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Regular article

Aid allocation with optimal monitoring: Theory and policy

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ABSTRACT

We explore the implications of allowing a poverty-averse donor to monitor aid use within the familiar context of the needs vs. aid effectiveness tradeoff. The paper focuses on the optimal aid allocation between two countries when the donor simultaneously decides about aid shares and country-specific monitoring effort aimed at increasing the amount reaching the poor. Endogenizing aid effectiveness is shown to raise the poor's income in the worse-governed country, yet not necessarily in the better-governed one, whereas the effect on country aid shares is essentially ambiguous. Those results still hold when the basic model is extended in various directions. Conventional aid allocation rules should be re-examined in their light.

1. Introduction

Non-interventionist approaches to the allocation of transfer money, in which the idea of controlling its use by the beneficiaries is essentially absent, tend to be increasingly called into question. This is especially evident in the case of development aid: approaches emphasizing policy dialogue, country ownership, and the absence of conditionalities and reform overload, themselves a reaction to the disappointing performances of conditionality-based programmes run by the International Monetary Fund and the World Bank, have led to great disillusionment in the donor community. The institutional weaknesses of many beneficiary countries, and the resulting incidence of aid misuse (Alesina and Weder, 2002), had been clearly underestimated. As recent evidence of massive embezzlement of aid resources, disbursements of aid in a sample comprising the 22 most aid-dependent countries in the world (in terms of WB aid) have been found to coincide, in the same quarter, with significant increases in the value of bank deposits in offshore havens (Andersen et al., 2020). Such correlation suggests that a portion of aid flows is diverted to foreign private bank accounts, most plausibly by members of the local elites (see also Olken, 2006; Easterly, 2007; Platteau et al., 2014, for more specific evidence of elite capture of foreign aid).

In a context where the use of aid money became increasingly scrutinized by taxpayers in donor countries, the reaction of donor agencies consisted of paying growing attention to governance factors and recognizing the high level of heterogeneity of the developing world. In the wake of this reaction a hard dilemma arose from the observation that the countries evincing the worst governance are also the poorest, that is, aid is least effective where it is most needed (Collier, 2007, Chap. 5; Kanbur and Sumner, 2012). The key notion that logically came to dominate thinking in the development aid debate is that of a trade-off between needs and governance. That notion is encapsulated in the aid allocation rule proposed by Collier and Dollar (2002), or in the Performance-Based Allocation (PBA) formula used by the World Bank's IDA (International Development Association). The latter allocates aid according to a formula involving recipient countries' income per capita, a measure of their governance, and their population size with unequal weights.[1,2] Because the weight associated to governance indicators in these allocation rules is important, the risk of exclusion for the so-called fragile (the poorest and worst-governed) countries quickly became manifest, thereby forcing the concerned aid agencies, the World Bank and the European Commission in particular, to use several types of 'sweeteners', that is exceptions to the formula, in order to keep these countries eligible.[3]

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[1] In the PBA formula, performance is essentially conceived in terms of governance, whether current governance quality or past governance as measured by the way aid has been used in the past (meaning the presence or absence of significant aid embezzlement).

[2] See, for instance, World Bank (2017), and note that the formula has not been modified since then. While the PBA formula assigns unequal weights to the three indicators mentioned above, The European Commission uses a similar formula that combines, in a geometric model with equal weights, the same set of indicators, to which measures of human development and vulnerability have been nevertheless added (Markova, 2013).

[3] On sweeteners and the way the PBA rule is applied, see Guillaumont and Wagner (2015).

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A more palatable solution, which is at the core of the present endeavor, consists of acknowledging that aid uses need to be supervised by the donor, and that the intensity of supervision efforts should be inversely related to the quality of governance in the recipient countries. In fact, this is the route increasingly trodden by the donor community, as reflected in the present-day tendency to practice conditionality or project and programme aid for fragile countries while earmarking budget support and partnership-based aid for better governed and less needy countries (see Temple (2010), for a discussion). Even within the category of project aid, governance-related constraints can be better overcome through the adoption of more simple project designs, often implying the choice of smaller size and more participative projects (Khwaja, 2009). Not only Western governments and development agencies, but also new donors, such as the United Arab Emirates and China, have come to adopt the new perspective.[4]The same trend is also observed for public transfers made inside large entities with heterogeneous membership inside the developed world itself. A striking illustration is provided by the European Union whose poorer member countries are also those where governance is of lower quality. Its leaders have recently agreed to set up a €750 billion fund to help members recover from the COVID-19 crisis. The rule guiding the allocation of this fund is that the countries hardest hit, those of southern Europe, will receive disproportionately large amounts of money even though their governance quality is comparatively low. Revealingly, the Commission has devised a monitoring-cum-sanction mechanism providing that payments may be suspended if the relevant milestones or targets are not fulfilled satisfactorily (Sapir, 2020). Moreover, as attested by the recent withholding of huge EU subsidies (€6.3bn) owed to Hungary (on December 12th, 2022), the initial tranche may not be disbursed if conditions have not been previously established to mitigate the risk of diversion of EU money to elites close to the government.[5] The same sort of challenge is facing national governments of developed countries which have to allocate central funds between regions which are unequally prosperous and unequally effective in their use of public money (north and south Italy, for example).

The possibility of influencing the way transfer money is used in recipient countries should logically modify the allocation rule among them, as it is defined by donors or transfer-makers. The reason is simply that they now have two instruments to affect the overall impact of aid: aid shares and monitoring intensity. To privilege the first instrument is unjustified since the two instruments are somehow substitutable. Assuming reasonably that the donor seeks to minimize overall poverty, the only meaningful yardstick for aid allocation is the post-aid per capita income of the poor, net of residual aid capture by local elites and of monitoring expenses aimed at mitigating such capture. Clearly, these two cost elements (from the viewpoint of the poor) depend on the extent of monitoring exerted by the donor.

It should be clear now that, although our analytical foray uses the language and framework of aid development literature, it has a much broader scope and relevance. It also bears emphasis that, rather oddly, the question of optimal monitoring has been essentially bypassed in that literature. To address it, we write a two-country model which has three noteworthy features. First, effectiveness of aid use, that is its capacity to reduce poverty, depends not only on the quality of basic or intrinsic governance as it is determined by domestic forces in the recipient country, but also on possible pressures exerted by the donor. This implies that a donor agency uses monitoring and, possibly, punishment mechanisms to obtain an outcome better aligned with its own, poor-oriented preference. Its influence is limited, however, because foreign monitors are unable to improve the basic governance climate within a country, which extends much beyond the domain of donor-funded aid programs or projects. For the same reason, recipient countries may not feel it necessary to modify basic governance within the ambit of aid projects in response to the external discipline imposed by the donor agency. Second, the donor simultaneously chooses the optimal levels for the two available instruments, namely the tailor-made external discipline based on the specific needs-governance situation of each beneficiary and the country aid shares (allowing for zero shares). Finally, and unlike in most models found in the literature of interest, the donor's poverty aversion is explicitly featured.[6]

None of the results achieved is trivial and could have been anticipated without the help of a model. A first set of salient results concerns the impact of endogenization of governance – at least the part of governance that affects the use of aid – on aid efficiency, as measured by the portion of aid that eventually reaches the poor after due allowance has been made for residual aid misuse and monitoring expenses. This impact is non-ambiguous: aid efficiency improves in the two countries, yet to a greater extent in the worse-governed country. Variations in country aid shares, however, can move in either direction. Thus, when a donor switches from exogenous monitoring (including zero monitoring) to optimal country-specific monitoring, the aid share of the worse-governed and poorer country can increase or decrease, and the conditions under which it decreases are fully elucidated. This being reckoned, what bears emphasis is the following complementary result: thanks to the donor's comparatively large monitoring effort applied to that country, the post-aid income of its poor is certain to increase, regardless of the way its aid share varies. Such is not necessarily the case for the other, better-governed country where the same switch from exogenous to endogenous monitoring can cause a fall in the aid share that is not fully compensated by a stronger, endogenously determined governance of aid use.

Another original contribution of our approach consists of highlighting the key role of model parameters: the initial level of the gaps between the per capita incomes of the poor and between intrinsic governance quality in the two countries, and the donor's degree of poverty aversion. In particular, these parameters influence the way country aid shares differ when aid allocation under optimal (endogenous) monitoring is compared to the same under exogenous uniform (or even optimal uniform) monitoring. Interestingly, they can work interactively in multiple ways. Regarding poverty aversion, an important result is that strong aversion does not make the donor less willing to seize the opportunity of disciplining fragile countries. What it does, however, is to reduce the donor's willingness to let the aid share allocated to these countries simultaneously fall.

Before presenting the structure of the paper, a few remarks that precise the perspective and the relevance of our contribution are in order. First, our effort belongs to standard public economics, as reflected in regional allocation models where a central government has to allocate fixed resources among regions which may use the corresponding amounts more or less efficiently or inclusively. However, a noticeable difference with the optimal redistribution literature, and, in particular, the asymmetric information framework found in the Mirrlees' type of model, is that, in our setting, the central government – here the donor – has full information about the behavior of recipient countries, which are assumed not to change behavior in response to the aid inflow and the monitoring imposed by the donor, except possibly in a very simple and predictive way.[7] That informational advantage, it must be stressed, does not afford the government full control over the recipients since modifying their behavior involves an increasing cost

[4] Think, for example, of China's effort to redesign BRI projects by shifting from vast investments to smaller-scale projects (Economist, September 9–15 2023a, 2023b: 49).

[5] Equally interesting is the fact that unlike Hungary, Poland submitted to the conditions imposed by the EU, and henceforth got the green light for access to its share of the fund.

[6] An exception, here, is Bourguignon and Platteau (2021).

[7] In the public economics literature, a model close to our own setting, but with asymmetric information, is Bordignon et al. (2001).

(disciplining is imperfect). In sum, the simplicity of our own framework regarding informational and behavioral assumptions is the price to pay for endogenizing governance while sticking to the dominant framework used in the aid literature.

Second, the perspective adopted is clearly normative, and it justifies the (convenient) assumption of a single donor in charge of allocating the available aid. Any coordination failure between multiple donors will most likely yield inferior outcomes. This is true even when competition has the effect of increasing aid flows since, in this case, other objectives than poverty reduction are plausibly driving aid givers. Third, the benefits of external discipline, as exerted by the donor, are obtained at the price of a loss of national sovereignty in the recipient countries. In our understanding, though, the donor agency is not preoccupied by such a loss. The only thing that matters for it is the predicament of the poor whose interest entails a reduction in the power of the political elite. The donor is therefore insensitive to the latter's claim to act on behalf of the entire nation and to be in charge of guarding its sovereign prerogatives. In point of fact, such a claim is often self-serving as it helps conceal the true motives behind the elite's behavior.

Fourth, the strategy consisting for rich countries of distributing aid through the channel of Non-Governmental Organizations (NGOs) or other private partner associations is not the panacea that it is sometimes thought to be. Allocating money to NGOs or local agencies does not actually solve the problem of aid misuse altogether. In particular, NGOs or so-called local partner associations may just be shell organizations set up by unscrupulous officials who are eager to get hold of the aid money wherever it is on offer.[8] Or they may be agencies unable to resist the pressures of rent-seeking officials on whom they depend for licences to operate.[9] Therefore, even when the donor chooses to earmark the whole aid fund for NGOs, monitoring aid use is necessary to (partially) improve governance. It is true, however, that NGOs, if only because they tend to be small and politically weak, may be easier to monitor and sanction than government agencies.

