

Rich Subjects, Poor Kings: Rebellion Relief and the Ratchet Effect in Taxation

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Abstract. Rulers face serious difficulties in their efforts to extract wealth from society through taxation. Historically, taxation was often not very high and attempts to increase it frequently caused revolts. Over time, however, taxation has increased dramatically while violent resistance has virtually disappeared. We present a model that shows how these patterns can be understood as arising from the Crown's desire to maximize its income from taxation in a context where it is institutionally unconstrained but does not have very good information about the wealth of the subjects it is trying to tax. In this setting, high tax demands can push poor subjects into violent resistance, which might provide the Crown with evidence that it needs to lower the tax to acceptable levels (provide tax relief). This possibility, however, provides an incentive to the rich subject to join the revolt to take advantage of tax relief and avoid an increase of taxation that willingness to accept might entail in the future (ratchet effect). This interaction is resolved in the Crown settling for taxation that, depending on its information about the subjects' wealth, can be low but peaceful, moderate but provoking occasional revolts by the poor, and high but risking that even the rich would join a revolt. As the Crown's ability to better assess the wealth of its subjects grows, taxation will increase while violent resistance will decrease even in the absence of an increase in the Crown's coercive capabilities or its public goods provision. The growth of the state can be understood as a direct consequence of administrative improvements rather than centralization of power, monopolization of violence, or provision of public goods.

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For all their fabulous wealth expressed in glittering palaces, sumptuous entertainment, lavish construction, and extravagant military spending, the princes of early modern Europe were burdened by heavy debt and usually hovered on the brink of bankruptcy. Their income often failed to keep up with their expenditures, and it was the rare prince who managed to accumulate any reserves (which were at any rate invariably squandered by their successors). Raising money from their subjects was thus a major princely concern even if it was disliked and despised. There is a significant scholarly literature on the *fiscal-military state*, which sees the rise of the modern centralized bureaucratic state in Europe essentially as a story about the growth of the government's ability to get into the pockets of its citizens. The perpetual deficits, however, reveal that extracting resources from the population was not easy even though the Crown often had the coercive advantage. Moreover, attempts to increase taxes very often provoked both local and widespread revolts, which were costly to put down and that further injured the Crown's revenue. Why was it so difficult for the Crown to obtain the resources it required?

While a complete answer to this question requires a deep study of elite cleavages and the evolution of representative institutions, here we want to focus on a particular reason that arises from the interaction of two features of early modern polities: the Crown's moral hazard problem with respect to the taxpayers and the asymmetric information about taxable wealth between them and the Crown. For most of the period under consideration (13th to 18th centuries), the Crown had quite a bit of control over how it spent its revenue. It certainly had complete control over domain income as well as customary dues inherited from feudal rights and prerogatives or from "ancient" perpetual grants. But even with extraordinary taxes and temporary grants the Crown often had a lot of leeway in how it chose to spend the funds, and this was so even in places that had some sort of representative assemblies, the power of the purse was non-existent, developed very slowly, and tended to be quite tentative.¹ Since there was no institutional check on the Crown's expenditures, the Crown could not commit to spend the funds in a manner consistent with the interests of the taxpayers. This reduced the value of taxes to the taxpayers, and decreased their willingness to contribute to the treasury.

The Crown could, of course, overcome some of this reluctance by making appropriate promises and then sticking to them. Although, as we shall see, this behavior was not unheard of, princes tended to adopt an alternative method: demand as much taxes as traffic would bear. It was often possible to evade payment or in more extreme circumstances flee the jurisdiction to avoid paying the taxes, but for our purposes we shall focus on the coercive constraint on these demands: the tax revolt. The Crown would try to tax as much as it could without provoking violent resistance. Even when taxes were paid peacefully, this was done in the shadow of coercion, which means that we can at most consider tax payments quasi-voluntary. Thus, the moral hazard problem tended to produce more or less coercive wealth extraction methods.²

If the Crown knew the wealth of the taxpayers, it could in principle extract everything above what they could expect to get by revolting. In this, however, the Crown labored under

¹Attempts to audit the Crown were interpreted as interference in policy domains that were customarily princely prerogatives, and could easily become dangerous cases of *lèse majesté*.

²We are, of course, grossly oversimplifying here because we wish to focus on one particular problem. Both the need and the extent of coercion the Crown could bring to bear depended on the cooperation of elites.

a serious disadvantage: it only had a very vague idea about the actual wealth of its subjects who were themselves at least somewhat better informed. As we shall see, this inability to assess the taxable wealth was widespread and although the Crown did introduce various innovations to cope with it, the taxpayers tended to retain the informational edge. One could characterize the relationship between Crown and taxpayer as a struggle to control the assessment of wealth. From the Crown's perspective, demanding too little risked leaving major sources of wealth untapped, but asking too much risked costly tax revolts. Moreover, in this context every deal it tried to offer the taxpayers would be scrutinized for possible repercussions for future taxes. Since the Crown could not commit not to use any information obtained to its advantage, taxpayers had to worry whether their behavior today would reveal something that the Crown could then use against them tomorrow.

