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Platteau, Jean-Philippe; Bourguignon, François

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Optimal Management of Transfers: an Odd Paradox

François Bourguignon* and Jean-Philippe Platteau†

Abstract

In this paper we consider transfers towards needy people but, unlike Atkinson, we assume that there exists a serious preference misalignment between the transfer maker and the beneficiary. The former wants to reduce the resulting discrepancy through monitoring the use of the transfer and imposing sanctions if the discrepancy proves too large. This external discipline combines with the 'internal discipline' of the beneficiary, that is his/her willingness and ability to align with the transfer maker's objective. Besides the fact that costs of monitoring and sanctioning are explicitly taken into account, an original feature of our model is that the two types of discipline are made comparable: they can be summed up to obtain an aggregate discipline. We show that, paradoxically, an (exogenous) improvement of internal discipline may be over-compensated by a fall of external discipline. As a result, total discipline actually decreases and the discrepancy between the actual and the intended uses of the transfer increases instead of decreasing. This paradoxical outcome is obtained despite better preference alignment as cost savings are optimally implemented. Another consequence is that the relationship between internal and total disciplines may be non-monotonous.

JEL : I38, D02, D86, F35 Keywords: transfer, preference misalignment, incentives, aid

*Paris School of Economics

†University of Namur

1 Introduction

Anthony B. Atkinson's contribution to public economics through his own work, his founding of the Journal of Public Economics and its long held editorship of that journal has been monumental. Not only has he been among the few economists who provided a strongest impetus to that area of economics, but he was also among those who were able to maintain it at the core of the discipline at a time where the dominant trend was in favor of 'minimizing the State'. The present paper is in the straight Atkinsonian tradition of transfer and redistribution policies in public economics. However, it is cast in a slightly different framework, which he did not envisage so frequently. It deals with the role of intermediaries between a transfer-maker, be it a donor, a government or a NGO, and the intended beneficiaries of the transfer. Equivalently, one could say that it focuses on the general case where there is some misalignment between the preferences of the transfer-maker and those of the transfer-receivers about the use to be made of the transfer.

The issue that first inspired this paper is the intended transfer by the providers of Official DevelopmentAssistance, or aid, to poor people in recipient countries. Institutionally, this transfer must go through the ruling governments, which may use it in their own way. If Atkinson argued forcefully in various instances in favor of the Official Development Assistance, in particular as Proposition 15 of Atkinson (2015)[1], he comparatively devoted less reflection to the use made of it and the possible discrepancy between donors' and recipient governments' goal. Yet, the issueof the optimal way for the donors to 'discipline' these governments so that they will comply as much as possible with the donors' preferences about the use to be made of aid has become of considerable importance in the aid literature.[2] Interestingly enough, it turns out that this framework and the properties it leads to for the optimal management of transfers are of much wider application in public economics.

Consider an organisation, say a state agency or a philanthropic organization, which wants to make transfers to people or groups of people in need. The beneficiaries are able to carry out actions that do not match the transfer-maker's objective, typically by diverting the money (or the in-kind transfers). They hold private in-

[1]See also Atkinson (2005)

[2]See Bourguignon and Platteau (2014) or Bourguignon and Gunning (2016)

formation and there is therefore a serious problem of preference misalignment that the transfer-maker must mitigate. Towards that end, s/he uses a twin mechanism of monitoring and punishment conditional on fraud detection. S/he chooses the optimal levels of these two decision variables by explicitly taking into account the costs involved. An additional feature confers a specific dimension on our problem. The transfer-maker is sensitive to the extent to which s/he is able to increase the beneficiaries' wellbeing, as s/he perceives it, while the beneficiaries or the intermediary acting on their behalf have a limited capacity to self-control their drive to misuse the transfer or, in our own terminology, to exert internal discipline. This setup has some familiarity with a specific brand of public economics, known as non-welfarist welfare economics, which depicts the government as having an objective function different from that of individuals. In this approach, the outcomes of individual behaviour are evaluated using a preference function different from the one that generated the outcomes (Kanbur, Pirttilä, and Tuomala, 2006).

Our framework enables us to raise an interesting question that, to our knowledge, has been so far ignored by economists. How does the external discipline imposed by the transfer-maker combine with the internal discipline exerted by the beneficiaries? In particular, what is the effect of an exogenous improvement of internal discipline on the level of external discipline and ultimately on the outcome of the transfer as assessed by the transfer-maker? The question is far from trivial since the way external discipline, which is endogenous, responds to exogenous changes in internal discipline is crucial to determine how total discipline and the behavior of the transfer-receiver are modified .

Applications of the above framework easily come to mind. Just think of problems of development aid, the point of departure of the present paper. When a donor organization wants to channel development aid to poor people in developing countries, it rightly worries about the possibility that a significant portion of the funds provided are embezzled by local elites acting as intermediaries. In this instance, self-control by the beneficiaries most typically means their ability to limit the obnoxious actions of the intermediaries, that is, the quality of governance inside their polity. There is today an abundant literature attesting that such a worry is well-founded (see, for example, Olken, 2006; Easterly, 2007; Platteau, Somville, and

Wahhaj, 2014).

As another example, consider the problem of a government that wants to reduce poverty but knows at the same time that some poor people are likely to misuse the money transferred either because of their drive to buy alcoholic beverages or drugs, or because of their vulnerability to the influence of doubtful intermediaries (including criminal gangs and drug cartels). In the same vein, microfinance institutions such as the Grameen Bank in Bangladesh strive to ensure that credit given to poor people for investment purposes is not diverted to consumption needs that are not viewed as a priority by the lending organization. Close monitoring and punishment (exclusion from the credit scheme) are resorted to with a view to mitigating the problem created by the inability of the target customers to credibly commit to using the loans as prescribed (for evidence on the self-control problem in poor rural communities, see for instance Datta and Mullainathan, 2014; Baland, Mali, and Guirkinger, 2011).

Moral hazard problems associated with conditional cash transfer programmes are of a similar kind: the transfer is considered to be misused by the state if parents receive it while they have not fulfilled their promise to send their children to school, or if they exploit the opportunity of a transfer-in-kind by depriving the children freely fed at school of the evening meal they used to have at home (Jacoby, 2002). In the latter case, the money spared is put to uses that the parents, but not the state, prioritize. A last important illustration concerns social allowances, such as unemployment insurance or family allowances. Monitoring is required to check that the unemployed worker has applied enough job-search effort (Hopenhayn and Nicolini, 1997; Boone et al., 2007; Setty, 2015). The planner pays a monitoring cost and receives a signal that is correlated with the worker's job-search effort, which is private information. He uses that signal to improve the efficiency of the contract by conditioning future payments and the unemployment insurance contribution not only on the employment outcome, but also on the signal.

In all the foregoing examples, the question arises as to which intensity of monitoring and which intensity of punishment or penalty are optimal. Not surprisingly, such questions have received primary attention in the literature on crime. As expected, results hinge upon the assumptions made. For example, the classic Beckerian approach claims that social welfare is strictly increasing in the magnitude of the fine and extreme penalties are therefore socially optimal (Becker, 1974). By contrast, when enforcement of the penalty can be erroneous, or when there exists a difference in the objectives of the social planner and the implementing agency, which bears the cost of monitoring but retains a portion of the penalty revenue, non-maximal fines can be optimal (Chander and Wilde, 1992; Bose, 1995; Saha and Poole, 2000). In our own version, the same result is obtained because we reasonably assume that punishment always entails costs for the transfer-maker.

