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Optimal disability assistance when fraud and stigma matter

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Abstract

I study the optimal redistributive structure when individuals with distinct productivities also differ in disutility of work due to either disability or distaste for work. Taxpayers have resentment against inactive benefit recipients because some of them are not actually disabled but lazy. Therefore, disabled people who take up transfers are stigmatized. Their stigma disutility increases with the number of non-disabled recipients. Tagging transfers according to disability characteristics decreases stigma. However, tagging is costly and imperfect. In this context, I show how the level of the per capita cost of monitoring relative to labor earnings of low-wage workers determines the optimality of tagging. Under mild conditions, despite their stigma disutility, inactive and disabled people get a strictly lower consumption than low-wage workers. The results are valid under a utilitarian criterion and a criterion which does not compensate for distaste for work.

Keywords: Tagging, Disability benefit, Fraud, Stigma.
JEL classification: H21, H53, I3

1 Introduction

In 2005, 60% of disability benefits' recipients suffered from mental disorders, 18% suffered from diseases of the musculoskeletal (e.g., back pain, osteoporosis, arthritis) or of the nervous system and most of the others had endocrine, blood, respiratory and circulatory diseases (Social Security Administration, 2006). Most of these disabilities are generally neither easily observable nor perfectly monitorable even with a deep medical examination. Moreover, for being eligible for disability benefits, the U.S. Social Security Act requires that the impairment precludes a substantial gainful activity (Hu et al., 2001). This condition adds difficulties to screen between eligible and non-eligible people applying for disability benefits. Therefore, disability transfer systems, so-called tagging systems, are always imperfect. Some of those who take up benefits will not "deserve" them, so-called type II errors. Benitez-Silva et al. (2004b) estimate that approximately 20% of applicants who are ultimately awarded benefits are not disabled. And some of those who are eligible for

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benefits will not take them up. In EU countries, about 30% of people (between 25 to 59 years old) who report severe disability do not get disability benefits and therefore work (Eurostat, 2001). However, the standard tagging literature assumes that eligible people do not work whether they are tagged or untagged (e.g., Salanié, 2002). Alternatively, the literature studies whether or not undeserving tagged recipients should be induced to work (e.g., Parsons, 1996; Boadway et al, 1999). Moreover, in much of the previous work on tagging since the seminal paper by Akerlof (1978), the decision of taking-up disability benefits is not modelled. An exogenously given probability determines whether eligible people are tagged or not. This paper examines how endogenizing the taking-up decision and having disabled people who do not apply for disability benefits and therefore work modify the optimal redistributive schedule in a standard tagging model.

Non-taking up exists due to costs of learning about and applying for the program or due to stigma costs (e.g., Sen, 1995; Currie, 2006). In this paper, we emphasize stigma as an explanation of the non-take-up phenomenon. This focus is motivated by the growing evidence that stigma is important (Hancock et al., 2004; Pudney et al, 2006) and by the relative lack of interest in this explanation in the economic literature, especially in optimal taxation models. Stigma results here from statistical discrimination. Society is deemed to value certain individual characteristics such as a willingness to work hard when one is able to do so (Sen, 1995; Lindbeck et al, 1999). A social norm claiming that disabled low-productivity people should get transfers also prevails (Wolff, 2004). However, due to the imperfect observability of disability, among inactive recipients there are lazy able people. The existence of this proportion of frauders is known in the society. Since people are unable to distinguish perfectly between able and disabled people, they infer that any inactive beneficiary may be a potential cheater. Recipients are then treated badly by other members of society. They are and feel stigmatized and embarrassed because they are believed to be lazy, on average. Stigma, as perceived by deserving individuals, increases with the number of undeserving recipients. No empirical papers have studied this *statistical stigma* phenomenon up to now. However, anecdotal evidence about people who cheat in welfare programs and then create doubts or social resentment against their peers, seems persistent enough to open the path of more investigations.[1] This modelling of stigma is also based on Besley and Coate (1992). To the best of my knowledge, this endogenous stigma mechanism is novel to the optimal income tax literature.

I study the optimal redistributive structure when individuals with distinct productivities also differ in disutility of work due to either disability or distaste for work. The government faces the usual adverse selection problem. It only observes incomes, neither productivities nor the disutility parameters. Therefore, some able people may be tempted to mimic disabled people, i.e. to choose the bundle intended for the latter. A costly monitoring technology and endogenous stigma are modelled. Tagging improves the equity-efficiency tradeoff by limiting mimicking effects and by reducing stigma intensity

[1] Anecdotal evidence about this statistical stigma effect also exists in politics or sport. For instance, during the 2006 Tour de France, when several exceptional bikers were revealed to have taken drugs to improve their performances, the entire profession lost its credibility and all bikers became suspected of being cheaters.

compared to a simple tax system based only on reported income. I show that the use of tagging is recommended when its gains in terms of incentives and of stigma are larger than its monitoring costs. In spite of the stylized nature of the model, simulations suggest that tagging is optimal as long as the per capita cost of monitoring does not take unrealisticly high values. I analytically show that it is always optimal to have some disabled and able people who work. Untagged workers have a larger consumption level (i.e. net labor earnings) than tagged disabled recipients at the optimum. The derived ranking of consumption levels can seem counter-intuitive at first sight since tagged disabled who have the lowest consumption level also burden the disutility of stigma. A direct efficiency effect implies this counterintuitive ranking. Intuitively, a larger consumption bundle for tagged disabled recipients than untagged disabled workers would imply that a smaller proportion of disabled enter the labor force (ceteris paribus) and more disabled then rely on disability benefits. There is then a direct loss of efficiency which would be exacerbated by the increasing number of able people cheating and applying for these relatively higher disability benefits. Beside these efficiency losses, since fraud would increase, the increased stigma suffered by the untagged disabled would imply an equity loss. The equity gain from tagged disabled people who get a larger transfer than untagged disabled would not offset these equity and efficiency losses. Consumption when untagged is then strictly larger than when tagged.

This result challenges the traditional ranking of consumption levels. In standard tagging models, the consumption level of untagged (inactive) disabled is always lower than the one of tagged (inactive) disabled. Compared to a simple tax system based only on income reports, tagging allows to relax the self-selection constraints while improving the well-being of some of the needy by increasing consumption of tagged disabled people. Since disabled are by assumption always inactive, no efficiency effect pushes the consumption of untagged disabled above the one of tagged disabled.

We proceed in the following section by setting up the basic model in the absence of tagging. Section 3 presents the first and second-best optima without tagging. In Section 4, I incorporate tagging in the model. The optimality of tagging is then discussed and illustrated with numerical examples. Appendix 1 contains the proofs of all propositions and lemmata.

2 The model

Productivities, disabilities and tastes for work

I consider an economy where a typical agent is described by a set of exogenous characteristics, denoted by $\chi = (w, \delta, \Delta)$. The first coordinate, w, denotes his productivity, δ measures disutility when working due to disability, i.e. the intensity of the physical or mental pain associated with work due to disability if relevant (Harkness, 1993; Cuff, 2000). The third coordinate, Δ, is disutility when working due to distaste for work (work aversion) (Laroque, 2005). These characteristics are private information to each person; their distributions are public information.

I denote γ the proportion of disabled people in the population. Their productivity is w_ℓ. $1-\gamma$ is the proportion of able people in the population. Their productivity is w_h, with $w_h > w_\ell > 0$. For simplicity, there is then a perfect correlation between disability and a lower productivity. This assumption is also in the vein of the statutory definition of disabled people who are eligible for disability benefits. The applicant is considered to be disabled not just because of the existence of a medical impairment, but because the impairment (drastically) reduces his productivity and precludes any substantial and gainful work (Hu at al., 2001). A disabled worker in a wheelchair who has the functional capability to engage in a substantial gainful job is not considered a disabled neither by the U.S. Social Security Act nor in my model.

When working, an agent produces a quantity $w \in \{w_\ell, w_h\}$ of an undifferentiated desirable commodity which can be reinterpreted as working in a low-productivity or a high-productivity job.

The disutility due to disability δ is distributed on the interval $[0, \infty[$, according to the cumulative distribution $F_\delta(\delta)$ and its associated density function $f_\delta(\delta)$, with $f_\delta(\delta) > 0$ $\forall \delta \in [0, \infty[$ and $\lim_{\delta \to \infty} f_\delta(\delta) = 0$. Only disabled people are concerned by the disutility from disability when working (i.e. $\delta = 0$ for able people). The distaste for work Δ is distributed on the interval $[0, \infty[$, according to the cumulative distribution $F_\Delta(\Delta)$ and the density function $f_\Delta(\Delta)$. By assumption, $f_\Delta(\Delta) > 0$ $\forall \Delta \in [0, \infty[$ with $\lim_{\Delta \to \infty} f_\Delta(\Delta) = 0$. Differing from standard tagging models, some disabled people choose to work despite their handicaps, and then do not suffer stigma costs. For simplicity, I assume that disabled people do not suffer from distaste for work ($\Delta = 0$).

Agents choose whether or not to participate in the labor force as in Choné and Laroque (2005) and Laroque (2005). Since extensive labor supply responses tend to be strong for low-skilled workers (Eissa and Liebman, 1996; Meyer and Rosenbaum, 2001) and since the evidence of responses in terms of labor hours on the job (along the intensive margin) are much more limited (Saez, 2001), assuming an extensive margin is realistic. The participation status of agent χ is described with a function $s(\chi)$, where $s(\chi)$ is equal to 0 (no work) or 1 (work). In the second-best environment which I shall be considering, when an agent works, his number of produced units of commodity, but not his productivity, is observed by the government (or tax authority). When an able agent participates ($s(\chi) = 1$), he chooses to produce either w_h or w_ℓ units of commodity, while he does not produce any marketable good when he does not participate ($s(\chi) = 0$). When a disabled agent participates ($s(\chi) = 1$), he is able to produce only w_ℓ units of commodity, while he does not produce any marketable good when he does not participate ($s(\chi) = 0$).

The tagging technology

In a simple redistributive tax system without tagging, income taxes and transfers depend only on reported income, i.e. on units of commodity produced. When tagging is introduced, disability agencies have access to more information than the tax authority. Targeted transfers are restricted for disabled claimants. However, disability agencies only imperfectly observe abilities, w, and still do not observe distaste for work, Δ. Hence, tagging involves errors. With a probability μ ($0 \leqslant \mu \leqslant 1$), so-called type II error, able individuals ("false positive") are accepted. The accuracy of tagging depends on the per capita amount of resources, M, devoted to it and is translated in terms of the probability of type II error, μ. The lower is μ, the higher the precision with which an able agent claiming disability benefits is detected. The per capita cost of monitoring, $M(\mu)$, depends on the precision of the monitoring technology with $\frac{\partial M}{\partial \mu} < 0$, $\frac{\partial^2 M}{\partial^2 \mu} \geqslant 0$, $\lim_{\mu \to 0} M(\mu) = +\infty$ and $M(1) = 0$. Monitoring takes place ex ante: it occurs before any benefit is distributed. It seems realistic to assume no sanction, whatsoever, including exposure or non-informal sanction of the caught non-eligible individuals.