In the under-institutionalized political environment where the Crown faces a moral hazard problem in spending and a credible commitment problem in its use of information, the struggle over wealth assessment would manifest itself in taxpayers obfuscating the Crown's inferences about their wealth by refusing demands and revolting, and the Crown attempting to provide incentives for taxpayers to accept its demands without violence. We show how these strategic imperatives tend to produce (i) taxes that tend to be much lower than what the asymmetry in coercive powers would lead one to expect; (ii) frequent tax revolts by the poorer strata of society despite the relatively low probability that the rebels would prevail; (iii) rulers granting tax relief even after suppressing tax revolts successfully; (iv) occasional, and much more dangerous, revolts by the wealthy; and (v) rulers sometimes increasing tax demands after their previous ones have been accepted. Thus, the struggle over control of tax assessment can help explain the puzzle of powerful yet seriously underfunded princes.

1 Moral Hazard, Tax Revolts, and Wealth Assessment

In this section we lay out some historical evidence for the assumptions we are going to make in our theoretical model. We defer the overview of related theoretical work until the discussion section where we can place our results in context.

That the Crown faced a moral hazard problem in its spending with respect to the interests of the taxpayers hardly needs explanation.³ To begin with, during most of this period the Crown's main expenditures were on warfare (which might or might not be beneficial to its citizens), the upkeep of the court, patronage, and the provision of justice and enforcement of property rights, both of which might not extend to the entire realm (where the Crown's vassals held these rights) and that at any rate tended to benefit the wealthy. The Crown did not provide much of anything in the way of public goods that the vast majority of the toiling, predominantly agrarian, taxpayers would ever get to enjoy.⁴

The problem extended even with respect to the elites. By the early 14th century, the French Crown had realized that it could not hope to raise much revenues by calling for the "defense of the realm" because "there was deeply ingrained distrust of taxation if genuine war was not in progress" (Henneman, 1971, 304). Elites were always suspicious that the

³maybe explain how Crown was mostly unconstrained by formal power of the purse of representative assembly or other elite groups

⁴cites

threat of war is just a pretext for the Crown to get more money that it would then use for something else. The kings were forced to call the *arriere-ban* just to demonstrate their intent to fight.⁵

Even the remarkably harmonious (by contemporary standards) relationship between the Dukes of Württemberg and their relatively pliant Estates shows the strains of the moral hazard problem. For example, in 1659 the Estates granted Duke Eberhard a significant sum after he promised not to join the Rhenish Alliance that France and Sweden were cobbling together against the Emperor; an alliance that would require him to furnish a military contingent. The Duke reneged in less than a year. He not only joined the alliance, but he refused to disband his existing troops and then asked the Estates to contribute even more. The Estates capitulated, saving face by appropriating the money to be spent at the Duke's discretion rather than for the express purpose that he had asked for, and merely asking that he did not engage in an "unnecessary military undertaking" (Carsten, 1959, 79–80).

It was possible, of course, for the Crown to induce agreement to furnish funds by scrupulously adhering to its promises even though it was not bound by them. The French Charles IV was quite successful in raising revenue because he was true to his word: he only levied subsidies when there was genuine need and even refunded the money if the emergency passed without him needing to spend it (Henneman, 1971, 304). Such remarkable commitment to the principle of *cessante cause cessat effectus* under which extraordinary taxation was to cease when the reason for it no longer obtained was quite rare. More often than not the Crown tried to maintain its autonomy in policy-making, which included the decisions on how to spend the money it received.

In most of the kingdoms and principalities during this period, the elites had representation through their Estates and parliaments although their powers and influence varied greatly from place to place. Where Estates existed, the elites could try to limit the autonomy of the Crown in at least two ways. First, they could withhold new grants until the Crown redresses their grievances to their satisfaction — the so-called principle of *redress before relief*. Second, they could condition new grants on Crown's past behavior, rewarding rulers who kept their word by cooperating on new subsidies, and becoming obstructionist with those that reneged on their commitments.⁶

In theory, therefore, the representative assemblies could provide some check on the Crown even when they did not have exclusive authority over taxation, direct control over expenditure, and rights to audit the Crown's accounts. In practice, however, Estates often proved unwilling to antagonize the Crown by insisting on such reciprocal deals (for their part, the rulers invariably professed to be offended by mere hints of such bargaining). For example, during the 1710s the Estates of Württemberg repeatedly protested that Duke Eberhard Louis kept a permanent military force that they had not authorized; that the ducal War

⁵insert the examples from Spain and England

⁶In the Holy Roman Empire, Estates could also petition the Emperor to intervene by arguing that their prince is ruling contrary to custom and to the ruin of the land. When it suited imperial interests to intervene on the side of the Estates, such petitions could be quite effective (Carsten, 1959, 106). The Empire was not unique in that respect, as the Prussian case illustrates. The Duchy of Prussia was a fief of the Polish Crown from its creation in 1525 until 1657, when sovereignty was given to the Great Elector Frederick William of Brandenburg. For over a century the Hohenzollerns had to deal with fractious Estates who did not hesitate to appeal to the King of Poland whenever they objected to ducal policies. It was this behavior that motivated the Great Elector to pursue full independence of Poland with such determination McKay (2001).

Council was collecting an excise tax that had been granted in emergency during the War of the Spanish Succession in 1704 and had been illegally taken out of their control; that the military was levying tax arrears and impressing people into building a new ducal residence; and so on. Even though they sometimes threatened to withhold their consent to funding, they never acted on those threats and in fact proceeded to authorize that very same excise tax year after year. In some ways this was just a repeat of the earlier episode when the duke had proceeded to levy taxes without the consent of the Estates after the failed diet of 1699.⁷ At best, then, elites could hope that their Estates would help them whittle down some of the more extravagant demands of the Crown but they could hardly expect them to provide an effective check on the Crown's rapaciousness through conditionality.

