TAXES AND BRIBERY: THE ROLE OF WAGE INCENTIVES

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This paper presents a simple model to evaluate alternative payment schemes for tax inspectors in the presence of corruption. We consider problems of both moral hazard, which arises because taking bribes cannot be observed without costly monitoring, and adverse selection, since not all potential tax inspectors can be identified as being honest or dishonest. We identify three wage regimes. First, one could pay the same wage that a tax inspector could earn elsewhere – his reservation wage. Second, one could pay a wage which solves the moral hazard problem, i.e. deters bribery. This we call an efficiency wage, by analogy with recent models examined in macro economics. Third, the government could pay a wage below the reservation wage, at which only the dishonest become tax inspectors – the capitulation wage. We make precise the conditions under which each yields the greatest amount of tax revenues, net of administrative costs.

Many countries in the developing world are undergoing structural adjustment programmes which require fundamental fiscal changes. Outside agencies advise restoration of budget balance, a task which involves expenditure cuts and tax increases. The treatment of public employee pay scales often poses a particular dilemma in this process. Wages and salaries are a significant component of government expenditures and one important question concerns the extent to which wages rather than employment cuts should be used to save money. There is sometimes a reluctance to advocate wage cuts, stemming in part from a feeling that this might impair the performance of the public sector. Hence, Tanzi (1990) argues that a policy of wage cutting ‘is likely to increase the inefficiency of public sector employees, especially at a time when the public sector is expected to play a larger role in restructuring the economy’ (p. 16).

In the context of tax collection the issue is particularly pressing, given the need to raise more tax revenues. A reduction in efficiency in this branch of the government is likely to mean that fewer returns are processed and when individuals’ living standards are squeezed, their incentive to accept bribes in lieu of collecting taxes is increased.1 On this count, it is even sometimes suggested that wages of tax inspectors should be increased to aid the effort to

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1 See, for example, Goode (1984) chapter 13 and Gould and Amaro-Reyes (1983).
balance the budget. In this paper, we will use a simple model to explore such arguments. We examine the logic of the efficiency wage argument as applied to tax collection and demonstrate some important qualifications to it.

The specific source of bureaucratic inefficiency in tax collection on which we focus here is collusion between tax collector and tax payer to evade taxes. The scope of such practices is vast. The Nigerian customs inspector who found a Mercedes Benz 350 SEL inside a cargo bin with milk for import, and who obligingly charged duty only on the milk (Idigbe (1986), p. 118), is a case in point. So is the practice by merchants in Zaire of keeping two sets of books, one for public use and the other secret, and paying off any tax collector expressing curiosity about ‘real books’ (Gould (1980), pp. 140–1). So is a scheme common in Eastern Nigeria in the 1950s, whereby an income-tax collector would understate the number of households in a district and allow all households to share the tax burden of the households declared, with the collector keeping part of the savings (Eastern Region of Nigeria (1960), p. 14). One observer (Simanjuntak (1979) p. 123) argues that collusion between tax collector and payer is likely, quantitatively, to be the most important form of corruption in Indonesia. Thus we are studying an important and broad class of abuses.

Inadequate wages are frequently cited as a prime cause of bureaucratic corruption: see, for example, Gould and Amaro-Reyes (1983, p. 25) and Palmier (1983, especially p. 208). Moreover, a common view is that higher wages would be cost-effective. For example, Lindauer et al. (1988, pp. 22–3) argue that cutting the size of civil services across Africa in order to allow for wage hikes might actually deliver better public services. Sharp increases in Indonesian civil service wages to combat corruption and other problems have been proposed by the 1970 Commission of Four on corruption (Palmier (1983, p. 217)) and by the Asian Development Bank (Soesastro et al. (1988, p. 58–9)). The 1977 Tax Review Commission in Ghana recommended higher wages for tax collectors and a special salary scale for them, separate from the rest of the civil service (Ghana (1977, p. 62)). Nonetheless, using high wages as an incentive device seems to be a relatively rare occurrence (Palmier (1983, p. 218)) – a fact to which we return below.

There are two reasons why higher wages might improve performance in the collection of taxes. The first concerns the incentives of tax inspectors to shirk, which in our model means taking bribes. It is related to the analysis of Shapiro and Stiglitz (1984). A wage premium may be used to increase the value of remaining in a job relative to outside opportunities and hence reduces

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2 There is a large literature on the problems of tax compliance from the perspective of tax payers who decide whether or not truthfully to declare their taxes: see, *inter alia*, Allingham and Sandmo (1972), Reinganum and Wilde (1985) and Srinivasan (1973). Most of this literature (Virmani (1987), Gang et al. (1988) and Gangopadhyay et al. (1991) are exceptions) takes the honesty of tax inspectors for granted. In this paper, we go to the opposite extreme assuming that tax payers cannot conceal their status from tax inspectors. We do this in the interests of focusing on the main set of issues with which this paper is concerned.

3 Our model allows the tax collector a choice between honest tax assessment and bribery. We do not allow shirking in the form of taking leisure on the job. First, it seems reasonable to suppose that the tax inspector’s superior might find it easier to observe the quantity of work being done as opposed to its accuracy. Second, adding such a dimension to the model would lead to a significant increase in complexity (see, for example, Mookherjee and Png (1990)).
shirking. The second argument concerns the quality (here the honesty) of those who are employed and has been analysed by Weiss (1980) among others. In his model, higher quality workers are assumed to have higher reservation wages. Most shirking models assume a homogeneous workforce. We relax this in our analysis so that some of the issues discussed in Weiss (1980) naturally arise. We show that there may be some interesting tensions between ‘solving’ the adverse selection and moral hazard problems.

While public sector wages may be low in LDCs, it is widely recognised that there are rents to those who behave dishonestly. In our model, these accrue in the form of bribes paid to corrupt inspectors by tax payers who wish to avoid paying their taxes. Paying higher wages constitutes one means of enforcing honest behaviour from those, who if paid only what they could receive in their next best occupation (i.e. their reservation wage), would be dishonest. However, the fact that wage premiums must be paid to all or none, makes their use less attractive. Moreover, inducing honest behaviour from all the dishonest, also means that nobody is actually caught being dishonest in equilibrium while when reservation wages are paid there is a gradual purification of the work force through time.

