprehensive presentation of the law, see Selma (2008).

size, from 400-hour minimum income equivalent for each missing disabled worker for establishments employing between 20 and 199 people, up to 600-hour minimum income for each missing disabled worker for the establishments employing 750 people and more.

Public policies aiming at promoting the employment of disabled people are various and the evaluation of their effects implies the consideration of many factors implying both labor demand-side and labor supply-side. A large literature relying on panel data highlights the negative impact of disability onset on labour market outcomes (*e.g.* Jones (2011), Lindeboom *et al.* (2016), Jones and McVicar (2020) for the UK; Barnay *et al.* (2015) for France; Polidano and Vu (2015) for Australia; Lechner and Vazquez-Alvarez (2011) for Germany; García-Gómez *et al.* (2013) for the Netherlands; Webber and Bjelland (2015), Meyer and Mok (2019) for the USA).

The impact of disability insurance programs on the consumption-leisure trade-off by disabled people is an important determinant. Some papers focus on potential threshold effects and moral hazard problems due to such programs. For instance, Campolieti and Riddell (2012) find a positive effect of the introduction of a minimum wage threshold (below which the individuals can concurrently receive a disability allowance), on the return to work for insured people with a long-term and severe disability in Canada. Staubli (2011) highlights a positive effect of the strengthening of eligibility criteria in disability insurance on the participation in the labor market for men aged over 55 years employed in the private sector in Austria. Based on Spanish data, Marie and Vall-Castello (2012) find that the increase of 36% in the level of disability pensions reduces the probability to be employed by 8% for people of 55 years-old and over with partial disability. Lopez Frutos and Vall Castello (2015), based on Spanish data too, find that receiving disability benefits reduces on average by 5% the probability of working but that this negative effect on labor supply only holds for people with mild disability.

The reduction of discrimination against disabled people is another factor to be studied. For instance, Vall Castello (2012) identifies a positive impact of reducing social security contributions for firms on the employment of disabled women, the magnitude of the effect being stronger for partially disabled women compared to totally disabled ones. Closer to our study, Wagner *et al.* (2001), Lalive *et al.* (2013) Malo and Pagán (2014), Mori and Sakamoto (2018) and de Araujo *et al.* (2021) evaluate the impact on the employment of disabled workers of a quota policy with financial penalties. These articles examine whether there is a discontinuity in the vicinity of the legal employment thresholds among eligible firms. They rely on the employment dynamics of disabled workers within companies (hiring of disabled and not-disabled workers, increase in working hours, capital / labor substitution). Wagner *et al.* (2001), using panel survey data (the German *IAB Establishment Panel*) find no significant differences in labor demand between companies where the quota applies and others. Lalive *et al.* (2013), Mori and Sakamoto (2018), de Araujo *et al.* (2021) rely on administrative data (respectively in Austria, Japan and Brazil) and Malo and Pagán (2014) rely on Spanish survey data. All these studies use the regression discontinuity design method to take into account the endogeneity of firm size. They highlight that the quota policy positively influences the employment of disabled workers for companies located in the vicinity of the discontinuity (one has to note that the magnitude of the causal effect of quota is different from one study to another, depending mainly on institutional features). The only exception appears in Araujo *et al.* (2021) which point out that the positive effect of the quota policy introduced in Brazil in 1991 on the employment of people with disabilities is only significant for the year 2016 (and not in 2007 which is the other date studied by the authors) and for firms with over 100 and over 200 employees.

Other studies also intend to estimate the causal impact of quota policy on the employment of disabled people with different methodology. In Germany, Verick (2004) estimates the causal effect of the People with Severe Disabilities Act (PSDA) introduced in 2001 on the rates of employment, unemployment, and inactivity for disabled people. Based on the German Socio-Economic Panel (GSOEP), they perform a DiD model in order to compare the labour outcomes between the severely, non- and moderately-disabled 3 years before and after the reform. They find that a small increase of the levies for non-compliant firms does not succeed in increasing the level of employment of people

with severe disabilities who largely exit from the labour market, especially in times of economic downturn. At the opposite, Wuellrich (2010) uses administrative panel data to estimate the effect of a 30% tax increase for non-compliant firms on the employment of disabled people in Austria. They use the interrupted time-series approach and underline a 1.9% increase in the number of disabled workers following the tax increase. Humer et al. (2007) estimate the Austrian Employment Act for the Disabled (EAD)'s effect on the employment rate of severely disabled people. This act cumulates higher employment protection, quota and government financial support to encourage firms to implement workplace accommodations. By using panel data regression with individual fixed effects, they find that the achievement of the legal severely disabled status has a detrimental and persistent over time effect for non-employed people when getting the status. However, the effect appears positive for employed people due to the huge employment protection legislation.

Finally, Nazarov et al. (2015) estimate jointly the propensity to participate in the labour market and the propensity to be in employment for people with and without disabilities. They use a bivariate probit with selection over the period 2003-2007 in order to observe the effect of the change in the disability quota system implemented in 2004-2006 in South Korea. They find a positive effect of the change in quota policy on the labour force participation but a non-significant positive impact on the employment.

More generally, 103 countries all over the world are identified as having implemented public policies combining mandatory employment quotas and fines to improve on the employment rate of disabled workers (ILO, 2019). But, for most of them, these policies failed to reach their objectives, firms preferring to pay the fine instead of hiring disabled people (Sargeant et al., 2018).

We contribute to this literature by attempting to check whether the new French public policy implemented from 2005 has succeeded in improving the employment rate of disabled workers. Our definition of disabled people is large by taking into account both people with administrative recognition of disability and people reporting at least one disability. Our methodology accounts for both observed and unobserved heterogeneity by estimating a difference-in-difference model with (individual and time) fixed effects. We may evaluate a reform by allowing for additional interaction terms. We allow the reform to modify the effect of the confounding variables on every workers, disabled or not. We take the within estimator, with clustered standard errors as Arellano (1987) in order to account for heteroscedasticity and autocorrelation. We first examine the likelihood that a worker keep one's job after a disability, by estimating the average treatment effect of the disability on the employment rate of disabled people, up to 3 years after disability onset. Then, we evaluate how the reform modified the magnitude of this effect. We show a large positive impact of the reform on disabled's employment rate. This paper is the first one to evaluate the influence of the French Law of 2005 on the employment rate of disabled people. The remainder of the paper is as follows. Section 2 and 3 are dedicated to the data and the methodology. The results are reported in section 4. The last section discusses the findings and finally concludes.