This does not imply that the relationship between Crown and elites was entirely adversarial. As Collins (1988, 6–7) notes about France, when it came to taxation,

the argument that the interests of these local elites and those of the Crown were antithetical must be revised. The place of taxation in this complex relationship was absolutely central, because the king used tax monies to help solidify his ties to local elites, just as he used royal offices (military, judicial, and financial) to do so. To argue that the basic situation of seventeenth-century political life was that of “monarchy against the aristocracy” [...] ignores the great congruity of interest of the two sides.

This held generally for every monarchy during this period.⁸ Even though this argument establishes that elites tended to benefit from taxation more than the wider public — a point well-taken, and one that we shall incorporate as an assumption in our model — it stops well short of asserting that the elites were happy with their lack of control over Crown expenditures. Even though most tax resistance came from the peasantry and the craftsmen, these groups were sometimes joined by the elites because they were all “affected by the royal taxation system: indirectly when the collection of the king's taxes hindered payment of seignorial and feudal duties and rents; directly when the king tried to tax *all* incomes, without regard to anyone's ‘quality’ ” (Mousnier, 1979, 741–2).

Since the Crown had no interest in deliberately provoking revolts and because collecting taxes required considerable cooperation by the taxpayers, royal demands tended to seek the acquiescence of those being taxed (Henneman, 1971, 25–6). Although this was usually a far cry from obtaining their voluntary consent, it represented a real constraint on the amount of resources the Crown could extract from its subjects. The upshot was that the Crown often chose not to press its demands too vigorously and ended up starved for revenue. Even the vast revenues of the French Crown “were barely enough to pay for the great effort to keep the kingdom from falling to pieces” (Wolfe, 1972, 247). As the fiscal strain grew, the relations between Crowns and their elites became tenser because the insatiable appetite for resources, especially in a time of need, often pushed monarchs into more overtly coercive behavior (Russell, 1982, 208). The Crown began to resort to direct threats to punish recalcitrant members of the elite, revoke traditional liberties of rights of Estates, collect

⁷See Carsten (1959, 104–14) for the somewhat acrimonious relationship between Duke Eberhard Louis and the Estates during this period.

⁸cites

taxes without seeking their consent, disregard their admonitions about spending choices, and even deny them existence altogether.

It is important to understand that when tax resistance spilled into open revolts, these were not revolutions that aimed at violent and fundamental restructuring of society like the French or Russian Revolutions were to do. These revolts occurred most often among the peasants and the craftsmen who could not achieve much without the involvement of elites that controlled fiscal and military resources (Elliott, 1969, 41–5, 55). These elites had no interest in undermining the system over which they ruled, which meant that any popular uprising that threatened to become revolutionary frightened them and swiftly brought them over to the Crown's side in its suppression. Conversely, any uprising that had any chance of achieving relief of the grievances that prompted it was of necessity conservative because it had to rely on the support of these elites. Bercé (1990, 169–319), who also emphasizes the deeply reactionary nature of peasant revolts in France, notes that these revolts were often spurred by common myths of a good king deceived by bad ministers into creating a new tax, or of tax remission granted by the king but subverted by the tax collectors. The goal of these rebels was often merely to bring royal attention to the injustice, not to overthrow the ruling order.⁹

One might wonder why such myths could persist and they must have because otherwise one could hardly see how those starting a tax revolt could ever hope to achieve anything against the overwhelming military power of the Crown. In fact, one is struck by how often these revolts unfolded in similar ways, with the rulers suppressing them (sometimes the rebels would simply surrender without a fight), executing a few ring-leaders, and then granting some relief of the grievances. Mousnier (1979, 741) notes how in the 17th century, their “frequency, [...] their forms of organization, and the ways in which they began and developed made them almost an institution.”¹⁰

Even if our story persuades that because of the moral hazard problem the Crown's tax demands would push its subjects toward the limits of their acquiescence, it suggests no apparent reason why it should so often push them over that brink into violent resistance or why the overall level of taxation was often quite obviously below what the rich could afford to pay. We argue that the key to the explanation of these phenomena is the Crown's inability to accurately assess the taxable wealth of its subjects. Indeed, as we shall demonstrate, if the Crown could obtain the relevant information, it would always tax at the highest rate that would avoid a revolt, meaning that it would both escape the violence and impose a heavier burden on the rich.

We are not the first to note the importance of taxation to the development state institutions, and to the effects various fiscal systems can have on government revenue. In his brief but very perceptive essay on economic history, Hicks (1969, 81–4) argues that the reason

⁹Mousnier (1979, 730–1) also relates tax revolts to the general expectation that the Crown was supposed to meet its regular expenses with revenue from the royal domain, reserving taxation only for exceptional circumstances like war. Every new tax or an increase in an existing tax was perceived as extortion, and there was little chance that people would voluntarily accept large changes of customary rules. As he notes, “the expressed motive of most popular revolts was the excessiveness, real or alleged, of taxation.”