Corruption of tax inspectors must be set in the broader social context of LDCs. Most societies have had some kind of tax system throughout their histories. For example, taxes levied at a village level have been common throughout Africa (see Bird (1974)). Since, within small communities, individuals’ characteristics are typically well known to the tax assessor, such tax schemes do not encounter the kinds of revelation problems which are the familiar starting point for analyses of optimal taxation. Also, in village societies, the gains from levying taxes, for example in the form of infrastructural investment, are usually visible to all tax payers within a community. This, and the fact that individuals are often bonded by kinship loyalties, makes tax compliance easier to achieve. The creation of large states with national bureaucracies has, however, weakened the basis of such tax systems. Tax revenues are funneled to urban areas and social obligation to newly contrived nation states may be weak. It is in the hiatus created by the breakdown of societies based on kinship ties but before the creation of a thoroughly modern

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4 As with these papers, it is essential to our analysis that tax inspectors are able to capture rents created by dishonesty. Becker and Stigler (1974) and, more recently Carmichael (1985), have emphasised that some (and perhaps all) of the rents could accrue to the government if prospective tax inspectors were required to post bonds. We follow Dickens et al. (1989) in supposing that this is not possible. They offer four main reasons for this; liquidity constraints, moral hazard by employees who sack workers without good reason, legal restrictions on contracts which mean that bonds cannot easily be enforced, and social constraints imposed by the fact the morale of honest workers may be discouraged. In the context of LDC’s, arguments focusing on liquidity constraints and legal difficulties would seem most severe. Bonds would also increase the likelihood of corruption at higher levels of government, since they could be used as a means of enhancing the bargaining power of higher level officials in extracting rents from those below them in the hierarchy. We believe, therefore, that asking tax inspectors to post bonds is unlikely to eliminate rents. Below, we show that demanding that individuals post bonds is closely analogous to privatising the revenue service (tax farming). Hence, the impossibility of posting bonds may also explain why tax farming may not work.
social order, that corruption is most likely to be a problem (see, for example, Huntington (1968)).

As well as comparing efficiency with reservation wages, we introduce a third possibility which we call capitulation wages. In this case, the government pays wages below what an individual can earn elsewhere, i.e. it has abandoned any attempt to solve either the moral hazard or adverse selection problem via wage incentives. The only tax receipts are now from those inspectors whose behaviour is monitored. We show that this may sometimes be a preferred regime from the viewpoint of tax revenues raised.

The remainder of the paper is organised as follows. The next section lays out the basic model and introduces the three wage strategies with which we are concerned. Section II calculates tax revenues in these three cases while Section III compares their performance on this criterion. Section IV relates our findings to contemporary and historical experience of tax collection, while Section V concludes.

1. THE MODEL

We develop the simplest model required to make the main points of interest (a further variant of this model is studied in detail in Besley and McLaren (1990)). We take a technologically determined relationship between tax payers and inspectors. Hence the government requires $N$ tax inspectors to service a population of $M$ potential tax payers. Of the $M$ tax payers, a fraction $\theta$ have incomes above the threshold at which a tax of $\tau$ must be paid, while the rest owe no tax. We assume that the government knows $\theta$ without knowing which tax payers actually owe anything.

Tax inspectors are of two sorts: $\gamma N$ are dishonest and $(1 - \gamma)N$ are honest. We assume that each faces the same outside opportunity. Dishonesty is defined as an immutable characteristic of preferences – an honest person regards his integrity as priceless and thus will not take a bribe for any material reward, while a dishonest person will maximise his expected income. While dishonesty is immutable it is possible, therefore, to make a dishonest person behave honestly by making it in his or her interest to do so.

In each period, tax inspectors and payers are randomly matched. With probability $\theta$, a tax inspector encounters a tax payer who must pay the tax, $\tau$. An honest tax inspector collects the tax and hands over the revenues to the

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5 Societies in the process of modernisation also often lack legal systems which can effectively sanction corruption. This puts an immediate constraint on the use of many legal sanctions which would most often be thought of as first best responses to corruption. Fines on corrupt officials may be very hard indeed to enforce. Radian (1980, c. 7) discusses some of the difficulties in using legal sanctions in tax compliance.

6 Strictly, we mean monitoring by honest individuals – being monitored by someone who is dishonest may mean that you have to share your ill-gotten gains but does not result in tax revenues.

7 It would be straightforward to have all taxpayers owing a fixed amount of tax with a fraction $\theta$ of them owing a larger amount of tax. This would involve carrying a constant through the analysis, which we prefer not to do. This possibility should, however, be borne in mind when considering revenues under capitulation wages.

8 We could easily extend the model to allow $\theta$ to be an i.i.d. random variable, which represented, in the case of an agricultural economy, the effect of the weather on farmers' incomes.
government, while a dishonest one offers to take a bribe.\textsuperscript{9} The bribe is the product of a bargain between the two agents, and for simplicity we adopt the generalised Nash bargaining solution (see, for example, Roth (1979)). The surplus to be distributed is just the unpaid tax revenues. In accordance with generalised Nash bargaining theory, the division between them will solve

\[ \text{Max } (\tau - b - s_0)\beta(b - b_0)^{\alpha}, \]

where \( \{s_0, b_0\} \) are the payoffs of the tax payer and tax inspector respectively, that would be obtained if no bargain were reached (the 'threat points'). We shall focus on the case where in the event of disagreement, all taxes are honestly paid i.e. \( s_0 = b_0 = 0 \). The parameters \( \alpha \) and \( \beta \) can be interpreted as measures of bargaining strength. It is now easy to check that the tax inspector gets a share \( \mu \equiv \alpha/(\alpha + \beta) \) of the surplus, i.e. \( b = \mu \tau \). The standard Nash case is that where \( \alpha = \beta = 1 \), and the tax inspector and payer get equal shares. More generally, \( \mu \) reflects the distribution of bargaining strength between the two agents.\textsuperscript{10} The limiting case where \( \beta = 0 \) and \( \alpha = 1 \), is that where no collusion on the part of the tax payer is required - the tax inspector just pockets the tax revenue himself.

Conditional on behaving dishonestly, the inspector faces some probability that he will be caught and dismissed. We model this by a supposing that each encounter is audited with an exogenous probability \( (1 - q) \). This presupposes that monitoring is costly, since otherwise the government would audit every encounter. The assumption that \( q \) is exogenous is extreme and we discuss implications of relaxing it in Section IV, with some details presented in the Appendix. We shall suppose that the tax inspectors who are caught taking bribes are dismissed from the revenue service, i.e. there is no system of enforceable fines to deter dishonesty.\textsuperscript{11} Similarly, our model imposes no fines on the tax payers who pay the bribes; they are simply required to pay the missing revenues. Obviously, the optimal policy would include some penalty for tax evading households, but that is not the focus here. Finally, we allow for random turnover at constant rate \( \delta \). Such turnover is assumed to occur at the beginning of the period.

