



## **SHOULD YOU ARM YOUR FUTURE VICTIMS?**

Jean-Paul Azam,  
University of Toulouse (ARQADE, IDEI)  
and Institut Universitaire de France,

EUDN/WP 2006 - 04

June 8, 2006

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by

**Jean-Paul Azam**

University of Toulouse (ARQADE and IDEI)  
and Institut Universitaire de France.

*Forthcoming in Economics & Politics*

**Abstract:** A model is presented where the ruler may arm the producers, in order to convince them that he will not expropriate them ex post. This sets an upper limit on the tax rate, not higher than their probability of loosing their income, should a war occur. The relevance of this analysis is illustrated by discussing various case studies, involving post-conflict situations. Some variants of the model are presented for highlighting some implementation problems, related to asymmetric information or to positive initial endowments of weapons or non produced wealth, which may lead to war in equilibrium.

**Acknowledgements:** Helpful comments by two anonymous referees are gratefully acknowledged, without implicating. This paper is part of the PAC Project CIT-2-CT-2004-506084 funded by the European Commission.

**JEL Classification Numbers:** P16 - D74 - N40.

**Keywords:** Credibility - Extortion - Tax - War.

**Mailing address:** Prof. Jean-Paul Azam,  
ARQADE, University of Toulouse 1,  
21 Allée de Brienne, 31 000 Toulouse, France.

E-mail: [azam@univ-tlse1.fr](mailto:azam@univ-tlse1.fr)

## 1. Introduction

Now, no new prince has ever at any time disarmed his subjects; rather, when he has found them unarmed he has always given them arms. This is because by arming your subjects you arm yourself; those who were suspect become loyal, and those who were loyal not only remain so but are changed from being merely your subjects to being your partisans (Machiavelli, 1961, p.114).

Niccolo Machiavelli wrote these lines in 1513 or 1514, after the fall of the Florentine republic, when the Medici had been restored in power by the Emperor. One of the main tasks performed during his political career before that date was to push for the creation of the Florentine militia, and to spend much effort for putting it together. Appointed chancellor of the *Nove di Milizia* – a committee for the creation of the militia – in 1507, he had “worked tirelessly to recruit troops throughout the Florentine territories” (Bull, 1961, p.15). Machiavelli had some obvious opportunistic reasons for writing these lines at the time, as he was longing to return to some form of office in Florence, but his purpose was most probably doctrinal, aiming to establish a kind of general rule, valid for any government.

The aim of the present paper is to examine how valid is Machiavelli’s advice quoted above, by the standards of modern economic theory, within a contract-theoretic framework. It illustrates how “subjects” are more “loyal” when they are armed, and will then rationally trust their ruler better, exert more effort in production, and pay a higher level of taxes. The behavior of the ruler is here modeled against a definitely Olsonian theoretical background, as a ‘stationary bandit’ (Olson, 2000, McGuire and Olson, 1996). In Olson’s framework, the stationary bandit has a clear incentive to manage carefully his territory, in order to extract as much resources as possible without ‘killing the goose that lays the golden eggs’, while the ‘roving bandit’ has no incentive to leave but ruins behind him. However, Olson does not address some important implementation issues, and in particular does not demonstrate formally how the ruler overcomes the basic time-inconsistency, or credibility, problem that affects tax policy: the ruler has an obvious reason to promise a low tax rate *ex ante*, in order to give his future victims a positive incentive to produce, but he has also a clear incentive to

expropriate the producers *ex post*, at least in a finite horizon game. If the ruler cannot commit credibly to exert restraint *ex post* in taxation, then producers will be deterred *ex ante* from investing resources in production, whatever the announced tax rate.

This problem has been discussed thoroughly by economists in the context of capital taxation, where irreversibility problems give the government an opportunity to renege on its promises, and to increase *ex post* the rate of capital taxation (e.g. Persson and Tabellini, 2000). The 'hold up' problem follows, whereby investment is deterred by the government's inability to commit credibly not to change the tax rules *ex post*. Economists have often emphasized the role of the institutions that protect the investor's interests. Besley (1995) presents several models to bring out the different shades of property rights that matter for investment, with an econometric application to Ghanaian farmers. This topic has also been tackled by political scientists and historians. In his recent book, Bates (2001) analyzes how the coercive power of the state can be used either for protecting the interests of investors, and thus promote growth and prosperity, or for predation, with dismal economic consequences. His examples are taken both from history, and from the contemporary world, in particular from Africa and other developing countries. Capital taxation can take different forms, including among others the appropriation by the state of all existing productive assets, as performed by Stalin (see Olson, 2000), or the sovereign decision to renege on the public debt. In their celebrated paper, North and Weingast (1989) have shown how the kings of England were able to borrow heavily for funding their wars, in particular against France, only after some ways were found of tying credibly their hands, and of convincing lenders that they would not renege *ex post*. The Glorious Revolution of 1688 brought about several institutional changes that reduced drastically the king's ability to renege on his commitments, resulting both in higher fiscal revenues and better borrowing opportunities. In particular, an independent judiciary and a powerful parliament were created to control the king's ability to renege. The superior economic performance of constitutional monarchy, where some form of restraint is imposed on the ruler, over absolutist states has been demonstrated empirically by DeLong and Shleifer (1993), using city growth as their welfare indicator over a long period, spanning about eight centuries, up to 1800. In France,

absolutism remained the rule for a longer time period than in England, with particular strength under Louis XIV, resulting in the stagnation of the economy and of fiscal revenue, while the king's taste for war was making his financial needs quite pressing. Eventually, the monarchy was brought down by the 1789 revolution, triggered ultimately by the need to raise more taxes.

However, this problem is far from a bygone issue, of purely historical interest, and many countries in the contemporary world are facing related problems. In most developing countries, the institutional endowment is often too weak to make solutions based on constitutional rules, democracy or the development of the judiciary a credible commitment device. Governments are very often accused of rigging the elections, and the judges find it sometimes hard to resist corruption and political interference. This is vividly illustrated by Tangri (1999), in the case of several African countries.

Credible commitment on the part of the state is also required for the control of political violence. This point has been emphasized by Azam (2001) and Azam and Mesnard (2003), who trace to commitment failure the root cause of civil war. In these models, the incumbent government promises to the potential rebels a transfer in return for not engaging in a rebellion. As war has a social cost, the government can buy off the potential rebels, by offering them a transfer worth at least as much as the expected value that they can capture by war, while keeping a positive surplus for itself. However, the government must promise more, the lower is its credibility, i.e. the lower the probability of its keeping its promise. If the latter is very low, then the budget constraint binds, and prevents the ruler from promising enough to buy off the rebels, and civil war follows. However, credibility is treated as exogenous in these models, although Azam (2001) discusses various mechanisms used by African governments to enhance the credibility of their promises.

Similarly, Fearon (1998) has shown how commitment failure may trigger a civil war, or rather a war of secession, between an ethnic majority and a minority group, who would do better by living together peacefully under credible commitment, in a two period model. He assumes majority rule in the second period, preventing the majority group from committing credibly at the initial date to an acceptable allocation of resources for the next

period. Because the relative fighting efficiency of the minority group decreases over time if it accepts peace in the first period, it is better off putting up a fight up front, in order to try and get secession and self government for the future. This model is thus a nice demonstration of the problems raised by majority rule under ethnic dominance. Collier and Hoeffler (2004) have provided some empirical support to such an effect, by showing econometrically how ethnic dominance increases significantly the probability of a country being affected by a civil war. Acemoglu and Robinson (2000, 2001) analyze the other side of the electoral coin, showing how the extension of the franchise was used in the 19<sup>th</sup> century in some western countries to enhance the credibility of the redistribution of income from the rich to the poor. The latter being more numerous can pass fiscal laws that redistribute income in their favor in an orderly fashion. This works as a deterrent to revolution, whereby the poor would capture wealth by force, with very detrimental consequences for social welfare. The rich can thus promise credibly to redistribute some of their wealth in favor of the poor, while protecting themselves from the curse of revolution. However, as the comparison with Fearon's argument described above makes clear, majority rule might be an effective deterrent for political violence in a society divided along class lines, as was 19<sup>th</sup> century Western Europe, where the poor are the most numerous, whereas it raises serious problems in a society divided along ethnic lines, when one group holds the majority. The present paper discusses some issues that may be relevant in the latter case, as well as in the cases where the ruler controls the state for other reasons.