How substitutable are internal and external disciplines at equilibrium is the central issue addressed in this paper. We reach the following conclusion: the transfer-maker may be induced to *over-compensate* a change in the internal discipline of the transfer-receiver depending on the cost of the external discipline. In particular, an increase in internal discipline may lead, paradoxically, to a fall in total discipline with the effect that the outcome sought by the transfer-maker becomes less satisfactory. Whether this happens or not depends not only on the initial level of internal discipline, but most importantly on the shapes of the cost functions. More precisely, if the internal discipline is initially of low quality and if the cost function is moderately convex, two conditions that are by no means abnormally demanding, total discipline tends to fall when the internal discipline improves.

The implications of the uncovered paradox are hard to minimize. Compare two countries that distribute social subsidies to needy categories of people but the representative beneficiary in the first country is better disciplined internally than the representative beneficiary in the second country. For example, moral norms or peer pressures are more pervasive in the former case with the consequence that, other things being equal, the incidence of fraud is smaller. If the conditions of the paradox are satisfied, the providers of subsidies in the two countries adjust their external discipline in such a way that at equilibrium there will be more fraud in the country whose quality of internal governance is higher. Because the cost element is ignored, a simple comparison between the prevailing levels of fraud may therefore be misleading. When the marginal cost of external discipline is rising slowly, the transfer-maker's optimal policy may consist of reducing his disciplining effort so much that total discipline decreases. Clearly, cost saving should be taken into account before concluding that more fraud in a country is due to less internal discipline.

The outline of the paper is as follows. In Section 2, the main assumptions behind the model are described while in Section 3, its building blocks are presented. In Section 4, we analyze the general case that obtains when the participation constraint of the transfer-receiver (or the intermediary) is not binding, leaving to Section 5 the simpler case where this constraint is binding. Section 6 concludes by stressing the implications of the basic mechanisms uncovered in the course of the analysis.

2 The setup of the model

In writing the model, we stick to a well-established tradition whereby problems of incentive alignment are analyzed within the Principal-Agent framework. We conceive of the Principal as a transfer-maker who is completely altruistic, and the Agent as the transfer-receiver or an intermediary between the transfer-makesr and the final beneficiaries. The latter can be viewed either as a unique recipient of the transfer or as a representative type of multiple transfer-receivers. Because we deliberately focus on the interaction between internal and external disciplines, which requires an elaborate treatment, we have reserved for another paper the task of analyzing the multiagent case in which one Principal and two heterogeneous agents are considered (see Bourguignon and Platteau, 2016).

Given the perspective that we adopt, a central question is how to represent the outcome variable which determines the transfer-maker's utility. We choose to measure this variable as the share of the transfer that reaches the beneficiaries targeted by the transfer-maker, or as the share that the beneficiaries, or an intermediary acting on their behalf, use according to the transfer-maker's prescriptions. The complement of this share is considered to be embezzled or diverted from the intended use. It is therefore a measure of the moral hazard risk borne by the transfer-maker, or of the fraud committed by the transfer-receiver. What its magnitude will be depends on a combination of internal and external disciplines. Internal discipline is given and measures the extent of good governance or self-control on the part of the transfer-receiver. External discipline is endogenous: it is influenced by the monitoring and punishment mechanism used by the transfer-maker to mitigate the moral hazard problem. The two types of disciplines are not independent since the optimal levels of monitoring and sanctions chosen by the transfer-maker obviously depend on the internal discipline of the transfer-receiver.

To resolve the issue that lies at the heart of this paper, the internal and external disciplines need to be made comparable, and total discipline must be defined as the aggregate of these two components. In the aid effectiveness literature, for example, external discipline is typically modeled as a mechanism of conditional aid release and it is not possible to measure it by an index variable capturing its intensity (Svensson, 2000; Azam and Laffont, 2003).

A few additional considerations are needed before we turn to the presentation of the model. First, we assume that the beneficiaries, or the intermediaries who act on their behalf, have perfect knowledge of the fraud whereas the transfer-maker, although s/he is able to infer the extent of the fraud, may get unequivocal evidence of itonly with a positive probability. Second, the punishment meted out by the transfer-maker is conditional on the fraud being substantiated. We may think of punishment as the withdrawal of future benefits such as when the payment of unemployment insurance is made dependent upon the history of past performances in job search or when the disbursement of future aid tranches are conditional on the satisfactory use of previous tranches. Punishment is more directly imposed when, for example, the foreign bank accounts of dubious intermediaries are frozen or their foreign visas denied, or when beneficiaries suffer a social cost for being publicly exposed as dishonest people. Third, both monitoring and punishment involve costs for the transfer-maker who is confounded with the implementing agency or regulator. Note that in contract theories featuring monitoring and punishment, monitoring typically has a cost that determines monitoring precision or effectiveness, but punishment does not entail a cost for the punisher (see Eswaran and Kotwal, 1985; Otsuka et al. 1993). Fourth, we assume that the agent's utility from fraudulent behaviour decreases as internal discipline gets tighter, but also that the marginal loss of utility caused by such a tightening increases when the amount of fraud is larger.

Our final remark concerns evidence regarding the effectiveness of monitoring. A detailed empirical study based on a review of 1,426 World Bank projects completed between 1981 and 1991 highlights the potential contribution of monitoring to effectiveness of project aid (Kilby, 2000). This study concludes that (i) past supervision has a positive and perceptible impact on project performance; (ii) early supervision is much more effective than later supervision; and (iii) the impact of supervision is relatively homogenous across regions, sectors and macroeconomic conditions.[3] Using the same dataset, Chauvet et al. (2012) argue that not only a more precise supervision of projects increases the likelihood of project success, but the effect of higher monitoring precision is significantly more effective when interests between donor and recipient (as perceived by the donor) are more diverging.

As mentioned in the previous section, another possible application of our framework is optimal unemployment insurance when job-search effort is not perfectly observable. In the study of Boone et al. (2007), the authors find that introducing monitoring and sanctions represents a welfare improvement for reasonable estimates of monitoring costs. This conclusion holds both relative to a system featuring indefinite payments of benefits and a system with a time limit on unemployment benefit receipts. Moreover, a sensitivity analysis carried out by Setty (2015) shows that compared to optimal unemployment insurance, monitoring saves about 60 percent of the cost associated with moral hazard.

3 The building blocks

Our model is deliberately parsimonious because the issue that we tackle is complex, and we need to achieve interpretable results. In this section, we successively describe the objective function of the transfer-receiver, the probability function for fraud detection, the transfer-receiver's optimal behaviour given the disciplining parameters chosen by the transfer-maker, and the latter's maximization problem that yields the optimal disciplining policy. It must be stressed that the model covers both the cases where the transfer-receiver is the final beneficiary who does not share the goals of the transfer-maker, and where s/he is an intermediary between the transfer-maker and the beneficiaries with his/her own objective. [4] In general, we shall make no distinction between these two cases in what follows, referring simply to the transfer-receiver, also designated as the 'agent', without further detail.

[3] Endogeneity (supervision influences performance which in turn influences subsequent supervision allocation decisions) is overcome by relating lagged annual supervision to annual changes in interim implementation performance whereas effectiveness is based on the final result of the project.

[4] Yet, the model ignores possible strategic relationships between the intermediary and final beneficiaries.