The outline of the paper is as follows. Section 2 reviews the directly relevant literature and helps situate the present contribution in its context. Section 3 presents the two-country model with optimal monitoring together with its main properties while Section 4 pursues the formal analysis by comparing exogenous with endogenous donor's discipline. The latter regime corresponds to optimal, country-specific discipline whereas the former stands for either absent external discipline, or uniform discipline set at a level below the one that would be optimal in either country. Section 5 discusses several extensions of the basic model, including the possible response of the recipient countries to the imposition of external discipline, the case of optimal uniform discipline across the two countries, and the case of n recipient countries. Section 6 summarizes the most important results by illustrating them graphically on the basis of numerical simulations. Section 7 concludes and brings out important policy implications of the whole analysis.

[8] Thus, in the case of Benin, local NGOs and associations, which are often "empty shells established with the sole purpose of capturing aid", have multiplied within a short period of time to number several thousands (Le Monde, 26 February 2001). In non-African countries, too, NGOs often constitute "an opportunistic response of downsized bureaucrats, with no real participation or local empowerment" and, inevitably, program officers themselves become involved in the creation of community institutions (Conning and Kevane, 2002: 383–84). In a more vivid language, NGOs are said to "often sprout up, like plants in the sunlight, solely to bathe in this foreign money" (Economist, Special Report: Aid to Africa, July 2–8 2005: 26).

[9] Thus, a staff member of USAID, the official aid agency of the US government, recently admitted to having seen the latter scenario "repeated countless times", leading him to the conclusion that "local agencies operate at the pleasure of the host government" (Economist, May 27-June 2 2023b: 16).

2. Literature review

As is apparent from a recent survey (Bourguignon and Gunning, 2017), the literature addressing the issue of aid allocation with a focus on agency problems is surprisingly narrow. Azam and Laffont (2003), who provided an earlier survey of aid allocation works using a macroeconomic framework, also proposed a simple and elegant framework for studying this problem. Within a principal–agent framework, the optimal contract between the donor and the recipient country specifies that the latter should receive an aid amount linearly and positively dependent on the poor's level of consumption that it provides.[10] Such a rule describes in a stylized manner the basic conditionality mechanism whose mode of operation essentially says that aid must be disbursed only after observing the consumption of the poor.

While Azam and Laffont do not explicitly address the issue of aid allocation across different countries, possibly with different internal governance characteristics, Svensson (2000, 2003) tackles this issue upfront in a two-stage game with two recipient countries and a single donor. The two recipients are identical yet subject to independent shocks, so that their ex post situation may differ. The key assumption is that the probability of good states increases monotonically with the amount of reform effort applied by the recipient country, yet this effort is not observed by the donor. In Svensson's model (2000), the second-best contract is a compromise between giving aid to those who most need it and providing optimal incentives for reforms. This translates into the following donor's strategy: in order to induce the recipient to exert higher effort, aid flows in bad states must be lowered and aid flows in good states (more likely to occur when reform effort has been higher) raised (p. 70). Aid thus depends negatively on the extent of (ex-post) poverty so as to preserve effort incentives.

Following the observation that aid effectiveness depends crucially on the quality of institutions and policies in the receiving countries (Burnside and Dollar, 2000), Collier and Dollar (2002) have investigated the problem of a donor's allocation of aid funds between several recipient countries which differ in terms of both policy quality (or governance in our own framework) and poverty. In their setup and unlike in the previous approaches, the quality of policies in each recipient country is taken as given by the donor. The latter then maximizes poverty reduction under that constraint, which leads to the conclusion that, holding the level of poverty constant, aid should increase with quality of policy and, holding policy quality constant, it should increase with poverty. Several papers have broadened or modified the framework proposed by Collier-Dollar, which appears as a key reference in the aid allocation literature.[11]

Thus, Carter (2014) also asks how to allocate a given amount of aid between countries with different levels of poverty and governance (see also Carter et al. (2015)). Instead of a donor's utility function, however, the author uses the Performance-Based Allocation (PBA) formula of the World Bank's IDA (International Development Association), which features a governance variable and a needs (income) variable, both weighed by a specific parameter. He then identifies the values of these parameters that maximize the discounted sum of the recipients' future utility, assuming that each recipient economy follows a Ramsey growth path under both governance and aid absorptive capacity constraints. Rather intuitively, the presence of the latter constraint implies that, for given governance levels, poorer countries ought not necessarily to receive more aid than richer countries. Bourguignon and Platteau –

[10] In an earlier theoretical model of aid conditionality (Adam and O' Connell, 1999), aid was conditional on domestic policy variables, which in turn were determining the welfare of the poor.

[11] See, for example, Cogneau and Naudet (2007) and Wood (2008). Note that the case of several donors and one recipient country is addressed in Knack and Rahman (2004) and Torsvik (2005), who examine how alignment of incentives is affected by the presence of multiple donors. The problem of aid coordination among donors is analyzed in Bourguignon and Platteau (2015).

thereafter BP – (2017, 2021) also consider governance levels in recipient countries as given. Besides reviewing the aid allocation literature, their 2017 paper analyzes the comparative static properties of a simple need-governance allocation problem within a more general theoretical framework than the specific model used by Collier and Dollar (2002). They show, in particular, how the sign of the effect of an increase in total aid upon its allocation among two countries depends on the relative quality of governance between the two recipient countries. In their 2021 paper, they cling to the same framework but introduce the poverty aversion of the donor into the aid allocation problem and depict the way the trade-off between needs and governance is played out. This leads them to question the intuitive view that a country which improved its internal governance should always receive more aid from a donor, as argued in Collier and Dollar (2002). The validity of such a view turns out to depend on the degree of poverty aversion. In the same paper, the authors consider a variant in which the aid amount received influences aid effectiveness (as measured by its share reaching the poor). As in Carter (2014), the idea is that more aid may worsen the incentives to use it effectively in the recipient country. The conclusions obtained in their basic model continue to hold. Finally, the similarities and differences between the general model offered and the PBA aid allocation formula used by the IDA are brought to light by translating the latter into the language of the former.

In the present contribution, the analysis differs from the line followed in the aforementioned works to the extent that they are based on the assumption that governance in recipient countries is exogenous or influenced by no other channel than the mere amount of aid transferred (and/or the conditions imposed on the recipient country so that this transfer can take place). By assuming the donor's ability to partly influence aid effectiveness within recipient countries at a cost, it merges two streams of our previous work: the optimal monitoring of a single aid recipient (BP, 2018) and the aid allocation problem (BP, 2017, 2021). A short early attempt was made in that direction in the last section of still another paper – BP (2022) –, but this was mostly devoted to the elucidation of further properties of the one-recipient endogenous governance model, particularly the corner solutions which were assumed away in (BP, 2018). Unfortunately, the model resulting from the extension of the analysis to two recipients proved too cumbersome and could not deliver analytically tractable results.[12] The present paper relies on a slightly modified framework that retains the general logic of our previous attempt but allows for a full analysis of the practical implications of endogenous governance for aid allocation and aid monitoring strategies.[13] Interesting extensions can also be obtained.

Because it allows for donor's (optimal) control of aid use, our endeavor involves the economics of monitoring and sanctioning which, to our knowledge, has not been applied to the aid allocation problem to this date.[14] More pointedly, we explore the question as to how, and with what consequences, a donor may vary a disciplining intensity as a function of the specific characteristics of two heterogeneous aid recipients.

Empirical research on the effects of monitoring aid use is as scant as theoretical research. One important reason is that monitoring costs and effects on aid effectiveness are rarely observed at the aggregate country level. However, two related attempts to assess the effectiveness of aid monitoring at the micro level deserve special attention. Based on a review of 1426 World Bank projects completed between 1981 and 1991, the first study highlights the potential contribution of monitoring to effectiveness of project aid (Kilby, 1995, 2001). It leads to the following conclusions: (i) supervision has a positive and perceptible impact on project performance; (ii) early supervision is much more effective than later supervision; (iii) supervision is profitable; and (iv) the impact of supervision is relatively homogenous across regions, sectors and macroeconomic conditions.[15] Using the same dataset, the second study, by Chauvet et al. (2017), argues 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.

3. The model and its properties

3.1. The setup of the model

We consider the case of two beneficiary countries i (= 1, 2) where the initial, pre-aid per capita incomes of the poor are w_1 and w_2, respectively. Their numbers are n_1 and n_2. It is convenient to define poor people as an arbitrary fraction (say, 30 or 40 percent) of the total population making up the lower part of the income scale. Thus, n_1 and n_2 are proportional to the populations of the two countries. The donor, for instance a bilateral or multilateral development agency, has to allocate an exogenous amount of aid T between the two countries, s_1 and s_2 (= $1 - s_1$) being the shares of total aid going to countries 1 and 2. However, a portion γ_i of aid is devoted to the task of monitoring the way it is used, so that only a share $s_i(1-\gamma_i)$ is actually reaching the poor in country i. This amount corresponds to the concept of 'operable' aid in the aid literature. To this subtraction we must add another that stems from local administrative cost, inefficient management or mere embezzlement of aid money by local elites. We assume that such domestic leakages represent a proportion y_i of operable aid, so that the poor of country i will eventually obtain a portion $(1-\gamma_i)(1-y_i)$ of the aid fund transferred to their government, and $s_i(1-\gamma_i)(1-y_i)$ of the total fund, T.

Based on these simple assumptions, the objective function of the donor is to maximize the utility derived from the improved, post-aid level of income of poor individuals in recipient countries, namely

$$\sum_{i=1}^{2} n_i u\left[w_i + s_i(1-\gamma_i)(T/n_i)(1-y_i)\right] \tag{3.1}$$

where $u(.)$ is a standard increasing and concave utility function and its argument represents the average income per capita of poor people in each country. By considering a representative individual of the poor population, this utilitarian specification of the donor's objective abstracts from the inequality of incomes among the poor inside each country. This is not a problem if one reasonably assumes that the distribution of relative incomes among the poor is unaffected by aid — i.e. all poor people benefit in the same proportion from the aid transfer. In the following, it will be convenient to use the familiar isoelastic specification:

$$u(z) = \frac{1}{1-\varepsilon} z^{1-\varepsilon} \tag{3.2}$$

where z denotes the terms between square brackets in (3.1), that is, the post-aid level of per capita income of the poor. With such specification, it can be seen that the donor's utilitarian objective function (3.1) is of the CES type, which means that the elasticity of substitution between the post-aid income of the poor in the two countries, clearly a key parameter in the aid allocation problem, is constant. Such a

[12] See BP (2022): 291

[13] A brief comparison of the two specifications appears throughout the paper.

[14] Fields where this type of analysis has been carried out include the economics of crime (Becker, 1974; Chander and Wilde, 1992; Bose, 1995); the public economics of tax compliance (Andreoni et al., 1998; Kleven et al., 2011) or social allowances (Boone et al., 2007; Setty, 2019); and the economics of (agrarian) contracts (Otsuka et al., 1993).