The basic version of the model is discussed in the next section, showing how a ruler might decide to arm his potential opponents, hereafter called the farmers for short, as a way to create a credible ceiling on the future tax pressure, in order to protect enough incentives for the producers to have a positive output and pay taxes. It thus shows how the shadow of conflict might be required for economic and political development. The model is the simplest possible one to bring out the different propositions, and is built in such a way that two kinds of equilibria can exist in this economy, depending on parameter values: prosperity, with positive output and taxes, or absolutism, with zero output and taxes. This stark simplicity should not be interpreted literally, of course, and is simply meant to characterize the 'good'

and ‘bad’ outcomes from the viewpoint of economic development and state formation. The model thus highlights how prosperity is basically predicated on the producer’s ability to defend himself against predation. It also shows that the ruler might not choose to secure prosperity, if the opportunity cost of providing such defense against predation is too high. Then “absolutism” prevails, and leaves no incentives for production. This provides the counter-factual outcome against which Machiavelli’s advice given above is guarding the “new prince”. The subsequent section, called Case studies, illustrates how the core insight from the basic model can be interpreted to shed light on real world issues, with an application to post-conflict situations. Then, various complications are added to this model, allowing to discuss free riding by some farmers and violence against innocent civilians, asymmetric information about the farmers’ ability to fight, and, in a subsequent section, the role of a positive initial endowment of weapons in the hands of the farmers. This issue is especially relevant in a post-conflict situation, where the defeated side still holds a lot of weapons, and the question arises of its disarmament. A particular attention is then devoted in the same section to the role of non produced wealth, called ‘diamonds’ for short, in complicating the ruler’s decision problem. It is shown there how ‘diamonds’ and corruption may combine to preclude the emergence of a prosperous economy with positive taxes. This exercise thus sheds some interesting light on the problem of ‘warlord politics’, recently brought out by Reno (1999), based on his analysis of such ‘diamond economies’ in Africa as Liberia, Sierra Leone, and the Democratic Republic of the Congo, as well as on some empirical results presented by Collier and Hoeffler (2004).

## **2. The Basic Model**

Let us start by the simplest case where a ruler is facing only one farmer. The ruler owns a stock of weapons  $W$ , while the farmer does not. In the theoretical presentation, I stick to this interpretation, and always call  $W$  ‘weapons’. However, this may be regarded also as a useful parable, and some other interpretations are clearly possible, where ‘weapons’ are in fact some institutional items that give the producers the ability to fight back against any attempt by the ruler at expropriating them, with some probability of success.

### *The Model*

The farmer can produce a quantity of food  $\alpha e$ , by exerting an effort  $e$ , and incurring a disutility  $e^2/2$ . The ruler is the principal, and offers the following contract: "I give you  $w$  weapons now, and either you pay me a tax  $T$  later, to be determined then, or I attack you and go for a war against you instead". At stage 1, the ruler thus gives  $w$ , while the farmer chooses his production level  $\alpha e$ . The latter is not contractible, as it is only observed at stage 2 by the ruler. At this point, the contract is negotiated in view of the output level, and either the farmer pays the tax  $T$ , or a fight takes place between the ruler and the farmer. By convention, I always assume in the following that the two players choose the peace-and-tax equilibrium rather than war, as soon as the payoff to the former is *at least as large* as that of the latter, thus ruling out indifference. This is a simple way to take into account a minute additional cost of war, assumed to be sufficient to break the tie in case of equal utility level. Call this the 'peace bias' assumption.

The simplest conflict technology is assumed, and is such that in case of fighting, the ruler wins with probability  $p$ , in which case he takes the whole output  $\alpha e$  as loot. This probability is such that:

$$0 < p = \psi < 1, \text{ if } \mu w \geq W - w, \quad (1)$$

and  $p = 1$ , otherwise.

This technology of conflict captures very simply the idea that in order to have a positive probability of winning a fight against the ruler, the farmer must possess a high enough quantity of weapons, relative to the stock held by the latter. Moreover, the parameter  $\mu$  captures in a simple way the relative fighting efficiency of the farmer. If it is very low, the latter needs a lot of weapons to ensure a positive probability of winning, while if it is high, the farmer has a good chance of winning even with a small stock. The stepwise shape of this probability function captures some kind of economies of scale, comparable to the S-shape assumed by Skaperdas (1992): there is no point in fighting with a too small quantity of

weapons, while your chances become significant beyond a certain threshold. A similar conflict technology is used in Azam and Mesnard (2003)<sup>1</sup>.

### *Equilibrium*

In stage 2, the farmer will accept to pay the tax, and avoid the risks involved in fighting, if his after-tax payoff is at least as large as the expected value of his income in case of war. This is captured by the following participation constraint:

$$\alpha e - T - e^2 / 2 \geq (1 - p) \alpha e - e^2 / 2. \quad (2)$$

This constraint can be simplified to read:

$$T \leq p \alpha e.$$

Given that the choice of  $w$  made by the ruler at stage 1 is irreversible, at stage 2 the latter only chooses between going for a war, or accepting the tax and be content with it. This happens if the latter course of action yields at least as much revenue as the expected value of the capture from the war. This is the self-enforcement, or credibility constraint, bearing on the ruler's behavior, which can be written as:

$$T \geq p \alpha e.$$

Taken together, these two constraints imply simply:

$$T = p \alpha e. \quad (3)$$

Equation (3) states that the tax levied must be proportional to output, if it is to be paid peacefully, while the coefficient of proportionality is equal to the probability of the ruler seizing the loot in case of war. This is the root of the incentive problem present in this model. The farmer understands that his tax liability will go up as he increases output, as the tax schedule (3), determined at stage 2, is duly taken into account at stage 1.

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<sup>1</sup> The non-convexity plays a part below in making the "absolutist" type of equilibrium qualitatively different from the "prosperity" one. This would not be the case with a standard contest-success function, say  $p = (W-w)/W$ , where a smoother difference would emerge.