We assume that tax inspectors are drawn from a large pool relative to the revenue office, which cannot therefore do anything to alter the constant proportion of dishonest individuals which it hires. We consider three possible

\textsuperscript{9} It would be straightforward, though tedious, to allow for probabilistic refusals to pay bribes by tax payers.

\textsuperscript{10} We do not model what determines bargaining strength here. Using the fact that the Nash bargaining model is the limit of a strategic model as the time between offers goes to zero (see Binmore et al. (1986)), we might think of these as being determined by differences between the tax inspectors’ and tax payers’ beliefs about the probability of breakdown in the bargaining procedure and/or differences in waiting time between different individuals’ offers and counter-offers.

\textsuperscript{11} This is consonant with our discussion of the weakness of legal systems in countries where corruption is a problem.
wage strategies for the government. First, it might pay an efficiency wage, at which nobody behaves dishonestly. Second, it can pay the reservation wage, which attracts a mixture of honest and dishonest tax inspectors. Third, it can pay a capitulation wage, which is below the reservation wage and attracts only the dishonest.

II. TAX REVENUES AND INSPECTOR INCENTIVES

II.1. Reservation Wages

To calculate tax revenues under reservation wages, it is necessary to calculate how revenues vary over time as a consequence of a varying labour force, i.e. due to the auditing and dismissal of dishonest inspectors. It is easily seen that revenues at time $t$ are equal to $R_t = N(1 - qD_t/N) \theta_T$ if there are $D_t$ dishonest tax collectors at time $t$. The evolution of $D_t$ can be derived to show that revenues are equal to

$$R_t = N(1 - q)^\gamma \frac{\delta + [\kappa(1 - \delta)]^\gamma}{[1 - \kappa(1 - \delta)]^\gamma} \theta_T,$$

where $\kappa \equiv [1 - (1 - \gamma) \theta(1 - q)]$. Net revenues to the government ($\Pi_{rw}$) are obtained by deducting the per period wage bill of $N\omega$ from the discounted present value of $R_t$. Hence, we obtain

$$\Pi_{rw} = \frac{1 + \rho}{\rho} N \left\{ \left[ 1 - q \gamma \left( \frac{\delta + \rho}{1 - \kappa(1 - \delta) + \rho} \right) \right] \theta_T - \omega \right\}.$$

This yields the same expression for revenues as would be the case were a constant fraction of tax inspectors $\phi \equiv \gamma'(\delta + \rho)/(1 + \rho - \kappa(1 - \delta))$ dishonest for all time. Thus $\phi$ can be thought of as a measure of the ex post selection advantage of reservation wages. The decline in the number of dishonest through time ensures that $\phi$ is less than $\gamma$, so that a decrease in $\phi$ can be thought of as an increase in the ex post selection advantage of paying reservation wages. It is straightforward to verify that $\phi$ is increasing in $\delta$ – less random turnover is better for ex post selection. It is also increasing in $q$ and $\rho$. Hence, a smaller probability of being caught implies a smaller advantage through ex post selection, as does an increase in the discount rate – the latter because these gains accrue through time and a higher discount rate implies greater impatience.

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12 The detailed calculation of revenues in the case where the government pays tax inspectors $\omega$ uses the techniques in Besley and McLaren (1990) to which the reader is referred for details.

13 It is straightforward to check that the present value of $R_t$ is equal to

$$\frac{1 + \rho}{\rho} \left\{ \frac{\delta[1 - \kappa(1 - \delta) + \rho] + \rho(1 - \delta)(1 - \kappa)}{[1 - \kappa(1 - \delta) + \rho][1 - \kappa(1 - \delta)]} \right\} \theta_T N.$$
Before comparing the different wage schemes, it is useful to consider the zero net revenue locus, defined as values of \( q \) and \( \gamma \) for which (3) equals zero. With reservation wages, it is characterised by

\[
q \gamma (\delta + \rho) = \left( \frac{C-1}{C} \right) \left[ 1 + \rho - \kappa (1 - \delta) \right],
\]

where \( C \equiv \theta \tau / \omega \) is the ratio of expected tax revenues to administrative costs if all tax inspectors were honest. We will assume throughout that \( C > 1 \), i.e. that in the absence of dishonesty, the tax would raise positive revenues.\(^{14}\) Equation (4) is represented by the locus \( RR \) in Fig. 1. Its intercepts are \( (C-1)/C \). The present value of net revenues is positive to the south-west of this locus. This makes precise the idea that it is only possible to raise revenues when the tax inspectorate is corrupt if the level of tax inspector corruption is low enough and/or the probability of being caught high enough.

\(^{14}\) We can obtain some idea of the order of magnitude of \( C \) by looking at the reciprocal of 'cost of collection' figures published by some tax bureaus. This is defined as the operating cost of the tax office divided by gross revenues, and figures like \( 0.4 \% \) to \( 0.7 \% \) (Malawi (1980, p. 6), Zimbabwe (1980–4, 5(iii)) or up to \( 1.7 \% \) (Ghana (1971, p. 13)) are common. These are comparable to state-level collection costs in the United States averaging around \( 1.2 \% \) reported by Dubin et al. (1989, table 10). Thus values of \( C \) in the neighbourhood of 100 seem like a reasonable guess. However, even with \( C = 10 \), the endpoints of the \( RR \) locus are at \( q = 1 \) where \( \gamma = (C-1)/C = 0.9 \) and \( \gamma = 1 \), where \( q = (C-1)/C = 0.9 \). This leaves less than \( 1 \% \) of the box above the curve. Thus, it would seem rare to have a tax system in which the reservation wage did not break even. Fig. 1 is drawn with \( C = 3 \) to make it easy to read.

Fig. 1. \( \theta = 0.5 \), \( \rho = \delta = 0.1 \), \( \mu = 0.5 \).
II.2 Efficiency Wages

To find the efficiency wage, we employ the standard technique of equating the lifetime value of an honest and dishonest life and solving for the wage which equates them. This yields

\[ w = \omega + b \frac{(\rho + \delta) q}{(1 - \delta) (1 - q)} \]

where \( \rho \) is the discount rate and \( \delta \) is the probability of being randomly dismissed in any time period. As expected, this exceeds \( \omega \) - a dishonest individual will always take a bribe if he is paid his reservation wage since he can earn this wage even if he is caught. The comparative statics of the efficiency wage can be obtained by differentiating (5). In this way, one can show that an increase in \( b \) raises the efficiency wage. This has two main implications. First, remembering that \( b = \mu \tau \), it rationalises the possibility that the cost of raising tax revenues be increasing in the tax rate. Secondly, it implies that paying efficiency wages is more expensive when inspectors have better bargaining power. A rise in the discount rate also increases efficiency wages – it is more expensive to deter the dishonest behaviour of more impatient individuals. Similarly an increase in the turnover parameter \( \delta \) increases the efficiency wage. The slacker is monitoring, the more costly are efficiency wages for quite natural reasons. Indeed as \( q \) tends to one, there is no finite wage which can deter the dishonest. Finally, it should be noted that the efficiency wage is independent of \( \theta \). This is because the efficiency wage makes a tax inspector indifferent between taking and not taking a bribe so that the probability of encountering a tax paying individual should not matter.