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

specification of what is here the equivalent of a social welfare function is quite common in the optimal taxation literature (see for instance Tuomala, 1983). On the other hand, as is well-known, the elasticity of substitution ε can also be interpreted as the donor's aversion for inequality or, in this particular case, poverty.[16]

Getting back to the post-aid income per capita of poor people, i.e. the argument of the utilitarian objective (3.1), it bears emphasis that $1 - y_i$ is a standard measure of aid effectiveness. Under these conditions, it is natural to refer to $(1 - \gamma_i)(1 - y_i)$ as a *monitoring-adjusted measure of aid effectiveness*. It reflects the role of efficiency considerations in the presence of aid monitoring.

The main contribution we seek for this paper lies in the endogenization of the leakage term y_i. It is precisely this leakage rate that the donor tries to control by spending a larger or smaller amount of resources on monitoring, possibly including sanctions in the case of excessive leakage. The leakage rate is assumed to be a function $\lambda(\beta_i, \gamma_i)$, where β_i is an exogenous factor specific to each country, and γ_i, also specific to each country, stands for the donor's expenditure on aid monitoring per dollar of aid, or the 'unit spending on monitoring' for country i.

In the same way as γ_i can be seen as the external discipline imposed by the donor on the government of country i, β_i may be interpreted as the internal discipline through which civil society within that country controls the government's operations or the latter restrains itself in predating on poor people. More generally, it can also be interpreted as the *basic (intrinsic) or overall governance* prevailing in country i, in the sense of the governance that ultimately determines the extent to which public spending directed to the poor actually reaches their target. The extent of aid leakage can therefore be seen as the simultaneous outcome of two forces: the intrinsic governance of a country, which bears upon the effectiveness of public spending in reaching poor people in general and the country-specific control exerted by the donor on the use of aid in particular.

This interpretation of the two indicators, β_i and γ_i, leads to a specification of the leakage function $\lambda(\beta_i, \gamma_i)$ as the transformation of some additive combination of functions of β_i and γ_i. These functions measure the extent of dissuasion conveyed by the two types of discipline, internal and external, which can be added to each other, whereas the transformation is meant to represent the actual impact of the combined dissuasive measures on the level of aid leakage. Accordingly, $\lambda(\beta_i, \gamma_i)$ is written:

$$y_i = \lambda(\beta_i, \gamma_i) = h\left[\varphi(\beta_i) + \psi(\gamma_i)\right] \tag{3.3}$$

with:

$$\varphi'(), \psi'() \geq 0;\ \varphi''(), \psi''() \leq 0;\ h() \in [0,1];\ h'() \leq 0;\ h''() \geq 0$$

In other words, the dissuasive power of both disciplines increases at a declining rate with their intensity, whereas the leakage rate declines at a declining rate as a function of their combined power. This functional specification seems extremely general, even though it includes purely additive forms, CES-like forms and even Cobb–Douglas as particular cases.[17] As far as the leakage rate function $\lambda(\beta_i, \gamma_i)$ is concerned, the chosen specification implies the following, rather intuitive properties:

$$\lambda(\beta_i, \gamma_i) \in [0,1];\ \lambda_\gamma \leq 0;\ \lambda_\beta \leq 0; \lambda_{\gamma\gamma} \geq 0; \lambda_{\gamma\beta} \geq 0 \tag{3.4}$$

where the notation λ_X stands for the partial derivative of the leakage function with respect to the parameter X and λ_{XY} the second cross-derivative with respect to parameters X and Y. In addition (3.3) implies:

$$\frac{\lambda_{\gamma\beta}}{\lambda_\beta} \geq \frac{\lambda_{\gamma\gamma}}{\lambda_\gamma} \tag{3.5}$$

Bearing in mind that both λ_β and λ_γ are negative, this relationship says that the (negative) relative impact of external discipline on the marginal effectiveness of internal discipline is smaller, in absolute value, than its impact on the effectiveness of external discipline. This property is rather intuitive: in a given aid project or programme, stronger donor monitoring affects its own marginal effectiveness more than the marginal effectiveness of the country's general governance.

Several remarks related to the preceding assumptions are in order. First, assuming that the leakage function is identical in the two countries is not restrictive. Indeed, leakage will be country-specific insofar as the donor varies the intensity of monitoring depending on the intrinsic governance indicator, β_i, which differs across the two countries. These indicators play a central role in our analysis, whose focus will be on the way intrinsic governance affects the degree of external monitoring and aid is allocated among the two countries. Second, it is worth pointing out that the specification (3.3) is a generalization of a model used by BP (2018, 2022) to depict the behavior of a not fully honest ruler of a recipient country who is facing both external and internal sanctions in the event that aid embezzlement is detected. Such event occurs with a probability reasonably assumed to rise at an increasing rate with the extent of the aid leakage.[18]

Third, we need to stress that there is no real alternative to the direct monitoring, and possibly sanctioning, of the recipient country by the donor if aid effectiveness is to be enhanced above and beyond what is implied by the general governance within the country. In particular, any contract specifying the (minimum) share of aid accruing to the poor that would not trigger off direct donor control would be necessarily deceived because of the fungibility of aid. More aid would be officially given to the poor within the aid project but this would be at the expense of what they would receive through internal channels. Fourth, it turns out that only condition (3.5) is required to establish the propositions made in the rest of this paper. This being said, the rather general functional form (3.3) provides an appealing intuitive basis to understand the nature of the relationship between the internal and external disciplines that constrain the behavior of the rulers of recipient countries or of the whole domestic administrative apparatus in charge of managing aid.

The model of aid allocation under endogenous, aid-specific governance is now complete. The donor must chose four key parameters: the allocation of total aid among the two countries, s_1, s_2, and the rate of monitoring in the two countries, γ_1 and γ_2. They are set in such a way as to maximize the objective function (3.1), under the constraints (3.3) and $s_1 + s_2 = 1$.

Before analyzing the properties of the model, it is important to emphasize that in our model the cost of monitoring the use of aid is imputed to each country and, as a matter of fact, to the poor. This corresponds to common practice. A M&E (Monitoring and Evaluation) item is generally included in the budget of aid projects. An alternative approach would consist of viewing monitoring expenses as a cost incurred by the donor in addition to the aid funds themselves. The donor's objective function could then be written as:

$$\sum_{i=1}^{2} n_i u\left(w_i + s_i(T/n_i)(1 - \lambda(\beta_i, \gamma_i))\right) - \sum_{i=1}^{2} \gamma_i s_i T \tag{3.6}$$

We shall show below that, under (3.5), this version of the model which was used in previous work — see BP (2021, 2022)- would yield results comparable to those obtained under the more conventional cost imputation assumption.

In what follows, we first characterize the solution of the model and then proceed by analyzing some key properties, most importantly the way aid allocation between the two countries and the donor's monitoring effort for each country depend on the basic governance levels, β_1 and β_2, and on the pre-aid incomes of the poor in the two

[16] With two (representative) individuals, inequality and relative poverty are equivalent concepts.

[17] A Cobb–Douglas is obtained by allowing η to go to zero in $\varphi(\beta) = a\beta^\eta; \psi(\gamma) = b\gamma^\eta; h(x) = x^{-\frac{e}{\eta}}$

[18] See Section 6.

countries. Without loss of generality, it is assumed in the rest of this paper that $\beta_1 < \beta_2$. In other words, country 1 is supposed to be the worse-governed country. In agreement with the observation made in the introduction that countries with weak governance are often the poorest, we make the additional assumption that the poor people of country 1 have a lower level of living than in country 2: $w_1 < w_2$. We shall stress the instances where the latter assumption matters for the validity of a proposition.

3.2. Solution of the model

The separability of the objective function (3.1) with respect to $\gamma_i$simplifies its maximization. Differentiating first with respect to γ_i, and using the specification $\lambda(.,.)$ of the leakage rate in (3.3), leads to the first-order condition: $n_i u'(z_i) z_{\gamma_i} = 0$, which implies $z_{\gamma_i} = 0$ and thus:

$$-(1-\gamma_i)\lambda^i_\gamma = 1 - \lambda^i \quad i = 1,2 \tag{3.7}$$

where λ^i is a shortcut for $\lambda(\beta_i, \gamma_i)$ and, as before, λ^i_X stands for the partial derivative of $\lambda(.,.)$ with respect to argument $X = (\beta_i, \gamma_i)$ for $i = 1,2$. Multiplying both sides by $s_i T$, this equation states that, at equilibrium, the marginal benefit of reducing the leakage so that more operable aid reaches the poor should be equal to the marginal cost of the monitoring of aid use.. Eq. (3.7) thus gives the optimal value of unit spending on monitoring as a function of the country's basic governance, β_i, and consecutively the optimal leakage rate of aid. Due to the separability of the objective function (3.1) with respect to γ_i, the optimal value of monitoring is independent of the pre-aid income of the poor and the allocation of aid, which is a convenient property. On the other hand, it is easily seen that the second-order condition for maximization is satisfied because of the convexity of the function $\lambda(\beta_i, \gamma_i)$ – or the concavity of the term $(1 - \lambda(\beta_i, \gamma_i))$ in the objective function – with respect to γ_i.

Taking now the derivative of the objective function with respect to s_1, and making use of $s_2 = 1 - s_1$, yields the following condition:

$$\frac{u'_1}{u'_2} = \frac{\left(1-\lambda(\beta_2, \gamma_2^*)\right)(1-\gamma_2^*)}{\left(1-\lambda(\beta_1, \gamma_1^*)\right)(1-\gamma_1^*)} \tag{3.8}$$

where u'_i stands for the marginal utility the donor derives from the net post-aid income of the poor in country i and γ_i^* for the solution of (3.7). This condition is the familiar equality of the rate of substitution of the donor's preferences between the income of the poor in the two recipient countries and the relative effectiveness in transferring income to them. This relative effectiveness is known once the first-order conditions (3.7) have been solved. Eq. (3.8) is then an equation in s_1, which appears in the arguments of the marginal utilities u'_1 and u'_2. In the case of the iso-elastic specification (3.2) of the utility function, it is possible to get an analytical expression of its solution. Call E_i^* the optimal monitoring-adjusted aid effectiveness in country i :

$$E_i^* = \left(1-\lambda(\beta_i, \gamma_i^*)\right)(1-\gamma_i^*), \; i = 1,2$$

As has been mentioned earlier, this indicator corresponds to the standard concept of aid effectiveness, $1 - \lambda(\beta_i, \gamma_i^*)$, corrected by the operable aid ratio, $1 - \gamma_i^*$. Then, solving (3.8) for $s_1$under (3.2) in the case of an interior solution in the $]0,1[$ interval yields:

$$s_1 = \frac{(E_1^*/E_2^*)^{1/\varepsilon}(w_2 + E_2^* T/n_2) - w_1}{T\left(E_1^*/n_1 + (E_1^*/E_2^*)^{1/\varepsilon} E_2^*/n_2\right)} \tag{3.9}$$

This expression may be rewritten so as to make salient the role of what can be termed the 'need-and-monitoring-adjusted aid effectiveness' for each country, $E_i^{*1/\varepsilon}/w_i$:[19]

$$s_1 = \frac{E_2^{*1-1/\varepsilon}/n_2}{E_1^{*1-1/\varepsilon}/n_1 + E_2^{*1-1/\varepsilon}/n_2} + \frac{w_2 E_2^{*-1/\varepsilon} - w_1 E_1^{*-1/\varepsilon}}{T\left(E_1^{*1-1/\varepsilon}/n_1 + E_2^{*1-1/\varepsilon}/n_2\right)} \tag{3.10}$$

[19] This labeling takes its inspiration from BP (2021), where 'need-adjusted aid effectiveness' was defined as $1 - y_i/w_i$..