The level of effort, output, and therefore of tax revenues, are determined at stage 1 by the farmer, who maximizes his objective function, given by the left-hand side of (2), taking due account of (3). Hence,  $e$  is determined by solving the following program:

$$U_F = \max_e \alpha e - T - e^2 / 2 = (1-p)\alpha e - e^2 / 2 .$$

From the first-order condition  $e = (1-p)\alpha$ , one derives easily that the supply of effort and the level of tax revenues are governed by the following step functions:

$$\begin{aligned} e &= T = 0 \text{ if } p = 1, \text{ and} \\ e &= (1-\psi)\alpha \text{ and } T = \psi(1-\psi)\alpha^2 \text{ if } p = \psi . \end{aligned} \quad (4)$$

In order to compute the equilibrium, assume first that the ruler assigns a positive value  $\varepsilon$  to his holding of weapons, in terms of consumption. This might capture either some subjective value attached by the ruler to owning weapons, or, more realistically, the value of some alternative use to which he might want to put them, e.g. foreign war, if one wants to describe the preferences of many kings and rulers of the past. Then, he is assumed to determine how much weapons to give to the farmer by solving the following program:

$$U_R = \max_{c,w} c + \varepsilon(W - w), \quad (5)$$

where  $c = T$  in case of peace, and  $c = p\alpha e$  in case of war. The equilibrium outcome can then be described as follows:

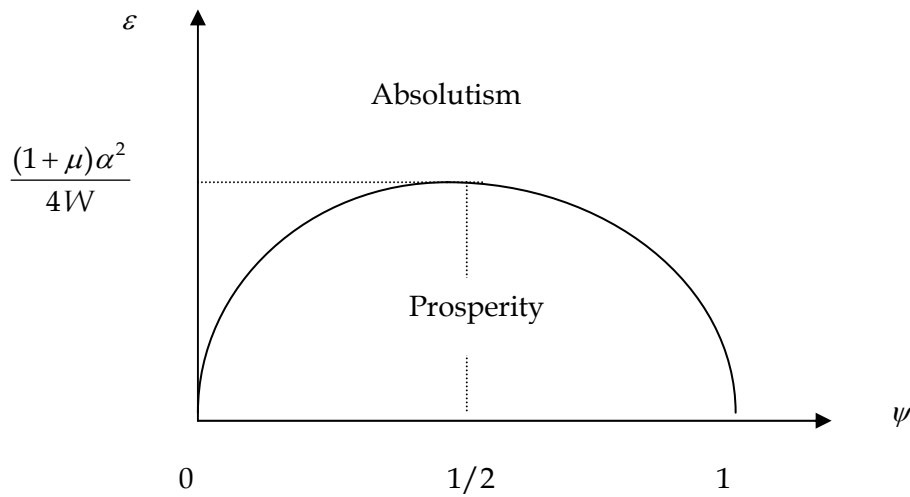
**Proposition 1:** The ruler chooses:

$$w = \frac{W}{1+\mu}, \text{ resulting in } T = (1-\psi)\psi\alpha^2, \text{ if } \varepsilon \leq (1+\mu)\frac{\psi(1-\psi)\alpha^2}{W}, \quad (6)$$

and chooses  $w = 0$ , otherwise, entailing then  $T = 0$ .

The proof is extremely simple, and is presented in the appendix. What proposition 1 states is simply that the ruler will choose to give enough weapons to the farmer for securing a sufficient level of incentives if he does not like weapons 'too much', relative to

consumption. Then, prosperity is based on a strange type of exchange, in which the farmer gives part of his output to the ruler in return for the transfer of some weaponry, that he does not value *per se*. Statecraft here is thus characterized by the art of making farmers appreciate what they are given in return for accepting to abandon part of their output. Otherwise, the ruler will choose to ruin the economy, by killing any incentive to produce, in order to stick to his stock of weaponry. The last inequality on the right-hand side of (6) describes the terms of this comparison, and shows the range of values of  $\varepsilon$  for which the utility value of  $w$  is lower than that of  $T$ , both measured at their positive equilibrium level. Absolutism, defined here by no sharing at all of the stock of weapons, and the resulting absence of incentive to effort, prevails when this inequality has the reverse sign, holding strictly.



**Figure 1: Comparative Statics in the  $\{\varepsilon, \psi\}$  Space**

Therefore, absolutism will prevail if either the ruler has a strong taste for weapons, i.e. maybe, some valuable foreign wars to fight, or if productivity is low relative to the stock of weapons, or else if the probability of winning by either side is close to zero or one. In other words, this proposition predicts that absolutism should be observed among pretty underdeveloped countries, where productivity is low, while the stock of weapons is large. This is reminiscent of both middle-age Europe, and contemporary Africa. The impact of the probability of winning on the choice between prosperity and absolutism is interesting: the self-enforcement constraint entails that the tax rate is equal to the probability of the ruler

wining in case of fighting. Hence, the farmer has a low incentive to produce if this probability is high. In fact, the term  $\psi(1-\psi)\alpha^2$  can be interpreted as a Laffer curve, although the ruler cannot choose the tax rate as he likes, because of the self-enforcement constraint. Figure 1 depicts the parameter configurations that yield either prosperity or absolutism as the equilibrium outcome, in the  $\{\varepsilon, \psi\}$  space. Absolutism prevails above the Laffer curve, and prosperity below it.

The following section sketches some case studies, which illustrate the relevance of the issue analyzed here.

### 3. Case Studies

Most conquerors of the past knew that they were better off by arming the conquered cities and territories, and demanding a tribute in return, than by destroying them. This was the case of Alexander the Great, who left behind him a whole chain of flourishing cities. Alexandria was probably the best example. One exception was Genghis Khan, who strove to leave the steppe naked, by destroying all the defeated cities on his way. This can be explained by differing values of  $\varepsilon$  within the present framework. In the case of Genghis Khan, it was probably not so much that he liked his weapons too dearly, but that he attached a great value to the frugal way of life of the Mongol nomads (Keegan, 1994). This is also captured by  $\varepsilon$ , which measures the *relative* value of weapons in terms of consumption, and can thus be high because the ruler is not attracted much by wealth and consumption.

The following case studies shed some light on the kind of interpretation that can be given to this basic model for applying its insight to the real world. They deal with the issue of the creation of a mixed army, in a post-conflict situation.

#### *How to Arm Your Potential Opponent*

In the contemporary world, an issue arises time and again in post-conflict situations, which this basic model helps to clarify. This is the problem of disarmament of the defeated side. There are two options: disarming the defeated side, or the rebels in less clear-cut situations, or merging somehow the two armies, in order to create a mixed, or encompassing, army. Disarmament is discussed formally below, while the second option provides a useful

interpretation of what 'arming the farmers' might mean. In the real world, arming the producers directly may not be a very practical solution, as it might lead to some development of criminal activity, or uncontrolled communal violence. The alternative option is to enroll soldiers from both sides in the army, even if this entails some military fragmentation, as units will form that are mainly recruited from one side or the other. It is important in the current framework that these units might take side credibly against the government, should the conflict resume.

Examples abound where a strategy of this kind was adopted. After World War 2, in Yugoslavia, Tito made sure that the Serbs had a strong representation in the army, although he was Croat. When the Tigrayans and their allies toppled the *Derg* regime in Ethiopia, in 1991, many of the guerrilla fighters were sent back to their mountains with limited personal gain, while many soldiers and officers from the defeated government side, and thus from the formerly dominant Amhara group, were kept in the army. The new army was reconstructed with personnel from both sides. In Chad, when Idriss Deby took over, in 1990, he made sure that the new army involved people from both the victorious northern ethnic groups, and the defeated southern ethnic groups. General Kamougué, the leader of the southerners, was made president of the national assembly. This senior position, formally second to the president, was giving him some leverage to call upon many military units, were the conflict to resume. In all these cases, peace was established durably, although with some imperfections, and some economic recovery took place. Before that, in Chad, Hisssein Habré had chosen a different course of action, trying to put the southerners on their knees by perpetrating massacres in the south, and had been unable to secure either peace or his hold on power. An additional benefit from the creation of a mixed army by merging forces from the two sides is that it gives some opportunity to reduce their uncertainty about each other's strength, and thus mitigates the asymmetric information problems that might lead to war in equilibrium, as shown below. From a theoretical point of view, notice as well that this is a potential solution to the Fearon (1998) problem discussed above. In his model, the rebels have an incentive to strike preemptively because their relative fighting efficiency decreases over time, while the dominant group is unable to commit credibly to a sharing rule for the

second period. Creating a mixed, or even fragmented, army might be the appropriate response to this problem, by arming the minority and making sure that its ability to strike back in case of aggression remains high enough to make the required sharing rule credible.