2. Data

In this paper, we use the French Health and Labour Market Histories Survey (*"Santé et Itinéraire professionnel"* in French), called SIP survey afterwards, which was designed within the framework of a partnership between the Ministry of Health and the Ministry of Labour, with scientific support from the Center for Employment Studies. The implementation thereof was carried out by the National Institute of Statistics and Economic Studies.

The first wave, in 2006, retrospectively questions 14,000 persons aged between 20 and 74 and living in ordinary households in France on their life paths (family, professional and health status) and provides a detailed description of these different dimensions at the time of the survey. A retrospective calendar allows to identify the exact date of disability onset, the length of disability and the evolution of labour market status (including public and private sector employment) to examine how an individual's career is affected by a health shock through a rigorously constructed counterfactual.

Thanks to this retrospective information, we can then build a comprehensive panel specifying, for each period, individual, professional and health information while controlling for individual and temporal heterogeneity.

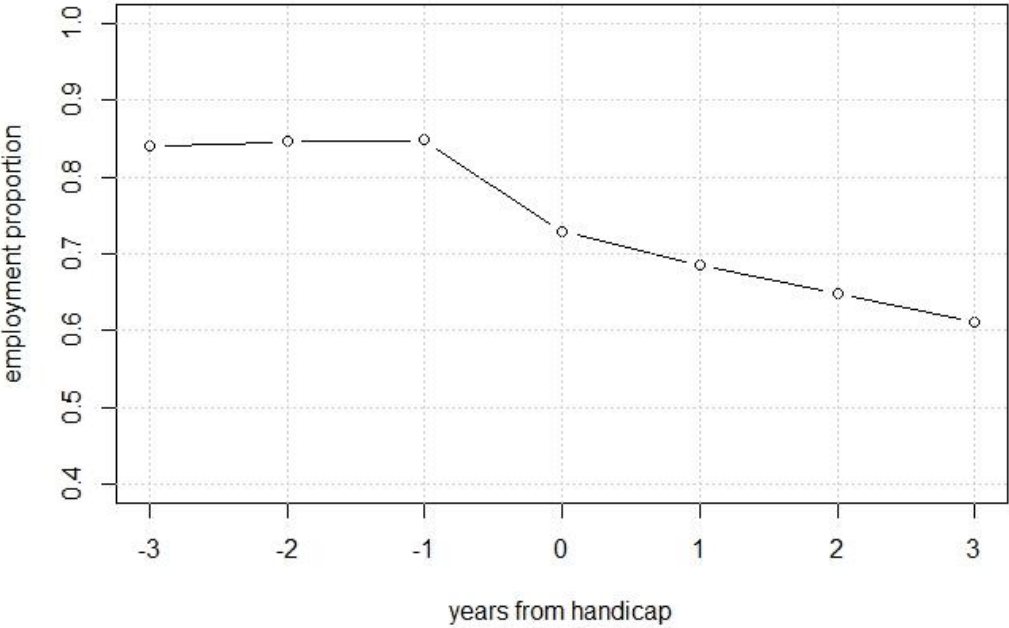
The second wave, in 2010, enables to follow up the population four years later (about 11 000 people). We use it to measure the post reform outcomes. We can identify for each year between 2006 and 2010 the employment status and the onset and duration of a disability.

The SIP Survey does not include administrative data, only self-reported disabilities and their potential links to changes in their professional situations. Disabilities are identified in various ways in the SIP questionnaire and along with the retrospective calendar (submitted with the questionnaire). They are self-reported regardless of whether they are explicitly related to professional events. This broad definition seems to be congruent with those of the Law wherein disability is considered as “any limitation of activity or restriction of participation in society suffered by a person in his/her environment due to a substantial, lasting or permanent impairment of one or more physical, sensory, mental, cognitive or psychological functions, a multiple disability or a disabling health disorder” (Law of February 11, 2005, art. 14). Our outcome variable describes the employment rate each year from the entry in the labour market to 2010. As the ramp-up of the 1987 was progressive (the legal quota required to companies progressively raised to 3% of the total workforce in 1988 and 6% in 1991), our analysis of the 2005 Law starts in 1991 in order to prevent from any short run consequences of the 1987 Law.

We only consider the first disability in the individual trajectory as the occurrence of many events of disability remains rare. Finally, we define the treated group (disabled) and the control group (no disability at any date during their professional life). In addition, we distinguish both periods: the pre-reform period (1991-2004) and the post-reform period (2006-2009). By and large, we get a final sample of 11,877 individuals, including 1,327 with a disability. Notice that an individual with a disability moves from the control group to the treatment group at the disability date.