Thus, the aid share of a country increases with its own need- and-monitoring-adjusted aid effectiveness, while it decreases with that of the other country. On the other hand, the first term on the right-hand side shows how the aid share depends on demographic weights corrected by the corresponding levels of monitoring-adjusted aid effectiveness.

3.3. Properties of the solution

Once the optimal monitoring efforts are applied, monitoring-adjusted aid effectiveness (E_i^*) is fixed in both countries so that the properties of the aid allocation model are identical to those derived in the case of exogenous aid effectiveness (BP, 2021). In particular, it is evident from (3.10), and according to intuition, that the share of country 1 decreases with w_1 and increases with w_2. The next set of results requires that we solve the problem of optimal monitoring in a two-country setup, which is the specific focus of the present paper. This involves determining the donor's optimal level of monitoring as given by (3.7), the associated leakage rate as well as the monitoring-adjusted aid effectiveness, and the way these indicators depend on the intrinsic governance of a recipient country. Proposition 1 sums up these results, and the original proof follows.

Proposition 1. *The optimal unit spending on monitoring by the donor falls with the basic governance of a country, implying that basic governance and external monitoring are substitutes. Albeit in the opposite direction, the donor's reaction is never strong enough to cause an increase in the aid leakage rate. As a result, the monitoring-adjusted aid effectiveness of a recipient country is an increasing function of its basic governance.*

Proof. Differentiating (3.7) with respect to β_i and γ_i yields:

$$\frac{d\gamma_i^*}{d\beta_i} = -\frac{\lambda^i_\beta - (1-\gamma_i)\lambda^i_{\beta\gamma}}{2\lambda^i_\gamma - (1-\gamma_i)\lambda^i_{\gamma\gamma}} \tag{3.11}$$

In view of (3.4), both the denominator and the numerator are clearly negative so that $\partial\gamma_i/\partial\beta_i$ is unambiguously negative. To show that the optimal leakage rate, $y_i^* = \lambda(\beta_i, \gamma_i^*)$, also falls with β_i, differentiate the leakage function:

$$\frac{dy_i^*}{d\beta_i} = \lambda^i_\beta + \lambda^i_\gamma \frac{d\gamma_i^*}{d\beta_i}$$

Then, making use of (3.11), it easily comes that:

$$sign\left\{\frac{dy_i^*}{d\beta_i}\right\} = -sign\left\{\lambda^i_\beta \lambda^i_\gamma + (1-\gamma_i^*)[\lambda^i_\gamma \lambda^i_{\beta\gamma} - \lambda^i_\beta \lambda^i_{\gamma\gamma}]\right\}$$

The expression in square brackets is positive according to property (3.5) of the leakage function. Therefore, the whole curly bracket is positive and the optimal leakage rate declines with the intrinsic governance of the country. Finally, it can be seen that since both the intensity of monitoring and the leakage rate fall with β_i, the whole monitoring-adjusted aid effectiveness of country i, E_i^*, increases with its intrinsic governance. □

Proposition 1 thus implies that the donor will apply more monitoring to the worse-governed country, country 1, yet not to such an extent that it could make the magnitude of aid leakage smaller, and monitoring-adjusted aid effectiveness higher, than in country 2.

Another property which needs to be brought into light bears upon the allocation of aid: once the monitoring-adjusted aid effectiveness as a function of the recipient countries' intrinsic governance is known, how the donor ought to allocate aid between the two countries comes down to the problem of aid allocation under exogenous governance. Somewhat intriguingly, as has been proven in BP (2021), the share of aid going to country 1 increases with its aid effectiveness, E_1^*, yet only if the poverty aversion of the donor is below some threshold value above unity. It would fall if poverty aversion is above that threshold and, in particular, if it becomes extremely large and close to the Rawlsian

criterion ($\varepsilon \to \infty$). Because it will be used again in the sequel of this paper, this property deserves to be stated in a separate proposition, the proof of which can be found in BP (2021):

Proposition 2. *There exists a critical value of poverty aversion such that the aid share of the worse-governed country increases with its basic governance below this value and decreases above it.*

The intuition behind Proposition 2 is worth precising because it helps grasp the complexity of the problem at stake. The key fact is that two opposite effects are at work, and whether one dominates the other depends on the value of ε. Through the first, a substitution effect, the donor is induced to reward better governance by dedicating a higher aid share to the country whose basic governance has improved. The second effect, an income effect, stems from the fact that the income of the poor in that country has thereby increased relative to the income of the poor in the other country. On that count, the donor wants to reduce the aid share awarded to the country whose governance has improved. The more poverty-averse the donor, the more sensitive to the income effect. Therefore, when poverty aversion is strong enough, the second effect outweighs the first and an inverse relationship between aid effectiveness and aid share is obtained.

Equipped with the properties elucidated in Propositions 1 and 2, the subsequent and most critical step of our analysis will consist of comparing the regimes of endogenous and exogenous discipline by looking at the end outcomes in terms of both the welfare of the poor in the two recipient countries and the pattern of aid allocation between them.

Before embarking upon this endeavor, however, it is worth checking whether the properties of the optimal monitoring intensity are still valid when the alternative specification of the donor's objective function (3.6) is adopted, in which the cost of monitoring is borne by the donor rather than the poor in the recipient country. Thanks to condition (3.5) again, it turns out that both the unit spending on monitoring and the leakage rate fall with intrinsic governance, while the opposite is true of the monitoring-adjusted effectiveness of aid. The difference with the preceding model is that the optimal monitoring and its elasticity with respect to overall governance now depend on the allocation of aid.[20] We will come back later to what this implies regarding the validity of other results of the model where the cost of monitoring is borne by the recipient country.

4. Comparing aid allocation under endogenous and exogenous or uniform monitoring

4.1. The issues at stake

This section is based on the observation that the possibility of varying the extent of monitoring when deciding about the allocation of aid among different countries does not seem present in the explicit or implicit formulae used today by bilateral or multi-lateral development agencies. The idea is to evaluate how different their aid allocation would be if they were optimizing aid monitoring based on their knowledge of the basic governance of each recipient country.

An extreme case would be to assume that development agencies play no role in the way aid funds are being used. They sign a check and let the recipient countries' government manage the corresponding funds as it wishes. In practice, however, some measure of monitoring takes place, which is codified in the bureaucratic functioning of these agencies. In many instances, it is even the case that an evaluation is undertaken at the end of projects or programs to show to their constituencies how aid money was used. This evaluation is admittedly based on some form of information collected and monitoring applied throughout the life of the funded projects and programs. Nonetheless, it is typically run in a modest or even perfunctory manner, meaning that it relies on rather standardized reports written by project or program managers rather than on detailed inquiries led by an independent staff dedicated to the task. Some agencies may be more ambitious than others and exert a tighter monitoring, yet their operations are always part of a bureaucratic routine. There is thus ground to believe that the intensity of monitoring is rather uniform among recipient countries, instead of being country-specific as in the model presented in Section 3.

Based on such a scenario, the present section compares the impact of aid and its allocation across countries under two different monitoring scenarios: (i) an exogenous, uniform monitoring intensity, γ^0, applied to all the recipient countries; (ii) an optimal, or endogenous, country-specific monitoring intensity, γ_i^*. Under (i), two particular cases are of interest: the case of no monitoring where $\gamma^0 = 0$, and the case where the better-governed country is considered as the reference point by the donor, who thus sets the exogenous uniform monitoring intensity at the level that would be optimal for that country. Since it is assumed that $\beta_1 < \beta_2$, this means that $\gamma^0 = \gamma_2^*$. Practically, however, it turns out that results are qualitatively similar for all values of the exogenous uniform monitoring intensity in the interval $[0, \gamma_2^*]$. This is the reason why we do not distinguish between the two particular cases in the following analysis.

Three sets of questions need to be elucidated. First, what is the impact of optimizing the intensity of monitoring on relative levels of aid effectiveness, and how do poor people in the two countries benefit from this change? Second, how do aid shares change when the donor shifts from exogenous to endogenous discipline (or monitoring)? Finally, is the sensitivity of the aid allocation rule to pre-aid incomes and basic governance parameters modified when the same shift of monitoring regimes occurs? As pointed out above, we consider that exogenous uniform monitoring is implicitly the current modus operandi of many development agencies while country-specific monitoring is the optimal procedure that all donors ought to follow. Seen in this light, the questions that we raise are of great policy relevance.

To simplify notations and derivations, we henceforth assume that $n_1 = n_2 = 1$. This is an innocuous assumption insofar as all the following propositions would remain valid in the general case.

4.2. The efficiencywise superiority of endogenous monitoring

The first issue when we compare endogenous, country-specific monitoring with uniform monitoring is how the two regimes can be ranked in terms of monitoring-adjusted aid effectiveness in the two countries. The result of the comparison is stated in Proposition 3.

Proposition 3. *Compared to the case where the intensity of monitoring is exogenous and uniform in the interval $[0, \gamma_2^*]$, endogenous monitoring causes monitoring-adjusted aid effectiveness to be higher in the two countries but relatively more so in the worse-governed country.*

Proof. The gain in effectiveness when moving from exogenous to optimal monitoring in country i is given by:

$$G_i = \frac{(1-\gamma_i^*)\left(1-\lambda(\beta_i,\gamma_i^*)\right)}{(1-\gamma^0)\left(1-\lambda(\beta_i,\gamma^0)\right)} = \frac{E_i^*}{E_i^0}$$

where E_i^0 denotes aid effectiveness in country i when monitoring is exogenously determined. Differentiating this expression with respect to

[20] The first-order condition of the new model is: $-u'(z_i)\lambda_\gamma^i - 1 = 0$, where z_i is the post-aid income of the poor. Differentiating with respect to γ and β yields:

$$\frac{d\gamma_i^*}{d\beta_i} = -\frac{\varepsilon\mu_i\lambda_\gamma^i\lambda_\beta^i + (1-\lambda^i)\lambda_{\beta\gamma}^i}{\varepsilon\mu_i(\lambda_\gamma^i)^2 + (1-\lambda^i)\lambda_{\gamma\gamma}^i}$$

which is negative. Substituting into (3.11) and making use of (3.5) lead to the conclusion that the leakage rate falls with the overall governance.