Nevertheless, the analysis performed so far is too simple, in various respects, and hides many interesting issues. The next section offers three simple theoretical extensions that help qualify the ‘arm your future victims’ result found above.

#### **4. Some Implementation Problems**

A first interesting extension addresses the free-riding problem that might induce farmers not to use the weapons given to them by the ruler for defending themselves, in case of war, undermining in so doing production incentives. The second one analyzes the uncertainty affecting tax revenues when there is asymmetric information about the farmer’s fighting efficiency. Two cases are discussed in turn, where either the farmer or the ruler is the informed player. Each of these cases helps to qualify and refine the simplest model analyzed above, and shows how war may break out in equilibrium.

##### *Free Riding among Farmers*

In the previous section, the collective action problem facing the farmers is drastically simplified by assuming that there is only one of them. Then, the armed farmer will not face any problem for deciding to use his weapons if he has to. However, in a world with many farmers, a free-riding problem may arise, depending on the ruler’s behavior. Casual definitions of ‘justice’, or ‘responsibility’, entail that an overlord should only fight against farmers who put out a challenge against his authority, and should leave alone those that remain peaceful, and fail to turn their weapons against their master in case of war. However, this viewpoint turns out to be very deceptive, and would ruin the tax revenues of a ruler who would give in to it. Therefore, a tax-conscious ruler should choose to be ‘unfair’, and punish also the peaceful farmers in case of war. This can be shown easily by simply extending the model analyzed above by allowing for two farmers.

Assume that the ruler is facing two farmers, to whom he is giving the quantities of weaponry  $w_1$  and  $w_2$ , subject to a contract of the type spelt out above. However, they can

engage in the fight less than the weapons available to them. Denote  $\tilde{w}_1 \leq w_1$  and  $\tilde{w}_2 \leq w_2$  the weapons that they effectively engage in the fight. Then the conflict technology becomes naturally:

$$p = \psi \text{ if } \mu(\tilde{w}_1 + \tilde{w}_2) \geq W - (w_1 + w_2), \quad 0 \leq \tilde{w}_1 \leq w_1 \text{ and } 0 \leq \tilde{w}_2 \leq w_2. \quad (7)$$

For the time being, assume again that the ruler can either wage a war, or collect taxes, but is unable to do both simultaneously. This is just a simplified way of capturing the idea that the fiscal administration loses some of its efficacy in war time, may be due to insecurity, development of a black market, etc. Then, one can prove the following proposition:

**Proposition 2:** If farmers can escape from being looted by the ruler's troops in case of war by not participating in the fight, then  $w = 0$  in equilibrium, implying  $T = 0$ .

**Proof:** If farmer 1 does not participate in the fight, while farmer 2 does, and escapes looting or taxing for that reason, his welfare is:

$$\alpha e_1 - e_1^2 / 2 > (1-p)\alpha e_1 - e_1^2 / 2,$$

where the right-hand side represents the welfare level reached by participating in the fight. Hence, free riding is a dominant strategy. The symmetric argument holds for farmer 2. Then, if no farmer uses his weapons at stage 2, there is no limit to the tax pressure imposed by the ruler, and incentives are reduced to zero at stage 1. Farmers will thus refrain from putting any effort in production. **QED**

Notice first that proposition 2 would also hold even if the spared farmers were to pay some taxes, provided they pay less in case of war than when peace prevails. This reduced efficiency of the tax administration in wartime is a fairly realistic assumption. For example, a black market emerges very often in warring countries, whereby many transactions go underground, and cannot be taxed. Reno (1999) provides many examples where the government loses control over parts of his territory in war time. Then, a simple solution to

solve the problem raised at proposition 2 can be found quite easily by the ruler. He must simply make a credible commitment to inflict as much damage in case of war to those that do not participate in the fighting than to those who do. Then, both farmers will be indifferent between participating or not, and incentives are restored. Notice that such a credible commitment is not difficult to make, and is not comparable to the assumed lack of credibility of the commitment not to tax "too much" ex post, that lies at the source of the present paper. For example, in the middle ages, the warlords used to hire highway men as additional soldiers, and the latter were known for indulging in uncontrolled looting and violence against villagers. In the south of France, for example, the "routiers", i.e. disbanded soldiers, were devastating the countryside until the mid-16<sup>th</sup> century. In Africa currently, private militias are a curse for villagers, as illustrated by the infiltration of looters from Liberia in Guinea and Côte d'Ivoire, all of them being loosely linked to the fighting Liberian warlords. Thousands of villagers have lost their lives to these raiders. As far as violence against civilians is concerned, experience shows that the commitment to let armed men raid villagers is easily made credible indeed.

When interpreted broadly, this result provides a new rationale for the type of violence against civilians that has become the hallmark of modern civil wars, and was also probably widespread in the past, with few exceptions. According to some widely cited figure, 84 % of all war-related casualties are civilians. Azam (2002) offers an analysis of this phenomenon, based on looting. He assumes that the two sides inflict violence upon civilians as a fallout of looting, the latter being performed in order to complement the small pay given to the soldiers, below their opportunity cost. Then, soldiers are given a free hand on some designated groups of civilians, whom they can prey with impunity. Azam and Hoeffler (2002) offer an alternative explanation, based on terror. In their model, the government sends raiders onto civilians in order to reduce the hiding and support that they might give to the guerrilla. They offer an econometric test, using the stock of refugees from any given country as a proxy for the amount of violence which is inflicted on civilians in this country. Their econometric results provide some support to the 'terror' interpretation, rather than to the 'looting' one, because more refugees flee countries affected by civil war where the

government has more financial means, in the form of foreign aid, than countries with less foreign aid. In their framework, this suggests that richer governments can devote more resources to terrorizing civilians, other things remaining equal, than poorer ones.

The present model yields a third possible explanation, by requiring that the ruler makes a credible commitment to inflict as much damage to those that do not participate in the fight than to those who do, at least in an expected sense. This credibility could be acquired in the real world by rulers who would punish equally those that rebel and those that do not, in case of fighting, in order to deter free riding, and support the incentives for production in case of peace. In Machiavelli's terms, this would mean that a ruler should not hesitate to acquire a reputation of cruelty. Contrary to the looting assumption, both the 'terror', and the 'incentives' rationale presented here could explain why we observe such non-sensical violence against civilians as we do in the real world. While the looting assumption could explain some casualties as a side-product of the appropriation of the loot, if farmers were to try and oppose the raiders, it can hardly explain the type of mindless violence that can be observed nowadays, like the 'short sleeves' mania that left so many innocent civilians crippled and unable to look after themselves in Sierra Leone, Liberia, and former Zaire. However, a less cruel solution is possible if the ruler can commit credibly to collect at least as much taxes on the farmers who are not involved in the fight in case of war than in case of peace. This is only credible if the tax administration is pretty efficient, and has been the standard practice in modern times in the developed world, where war is often funded by increased taxation. Nevertheless, Picasso's 'Guernica' painting is a vivid reminder that violence against civilians is part and parcel with even a modern-time civil war in the Western world.

### *Asymmetric Information 1: Informed Farmer*

A fundamental parameter in the present model is  $\mu$ , which measures the relative fighting efficiency of the farmer. The analysis performed above assumes that it is known with certainty by both players, which is a bit heroic. More interesting results come up if some information asymmetry is assumed instead. The case where the farmer is the informed player is pretty straightforward, and its main interest is to spell out the circumstances in

which the ruler will take the risk of throwing the economy into depression, pulling down tax revenues with it, with a strictly positive probability, or even take the risk of war.