Type II error aside, the accuracy of tagging is also limited by a non-take-up phenomenon. Even if disabled people are aware of their eligibility, part of them might not claim disability benefits to avoid disability benefit and the associated stigma. For tractability, the imperfection of tagging is limited to type II errors and non-take-up. Disability agencies perfectly tag disabled people who apply for disability assistance (i.e., there is no 'false negative' or type I error).

Stigma

There is a social norm to earn one's income from work when one is able to do so (Elster, 1989; Sen, 1995; Lindbeck et al., 1999) and transfers are regarded as entitlements for deserving people—e.g. disabled and very low productivity people (Romer, 1997; Wolff, 2004). Taxpayers know from media that among the inactive people who get transfers there are able people with high distaste for work. These undeserving can generally not (perfectly) be distinguished from the deserving, neither by the tax authority and nor by people in general. Hence, undeserving individuals impose a "reputational externality" (Besley and Coate, 1992) on the deserving ones. When it is known that an individual is inactive (or on disability assistance), other individuals will infer that this individual will likely be lazy. To be a disabled inactive recipient and considered as an undeserving (i.e. lazy) recipient, when one truly is disabled is demeaning and stigmatizing. Stigma results here from statistical discrimination. Hence let us call it *statistical stigmatization.* It seems realistic to assume that statistical stigma hurts those who are disabled and choose to claim disability benefits more than able recipients because disabled people face a limited choice set. For tractability and without loss of generality, I then assume zero stigma effect for the able recipients.

Disabled people who take up transfers feel—and are— stigmatized, hence are burdened by a disutility, $-\sigma$ with stigma level $\sigma \geqslant 0$. In Besley and Coate (1992), stigma is an increasing function of the difference between the average disutility of all welfare recipients and a social norm (the latter is assumed to be equal to the average disutility of labor within the population as a whole). I rather model stigma as an increasing function of the number of undeserving recipients. The higher this number is (the more people depreciate inactive recipients), the higher is stigma. I then define stigma as:

$$\sigma(\pi_\iota^\Delta) = g\pi_\iota^\Delta \text{ with } 0 \leqslant g < \infty$$

where π_ι^Δ is the number of people who unduly collect benefits, i.e. the proportion of able who are inactive in the population.[2] To fix $g = 0$ is equivalent to neglecting stigma effects. For my qualitative results to be valid, all I really need is that there be a monotonic positive relationship between π_ι^Δ and the subjective number of undeserving recipients taxpayers inferred from media.[3]

Alternatively, stigma can be defined as an increasing function of the proportion of undeserving recipients among all recipients. This assumption does not modify the qualitative nature of the results as shown in Appendix 2. Lindbeck et al. (1999) argue that living on transfers becomes relatively less embarrassing when more individuals do likewise. When the population share of transfer recipients is large (small), the individual's discomfort from such a lifestyle is relatively weak (strong). In my model, who receives the benefits also matters. Reducing the number of undeserving recipients reduces stigma.

Individual utilities and threshold values

The agents' behaviors depend on their disutility when working (Δ for able workers, δ for disabled workers) and on stigma (σ) when inactive and disabled. Income, or consumption, is assumed to always be desirable. Utility of consumption $u(c)$ is a continuous, differentiable, strictly increasing and strictly concave function with $\lim_{c\to 0} u'(c) = +\infty$.

In the second-best environment, for each individual the government observes only the number of produced units of the commodity.[4] Productivities are imperfectly observed by disability agencies and only when agents apply for disability benefits. The other individual characteristics, δ and Δ, are never observable and then cannot be used to base the tax-subsidy scheme on. Therefore, at most three distinct tax/transfer levels can be implemented which is equivalent to three consumption bundles: c_ι for inactive people, c_δ for agents producing w_ℓ units of commodity, c_Δ for agents producing w_h units of commodity.

In the standard tagging literature, the participation status is exogenous and the same for all disabled people: they all do not work (e.g. Parsons, 1996; Salanié, 2002).[5] In my model, according to his own disability characteristic δ, each disabled person decides to work or not. The utility level of a disabled agent $\chi = (w_\ell, \delta, \Delta = 0)$ is

$$\begin{cases} u(c_\iota) - \sigma(\pi_\iota^\Delta) & \text{when } s = 0 \\ u(c_\delta) - \delta & \text{when } s = 1 \end{cases} \tag{1}$$

The individual is either inactive ($s = 0$), gets disability benefit c_ι and suffers from stigmatization $\sigma(.)$ or he works ($s = 1$), has c_δ after taxation and suffers a pain δ caused by his

[2] As in Besley and Coate (1992), disabled recipients experience the same stigma cost. Precisely how much a disabled person will feel stigmatized will also depend on individual specific characteristics, e.g. his own self-esteem. For tractability, the model endogenizes stigma but neglects heterogeneity in stigma intensities.

[3] Alternatively, I may consider that the proportion of able people $(1-\gamma)$ is common knowledge and that a statistic over people employed in high-productivity jobs is also available. Therefore, by substraction, every taxpayer can deduce the number of undeserving recipients, π_ι^Δ.

[4] In Choné and Laroque (2005) and Laroque (2005), an agent reveals his true productivity when he works (agent's productivity is not observed when he does not work). Therefore, when any agent with productivity w participates, he produces w units of commodity. I relax this assumption here: productivity levels of workers are not observable.

[5] In the seminal paper of Akerlof (1978), all disabled people do work and have the same gross labor earnings when they are tagged or untagged. My model assumes distinct working status when tagged or untagged as confirmed by empirical evidence presented in the introduction.

disability. As noted by Parsons (1996) and Salanié (2002), it is realistic to assume that a recipient of disability benefit is banned from working.

The utility level of an able agent $\chi = (w_h, \delta = 0, \Delta)$ is

$$\begin{cases} u(c_\iota) \text{ with probability } \mu & \text{when } s = 0 \\ Max\,(u(c_\delta), u(c_\Delta)) - \Delta \text{ with probability } (1-\mu) & \text{when } s = 0 \\ Max\,(u(c_\delta), u(c_\Delta)) - \Delta & \text{when } s = 1 \end{cases}$$

An able agent can choose to apply for disability benefits and, hence, not work ($s = 0$). He then gets benefits with probability μ. With probability $(1-\mu)$, he is caught and therefore goes back to work where his utility is $Max\,(u(c_\delta), u(c_\Delta)) - \Delta$. Alternatively, an able agent can choose to work ($s = 1$). He then produces w_h or w_ℓ units of the good depending on the ranking of c_Δ and c_δ at the optimum. If $c_\delta = c_\Delta$, I assume that able workers prefer to produce w_h units of good.

Since the unobservable parameters δ and Δ are distributed on infinite size support, it simply becomes too costly (unfeasible) to induce all able and disabled to participate in the labor force. So, whatever the allocation of consumption levels, there will be some finite cutoff levels $\widetilde{\delta}$ and $\widetilde{\Delta}$ such that only disabled agents with $\delta < \widetilde{\delta}$ work while those with $\delta > \widetilde{\delta}$ do not work and only able people with $\Delta < \widetilde{\Delta}$ work and those characterized by $\Delta > \widetilde{\Delta}$ claim disability benefits and receive them with probability μ. The cut-off values or threshold levels satisfy the following equalities:

$$\widetilde{\delta} = u(c_\delta) - u(c_\iota) + \sigma(\pi_\iota^\Delta) \tag{2}$$

and, as regards $\widetilde{\Delta}$, we have for the case $c_\Delta \geqslant c_\delta$:

$$\begin{aligned} & u(c_\Delta) - \widetilde{\Delta} = u(c_\iota)\mu + [u(c_\Delta) - \widetilde{\Delta}](1-\mu) \\ & \Leftrightarrow \widetilde{\Delta} = u(c_\Delta) - u(c_\iota) \end{aligned} \tag{3}$$

When $c_\Delta < c_\delta$:

$$\begin{aligned} & u(c_\delta) - \widetilde{\Delta} = u(c_\iota)\mu + [u(c_\delta) - \widetilde{\Delta}](1-\mu) \\ & \Leftrightarrow \widetilde{\Delta} = u(c_\delta) - u(c_\iota) \end{aligned} \tag{4}$$

Equations (3) and (4) emphasize that the decision of able people to apply or not for disability benefits does not depend on the probability μ.

Proposition 1 *Consumption when producing more units of good (w_h) is larger than when producing less (w_ℓ): $c_\Delta \geqslant c_\delta$*

It follows that for able workers, the strategy to choose to produce w_ℓ units is strictly dominated by the choice of producing $w_h (> w_\ell)$ units:

$$Max\;\; (u(c_\delta) - \Delta, u(c_\Delta) - \Delta) = u(c_\Delta) - \Delta, \forall \Delta$$

The statistical stigma function $\sigma(\pi_\iota^\Delta)$ can explicitly be written as

$$\sigma\left(\pi_\iota^\Delta\left(\widetilde{\Delta},\mu\right)\right)=g(1-\gamma)\mu\left(1-F_\Delta\left(\widetilde{\Delta}\right)\right) \tag{5}$$

where the proportion of able inactive π_ι^Δ is $(1-\gamma)\mu\left(1-F_\Delta\left(\widetilde{\Delta}\right)\right)$ and, from (3), $\widetilde{\Delta}$ is a function of c_Δ and c_ι. Moreover, $\sigma\to g(1-\gamma)$ if $\widetilde{\Delta}\to 0$. Equation (2) becomes

$$\widetilde{\delta}=u(c_\delta)-u(c_\iota)+\sigma\left(\pi_\iota^\Delta\left(\widetilde{\Delta},\mu\right)\right) \tag{6}$$

From (3) and (5),

$$\frac{\partial\sigma}{\partial c_\iota}=\frac{\partial\sigma}{\partial\widetilde{\Delta}}\frac{\partial\widetilde{\Delta}}{\partial c_\iota}=g(1-\gamma)\mu f_\Delta\left(\widetilde{\Delta}\right)u'(c_\iota)>0 \tag{7}$$

with $\frac{\partial\sigma}{\partial\widetilde{\Delta}}=-g(1-\gamma)\mu f_\Delta\left(\widetilde{\Delta}\right)<0$ and $\frac{\partial\widetilde{\Delta}}{\partial c_\iota}=-u'(c_\iota)<0$.

Combining these results with equation (6), and totally differentiating, I obtain:

$$\frac{\partial\widetilde{\delta}}{\partial c_\iota}=-u'(c_\iota)\left(1+\frac{\partial\sigma}{\partial\widetilde{\Delta}}\right)$$

If one wanted to guarantee that $\frac{\partial\widetilde{\delta}}{\partial c_\iota}<0$[6], we would need to assume that, at the optimum:

$$g<\frac{1}{(1-\gamma)\mu\max_{\widetilde{\Delta}}\left[f_\Delta\left(\widetilde{\Delta}\right)\right]} \tag{8}$$

i.e. an upper bound on the marginal disutility of stigma. Inequality (8) takes the opposite sign, i.e. a lower bound on g, if one wants to guarantee $\partial\widetilde{\delta}/\partial c_\iota>0$. A priori, any restriction on g is assumed. I study in Section 5 when condition (8) is not satisfied.