3.1 Objective of the agent

For each unit of transfer or subsidy, the agent's problem is written:

$$\underset{y}{Max}\, V(y) = y - \beta y^2 - \gamma\pi(by) - g \tag{1}$$

where y is the share of the transfer misused by the transfer-receiver (that is, the extent of fraud[5], so that $y \in [0,1]$. The second term in (1) is the internal cost of the fraud for the agent or the intermediary, with β (>0) meant to represent the internal discipline. This parameter can be conceived as a tax borne by the agent. If the agent is viewed as an intermediary between the transfer-maker and intended beneficiaries , the cost of fraud may correspond to the sanctions imposed by the community of beneficiaries on the dishonest intermediary or, alternatively, to a self-inflicted cost, such as when the intermediary acts as a patron and makes voluntary gifts to clients to buy their compliance (Platteau, 2004; Platteau and Abraham, 2004). If the agent stands for the beneficiaries themselves, the internal cost of the transfer's misuse may be thought of as the measure of self-control that they exert upon themselves.

The relationship between this internal cost and the extent of the fraud, y, is assumed to be quadratic. It would be possible, although analytically more intricate, to only assume convexity. In any case, the point is to ensure that not only the agent's utility, V, in (1) decreases as β is raised, but also the marginal loss of utility caused by an increase in β is greater when the fraud is more important, that is $V_{y\beta} = \frac{\delta^2 V}{\delta\beta.\delta y} \leq 0$. As will soon become clear, the same property applies to externally imposed discipline.

The third term in (1) describes the external discipline imposed by the transfer-maker. We denote by $\pi(by)$ the probability that the fraud is detected in the sense of being sufficiently substantiated to be plainly evident for the transfer-maker, the transfer-receiver, and the public at large. The coefficient b in that probability represents the monitoring activity of the transfer-maker. The more intensive the monitoring, the more probable a given level of fraud wil be substantiated. Since γ is the punishment imposed when the fraud is detected, the product $\gamma\pi(by)$ is the expected

[5]An important case is when the transfer is given conditionally on some action by the transfer-receiver or the final beneficiary, e.g. a certain intensity of job search. In that case, y may be intepreted as the income equivalent of the transfer receiver not complying with the transfer-maker conditionality.

cost of the external discipline and $V(y)$ in (1) must be interpreted as the expected utility of the transfer-receiver. Note that the transfer-maker is actually able to infer the extent of the fraud since s/he sets the parameters of the external discipline and is supposed to observe β, which determines internal discipline. . However, to have legitimacy in carrying out punishment, the transfer-maker needs to justify his/her action on the basis of solid evidence verifiable by third parties.

An alternative, more conventional manner of describing the punishment problem consists of assuming that the transfer-maker observes y only with some noise: like the transfer-receiver and the wider public, s/he observes $y+u$, where u is a random term. The contract imposed by the transfer-maker then specifies that only if the *observed* fraud does not exceed a maximum tolerable level, M, will s/he refrain from fulfilling his/her punishment threat. The agent's problem would then write:

$$V(y) = y–\beta.y^2 - \gamma.Pr(u > M-y)\text{- g}$$

The function of monitoring can be conceived as reducing the variance of u, either by exerting greater surveillance over the agent's actions or by acquiring information on the real value of u, say by getting information on the impact of exogenous shocks that the agent can invoke to exculpate him/herself. If u is distributed as a normal variable $N(0,s)$, an amount λ of monitoring would transform $N(0,s)$ into $N(0,s/(1+\lambda)$ so that the probability of punishment would write:

$$Pr(u > M-y) = 1-F[(M-y)(1+\lambda)/s]$$

In order to avoid adding a decision variable, M, to the transfer-maker's problem, we adopt the specification (1) where b stands simultaneously for the roles of M and λ in the preceding expression. Moreover, choosing the form $\pi(by)$, with $\pi(0) = 0$, to represent that probability enables us to work with a simple specification that facilitates our analytical derivations.

Overall, it can be seen from the second and third terms in (1) that our choice of the agent's utility function has the advantage not only of expressing the two types of discipline in a meaningful and tractable manner but also to make them directlly comparable..[6]

The last component of the agent's utility function, g, is the cost of handling one unit of transfer, which is assumed to be constant (it is, therefore, independent of the amount of the fraud). Such a cost includes all the expenses or effort that the agent must incur in order to benefit from the transfer, including the cost of collecting information, paperwork, time spent in meeting and organizing, etc. If the transfer-maker is a donor agency and the agent is an intermediary, the cost g arises from the need to organize meetings with the donor, to write applications for aid funds, to receive foreign experts and host foreign missions, to submit follow-up reports, and the like.

3.2 Specifying the probability of fraud detection, $\pi(y)$

It will be assumed that the probability of fraud detection is an increasing and convex function of the share of the transfer diverted from the intended use. There are several justifications underlying the convexity assumption. First, as diversion increases, the transfer-maker observes that the outcome of the transfer is increasingly below expectation. Second, it is obviously more difficult to conceal malprac-

[6] The agent's utility function is admittedly unconventional not only because it allows for two distinct forms of punishment, internal and external, but also because the self-control or internal disciplining mechanism, instead of being captured by a positive term representing altruism, appears as a negative coefficient representing a tax (self-) imposed on the agent. In other words, we have refrained from writing the agent's utility in a way that would replace $-\beta y^2$ by $+\alpha v(1-y)$ where α is the altruism coefficient and $v(1-y)$ is increasing and concave. Foster and Rosenzweig (2002), for example, interpret the aid recipient's (government's) altruism as reflecting a "traditional aristocratic governance structure" in which the elites are compelled to attach a certain weight to the welfare of the community. In Azam and Laffont (2003), likewise, the level of internal discipline is described by a parameter in the utility function of the recipient government that represents its altruism with respect to the poor people, the very people donors want to help. The reason why we depart from this practice is that, in the altruistic case, it may well happen that the indirect utility of the intermediary increases with his/her degree of altruism. This leads to the paradox that a transfer-maker may be more severe with a more altruistic agent or an agent belonging to a better governed society, at least when the agent is on his/her participation constraint. This case can reasonably be dismissed for lack of realism (see Bourguignon et al., 2014).

tices when they are important and their consequences are therefore more visible than when they correspond to a minor theft or misuse. In particular, the number of sources of evidence about the fraud increases with its amount. If the transfer consists of development aid, the donor is thus told of elite people increasing luxury spending, of contractors being bribed, of aid-supported infrastructure being incomplete or of dismal quality, etc..[7] Increased disclosure of information arises not only from the greater difficulty of concealing large thefts but also from greater willingness of non-elite people to speak out when embezzlement exceeds acceptable levels. If the transfer consists of social allowances, egregious misuses are more easily whistle-blowed by neighbours and relations than minor frauds. Third, the case that the transfer-maker can make against fraudulent behaviour in front of the public opinion becomes increasingly easier as the fraud bears on larger amounts.

To make the analytics of the model tractable, we shall assume that the probability of detection is a quadratic function of the fraud:

$$\pi(by) = b^2 y^2$$

The obvious interest of that specification is to introduce a symmetry between external and internal disciplines, which very much facilitates the analysis. Of course, it is valid only for y being in the interval $[0,\, 1/b]$.A more rigorous specification accounting for the fact that $\pi()$ is a probability function would be:

$$\pi(by) = Inf\left(b^2 y^2, 1\right)$$

Yet, only the "interior" specification $y < 1/b$, where non-degenerate solutions are found, will be considered in what follows.

3.3 The agent's behaviour

The interior solution of the agent's program, (1), is given by $dV/dy = V_y = 1 - 2\beta y - b\gamma\pi'(by) = 0$. When $\pi = (by)^2$, this yields the optimal level of diversion,

[7] Note that the issue of the diversion of aid from its prime purpose arises more in the case of budget support than project aid where donor monitoring is easier, although still costly. On the way budget support and project aid may be combined in some optimal way to reduce the misalignment of goals between donors and recipient governments, see Legros and Sraieb (2017).