β_i and making use of the first-order maximization condition (3.7), the sign of that derivative is given by:

$$sign\left(\frac{dG_i}{d\beta_i}\right) = sign\left\{-\frac{\lambda_\beta(\beta_i,\gamma_i^*)}{1-\lambda(\beta_i,\gamma_i^*)} + \frac{\lambda_\beta(\beta_i,\gamma^0)}{1-\lambda(\beta_i,\gamma^0)}\right\}$$

It is easily proven that, given $\lambda_\gamma > 0$ and $\lambda_{\beta\gamma} \geq 0$ in (3.5), $\lambda_\beta/(1-\lambda)$ is an increasing function of γ.Thus, $dG_i/d\beta_i$ is unambiguously negative since $\gamma_i^* \geq \gamma^0$. The relative gain in (monitoring-adjusted) aid effectiveness due to endogenous monitoring is thus higher for the worse-governed country. Indeed, since $\beta_2 > \beta_1$,we have that $E_1^*/E_1^0 > E_2^*/E_2^0$ and, therefore,

$$\frac{E_1^*}{E_2^*} > \frac{E_1^0}{E_2^0} \quad \square \tag{4.1}$$

The general increase in aid effectiveness caused by the use of optimal tailor-made monitoring is an expected result, and it is linked to the separability of the donor's objective function with respect to unit monitoring spending. The intuition behind the larger increase observed for the worse-governed country is essentially that the restriction of the exogenous uniform monitoring, γ^0 to the interval $[0,\gamma_2^*]$, together with Proposition 2, imply that $\gamma^0 \leq \gamma_2^* < \gamma_1^*$. The endogenization of monitoring thus leads to a bigger change in the worse-governed country.

The comparatively strong increase in monitoring-adjusted aid effectiveness entails a similar property for the post-aid income of the poor, aid shares being constant. This additional result necessarily holds when the pre-aid income is lower in the worse-governed and poorer country (see footnote 15 above). The reason is that aid then represents a higher share of the poor's post-aid income in that country, so that it has the effect of bridging part of the inter-country gap in the poor's incomes.

4.3. Comparing aid shares under endogenous and exogenous monitoring

Our task under this subsection is to examine the effect on aid shares caused by a shift from exogenous uniform monitoring to optimal country-specific monitoring. In a first stage, we consider the case of corner solutions, ignored until now, and the possibility that the endogenization of monitoring makes a country aid-worthy in the eyes of a donor who did not deem it eligible under exogenous uniform monitoring. Clinging to our assumption that country 1 is the worse-governed recipient ($\beta_1 < \beta_2$), it can be seen from (3.9) that, in terms of monitoring-adjusted aid effectiveness, the condition under which this country will receive no aid ($s_1 = 0$) is:

$$E_1^{*1/\epsilon}/w_1 \leq \frac{E_2^{*1/\epsilon}/w_2}{1+TE_2^*/w_2}$$

In words, country 1 receives no aid if its need-adjusted aid effectiveness is smaller than a function of the same indicator in the other country. From the proof of Proposition 3, we know that $E_1^*/E_1^0 > E_2^*/E_2^0$. It follows that a switch from exogenous to endogenous monitoring would raise the value of the left-hand side of the preceding condition more than the value of the right-hand side, thus making the condition harder to satisfy. Therefore, if we assume that the above condition holds under exogenous monitoring, it is quite possible to encounter situations in which it is violated under endogenous monitoring. Hence the following proposition:

Proposition 4. *The donor's shift from exogenous uniform to endogenous monitoring may cause the worse-governed country to become aid-eligible.*

We can now tackle the case of an interior solution. The way the aid share of the worse-governed country compares under the two regimes is stated in Proposition 5, the proof of which is provided in Appendix A. The critical role of the degree of the donor's poverty aversion clearly comes out.

Proposition 5. *If the poverty aversion of the donor lies above some floor value smaller than unity, and if the exogenous, uniform unit spending in monitoring, γ^0, lies in the interval $[0,\gamma_2^*]$, there then exists a threshold on the pre-aid income of the poor in the worse-governed country below which that country's aid share becomes smaller when the donor switches from exogenous to endogenous monitoring. Above the threshold, which is an increasing function of the pre-aid income in the better-governed country, the aid share of the worse-governed country becomes larger.*

The logic behind Proposition 5 is revealing of the way our model works. We know that the switch from exogenous (uniform) to endogenous (country-specific) monitoring makes aid relatively more effective – in the sense of monitoring-adjusted effectiveness – in the worse-governed country, which prompts the donor to raise its aid share, according to a standard substitution mechanism. However, the same switch also increases the ratio of the post-aid incomes of the poor in favor of the worse-governed country. This sparks an income effect, which is more or less pronounced depending on the relative amounts of initial pre-aid incomes. The switch of monitoring regime will entail an increase in the aid share of the worse-governed country if the substitution effect outweighs the income effect, keeping in mind that the strength of the latter effect depends on the degree of the donor's poverty aversion. For a given aversion, the size of the income effect depends on the pre-aid income of the poor in the worse-governed country. If that income is large relative to the other country, the income effect is dominated by the substitution effect and the monitoring switch raises the aid share of the worse-governed country. The opposite outcome is obtained if the pre-aid income of the poor in the same country is small, giving rise to a large income effect.

The Rawlsian case where poverty aversion tends towards infinity provides an illustration of the limit case in which the aid share allocated to the worse-governed country falls as a result of the regime shift. In this case, the post-aid incomes of the poor are identical in the two countries:

$$w_1 + s_1E_1^*T = w_2 + (1-s_1)E_2^*T$$

Solving for s_1 and comparing the exogenous (s_1^0) and endogenous (s_1^*) monitoring regimes yields:

$$s_1^* - s_1^0 = \frac{w_2 - w_1}{T}\cdot\left(\frac{1}{E_1^*+E_2^*} - \frac{1}{E_1^0+E_2^0}\right) + \left(\frac{E_2^*}{E_1^*+E_2^*} - \frac{E_2^0}{E_1^0+E_2^0}\right)$$

Since the two terms in brackets are negative, the whole expression is also negative for w_1 smaller than w_2, which is in agreement with Proposition 5.

4.4. Post-aid incomes of the poor under endogenous and exogenous monitoring

More important than the aid shares accruing to individual recipient countries, which depend on their basic governance and the incomes of their poor, is the net change in these incomes after aid has been delivered. Putting Propositions 3 and 5 together, it appears that the post-aid income of the poor in the worse-governed country unambigously increases when the donor shifts to tailor-made optimal monitoring. However, this result is not guaranteed in the case of the better-governed country. The source of ambiguity lies in the conjunction of two effects. On the one hand, it was seen earlier that, the aid shares being given, the shift has the effect of raising the levels of monitoring-adjusted aid effectiveness in the two countries, and hence of the post-aid incomes of their poor, but relatively more so in the worse-governed and poorer country. On the other hand, aid shares are modified. When the share allocated to the worse-governed country increases, it reinforces the aid effectiveness effect in that country while it runs against it in the better-governed country, opening the possibility that the post-aid income of the poor declines in the latter. Of course, the situation could be reversed when the aid share of the worse-governed country falls with the shift of monitoring regime. The following proposition, the proof of which is presented in Appendix B, summarizes these properties.

Proposition 6. *When switching from exogenous, uniform monitoring γ^0 in the interval $[0, \gamma_2^*]$, to country-specific endogenous monitoring, the post-aid income of the poor in the worse-governed country increases relative to the corresponding income in the other country. This also holds true in absolute terms. As for the post-aid income of the poor in the better-governed country, it may fall.*

It is evident that the conditions under which the post-aid income of the poor in the better-governed country falls when the donor switches to endogenous monitoring depend on the unit spending on monitoring, γ^0, which is exogenously given. In this respect, a trivial but informative property of the model is that the post-aid income of the poor in the better-governed country necessarily decreases with monitoring endogenization if γ^0 is close to the optimal monitoring estimated for that country, γ_2^*. In such a case, indeed, the monitoring-adjusted aid effectiveness for country 2 does not change perceptibly with the switch to tailor-made monitoring, yet its aid share may fall under the conditions of Property 5. The post-aid income of the poor in the better-governed country therefore ends up being lower than under exogenous monitoring.

4.5. Sensitivity of aid shares under endogenous and exogenous monitoring

There is a last problem that we want to address. It concerns the comparative sensitivity of the aid allocation pattern to pre-aid incomes and basic governance under the regimes of endogenous and exogenous monitoring. This is a topical issue because we would like to know how the aid allocation (PBA) rules used by many donor agencies are biased. More precisely, do these rules put an excessive weight on the basic governance or on the income level of the poor in the recipient countries? As seen below, there is no clear answer to that question, except in one single instance.

Our approach is based on a comparison between the relevant partial derivatives of the aid share of the worse-governed country under endogenous and exogenous monitoring. When sensitivity to variations in pre-aid income of the poor is considered, the exercise yields the results stated in Proposition 7 and proven in Appendix C.

Proposition 7. *In comparison with the situation obtained under exogenous uniform monitoring, aid allocated to the worse-governed country under optimal monitoring is less sensitive to variations in the pre-aid per capita income of its poor. This is also true of the sensitivity to variations in the pre-aid income of the poor in the other country, yet only if the poverty aversion of the donor is below some threshold smaller than unity.*

In other words, endogenous monitoring acts as a kind of shock-absorber that cushions the impact of pre-aid income variations on the aid share of the worse-governed country: that aid share will be less affected by a change in pre-aid income than it would be under a regime of exogenous (uniform) monitoring. This is not generally true when the change in the poor's pre-aid income occurs in the better-governed country.

The analytics are more intricate when comparing the sensitivity of the aid share of the worse-governed country to its basic governance under the two monitoring regimes. This complexity reflects the non-intuitive result, recalled in Proposition 1, according to which this aid share may well be decreasing with the same country's level of aid effectiveness. The consequence of the non-monotonous relationship between basic governance and aid share for the worse-governed and poorer country is that no property similar to the one obtained in Proposition 7 can be established regarding variations in basic governance. One conclusion can safely be drawn, though: the direction of change of the aid share when the basic governance of the worse-governed country varies may not be the same under the two monitoring regimes. To see this, let us start by stating the following lemma (the proof is provided in Appendix D):

Lemma 1. *Let ε^0 and ε^* be the thresholds of the poverty aversion parameter above which the optimal aid share of the worse-governed country starts decreasing with its basic governance under exogenous (uniform) and endogenous monitoring, respectively. Then, it is the case that $\varepsilon^* < \varepsilon^0$.*

Then, an interesting proposition follows:

Proposition 8. *There exists a range of values of the poverty aversion parameter such that the aid share of the worse-governed country increases with its basic governance under exogenous uniform monitoring, but decreases under endogenous monitoring.*

The intuition behind Proposition 8 is easily elucidated. We just need to bear in mind the mechanism behind Proposition 5: the income effect sparked by an improvement in the basic governance of the worse-governed country is necessarily larger under endogenous monitoring, precisely because monitoring is optimized and aid represents a larger share of the poor's post-aid income. Since, as we know, the income effect prompts the donor to lower that country's aid share (especially so if poverty aversion is strong), we expect a comparatively sharp decrease under endogenous monitoring. Note carefully that this outcome is obtained because exogenous monitoring is assumed to be at a level at most equal to the optimal monitoring intensity for the better-governed country, which is itself smaller than the optimal intensity for the worse-governed country.

5. Discussion and extensions

This section discusses several possible extensions of the model proposed in the preceding sections, and makes a number of additional comments.