¹⁰Paik, Steele, and Tanaka (2012) find statistical evidence in a set of 267 rebellions in Tokugawa Japan (1603–1868) that post-revolt tax rates were significantly lower on average, and this is in a country where the ruling class had unquestionable dominance in coercive capability.

for the “chronic deficiency of tax revenue” can be traced to the Crown’s inability to tap into the wealth of much of society. Taxing trade through tolls or customs duties was possible (especially at ports, town gates, river crossings, and mountain passes) but it was much more difficult when frontiers were ill-defined and porous. Excise taxes required a relatively sophisticated administrative apparatus that remained well beyond the capacity of most polities for a long time (Brewer, 1990, 104–08). In addition, indirect taxes like excise and customs increased prices and threatened to affect adversely the scope of commercial activities and the volume of trade, which could actually decrease the tax yield.

Taxing income cannot be done until there is a way to ascertain that income, which can be quite impossible in a world where few systematic records are kept, where accounting practices are primitive (double-entry book-keeping was slow to spread from Italy, and even as late as the 18th century the French Crown did not have anything resembling a budget), and where there is no pressing need to determine wealth in order to engage in daily economic activities. It was only with the rise of state officials living on known salaries, landlords receiving income from contractual rents, and the Corporation that had to keep track of revenues to pay dividends that some income became easy to assess.

Two common ways of trying to get around the problem of assessing income is by ignoring it or by looking for some more easily measurable proxy for wealth. The old capitation taxes, which imposed a fixed amount on an individual as defined by a census, were straightforward to impose since they required no assessment of anything except the relevant population. Related variants were the hearth and window taxes that were imposed on dwellings since these were easier to count than people (although counting hearths still required entry into private dwellings). Deeply regressive, these taxes obviously failed to tap into much wealth since they had to be affordable by the poorest members of the taxpayer population. Even then, since it was the peasants who were usually the poorest and because the tax took no account of how ability to pay could change with circumstances, these impositions could become unbearable after bad harvests or in tough economic conditions, and could trigger revolts.

A slightly improved approach to the capitation tax that still necessitated no inquiry into the wealth of the subjects was to introduce gradations according to social rank, with the latter presumably serving as an index of wealth. Thus, the poll tax introduced by Crown Louis XIV in 1695 defined twenty-two classes of society from the lowest comprising day laborers and servants, who paid 1 *livre*, all the way up to the *Dauphin* himself, who paid 2,000 *livres*. Analogous variants were also occasionally used in England since the 14th century, and came into wide use during the fiscal stresses of the tumultuous 16th century. With such crude indicators of wealth, however, these tax were simultaneously too burdensome for many in the lower ranks (who lived on a small margin) and too light for those in the top ranks. The flat impositions spurred efforts to gain exemptions and when this was not possible produced rumblings of revolt. When Württemberg saw a graduated poll tax in the wake of the French invasion and exactions in 1707–08, someone scribbled a warning on the doors of the Estates’ house in Stuttgart: “if you consent to the Duke’s demands, we shall revolt.”¹¹

¹¹The tax was promptly abandoned and when another duke attempted to impose it in 1764, the Estates managed to obtain an injunction from the Imperial court that put a stop to it. See Carsten (1959, 110, 140–2).

In order to tax property — which could also be used as an index of wealth — rulers had to carry out difficult, time-consuming, and expensive valuations of property. In practice, this meant that they could not do so very often and as a result taxpayers were assessed on past values of their property, often as distant in the past as several centuries! To make matters worse, assessments could be easily tampered with either by holding property in some less traceable forms, by colluding with the tax assessors who were often one own's neighbors (who presumably had a better idea about one's holdings than an outsider), or by the simple expedient of lying — since rulers were often reduced to relying on self-reported valuations and the practice of requiring an oath was inconsistently used (Braddick, 1996, 94, 163–4). The persistent theme, of course, is that taxpayers knew more about their wealth than the Crown did, and that it was very expensive for the Crown to acquire the necessary information.

Scholars have analyzed various fiscal systems precisely from the vantage point of how easy taxes were to collect (which includes assessment, administration, and enforcement). The widespread practice of tax-farming, for instance, is a rational way of dealing with the problem of asymmetric information about the tax base in such an environment, especially when the tax rights are auctioned off at fairly regular intervals to a large group of bidders.¹² Tilly, for instance, bases part of his argument about the different paths to the modern state on the presumed difficulty of collecting land taxes than taxes on commerce.¹³ Ertman (1997, 16) rightly disputes this assumption (using the evidence collected by Brewer (1990) on the excise tax in England) but then goes to the other extreme by asserting that “land taxes were not difficult to administer, because central governments could dispense with the time-consuming business of wealth or income assessments and instead simply demand fixed amounts from each local area.”

This remarkably sanguine view seriously underestimates the need to figure out what was there to be taxed. It is now well-documented, for example, that royal tax figures in France “represented proposed revenues, or ‘hoped-for’ revenues, not in any sense money actually collected. [...] All the chilling tax figures from the 1640s are mere imagination; they have little foundation in reality” (Collins, 1988, 200–05).

The English Crown did not fare much better. For instance, the fifteenth, a tax on personal property that required the government to assess the current wealth of the taxpayers, developed during the reign of Edward I but “ossified [by 1336 and] remained basically unchanged until its termination in 1624 [...] [F]rom tax to tax and irrespective of economic growth or decline, each ward and vill made the same contribution as in 1334. Moreover, from 1336 onwards the assessment of individual wealth was placed beyond the competence of centrally appointed officials and reserved for the local community to determine” (Bush, 1991, 381–2). The under-assessment of wealth in England was so extreme in the early 17th century that subsidies dropped in yield when national wealth was going up (Braddick, 1996, 163).