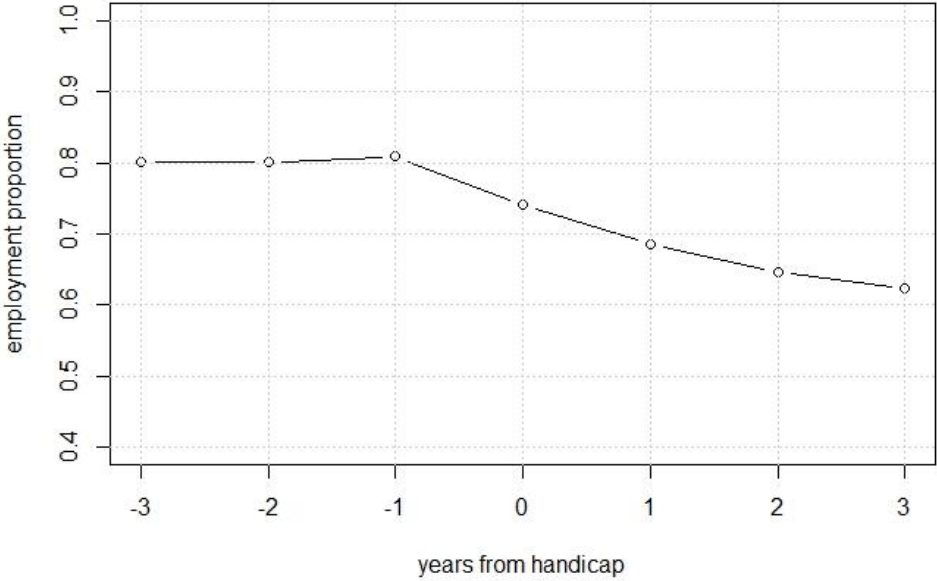
Figures 1 and 2 point out the trend of employment rate when a disability occurs, respectively before and after the Law of 2005. As compared to the year before the health event ($t-1$), the onset of a disability results in an employment rate ($t+1$) decline in about 16 pp (before the reform) and about 11 pp (after the reform). Moreover, the initial level of employment rate differs between both disabled groups with a higher level in pre-reform period.

Figure 1 : Employment rate after a disability shock (pre- reform period – 1991-2004)



Source: SIP survey

Figure 2 : Employment rate after a disability shock (post-period reform – 2006-2009)



Source: SIP survey

These differences could rely on group composition (due, in particular, to the ageing of the studied population) but also on time period heterogeneity (economic crisis and its consequences on the level of unemployment). The sample statistics reported in Table 1 illustrate these differences between disabled and non-disabled people before and after the reform.

People without disabilities include more female (55%) and are 52 in average at the end of the data set, which is far from the legal retirement age. Most of them live in couple (a little less than 90%). About 87% were raised by their parents, and around 32% report problems for them or their relatives during childhood (mistreatment, war, violence at school, bad material living conditions, family conflicts, death of a close relative, illness of a close relative, separation from the family). Since the entry into the labour market, the proportion of years in employment and of unhealthy years are respectively 80% and 9% (in the total number of years spent in the labour market from 2010). Finally, about 23% completed a primary education, 36% a secondary education and 41% reached at least the A level.

The disabled population has clear different characteristics compared to non-disabled people and over time (before and after the reform).

First, we notice that differences between disabled and non-disabled people are of same kind for both periods, except for gender as disabled people are more likely to be male before the reform and female after. Disabled people are older (gap of 2.6 years before the reform and 3.1 years after the reform) and slightly less educated (73.7% attain a secondary level of education and above before the reform; 76.6% after the reform) than non-disabled people (77.0%). We assume that disabled people are more likely to exit from the labour market than non-disabled people.

Second, there are differences between disabled people before and after the reform. Disabled people after the reform are more likely to be women (55.6% vs. 51.6%), as old at the end of the sample (54.5 years old vs. 54.1 years-old), older at disability onset (52.3 years-old vs. 42.6 years-old), a little bit more educated (+3 pp. at A level and more) and more exposed to past adverse health events (increase in 5.7 pp of the proportion of unhealthy years). It is tricky to conclude whether these differences of characteristics play in favor of job retention: if we expect a positive effect of a higher level of education, the effect of the older age at disability onset remains unclear as it may signal frailty and comorbidities or healthy worker effect. Anyway, these differences could bias the estimate of the reform effect due to a composition effect. Our empirical strategy addresses this issue by controlling for the differences of attributes concerning disabled workers before and after the reform.

Table 1 – Sample statistics

* significant at 10%. ** significant at 5%. Source: SIP survey

	Disabled 1991-2004	Non- disabled	Difference	Student	Disabled 2006-2009	Difference	Student	Difference	Student
	(1)	(2)	(1)-(2)	(1)-(2)	(3)	(3)-(2)	(3)-(2)	(1)-(3)	(1)-(3)
Observations	640	10,550	-	-	687	-	-	-	-
Women	51.6%	55.1%	-3.5%*	1.73	55.6%	0.5%	0.27	-4.0%	1.48
Men	48.4%	44.9%	3.5%*	1.73	44.4%	-0.5%	0.27	4.0%	1.48
Live in couple ^a	86.3%	87.1%	-0.8%	0.59	93.6%	6.5%**	6.59	-7.3%**	4.45
Education:									
Primary	26.3%	23.0%	3.3%*	1.82	23.4%	0.4%	0.26	2.8%	1.18
Secondary	43.9%	35.8%	8.1%**	4.01	43.8%	8.0%**	4.10	0.1%	0.03
A level and more	29.8%	41.2%	-11.4%**	6.06	32.8%	-8.4%**	4.55	-2.9%	1.14
Problems during childhood	41.3%	31.7%	9.6%**	4.78	38.9%	7.2%**	3.74	2.4%	0.89
Raised by the parents	86.6%	86.8%	-0.3%	0.19	86.2%	-0.7%	0.48	0.4%	0.21
Age at disability	42.6				52.3			-9.7%**	14.3
Age in 2010	54.1	51.5	2.6%**	5.4	54.5	3.1%**	5.9	-0.4	0.6
% years in employment ^a	82.2%	79.7%	2.5%**	2.24	78.7%	-1.0%	0.92	3.5%**	2.32
% years with illness ^a	9.8%	8.7%	1.1%	1.11	14.4%	5.7%**	5.49	-4.6%**	3.24
Sector: Public ^a	20.6%	23.3%	-2.7%	1.63	22.4%	-0.9%	0.55	-1.8%	0.79
Sector: Private ^a	64.5%	68.4%	-3.9%**	1.99	70.0%	1.6%	0.89	-5.5%**	2.13

a. For the disabled, the situation is measured one year before the disability. For the others, in 2010.

3. Methodology

In order to evaluate the proper causal effect of the 2005 Law on the employment rate of disabled people, we need to control for the structural differences between disabled populations before and after the reform previously identified. The triple-difference methodology enables to control for the effect of the variation in the sample structure.