Assume that the relative fighting efficiency of the farmers is their private information, with two possible values:  $\mu = \mu_H$  or  $\mu = \mu_L < \mu_H$ . The ruler only knows the probability distribution over these two values, which assigns the probability  $0 < \pi < 1$  to  $\mu = \mu_H$ . Define:

$$w_H = \frac{W}{1 + \mu_H} \text{ and } w_L = \frac{W}{1 + \mu_L}.$$

Then it can be checked easily that the expected value of the transfer in his favor, or of the catch in case of war, may be written as the following step function of  $w$ , denoted  $ET = \Phi(w)$ :

$$\Phi(w) = 0 \text{ if } w < w_H,$$

$$\Phi(w) = \pi(1 - \psi)\psi\alpha^2 \text{ if } w_H \leq w < w_L,$$

$$\Phi(w) = (1 - \psi)\psi\alpha^2 \text{ if } w_L \leq w.$$

The first and third equations are the same as in the basic model presented above. The second equation is the new item introduced by this type of asymmetric information. The analysis of this case is a bit tricky. As  $w$  is costly to the ruler, he will only give the minimum value of  $w$ , if he gives any level of weaponry included in this range, as giving more than this within the same range would not enhance his chance of winning. Then, if the ruler gives the level  $w_H$  of weapons to the farmer, the latter only stands a chance of salvaging some of his income in case of war if he is of the  $H$  type, which is assigned the probability  $\pi$  by the ruler. Otherwise, the farmer does not stand a chance in case of fighting, and gets nothing in case of war. In that case, no output will be forthcoming. So, if he gives  $w_H$  at stage 1, the ruler can either observe zero output, or  $(1 - \psi)\alpha^2$ , at stage 2. However, the ruler cannot commit *ex ante* to be content *ex post* with demanding  $T = \psi\alpha e$ , when he has given  $w_H$  at stage 1. If he did, then both types would produce  $\alpha e = (1 - \psi)\alpha^2$ . He would then be able to get by waging a war an expected catch worth:

$$(\pi\psi + 1 - \pi)(1 - \psi)\alpha^2,$$

which is higher than the value of the transfer obtained if the farmer was giving  $T = \psi\alpha e = \psi(1 - \psi)\alpha^2$ , irrespective of his type, assuming commitment. This promise would thus not be consistent with a sub-game perfect equilibrium. Hence, war is a dominant strategy in this case, so that the equilibrium is in fact revealing the type of the farmers. The rational farmer will realize this, and will supply effort  $e = 0$ , if he is of the  $L$  type, and  $e = (1 - \psi)\alpha$ , otherwise. Notice that in the latter case, the farmer will produce a positive output, knowing that this will trigger a war, because he has a large enough stock of weapons. The expression in the second line above follows, and corresponds to a case of war, whenever output is strictly positive. This case conflates the two reasons identified by Azam and Mesnard (2003) for the outbreak of a civil war: commitment failure and asymmetric information.

Now, the ruler's objective function must be defined as:

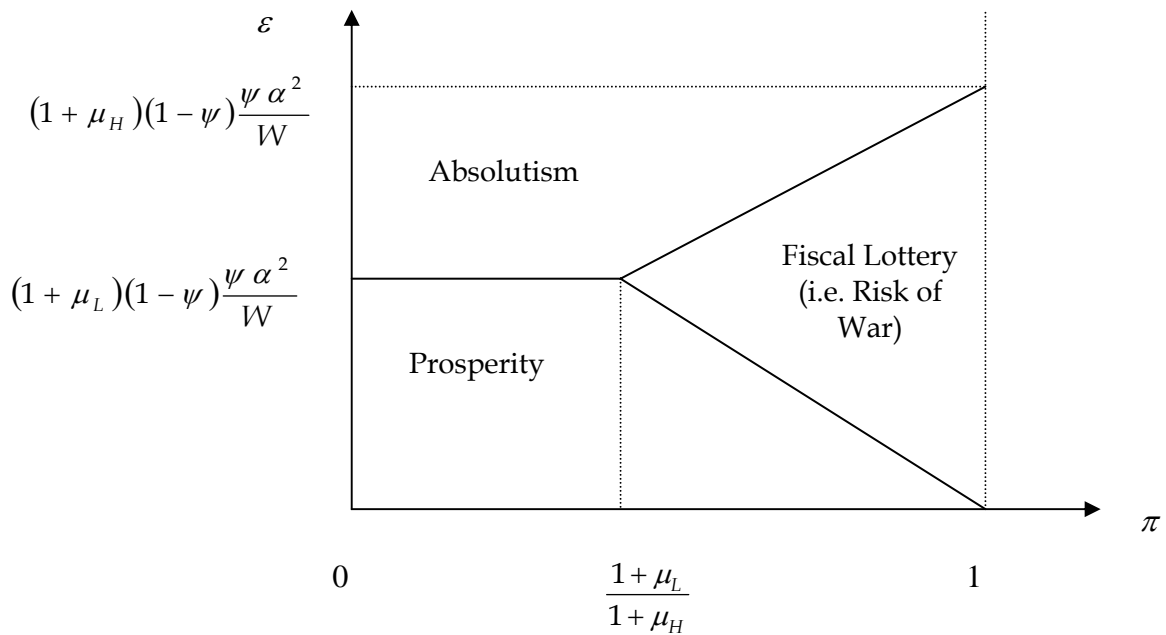
$$U_R = \max_w \Phi(w) + \varepsilon(W - w),$$

and becomes, after substituting from above:

$$\begin{aligned} U_R &= \varepsilon W \text{ if } w = 0, \\ U_R &= \pi(1 - \psi)\psi\alpha^2 + \frac{\varepsilon W \mu_H}{1 + \mu_H} \text{ if } w = w_H, \\ U_R &= (1 - \psi)\psi\alpha^2 + \frac{\varepsilon W \mu_L}{1 + \mu_L} \text{ if } w = w_L. \end{aligned} \tag{8}$$

The ruler will thus choose to give the level of  $w$  that yields the highest level of his objective function, among the three possible payoffs described in (8). Thus, depending on the different values of the parameters, the equilibrium can be found in three different regimes, corresponding to the three lines of (8). If the value of the ruler's objective function is the highest in the first line, we have the absolutist regime, already discussed above. If the third line gives the highest value, then we find again the prosperity regime, as in the simpler case analyzed above. However, the type of asymmetric information introduced here results in the

existence of a third regime, prevailing when the second line yields the highest value, and which is characterized by the risk of an open war breaking out, with probability  $\pi$ , which may be regarded as a the 'fiscal lottery regime', in the current setting. In this case, denoting  $C$  the ruler's catch, he chooses a value of  $w$  such that  $C = (1 - \psi)\psi\alpha^2$  with probability  $\pi$ , and  $C = 0$  with probability  $1 - \pi$ . Examination of the equations in (8) allows to identify the impact of the different parameters on the ruler's behavior. He chooses the value of  $w$  that entails the highest value of  $U_R$ . Figure 2 shows which regime is so chosen, as a function of  $\varepsilon$  and  $\pi$ .