If the government pays the efficiency wage to all tax inspectors at all times the present discounted value of net revenues is

\[ \Pi_{ew} = \left[ \theta \tau - \omega - qb \frac{(\rho + \delta)}{(1 - \delta) (1 - q)} \right] N \frac{1 + \rho}{\rho}. \]

Using (6), we can characterise the zero net revenue locus as the value of \( q \) which satisfies

\[ q = (1 - \delta) \theta (C - 1) / [(1 - \delta) \theta (C - 1) + (\delta + \rho) \mu C] < 1, \]

where \( \mu ( \equiv b / \tau ) \) is the parameter reflecting bargaining strength which we introduced above. Equation (7) is represented by the horizontal line \( EE \) in Fig. 1. Above the critical value of \( q \), the government is unable to raise positive tax revenues using efficiency wages. The reasoning behind this is clear – if the probability of getting away with bribery is high enough, then the efficiency wage which deters honesty is so high that the administrative cost of the tax always exceeds revenues. It is straightforward to verify that the critical value

\[ ^{15} \text{The exact derivation of the efficiency wage is given in Besley and McLaren (1990).} \]
of $q$ in (7) is increasing in $C$ and decreasing in the bargaining power parameter $\mu$. It is also increasing in $\theta$, the probability of encountering a taxpayer who owes revenue, $\theta$ and the random dislocation parameter $\delta$.

II.3. Capitulation Wages

The third wage regime occurs where the government sets wages below the reservation wage of the dishonest individuals. While nobody honest would be prepared to become a tax inspector, the government may still attract dishonest individuals provided that it pays a wage which exceeds the wage available in the next best occupation less the expected value of the bribe.\(^{16}\) Equating the value of a dishonest life with that of a life in the private sector yields

$$ w = \omega - q\theta b. \quad (8) $$

Hence the capitulation wage equals the reservation wage less the expected value of bribery income. Hence this wage is decreasing in both $q$ and $\theta$.\(^{17}\)

The present value of revenues in the capitulation wage regime is

$$ \Pi_{cw} = \frac{1+\rho}{\rho} N[(1-q) \theta r - \omega + \theta q b]. \quad (9) $$

Using this, it is straightforward to check that capitulation wages break even if $q$ is less than the critical value defined by

$$ q = \left( \frac{C-1}{C} \right) \frac{1}{1-\mu}. \quad (10) $$

Net revenues under capitulation wages seem likely to be positive for reasonable values of the parameters. For example, if $\mu = 0.5$, then capitulation wages always yield positive net revenues for $C \geq 2$. Equation (10) is represented by the horizontal line $CC$ in Fig. 1.

Only dishonest individuals apply to become tax inspectors in this wage regime and the government only obtains tax revenues from successful monitoring. Moreover, there is little to be gained by dismissing someone who is caught taking a bribe since it is known that his replacement will also be dishonest. Nevertheless, we shall demonstrate below that paying capitulation wages to tax inspectors may make sense for certain configurations of parameter values. Furthermore, in Section IV we shall argue that the situation of some countries' revenue services bear the hallmarks of a capitulation wage regime.

In this section, we have shown how each of the three wage regimes can be characterised in terms of the values of $\gamma$ and $q$ which yield positive net revenues.

\(^{16}\) To find the optimal wage in this regime, the techniques in Besley and McLaren (1990) are again relevant.

\(^{17}\) The wage may sometimes be negative so that it makes sense for the government to sell the office of tax collector. This raises many of the issues concerning bond posting discussed above. We shall confine ourselves, therefore, to cases where the capitulation wage is positive.
Our next task is to use this to compare them, by finding conditions under which each yields the greatest payoff to the government in terms of net revenue.

III. TAX REVENUE COMPARISONS BETWEEN WAGE REGIMES

In this section we develop comparisons between the three wage regimes that we have identified. We do so by considering three decision loci representing values of $q$ and $\gamma$ for which the government would be indifferent between any two of the wage regimes on net-revenue grounds.\footnote{Note that it is legitimate to make a once and for all comparison between the regimes. The value of reservation wages is increasing through time so that \textit{ex post} you would never want to switch to another wage regime if reservation wages were ever worthwhile. Similarly, the decision to switch to reservation wages would involve comparing their value, discounted to the present, with any of the other wage regimes.} Comparing (3) and (9), it is straightforward to check that reservation and capitulation wages yield the same revenues if and only if

$$\gamma = \frac{[\rho + \delta + \theta(1 - \delta)](1 - q)}{[\rho + \delta + \theta(1 - \delta)](1 - q)} (1 - \mu).$$

By differentiating (11) it is easy to establish that $\gamma$ is a decreasing, convex function of $q$. It is illustrated as the curve $XX$ in Fig. 1. In the case of reservation versus efficiency wages, comparison of (3) and (6) gives a locus with a critical value

$$\gamma = \frac{\mu[\rho + \delta + \theta(1 - q)(1 - \delta)]}{(1 - q)(1 - \delta)} \theta(1 + \mu).$$

This defines $\gamma$ as an increasing, concave function of $q$ which is labelled as $YY$ in Fig. 1. Finally, consider the choice between efficiency and capitulation wages (by comparing (6) and (9)). In this instance, it is easy to see that there is a critical value of $q$ (which is independent of $\gamma$) and given by

$$q = \frac{\theta(1 - \mu)(1 - \delta) - \mu(\rho + \delta)}{\theta(1 - \mu)(1 - \delta)} < 1.$$  

This is the horizontal line $ZZ$ in Fig. 1. Note that capitulation wages always dominate efficiency wages at the top of the box, since $\Pi_{hw}$ tends to minus infinity as $q$ tends to one. This is just another way of saying that, for sufficiently weak monitoring, it just is not feasible to deter bribery through the wage, whereas capitulation is always feasible. With these schedules in place, we can characterise the parameter values in which each of the wage strategies is optimal. They are labelled as $RW$, $EW$ and $CW$, standing for reservation, efficiency and capitulation wages, respectively.