$\widetilde{y}(b,\gamma)$:

$$\widetilde{y}(b,\gamma) = \frac{1}{2(\beta + b^2\gamma)} \tag{2}$$

It will be analytically convenient in what follows to refer to $b^2\gamma$ as a measure, φ, of the aggregate *external discipline* imposed by the transfer-maker :

$$\varphi = b^2\gamma \tag{3}$$

and to formally ignore the distinction between monitoring and punishment when this is not needed. The optimal fraud can then be written simply as:

$$\widetilde{y}(\varphi) = \frac{1}{2(\beta + \varphi)}, \tag{4}$$

where $(\beta + \varphi)$ is the aggregate discipline corresponding simply to the sum of internal and external disciplines. At this optimum, the fraud is a decreasing function of both internal and external disciplines.

In order to avoid the unrealistic corner solution $y = 1$, it is necessary to assume that $\beta + \varphi > 1/2$. Of course, it will never be in the interest of the transfer-maker to allow for such a possibility. On the other hand, the agent will never choose to refrain from cheating altogether because V_y is necessarily positive when $y = 0$. Therefore, the probability of fraud detection is strictly positive at equilibrium.

3.4 Optimal punishment/monitoring by the transfer-maker

The transfer-maker draws satisfaction from increasing the consumption of the intended final beneficiaries and, for a given amount of transfer, his utility increases as the extent of misuse by these beneficiaries is reduced. His satisfaction thus appears as a function of the external discipline imposed. Assuming a logarithmic specification to simplify the analysis, this satisfaction, or utility, is written:

$$U(\varphi) = Ln\,[w + T(1 - \widetilde{y}(\varphi)] \tag{5}$$

where w is the per capita income of the beneficiaries prior to the transfer, and T the total transfer amount per capita, which is taken as exogenous. Such an objective function fits well the decision process of bilateral or multilateral development agencies, which are essentially given exogenous aid funds they have to manage with their own resources. It also matches the situation of state departments in charge of social transfers insofar as they are required to follow pre-determined rules when they channel the money to beneficiaries. A more general specification would make not only φ but also T endogenous. However, such an approach would significantly increase the complexity of the analysis without affecting the most important results achieved in this paper.[8]

Exerting external discipline has a cost for the transfer-maker, whether it arises from monitoring the use of the funds provided - the b parameter above - or from imposing sanctions when the agent is found to cheat- i.e. γ above. Regarding punishment, the cost may involve starting a complex lawsuit but also the moral cost of appearing as too harsh in the eyes of the population. Because such a cost is incurred only if the fraud is detected, it is logical that the cost of external discipline per transfer unit depends on both its intensity, φ, and the probability of detection that depends itself on the size of the fraud. A simple Cobb-Douglas like functional form that represents such a unit cost function is:

$$\Gamma(\varphi) = B.\varphi^k.(\beta+\varphi)^{-2p} \tag{6}$$

where B, k and p are constant positive parameters. Recall that, in the above expression, $(\beta+\varphi)^{-2}$ stands for the probability, π, that the fraud will be detected. It is shown in Appendix A1 that expression (6) results logically from minimizing the total cost of monitoring (b) and of the expected value of the sanction ($\gamma\pi$), under the constraint that $b^2\gamma = \varphi$,when the cost of monitoring and the cost of the sanction are convex power functions with elasticities q and m, respectively. With this specification, it is reasonable to assume that the total (unit) cost is convex with respect to the strength of the external discipline, φ, (i.e. $k > 1$), and concave with respect to

[8]A discussion of the case where T is allowed to be endogenous is offered in the on-line earlier version of this paper at , https://www.parisschoolofeconomics.eu/docs/bourguignon-francois/optimal_management(+extensions,-13-07-17).pdf.

the probability of detection, π, (i.e. $p < 1$). The latter is justified by the fact that an increase in that probability raises the expected cost of the sanction but not that of the monitoring. The elasticity of the total cost of the external discipline with respect to the probability of detection must therefore be less than unity, hence $p < 1$[9]. Finally, it must be logically assumed that the overall cost of the external discipline is non-decreasing with its strength, φ.[10] Altogether, these assumptions imply the following constraints on the parameters of the cost function, $\Gamma(\varphi)$:

$$p < 1 < k;\ k \geq 2p \tag{7}$$

Putting satisfaction and costs together, the objective of the transfer-maker is to find the strength of the external discipline that maximizes:

$$Max_{\varphi}\ U(\varphi) - T.\Gamma(\varphi)$$

or, using (5) and (6):

$$Max_{\varphi}\ Ln\left[w + T(1 - \widetilde{y}(\varphi))\right] - TB\varphi^{k}(\beta + \varphi)^{-2p} \tag{8}$$

This maximization must take place under the participation constraint of the agent. Using (1) and (3), this constraint writes:

$$\widetilde{y}(\varphi) - \beta\widetilde{y}^{2}(\varphi) - \varphi\widetilde{y}^{2}(\varphi) - g \geq V^{0} \tag{9}$$

where V^0 is the reservation utility of the agent per unit of transfer. Assuming without loss of generality that $V^0 = 0$, the transfer-maker must make sure that the agent can at least cover the cost of handling the transfer. Using (4), this constraint writes simply:

[9] A full justification of this condition may be found in (26) in Appendix A1

[10] If this were not the case, it can be seen on (6) that the cost of the external discipline would tend towards zero when φ becomes increasingly large. An infinite punishment would thus be the optimal strategy for the transfer maker, a rather unrealistic case. The idea of a punishment being commensurate to the crime being punished is analyzed in the optimal law enforcement literature (see Garoupa, 1997).

$$1/4(\beta+\varphi)-g \geq 0 \tag{10}$$

As far as the transfer-maker's participation constraint is concerned, we assume that the parameters of the model are such that, at the optimum :

$$Ln\left[w+T\left(1-\widetilde{y}(\varphi)\right)\right]-T.\Gamma(\varphi)>Ln(w)$$

In other words, we assume that the income per head of the beneficiaries is sufficiently low and/or the parameters of the cost functions are sufficiently small to make the principal's participation constraint automatically satisfied.[11]

Now, the Lagrangian of the transfer-maker's maximization problem can be written :

$$Ln\left\{w+T\left[1-1/2(\beta+\varphi)\right]\right\}-TB\varphi^{k}(\beta+\varphi)^{-2p}+\mu\left\{1/4(\beta+\varphi)-g\right\} \tag{11}$$

where μ is the multiplier associated with the agent's participation constraint. Two situations can then arise depending upon whether this constraint is binding at equilibrium or not. The case where it is binding reflects conditions under which the monitoring and punishment technology is cheap enough to allow the transfer-maker to prevent the agent from obtaining any surplus. Conversely, when the cost of this technology is too high, the transfer-maker will not find it profitable to put the agent at his reservation utility. We start by examining the latter, more general case, which also turns out to be the more analytically complex and challenging. Note that it is also especially pertinent when the agent is thought of as an intermediary who is obviously interested in obtaining a surplus from the transaction s/he gets involved in.

[11] This assumption makes unnecessary to take into account the aforementioned condition $\beta+\varphi>1/2$, which guarantees that the agent does not misuse the whole transfer. If this were the case, the principal would prefer to abstain from making the transfer altogether.