Interestingly, even when the Crown and the elites agreed on the size of the tax base, disagreements about what was possible to tax without ruining the taxpayers could create open ruptures. In 1626, the Catalan Corts was confronted with a demand for 250,000 ducats

¹²perhaps explain a bit

¹³cite

a year for fifteen years by Olivares who was desperately trying to plug the fiscal hole in which the Spanish Crown was descending. The money was intended for military upkeep, with Olivares promising that it will all be spent in the province and collected exclusively by locals, but it exceeded the customary contribution by nearly 60 percent. Even though both sides had estimated the population of the principality to be about one million (the actual figure was closer to 400,000), there was a “sharp divergence between the king’s advisers and the Catalans over the fiscal resources of the Principality,” with the latter considering the demand exorbitant and ruinous (Elliott, 1984, 237–38).

The Crown could always count on the taxpayers to meet any request for funds like the Catalans did in 1626:

Today the Principality of Catalonia is very poor and exhausted, and overburdened with dues, and it is impossible to find the sum demanded by His Majesty — a sum which is very excessive in view of the poverty of the towns, and could only bring ruin and destruction upon them.¹⁴

Naturally, the Crown took a dim view of these claims. Earlier in 1618, the Spanish Council of Finance had told the Duke of Lerma that the sums of money he was trying to send to Germany and Italy simply did not exist, only to be told by the king in person that “these provisions are so vital that the Council of Finance must find them.”¹⁵ That the Crown sometimes had good reason not to take these claims at face value is evident both from what the taxpayers were in the end able to deliver without ruining themselves in the process, and more directly from the financial statements of some representative assemblies. For instance, in 1667 the expenditures of the Württemberg Estates hovered about 200,000 guilders per year (which included paying down a large ducal debt they had assumed), and tax arrears were only about 33,000. “These figures are indicative of the soundness of the Estates’ financial position; but this was not the opinion of the Small Committee, which complained vigorously about the bad state of the finances and the plight of the country” (Carsten, 1959, 83). These particular Estates have a long history of vigorous protestation of their poverty followed by increased grants to the duke.

There is also substantial evidence that taxpayers were quite aware of their informational advantage and jealously guarded it, sometimes by violently resisting the Crown’s intrusive attempts to assess their wealth. The 1487 subsidy for an army of 10,000 archers in England authorized royal commissioners to assess the wealth, and it quite explicitly denied that this could become a precedent “considering that there never was before that time any like grant made” and it even provided that the certificates of wealth these commissioners made would be “never returnable in any of the king’s court of record.” Despite these precautions, the subsidy was quite unpopular, led to widespread resistance, and in the end collected no more than £27,000 of the £75,000 it was supposed to. Five of the six tax rebellions in the 15th century in England were directed against changes in the system of direct taxation.¹⁶

The English even resisted placing assessors and taxpayers on oath, so the practice was abandoned after 1566 (Braddick, 1996, 94). The perpetual hostility to wealth assessment

¹⁴Quoted in Elliott (1984, 245).

¹⁵Russell (1982, 208); Elliott (1984, 187–90).

¹⁶Dowell (1884, 169–70); Bush (1991, 382–3).

caused William Petty to admit that the “objection against this so exact computation of the Rents and [worth] of lands, &c. is, that the Sovereign would know too exactly every mans Estate.” To this he had only to offer the tepid defense that “it would be a great discommodity to the Prince to take more than he needs,” which of course caused him to wonder “where is the evil of this so exact knowledge?”¹⁷

Perceptive observers knew very well where this particular evil lay because taxpayers could not rely on the tender mercies of benevolent monarchs. For instance, Francis Bacon praises Queen Elizabeth I for raising funds “by the assent of parliament, according to the ancient customs of this realm” and then asserts that her subjects paid their taxes “with great goodwill and cheerfulness” because of her spending the money exclusively for “defence and preservation of the subject, not upon excessive buildings, nor upon immoderate donatives, nor upon triumphs and pleasures: or any the like veins of dissipation of treasure, which have been familiar to many kings.” But he then makes plain that the actual source of this tax merriment was not to be found in any postulated reduction of the moral hazard but in the prosaic fact that the subjects had been “taxed and also assessed with a very light and gentle hand”, for “the Englishman is the most master of his own valuation, and the least bitten in his purse of any nation of Europe.”¹⁸

The English were not the only ones concerned with keeping their wealth information away from the Crown, as two examples from France and Germany illustrate. The Estates of Languedoc, one of the few *pays d'états* of ancien régime France that survived until the Revolution, met annually as a single assembly, and deliberated in secrecy. Even though they were always convoked by the king, the Estates admitted no royal representatives to these deliberations, destroyed all records at the end of the session, and offered no tally of votes to accompany their final decision. The secrecy made it difficult for the king to bribe or threaten individual members since there was no information forthcoming on which to condition rewards or penalties. The need to conceal the nature of deliberations was more general, however. The first order of business for the assembly after checking the credentials of the deputies, was to swear to “serve the king and the province faithfully and to reveal nothing, by speech or writing, of anything said or done in the assembly that might be harmful and prejudicial to the assembly or to the individuals composing it”.¹⁹

The Estates of Württemberg did have to acquiesce to the presence of ducal officials — the so-called *Amtleute* who were supposed to represent rural districts, a right that the deputies from the towns claimed for themselves — but they managed to exclude them from the agenda-setting committee that was elected at the beginning of each session. This committee deliberated in secrecy, discussed ducal demands, prepared the list of grievances, and all other matters of interest. It then submitted its recommendation to the full assembly for

¹⁷“A Treatise of Taxes & Contributions” in Petty (1899, 53–4). Available online at The Online Library of Liberty, http://oll.libertyfund.org/?option=com_staticxt&staticfile=show.php%3Ftitle=1677, accessed June 14, 2013.