To home in on the implications of these results, we shall plot the three decision loci for various parameter values. For all of the ensuing illustrations,
we set $\rho = \delta = 0.1$ and $\mu = 0.5$. The parameter that we vary is $\theta$. Variations in $C$ affect only the location of the zero net revenue loci, but as equations \((11)-(13)\) indicate, they do not affect the location of the decision loci. We shall examine the comparative performance of alternative wage strategies, therefore, without reference to whether revenues are positive. The variations in $\theta$ that we consider are best thought of as changes in the density of tax payers among the population and possibly changes in inequality. Increasing $\theta$ might be thought of as mirroring what happens in the process of economic development.

Fig. 2 illustrates the case of $\theta = 0.1$. In this instance, only one of the loci that we illustrated above is relevant, i.e. capitulation wages are always preferred to efficiency wages and we have a choice only between reservation and capitulation wages. Hence, for parameter values in the $CW$ region capitulation wages are preferred while for all others the choice would be for reservation wages. The decisive factor is simply the size of $\gamma$ for given $q$. When $\gamma$ is low and there is very little dishonesty, we have reservation wages. This is so because increases in $\gamma$ lower $\Pi_{rw}$ but have no effect on $\Pi_{cw}$, since under capitulation wages the composition of the tax inspectorate is independent of the aggregate proportion of dishonest. For these illustrative parameter values capitulation wages are the optimal response to the existence of a large corruption problem, from a revenue raising perspective. Efficiency wages do not figure at all.

If we increase the value of $\theta$ to $0.5$, then the picture changes quite dramatically to that found in Fig. 1. There are now three regions of interest. For low $q$ and high $\gamma$, efficiency wages are preferred. This makes sense. There are many dishonest inspectors and monitoring is effective so that it both pays to deter corruption and is not too expensive to do so. When $\gamma$ is high but is accompanied by poor monitoring, capitulation wages yield the highest net revenues. Since $q$ is high, efficiency wages would be expensive while high $\gamma$
makes reservation wages relatively unattractive (since $\phi$ is increasing in $\gamma$). It is also interesting to note that capitulation wages make sense in precisely those cases where the other wage regimes would yield no revenues at all. Hence, the payment of capitulation wages ought generally to be associated with economies where tax revenues relative to GNP are generally low. In cases where $\gamma$ is low, reservation wages yield the highest net revenues, even when $q$ is high. In Fig. 1, the reservation wage regime occupies over 50% of the parameter space.

Fig. 3 illustrates the case where $\theta = 0.9$. The main difference with Fig. 1 is that there is a greater role for efficiency wages compared to both reservation and capitulation wages. It is only when monitoring is very lax indeed that capitulation wages can serve a role. That an increase in $\theta$ has this effect should come as no surprise. An additional tax payer adds $\tau$ to the tax base. Under efficiency wages all of this increase winds up in the hands of the government, whereas in the other regimes, part of it leaks out through bribery. Thus the region in which efficiency wages is optimal grows.

Using these diagrams one can also explore the effects of varying other parameters on the choice of wage regime. The comparative statics with respect to $\mu$ may sometimes have paradoxical implications. One result, which we refer to as the persuasion paradox is illustrated in Fig. 4. It refers to a case in which an increase in the bargaining power of tax inspectors may be disadvantageous to them. The diagram illustrates a case in which $\mu$ is increased from 0.5 to 0.7. The direction of shift in the loci is given by the arrows. This increase in bargaining power eliminates the efficiency wage regime. It is in the region $aefcd$ that this may have paradoxical implications. Parameter values in this region previously implied that efficiency wages were a good idea, whereas now an optimising government would choose capitulation wages. Tax inspectors
lose all of their rents and hence an increase in bargaining power can actually hurt the inspectors in our model.

IV. ENDOGENOUS MONITORING

So far, we have not modelled the process by which $q$, the level of monitoring of tax collectors is determined and, arguably, this is to assume away a crucial dimension of behaviour for the problem in question. The issue is particularly pressing in light of the evidence that bribery pervades all levels of a bureaucracy, not being confined to those officials who interact with taxpayers. Thus Klitgaard (1988) observes that when auditing is undertaken, one has to be concerned about the practice of bribing 'officials in charge of investigating erring officials so they will sit on cases, delay investigation and, better still, dismiss complaints.' (p. 20).

In fact, we show in the Appendix that a straightforward extension of our model to a two tier hierarchy preserves the basic results. In the extended model, an upper tier of super-auditors are recruited from the same pool as the tax collectors. The value of $q$ can be made endogenous as follows. Suppose that the fraction of dishonest types in the pool and the technical efficiency of the auditing process are exogenously given, but that the government can choose the number of super-auditors. Auditing efficiency can be thought of as reflecting the ease with which corrupt deeds can be concealed. In this world, $q$ is determined by the choice of the size of upper tier, taking into account the
cost of auditing and the benefit that it brings in terms of improved lower-tier performance. We then show that a combination of high $\gamma$ and an inefficient auditing technology yields a high $q$. Moreover, capitulation wages are optimal in this case. Thus, as in Fig. 3, a cynical and inefficient bureaucracy is better off paying capitulation wages.

One could, however, imagine building more sophisticated models. In practice there are multiple tiers in any bureaucracy and one could build a model along the lines of Calvo and Welicz (1979) to illustrate this in our case. The issue would then be whether to pay capitulation, efficiency or reservation wages at each tier of the bureaucracy. As is well understood, paying efficiency wages at some level of the bureaucracy does rely on there being at least some honest individuals somewhere above them in the bureaucracy who monitor honestly. This seems to be recognised in practice as the experiment with efficiency wages in 19th century China, reported below, confirms.

One interesting effort along these lines is Gangopadhyay et al. (1991). They show that with a hierarchy of auditors and a sufficiently sophisticated system of fines for cheating and rewards for turning in cheaters at all levels of the hierarchy, it is possible to eliminate corruption even if there is no inherently honest person in the bureaucracy. This result depends on the availability of sufficiently high and enforceable fines, which as noted above are not always an option because of the legal system which is often a source of corruption itself (see footnote 5). In addition, Mookerjee and Png (1990) show that if inspectors have the additional option of performing fewer inspections than they are supposed to and it is harder to detect or punish this offence than outright corruption, fines can actually be destructive by discouraging inspectors from diligence in performing their function. For these reasons it is not clear that the policy conclusions of Gangopadhyay et al. will apply to all hierarchies.