4 The general case: the agent's participation constraint is not binding

As the agent's participation constraint is not binding at equilibrium, the Lagrangean coefficient μ is nil in (11).The original maximization problem thus writes simply:

$$Max_{\varphi}\, U(\varphi) - T\Gamma(\varphi) = Log\left[w + T(1 - \frac{1}{2(\beta+\varphi)})\right] - TB\varphi^{k}(\beta+\varphi)^{-2p} \quad (12)$$

An interior solution, if it exists, is then obtained by equalizing the corresponding marginal utility of the external discipline, $U'(\varphi)$, and the marginal cost, $T\Gamma'(\varphi)$. The former is given by :

$$U'(\varphi) = \frac{T}{2}.\frac{(\beta+\varphi)^{-2}}{w + T(1 - \frac{1}{2(\beta+\varphi)})} \quad (13)$$

which is monotonically decreasing with respect to φ and, as could be expected, tends towards zero when φ tends towards infinity - see Figure 1. The marginal cost per unit of transfer is given by:

$$\Gamma'(\varphi) = B.\varphi^{k-1}(\beta+\varphi)^{-2p-1}\left[k(\beta+\varphi) - 2p\varphi\right] \quad (14)$$

For further use, this may also be expressed as:

$$\Gamma'(\varphi) = \frac{\eta}{\varphi}\Gamma(\varphi);\ with\ \eta = k - \frac{2p\varphi}{\beta+\varphi} \quad (15)$$

where η is the elasticity of the cost of the external discipline.

It turns out that analyzing the standard first-order optimality condition:

$$U'(\varphi) = T\Gamma'(\varphi) \quad (16)$$

is rather intricate. Knowing the shape of the marginal utility function, a simpler way to proceed consists of considering the relative value $R(\varphi) = T\Gamma'(\varphi)/U'(\varphi)$ of the marginal cost with respect to the marginal utility rather than both of them separately.

An interior solution is then given by equalizing this ratio to unity.

It comes after some manipulation that:

$$R(\varphi) = 2B\left[(k-2p)\varphi + k\beta\right]\left[\frac{\varphi^{k-1}}{(\beta+\varphi)^{2p-1}}\right]\left[w + T(1 - \frac{1}{2(\beta+\varphi)})\right] \qquad (17)$$

Given that $k > Max(1, 2p)$ as assumed in (7), it can be seen that the three terms in square brackets are increasing functions of φ, so that $R(\varphi)$ increases monotonically from zero to infinity when φ goes from zero to infinity. It follows that $R(\varphi)$ necessarily goes once and only once through unity and this occurs for a strictly positive value, φ^*. Thus, there is a single intersection point between the marginal cost and the marginal utility curve, and therefore, a single (interior) solution to the optimality condition (16). Moreover, the marginal cost curve crosses the marginal utility curve from below so that the second order condition for optimality is satisfied, whatever the actual shape of the marginal cost curve (14), when its parameters meet constraints (7) - see Figure 1.

The preceding argument suggests that corner solutions, $\varphi = 0$ or $\varphi = \infty$ to the maximization problem (12) can only obtain when conditions (7) are not satisfied. [12]

We now look at the comparative statics of this interior solution with respect to the internal discipline β, which is the main objective of the paper. Several interesting results emerge. Combined with the existence result, the first one may be stated as follows :

Theorem 1. *(Substitutability) The optimal external discipline is a substitute for the internal discipline: an increase in internal discipline, β, causes the optimal external discipline, φ, to decrease.*

At first sight, this property seems very intuitive. With a better internal discipline, the agent allocates a larger share of the money according to the wishes or the prescriptions of the transfer-maker, and this reduces the marginal utility of the external discipline for the latter. Without change in the marginal cost, the external discipline

[12] These cases are analysed in detail in the online version of this paper.

should thus diminish. What is less evident, however, is the way the marginal cost is modified. As can be seen from (15), an increase in β has two opposite effects on the marginal cost. On the one hand, it increases the elasticity, η, of the cost with respect to the level of external discipline but, on the other hand, it reduces the cost $\Gamma(\varphi)$. The substitutability between internal and external disciplines is reinforced if the maginal cost increases, that is, if the former effect is stronger than the latter. In the opposite case where the marginal cost decreases with β, it is shown in Appendix A2 that it decreases less than the marginal utility - i.e. the $R(\varphi)$ curve keeps shifting upward - so that the substitutability between internal and external disciplines holds in that case too.

The question then arises of the extent of the substitution of internal by external discipline. Is it partial, complete, or could it even overshoot the initial change in internal discipline? The substitution is partial (under-substitution), and possibly complete, if the total discipline $\beta + \varphi$ does not decrease when β increases, or:

$$-1 \leq \frac{d\varphi}{d\beta} \leq 0 \tag{18}$$

Alternatively, over-substitution occurs when :

$$\frac{d\varphi}{d\beta} < -1 \tag{19}$$

In this second case, therefore, the overall discipline falls despite the fact that its internal component, β, has increased.

A rather simple condition determines whether over- or under-substitution occurs:

Theorem 2. *(under- and over-compensation) An increase in internal discipline, β, is always compensated by a drop in external discipline, φ. There is under-compensation or complete substitution, i.e. total discipline, $\beta + \varphi$, increases or remains constant, iff:*

$$\eta \geq 1 \tag{20}$$

There is over-compensation, i.e. total discipline, $\beta + \varphi$, decreases, otherwise. In this second eventuality, the optimal level of fraud increases despite the higher level *of internal discipline.*

A formal proof of the above theorem is given in Appendix A3. An intuitive proof is as follows. Consider the equilibrium condition (16) and a small simultaneous change in internal and external discipline leaving the total discipline unchanged: $\Delta\beta + \Delta\varphi = 0$ or $\Delta\varphi = -\Delta\beta$. Clearly, the marginal utility is unchanged. This is not true of the marginal cost, though . Since η is the elasticity of the total cost, the marginal cost Γ' is approximatley proportional to $\eta\varphi^{\eta-1}$, and the change in the marginal cost $\Delta\Gamma'$ to $-\eta(\eta-1)\varphi^{\eta-2}$. If $\eta = 1$, the equilibrium has not been disrupted and there is no need for a further change in φ. There is perfect substitution between internal and external discipline. If $\eta > 1$, the marginal cost has moved down and it is thus necessary to increase φ (that is, φ should fall to a smaller extent than what is needed to keep $\beta + \varphi$ constant) in order to get back to equilibrium. There is under-compensation: total discipline therefore goes up together with internal discipline, yet it increases to a smaller extent. Finally, the marginal cost moves up if $\eta < 1$, which requires a drop in φ beyond what allows to keep $\beta + \varphi$ constant if equilibrium is to be re-established. There is overcompensation and total discipline falls despite the fact that the internal discipline has improved.

The intuition of this apparently paradoxical result is simple. When internal discipline increases, the fraud committed by the agent decreases: a larger portion of the money is used according to the wish of the transfer-maker (or a higher portion of what is channeled through the intermediary reaches the targeted beneficiaries) and, as a consequence, the marginal utility of the transfer-maker falls. To re-establish equilibrium, the transfer-maker must reduce his (her) marginal cost, which he (she) does by lowering φ, as stated in Theorem 1. By how much depends on the elasticity of the marginal cost, which depends itself on the convexity of the cost function, and therefore on its elasticity. If it is large, the change in φ needed to reequilibrate the optimality condition is small and the change in the overall discipline remains positive. If the elasticity of the cost function is small, however, re-establishing optimality requires a large change in φ, which may lead to a decline in the overall discipline.