Government

Two normative criteria are used in this paper. I consider a utilitarian Social Welfare Function (SWF), i.e. a sum of utilities weighted by the share in the population, which is generally used in the tagging literature and in the crime and fraud literature (e.g., Diamond and Sheshinski, 1995).

$$\begin{aligned}U\left(\widetilde{\delta},\widetilde{\Delta},\mu,c_\delta,c_\Delta,c_\iota\right)\equiv\gamma&\left\{\int_0^{\widetilde{\delta}}[u(c_\delta)-\delta]dF_\delta(\delta)+\left(1-F_\delta\left(\widetilde{\delta}\right)\right)\left(u(c_\iota)-\sigma\left(\widetilde{\Delta},\mu\right)\right)\right\}\\+(1-\gamma)&\left\{\int_0^{\widetilde{\Delta}}[u(c_\Delta)-\Delta]dF_\Delta(\Delta)\right.\\&\left.+(1-\mu)\int_{\widetilde{\Delta}}^{\overline{\Delta}}[u(c_\Delta)-\Delta]\,dF_\Delta(\Delta)+\mu\left(1-F_\Delta\left(\widetilde{\Delta}\right)\right)u(c_\iota))\right\}\end{aligned} \tag{9}$$

I compare outcomes under the latter criterion and a criterion which does not compensate for the distaste for work (Δ) that I call the Δ-excluded criterion. The only difference with the utilitarian criterion (9) is the term $u(c_\Delta)-\Delta$, which is substituted by $u(c_\Delta)$:

[6] Following an increase in c_ι, the global effect on $\widetilde{\delta}$ can be decomposed into a positive direct effect and a negative indirect effect. The increase in the proportion of disabled people claiming assistance (or equivalently the diminishing in the level of $\widetilde{\delta}$) is the direct effect. The indirect effect stems from the enlargement of stigma that follows the fall in $\widetilde{\Delta}$ which in turn leads to a decrease in the proportion of disabled recipients.

$$W\left(\widetilde{\delta}, \widetilde{\Delta}, \mu, c_\delta, c_\Delta, c_\iota\right) \equiv \gamma \left\{ \int_0^{\widetilde{\delta}} [u(c_\delta) - \delta] dF_\delta(\delta) + \left(1 - F_\delta\left(\widetilde{\delta}\right)\right)\left(u(c_\iota) - \sigma\left(\widetilde{\Delta}, \mu\right)\right) \right\}$$
$$+(1-\gamma)\left\{ F_\Delta\left(\widetilde{\Delta}\right) u(c_\Delta) + \left(1 - F_\Delta\left(\widetilde{\Delta}\right)\right)((1-\mu)u(c_\Delta) + \mu u(c_\iota)) \right\} \tag{10}$$

This government does not respect the consumer sovereignty principle for able people and the objective function (10) violates the Pareto principle. However, by violating these principles, the Δ-excluded criterion avoids the subjacent contradiction we have when using a utilitarian criterion and a tagging or monitoring technology. It is contradictory to use costly monitoring to screen people with high distaste for work, Δ, on the one hand, and to compensate for distaste for work, Δ, by including Δ in the SWF, (9), on the other hand.

The choice of the Δ-excluded criterion is also motivated by the literature which argues in favor of a distinction between "relevant" and "irrelevant" characteristics (Fleurbaey and Maniquet, 2006). Whereas the former calls for compensation, the latter does not, because they are considered as being the responsibility of the individuals. In the same vein, Arneson (1990) defends a conception of social justice as equal opportunity for welfare. He also makes a distinction between the part of one's utility for which one is responsible and the part for which one is not. I therefore exclude from the normative criterion the part of the utilities for which one is responsible for. The normative criterion is then a sum of such corrected utility functions weighted by the share in the population. The interpretation given to δ and Δ determines their inclusion or not in the welfare criterion. In my setting, individuals are not responsible for their ability which is interpreted as determined by their innate characteristics and their family background. The mental or physical handicaps when working, δ, simply reflect a plausible heterogeneity and are reasonably assumed not to be the responsibility of these people. Disabled individuals are not responsible for the statistical stigmatization phenomenon. One can then argue that they are not responsible for the impact of stigmatization on their well-being (σ). Therefore, there are good reasons to integrate these features in the objective function. In contrast, the government might argue that income should not be transferred as compensation for distaste for work (Δ) because individuals are responsible for their own taste for work.

The distinction between the two criteria will become more explicit when I discuss the first-best optimum in Section 3.1.

The government budget constraint is

$$\pi_\delta(w_\ell - c_\delta) + (\pi_\iota^\delta + \pi_\iota^\Delta)(-c_\iota) + \pi_\Delta(w_h - c_\Delta) - \left(\pi_\iota^\delta + \frac{\pi_\iota^\Delta}{\mu}\right) M(\mu) = -R \tag{11}$$

where R ($\gtrless 0$) is the resources (per head) available to (or required by) the economy. I define $\pi_\delta = \gamma F_\delta\left(\widetilde{\delta}\right)$, i.e. the share of population which is disabled and work for labor earnings w_ℓ, $\pi_\iota^\delta = \gamma\left(1 - F_\delta\left(\widetilde{\delta}\right)\right)$ the share of population which is disabled and inactive, $\pi_\iota^\Delta = (1-\gamma)$ $\left(1 - F_\Delta\left(\widetilde{\Delta}\right)\right)\mu$ the share of population which is able and inactive (they unduly collect disability benefits), $\pi_\Delta = (1-\gamma)\left[F_\Delta(\widetilde{\Delta}) + \left(1 - F_\Delta\left(\widetilde{\Delta}\right)\right)(1-\mu)\right]$ the share of population which is able and work for labor earnings w_h. The budget constraint includes per capita costs of monitoring. The per capita cost of monitoring $M(\mu)$ appears ex ante and for any individual who has applied for welfare, i.e. for the proportion $\pi_\iota^\delta + (1-\gamma)\left(1 - F_\Delta\left(\widetilde{\Delta}\right)\right) \equiv \pi_\iota^\delta + \frac{\pi_\iota^\Delta}{\mu}$. Thus, the total cost of monitoring is increasing in the proportion of monitored individuals.

There exist four links between able and disabled people in the model. First, able inactive people receive the same benefit (c_ι) as disabled inactive people. This creates mimicking problems which can be limited by increasing the differential $c_\Delta - c_\delta$ and/or by using costly tagging. Second, the disutility of work (Δ) appears in the utility of able workers as well as in the stigma disutility burdened by disabled inactive people. When giving financial incentives such that the proportion of able people who work increases and then $\widetilde{\Delta}$ increases, one also limits stigma. Third, stigma is also a function of μ, the proportion of type II errors. Investing tax receipts in monitoring reduces μ, and, hence, reduces stigma. Finally, the budget constraint (11) establishes the additional link.

3 Model without tagging

To better understand the role of stigma and mimicking on financial incentives, I first neglect the tagging technology. As long as stigma prevails ($g > 0$), equation (2) grasps that the ranking of c_δ and c_ι is already an open question without introducing tagging. No tagging means $\mu = 1$ and c_ι is then a transfer only based on income reported. Any inactive person gets it.

As traditional, I study the optima, starting with the case of complete information of the planner (first-best), following with the situation where the planner only observes part of the agents' characteristics (second-best).

3.1 The first-best social optimum

The first-best social optimum is obtained when the social planner observes individual characteristics $\chi = (w, \delta, \Delta)$. Under both criteria (9) and (10), the first-order conditions require identical marginal utility for all individuals (equal to the marginal cost of public funds, λ). Hence, consumption levels must be the same for all individuals:[7]

$$c_\delta = c_\iota = c_\Delta = \overline{c} \tag{12}$$

Let us give the other characteristics of the first-best optimum under the utilitarian criterion first. All able individuals with disutility of work below some cut-off $\widetilde{\Delta}$ should

[7] This result depends on the additively separable utility functions. Among the possible specifications, an alternative could be the form $u(c-D)$, where D stands for the individual disutility (i.e. δ or Δ or the stigma function $\sigma(\pi_\Delta^\iota)$). Then, at the first-best utilitarian optimum, perfect insurance equalizes utility levels and not consumptions. Most of the other outcomes will also depend on the chosen utility function. However, the economics behind the optimal tax/transfer system would remain unchanged with this alternative specification. Further, the additively separable utility function has the advantage of comparing more directly and more clearly my results with the traditional ones for which similar additively separable utility functions and a utilitarian criterion as well are assumed (e.g., Akerlof, 1978; Diamond and Sheshinski, 1995; Parsons, 1996).

work. The cut-off is determined by comparing the utility gain from an extra worker producing w_h, $u(c_\Delta) - \widetilde{\Delta} - u(c_\iota)$ with the social value of extra net consumption as a consequence of work, which is the sum of the gross income and the change in consumption which results from the change in status:

$$u(c_\Delta) - \widetilde{\Delta} - u(c_\iota) = -u'(\overline{c})(w_h - c_\Delta + c_\iota)$$

More precisely, the optimal cut-off level for able individuals is such that the net loss of utility when the marginal able individuals are shifted from inactivity to the work status is equal to the gain of resources (w_h) valued according to their common marginal utility:

$$\widetilde{\Delta} = u'(\overline{c})w_h > 0 \tag{13}$$

As $\widetilde{\Delta} < \infty$, some able people do not work, which highlights the previously mentioned contradiction between the social norm prevailing in society against living on other's work if one is able and a utilitarian criterion which does compensate for distaste for work. Moreover, from the previous equation and (5), $\sigma(\pi_\iota^\Delta) > 0$ in first-best with a utilitarian criterion.

All disabled individuals with disability levels below some cut-off $\widetilde{\delta}$ should work. The optimal cut-off level for individuals who produce w_ℓ is such that the net loss of utility when the marginal disabled individuals are shifted from inactivity to work status is equal to the gain in resources (w_ℓ) valued according to their common marginal utility:

$$\widetilde{\delta} - \sigma(\pi_\iota^\Delta) = u'(\overline{c})w_\ell > 0 \tag{14}$$

From the two previous equations, $\widetilde{\Delta}$ and $\widetilde{\delta}$ are finite. It is then optimal for some able and disabled people not to work under a utilitarian criterion.

With the Δ-excluded SWF in (10), turning to the cut-off $\widetilde{\Delta}$, there is always a net gain in utility when one more able individual shifts from being inactive to working. Moreover, from (12), the social utility of the marginal individual is unchanged : $u(c_\Delta) - u(c_\iota) = 0$. Therefore, under the Δ-excluded SWF in (10), it is optimal to place all able individuals in work:

$$\widetilde{\Delta} \to +\infty$$

Therefore, there is no stigma effect: $\sigma(\pi_\iota^\Delta) = 0$. Introducing $\widetilde{\Delta} \to +\infty$ and (12) in the budget constraint gives $\overline{c} = \pi_\delta w_\ell + \pi_\Delta w_h + R$.

For disabled people, the cut-off is now determined by

$$\begin{aligned} & u(c_\delta) - \widetilde{\delta} - u(c_\iota) = -u'(\overline{c})(w_\ell - c_\delta + c_\iota) \\ & \Leftrightarrow \widetilde{\delta} = u'(\overline{c})w_\ell \end{aligned} \tag{15}$$

Therefore, $\widetilde{\delta}$ is finite which implies that it is optimal for some disabled individuals not to work.

In a first-best context, according to my results, the person should be pushed to work by all means provided that their net loss of utility (due to stigma, disability or even distaste for work with a utilitarian criterion) is lower than the gain of resources, the difference being a gain for society. In the next proposition, I summarize the first-best results which emphasize the distinction between the two alternative SWF.