3.1. Did estimation.

We wish to estimate the effect of a disability on employment rate. Let y be the left-hand variable and W the disability variable. Let X be the matrix of confounding variables (age, gender, living in couple, education, raised by the parents, problems during childhood, past trajectories in terms of illness and employment events). A standard specification will be:

$$y_{it} = b_0 + X_{it}b_1 + W_{it}(c_0 + X_{it}c_1) + u_{it}$$

with $u_{it} = \alpha_i + \delta_t + \varepsilon_{it}$ the panel disturbance with two fixed effects, including the unobservable heterogeneity term (α_i), the time trend (δ_t) and the idiosyncratic error term (ε_{it}). We assume that all these terms have a zero mean, without loss of generality provided the model includes a constant term b_0 .

The effect of the disability for the individual i implied by this model is given by:

$$ATT(X_{it}) = E[y_{it}|W_{it} = 1, X_{it}] - E[y_{it}|W_{it} = 0, X_{it}] = c_0 + X_{it}c_1$$

and the average effect of the disability on the disabled is obtained by computing the mean of these quantities on the disabled only:

$$ATT(\bar{X}_1) = c_0 + \bar{X}_1c_1$$

where \bar{X}_1 is the mean of the confounding variables on the disabled population. We need to choose a reference year for this mean. We take the year before the disability onset. It is possible to obtain the average effect of the disability on the disabled directly from a regression. One simply need to center the confounding variables according to \bar{X}_1 before to take the cross products with the disability dummy:

$$y_{it} = \beta_0 + X_{it}\beta_1 + W_{it}(\gamma_0 + (X_{it} - \bar{X}_1)\gamma_1) + u_{it}$$

we get :

$$\begin{aligned} ATT(X_{it}) &= E[y_{it}|W_{it} = 1, X_{it}, \bar{X}_1] - E[y_{it}|W_{it} = 0, X_{it}, \bar{X}_1] \\ &= \gamma_0 + (X_{it} - \bar{X}_1)\gamma_1 \end{aligned}$$

so that when $X_{it} = \bar{X}_1$ we get:

$$ATT(\bar{X}_1) = \gamma_0$$

and now the regression coefficient of W directly gives an estimate of the ATT. This method can be extended to evaluate the effect of a disability at different dates.

In this paper, we take the difference up to three years after the disability, and discard the years after for the disabled because there are not enough data for an estimation. Notice that not all disabled have three years of data after the disability, so that that the mean used as a reference will (slightly) differ according to the lag from the disability onset. Four disability dummies will be used to measure the

effect of a disability at the four dates from t to $t + 3$. We denote them $W_{it}(k)$, with $k = 0, \dots, 3$ where 0 denotes the disability onset. We get the model:

$$y_{it} = \beta_0 + X_{it}\beta_1 + \sum_{k=0}^3 W_{it}(k)(\gamma_{0k} + (X_{it} - \bar{X}_k)\gamma_{1k}) + u_{it}$$

where \bar{X}_k denotes the mean of the confounding variables one year before the disability onset, for the disabled who have k years of data after the disability onset. The ATT after k years of disability is simply given by γ_{0k} . Following Bertrand, Duflo and Mullainathan (2004), we take the within estimator, with clustered standard errors a la Arellano (1987) in order to account for heteroscedasticity and autocorrelation.

3.2. Reform evaluation (triple difference).

We may also evaluate a reform by allowing for additional interaction terms. We allow for the reform to modify the effect of the confounder variables on all the workers, disabled or not. Here the reference population for the disabled matters because their characteristics influences the estimation of the ATTs.

We compare the effects on the populations before the reform and after the reform. The first mean will be computed as the mean of the disabled one year before their disability during the pre-reform period, and the second mean will be computed as the mean of the disabled one year before their disability during the post-reform.

The difference from the previous estimation method is that the same mean will be used for the two observation periods, instead of a different mean per period. The goal is to control for the effect of the disabled sample structure. Let R_t be the reform dummy.

By definition, it applies to everyone in the same year since the law changes for everyone:

$$y_{it} = \beta_0 + X_{it}\beta_1 + R_t(\beta_2 + X_{it}\beta_3) + \sum_{k=0}^3 W_{it}(k)(\gamma_{0k} + (X_{it} - \bar{X}_k)\gamma_{1k}) \\ + R_t \sum_{k=0}^3 W_{it}(k)(\gamma_{2k} + (X_{it} - \bar{X}_k)\gamma_{3k}) + u_{it}$$

and the term in $R_t\beta_2$ will be absorbed into the time trend δ_t so that the model can be rewritten :

$$y_{it} = \beta_0 + X_{it}(\beta_1 + R_t\beta_3) + \sum_{k=0}^3 W_{it}(k)(\gamma_{0k} + R_t\gamma_{1k} + (X_{it} - \bar{X}_k)(\gamma_{2k} + R_t\gamma_{3k})) + u_{it}$$

and the average effect of the reform on the disabled is given by the variation of the disability effect for a given structure of the disabled population summarized by \bar{X} .

It is given by:

$$ATT(\bar{X}, R_{it} = 1) - ATT(\bar{X}, R_{it} = 0) = \gamma_{2k}$$

the regression coefficient of $W_{it}(k)R_t$.

4. Results

4.1. Separate estimates

The separate difference-in-differences estimators are reported in Table 2. They represent the estimates that one performs when only one period of data is available (pre-reform or post-reform).

Pre-period reform (1991-2004)

Before the reform, a disability reduces the employment rate by 11 percentage points (pp.) one year after the disability. The effect become stronger over time, since the decrease reaches 17 pp. three years after the disability. But the effect of disability is also heterogeneous as the coefficients of the cross products of the disability dummies with the individual attributes are significant. The effect of the disability on the employment is likely to be stronger with age, regardless of the distance from disability onset.

Medium-run effects (t+3) depend on additional variables. A low level of education (primary or a secondary education) increases the negative effect of the disability on the employment rate and, on the contrary, living in couple reduces its negative effects. In addition, the adverse impact of disability is reinforced when considering past trajectories characterized by more illness but also by more employment years.