¹⁸“Certain observations upon a libel published this present year, 1592, entitled, A declaration of the true causes of the great troubles presupposed to be intended against the realm of England,” in Bacon (1824, Volume III, pp. 71–2). The argument is all the more convincing when one recalls that Bacon’s object here was to counter what he considered a libelous claim that England was in an impoverished state as a result of ruinous taxation due to Elizabeth I’s wars with Spain. Even as he was defending the queen’s policies Bacon could not but dwell on the causes of (what he believed to be) uncommonly low taxes.

¹⁹Mousnier (1979, 618); Brink (1980, 438).

formal approval, which was nearly always granted. In this way, the ducal officials were “excluded from the confidential deliberations of the committee which they might have tried to influence in the prince’s favour, or might have divulged to him.”²⁰

Consistent with these observations, our theoretical model incorporates several key features: (i) moral hazard: once a tax is granted, there is no way to control how the Crown spends the money; (ii) asymmetric information: taxpayers know their wealth, but the Crown cannot assess it on its own; (iii) commitment problem: the Crown is unconstrained in how it uses any information it acquires from the taxpayers; (iv) elite privilege: the Crown’s spending of public money tends to favor the wealthier elites; (v) proposal power: the Crown has the initiative in making tax demands and could threaten that failure to accept them would result in their (involuntary) collection, which gives its demands a flavor of ultimata; and (vi) coercive advantage: whereas rebels stand to be dispossessed, the Crown faces no comparable risk. The model abstracts away from representation and coordination for collective action among taxpayers and elites, as well as the possibility that the Crown could ally itself with some segment of society in order to increase its ability to extract resources from another. It also does not deal with different fiscal systems — a vast topic on its own — and with the mundane, but possibly important, issues of tax avoidance and evasion. All of this drastic simplification is made so we can focus on the interaction between the Crown’s two fundamental problems of commitment and lack of information.

The last two assumptions are meant to be broadly consistent with practice and are deliberately chosen in their more extreme variants in order to give the Crown an overall edge with respect to the taxpayers. If we find that despite these advantages the Crown still ends up under-taxing, then our results will be much more convincing than if we found under-taxation when the Crown is assumed to be in a weaker position.

2 The Model

The Crown bargains with a Subject whose wealth is $y \geq 0$ over the amount of taxation.²¹ The Crown demands a payment of $x \geq 0$, and the Subject can either acquiesce and pay or rebel.

If the Subject pays, the Crown provides a good produced from x , in which case her payoff is $U(x; y)$. This function is continuous in both arguments and strictly increasing in y . To incorporate the notion of moral hazard, we assume that for any amount of taxation, the Crown provides some benefit to the Subject (e.g., patronage, enforcement of property rights, defense), but the Subject has no direct control over that provision. The payoff function represents this in a simple way: the Subject’s utility is strictly concave in x (so that she benefits from some taxes but finds whatever the Crown is willing to provide unattractive at higher levels of taxation), with $U(0; y) = y$ (only private consumption when there is no tax), and $U(y; y) = 0$ (no utility when all wealth is taxed away). Finally, since these benefits tend to accrue disproportionately to the wealthy, we assume that

²⁰Carsten (1959, 26–8). The *Amtleute* were never allowed to participate in the standing Small and Large Committees that made decisions between diets of the full Estates. The Small Committee in particular controlled the financial administration of the Estates and could authorize grants within certain limits without the need to convoke a diet.

²¹We refer to the Crown as “it” and to the Subject as “she” for ease of exposition.

ASSUMPTION 1 (WEALTH PRIVILEGE). U is supermodular: $\frac{d^2U}{dx dy} > 0$ for all $x < y$.

If the Subject rebels, she survives the revolt with probability $p(y)$, which is strictly increasing in her wealth. Revolt is always risky: $p(y) \in (0, 1)$ for all $y > 0$. Rebels pay no taxes and forego any benefit the Crown would have provided with these taxes. If the Subject does not survive the rebellion, the Crown expropriates all her wealth. When rebellion is successful, the Subject escapes taxation, at least for a while. But when rebellion fails, Crown can impose large penalties. The Subject's expected payoff from rebelling is:

$$R(y) = p(y)U(0; y).$$

We restrict attention to revolt technologies that do not admit very large changes in the probability of survival for small increases in wealth:

ASSUMPTION 2 (TECHNOLOGY OF COERCION). $p(y) + y \cdot \frac{dp}{dy} < 1$.