Proposition 2 *In a first-best economy, some able people do not work ($\widetilde{\Delta} < \infty$) under the utilitarian SWF (9) while they all do work under the Δ-excluded SWF (10) ($\widetilde{\Delta} \to +\infty$). Stigma is strictly positive under the utilitarian SWF while it is zero under the Δ-excluded SWF. Under both SWF, some disabled do enter the labor force while others do not.*

3.2 The second-best optimum

I now turn to more realistic second-best situations, where the distributions of characteristics in the society is common knowledge, but the individual agent's characteristics $\chi = (w, \delta, \Delta)$ is private information. The tax authority (perfectly and costlessly) observes reported income and, thus, also participation in the labor force. These are, however, the only characteristics that taxes and subsidies can be made conditional on. I follow the standard optimal tax and tagging literature (Mirrlees, 1971; Akerlof, 1978) and assume no dishonest income reporting.

The second-best maximization problem requires the introduction of two additional constraints, equations (3) and (6), beside the budget constraint (11). Equations (3) and (6), which define cutoff levels $\widetilde{\Delta}$ and $\widetilde{\delta}$, somewhat play the role of the more standard self-selection constraints traditionally defined in optimal tax models.

The utilitarian government maximizes (9) subject to (3), (6) and the budget constraint (11). Since tagging is not considered $\mu = 1$ is substituted into this constrained optimization problem.

The government which does not compensate for disutility of work maximizes (10) subject to (3), (6), (11), and $\mu = 1$.

The following proposition paves the way towards a characterization of the second-best consumption (or tax) schedules; it is valid under the two normative criteria and do not require deriving the first-order conditions to be shown.

Proposition 3 *Under both criteria (9) and (10), it is always optimal to have some disabled people not work, $\widetilde{\delta} < \infty$, and some able mimicking disabled, $\widetilde{\Delta} < \infty$. It is also optimal that some disabled and able people work in the economy, $\widetilde{\delta} > 0$ and $\widetilde{\Delta} > 0$. The consumption when producing w_h units of goods is strictly larger than consumption when inactive: $c_\Delta > c_\iota$.*

As is well-known from the optimal income tax literature, it may be efficient that low ability or disabled people do not work, simply because their productivity is not high enough to compensate for the loss in their utility from work (Mirrlees, 1971). The literature (since Diamond and Mirrlees, 1978) demonstrates that the optimal social insurance induces all able individuals to work. Since disutilities when working are on an infinite support here, it is efficient that some of the disabled, but also some of the able people, not work.

Moreover, according to my results, the government should make work pay for a subset of disabled people, and able people as well.

A still open question is the ranking of consumption levels while inactive (c_ι) and while producing w_ℓ (c_δ). I now develop the first-order conditions from the constrained maximization problem. I use λ as the Lagrange multiplier associated with the budget constraint (11), $\widetilde{\delta}$ and $\widetilde{\Delta}$ strictly are strictly positive (from Proposition 3), and I assume the three consumption levels are strictly positive. The first-order conditions and their intuitions are first given under the Δ-excluded criterion (10).

The first-order conditions can be stated as the resource constraint (11) and equations (16)-(18).

$$\pi_\Delta\left[u'(c_\Delta)-\lambda\right]=\left\{\pi_\iota^\delta\frac{\partial\sigma\left(\pi_\iota^\Delta\left(\widetilde{\Delta}\right)\right)}{\partial\widetilde{\Delta}}-(1-\gamma)f_\Delta(\widetilde{\Delta})\widetilde{\Delta}\right. \tag{16}$$

$$\left.+\lambda\left[-(1-\gamma)f_\Delta(\widetilde{\Delta})(w_h-c_\Delta+c_\iota)-\gamma f_\delta(\widetilde{\delta})\frac{\partial\sigma\left(\pi_\iota^\Delta\left(\widetilde{\Delta}\right)\right)}{\partial\widetilde{\Delta}}(w_\ell-c_\delta+c_\iota)\right]\right\}u'(c_\Delta)$$

where I have used $\frac{\partial\widetilde{\Delta}}{\partial c_\Delta}=u'(c_\Delta)>0$ from (3), $\frac{\partial\widetilde{\delta}}{\partial c_\Delta}=u'(c_\Delta)\frac{\partial\sigma}{\partial\widetilde{\Delta}}<0$ since $\frac{\partial\widetilde{\delta}}{\partial\sigma}=1$ (from (6)) and $\frac{\partial\sigma(\widetilde{\Delta})}{\partial\widetilde{\Delta}}=-g(1-\gamma)f_\Delta\left(\widetilde{\Delta}\right)<0$ (from (5)). The left-hand side of (16) is the social value of giving consumption to the able workers rather than holding the resources. The right-hand side actually characterizes the effects due to imperfect information which prevents us from reaching the first-best outcome where $u'(c)=\lambda\ \forall c\in\{c_\Delta,c_\iota,c_\delta\}$. There are three effects. First, the effect on the stigma function (borne by disabled recipients) of a change in the cut-off $\widetilde{\Delta}$ as a result of the change in consumption c_Δ. Second, the effect on net utilities (of marginal individuals characterized by $\Delta=\widetilde{\Delta}$) of a change in the cut-off $\widetilde{\Delta}$ as a result of the change in consumption c_Δ. This term is present due to the fact that Δ is not included in the objective function. Third, the social value of the resources savings from the induced changes in labor supplies. The net effect on tax revenue is ambiguous. Actually, the change in consumption c_Δ has an effect on $\widetilde{\Delta}$ and on $\widetilde{\delta}$. An increase in c_Δ attracts more able individuals to work and the revenue from income tax increases. However, this decreases the intensity of the stigmatization. Therefore, more disabled individuals will go to assistance which reduces the revenue from income tax (as long as $c_\iota>c_\delta-w_\ell$).

$$\pi_\delta\left[u'(c_\delta)-\lambda\right]=-\lambda\gamma f_\delta\left(\widetilde{\delta}\right)(w_\ell-c_\delta+c_\iota)u'(c_\delta) \tag{17}$$

where we have used $\frac{\partial\widetilde{\delta}}{\partial c_\delta}=u'(c_\delta)>0$ from (6). The left-hand sides of (17) is the social value of giving consumption to the disabled workers rather than holding the resources. The right-hand side is the social value of the resources savings from the induced changes in the labor supply of the disabled individuals as a consequence of altered c_δ. Actually, increasing c_δ reduces the proportion of inactive disabled individuals. This reduces benefits allowances and therefore reduces public expenditure.

$$\pi_\iota\left[u'(c_\iota)-\lambda\right]=\left\{-\pi_\iota^\delta\frac{\partial\sigma}{\partial\widetilde{\Delta}}+(1-\gamma)f_\Delta\left(\widetilde{\Delta}\right)\widetilde{\Delta}\right. \tag{18}$$
$$\left.+\lambda\left[(1-\gamma)f_\Delta\left(\widetilde{\Delta}\right)(w_h-c_\Delta+c_\iota)+\gamma f_\delta\left(\widetilde{\delta}\right)(1+\frac{\partial\sigma(.)}{\partial\widetilde{\Delta}})(w_\ell-c_\delta+c_\iota)\right]\right\}u'(c_\iota)$$

where $\pi_\iota=\pi_\iota^\delta+\pi_\iota^\Delta$ and where (7) and $\frac{\partial\widetilde{\Delta}}{\partial c_\iota}=-u'(c_\iota)<0$ from (3) are used. The left-hand side of (18) is the social value of giving consumption to the inactive (able and disabled) people respectively, rather than holding the resources. The right-hand side includes three effects which prevents us from reaching the first-best outcome. First, the effect on the stigma function (borne by disabled non-workers) of a change in the cut-off $\widetilde{\Delta}$ as a result of the change in consumption c_ι. Second, the effect on net utilities of a change in the cut-off $\widetilde{\Delta}$ as a result of the change in consumption. Third, the social value of the resources savings from the induced changes in labor supplies. Any change in consumption c_ι has a negative effect on $\widetilde{\Delta}$ and on $\widetilde{\delta}$ as well as long as inequality (8) is satisfied. Increasing c_ι then reduces the levied taxes since the number of both able and disabled workers decreases. When (8) is violated, increasing c_ι increases $\widetilde{\Delta}$. Hence the effect on levied taxes is ambiguous.

A redistributive principle in the optimal redistributive program can be enounced as follows.

Lemma 1 *The inverse of the marginal cost of public funds is equal to the average of the inverses of increasing by a unit the utility of each individual in each group, the weights being the shares in the population :*

$$\frac{1}{\lambda}=\frac{\pi_\delta}{u'(c_\delta)}+\frac{\pi_\iota}{u'(c_\iota)}+\frac{\pi_\Delta}{u'(c_\Delta)} \tag{19}$$

The weighted sum on the righthand-side comes from the weighted additively separable form of the SWF (10). This formula emphasizes that the government should redistribute more towards people whose marginal utility per population share is larger. This redistributive principle has important implications for the benefit structure of the redistributive system:

Proposition 4 *Consumption of workers in low-productivity jobs is strictly larger than the benefit for inactive people, $c_\delta>c_\iota$. It cannot be ruled out that workers in low-skilled jobs pay taxes.*

This result can seem counter-intuitive at first sight since those who get the lowest consumption are also those who suffer from stigma. However, compared to $c_\iota\geqslant c_\delta$, $c_\delta>c_\iota$ means that more disabled people work (ceteris paribus), so that more tax revenue is collected from them. Efficiency is then improved. Second, disabled people who work do not suffer from stigma, which means that equity is improved. Third, able individuals with high preferences for leisure are less prone to claim disability benefits when these are relatively smaller (hence efficiency is improved). Finally, a decrease of disability fraud reduces stigmatization and, ceteris paribus, improves the well-being of tagged disabled (hence equity increases). The equity-efficiency tradeoff is then improved when $c_\delta>c_\iota$ compared to $c_\iota\geqslant c_\delta$.

From Proposition 1 and 4, the optimal ranking of consumption levels is then $c_\Delta \geqslant c_\delta > c_\iota$.

Consider now the utilitarian Social Welfare Function (9).

Proposition 5 *Qualitative properties highlighted with the Δ-excluded criterion are also valid under the utilitarian criterion (9)*

Compared to the Δ-excluded criterion, the solution under the utilitarian criterion is identical except that there is no more change in welfare (directly) due to the behavioral response of the marginal able workers leaving the labor force, characterized by $\Delta = \widetilde{\Delta}$. On the margin these individuals are indifferent between becoming inactive and remaining active (see equation (3)). Their well-being weight is now the same in the SWF, whether they are active or not, which is not the case under the Δ-excluded criterion. However, since the SWF take both a weighted additively separable form, the qualitative nature of the optimum under both criteria is identical. (This clearly appears in the proof). But this does not mean that the optima are quantitatively identical as shown in Section 5.

4 Model with tagging

Let us now look at the case where the government considers that only disabled people are eligible for receiving transfers (when inactive), and therefore introduce tagging.

4.1 The first-best social optimum

In a first-best economy, the government maximizes the SWF in (9) or (10) subject to the budget constraint (11). As the set of individual characteristics χ is observable, the disability agencies have no role to play and there is no monitoring, no type II error. The characterization of the first-best economy with tagging is then equivalent to the one derived without tagging in Section 3.1.