Broadly speaking, the results are as expected. High qualified people are more able to keep a job, and people who live in couple seem to benefit from a better social environment and support, which seems to be favorable to employment. Work disutility increases with health depreciation (captured by past health events) and thus results in a weaker labour market participation. As a matter of course, the influence of disability on employment is directly related to the previous position in the labour market. For disabled people, the proportion of years in employment could be considered as a good proxy of employment position one year before the onset of disability.

Post-period reform (2006-2009)

On the post reform period, the negative effect of a disability is confirmed with a decrease of 11.6 pp in the short run (t+1) and of 12.4 pp in the medium-run (t+3). The reduction of the coefficient between the two periods may be interpreted as a positive effect of the reform on the employment of disabled people because the detrimental effect of disability on employment is weaker after the reform. Yet, as we already mentioned, the difference in the ATTs before and after the reform is misleading due to structural differences between disabled people leading to bias the effect of the reform. We also notice that the negative effect seems to decrease from 3 years after disability onset (-12.4 pp vs. -13.0 pp two years after disability).

Another difference lies in the interaction term. Findings are relatively similar to the pre-reform period. Age is the only variable which significantly and durably affects the ATTs over time. The additional role of the share of past employment periods is particularly strong and increases over time to reach -48.2pp.

Table 2 - Effect of a disability on the employment rate:
separate estimations

ATT: Average effect of the Treatment on the Treated. Tk: is the dummy for k years after a disability (k=0 to 3). Coef.: estimated coefficient. ASE: Asymptotic Standard Error. Within estimations with Arellano clustered standard errors. ** significant at 5%, * significant at 10%. Source: SIP Survey.

	Before reform		After reform	
	Coef.	ASE	Coef.	ASE
Average effect of a disability on the disabled (ATT):				
t (T0 dummy)	-0.112**	0.015	-0.067**	0.013
t+1 (T1 dummy)	-0.138**	0.017	-0.116**	0.016
t+2 (T2 dummy)	-0.156**	0.018	-0.130**	0.019
t+3 (T3 dummy)	-0.169**	0.020	-0.124**	0.026
Age in 2010	0.008**	0.003	0.002	0.003
Living in couple	-0.013*	0.007	-0.012*	0.007
prop. past illnesses	-0.146**	0.034	-0.172**	0.032
prop. past employment	0.576**	0.018	0.589**	0.017
Cross products with T0:				
Age in 2010	-0.077**	0.018	-0.074**	0.013
man (ref. woman)	-0.031	0.035	-0.079**	0.028
Living in couple (ref. single)	0.074	0.051	0.005	0.042
primary education (ref. A level +)	-0.040	0.042	-0.070	0.044
secondary education (ref. A level +)	-0.027	0.036	0.031	0.029
Problems during childhood (ref. none)	0.023	0.034	-0.027	0.033
Raised by the parents (ref. not)	0.097*	0.053	-0.014	0.035
prop. past illnesses	0.015	0.066	-0.003	0.045
prop. past employment	-0.242**	0.057	-0.277**	0.053
Cross products with T1:				
Age in 2010	-0.105**	0.018	-0.107**	0.016
man (ref. woman)	-0.045	0.037	-0.076**	0.036
Living in couple (ref. single)	0.076	0.053	-0.009	0.051
primary education (ref. A level +)	-0.046	0.045	-0.056	0.052
secondary education (ref. A level +)	-0.087**	0.039	0.027	0.036
Problems during childhood (ref. none)	0.015	0.038	-0.010	0.040
Raised by the parents (ref. not)	0.066	0.057	0.013	0.047
prop. past illnesses	0.009	0.070	0.025	0.056
prop. past employment	-0.201**	0.061	-0.348**	0.061
Cross products with T2:				
Age in 2010	-0.136**	0.019	-0.125**	0.019
man (ref. woman)	-0.022	0.038	-0.060	0.043
Living in couple (ref. single)	0.136**	0.061	0.058	0.065
primary education (ref. A level +)	-0.073	0.047	-0.141**	0.060
secondary education (ref. A level +)	-0.116**	0.041	0.001	0.043
Problems during childhood (ref. none)	0.060	0.040	-0.044	0.046
Raised by the parents (ref. not)	0.071	0.058	0.009	0.054
prop. past illnesses	-0.047	0.078	0.035	0.072
prop. past employment	-0.268**	0.070	-0.437**	0.073
Cross products with T3:				
Age in 2010	-0.169**	0.019	-0.184**	0.027
man (ref. woman)	-0.066*	0.040	-0.022	0.059
Living in couple (ref. single)	0.249**	0.065	0.071	0.103
primary education (ref. A level +)	-0.136**	0.051	-0.181**	0.075
secondary education (ref. A level +)	-0.153**	0.041	-0.047	0.060
Problems during childhood (ref. none)	0.012	0.041	-0.037	0.059
Raised by the parents (ref. not)	0.014	0.059	0.051	0.069
prop. past illnesses	-0.119**	0.075	0.106	0.102
prop. past employment	-0.367**	0.069	-0.482**	0.093
Individual dummies	Yes		Yes	
Times dummies	Yes		Yes	
Observations	138021		143410	

4.2. Composition effects.

Table 3 - Effect of a disability on the employment rate: composition effects

ATT: Average effect of the Treatment on the Treated. Tk: is the dummy for k years after a disability (k = 0 to 3). Coef: estimated coefficient. ASE: Asymptotic Standard Error. *** significant at 1%, ** significant at 5%, * significant at 10%. Source: SIP Survey.