One way to think about this is in terms of opportunity costs of revolting. Let

$$\theta(y) = U(0; y) - p(y)U(0; y) = (1 - p(y))y \quad (1)$$

denote the difference between the Subject's payoff when she is free from taxation and the expected value of rebelling to obtain that freedom. Assumption 2 implies that $\theta(y)$ is increasing: wealthier Subjects stand to lose more from rebellion. Even though they are more likely to survive, they also derive much larger benefits from peaceful private consumption than poorer Subjects do.²²

The Crown's payoff when the Subject agrees to pay x is $V(x)$, where we assume that the utility function is strictly increasing and concave, and that $V(0) = 0$. If the Subject rebels, the Crown expropriates her wealth with probability $1 - p(y)$, and since it collects no tax when she survives the rebellion, the Crown's expected payoff is

$$W(y) = (1 - p(y))V(y).$$

It is worth noting that we have implicitly assumed that the only cost of rebellion is foregone taxation to the Crown and foregone royal benefits for the Subject. Although this does characterize a few tax revolts, most do involve fighting that causes destruction quite apart from these costs. Formally, these costs make revolts less attractive to both sides and increase the incentives to find a mutually acceptable deal. From this perspective, however, we do not need them because the assumptions on the payoff functions guarantee that both actors would prefer to avoid a revolt already. Since our results will also hold for any model with explicit costs as long as they are not too large, we can omit them from the specification for the sake of simplicity.

The interaction takes place over two periods, which are structurally identical. The Subject obtains her income y and the Crown makes a take-it-or-leave-it (TILI) demand x . If the

²²As we shall see, Assumption 2 is sufficient for the results we obtain, but it is not necessary. Common contest-success functions satisfy this assumption. For example, $p(y) = e^{-\frac{1}{y}}$ does, as does the standard ratio form: $p(y) = \frac{\omega y^\alpha}{\omega y^\alpha + \psi^\alpha}$, with $\omega > 0$, $\alpha \in (0, 1]$, and $\psi > 0$, where the latter measures the Crown's coercive resources.

Subject accepts, the actors realize their per-period payoffs of $V(x)$ and $U(x; y)$ respectively. If the Subject rebels and survives, she pays no tax in the current period, and the actors also obtain their per-period payoffs of $V(0)$ and $U(0; y)$. If the Subject rebels but does not survive, the Crown expropriates her income, so the per-period payoffs are $V(y)$ and 0, respectively. Expropriation is permanent: if the Subject rebels in the first period and does not survive, then the Crown retains her entire income in the second period as well. (That is, the interaction stops after the first period, with second-period payoffs fixed at $V(y)$ and 0.) The total payoff is the (undiscounted) sum of the per-period payoffs.

The model incorporates the lack of institutional constraints on the Crown by assuming that the Crown is free to set whatever tax demands it chooses. In particular, it cannot pre-commit to the second-period taxation at the outset.

3 Tax Acquiescence When Subject's Wealth Is Known

To develop intuition for the workings of the model, we begin our analysis under the assumption that the Crown is completely informed about the wealth of the Subject. This exercise also serves to introduce notation that will be very useful later on. The solution concept here is subgame-perfect equilibrium.

Consider the second period and suppose the Subject either did not rebel in the first period or survived a revolt. Since $U(x; y)$ is strictly concave in x , it has a unique unconstrained maximizer, $x_e(y)$, which represents the tax that Subject prefers. By Assumption 1, the Subject-preferred tax is increasing in y . However, this is not the tax that Subject would have to pay in equilibrium because by subgame perfection, for any given x , Subject will pay if, and only if, $U(x; y) \geq R(y)$. Since the Crown's payoff is increasing in the tax, it will demand the highest tax Subject would agree to, denoted $x_k(y)$, which implies that the equilibrium *coercive tax* is defined by

$$U(x_k(y); y) = R(y).$$

This equation has a unique solution because $U(0; y) > R(y)$, $R(y)$ is constant, and $U(x; y)$ concave in x together imply that $U(x; y)$ and $R(y)$ will intersect only once, at some $x_k(y) > 0$. Observe now that $U(x_e(y); y) > U(0; y) > R(y)$ also implies that the intersection of $U(x; y)$ and $R(y)$ must occur when $U(x; y)$ is decreasing at $x_k(y)$, which immediately implies that $x_k(y) > x_e(y)$. That is, the coercive tax is strictly higher than the tax the Subject is willing to pay voluntarily. As it turns out, our assumptions also imply that richer Subjects could also be coerced into higher payments as well, as the following result demonstrates (all proofs are in Appendix A).

LEMMA 1. *The coercive tax is increasing in the Subject's wealth.* □

This result, illustrated in Figure 1, might (or should be) surprising.²³ Recall that since the probability of surviving the revolt is increasing in wealth and because winning means keeping one's wealth, the richer the Subject, the higher the expected payoff from rebellion.

²³We used the following functional forms: $U(x; y) = y - x + \lambda \sqrt{x(y-x)}$, where $\lambda = 3$ measures the importance of royal benefits to the Subject, and $p(y) = y/(1+y)$.

Since the Crown is taxing at the revolt constraint, one might expect that this should induce it to offer better deals to the rich. Indeed, as we shall see in the discussion section, this is what happens in the standard models of bargaining in the shadow of power where the types with higher expected payoffs from fighting must be offered more attractive peace terms to be induced not to fight.