4.2 The second-best optimum

Allowing tagging means assuming μ as a variable and $\mu \in]0,1]$. I turn now to the constrained maximization of the Δ-excluded SWF. The government maximizes (10) subject to the budget constraint (11) and equations (3) and (6). The multiplier associated with the budget constraint is again denoted by λ. Again $\widetilde{\delta}, \widetilde{\Delta} > 0$, the first-order conditions are therefore given by:

$$\pi_\Delta \left[u'(c_\Delta) - \lambda\right] = \left\{ \pi_\iota^\delta \frac{\partial \sigma}{\partial \widetilde{\Delta}} - (1-\gamma)\mu f_\Delta \left(\widetilde{\Delta}\right) \widetilde{\Delta} \right. \tag{20}$$
$$\left. + \lambda \left[-(1-\gamma) f_\Delta \left(\widetilde{\Delta}\right) \left[\mu(w_h - c_\Delta + c_\iota) + M\right] - \gamma f_\delta(\widetilde{\delta}) \frac{\partial \sigma}{\partial \widetilde{\Delta}} (w_\ell - c_\delta + c_\iota + M) \right] \right\} u'(c_\Delta)$$

where I have used $\frac{\partial \sigma}{\partial \widetilde{\Delta}} = -f_\Delta(1-\gamma)\mu f_\Delta\left(\widetilde{\Delta}\right) < 0$ (from (5)). In equation (20) and the following ones, I use M for $M(\mu)$ and σ for $\sigma\left(\pi_\iota^\Delta\left(\widetilde{\Delta},\mu\right)\right)$.

$$\pi_\delta\left[u'(c_\delta)-\lambda\right] = -\lambda\gamma f_\delta\left(\widetilde{\delta}\right)(w_\ell - c_\delta + c_\iota + M)u'(c_\delta) \tag{21}$$

$$\begin{aligned}\pi_\iota\left[u'(c_\iota)-\lambda\right] = &\left\{-\pi_\iota^\delta\frac{\partial \sigma}{\partial \widetilde{\Delta}} + (1-\gamma)\mu f_\Delta\left(\widetilde{\Delta}\right)\widetilde{\Delta}\right. \\ &\left.+\lambda\left[(1-\gamma)f_\Delta\left(\widetilde{\Delta}\right)[\mu(w_h - c_\Delta + c_\iota) + M] + \gamma f_\delta\left(\widetilde{\delta}\right)\left(1+\frac{\partial \sigma}{\partial \widetilde{\Delta}}\right)(w_\ell - c_\delta + c_\iota + M)\right]\right\}u'(c_\iota)\end{aligned} \tag{22}$$

$$(1-\mu)\frac{\partial \pounds}{\partial \mu} = 0 \text{ and } \frac{\partial \pounds}{\partial \mu} \geq 0 \tag{23}$$

where $\frac{\partial \pounds}{\partial \mu} \geq 0$ can be rewritten as

$$\begin{aligned}&\pi_\iota^\delta\frac{\partial \sigma}{\partial \mu} + \frac{\pi_\iota^\Delta}{\mu}(u(c_\Delta) - u(c_\iota)) \leq \\ &\lambda\left\{-(1-\gamma)\left(1-F_\Delta\left(\widetilde{\Delta}\right)\right)(w_h + c_\Delta + c_\iota) - \left(\pi_\iota^\delta + \frac{\pi_\iota^\Delta}{\mu}\right)\frac{\partial M}{\partial \mu} + \gamma f_\Delta(\widetilde{\delta})\frac{\partial \sigma}{\partial \mu}(w_\ell - c_\delta + c_\iota + M)\right\}\end{aligned} \tag{24}$$

where I have used $\frac{\partial \widetilde{\delta}}{\partial \mu} = g(1-\gamma)\left(1-F_\Delta\left(\widetilde{\Delta}\right)\right) > 0$ from (5) and (6).

Equations (20)-(22) and their interpretations are identical to (16)-(18) except that the monitoring costs and effects on the level of activity of people have to be considered. Now, monitoring costs are included in the budget constraint and $\mu F_\Delta\left(\widetilde{\Delta}\right)$ among the $1-\gamma$ able workers are inactive and get disability benefits, i.e. the proportion of total population π_ι^Δ.

Let us now turn to the first-order conditions with respect to μ, i.e. equations (23) and (24). In case of a corner solution $\mu = 1$, i.e. tagging is suboptimal and we have the inequality sign in (24). In case of an interior solution $\mu < 1$, it is optimal to use tagging, and equation (24) is binding. When tagging is optimal ($\mu < 1$), the optimal amount of monitoring should be such that the social value of the increase in stigma borne by disabled recipients combined with the social value of the supplementary resources from increasing total disability transfers to able (the left-hand side of (24)) just offset the valuation at the marginal cost of public funds. The latter consists of three elements. The first element is the loss of resources due to an increase in the number of able recipients. Actually, from the cut-off equation (3), an increase in μ does not modify $\widetilde{\Delta}$. Therefore, the share of the able population is not affected. Yet, for a given $\widetilde{\Delta}$, more able people receive disability benefits. This increases the cost of a change in monitoring. The second element is the marginal cost of monitoring: there is a negative effect on the total amount of per capita cost of monitoring as a result of the change in monitoring (μ). The last element is stigmatization which leads to more disabled people who prefer to work: $\frac{\partial \widetilde{\delta}}{\partial \mu} = g(1-\gamma)\left(1-F_\Delta\left(\widetilde{\Delta}\right)\right) > 0$. This decreases public expenditures. The net effect on public expenditures is then ambiguous when μ is modified. When the marginal cost of monitoring is not huge, monitoring is always optimal (i.e. $\mu < 1$) because it reduces the number of undeserving recipients and thereby reduces stigmatization.

Proposition 6 *The ranking of consumption levels is identical with and without tagging:* $c_\Delta \geqslant c_\delta > c_\iota$

As in the model without tagging, financial incentives are used for having disabled people entering the labor force, which pushes c_δ strictly below c_ι at the optimum. From (6), this also means that the disutility when working for marginal disabled, characterized by $\widetilde{\delta}$, is larger than the stigma disutility suffered by inactive disabled people.

The result $c_\delta > c_\iota$ contrasts with the traditional optimal ranking, i.e. $c_\iota > c_\delta$ (e.g., Parsons, 1996 and Salanié, 2002). In standard tagging models, tagged disabled people get a larger consumption than untagged ones. Then, since some of the needy get higher transfers, equity is improved. At the same time, tagging also improves efficiency by circumventing the incentive constraints that normally limit the extent of redistribution. The second effect still prevails in my model, but the first effect is offset by a new efficiency effect. Giving financial incentives to work up to the point that c_ι becomes strictly larger than c_δ directly improves efficiency and indirectly increases equity in my model. In standard models, since disabled are by assumption always inactive, no efficiency effect will push the consumption of untagged disabled above the one of tagged disabled.

Towards a characterization of conditions when tagging is optimal

From inequality (24), it is obvious that if $|\partial M/\partial\mu|$ is very high, the right-hand side of this inequality can become strictly higher than the left-hand side and therefore, from (23), $\mu = 1$ prevails at the optimum. No monitoring is optimal, and whoever does not work gets c_ι. A simple negative income tax system then prevails, and, hence, results of Section 3.1 apply. However, when $|\partial M/\partial\mu|$ is not huge, monitoring is always optimal because it reduces the number of ineligible recipients. Section 5 provides illustrative examples to check the empirical relevance of the level of monitoring cost beyond which tagging starts being suboptimal.

Proposition 7 *With tagging, properties highlighted with the* Δ*-excluded criterion are also valid under a utilitarian criterion*

As in the case without tagging (Proposition 5), even if the qualitative results are identical under both normative criteria, Section 5 shows how the quantitative properties of the outcomes under both criteria are distinct.

5 An illustration

Combining constraints (3), (6), (11) and the normative criterion (10), it is convenient to rewrite the problem as:

$$\begin{aligned} W_1\left(\widetilde{\delta}, \widetilde{\Delta}, \mu, c_\iota\right) \equiv \gamma \left[\widetilde{\delta} L(\widetilde{\delta}) - \sigma\left(\widetilde{\Delta}, \mu\right) - \int_0^{\widetilde{\delta}} \delta l(\delta) d\delta\right] + \\ + \left[(1-\gamma)\left((1-\mu) + H\left(\widetilde{\Delta}\right)\right)\right] \widetilde{\Delta} + u(c_\iota) \end{aligned} \tag{25}$$

with

$$c_\iota\left(\widetilde{\delta},\widetilde{\Delta},\mu,c_\delta,c_\Delta\right)=\frac{\pi_\delta w_\ell+\pi_\Delta w_h-\left(\pi_\iota^\delta+\frac{\pi_\iota^\Delta}{\mu}\right)M(\mu)+R}{\pi_\delta\frac{c_\delta}{c_\iota}+(\pi_\iota^\delta+\pi_\iota^\Delta)+\pi_\Delta\frac{c_\Delta}{c_\delta}}$$

This last equation can be rewritten as $\phi\left(\widetilde{\delta},\widetilde{\Delta},\mu,c_\delta,c_\Delta\right)=0$. Using a logarithmic utility function $u(.)\equiv\ln(.)$ and equations (3), (6), it is convenient to rewrite ϕ as

$$c_\iota\left(\widetilde{\delta},\widetilde{\Delta},\mu\right)=\frac{\pi_\delta w_\ell+\pi_\Delta w_h-\left(\pi_\iota^\delta+\frac{\pi_\iota^\Delta}{\mu}\right)M(\mu)+R}{\pi_\delta e^{\widetilde{\delta}-\sigma\left(\widetilde{\Delta},\mu\right)}+(\pi_\iota^\delta+\pi_\iota^\Delta)+\pi_\Delta e^{\widetilde{\Delta}}}\tag{26}$$

Substituting (26) into the objective function (25), the problem becomes a three dimensional problem $\left(\widetilde{\delta},\widetilde{\Delta},\mu\right)$. (In the same vein, the constrained maximization of utilitarian criterion (9) can easily become a three dimensional problem.)

The subjacent system of first-order conditions is highly nonlinear and too complex to be studied analytically. The system is still nonlinear when $\mu=1$ (i.e. tagging is suboptimal), see Appendix 3. Therefore, since multiple local optima may exist, for each vector of parameters (g,R,w_ℓ,w_h,γ) and for some specific distribution functions $F_\delta(\delta)$, $F_\Delta(\Delta)$ and monitoring function $M(\mu)$, I evaluate the objective function (25) for a wide range of values of the endogenous variables $\left(\widetilde{\delta},\widetilde{\Delta},\mu\right)$. Through this numerical method, I check whether the solution found is the global optimum.