Estimation period	Before Reform (1991-2004)				After Reform (2006-2009)			
	Before Reform		After Reform		Before Reform		After Reform	
Reference population	(1)		(2)		(3)		(4)	
ATT	Coef.	ASE	Coef.	ASE	Coef.	ASE	Coef.	ASE
t	-0.112**	0.015	-0.148**	0.020	-0.039**	0.017	-0.067**	0.013
t+1	-0.138**	0.017	-0.194**	0.020	-0.061**	0.021	-0.116**	0.016
t+2	-0.156**	0.018	-0.234**	0.020	-0.076**	0.026	-0.130**	0.019
t+3	-0.169**	0.020	-0.241**	0.019	-0.046	0.035	-0.124**	0.026

Column (1) should be compared with column (3), and column (2) should be compared with column (4). Column (1) and column (4): usual ATTs reported from Table 2. Column (2): effect that the after-reform disabled would have had, if their disability happened before the reform. Column (3): effect that the before-reform disabled would have had, if their disability happened after the reform.

In order to study the effect of the variables in the disabled population, we have performed two additional estimation (columns 2 and 3, Table 3). The effect that a disability would occur on the post-reform disabled population if they had had the same characteristics as the ones of the disabled population in the pre-reform period is presented in the column 2. We see that the ATTs for this population are much stronger than for the pre-reform population for all time spans. After 3 years, the decrease in the employment rate is 24 pp instead of 17 pp for the pre-reform population. This confirms that the post-reform disabled population is frailer in terms of professional trajectories than the pre-reform one. Alternatively, we have also computed in the column 3 how the pre-reform disabled population would have fared in the labour market if they had had the same characteristics as that of the disabled population on the post-reform period. We see that the effect of a disability is much lower for the pre-reform population. Three years after the disability onset, the effect is not even significant. The strongest effect over the whole observation period is lower than 8 pp. For the post-reform population, a disability decreases the employment probability by 12.4 pp, with a maximum effect at 13.0 pp. This is an evidence that the pre-reform disabled population has features that raise the likelihood to remain in the labour market compared to post-reform population.

4.3. Effect of the reform.

Table 4 - Effect of the reform on the employment rate of disabled

R: reform dummy. ATT: Average effect of the Treatment on the Treated. Tk: is the dummy for k years after a disability (k = 0 to 3). Coef.: estimated coefficient. ASE: Asymptotic Standard Error. ** significant at 5%, * significant at 10%. Source: SIP Survey.

Reference population	Before reform		After reform	
ATT before reform for the reference population:	Coef.	ASE	Coef.	ASE
t (T0 dummy)	-0.126**	0.016	-0.164**	0.020
t+1 (T1 dummy)	-0.154**	0.019	-0.213**	0.022
t+2 (T2 dummy)	-0.176**	0.022	-0.256**	0.024
t+3 (T3 dummy)	-0.193**	0.025	-0.267**	0.025
Reform effect for the reference population:				
t (RxT0 cross product)	0.087**	0.023	0.097**	0.024
t+1 (RxT1 cross product)	0.093**	0.028	0.097**	0.027
t+2 (RxT2 cross product)	0.100**	0.034	0.126**	0.030
t+3 (RxT3 cross product)	0.147**	0.043	0.143**	0.036
Model estimation		Coef.	ASE	
Age/10		0.004	0.002	
Living in couple		0.001	0.036	

prop. past illnesses	-0.263*	0.152
prop. past employment	0.401**	0.085
Cross products with R		
Age/10	-0.004	0.002
Living in couple	-0.013	0.037
prop. past illnesses	0.093	0.155
prop. past employment	0.188**	0.087
Cross products with T0:		
Age/10	-0.008	0.002
man (ref. woman)	-0.030	0.035
Living in couple (ref. single)	0.067	0.051
primary education (ref. A level +)	-0.040	0.042
secondary education (ref. A level +)	-0.028	0.036
Problems during childhood (ref. none)	0.024	0.035
Raised by the parents (ref. not)	0.095*	0.053
prop. past illnesses	0.027	0.067
prop. past employment	-0.239**	0.057
Cross products with T1:		
Age/10	-0.011	0.002
man (ref. woman)	-0.043	0.037
Living in couple (ref. single)	0.073	0.055
primary education (ref. A level +)	-0.046	0.045
secondary education (ref. A level +)	-0.089**	0.039
Problems during childhood (ref. none)	0.015	0.038
Raised by the parents (ref. not)	0.064	0.057
prop. past illnesses	0.019	0.072
prop. past employment	-0.202**	0.061
Cross products with T2:		
Age/10	-0.014	0.002
man (ref. woman)	-0.021	0.039
Living in couple (ref. single)	0.134**	0.063
primary education (ref. A level +)	-0.071	0.047
secondary education (ref. A level +)	-0.117**	0.041
Problems during childhood (ref. none)	0.059	0.040
Raised by the parents (ref. not)	0.068	0.058
prop. past illnesses	-0.035	0.081
prop. past employment	-0.267**	0.070
Cross products with T3:		
Age/10	-0.017	0.002
man (ref. woman)	-0.065	0.040
Living in couple (ref. single)	0.249**	0.066
primary education (ref. A level +)	-0.134**	0.051
secondary education (ref. A level +)	-0.155**	0.042
Problems during childhood (ref. none)	0.011	0.042
Raised by the parents (ref. not)	0.011	0.059
prop. past illnesses	-0.105	0.078
prop. past employment	-0.365**	0.069
Cross products with RxT0:		
Age/10	0.001	0.002
man (ref. woman)	-0.050	0.045
Living in couple (ref. single)	-0.061	0.067
primary education (ref. A level +)	-0.030	0.061
secondary education (ref. A level +)	0.059	0.046
Problems during childhood (ref. none)	-0.051	0.047
Raised by the parents (ref. not)	-0.109*	0.064
prop. past illnesses	-0.030	0.081
prop. past employment	-0.037	0.077
Cross products with RxT1:		
Age/10	0.000	0.002
man (ref. woman)	-0.033	0.051
Living in couple (ref. single)	-0.082	0.075
primary education (ref. A level +)	-0.010	0.069
secondary education (ref. A level +)	0.115**	0.053
Problems during childhood (ref. none)	-0.025	0.055
Raised by the parents (ref. not)	-0.051	0.074
prop. past illnesses	0.006	0.091
prop. past employment	-0.146*	0.087
Cross products with RxT2:		
Age/10	0.001	0.003
man (ref. woman)	-0.039	0.057
Living in couple (ref. single)	-0.076	0.090

primary education (ref. A level +)	-0.070	0.076
secondary education (ref. A level +)	0.118**	0.060
Problems during childhood (ref. none)	-0.103*	0.061
Raised by the parents (ref. not)	-0.060	0.079
prop. past illnesses	0.070	0.108
prop. past employment	-0.170*	0.101
Cross products with RxT3:		
Age/10	-0.001	0.003
man (ref. woman)	0.043	0.071
Living in couple (ref. single)	-0.177	0.122
primary education (ref. A level +)	-0.047	0.090
secondary education (ref. A level +)	0.109	0.073
Problems during childhood (ref. none)	-0.049	0.072
Raised by the parents (ref. not)	0.040	0.091
prop. past illnesses	0.210	0.129
prop. past employment	-0.116	0.116
Individual dummies		yes
Time dummies		yes
Observations		149,709