One interesting argument, suggested by considering the possibility of corruption at a higher level, is that raising wages at the lower tier could actually increase corruption by raising $q$. To see this, consider a world in which different members of the higher tier have different reservation prices for dishonesty. A higher wage then raises the value of keeping a job at the lower tier, thereby raising the amount that the upper tier might be able to extract from the lower tier from every bribe. This would encourage more super-auditors to behave dishonestly than would otherwise be true (resulting in a higher $q$). This effect would dominate other beneficial effects of raising wages if the schedule giving reservation prices for dishonesty were steep enough in the relevant range. Moreover, in such a case, it could eliminate the use of efficiency wages altogether. In general, such concerns militate further against using an efficiency wage in response to corruption and this should be borne in mind below when we consider why efficiency wages seem so rarely to be paid in

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19 Another reason is that their results depend crucially on the assumption that super-auditors never overstate the level of bribery that they have discovered, even though the bonuses paid to the auditors in their model, proportional to the size of the reported bribery, would generate a clear incentive for such overstatement.

20 We are grateful to a referee for suggesting this argument and thereby thinking about the behaviour of the upper tier of the bureaucracy more carefully than we had done previously.
practice. Under capitulation wages, the lower tier actually gets no rent which it can pass on to the upper tiers and this will, ironically, tend to encourage honest upper tier monitoring. Under reservation wages, there is some rent to be passed on and we would expect to see some upper tier dishonesty.

These more complicated stories suggest a non-separability between the choice of wage rate and \( q \) which our simple diagram ignores. As we will argue in the next section, however, we still find this framework to provide a useful, if simplified, lens through which to view real world tax systems. Clearly a rich agenda remains for future work.

V. DISCUSSION

The main point of this exercise has been to clarify issues that arise in discussing which wage a government should offer. It is interesting, in light of this, to look at what governments faced with the problems that we have discussed actually do. One would expect, given enough time and a strong enough desire to raise revenues, that governments would eventually learn the best wage strategy. Supposing for the moment that this indeed captures the motives of government and that they are rationally pursued, it is instructive to consider what predictions our model would make.

First, in economies with an entrenched ethic of honesty, tax collectors would be paid their opportunity cost. Secondly, in economies with more cynical employees available to the government, there will be two patterns. In the first of these, monitoring will be effective, revenue bureau wages high, corruption rare and there will be rents to tax inspectors. In the second of them, the opposite will hold on all counts. But what patterns do we actually see?

Lindauer et al. (1988) review data from several African countries and cast doubt on views found in earlier policy documents to the effect that African public sector wages were high relative to the private sector. Their main finding is that public sector wages in Africa have fallen very fast in the 1970s and 1980s. Uganda is cited as an extreme example, where according to a public commission report, 'the civil servant had either to survive by lowering his standards of ethics, performance and dutifulness or remain upright and perish. He chose to survive.' (p. 21) However, the data they survey are crude and aggregative, and it is hard to say anything about the comparison of public salaries with opportunity costs.

Some information is provided by the small empirical literature on civil service pay in LDCs. There has been some work on estimating wage equations for public and private sector employees. An example is Lindauer and Sabot (1983), who found a small premium to civil service employment in Tanzania, after correcting for all available personal characteristics. Knight and Sabot

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21 It also bears remarking that if higher tier individuals have any say in determining the pay scales at the lower tier, they may have an interest in not paying a wage as low as the capitulation wage in order for some scope for surplus extraction to remain.
(1987) found that Kenyans with secondary education were paid somewhat less in the public sector than in the private sector. Educated Tanzanians were paid much less in the public sector. There was a weaker pattern in the opposite direction for those without secondary school. However, van der Gaag et al. (1989) have pointed out a potentially serious flaw in such studies. Unobservable personal characteristics (such as closeness to someone in power) which may affect the likelihood of getting a government job may also affect the wage one is paid after obtaining the job. This means that OLS estimation of the wage equation may be biased. In their samples for Peru and the Cote d'Ivoire, van der Gaag et al. find that correcting for the selection bias changes the civil service premium into a deficit, suggesting that the unobserved characteristics which make it more likely that a worker obtains a government job also make him likely to receive a higher wage once he has obtained it. This also suggests that many of the previous empirical results in this area may be misleading.\(^{22}\)

Interestingly, van der Gaag et al. have some difficulty explaining their result. They state that ‘If they (public sector workers) suffer from wage discrimination, why do workers continue to seek employment in and remain in the public sector?’ (p. 85). Their answer, that civil servants can moonlight, seems weak indeed considering the fact that private sector workers can also moonlight if they wish to. The theory of capitulation wages, however, provides an alternative plausible and coherent answer to this puzzle.

Perhaps the best way to assess the empirical relationship of civil service salaries to opportunity cost is to study government documents drawn up to assess that very thing for the purpose of adjusting salary scales. This is the course followed by Bennell (1981), for Ghana, Kenya and Nigeria. The overwhelming conclusion is that civil servants in those countries, in every grade and in every period studied, are paid less than they would be in the corresponding job in the private sector. The gap seemed to be wider for higher grades and appeared to be widening over time.\(^{23}\)

Thus it may be reasonable to guess tentatively that most LDCs pay civil servants less than their opportunity cost. The real interest in this paper is in the pay of tax inspectors specifically. There is no obvious reason to believe that they are treated differently from other civil servants, but it makes sense to try and check.

Although data on tax collector remuneration is very hard to find, a scattering of figures available from Africa suggest that wages below opportunity costs for tax collectors are the norm there. In Zaire, for example, civil service salaries which are well below the poverty line result in a widespread perception that the civil servants must cheat in order to survive (Gould (1980), pp. 70-1). Budget documents from Nigeria indicate that in 1982 the bottom two ranks

\(^{22}\) A referee has suggested that an additional reason for the discrepancies in these results is the steady decline of public sector wages in Africa. This could cause earlier studies to show a public sector premium and later ones a deficit.

\(^{23}\) Of course, with austerity measures undertaken by these governments in the 1980's, it would be hard to imagine a reversal of this trend.
(Grade 03 and 04) of employees in the Tax Collection and Accounting Division of the Inland Revenue Department, together amounting to 73% of the Division, were projected to earn salaries of N1,398 and N1,626 respectively (Nigeria (1982), p. 315), as compared with the statutory minimum wage of N1,500 (p. xiii). It is difficult to believe that tax collectors, who generally meet some basic standards of literacy and numeracy, would command only the minimum wage in the private sector. The inability of tax collector wages to compete with private sector offers is noted in Ghana (1977, p. 62) and seems to be mirrored annually in Zimbabwe (1980–4, section 3).

It seems reasonable, therefore, to take \( w < \omega \) as a stylised fact in some parts of Africa, and since many of these societies clearly exhibit low levels of bureaucratic loyalty (high \( \gamma \)) and weak monitoring (high \( q \)), this is what we would expect to see.