5.1 Calibration

My aim here is merely to provide illustrative examples and I therefore only give results for specific δ and Δ distributions and some specific values of the distinct parameters. A fully fledged study and discussion of the controls is beyond the scope of this paper. I assume δ and Δ are distributed according to Gamma distributions.[8] Let r_δ, r_Δ be the parameters characterizing Gamma distributions respectively for δ and Δ. In 1998, almost 20% of people in the US report some level of disability (Stoddard et al., 1998). In 2001, almost 15% of the population from EU countries (Sweden excluded) of working age report severe and moderate disability (Eurostat, 2001). Following Benitez-Silva et al. (2004a) who show that the hypothesis that self-reported disability is an unbiased indicator that cannot be rejected, I fix $\gamma=0.15$. Here, with two levels of skills, assumptions about w_h and w_ℓ can hardly be based on actual wage distributions. As a benchmark, the base setting for parameters is

$$w_\ell=50,\ w_h=100,\ R=0,\ g=3,\ r_\delta=5 \text{ and } r_\Delta=1$$

[8] A positive random variable follows a Gamma law of parameter r if its density is given by:

$$f(x)=\frac{1}{\Gamma(r)}\exp(-x)x^{r-1}$$

The parameter r of a Gamma distribution is equal to the mean and the variance of the distribution. Gamma distribution takes a large variety of shapes by perturbing only its r parameter. I have checked that our conclusions are maintained with other continuous distributions defined on the infinite support $[0,+\infty)$.

A sensitivity analysis on g will be conducted later. I consider R strictly larger than $-[(1-\gamma)w_h + \gamma w_\ell] = -92.5$ otherwise the budget constraint (11) is violated.

The per capita cost of monitoring is

$$M(\mu) = a(1/\mu - 1) \tag{27}$$

with $a > 0$. This monitoring technology satisfies the properties described in Section 2 and is tractable since it only depends on one parameter, a. Empirical evidence show a large bureaucracy and costs involved in making disability determinations in the U.S. The average cost of running Social Security Administration bureaucracy, which determines eligibility for disability benefits under the Disability Insurance, is about \$2000 per application in the U.S. (Benitez-Silva et al., 2004b). The claims are typically reviewed every year. Hence, the monthly average cost of monitoring is \$166.7.

Up to now, the two monetary values fixed in the model are $w_\ell = 50$ and $w_h = 100$. It is difficult to calibrate the per capita cost of monitoring relative only to two levels of wage. In the U.S., the average monthly disability benefit is \$786, i.e. 4.7 times the per capita monitoring cost. In the 1990s, the average labor earnings of disabled people who worked was slightly higher than the monthly disability benefit but the variance is large (Benitez-Silva et al., 2004b). I consider M as 0.15 to 0.3 times the labor earnings of disabled workers (w_ℓ) to get a range of empirically relevant parameters. Benitez-Silva et al. (2004b) estimate that approximately 20% of applicants who are ultimately awarded benefits are not disabled. Substituting $\mu = 20\%$ and $M \in [7.5; 15]$ into (27), I get $a \in [1.8; 3.8]$ as a large interval of plausible values for a. I fix the magnitude of the per capita cost of monitoring, a, to 2 when it needs to be fixed.

When tagging is suboptimal

My simulations give the threshold values of a, the parameter of the per capita monitoring cost in (27) beyond which tagging is suboptimal (i.e. $\mu = 1$) as expected in Section 4. With the Δ-excluded criterion (10), tagging is suboptimal when $a \geq 73$. With the utilitarian criterion (9), tagging is suboptimal when $a \geq 50.3$. Under both criteria, the threshold value beyond which tagging is suboptimal is large relative to labor earnings in low-productivity jobs ($w_\ell = 50$) or relative to (per capita) governmental exogenous resources ($R = 0$). This threshold also seems unrealisticly high compared to the interval of empirically plausible values, $1.8 \leq a \leq 3.8$, I previously proposed.

Another situation where tagging is suboptimal which cannot be grasped by the first-order conditions analysis, but through simulations is the following. Under the utilitarian criterion (9), when the exogenous resources R become very high (and larger than a and w_h according to all my simulations), tagging becomes suboptimal ($\mu = 1$). With my previous calibrations, tagging becomes suboptimal when $R \geq 130.96$ under the utilitarian criterion, as shown in Figure 1. This numerical result is intuitive. Under the utilitarian criterion, since the disutility terms Δ reduces the social welfare level, it is optimal that more and more able workers stop working when R increases. For $R \geq 130.96$, tagging stops being used and no more able people with $\Delta > \widetilde{\Delta}$ work. The proportion of able workers, π_Δ, then sharply shrinks. At $R = 130.96$, there is a discontinuity in the probability of type II errors μ which jumps up to 1. The proportion of able workers then has also a discontinuity at $R = 130.96$ (see Figure 1).

Under the criterion (10) which does not compensate for distaste for work, my simulations do not report a threshold R beyond which tagging is suboptimal, given the previously chosen parameters. Intuitively, able people who stop working reduce efficiency without improving equity under Δ-excluded criterion (10). Therefore, under this criterion, the proportion of able people who work, π_Δ, is stable (see Figure 1) with R. Financial incentives and tagging both are used to maintained π_Δ high and stable.

Comparison of the optima under the Δ-excluded SWF and the utilitarian SWF

The Δ-excluded criterion always allows to reach a higher welfare level than the utilitarian criterion and a lower stigma level. According to simulations, any Δ-excluded optimum always gives incentives to or enforce more able people to work (the probability of type II errors is lower) than the utilitarian optimum.

The results of simulations do not allow to give general rankings of the optimal c_i ($i = \delta, \iota, \Delta$) under the utilitarian SWF compared to the same consumption bundle under the Δ-excluded criterion. For example, in Figure 2, when $a < 72.2$, the optimal level of c_δ under the utilitarian criterion is below the optimal level of c_δ under the Δ-excluded criterion. When $a \geq 72.2$, this ranking is reversed.

Sensitivity analysis

The Δ-excluded and utilitarian social welfare levels are continuous and decreasing in the parameter of the per capita cost of monitoring (a) and increasing in the exogenous resources (R). Increasing the cost parameter a in the range where tagging is suboptimal, i.e. where the monitoring is not used (i.e., $a \geq 50.3$ under the utilitarian criterion and $a \geq 73$ under the Δ-excluded criterion) has no more impact on the optimal variables, see Figure 2. Stigma is not monotonous neither with a nor with R. The probability of type II error (μ) continuously increases with the cost parameter a (up to $\mu = 1$). Under Δ-excluded criterion (10), consumption bundles have discontinuities at $a = 73$, i.e. when tagging becomes suboptimal (see Figure 2). Under utilitarian criterion (9), consumption bundles are continuous with a.

When the exogenous resources increase, we already know that the proportion of able workers never increases. And the proportion of disabled workers, π_δ, decreases under both criteria. When $R > 120$, π_δ decreases below 0.001 under both criteria.

When the marginal disutility of stigma g increases, the welfare levels under both criteria continuously decrease. The effect of g on the optimum stigma level $\sigma(.)$ level is always positive for small g and may become negative for larger values. Monitoring is used more intensively, and therefore type II errors decrease with g. With my calibrations, under the utilitarian criterion, as long as $g < 14.7$, inequality (8) is satisfied hence $\partial\widetilde{\delta}/\partial c_\iota < 0$ is guaranteed. Under the Δ-excluded criterion, $g < 15.2$ guarantees $\partial\widetilde{\delta}/\partial c_\iota < 0$.

Finally, Appendix 4 studies how results are affected when the δ or Δ disutility distributions are right-bounded.

6 Conclusion

Since the seminal paper of Akerlof (1978), the tagging literature shows that tagged disabled people should get a larger consumption level than untagged disabled people as long as the administrative and (net) efficiency costs do not offset the advantage of tagging in terms of equity.

My paper challenges these results. I have introduced participation decisions for both able and disabled people in this framework. Individual disutilities of work, either due to disability or distaste for work, are heterogenous among people and private characteristics. Levels of productivity are also unobservable by the tax authority. According to their disutility of work due to disability or distaste for work, some able and disabled people do not participate in the labor force. However, there is a social norm against living off other people when one is able and to deserve transfers when one is disabled. Moreover, the taxpayers and the government do not perfectly screen between disabled and able recipients of transfers. Therefore, the higher the number (or proportion) of able inactive people, the higher the social resentment against all the inactive people. Hence disabled people who receive transfers have a loss of utility due to stigma. Stigma increases with the number (or proportion) of non-disabled recipients.

Tagging transfers according to disability characteristics enables us to reduce this number of frauders, and therefore improves equity by reducing stigma. Considering endogenous stigma then plays in favor of tagging. Tagging is optimal as long as its monitoring costs do not offset the gains in terms of incentives and of reduction of stigma. In this context, tagged disabled people should get a lower consumption level than untagged disabled people, which is in contrast to standard results.

There are two main questions pertaining to the optimal consumption profile and stigma which I have not addressed and yet seem worthy of attention. The first focuses on outcomes under alternative SWF. Rather than using a utilitarian criterion or the criterion which does not compensate for distaste for work, a future analysis could study a SWF which is a weighted sum of individual utilities where the weights are distinct from the proportions of population. This should not affect the main results. However, some assumptions on the weights may be necessary to be able to rank consumption bundles. The optimum under a maxi-min criterion (i.e. a criterion which maximizes the well-being of the least-well off who are the tagged disabled in the model) could also be presented. However, the first-order conditions' analysis under maxi-min does not allow us to unambiguously rank the consumption bundles for tagged and untagged disabled agents. Simulations would then be required.

The second question concerns the utility form of disabled applicants who respond to less favorable treatment by other members of society. When a disabled individual works, he shows that he is not a cheater. Beside stigma suffered by disabled recipients, some reward could then be introduced in the disabled worker's utility function. Moreover, if stigma hurts more cheaters than disabled people, stigma could also serve the useful role of reducing the number of undeserving claimants. Defining stigma as such a policy instrument can suggest an interesting way to pursue this line of analysis one step further.

Finally, my modelling of stigma contrasts with the argument that means-testing and tagging imply more stigma than a more universal and unconditional transfer system, e.g. a basic income which does not depend upon performing any labor services or satisfying other conditions (Van Parijs, 2000). This argument, however, requires a distinct definition for stigma: the psychological costs due to the demeaning and intrusive procedures about benefits reserved for the needy, the destitute, those identified as unable to fend for themselves (Van Parijs, 2000). Jacquet and Van der linden (2006) show that tagging is suboptimal, under fairly mild conditions, when this alternative definition of stigma is considered.

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Appendix 1: Proofs of Lemmata and Propositions

Proof of Proposition 1

I proceed by contradiction. Suppose $c_\Delta < c_\delta$. All able individuals who work choose to produce w_ℓ units and receive net income c_δ. From (3) and (4), nobody get c_Δ as consumption bundle. Then, keeping c_δ fixed, we can assume $dc_\Delta > 0$ such that $c_\Delta + dc_\Delta = c_\delta$. Now able people who work produce w_h units and get c_Δ as consumption bundle. Increasing the level of c_Δ up to c_δ does not require any additional consumption since $c_\Delta + dc_\Delta - c_\delta = 0$ and since $\widetilde{\Delta}$ and the number of able people who work is unchanged. The number of able people who apply for and take up benefits is then also unchanged. Hence from (2), $\widetilde{\delta}$ and the number of disabled taking up assistance do not change as well. Yet, all able workers now choose skilled jobs and earn $w_h (> w_\ell)$. Since the cost in terms of supplementary consumption is zero and the difference $w_h - w_\ell$ is strictly positive, a net receipt appears: $w_h - w_\ell > 0$. The fiscal pie increases and more redistribution can occur. This will indubitably increase welfare. Therefore, it cannot be optimal for the government to let $c_\delta > c_\Delta$, and, thus, consumption when producing more units must be larger: $c_\Delta \geqslant c_\delta$.