Actually, things are slightly more complicated than the preceding argument suggests. This is because the elasticity of the cost function, η, depends itself on both the internal and external disciplines. Thus, condition (20) actually is a condition on the whole set of parameters of the model. As there is no analytical solution to the optimality condition $R(\varphi) = 1$, it is not possible to precisely identify the condition under which η is above or below unity. Yet, an interesting and important particular case is when the strength of the internal discipline is very small. In the limit case where $\beta = 0$ gets close to 0, it can be seen from (15) that the $\eta \geq 1$ condition for under-compensation is satisfied only if $k \geq 2p+1$. If this is not the case, then over-compensation necessarily occurs. Hence the following interesting result:

Theorem 3. *(limit case of over-compensation) When the internal discipline is sufficiently weak, i.e. β sufficiently small, and $k < 2p+1$, any improvement in the internal discipline is accompanied by a fall in the external and total discipline so that the fraud actually increases.*

This result can be actually extended to consider the whole interval of variation of the internal discipline.

Theorem 4. *(non-monotonicity) The relationship between internal discipline (β) and total discipline ($\beta+\varphi$) or the level of the fraud $(1/2)(\beta+\varphi)^{-1}$ is not monotonous. If $k < 2p+1$, the optimized fraud is an increasing function of β for low enough values of β. However, this property reverts at some stage as β increases.*

The proof directly follows from Theorems 1-3 and from the definition of η as given by (15). Notice first that the elasticity η is a decreasing function of $\varphi/\beta+\varphi$. Second, it is evident that $(\varphi/\beta+\varphi)$ is a decreasing function of β since $d\varphi/d\beta < 0$ on the basis of Theorem 1. It follows that $d\eta/d\beta > 0$ for all values of β. Theorem 3 states that $\eta < 1$ for low enough values of β. As β increases, η thus increases from below to above unity so that under-compensation follows over-compensation when the agent's internal discipline improves. The turning point is given by:

$$\eta = 1 \; or \; \frac{\varphi}{\beta+\varphi} = \frac{k-1}{2p}$$

The condition $k < 2p+1$ for the optimized fraud to possibly increase with the agent's internal discipline may be looked at from the point of view of the parameter k or the parameter p. In the former case, the condition is that the cost of the external discipline must not increase too quickly with the strength of the discipline, or the cost curve not to be too convex for a given probability of fraud detection. In the latter case, the condition is that the cost of the external discipline must not increase too slowly with the probability of detection. In other words, the relative importance of the probability of detection in the marginal cost of the external discipline appears as the key factor explaining that the external discipline is an under- of over-substitute to the internal discipline. The over-substitution case occurs when the elasticity of the probability of detection in the cost function is relatively large. Under this condition, an increase in the internal discipline makes the cost function less convex. It may even make it concave, so that the marginal cost becomes a decreasing function of the external discipline. It is such a configuration thatyields the counter-intuitive case of over-substitution.

To see that the condition $k < 2p+1$ is not unduly restrictive, it is worth going back to the parameters of the original cost functions for monitoring and punishment, and to take into account the original constraints (7) on k and p. With q (>1) being the elasticity of the cost of monitoring, b, and with m (>1) being the elasticity of the cost of punishment, γ, the following equivalence may be derived from the definitions of k and p, as given in Appendix A1.

Theorem 5. *The condition $Max(1,2p) < k < 2p+1$ is equivalent to the following conditions on the elasticities of the cost of monitoring (q) and of punishment (m):*

$$q > 2 \; and \; 2 < m < \frac{3-2/q}{1-2/q} \tag{21}$$

The proof is given in the Appendix A4.

The condition $m > 2$ is equivalent to the condition that the total cost (6) is increasing with the external discipline and simply guarantees that the optimal external discipline - i.e. the punishment - is not infinitely large, a rather unrealistic case. As for the condition $q > 2$, it guarantees the optimal external discipline is not zero, which seeems of little interest in the present context. Within this range, $[2,\infty]*[2,\infty]$ for q and m, the paradoxical result of an over-substitution of internal by external discipline simply requires the cost of punishment not to be too convex. The range of variation for m remains nevertheless substantial. It has practically no limit (above 2) when q is slightly above 2 . Its upper limit decreases slowly when q increases but always remains above 3.

The critical value for m and q featured in the above conditions, set at 2, seems to be arbitrary but can be elucidated. It is actually the consequence of the assumption of a quadratic internal cost of fraud and a quadratic probability of detection. If the elasticity of these two functions had been $e\,(>1)$ rather than 2, the critical value of the elasticities of the cost functions for the paradoxical result to hold would have been e, too.

Based on the foregoing examples, it has to be admitted that the over-substitution of internal by external discipline is a real possibility as soon as the internal discipline is weak enough, provided of course that the principal finds it optimal to make the transfer.

Considering now the comparative statics with respect to the other parameters of the model, the following results are easily obtained:

Theorem 6. *(other comparative statics) The external discipline is a decreasing function of the cost parameters, B, and of the income of the beneficiaries. The external discipline is also decreasing with the size of the transfer.*

The proof is immediate from differencing the optimality condition $R(\varphi) = 1$ with respect to B, w and T. That higher values of the cost parameters reduce the extent of the external discipline is rather obvious. What is perhaps less evident is that the initial income of the beneficiaries has the same effect. This is easily understood, though. Other things being equal, it can be seen from (13) that an increase in w causes the marginal utility of the transfer-maker to fall. Equilibrium is re-established by reducing the discipline so as to lower the marginal cost. Put in the converse manner, the optimal external discipline is more severe for poorer beneficiaries, the level of internal discipline and the size of the transfer being the same.

Regarding the effect of a change in the transfer amount, the proof is again straightforward. It is obvious from (14) that the marginal cost of external discipline, $T\Gamma'$, increases with T. As for the the marginal utility, (13) implies that it unambiguously decreases as T rises. Clearly, optimality is re-established by reducing external discipline.

Distinguishing between the two components of external discipline, the following additional results can be established:

Corollary 1. *The optimal levels of monitoring and punishment both decrease monotonically with the level of internal discipline.*

The proof is given in Appendix A5.

Corollary 2. *Both monitoring and punishment are decreasing functions of their own cost. However, whether they are gross complements or substitutes is ambiguous.*

The proof is given in Appendix A6.

5 The particular case: the agent's participation constraint is binding

The transfer maker maximization problem now includes the agent's participation constraint given by (10):

$$V(\widetilde{y}) = \frac{1}{4(\beta+\varphi)} - g \geq 0 \;\; or \;\; \varphi \leq \frac{1}{4g} - \beta$$

By assumption, this constraint is not binding under the solution of the general case. Since that solution does not depend on the cost of managing aid, g, it is sufficient to assume that this cost is sufficiently high for the agent's participation constraint to be binding. The transfer-maker is then deprived of any choice possibility: the agent will only agree to manage, or to accept the transfer if the external discipline does not exceed the threshold $\varphi = 1/4g - \beta$.

The comparative-static analysis is rather straightforward and yields the following results. First, when the level of internal discipline, β, increases, the external discipline, φ, is adjusted so as to maintain total discipline, $\beta + \varphi$, constant (at the level $1/4g$). We have perfect substitutability between the two types of discipline, instead of under- or over-substituability as before.

Second, the external discipline is not affected anymore by the size of the transfer or the needs of the beneficiaries. The only parameter other than β that affects φ is the unit cost of handling the transfer for the agent, g. When g rises, the transfer-maker is forced to reduce external discipline in order to keep the agent at his (her) reservation utility.

We are now in a position to summarize the results obtained under the assumption of a binding participation constraint of the agent, allowing for a comparison with the case of a non-binding constraint.