An exceptional case may be Malawi. One observer claims that ‘there is a need for a scientific explanation of the low level of corruption within the Malawian administration. One cannot even say that the civil servants are well paid’ (Medard (1986), p. 124). The explanation being offered is that \( \gamma \) and \( q \) are low: ‘it seems that the reason, apart from the atmosphere of puritanism enforced by the State and inspired by the influence of missions, can be found in the action of the party which is efficient in controlling the administration.’ In a low \( \gamma \) society we would not expect tax collectors to receive anything less than their opportunity cost, and so it is interesting to note that as of 1976 (the only year for which we were available to find data), virtually every tax office employee was earning an income far above the minimum wage (K0·25 – 0·40 per day) and above the median private sector income, and a large portion were earning an income that would put them in the top 5% of the private sector income distribution, and thus it is quite plausible that they earn their opportunity cost (see table 1).  

Thus we have a variety of countries which could arguably be placed in the upper right hand side of Fig. 1, with tax collector wages below opportunity cost and much active corruption, and another on the left hand side with wages around opportunity cost and little active corruption. These observations crudely fit the model. We have not been able to find an example of any country with widespread bureaucratic cynicism and simultaneously strong monitoring of tax collectors; the relative emptiness of the lower right hand corner of the

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84 For testimony on bureaucratic attitudes towards honesty in Ghana, see the Anin Commission’s report on corruption (e.g. West Africa, no. 3049, December 1, 1975, pp. 1430–1 and pp. 1435–7), which laments that the ‘devout have vanished from the land’ (p. 1435). See Gould (1980) for an account of the problem in Zaire. On the question of whether monitoring is weak, note the recommendation of the 1977 Ghanaian tax commission to institute internal auditing (Ghana (1977, p. 19)) and that in Zaire corruption is ‘tolerated and…encouraged by officials’ (Gould (1980, p. 140)).

85 In addition, Malawi has been singled out for having a strongly hierarchical civil service salary structure (Lindauer et al., 1988). This is interesting because, as Bulow and Summers (1986) point out, the same issues that lead to incentive arguments for higher wages can also lead to incentive arguments for job ladders. Thus, the much larger gap between senior and junior salaries in Malawi than is typical in Africa is consistent with our conjecture that other countries offer tax collectors capitulation wages, while Malawi offers something closer to reservation wages.
box, together with the thinness of the tax base (low $\theta$) in many of these cases, may be taken as a positive explanation of the rarity of efficiency wages in tax collection.

The only clear experiment with efficiency wages that we have encountered is in mid-nineteenth century China (see, Newbery (1987), p. 189). The existing customs service was run and staffed by Chinese and was extremely corrupt, based on ‘the old-time method of selling jobs with merely nominal pay attached, and allowing purchasers to fleece both Government and public, provided that fleecing was done discretely and in recognised ways.’ (Wright (1950), p. 276). The officials of the Shanghai Customs House were described as ‘unpaid subordinates living by exaction and bribery’ (Lanning (1915), p. 3). This appears to be a clear cut example of a capitation wage regime.\(^\text{26}\)

In the 1850s foreigners were put in charge of the service, the Irishman Robert Hart taking over in 1863. He raised wages to improve the quality of the workforce (Wright (1950), pp. 268, 275–6) and hired a team of qualified foreigners as inspectors. The effect on tax revenues was resounding. There is no good reason to suppose that there was a change in the honesty of the pool of available labour, but the monitoring of customs officials was greatly increased, with random audits and immediate dismissal for any proven impropriety (Wright (1950), p. 287). However, it seems that such improprieties were rare, as they should be under efficiency wages. Hence, the reform enacted in China can be thought of as a drop from the top right hand corner of the box in Fig. 1 to the bottom right hand corner facilitated by improved monitoring.

Thus certain broad features of our model do seem consistent with observed patterns of policy. It is slightly puzzling that some government behaviour does seem to be sub-optimal, in terms of our model. This is in cases where rents coincide with cynical labour forces and weak monitoring. In the capitation wage regime that we described above, the government set a wage so that expected rents were zero. An example of an economy in which rents persist

\(^{26}\) This is not the same as tax farming as we define it here, since customs officers seem to have had no legal right to pocket tax revenues, and the government did not receive the full amount due to it. However, Lanning (1915) p. 3 does describe the system as a regime with tax farming.

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### Table 1

<table>
<thead>
<tr>
<th>Grade of employee</th>
<th>Executive</th>
<th>Clerical</th>
<th>Customs Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customs and Excise</td>
<td>35%</td>
<td>29%</td>
<td>29%</td>
</tr>
<tr>
<td>Income tax</td>
<td>47%</td>
<td>21%</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: Executive grade civil servants received salaries of K1,098–2,034, which would correspond to the 95th to 97th percentiles of the private sector income distribution. Clerical grade civil servants received salaries of K222–981, corresponding to the 53rd to 98th percentiles. Customs service salaries were lumped in with police officer’s salaries, which had a range similar to that of the clerical grade.

Source: Malawi (1976, pp. 93, 95, 155–6); Malawi (1978, pp. 71, 80).
even though in other respects we have a capitation wage regime is Zaire. Gould (1980, p. 146), for example, discusses car ownership among tax officials which leaves little doubt about rents. The most infamous case of capitation wages coexisting with rents is in Indonesia. The Indonesian manufacturer who asserted that 'Being a tax collector is better than owning a clove tree' expressed succinctly a widespread perception about the country's tax service. Evidence that gross returns to being a tax collector exceed opportunity cost for the bulk of applicants is found in a number of indirect ways. First, there is a long queue for tax collector positions. One survey (Simanjuntak (1980), pp. 125-6) found that 96.8% of job-hunting university graduates surveyed preferred government work to all other forms. In addition, no one ever seems to leave a job in the tax office once it has been attained (IRS (1984), p. 46). Hence, rents appear to be accruing even though it is apparently a high $\gamma$ and high $q$ service. Thus, there seems to be a bias in favour of the civil service, and a conclusion from our model would be that, without any distributional reason to arrange a transfer to civil servants, tax collector wages in places like Zaire and Indonesia may actually be too high!

**VI. Concluding Remarks**

The contribution of this paper is to analyse a new dimension of the tax compliance problem relevant for the large areas of the world in which bureaucratic cynicism is a problem. In contrast to the existing literature, here it is the tax inspectors rather than just the taxpayers who are dishonest. This has enabled us to analyse the view that corruption is best combated by using efficiency wages. In addition, we consider the possibility of paying reservation wages and a further wage regime which we call capitation wages - a possibility which does not seem to have been noted in this class of models previously.