Proof of Proposition 3

As $\forall \delta : f_\delta(\delta) > 0$, all disabled people work means $\widetilde{\delta} \to \infty$ at the optimum. Since consumption levels are finite, from (6), $\widetilde{\delta}$ cannot tend to ∞. The same argument applies for showing that some able people mimic disabled inactive workers at the optimum.

If no-one works, it is optimal for everyone to have the same consumption : $c_\iota = c_\Delta = c_\delta = R$. This allocation will not be optimal if those with the least handicap, δ (resp. the least disutility of work, Δ) were to choose to work for the additional consumption equal to their marginal product. It will be the case because: $u(R + w_\ell) > u(R)$ (resp. $u(R + w_h) > u(R)$). This implies that $\widetilde{\delta} > 0$ (resp. $\widetilde{\Delta} > 0$) at the optimum.

From (3) and $\widetilde{\Delta} > 0$, we know:

$$c_\Delta > c_\iota$$

Some of the able (those characterized by an Δ lower than $\widetilde{\Delta}$) will decide to work (with productivity w_h) to obtain a higher consumption level.

Proof of Lemma 1

The proof is straightforward by dividing (16), (17) and (18) by $u'(c_\Delta)$, $u'(c_\delta)$ and $u'(c_\iota)$ respectively, and adding these equations.

Proof of Proposition 4

From Lemma 1 and Propositions 3 that induces $0 < \pi_j < 1$ $(j = a, \ell, d)$, we know that two rankings can prevail at the optimum: either

$$\frac{1}{u'(c_\Delta)} \geqslant \frac{1}{u'(c_\iota)} > \frac{1}{u'(c_\delta)} \Leftrightarrow c_\Delta \geqslant c_\delta > c_\iota \tag{28}$$

or

$$\frac{1}{u'(c_\Delta)} > \frac{1}{u'(c_\delta)} \geqslant \frac{1}{u'(c_\iota)} \Leftrightarrow c_\Delta > c_\iota \geqslant c_\delta \tag{29}$$

In both cases, (28) and (29), $u'(c_\Delta) < \lambda$. Moreover, if (28) prevails, we have: $u'(c_\iota) > \lambda$ and if (29) is correct then: $u'(c_\iota) > \lambda$. But the latter cannot prevail at the optimum. If the first-order condition with respect to c_δ (17) is considered, because of $u'(c_\delta) > \lambda$, the left-hand side would be positive and it would require that $w_\ell - c_\delta + c_\iota < 0 \Leftrightarrow c_\delta - c_\iota > w_\ell > 0$. That contradicts $c_\iota \geqslant c_\delta$.

I show now that the sign of $w_\ell - c_\delta$ is ambiguous. The budget constraint (11) where $\mu = 1$ can be rewritten as:

$$w_\ell - c_\delta = \left(\pi_\iota^\delta + \pi_\iota^\Delta\right) w_\ell + \left(\pi_\iota^\delta + \pi_\iota^\Delta\right)(c_\iota - c_\delta) + \pi_\Delta(w_\ell - w_h) + \pi_\Delta(c_\Delta - c_\delta) - R \tag{30}$$

In the right-hand side, two terms are negative: $\pi_\Delta(w_\ell - w_h)$ and $\left(\pi_\iota^\delta + \pi_\iota^\Delta\right)(c_\iota - c_\delta)$ (from Proposition 4) and the other terms are positive ($c_\Delta - c_\delta \geq 0$ from Lemma 1) except $-R$ which can take both signs. Hence, the sign of $w_\ell - c_\delta$ is ambiguous. The gross income of untagged disabled can be increased (in case of a transfer: $w_\ell - c_\delta < 0$) or decreased (in case of a tax: $w_\ell - c_\delta > 0$) by the optimal tax-transfer system.

Proof of Proposition 5

When using a utilitarian criterion, the unique modifications in the first-order conditions (16)-(18) in comparison with the ones obtained with the Δ-excluded SWF (10) concerns the ones with respect to c_Δ and c_δ. The terms $-(1-\gamma)f_\Delta(\widetilde{\Delta})\widetilde{\Delta}$ and $+(1-\gamma)f_\Delta(\widetilde{\Delta})\widetilde{\Delta}$ disappear from (16) and (18). Equations (16)-(18) become:

$$\begin{aligned}\pi_\Delta\left[u'(c_\Delta) - \lambda\right] = &\Bigg\{\pi_\iota^\delta \frac{\partial\sigma\left(\pi_\iota^\Delta\left(\widetilde{\Delta}\right)\right)}{\partial\widetilde{\Delta}} \\ &+\lambda\left[-(1-\gamma)f_\Delta(\widetilde{\Delta})(w_h - c_\Delta + c_\iota) - \gamma f_\delta(\widetilde{\delta})\frac{\partial\sigma\left(\pi_\iota^\Delta\left(\widetilde{\Delta}\right)\right)}{\partial\widetilde{\Delta}}(w_\ell - c_\delta + c_\iota)\right]\Bigg\} u'(c_\Delta)\end{aligned}$$

$$\pi_\delta\left[u'(c_\delta) - \lambda\right] = -\lambda\gamma f_\delta\left(\widetilde{\delta}\right)(w_\ell - c_\delta + c_\iota)u'(c_\delta)$$

$$\begin{aligned}\pi_\iota\left[u'(c_\iota) - \lambda\right] = &\Bigg\{-\pi_\iota^\delta\frac{\partial\sigma}{\partial\widetilde{\Delta}} \\ &+\lambda\left[(1-\gamma)f_\Delta\left(\widetilde{\Delta}\right)(w_h - c_\Delta + c_\iota) + \gamma f_\delta\left(\widetilde{\delta}\right)(1 + \frac{\partial\sigma(.)}{\partial\widetilde{\Delta}})(w_\ell - c_\delta + c_\iota)\right]\Bigg\} u'(c_\iota)\end{aligned}$$

Therefore, dividing these equations by $u'(c_\Delta)$, $u'(c_\delta)$ and $u'(c_\iota)$ respectively, and adding them, Lemma 1 is still valid. Therefore, Propositions 4 is still valid under the Δ-excluded criterion since its proof is straightforward from Lemma 1.

Proof of Proposition 6

First, Proposition 1 is valid whatever the objective function. Second, Equation (19) is again derived by dividing (21), (22) and (23) by $u'(c_\Delta)$, $u'(c_\delta)$ and $u'(c_\iota)$ respectively, and adding these equations. Therefore, since $\widetilde{\delta}, \widetilde{\Delta} > 0$, Proposition 6 can be shown exactly as Proposition 4. The proof is then not reproduced here.

Proof of Proposition 7

With a utilitarian objective function, the unique modification in the first-order conditions in comparison with the ones obtained with the criterion where Δ is simply excluded concerns the ones with respect to c_Δ and c_δ. The term $-(1-\gamma)\mu f_\Delta\left(\widetilde{\Delta}\right)\widetilde{\Delta}$ into (20) disappears. Similarly, the term $(1-\gamma)f_\Delta(\widetilde{\Delta})\mu\widetilde{\Delta}$ into (22) is cancelled. Therefore, dividing these first-order conditions by $u'(c_\Delta)$, $u'(c_\delta)$ and $u'(c_\iota)$ respectively, and adding them, Lemma 1 is still valid. With the utilitarian criterion, the proof of Proposition 5 can then be replicated here.

Appendix 2. When stigma depends on the proportion of cheaters rather than on its absolute number

In the model without tagging (that is $\mu = 1$), consider stigma as a function of the proportion of undeserving recipients rather than their number:

$$S\left(\widetilde{\Delta}, \widetilde{\delta}\right) = \frac{g(1-\gamma)\left(1 - F_\Delta\left(\widetilde{\Delta}\right)\right)}{(1-\gamma)\left(1 - F_\Delta\left(\widetilde{\Delta}\right)\right) + \gamma\left(1 - F_\delta\left(\widetilde{\delta}\right)\right)} \tag{31}$$

From (3) and (6) where equation (31) is substituted into the latter and using the implicit function theorem, I have:

$$\frac{\partial\widetilde{\delta}}{\partial c_\iota} = \frac{-u'(c_\iota)\left(1 + \partial S/\partial\widetilde{\Delta}\right)}{\left(1 - \partial S/\partial\widetilde{\delta}\right)} \tag{32}$$

where

$$\partial S/\partial\widetilde{\Delta} = -\left[g(1-\gamma)\gamma\left(1-F_\delta\left(\widetilde{\delta}\right)\right)f_\Delta\left(\widetilde{\Delta}\right)\right] / \left[(1-\gamma)\left(1-F_\Delta\left(\widetilde{\Delta}\right)\right) + \gamma\left(1-F_\delta\left(\widetilde{\delta}\right)\right)\right]^2 < 0$$

and

$$\partial S/\partial\widetilde{\delta} = \left[g(1-\gamma)\gamma\left(1 - F_\delta\left(\widetilde{\delta}\right)\right)f_\delta\left(\widetilde{\delta}\right)\right] / \left[(1-\gamma)\left(1 - F_\delta\left(\widetilde{\delta}\right)\right) + \gamma\left(1 - F_\delta\left(\widetilde{\delta}\right)\right)\right]^2 > 0$$

If one wants to guarantee that $\partial\widetilde{\delta}/\partial c_\iota < 0$, from (32), one needs: $(1 + \partial S/\partial\widetilde{\Delta})(1 - \partial S/\partial\widetilde{\delta})^{-1} > 0$, i.e.: either

$$g < C\left(\widetilde{\Delta}, \widetilde{\delta}\right)\left[f_\Delta\left(\widetilde{\Delta}\right)\left(1 - F_\delta\left(\widetilde{\delta}\right)\right)\right]^{-1} \text{ and } g < C\left(\widetilde{\Delta}, \widetilde{\delta}\right)\left[f_\delta\left(\widetilde{\delta}\right)\left(1 - F_\delta\left(\widetilde{\delta}\right)\right)\right]^{-1}$$

or

$$g > C\left(\widetilde{\Delta},\widetilde{\delta}\right)\left[f_{\Delta}\left(\widetilde{\Delta}\right)\left(1-F_{\delta}\left(\widetilde{\delta}\right)\right)\right]^{-1} \text{ and } g > C\left(\widetilde{\Delta},\widetilde{\delta}\right)\left[f_{\delta}\left(\widetilde{\delta}\right)\left(1-F_{\delta}\left(\widetilde{\delta}\right)\right)\right]^{-1}$$

where $C\left(\widetilde{\Delta},\widetilde{\delta}\right)=\left[(1-\gamma)\left(1-F_{\Delta}\left(\widetilde{\Delta}\right)\right)+\gamma\left(1-F_{\delta}\left(\widetilde{\delta}\right)\right)\right]^{2}[(1-\gamma)\gamma]^{-1}$.