The first issue is about the possible reaction of the recipient country to the discipline imposed by the donor to improve the effectiveness of aid use. It has been mentioned earlier that the specification of the model is actually consistent with such a reaction insofar as it consists of a relaxation, by the recipient country's elite, of its own (basic or overall) discipline when running projects and programs funded by aid transfers. It is only a matter of interpretation of the function $\psi(.)$ in (3.3) since it can be seen as reflecting both the monitoring technology of the donor and, in the opposite direction, the governance-related reaction of the aid-receiving central or local governments. Presumably, this is not very different from assuming that the basic governance parameter, β_i, may fall in response to external discipline. Going beyond this simple way of endogenizing the recipient country's reaction, and assuming, for instance, that the disciplining intervention of the donor truly modifies the overall governance in that country would also logically involve making the pre-aid income of the poor, ω_i, dependent on the quality of the basic governance parameter, β_i. In other words, the discipline imposed by the donor would trigger a reduction of the poor's pre-aid income in the recipient country. This seems to be a rather extreme assumption, though.[21]

A second issue concerns the tailoring of monitoring effort to the specific situation of each recipient country. There are serious reasons why a donor may prefer uniform to differentiated monitoring. In particular, equality of treatment of heterogeneous countries may be more palatable or justifiable, especially so if differences in governance quality are largely attributable to historical or other factors beyond the control of present-day governments. In this case, a hard trade-off arises between equity and efficiency considerations. The case of exogenous uniform monitoring at a level below what would be optimal in either recipient county has been analyzed in the previous section. Considering now

[21] Note that making ω_i an increasing function of β_i in our derivation work would essentially reinforce the income effect of an improvement in basic governance. This would most likely lower the poverty aversion threshold above which the aid share starts decreasing with basic governance.

the case of uniform monitoring when its intensity is optimized by the donor, the following maximization problem must be solved:

$$Max_{s_1,s_2,\gamma^0} u\left(w_1 + s_1T(1-\gamma^0)(1-y_1)\right) + u\left(w_2 + s_2T(1-\gamma^0)(1-y_2)\right) \quad s.t.\ s_1 + s_2 = 1$$

where the simplifying assumption $n_1 = n_2 = 1$ is retained. It can be proven that, as could be expected, the solution, γ^{0*}, of this maximization problem is such that:

$$\gamma_2^* \leq \gamma^{0*} \leq \gamma_1^*$$

where γ_i^* is the optimal monitoring intensity applied to country i when differentiated monitoring is allowed. As could be expected, Propositions 3 to 7 above remain valid if γ^{0*} is sufficiently close to γ_2^*, while they would not hold anymore if γ^{0*} gets close to γ_1^*.

In short, optimizing the uniform intensity of monitoring instead of considering it as fully exogenous, and anywhere below the optimal intensity for the better-governed country, makes the effect on aid shares of optimal country-tailored monitoring even more ambiguous. However, since the direction of variation shifts when the optimal uniform monitoring intensity goes from its optimal value for the better-governed country to the optimal value for the worse-governed county, a configuration of the parameters of the model must exist in the neighborhood of which the aid share is rather insensitive to the type of optimal monitoring regime.

A third variation around the basic model consists of extending it to any number of countries. This is a rather trivial exercise when using the model based on country-specific monitoring. The reason is that the optimal level of monitoring does not then depend on the income of the country's poor, so that it does not depend either on its aid share and the aid volume received. Properties 3 to 7 generalize by comparing each recipient country to some kind of mean over all other countries with a strictly positive aid share. Things are radically different in the case of optimal uniform monitoring intensity: it is now the average of the marginal gain from monitoring obtained for all the recipient countries and duly weighted by their respective aid shares, that must be set to zero, instead of the marginal gain for each country taken separately (as it is the case under differentiated monitoring). The analytical characterization of the optimal common intensity of monitoring is quite intricate, even more so as the set of countries with strictly positive aid shares is itself to be determined. However, conclusions analogous to those reached in the two-country model when optimal uniform monitoring is compared with optimal country-specific monitoring are likely to hold once the situation in each recipient country is related to an average computed for all the other countries.

Finally, the question arises as to whether and how a different assumption regarding who bears the cost of monitoring can affect the preceding properties. The lack of separability with respect to γ_i in the objective function (3.6), where the cost is borne by the donor, makes the problem analytically complex. However, the analysis of the switch from exogenous to endogenous monitoring in this model can be decomposed into two stages. First, it was seen above that, for a given aid allocation, the properties of the optimal monitoring were unchanged. Switching from exogenous to endogenous monitoring increases monitoring-adjusted aid effectiveness relatively more in the worse-governed country and the effects in a second stage, upon the allocation of aid and post-aid incomes are identical. The difference with the foregoing analysis is that this change in the allocation of aid modifies the optimal monitoring intensities. In particular, the fact that the post-aid income of the poor necessarily increases in the worse-governed country lowers the intensity of monitoring in that country, thus dampening somewhat the first-round effect on aid effectiveness and aid allocation. Clearly, this second-round effect cannot reverse the direction of the first-round effect, that is, it may not happen that aid effectiveness is reduced rather than enhanced or that poor people are made poorer in the worse-governed country. In other words, the prediction that the post-aid income of the poor in the worse-governed country increases as a result of aid is preserved and this is also true of the conclusion that the aid share can be modified in favor or against that country. However, the conditions under which the aid share shifts in one direction or the other are more ambiguous.

6. Numerical simulations

Before concluding, it is useful to illustrate our main results with the help of numerical simulations based on set values for the key parameters of country 2 (w_2 and β_2).To do so, we adopt a particularly simple specification of the leakage rate function (3.3):

$$\lambda(\beta_i, \gamma_i) = (\beta_i + b\gamma_i^{\alpha})^{-1}$$

where b and α are parameters that define the effectiveness of monitoring[22] The calibration of the model is performed under the following assumptions. Considering country 2 as the reference country, we examine how aid allocation changes with the characteristics of country 1, assuming that its overall governance is worse than in country 2: $\beta_1 \leq \beta_2$. More precisely, we define the poor as the 40 percent poorest individuals in a country, and we arbitrarily fix $w_2 = 100$ and $\beta_2 = 5$. The latter assumption about β_2 implies that the extent of aid leakage (the proportion of aid that does not reach the poor) in country 2, y_2, is 20 percent in the absence of monitoring. Given that the aid to GDP ratio for Sub-Saharan African IDA countries is 3.6 percent,[23] it can be estimated that the income of the poorest 40 percent people would be raised by 30 percent if they were to receive, directly or indirectly, the whole aid transfer accruing to their country (that is, if the aid leakage were zero).[24] If the leakage is 20 percent, the poor's income would thus be raised by only 0.30, that is, (1-0.2)x100 = 24 percent. This increase may still appear to be big, albeit not implausible when considering the portion of aid spending that reaches the poor indirectly, that is, through general purpose spending or investment.[25]

To complete the calibration, we assume that $n_1 = n_2 = 1$, meaning that the size of the population, or the number of the poor (since poor people represent 40 percent of the population), is the same in the two aid recipient countries. What differs is the severity of poverty, as measured by w_i. In the following simulation exercise, w_1 will be allowed to vary from 50 to 110, equivalent to a variation from .5 to 1.1 times the level of w_2. Finally, the baseline values of the cost function parameters common to both recipient countries are: $\alpha = .5$ and a value for b such that the optimization procedure delivers interior solutions in most of the range of variation of the parameters w_1 and β_1.

Four sets of graphs are shown here. In all of them, the pre-aid income of the poor in country 1 (the worse-governed) is measured along the horizontal axis. Measured along the vertical axis are that country's aid share in Figs. 1 and 2 and the post-aid income of poor people in the two countries in Figs. 3 and 4. What distinguishes Fig. 1 from Figs. 2 and 3 from Fig. 4 is the assumed value of the donor's poverty aversion: it is equal to 1 in Figs. 1 and 3, and to 3 in Figs. 2

[22] This specification bears some resemblance to the one used in BP (2022).

[23] IDA (International Development Agency) is the aid arm of the World Bank. Only low-income and some lower-middle income countries are eligible to IDA aid.

[24] The 30 per cent figure is obtained by assuming that household incomes represent roughly two-thirds of GDP while, on average, the poorest 40 per cent of the population get 18 per cent of the total household incomes in Sub-Saharan Africa.

[25] To check that a 24 percent increase in income is not disproportionate, we may notice that transfers in cash and in kind transfers (on account of education and health) to the poor represent, on average, a bit less than 20 percent of the income of the poorest 40 percent in the three Sub-Saharan countries that appear in the Commitment to Equity Institute database (https://commitmentoequity.org/datacenter/). Adding other potential effects of aid on household income in general, the 24 percent estimate obtained for a reasonably well-governed country does not look unreasonable.

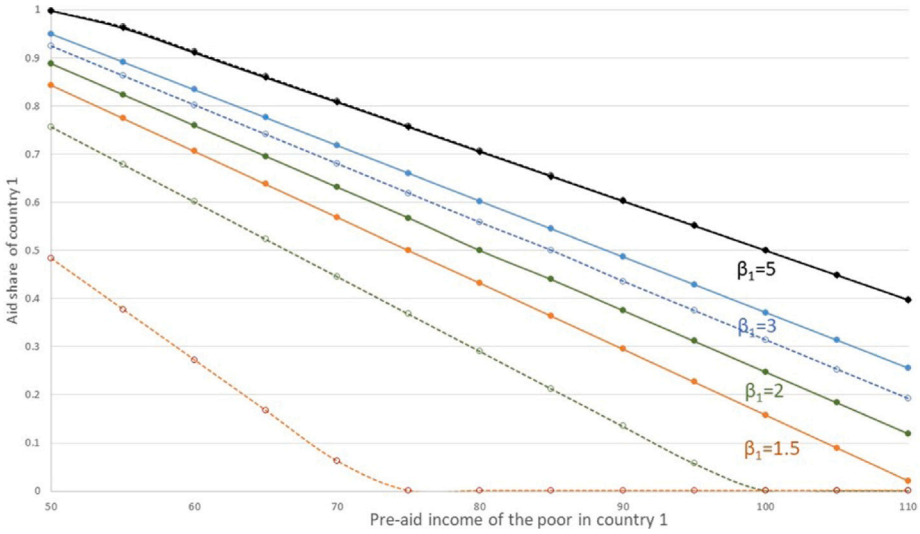

Fig. 1. Aid share of country 1 as a function of poor's income (w_1) for selected values of overall governance (β_1) under endogenous and zero monitoring (respectively solid and dashed line with same color) ($w_2 = 100$; $\beta_2 = 5$; $\varepsilon = 1$).