Overall, the results suggest that the efficiency wage strategy may not be a good idea much of the time, even for relatively high levels of corruption (high $\gamma$ in our model). For efficiency wages to make sense, one needs an evenly distributed tax burden, a corrupt pool of potential collectors and strong monitoring. Without these conditions, the government may be better off paying a wage at which nobody behaves honestly, relying on monitoring of tax inspectors as a means of raising revenues. This state mirrors the position which some countries may actually be in – tax inspectors' rewards are very low (lower than available in other kinds of urban employment) but are supplemented by

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28 Many students cited a reservation salary above government starting salaries, which the author takes to be a sign of anticipated gains from corruption.
30 Palmier (1983, p. 217) describes the half-hearted attempts to institute a monitoring system for Indonesian civil servants. IRS consultants (IRS (1984, p. 43)) list the lax government attitude toward tax evasion as a major problem, citing an official's remark to the effect that 'we are to trust taxpayers in their dealings with the government; they will do what is right.'
31 See Besley and McLaren (1990) for further discussion of this.
bribery. It seems striking that this situation may sometimes make sense when the criterion of revenues raised is used to evaluate it relative to others.

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References


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Taxes and Bribery


Appendix: The Model with a Hierarchy

Here we extend our basic model to one in which the tax collectors are inspected by an upper tier of super-auditors, whose numbers and behaviour determine ‘q’ endogenously. Assume that the super-auditors are drawn from the same pool as the lower-tier collectors, and that each of them can inspect $\frac{1}{z}$ tax collectors each period. The tax office needs $N_1$ tax collectors and must choose $N_2$, the number of super-auditors to monitor them. When an honest super-auditor catches a tax-collector taking a bribe, he turns him over to the authorities to be dismissed. When a dishonest super-auditor catches a tax-collector taking a bribe, the two collude. In analysing the resulting bargaining, consider two extreme cases:

Case 1: The super-auditor has all of the bargaining power. Thus, he says to the guilty tax collector: ‘If I turn you in, you will be fired. However, I give you the alternative
of offering me a bribe of \( b^* \) in exchange for being silent. Take it or leave it.’ Of course, \( b^* \) will be chosen to make the collector (almost) indifferent between the bribe and dismissal. Thus, the tax collector will be just as well off being caught by a dishonest super-auditor as by an honest one.

**Case 2:** The tax collector has all of the bargaining power. Thus, he will tell the auditor: ‘You have caught me taking a bribe and can turn me in to be dismissed. However, you receive no reward for doing so. I offer you an alternative: take this bribe of \( b^{**} \) and look the other way. Take it or leave it.’ Of course, \( b^{**} \) will be the smallest positive bribe possible, so the tax collector will be (almost) indifferent between being caught by a dishonest super-auditor and not being caught at all.

In Case 1, the decision problem for a dishonest tax collector is exactly what it was in the text of the paper with \( (1 - q) = N_2/\alpha N_1 \). In Case 2, the problem is identical but with \( (1 - q) = (1 - \gamma) N_2/\alpha N_1 \). All cases with bargaining power divided between the two will be intermediate between these two cases.

Clearly, there is no efficiency wage for the highest tier since there is no-one to monitor that tier. Further, it can never be optimal to pay a capitulation wage to the upper tier, since if the upper tier were composed only of dishonest types no dishonest tax collectors would be deterred from taking bribes and they would never remit revenues to the government – thus the government would not benefit from having an upper tier at all. Thus, the optimal policy will involve paying reservation wages to the upper tier. The tax agency’s monitoring costs associated with a given level of \( q \) are thus given by:

\[
c(q) = \omega N_2 = \begin{cases} \omega (1 - q) \alpha N_1 & \text{in Case 1} \\ \frac{\omega (1 - q) \alpha N_1}{(1 - \gamma)} & \text{in Case 2}. \end{cases}
\]

Minus one times the derivative of this is the marginal savings from relaxing supervision:

\[
-c'(q) = \begin{cases} \omega \alpha N_1 & \text{in Case 1} \\ \frac{\omega \alpha N_1}{(1 - \gamma)} & \text{in Case 2}. \end{cases}
\]

The problem of the revenue office is to choose \( q \) so as to maximise:

\[
\max [\Pi_{rw}(q; \gamma), \Pi_{ew}(q; \gamma), \Pi_{rw}(q; \gamma)] - \frac{(1 + \rho)/\rho}{c(q)},
\]

where \( \Pi_{rw}(q; \gamma), \Pi_{ew}(q; \gamma), \) and \( \Pi_{rw}(q; \gamma) \) are given by (3), (6), and (9) respectively. The optimum can be characterised as a function of the underlying parameters \( \alpha \) and \( \gamma \). Two immediate comparative static results emerge using recent results on comparative statics of non-convex optimisation (see Milgrom and Shannon (1991)). First, since \( \Pi_{rw}(q, \gamma), \Pi_{ew}(q, \gamma), \) and \( \Pi_{rw}(q, \gamma) \) do not depend on \( \alpha \) but \( -c'(q) \) is increasing in \( \alpha \), the optimal \( q \) is non-decreasing in \( \alpha \). Secondly, since neither \( \Pi_{ew}(q, \gamma) \), nor \( \Pi_{ew}(q, \gamma) \) depends on \( \gamma \) but \( -c'(q) \) is non-decreasing in \( \gamma \), then if \( \gamma \) is large enough that reservation wages are suboptimal in the lower tier for all \( q \), then the optimal \( q \) is non-decreasing in \( \gamma \). Recalling our earlier results on the choice of lower-tier wages for given \( \gamma \) and \( q \), this gives us the following proposition:

**Proposition:** With endogenous monitoring in a two-tier hierarchy, if \( \alpha \) and \( \gamma \) are such that lower-tier capitulation wages are optimal, then increasing \( \alpha, \gamma \), or both will not change that.

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32 i.e., bigger than \( \gamma \) at the \( XX-YY-ZZ \) intersection in Fig. 3.

33 Formally, these follow from the fact that the objective function satisfies cardinal complementarity conditions in \( (q; \alpha, \gamma) \) as explained in Milgrom and Shannon (1991), section 2.
Thus, in a well-defined sense, one of the main insights in the main text is preserved: capitation wages as the optimal policy are still associated with weak monitoring technology and cynical labour forces. If we drew a box in \((\alpha, \gamma)\) space analogous to Fig. 3, we would still find that the \(CW\) zone occupied the upper right-hand corner.

\(^{34}\) In fact, a stronger result is available. There exists a critical value of \(\alpha\), such that for all \(\alpha\) above that value, capitulation wages are optimal. At this point, the optimal \(q\) is one and effectively, the upper tier can be dispensed with.
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