The first-order conditions from the constrained maximization of Δ-excluded criterion (10), where $\mu=1$, and where stigma is defined by (31) are:

$$\pi_{\Delta}\left[u'(c_{\Delta})-\lambda\right]=\left\{\pi_{\iota}^{\delta}\left(\frac{\partial S}{\partial\widetilde{\Delta}}+\frac{\partial S}{\partial\widetilde{\delta}}\frac{\partial S/\partial\widetilde{\Delta}}{1-\partial S/\partial\widetilde{\delta}}\right)-(1-\gamma)F_{\Delta}\left(\widetilde{\Delta}\right)\widetilde{\Delta}\right.$$
$$\left.+\lambda\left[-(1-\gamma)f_{\Delta}\left(\widetilde{\Delta}\right)(w_h-c_{\Delta}+c_{\iota})-\gamma f_{\delta}\left(\widetilde{\delta}\right)\frac{\partial S/\partial\widetilde{\Delta}}{1-\partial S/\partial\widetilde{\delta}}(w_{\ell}-c_{\delta}+c_{\iota})\right]\right\}u'(c_{\Delta})$$

$$\pi_{\delta}\left[u'(c_{\delta})-\lambda\right]=\left[\pi_{\iota}^{\delta}\frac{\partial S/\partial\widetilde{\delta}}{1-\partial S/\partial\widetilde{\delta}}-\lambda\gamma f_{\delta}\left(\widetilde{\delta}\right)\frac{1}{1-\partial S/\partial\widetilde{\delta}}(w_{\ell}-c_{\delta}+c_{\iota})\right]u'(c_{\delta})$$

$$\pi_{\iota}\left[u'(c_{\iota})-\lambda\right]=\left\{-\pi_{\iota}^{\delta}\left(\frac{\partial S}{\partial\widetilde{\Delta}}+\frac{\partial S}{\partial\widetilde{\delta}}\frac{1+\partial S/\partial\widetilde{\Delta}}{1-\partial S/\partial\widetilde{\delta}}\right)+(1-\gamma)f_{\Delta}\left(\widetilde{\Delta}\right)\widetilde{\Delta}\right.$$
$$\left.+\lambda\left[(1-\gamma)f_{\Delta}\left(\widetilde{\Delta}\right)(w_h-c_{\Delta}+c_{\iota})+\gamma f_{\delta}\left(\widetilde{\delta}\right)\frac{1+\partial S/\partial\widetilde{\Delta}}{1-\partial S/\partial\widetilde{\delta}}(w_{\ell}-c_{\delta}+c_{\iota})\right]\right\}u'(c_{\iota})$$

Divide these three equations respectively by $u'(c_{\Delta})$, $u'(c_{\delta})$ and $u'(c_{\iota})$ and sum them, I find back equation (19). Therefore, Lemma (1) and Proposition (4) are maintained when stigma is defined as a function of the proportion of cheaters.

I have also checked that these lemma and propositions are still valid with a utilitarian criterion. Finally, a similar exercise can be maintained when tagging is introduced: the previous results of Section 4 are still valid.

Appendix 3. Non-linear first-order conditions from the maximization of (25)

Let us present the first-order conditions from the maximization of (25) where (26) is substituted and where $\mu=1$, that is without tagging. The problem then becomes a maximization with respect to $\left(\widetilde{\delta},\widetilde{\Delta}\right)$. Let $W_2\left(\widetilde{\delta},\widetilde{\Delta}\right)$ denotes (25) after substitution of

(26). The optimum $\left(\widetilde{\delta},\widetilde{\Delta}\right)$ verifies

$$\partial W_2\left(\widetilde{\delta},\widetilde{\Delta}\right)/\partial\widetilde{\delta}=\gamma L\left(\widetilde{\delta}\right)+\gamma\left[A\left(\widetilde{\delta},\widetilde{\Delta}\right)B\left(\widetilde{\delta},\widetilde{\Delta}\right)\right]^{-1}$$
$$\left[f_\delta\left(\widetilde{\delta}\right)w_\ell A\left(\widetilde{\delta},\widetilde{\Delta}\right)-B\left(\widetilde{\delta},\widetilde{\Delta}\right)\left(f_\delta\left(\widetilde{\delta}\right)\left(e^{\widetilde{\delta}-\sigma(\widetilde{\Delta})}-1\right)+F_\delta\left(\widetilde{\delta}\right)e^{\widetilde{\delta}-\sigma(\widetilde{\Delta})}\right)\right]=0$$

and

$$\partial W_2\left(\widetilde{\delta},\widetilde{\Delta}\right)/\partial\widetilde{\Delta}=(1-\gamma)\left(f_\Delta\left(\widetilde{\Delta}\right)\left(\gamma g+\widetilde{\Delta}\right)+F_\Delta\left(\widetilde{\Delta}\right)\right)\left[A\left(\widetilde{\delta},\widetilde{\Delta}\right)B\left(\widetilde{\delta},\widetilde{\Delta}\right)\right]^{-1}$$
$$(1-\gamma)\left[f_\Delta\left(\widetilde{\Delta}\right)A\left(\widetilde{\delta},\widetilde{\Delta}\right)-B\left(\widetilde{\delta},\widetilde{\Delta}\right)f_\Delta\left(\widetilde{\Delta}\right)\right.$$
$$\left.\left(\gamma F_\delta\left(\widetilde{\delta}\right)e^{\widetilde{\delta}-\sigma(\widetilde{\Delta})}g-1\right)+e^{\widetilde{\Delta}}\left(f_\Delta\left(\widetilde{\Delta}\right)+F_\Delta\left(\widetilde{\Delta}\right)\right)\right]=0$$

where

$$A\left(\widetilde{\delta},\widetilde{\Delta}\right)=\gamma\left[\left(1-F_\delta\left(\widetilde{\delta}\right)\right)+F_\delta\left(\widetilde{\delta}\right)e^{\widetilde{\delta}-\sigma(\widetilde{\Delta})}\right]+(1-\gamma)\left[\left(1-F_\delta\left(\widetilde{\delta}\right)\right)+F_\Delta\left(\widetilde{\Delta}\right)e^{\widetilde{\Delta}}\right]>0$$

and

$$B\left(\widetilde{\delta},\widetilde{\Delta}\right)=\gamma F_\delta\left(\widetilde{\delta}\right)w_\ell+(1-\gamma)F_\Delta\left(\widetilde{\Delta}\right)+R>0$$

The above system defines an implicit relationship between the optimal values of $\widetilde{\delta},\widetilde{\Delta}$ and the various parameters of the model (e.g. g, recall $\sigma\left(\widetilde{\Delta}\right)=g\pi_\iota^\Delta$, and R). This relationship is highly nonlinear.

Appendix 4. Right-bounded distributions of disutility

Even if it seems empirically plausible to assume that some disabled people are completely unable to work, $\overline{\delta}\to\infty$ and that some of the able are very prone to be voluntarily inactive, $\overline{\Delta}\to\infty$, it is interesting to check how my results are affected when the distributions of δ and Δ are right-bounded.

Assume now $\overline{\delta}<+\infty$. Intuitively, when the disabilities are not too high, it may be optimal to give financial incentives such that all the disabled people work. More precisely, the optimum may be characterized by $\widetilde{\delta}=\overline{\delta}$. In this case, a simple negative income tax system allows one to perfectly screen between disabled and able people. One knows that all non-workers are lazy able individuals and that one can costlessly instruct them to work. The constraint (3) does then not have to be satisfied. Such an optimum is characterized by the first-best ranking of consumption: $c_\Delta=c_\delta$. Unreported simulations show that with a right-truncated disabilities distribution, starting from a situation where $\widetilde{\delta}<\overline{\delta}$ is optimal, $\widetilde{\delta}=\overline{\delta}$ becomes optimal if:

(i) the upper bound of the distribution of pains due to disability ($\overline{\delta}$) decreases

(ii) the parameter of the per capita cost of monitoring (a) increases

(iii) the exogenous resources (R) decrease

(iv) the marginal disutility of stigma (g) increases.

Unreported simulations show that with a right-truncated distribution of distastes for work, starting from a situation where $\widetilde{\Delta} < \overline{\Delta}$ is optimal, $\widetilde{\Delta} = \overline{\Delta}$ becomes optimal under the same assumptions (i) to (iv). It is then optimal not to use tagging and only financial incentives through the negative income tax system to get an optimum where all able people work, that is $\widetilde{\Delta} = \overline{\Delta}$. These results are valid under the utilitarian criterion (9) and the Δ-excluded criterion (10).

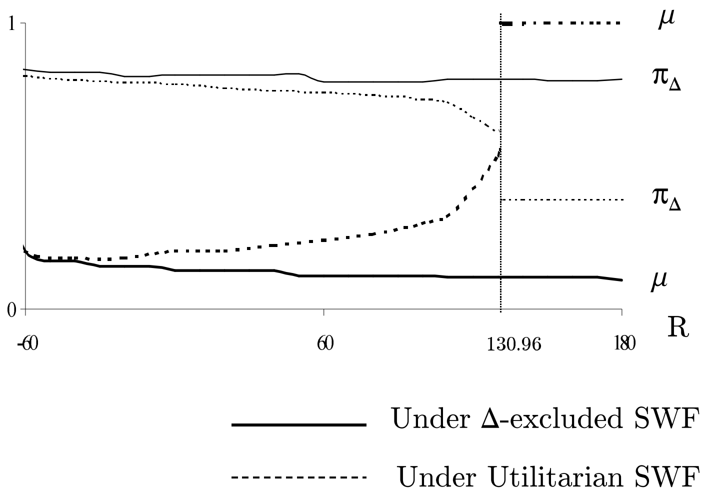

Figure 1: Under the utilitarian SWF, the probability of type II error, μ, increases and the proportion of able workers, π_Δ, decreases, with exogenous resources, R. Under the Δ-excluded criterion, μ decreases with R and π_Δ is maintained stable. Under the utilitarian SWF, tagging is suboptimal ($\mu = 1$) when $R \geq 130.96$.

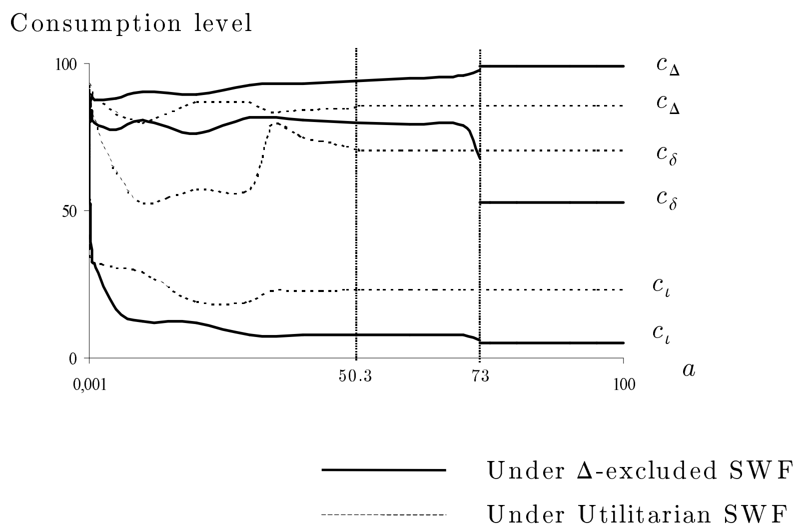

Figure 2: Consumption levels under the utilitarian and Δ-excluded criteria as functions of a, the magnitude of the per capita cost of monitoring. Tagging is suboptimal and consumption bundles constant when $a \geq 73$ under the Δ-excluded criterion, and when $a \geq 50.3$ under the utilitarian criterion.