**Figure 2: Choice of Regime with Informed Farmers**

Like in the previous case, absolutism is chosen for large values of  $\varepsilon$ , while prosperity prevails in the lower part of this space. However, a new type of equilibria may be chosen, in the 'fiscal lottery regime', when the probability of the farmers being of the  $H$  type is high. In this case, the ruler gives enough weapons to assure the  $H$  type farmers that they will be able to prevent the coming war from taking everything away from them with probability one, but not enough to give confidence to the  $L$  type ones. The latter know that, with their given stock of weapons, they do not stand a chance of fighting the ruler victoriously, and will thus be entirely expropriated *ex post*. Then, they produce nothing *ex ante*, as incentives are missing, and the ruler gets no tax revenues. This occurs with probability  $1 - \pi$ , which is low in the

relevant part of the parameter space. In doing this betting, the ruler is trading off a fall in tax revenues in the unfavorable state of nature, with a low probability, against economizing weapons with certainty. Then, given this probability, 'fiscal lottery' will be chosen for intermediate levels of the value assigned to holding weapons by the ruler  $\varepsilon$ . Above that, the ruler wants to keep his weapons so badly, that he does not mind ruining the economy and his tax revenues, by destroying incentives. Below it, the ruler does not care much for weapons, and is prepared to give them away in return for securing prosperity, by giving the farmers enough weaponry to reassure them, whatever their type.

Despite its theoretical interest, and in particular the identification of the third regime, the type of asymmetric information analyzed above does not seem the most interesting, nor the most natural one to focus on, except in special circumstances where the fighting efficiency of the farmers has changed, in response to some exogenous shocks. This might be the case when some kind of 'Robin Hood' takes to the bush for mobilizing the farmers, and increases their ability to use weapons, with an impact that the ruler cannot assess with certainty. Hobsbawm (2000) has provided the classic analysis of the "social bandits", à la Robin Hood, but this remains a controversial issue. However, in general, the opposite assumption seems attractive, i.e. that the ruler is the informed player, as he is the one who gives the weapons away, and who values them for their own sake. This is also a way of capturing the idea that the ruler is more experienced in the use of weapons, and knows better than the farmers their real effectiveness, and how effectively the farmers can use them. However, this assumption makes the analysis a bit trickier, as it introduces a signaling problem. It gives the ruler an opportunity to lure the farmers into believing that they have a chance to win, and thus have some incentives to produce, while they have none in fact, but can't discover it unless they put up a fight.

### *Asymmetric Information 2: Informed Ruler*

The asymmetric information assumption is now turned upside down, with an informed ruler, while the farmer only knows the probability distribution over the two types. The notation is kept the same as in the previous analysis.

The core issue in this case is the signaling problem. As the ruler knows the farmer's type, and is moving first by giving weapons, if at all, his behavior is liable to give away some information to the farmer about his own type, in some cases. Remember that the parameter under scrutiny  $\mu$  represents the relative efficiency at fighting of the ruler and the farmer, and can thus be interpreted equally as a characteristics of the former or of the latter. This is just a matter of convention.

If the ruler gives  $w_L$ , then the farmer owns enough weapons to secure his property rights, whatever his type. Then he will always pay  $T = \psi(1-\psi)\alpha^2$ , as  $p = \psi$  necessarily in this case, and the ruler gets the following payoff:

$$U_R = \psi(1-\psi)\alpha^2 + \varepsilon W \frac{\mu_L}{1 + \mu_L}.$$

If the ruler gives 0 weapons, by choosing absolutism, in the terminology introduced above, the outcome is also independent of the farmer's type, with no incentives to produce, and no tax revenues.

If the ruler gives  $w_H$ , which is lower than  $w_L$ , then the farmer cannot infer his own type with certainty, and does not know which outcome will prevail at stage 2. He is only able to determine some probability distribution over payoffs. Denote  $\tilde{\pi}$  his belief about his probability of being of type  $H$ , knowing that the ruler has given him  $w_H$ . If he is of type  $H$ , which occurs with probability  $\tilde{\pi}$ , then the expected loss in case of war is  $\psi \alpha e$ . If he is of type  $L$ , which happens with the complementary probability, his expected loss from the war is  $\alpha e$ , as  $p = 1$  in this case. This potential ruin affects necessarily his incentives. So, if he gets  $w_H$ , his expected loss is:

$$(\tilde{\pi} \psi + 1 - \tilde{\pi}) \alpha e.$$

Then, his chosen effort level derives from:

$$\max_e \tilde{\pi}(1-\psi)\alpha e - \frac{e^2}{2},$$

yielding  $e = \tilde{\pi}(1-\psi)\alpha$ . So he accepts to pay  $\psi(1-\psi)\tilde{\pi}\alpha^2$ , which is acceptable with probability  $\tilde{\pi}$  to the informed ruler, and with probability  $1 - \tilde{\pi}$ , there is a fight, and he loses everything. Notice that the farmer cannot afford to give his whole output to the ruler in this case, with a view to avoid the fight, as this would not be incentive compatible. The ruler would take this amount whatever the farmer's true type, and would thus fail to reveal his information. Therefore, the farmer is better off by accepting only to pay the smaller tax corresponding to the  $H$  type, while accepting the risk of going for a war and being defeated with probability 1 if he happened to be in fact of the  $L$  type. The ruler is better off when offering such a contract than by demanding the higher tax level, as he would then trigger a certain war, and destroy incentives from the start. Hence, giving  $w_H$  may be regarded as a 'deception strategy', on the part of the ruler, when he knows that the farmer is of the  $L$  type. He is then giving him some weapons, but not enough to stand any chance of winning a fight, while relying on the farmer's ignorance of his true own type to provide enough incentives for sustaining some production. This strategy qualifies certainly as a Machiavellian one, in the modern sense of this word.

This type of signaling models, as simple as they are, are liable to yield multiple equilibria (see e.g. Gibbons, 1992), which are not necessarily illuminating. For the purpose at hand, the main point is to show that the deception strategy described above, whereby the informed ruler gives the farmers enough weapons to sustain some incentives for production, while this is not enough to give them any chance of winning a fight against him, is an equilibrium of the game, for some values of the parameters. The simplest equilibrium with this property is described in the following proposition.

**Proposition 3:** There exists a pooling pure-strategy perfect Bayesian equilibrium where the ruler gives  $w_H$  to both types of farmers, with  $\tilde{\pi} = \pi$ , if:

$$\pi \geq \max \left\{ 1 - \frac{\varepsilon(w_L - w_H)}{\psi(1-\psi)\alpha^2}, \frac{\varepsilon w_H}{\psi(1-\psi)\alpha^2} \right\}. \quad (9)$$

The proof is presented in the appendix. The main intuition behind proposition 3 is that if the probability of the farmer being of the  $H$  type is high enough, then there exists a range of values of  $\varepsilon$  such that the ruler will choose the deception strategy. This is grasped more easily if (9) is written as:

$$\frac{(1-\pi)\psi(1-\psi)\alpha^2}{w_L - w_H} \leq \varepsilon \leq \frac{\pi\psi(1-\psi)\alpha^2}{w_H}.$$

For higher values of  $\varepsilon$ , he will choose instead to hold on to his stock of weapons, while for lower ones, he will prefer to give  $w_L$ , as this yields a higher level of expected tax revenues. Moreover, this range is larger, the larger is  $\pi$ , because the farmer's effort increases with the latter, enhancing the returns to the gift of weaponry. In other words, giving weapons to the farmer is more valuable to the ruler, the higher is the chance of winning that the farmer believes to have. Notice that (9) implies that  $\pi \geq \frac{w_H}{w_L}$ . For lower values of  $\pi$ , the risk of war is too high, reducing too much the farmer's incentives, so that the ruler chooses not to use this strategy.

This closes the analysis of implementation problems, which have been shown to give rise to violence against civilians, as an incentive mechanism, to fiscal lottery, with a risk of war, and to the deception strategy, that can also explain the risk of war. Let us now turn to another set of issues, related to initial endowments.