Theorem 7. *When the transfer-maker is able to put the agent at his (her) reservation utility, changes in external discipline exactly compensate changes in internal discipline, and this is true regardless of the initial level of internal discipline. The size of the transfer and the income of the beneficiaries do not influence external discipline, but the unit cost of handling the transfer for the agent does. When this cost increases, external discipline is reduced.*

It remains to specify when the participation constraint is binding. This will be the case if the marginal utility of external discipline is above its marginal cost when the external discipline is at the level that makes the agent indifferent between participating or not. Namely (13) and (15) imply:

$$\frac{T(\beta+\varphi)^{-2}/2}{w+T(1-\frac{1}{2(\beta+\varphi)})} \geq \frac{T\eta}{\varphi} B\varphi^{k}(\beta+\varphi)^{-2p} \; with \, \beta+\varphi = 1/4g$$

After a few transformation, this condition writes:

$$\frac{1}{2\left[w+T(1-2g)\right]} \geq B\left[k-2p(1-4\beta g)\right](1-4\beta g)^{k-1}(4g)^{2p-1-k}$$

Practically, the participation constraint is more likely to be binding as the management cost of the transfer, g, is high and the cost parameters of the cost function of the external discipline, the income of the beneficiaries, and the size of the transfer are small. Not surprisingly, these last three conditions are the same as those that would lead to a high level of external discipline in the unconstrained model . More importantly, however, it is easily shown that the right-hand side of the preceding inequality is a decreasing function of the internal discipline when the condition $k < 2p+1$ holds[13], precisely the same condition that causes total discipline to be a decreasing function of internal discipline when the latter is small enough. If that condition is satisfied, the participation constraint of the agent is binding for high levels, rather than low levels of internal discipline. Therefore, when the internal discipline goes down from an initially high level, participation is first binding so that total discipline is constant (at 1/4g). At some stage, however, the participation constraint does not bind anymore and total discipline increases when the internal discipline keeps falling. The opposite outcome is obtained when $k \geq 2p+1$. When the internal discipline goes up from an initially low level, participation is first binding, so that total discipline is constant (at 1/4g). At some stage, however, the participation constraint does not bind anymore, and total discipline increases when the internal discipline keeps on improving.

6 Conclusion

This paper has attempted to elucidate the impact of the level of internal discipline or the quality of internally-generated governance on the outcome of transfers when monitoring and punishment are optimally used to mitigate their misappropriation or misuse. This exercise has yielded several important results some of which are

[13] To see this, define $X = (1-4\beta g)$ so that the RHS of the preceding inequality is proportional to $kX^{k-1} - 2nX^k$. As $X < 1$, this expression is an increasing function of X and therefore a decreasing function of β if $k < 2p+1$.

quite unexpected. To begin with, and according to intuition, external discipline acts as a substitute for internal discipline: when the latter improves, the transfer-maker responds by reducing the level of external discipline (along both the monitoring and the punishment dimensions). Yet, the portion of the transfer that is used according to the wishes of the transfer-maker depends on total discipline, which consists of the sum of internal and external disciplines. The central question is thus whether the improvement in internal discipline also results in an increase in total discipline so that the objective of the transfer-maker is better satisfied. This is where unexpected results emerge from our formal analysis.

When the participation constraint of the agent is binding, whether the agent is viewed as the beneficiaries themselves or as an intermediary acting on their behalf, internal and external disciplines exactly balance out with the consequence that total discipline and the portion of the transfer used according to the transfer-maker's wish remain constant. In other words, any change in internal discipline is fully neutralized by a change in exernal discipline. When the agent is able to retain a surplus from the tranfer, on the other hand, our surprise actually increases. It now becomes possible that an improvement in internal discipline is over-compensated by the transfer-maker so that total discipline is paradoxically reduced and misuse or misappropriation of the transfer increases. Whether this happens or not depends on the initial level of internal discipline and on the shapes of the cost functions, that is, on the technolologies of monitoring and punishment available to the transfer-maker. More precisely, the paradox occurs when the internal discipline is low and the cost functions not too convex.[14] Moreover, the relationship between internal discipline and total discipline or the extent of the transfer's misuse is not necessarily monotonous: if there is over-substitution of internal by external discipline so that the misuse of the transfer increases with the internal discipline when the latter is low, both properties are likely to revert at some stage as internal discipline improves. The policy implication is important: if one wishes to avoid that the final beneficiaries are "punished" by the transfer-maker because intermediaries achieve a better internal discipline, innovations must ensure that monitoring and punishment technologies are convex enough

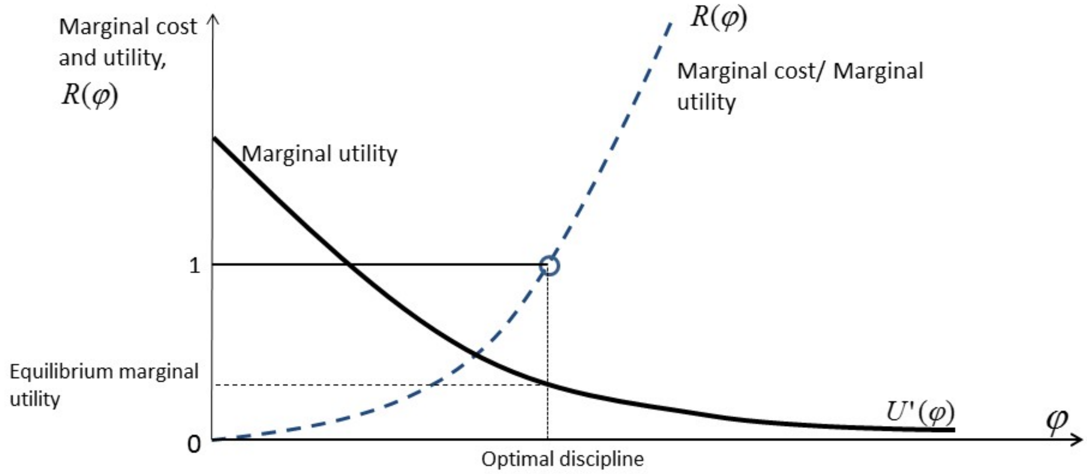
[14] Or, more exactly, the paradox occurs when the cost functions are not much more convex than the function that describes the internal cost of the transfer's misuse.

in their costs.

The model allows us to determine the effects of variations in the transfer size in addition to those of the internal discipline of the intermediaries. This is done in a framework where the utility of the transfer-maker is concave in the average income accruing to the beneficiaries, itself the sum of their stand-alone income and the amount of transfer per capita. With respect to the latter, the most interesting result is the following: when the agent's participation constraint is not binding, implying that the intermediary is able to gain a surplus income from the transaction, the optimal external discipline chosen by the transfer-maker decreases with the magnitude of the transfer. When this constraint is binding, however, the external discipline is unaffected by the transfer amount. In other words, a greater budget earmarked for transfers induces the transfer-maker to relax his (her) discipline but only when s/he is unable to put the agent (the intermediary) at his (her) reservation utility. The effect of the initial level of income is analogous to that of the transfer amount: a higher income induces the transfer-maker to relax the external discipline but only when the agent's participation constraint is not binding.

The major implication of the whole endeavor is, therefore, that when discipline or governance is considered to be partly endogenous to the transfer-maker's effort, no general prediction can be made about the effect of variations in internal discipline or governance on the outcome of the transfer. We need to know more about initial levels of internal discipline, the aggregate transfer budget, and the characteristics of the disciplining technology to be able to infer more precise testable propositions. Absent such information, empirical results are likely to be misleading or difficult to interpret. Unfortunately, data about monitoring and punishment costs and about internal discipline are hard to get. One special difficulty arises from the fact that the quality of governance measured by indicators currently used by economists and political scientists is the outcome not only of internal but also of external discipline. As pointed out by Edwards (2014) in regard of development aid, "aid agencies influence policies, and the reality in the recipient country affects the actions of aid agencies" (p.41). The question as to how to identify the specific contribution of internal discipline is therefore a most serious challenge. We hope to have shown with the help of theory that the stake involved in this empirical challenge is quite high.