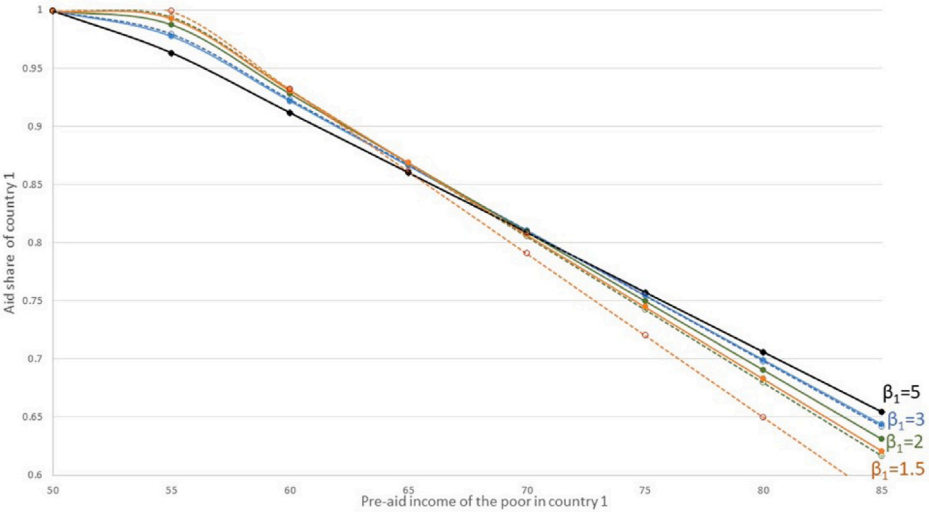

Fig. 2. Aid share of country 1 as a function of poor's income (w_1) for selected values of overall governance (β_1) under endogenous and zero monitoring (respectively solid and dashed line with same color) ($w_2 = 100$; $\beta_2 = 5$; $\varepsilon = 3$).

and 4. In Figs. 1 and 2, on the other hand, four pairs of curves are depicted, which correspond to four different values of basic governance in country 1: while β_2 is fixed and equal to 5, β_1 takes on the successive values of 1.5, 2, 3, and 5. Under the last assumption, the two countries are thus assumed to have the same level of basic governance. For a given value of β_1, a pair of curves allows a comparison between the situations obtained under endogenous monitoring (see the solid curves) and those obtained under exogenous uniform monitoring (the dashed curves), assuming zero monitoring in the latter case.

In Figs. 3 and 4, by contrast, only one value has been selected for the basic governance prevailing in country 1 ($\beta_1 = 2$). The use of solid and dashed curves to represent the exogenous and endogenous monitoring regimes is maintained but, in these figures, the impact on the post-aid income of the poor under either regime is estimated not only for country 1 but also for country 2.

From a careful look at Figs. 1–4, the following observations emerge:

1. There is an inverse relationship between w_1 and s_1.

2. For a given degree of poverty aversion, the differences in s_1 between the exogenous and endogenous monitoring regimes is larger as the gap in basic governance between the two countries is wider (β_1 is further away from β_2).

3. For a given level of basic governance, the gap in aid shares between a regime of zero monitoring and a regime of endogenous monitoring is increasing as the gap inn pre-aid incomes of the poor is getting smaller (Proposition 7).

4. When poverty aversion is stronger ($\varepsilon = 3$), the differences in s_1 between the exogenous and endogenous monitoring regimes are extremely small, and they are all the smaller as β_1 gets closer to β_2. The same holds true for the post-aid income of the poor whether in country 1 or country 2 (as shown for a unique value of β_1). The implication is that, as ε becomes sufficiently large, the endogenization of monitoring ceases to have a perceptible impact on aid shares. The rationale is as follows. A strongly poverty-averse donor is not much willing to accept a fall in the aid share of the poorer, worse-governed country, even while he resorts to strict monitoring in order to control aid misuse.

5. When poverty aversion is reasonably strong ($\varepsilon = 3$), the curves depicting s_1 as a function of w_1 intersect, meaning that s_1 under

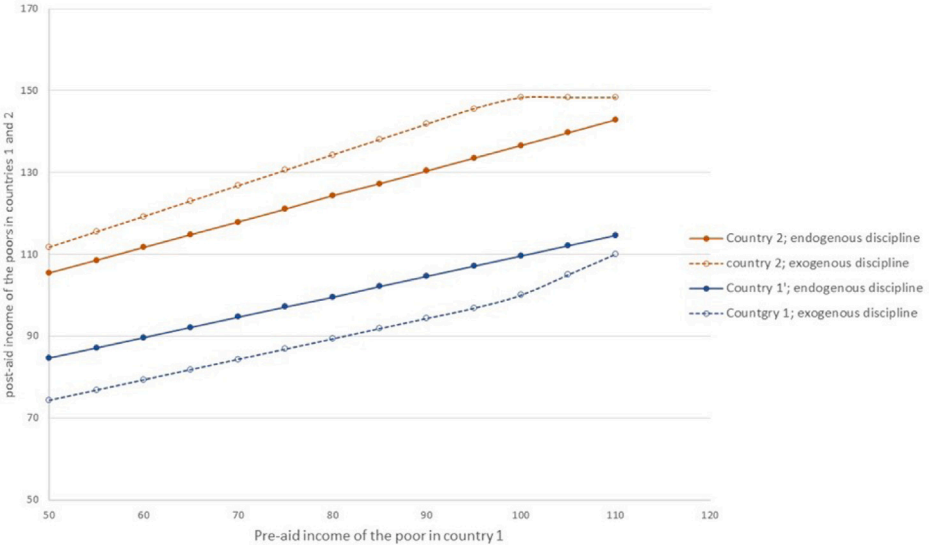

Fig. 3. Income of the poor in countries 1 and 2 as a function of country's 1 pre-aid income (w_1) with endogenous (solid lines) and zero (dashed line) monitoring ($w_2 = 100$; $\beta_2 = 5; \beta_2 = 2$; $\varepsilon = 1$).

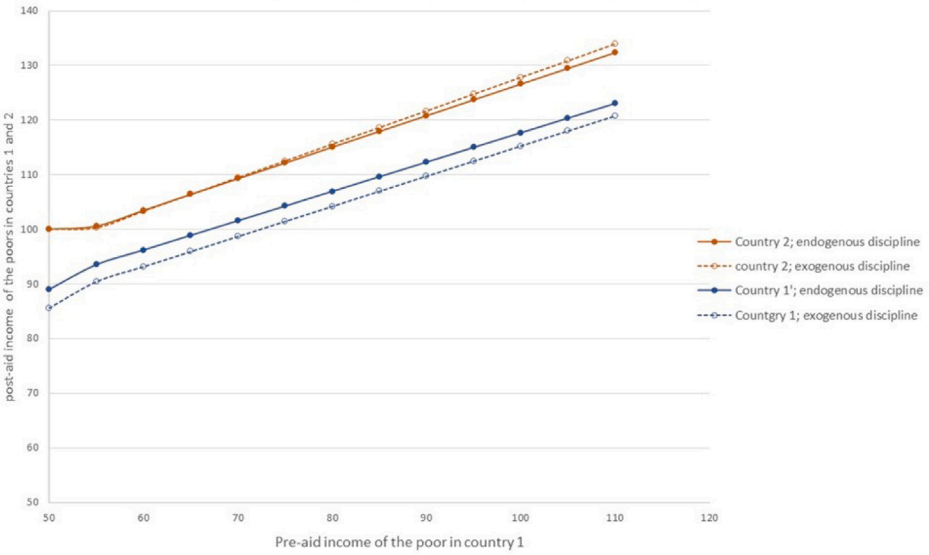

Fig. 4. Income of the poor in countries 1 and 2 as a function of country's 1 pre-aid income (w_1) with endogenous (solid lines) and zero (dashed line) monitoring ($w_2 = 100$; $\beta_2 = 5; \beta_2 = 2$; $\varepsilon = 3$).

endogenous monitoring, from being higher than under exogenous monitoring, becomes smaller once w_1 is low enough (Proposition 5). The intersection points correspond to the critical values of w_1 at which s_1 is not affected by the switch of monitoring regime.

6. When poverty aversion is reasonably strong ($\varepsilon = 3$), the curves depicting the post-aid income z_2 as a function of w_1 may intersect, meaning that z_2 under endogenous monitoring, from being higher than under exogenous monitoring, may become smaller once w_1 is low enough. Moreover, if the initial value of w_1 is low, z_2 may not increase as w_1 rises.

7. The post-aid income of the poor in both countries, z_1 or z_2, is lifted as w_1 increases.

8. The donor's switch to endogenous monitoring causes z_1 to increase but z_2 to decrease over the whole range of w_1 values. However, the inter-regime differential dwindles markedly when ε rises and, when $\varepsilon = 3$ and w_1 is below 70–80 percent of w_2, it becomes almost imperceptible and the relationship between endogenous and exogenous monitoring may even be inverted as far as country 2 is concerned (Proposition 6).

7. Conclusion and policy implications

How to keep fragile countries eligible for aid otherwise than through the ex post introduction of ad hoc 'sweeteners' to aid allocation formal rules is a question facing all aid-givers who are poverty-averse and at the same time preoccupied by inefficiencies in aid use. The approach advocated in this paper pursues the well-established idea of a trade-off between needs and governance, yet at the same time it aims at enhancing the chances of doubly unfortunate countries – those which are relatively poor and ill-governed – to get access to aid, or to see their benefits from aid increase. This approach is actually well known among practitioners: instead of considering governance in poor countries as given, and allocate aid accordingly, the donor decides to exert influence on local aid-related governance through costly disciplining instruments based on monitoring and punishment. In the new setup, conventional concepts of aid effectiveness become misleading. The reason is that the level of aid embezzlement or misuse in the recipient countries is determined not only by their basic or overall governance, which

is reasonably assumed to lie beyond external control, but also by the external discipline optimally chosen and imposed by the donor regarding aid use.

The adoption of a modified need-governance framework that embeds endogenous monitoring leads to results that significantly differ from those reached by the conventional approach in which monitoring is either absent or exogenously given. In this final section, attention is drawn to four key policy implications of the new approach proposed.

First, country aid shares are a dubious indicator of the benefits which a particular country earns through aid transfers. Since the donor has two instruments to pursue its objective of alleviating poverty – aid shares and the extent of tailor-made monitoring applied to each recipient country–, it will always be the case that, even when its aid share diminishes, the worse-governed country will gain from the shift from exogenous to endogenous monitoring. That is, the wellbeing of its poor will increase and, moreover, this increase will always be larger than the improvement of the poor's lot in the other, better-governed country. An immediate consequence is that aid-givers appealed by the idea of optimizing monitoring ought to stop conceiving their decisions in terms of country shares. Instead, because they would jointly determine the optimal level of monitoring and the country share for each and every recipient country, preferential treatment of a category of countries is not necessarily reflected in their relative access to aid. The proper measure is the change in the standard of living of their poor as a result of both aid and monitoring efforts.

Second, the donor's preference for poverty reduction plays a key role in determining whether the switch to endogenous monitoring will perceptibly affect aid shares. A strong poverty aversion will thus make for small or even insignificant effects. This outcome, it bears stressing, does not come from a low weight attached to aid effectiveness considerations by the donor. On the contrary, a donor strongly bent on reducing poverty, and hence on lifting the incomes of the poor in the poorer and worse-governed country, wants to tighten external discipline when such a possibility is being opened. Where the difference lies between the behaviors of a strongly and a weakly poverty averse donor lies elsewhere: because the former derives a comparatively high marginal utility from an improvement in the poor's income, he is reluctant to (significantly) lower the aid share of the poorer country even while aid use is monitored (much) more strictly in that country. It would therefore be wrong to think that strong poverty aversion makes endogenous monitoring less appealing. This would be so only if the donor limits his interest in the amount of aid accruing to the poorer country, regardless of what portion of it reaches the poor, which is an obviously odd preference profile when monitoring is available.