## 5. Initial Endowments

The basic model presented above assumes that the ruler is the only source of weapons, while the farmer is the only source of income. The extensions presented in this section show the qualifications that need to be added when these two assumptions are relaxed, while neglecting the implementation issues analyzed above. The first one looks at the issue raised by a positive initial endowment of weapons in the hands of the farmer, and thus discusses the issue of disarmament, which is particularly important in post-conflict situations, or when some foreign power may provide some military support to a potential rebellion. This is the issue mentioned in Machiavelli's excerpt cited at the beginning.

*The Farmer's Initial Endowment of Weapons*

If the farmer owns initially  $0 < w_0 < W$ , as might be the case in a post-conflict situation, the only change to the basic model is that the arming constraint for ensuring to the farmer a positive probability of winning a potential fight becomes:

$$p = \psi \text{ if } \mu(w_0 + w) \geq W - w,$$

which may be rearranged to read:

$$w \geq \frac{W - \mu w_0}{1 + \mu}.$$

Hence, the farmer's initial endowment of weapons reduces the cost to the ruler of securing the farmer's incentive to produce. It is thus a factor that makes prosperity more likely. The ruler will choose this outcome rather than the absolutist regime if:

$$\varepsilon \leq \frac{(1 + \mu)(1 - \psi)\psi \alpha^2}{W - \mu w_0}, \quad (10)$$

with the opposite inequality if the denominator is negative. Notice that the right-hand side of (10) is larger than without initial endowment, for a small enough endowment level, that keeps it positive. Therefore, the farmer's positive endowment of weapons may turn a pretty harsh ruler into a prosperity supporter.

The interesting question in this case is that of disarmament, which is relevant in a post-conflict situation. Assume now that at stage 1 the ruler can give a negative quantity of weapon  $w$ . Stage 2 remains as before. Then it is very easy to prove the following proposition:

**Proposition 4:** Faced with an initial endowment of weapons in the hands of the farmer, if he chooses the prosperity regime, the ruler will proceed to disarm him partially of an amount of weaponry:

$$\frac{\mu w_0 - W}{1 + \mu},$$

if the latter is positive, and will arm him of the corresponding amount, if the latter is negative.

The proof is pretty obvious, in view of the above, and is not presented. It rests on the assumption that the ruler assigns a positive value to his holding of weapons, while the farmer's one falls to zero as soon as the arming constraint is fulfilled. Hence, the transfer of weapons from the farmer to the ruler described at proposition 4 is weakly Pareto-improving, enhancing the ruler's welfare without affecting the farmer's one.

Another interesting discussion emerges when the ruler is assumed to control also a non-produced stock of wealth.

### *Non-Produced Wealth*

Assume now that there is a stock of wealth available to the government, which is not produced by the farmer. Call the stock of these 'diamonds'  $D > 0$ , assumed to be under the ruler's control. This wealth is appropriated by the farmer if the latter wins the war against the ruler. This changes the constraints to be satisfied for peace to prevail at stage 2. They become:

(i) Farmer's participation constraint:

$$\alpha e - T \geq (1 - p)(\alpha e + D), \text{ and}$$

(ii) Ruler's credibility constraint:

$$T + D \geq p(\alpha e + D).$$

Taken together, these constraints entail:

$$T = p\alpha e - (1 - p)D. \tag{11}$$

Hence, 'diamonds' shift the tax ceiling downwards, by making war more profitable for the farmer. Because a quasi-linear objective function has been assumed above for the farmer, no wealth effect affects the latter's supply of effort, so that the effort supply function is unaffected relative to (4). The only change is that the tax schedule is shifted downwards when  $p = \psi$ , becoming:

$$T = \psi(1 - \psi)\alpha^2 - (1 - \psi)D. \tag{12}$$

Therefore, the ruler chooses  $w$  to maximize (5) under the relevant constraints, including (12). The ruler's behavior can thus be described by adapting proposition 1, by changing the right-hand inequality that determines the cut-off value of  $\varepsilon$  in (6) into:

$$\varepsilon \leq (1 + \mu)(1 - \psi) \frac{\psi a^2 - D}{W}.$$

In words, the existence of non-produced wealth, under the control of the government, entails a downward shift of the cut-off value of the ruler's taste for weapons, and may thus be liable to push milder rulers into choosing absolutism. It may even make prosperity impossible if  $D > \psi \alpha^2$ .

The reason for this pessimistic result is that, in this framework, the ruler needs the farmers to produce what will come back to him as tax revenues. In order to protect this resource, the ruler is led to give them 'weapons', for providing them with credible incentives. When there are non produced resources in addition to produced output, the farmer's greed becomes more acute, and may turn him into a predator, reducing the productivity of the weapons given to him in terms of tax revenues. This reduces in turn the incentive for the ruler to give these weapons away.

It is fairly easy to guess at this point that combining non-produced wealth with some of the implementation problems discussed in the previous section can only make things worse. In particular, this would enlarge the set of parameter values for which the war would break out, in case of asymmetric information. This prediction is supported by the empirical results by Collier and Hoeffler (2004), showing that the share of primary commodity exports in GDP is a good predictor of the occurrence of a civil war. However, without going back to this kind of issues, the 'diamonds' introduced in this section can also be a cause of war, as shown with the next exercise.

### *'Diamonds' and Corruption*

One complication introduced by the existence of 'diamonds' in the present model is that now some equilibria might require the ruler to transfer income to the farmer, instead of taxing him. This follows from (11), when  $(1 - p)D > p\alpha e$ , which entails a negative value for

*T.* This raises of course a whole set of issues in developing countries, where governments are not well equipped to channel funds in favor of outsiders. Azam and Mesnard (2003) have shown how credibility issues may arise in such a case. Here, I deal with another issue, related to corruption and civil service inefficiency, two prominent problems in many developing countries. The public administration is often more efficient at collecting funds than at delivering subsidies, especially in developing countries. This comes out clearly from recent work performed at the World Bank and elsewhere<sup>2</sup>. As a result, it is realistic to assume that the ruler's attitude towards taxes and subsidies are not symmetrical.

In order to capture this type of problems, let us make the following 'melting ice' assumption: because of various costs involved in channeling funds to the farmers, including may be corruption, only a fraction  $0 \leq \lambda < 1$  of a transfer from the ruler effectively reaches the farmer. Let  $S$  denote the subsidy paid by the ruler when  $(1-p)D > p\alpha e$ . Only a fraction  $\lambda S$  reaches the farmer, so that his participation constraint in the peace equilibrium is:

$$\lambda S \geq (1-p)D - p\alpha e.$$

The ruler's credibility constraint now reads:

$$D - S \geq p(\alpha e + D),$$

or

$$S \leq (1-p)D - p\alpha e.$$

Clearly, they cannot hold simultaneously for  $S \geq 0$ . Therefore, in this simple model, the farmer's participation constraint and the ruler's credibility constraints cannot hold simultaneously when the 'melting ice' assumption described above holds and non-produced wealth is too high relative to produced output. In this case, war is unavoidable at stage 2. Then, the ruler is better off if he does not give any weapons to the farmer, and thus leaves no

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<sup>2</sup> For example: "A well-known survey of primary schools in Uganda revealed that only 13 % of student capitation grants made it to schools in 1991-95, and comparable surveys in other countries recently made similar findings" (Reinikka and Svensson, 2004, p.326).

incentives for production. This pessimistic result is described more precisely in the following proposition:

**Proposition 5:** If the ruler's endowment of non-produced wealth  $D$  is such that  $(1-p)D > p\alpha e$ , no equilibrium with peace and/or prosperity can exist under the 'melting ice' assumption.