Figure 1: Equilibrium of marginal utility and marginal cost of external discipline



Appendix

A1. Derivation of the cost function

Let C(b) and D(γ) be, respectively, the cost of monitoring and punishmment per unit of transfer. Both functions are assumed to be increasing and convex. Bearing in mind that punishment is only meted out when fraud is detected, which occurs with probability $\pi = b^2y^2$, the cost function of the external discipline per unit of transfer defined in (3) is obtained from :

$$\Gamma(\varphi) = Min_{b,\gamma} C(b) + D(\gamma)\left[\frac{1}{4}\frac{b^2}{(\beta+\varphi)^2}\right] \; s.t \; \varphi = b^2\gamma \tag{22}$$

To simplify the analysis, we specify the two cost functions as convex power functions:

$$C(b) = \frac{cb^q}{q},\; D(\gamma) = \frac{d\gamma^m}{m},\; with\; q \geq 1,\; m \geq 1$$

Then, using the definition of φ above to express γ as a function of b and φ, the transfer-maker's cost minimization problem becomes:

$$\Gamma(\varphi) = Min_b\, c\frac{b^q}{q} + \frac{d}{4m}\frac{b^2}{(\beta+\varphi)^2}\frac{\varphi^m}{b^{2m}} \tag{23}$$

the solution of which is given by:

$$b^*(\varphi) = \left[\frac{d}{c}\frac{m-1}{2m}\frac{\varphi^m}{(\beta+\varphi)^2}\right]^{\frac{1}{q+2(m-1)}} \tag{24}$$

After plugging this expression back into (23), we obtain expression (6) for the cost of the external discipline per transfer unit:

$$\Gamma(\varphi) = B\varphi^k(\beta+\varphi)^{-2p} \tag{25}$$

where:

$$p = \frac{q}{q+2(m-1)};\; k = mp;\; B = \frac{c^{1-p}d^p 2^{-(1+p)}}{q(m-1)^{1-p}m^p}[(m-1)2+q] \tag{26}$$

It can be seen on this expression that p can logically be assumed to be less than one as in the main text, whereas the assumption made there that $k > 1$ - which actually requires $q > 2$ in the preceding specification - is for practical convenience. The complementary case $1 < q < 2$ is analyzed in detail in the online earlier version of this paper.

A2. Proof of Theorem 1

Consider $R(\varphi)$ as given by (17) . It is clearly increasing in β if $p < 1/2$. To see that this is aso true if $p \in [1/2, 1]$ take the logarithmic differential:

$$\frac{1}{R}\frac{\partial R}{\partial \beta} = \frac{k}{k(\beta+\varphi)-2p\varphi} - \frac{2p-1}{(\beta+\varphi)} + \frac{(\beta+\varphi)^{-2}/2}{w+T(1-\frac{1}{2(\beta+\varphi)})}$$

The third term on the RHS is clearly positive. Evaluate then the sum S of the first two terms. It comes after rearrangements that:

$$S = \frac{2(1-p)\,[k(\beta+\varphi)-2p\varphi]+2p\varphi}{[k(\beta+\varphi)-2p\varphi]\,(\beta+\varphi)}$$

This sum is positive since $k(\beta+\varphi)-2p\varphi = (k-2p)\varphi + k\beta$ is positive under conditions (7). As R'(φ) is positive, the substitutability between β and φ follows. QED

A3. Proof of Theorem 2.

Differentiate logarithmically the optimality condition:

$$R(\varphi) = 2B\,[(k-2p)\varphi + k\beta]\left[\frac{\varphi^{k-1}}{(\beta+\varphi)^{2p-1}}\right]\left[w+T(1-\frac{1}{2(\beta+\varphi)})\right] = 1$$

with respect to φ, while keeping $(\beta+\varphi)$ constant, and denote Δ_φ the corresponding operator. It comes:

$$\frac{\Delta_\varphi(R)}{R} = \frac{-2p}{k(\beta+\varphi)-2p\varphi} + \frac{k-1}{\varphi} = \frac{k-1-\frac{2\varphi p}{\beta+\varphi}}{\varphi\,[k(\beta+\varphi)-2p\varphi]}$$

As it is assumed that $k > 2p$, the denominator of the last term is positve, it is thus the case that:

$$sign(\frac{\Delta_\varphi(R)}{R}) = sign(\eta - 1)$$

As R is an increasing function of φ, it follows that φ must fall by less than β to reestablish equilibrium if the cost elasticity, η, is more than unity and by more than β if η is less than unity. The total discipline, $\beta+\varphi$, increases in the former case and decreases in the latter. QED.

A4. Proof of Theorem 5

From conditions (26), it comes immediately that $k \geq 2p$ is equivalent to $m \geq 2$, $k > 1$ to $m > 1/p$ and $k < 2p{+}1$ to $m < 2 + 1/p$. Substituting the expression of p in (26), $k > 1$ thus implies $q > 2$ whereas $k < 2p{+}1$ requires:

$$m < 2 + \frac{q + 2(m-1)}{q}$$

or:

$$m(1 - 2/q) < 3 - 2/q$$

which is (21) when $q > 2$.

A5. Proof of Corollary 1

It can be seen from (24) that b^* is an increasing function of φ and a decreasing function of β. As φ reacts negatively to an increase in β (Theorem 1), b^* decreases when β increases. Things are less easy for $\partial\gamma^*/\partial\beta$. First, the optimal punishment is defined by:

$$\gamma^* = \varphi/b^{*2}$$

Replacing b^* by (24), it comes that :

$$\gamma^* = \varphi \left[\frac{d}{c} \frac{m-1}{2m} \frac{\varphi^m}{(\beta+\varphi)^2} \right]^{\frac{-2}{q+2(m-1)}}$$

Differentiating logarithmically with respect to β leads to:

$$sign(\frac{\partial\gamma^*}{\partial\beta}) = sign \left[\frac{\partial\varphi}{\partial\beta} - \frac{\varphi/(\beta+\varphi)}{\varphi/(\beta+\varphi) + (q-2)/4} \right] \qquad (27)$$

Differentiating the equilibrium condition $R(\varphi) = 1$ with respect to φ and β yields after some manipulation:

$$\frac{\partial\varphi}{\partial\beta} = -\frac{\varphi/(\beta+\varphi)}{\varphi/(\beta+\varphi)+N/M}$$

where:

$$M = \frac{1}{(\beta+\varphi)-1} + \frac{4(m-1)\left[m(\beta+\varphi)-\varphi\right]+2q\varphi}{\left[q+2(m-1)\right]\left[m(\beta+\varphi)-2\varphi\right]};$$

$$N = \frac{m(m-1)(q-2)(\beta+\varphi)-2qm\varphi}{\left[q+2(m-1)\right]\left[m(\beta+\varphi)-2\varphi\right]}$$

It is then easily proven that $N/M \leq (q-2)/4$, so that the sign in (27) is negative. QED

A6. Proof of Corollary 2

Consider optimal monitoring as given by (24). An increase in c clearly reduces the extent of monitoring for given external discipline, φ. As external discipline falls with the two cost parameters, c and d, and as $\varphi^m/(\beta+\varphi)^2$ varies in the same direction as φ (provided that $m \geq 2$, which must be fulfilled in the case of an interior solution), the overall effect of a change in c on b^* is negative. The corresponding two effects when the cost of punishment increases are opposite to each other. Hence the ambiguity.

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