Third, in the case where endogenous monitoring greatly affects outcomes, a distinct possibility is that the poor in the better-governed country will suffer a fall in their post-aid income as a result of the shift of monitoring regime. A conflict of interest would then arise between the poor in the two recipient countries, which does not imply, however, that the poor in the better-governed country would lose interest in the aid transfer. As a matter of fact, they always benefit from such a transfer in absolute terms. As for the elites, whichever the country to which they belong, they always lose from the regime shift. On the one hand, the amount of 'operable aid' (net of the monitoring cost) is smaller after governance has been endogenized and, on the other hand, their own take of the aid proceeds is getting reduced when monitoring is optimized.

Fourth, the initial values of the inter-country gaps regarding key parameters of the model may determine the intensity, or even the direction of the effects at stake. Moreover, as witnessed by the varying slopes of the curves displayed in the figures, interaction effects between these parameters are typically at work. For example, for a given ratio of pre-aid per capita incomes of the poor, a wide (narrow) gap between basic governance levels will cause a large (small) differential between the country aid shares received under endogenous monitoring relative to those received under exogenous monitoring. There is an interaction between these two country parameters, however: the lower (higher) the pre-aid income in the worse-governed country compared to the pre-aid income in the better-governed country, the narrower (larger) this differential. In our second example, the interaction is between a country parameter and a donor's parameter. Thus, the fall of the post-aid per capita income of the poor in the better-governed country when the donor switches from exogenous to endogenous monitoring (see the third point above) can only occur if not only the donor's poverty aversion is strong enough but also the ratio of pre-aid incomes is low enough. The rationale behind this interaction is immediately intuitive.

The rigorous approach proposed in this paper clearly leads to results at odds with, and less trivial than those derived from standard PBA (performance-based) aid allocation rules. It also shows the important role of the donor's poverty aversion, a dimension of the problem which has been largely and strangely ignored by the literature. Considerable operational challenges are involved, among which the necessity to address serious measurement issues. In particular, there is a need to (i) define a proper way to assess the standard of living of poor people both before and after an aid intervention; (ii) to design a satisfactory method of estimating the degree of embezzlement or misuse of public resources in general (in order to assess basic or self-governance), or to translate existing indicators of governance quality into the shares of these resources that are appropriated by the local elite; and, last but not least, (iii) to estimate the monitoring cost function, implying the need to gain a more or less precise idea about the relationship between monitoring effort and improvement in the fraction of transfers that ends up with the poor themselves. The latter requires that the technology of supervision is specified. Finally, albeit not a measurement issue, the degree of poverty aversion of the donor is a crucial parameter, which needs to be made explicit at the time of the aid allocation-cum-monitoring decision.

Our hope is to have convinced the reader that tackling these difficult operational issues is a worthwhile task. As a matter of fact, the problem of fragile countries is going to stay with us for any foreseeable future, and adopting a systematic procedure that involves country-specific monitoring is better than relying on 'ad hoc' sweeteners to preserve aid eligibility of these countries at all costs (or without adequate knowledge of the costs).

CRediT authorship contribution statement

François Bourguignon: Writing – original draft, Methodology, Formal analysis, Conceptualization. **Jean-Philippe Platteau:** Writing – original draft, Methodology, Formal analysis, Conceptualization.

Data availability

No data was used for the research described in the article.

Appendix A. Proof of Proposition 5

Proof. Bearing in mind (3.9), the difference Δs_1 in the optimal shares of aid received by country 1 under the regimes of endogenous and exogenous monitoring can be written as follows:

$$\Delta s_1 = \frac{1}{D}(E_1^*/E_2^*)^{1/\varepsilon}(w_2/T+E_2^*)-\frac{1}{D^0}(E_1^0/E_2^0)^{1/\varepsilon}(w_2/T+E_2^0)-(w_1/T)\left(\frac{1}{D}-\frac{1}{D^0}\right),$$

where $D = E_2^*(E_1^*/E_2^* + (E_1^*/E_2^*)^{1/\varepsilon})$, and symmetrically for D^0 using E_1^0 and E_2^0. If poverty aversion is less than or equal to unity, it is the case that $\frac{1}{D}(E_1^*/E_2^*)^{1/\varepsilon} < \frac{1}{D^0}(E_1^0/E_2^0)^{1/\varepsilon}$. This is because the function $g(x) = x^{1/\varepsilon}/(x + x^{1/\varepsilon})$ is decreasing when $\varepsilon \geq 1$ and $E_2^* > E_2^0$. Then, the preceding expression may be rewritten as:

$$\Delta s_1 = A(w_2/T) + B - C(w_1/T)$$

with:

$$A = \frac{1}{E_2^*} g[(E_1^*/E_2^*)] - \frac{1}{E_2^0} g[(E_1^0/E_2^0)],\ B = g[(E_1^*/E_2^*)]$$
$$- g[(E_1^0/E_2^0)],\ C = \frac{1}{D} - \frac{1}{D^0}$$

It is easily checked that the A, B and C factors are all negative. This implies that if poverty aversion is above unity, Δs_1 is positive when w_1/T is above some positive threshold, $(A/C)w_2 + BT/C$, increasing in w_2, and is negative below it. As this property is valid for $\varepsilon = 1$ it is also valid, by continuity, in some interval of ε below unity. There is uncertainty about the sign of Δs_1 for still lower values of poverty aversion. □

Appendix B. Proof of Proposition 6

Proof. Denoting $z_i = w_i + s_i T E_i$ the post-aid income of country i, it comes from Proposition 3 – or (4.1) – and the first-order condition on aid shares (3.8) that:

$$\frac{z_1^*}{z_1^0} > \frac{z_2^*}{z_2^0}$$

where z_i^0 and z_i^* are respectively the optimal post-aid income under exogenous and endogenous monitoring. Clearly, the income of at least one country must increase with the endogenization of monitoring through the optimization of the latter. From the preceding inequality, this must be the case of country 1, but not necessarily of the other country if its aid share declines – i.e. that of country 1 increases – and overweights the gain arising from higher aid effectiveness.

To show that z_2^* may be smaller than z_2^0 is a bit intricate. Making use of (3.9), the optimal post-aid income of country 2 for given monitoring-adjusted aid effectiveness E_1 and E_2 is:

$$z_2 = w_2 + \frac{TE_1 - (E_1/E_2)^{1/\varepsilon} w_2 + w_1}{[E_1/E_2 + (E_1/E_2)^{1/\varepsilon}]}$$

The change in that post-aid income when switching from exogenous uniform to endogenous monitoring can be expressed as:

$$\Delta z_2 = -A' w_2 + B' T + C' w_1$$

where A', B', C' are given by:

$$A' = g(E_1^*/E_2^*) - g(E_1^0/E_2^0);\ B' = E_2^* h(E_1^*/E_2^*) - E_2^0 h(E_1^0/E_2^0);$$
$$C' = k(E_1^*/E_2^*) - k(E_1^0/E_2^0)$$

with $h(x) = x/(x + x^{\frac{1}{\varepsilon}})$ and $k(x) = 1/(x + x^{\frac{1}{\varepsilon}})$. Assuming $\varepsilon \geq 1$, it is already known – see above – that $g()$ is decreasing. In addition it can be seen that $h()$ is increasing and $k()$ is decreasing. The coefficients A' and C' are thus negative whereas B' is positive. It follows that Δz_2 is negative iff:

$$w_1 > \frac{A'}{C'} w_2 - \frac{B'T}{C'} = Y^1$$

In addition, the aid share of country 2 must be initially positive, which requires:

$$w_1 > (E_1^0/E_2^0)^{1/\varepsilon} w_2 - TE_1^0 = Y^2$$

Finally, it can be shown that there is a ceiling value of w_2 below which $Y^2 < Y^1$. Let $\overline{w}_2$ be that value , which is function only of the monitoring-adjusted aid effectiveness in the two countries under exogenous and endogenous monitoring. Then $w_2 < \overline{w}_2$ and $w_1 > Y^1$ guarantee that the post-aid income of the poor in the better-governed country is positive with exogenous monitoring and declines when monitoring is made endogenous. □

Appendix C. Proof of Proposition 7

Proof. From (3.9), the derivatives of the optimal aid share of country 1 with respect to the pre-aid per capita incomes of the poor in the two countries are given by:

$$\frac{\partial s_1}{\partial w_1} = -\frac{1}{E_1^* + (E_1^*/E_2^*)^{1/\varepsilon} E_2^*};\ \frac{\partial s_1}{\partial w_2} = \frac{1}{E_1^*(E_1^*/E_2^*)^{-1/\varepsilon} + E_2^*}$$

Since $E_i^* > E_i^0$ and $E_1^*/E_2^* > E_1^0/E_2^0$, the denominator of the first expression is higher under optimal monitoring. In absolute terms, the value of $\frac{\partial s_1}{\partial w_1}$ is therefore smaller. Things are more intricate for the second expression. The denominator, which can be written as $E_2^*[(E_1^*/E_2^*)^{1-1/\varepsilon} + 1]$, is clearly larger under optimal monitoring if $\varepsilon \geq 1$. In this case, $\partial s_1/\partial w_2$ is again smaller compared to the alternative regime of uniform monitoring. The possibility nevertheless exists that a sufficiently low value of ε causes the denominator to be smaller, rather than higher, under optimal monitoring. It may then be noted that, when ε gets close to zero, the denominator tends towards infinity – i.e. $E_1/E_2 < 1$ – but it does so faster under exogenous monitoring since $E_1^0/E_2^0 < E_1^*/E_2^*$. By continuity, there exists a value of poverty aversion within the range of $[0, 1[$ below which the denominator of $\partial s_1/\partial w_2$ is smaller under optimal monitoring. It is therefore the case that $\partial s_1/\partial w_2$ is smaller under optimal than under exogenous monitoring for all ε above the same threshold. □

Appendix D. Proof of Lemma 1 and Proposition 8

Proof. As shown in the proof of Proposition 1, the direction of change in the aid share of the worse-governed country when its basic governance has improved is given by the sign of $(1 - \mu_1\varepsilon)$, where μ_1 is the net share of the aid amount in the post-aid income of its poor. Based on Proposition 1, denote ε^0 and ε^* the critical values of poverty aversion at which the aid share of the worse-governed country shifts from being increasing to being decreasing under the exogenous (uniform) and the endogenous monitoring regimes, respectively. Set $\varepsilon = \varepsilon^0$ and denote by μ_1^0 the corresponding value of μ_1 under exogenous monitoring, so that: $\mu_1^0 = s_1^0 T E_1^0/z_1^0$. Keeping $\varepsilon = \varepsilon^0$, we examine the case of optimal country-specific monitoring. It was seen earlier that all parameters being the same, the optimal post-aid income of the poor in country 1 is then higher: $z_1^* > z_1^0$. As a result, the share of aid in the post-aid income of the poor in that country is such that $\mu_1^* > \mu_1^0$. For $\varepsilon = \varepsilon^0$, the following relationship consequently holds:

$$1 - \mu_1^* \varepsilon^0 < 1 - \mu_1^0 \varepsilon^0 = 0$$

In turn, this implies that $\varepsilon^* < \varepsilon^0$, and $\partial s_1/\partial \beta_1$ is negative in the interval $[\varepsilon^*, \varepsilon^0]$ under endogenous monitoring while being positive under exogenous monitoring. □

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