The proof is presented in the appendix. Therefore, 'diamonds' are a curse in this model, as they deter the ruler from arming the farmers sufficiently to secure a large enough share of their own output to make it worthwhile to produce it. In this way, natural resources crowd out production more radically than the much discussed 'Dutch Disease' (see Corden, 1984, for a survey). This result provides a theoretical rationale for the kind of 'warlord politics' that Reno (1999) has analyzed in Liberia, Sierra Leone, and Congo-Zaire. However, for this analogy to hold, the ruler must not necessarily be interpreted as the official ruler of the country. For example, in Liberia, Charles Taylor has become the ruler over a large part of the country much before he was elected as President. The same holds true for Savimbi in Angola, who was certainly the ruler in the part of the country that he controlled, before he was killed. In African countries, in many cases, one should not regard the government, which controls the capital city, as the center of power that controls the whole country, as Herbst (2000) has recently demonstrated.

## 6. Conclusion

The simple model presented in this paper, with its different variants, provides by and large some support to Machiavelli's advice to a new prince quoted at the beginning of this paper, to make sure that his subjects are armed enough. In its basic version, the only qualification added to this precept is that some princes may like weapons too much for complying with this advice. Depending on this taste, which can also be understood as reflecting the potential alternative use to which the weapons can be turned by the ruler, absolutism or prosperity will prevail in equilibrium. In the former case, the producers have

no way to secure a share of their output for themselves, and will simply give up production. In the latter, the odds are favorable enough for the farmers to keep some incentives to produce.

After showing how 'arming the farmers' can be understood in a post-conflict situation, various extensions discussing some implementation issues were presented in the subsequent section. They help refining Machiavelli's point, by showing how violence against civilians in case of civil war may be for the ruler a way of solving some free-rider problems among the producers. If farmers can get away without participating in the fighting, if a war breaks out, then no farmer will defend himself in the Nash equilibrium, thus destroying the positive incentive effect of arming them. The ruler may solve this problem by acquiring a reputation of cruelty, by inflicting violence against innocent civilians, with the view to convince farmers to join the fighting in case of war in the future, and thus protect some incentives to produce in case of peace. Highway men during the middle ages, and private militias in present Africa, are precisely making such a threat credible. Then, asymmetric information was discussed in the same section, under two polar assumptions. If the farmer is the informed player about his fighting efficiency relative to the ruler's, then war may break out as a screening device, because of incentive-compatibility problems. If the ruler is the informed player, then a signaling problem arises and complicates the ruler's choice. Proposition 3 shows that there exists a pooling equilibrium where the ruler gives the same quantity of weapons to both types of farmers. This does not give the weak type any chance of winning a fight, while the informed ruler is thus exploiting the farmer's ignorance, for supporting some incentives for production. In this case, war will also occur with some probability, if the farmer happens to be of the weak type.

The problems raised if the two players have initial endowments of weapons, as far as the farmer is concerned, or of non-produced wealth, in the case of the ruler, were discussed next. While the former case yields rather optimistic results, making prosperity more likely, with or without disarmament, the latter is more problematic. The control of non-produced wealth by the ruler makes the farmer greedier, and thus reduces the productivity of the weapons given to him in terms of tax revenues. This in turn deters the ruler from giving

these weapons, in some cases. A too large endowment of natural resources, like diamonds, may thus make prosperity impossible. In some cases, the ruler should in fact transfer some wealth to the farmer to maintain peace, when the non-produced wealth is too large, and corruption may make this too costly for him. Then, war is unavoidable, and incentives to produce are destroyed. This is an extreme case of the so-called “resource curse”.

Therefore, this model and its variants provide some insight into the choice between war and peace, on the one hand, and if the second alternative is chosen, between absolutism and prosperity, on the other hand. Further research should analyze how this insight can be exported to a wider field of application, where ‘weapons’ and ‘fighting’ are understood in a broader sense. It should probably look carefully at the details of this extension, and show how far the different means of securing peacefully the property rights of the producers are efficient for bringing prosperity about. Democracy, an independent judiciary, trade unionism (remember *Solidarnosc*), land reform, etc. should thus be discussed in comparative perspective, with a view to identify the conditions that make them effective. This shows the way to future research.

## Appendix

### Proof of Proposition 1.

Substitute for  $T$  and write the ruler’s objective function as either:

$$U_R = (1 - \psi)\psi\alpha^2 + \mu\varepsilon W / (1 + \mu), \text{ if } w = W / (1 + \mu), \text{ or } U_R = \varepsilon W \text{ if } w = 0.$$

Then, the ruler chooses the prosperity equilibrium, with positive output and taxes, if the former is larger than the latter, i.e. if  $\varepsilon$  is such that the right-hand side inequality in (6) holds.

**QED**

### Proof of Proposition 3.

If the farmer is of the  $H$  type, then the ruler gets:

$$\psi(1 - \psi)\alpha^2 + \varepsilon(W - w_L), \text{ if he gives } w_L,$$

$\tilde{\pi} \psi (1 - \psi) \alpha^2 + \varepsilon (W - w_H)$  , if he gives  $w_H$  ,  
 $\varepsilon W$  , if he gives 0.

Therefore,  $w_H$  is given to the  $\mu_H$  -type farmer if:

$$\tilde{\pi} \psi (1 - \psi) \alpha^2 \geq \varepsilon w_H, \text{ or } \tilde{\pi} \geq \frac{\varepsilon w_H}{\psi (1 - \psi) \alpha^2}, \text{ and} \quad (\text{A.1})$$

$$\tilde{\pi} \psi (1 - \psi) \alpha^2 + \varepsilon (W - w_H) \geq \psi (1 - \psi) \alpha^2 + \varepsilon (W - w_L), \text{ or } \tilde{\pi} \geq 1 - \frac{\varepsilon (w_L - w_H)}{\psi (1 - \psi) \alpha^2}. \quad (\text{A.2})$$

These are the two values used in (9). It remains to be proved that these two inequalities also ensure that  $w_H$  is also given to the  $\mu_L$  -type farmer.

If the farmer is of the  $L$  type, then the ruler gets:

$\psi (1 - \psi) \alpha^2 + \varepsilon (W - w_L)$  , if he gives  $w_L$  ,  
 $\tilde{\pi} (1 - \psi) \alpha^2 + \varepsilon (W - w_H)$  , if he gives  $w_H$  ,  
 $\varepsilon W$  , if he gives 0.

Therefore,  $w_H$  is given to the  $\mu_L$  -type farmer if:

$$\tilde{\pi} (1 - \psi) \alpha^2 \geq \varepsilon w_H, \text{ or } \tilde{\pi} \geq \frac{\varepsilon w_H}{(1 - \psi) \alpha^2}, \text{ and} \quad (\text{A.3})$$

$$\tilde{\pi} (1 - \psi) \alpha^2 + \varepsilon (W - w_H) \geq \psi (1 - \psi) \alpha^2 + \varepsilon (W - w_L), \text{ or } \tilde{\pi} \geq 1 - \frac{\varepsilon (w_L - w_H)}{(1 - \psi) \alpha^2}. \quad (\text{A.4})$$

It is easily checked that (A.1) and (A.2) imply (A.3) and (A.4). **QED**

### **Proof of Proposition 5:**

If he keeps the farmer defenseless, with  $p = 1$ , the ruler's gets a payoff:

$$U_{R1} = D + \varepsilon W .$$

If he arms the farmer sufficiently to get  $p = \psi$  , the ruler's payoff is:

$$U_{R\psi} = \psi (\alpha e + D) + \varepsilon (W - w).$$

The former is larger than the latter, if  $(1 - \psi) D > \psi \alpha e$  , as:

$$U_{R1} - U_{R\psi} = (1 - \psi)D - \psi \alpha e + \varepsilon w > 0.$$

Therefore, the ruler chooses  $p = 1$  in this case. **QED**

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