The effect of the reform can be evaluated on the pre-reform disabled population, or on the post-reform disabled population. We find a similar effect of the reform on both populations (see Table 4). On the short run, the reform increases the employment rate by 9.7 pp after one year and by 14.3 pp after three years, for the pre-reform population. The effects are stronger for the post reform population (8.7 pp and 14.7 pp respectively). This is a very strong and increasing effect over time. As the coefficients can be added, for the post sample population (the most relevant), the disability effect passes from -26.7 pp to -12.4 pp after 3 years. The reform allows to cancel more than the half of the detrimental effect of disability on employment.

4.4. Heterogeneous effects of the reform.

By looking more closely, we can figure out how other variables influence the effect of the reform (cross products with reform, Table 4) in the short term (by 2 years after the reform). The most relevant factor is having a secondary education level (in reference to A level +) which increases the benefit from the reform (11.5 pp after one year and 11.8 pp after two years). This education level corresponds to vocational training certificates in France, and our results suggest that this population benefited more from the reform than the more skilled workers. We also observe that the reform advantages less those meeting stable employment or diseases events in their past trajectory: these effects magnify our hypothesis of the 2005 reform target on underqualified but relatively healthy populations. Finally, age and gender don't seem to be relevant to differentiate the effect of reform on disabled's employment.

The table 5 complements the heterogeneous analysis by disentangling employment, unemployment and inactivity. The onset of disability lowers the employment rate and this negative effect grows over time. Inversely, disability amplifies unemployment and inactivity situation respectively by 6 pp and 13.3 pp, after three years. Therefore the most outstanding fact refers to the process of precariousness of disabled. The role of reform seems major, as already mentioned, to preserve employment but also to partially prevent from inactivity. The reform removes more than three quarters of the deleterious effect of disability on inactivity.

Table 5 - Heterogeneous effects for the before-reform population

Standard deviation between parentheses. ** significant at 5%, * significant at 10%. Source: SIP Survey.

Outcome variables	Employment	Unemployment	Inactivity	Sector : public	Sector : private	Sector : not available
ATT before reform for the reference population:				Employment decomposition		
t (T0 dummy)	-0.126** (0.016)	0.015 (0.010)	0.111** (0.015)	-0.029** (0.008)	-0.078** (0.014)	-0.019 (0.009)
t+1 (T1 dummy)	-0.154** (0.019)	0.036** (0.013)	0.118** (0.017)	-0.028** (0.010)	-0.097** (0.018)	-0.030** (0.011)
t+2 (T2 dummy)	-0.176** (0.022)	0.043** (0.015)	0.133** (0.019)	-0.034** (0.012)	-0.098** (0.021)	-0.044** (0.013)
t+3 (T3 dummy)	-0.193** (0.025)	0.060** (0.018)	0.133** (0.021)	-0.028** (0.014)	-0.100** (0.024)	-0.066** (0.016)
Reform effect for the reference population:						
t (RxT0 cross product)	0.087** (0.023)	-0.016 (0.015)	-0.071** (0.021)	0.027** (0.013)	0.090** (0.023)	-0.030** (0.015)
t+1 (RxT1 cross product)	0.093** (0.028)	-0.036* (0.020)	-0.057** (0.025)	0.015 (0.014)	0.097** (0.029)	-0.019 (0.018)
t+2 (RxT2 cross product)	0.100** (0.034)	-0.030 (0.024)	-0.069** (0.030)	0.022 (0.017)	0.086** (0.035)	-0.008 (0.020)
t+3 (RxT3 cross product)	0.147** (0.043)	-0.045 (0.030)	-0.102** (0.036)	0.032 (0.024)	0.088** (0.041)	0.027 (0.024)

In addition, as underlined in the first section, the law of the 11th of February 2005 has notably implemented the legal quota of disabled workers to public organizations (the 1987 Law only targeted the private sector). We may imagine that this measure could promote the employment of disabled people in the public sector. Then we have decomposed the effect between both sectors. The first interesting result reveals that the detrimental impact of disability is much more noticeable in the private sector than in the public one. The decline in employment rate is constant over time and reaches 10 pp in the private sector *versus* 2.8 pp in the public one, three years after the disability onset. These findings are congruent with a previous French study that pointed out the strong detrimental effect of a disability on private employment, but no significant impact on public employment during the five years following a disability regardless of the duration or origin of this disability (Barnay et al., 2015).

The implementation of the reform has no effect on the employment in the public sector for disabled people. However, the reform is particularly successful in the private sector. After two years, the reform offsets the effect of disability by about 90%. Thanks to this reform, the overall negative effect of disability on employment appears to be lower in the private sector than in the public sector. By comparing a 3-years-time span, the net effect of disability on employment rate is -2.8 pp in the public sector but only -1.2 pp in the private sector.

4.5. Placebo effect on employment

The definition of reform could appear questionable because it only relies on the implementation year. So we conduct a placebo analysis to test others reform dates. To observe a same three-years-post period, we retain 1999, 2000 and 2001. The robustness tests lead us to temper our results after two and three years, especially for 2001 placebo. If the reform was implemented in 2001, the positive impact would have been equal to 8 pp two years after (as compared to +12.6 pp measuring the 2005 reform effect for the reference population with after reform characteristics, see on table 2). In all cases, where positive effects are recorded, they are much smaller than in the exact year of the reform.

Even though we are able to control for many individual characteristics explaining composition effects before and after the reform for disabled people, we can't perfectly take into account institutional context, changes in company hiring practices and evolution of the economic situation. For instance, on

a very large macroeconomic point of view, the French unemployment rate dropped from 10.7% to 7.8% in 1997-2002 period. This period was undoubtedly employment-friendly in the private sector.

Table 6 – Placebo effect on employment

Standard deviation between parentheses. ** significant at 5%, * significant at 10%. Source: SIP Survey.

Placebo year	1999	2000	2001
T	0.040 (0.027)	0.043* (0.026)	0.053** (0.025)
t+1	0.047 (0.032)	0.041 (0.032)	0.045 (0.030)
t+2	0.073** (0.036)	0.067** (0.036)	0.080** (0.033)
t+3	0.058 (0.041)	0.053 (0.041)	0.067* (0.038)

5. Discussion and conclusion

For the first time, our study proposes to measure the effect of the French Disabled Workers Act of 2005 on disabled workers' employment. A first set of estimations has been performed, with the difference in differences, applied separately before and after the reform. This procedure allows to control for observed heterogeneity (differences in disabled and not-disabled population), unobserved heterogeneity (individual and time constant variables) and differences in disabled people between both periods (before and after reform). By starting the analysis in 1991, we cancelled the impact of 1987 Law.

We find a strong negative effect of the disability on the employment probability both before and after the reform. However, the characteristics (age, gender, education, past trajectories in terms of employment and health adverse events) of disabled workers are different in the pre-reform and post-reform periods. Therefore, we have extended our model in order to control for the variation in the disabled characteristics, in order to isolate the causal effects of the reform. In addition, thanks to interaction terms, we underline how education and past trajectories can play an additional role on employment of disabled.

Three significant results can be put forward.

First, contrary to the 1987 law which failed to improve the level of employment for people with disabilities, the 2005 Law seems to have succeeded in achieving this goal as the detrimental effect of disability on employment was strongly reduced. This result is conform to the previous studies which measure the impact of a quota policy with a substantial increase of the financial penalty for non-compliant employers such as Humer et al. (2007) or Wuellrich (2010).

Second, the 2005 Law has mainly benefitted to disabled people in the private sector, a result that has not been highlighted up to now. The public sector is intrinsically more protective than the private sector. Disabled people could be recipients from specific policies (such as guaranteed employment, compulsory vocational rehabilitation, long-term sick leave) that are likely to improve job retention. Consequently, the effects of disability on the career path in the public sector remain limited (-3.4 pp two years after). But the 2005 reform has failed to protect people with disabilities in the public sector. It could be explained by the fact that the financial penalties for non-compliant employers were progressively implemented between 2005 and 2010 in the public sector. It is likely that time span is insufficient to expect measuring a potential effect of the reform in the public sector.

Third, the reform conducts to support employment for disabled people with secondary education level and with a better trajectory in terms of employment and health. This law introduced a broader perimeter than the 1987 one enabling to calculate the employment quota. The scope of the

employment obligation has notably been extended to new categories of disabled people⁶. Then, 16,000 establishments were newly submitted to the obligation to comply with the law in 2006. Jobs in these companies correspond to truck drivers, construction worker, masons, security agents or sellers in department stores...which do not require high education level but require to be healthy.

Some limitations must be discussed. First and foremost, the nature of data may result in biases. Contrary to other studies such as Wagner *et al.* (2001) and Lalive *et al.* (2013), we do not use firm data but household one. Consequently, characteristics of firms are omitted variables. Notably, we can't disentangle employees who belong to firms below or under 20 employees. However, the 2005 Law only concerns firms employing at least 20 workers. As a result, among over-20-employee's companies, we do not know those which currently repeal the Law. In addition, we are not able to find out how Law changes the employment proportion of disabled by eligible firm. Changes in employment are also not observed anymore. These biases should not be a serious problem because we aim to estimate an effect of the Law on the entire disabled population, regardless the type of job (self-employed, employed in a big company...).

There could be a selection bias because the survey is restricted to people who were still alive in 2010 with a disability which first occurred between 1991 and 2005. We assume this definition excludes the people who suffered from the most severe disabilities a long time ago, because their life expectancy is lower but also because the most disabled don't probably live independently in 2010. Following the first argument, our sample would include people with less severe disabilities before 2005 than after. However, we control for gender, education, age at disability but also health (by considering past health adverse events), so that this argument is not fully valid insofar as the severity of the disability is approximated by past health status.

In addition, we cannot control for the memory bias which can potentially affect the self-reporting of individuals. In the pre-period reform, the onset of disability could have appeared 20 years before. The relevance of this limitation can be reinforced by the large definition of disability, including the less severe forms of disability. We are confident in assuming that a significant part of this potential gap is taken into account by interaction terms such as education level and age.

Furthermore, one of the significant limitations is relative to interpretation of this positive effect. Data do not enable us to distinguish strategic behaviours and moral hazard behaviours between supply and demand sides in the labour market. Thanks to the evaluation on 1987 Law, firms' behaviours seem likely to have been influenced by economic incentives. We could suppose as well, following the example of Gneezy and Rustichini (2000), that the introduction of a penalty or a tax revealed information in a situation of uncertainty. It appeared that the higher level of financial penalty than in the 1987 Law, affected French firms' demand for disabled labour upward.

In conclusion, we find that the 2005 Law seems to have met its initial ambition in the private sector. Indeed, we find that becoming disabled is significantly less detrimental for employment after the reform. Despite these encouraging findings, according to the French Labour Ministry, in 2018, 20% of the eligible institutions preferred to pay a contribution rather than directly or indirectly hire disabled people, and the unemployment rate of disabled people remains the double of the general population rate, suggesting to speed up the promotion of employment for this frail population.

⁶ Emplois « à conditions d'aptitudes particulières » (Ecap)

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