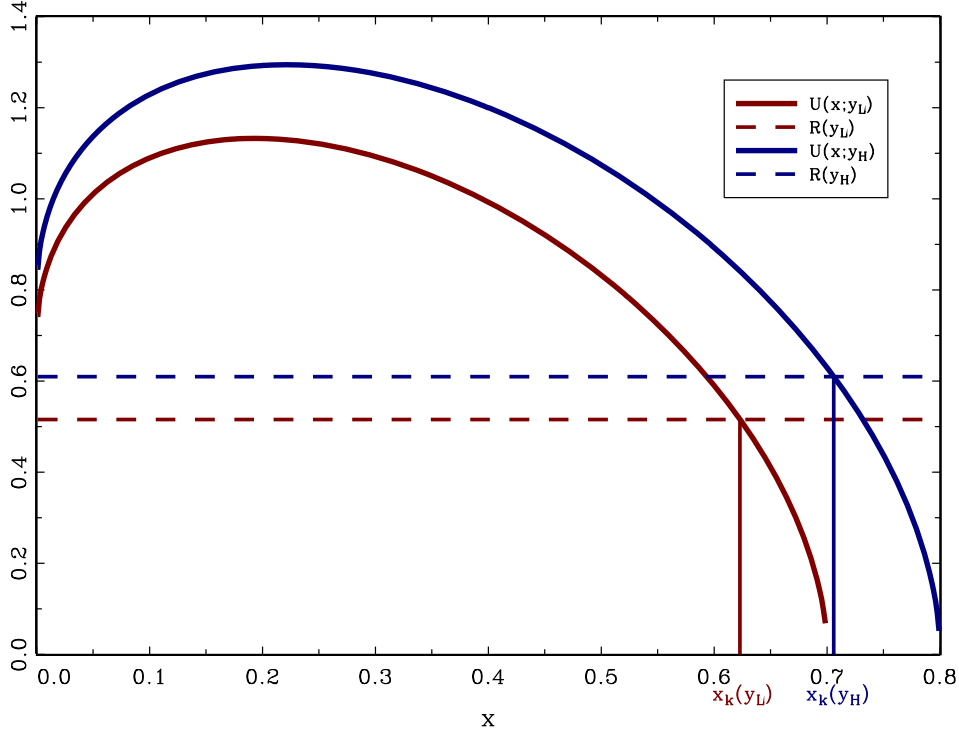


Figure 1: Coercive Taxation and Rebellion ($y_L = 0.7$, $y_H = 0.8$).

In this model, however, the acceptable tax demand is increasing in wealth. In other words, the richer the Subject, the more she can be induced to pay *even though* her payoff from rebellion is higher. The reason is that the richer Subject also faces a larger *opportunity cost* of peaceful tax-payment: the richer the Subject, the more she stands to lose by rebelling. Another way of saying this is that for any tax demanded, the difference between what Subject would obtain by paying and what she can secure by rebelling is increasing in wealth. Recall that the rebellion payoff is independent of the Crown's demand and consider first a demand of zero taxation: $x = 0$. Since the Crown would provide no good in this case, all consumption is private, so agreeing to this demand leaves Subject with $U(0; y) = y$. Rebelling at this demand secures $p(y)U(0; y) = p(y)y < y$, so there is clearly no point in rebelling when one is not taxed. The opportunity cost of paying no tax in while remaining at peace is $y - p(y)y = (1 - p(y))y = \theta(y)$, which is increasing by Assumption 2. This leads us to our first result.

PROPOSITION 1. *Under complete information, the second period is always peaceful. In the unique equilibrium the Crown demands $x_k(y)$ and Subject accepts.* \square

The Crown will therefore tax the Subject with known income all the way down to her indifference point between paying that tax and rebelling. An important implication is that pushing her to that point is strictly preferable for the Crown than having to suppress a rebellion:

COROLLARY 1. *The Crown strictly prefers to obtain the coercive tax than to cause Subject to rebel regardless of Subject's wealth: $V(x_k(y)) > W(y)$.* \square

This is why there is no need to assume additional costs of rebellion in order to provide sufficient incentives to the actors to avoid violence in equilibrium.

Consider now the first period. Define three demands: the initial one the Crown makes in the first period, x_1 , and the two outcome-contingent demands it can make in the second period, one after acceptance of the first-period demand (x_A), and another after its rejection (x_R). By Proposition 1 and subgame perfection, if the Subject acquiesces in the first period or survives a rebellion, the Crown will impose the coercive tax in the second period regardless of what happens in first:

$$x_A = x_R = x_k(y),$$

which means that Subject will always accept in the second period. Consider now an arbitrary x_1 , and note that if Subject accepts that, her payoff is:

$$U(x_1; y) + U(x_k(y); y) = U(x_1; y) + R(y),$$

whereas if she rejects it, her payoff is

$$R(y) + p(y)U(x_k(y); y) = R(y) + p(y)R(y).$$

Thus, the Subject accepts x_1 only if $U(x_1; y) \geq p(y)R(y)$. Since the Crown has no best response to the Subject rejecting with positive probability when indifferent, in equilibrium it must be that the Subject accepts in that case. Because the Crown's payoff is increasing in the accepted demand, it follows that the Crown must make the Subject indifferent. Let $x_d(y)$ uniquely solve

$$U(x_d(y); y) = p(y)R(y), \tag{2}$$

and be a first-period coercive tax.²⁴ As one would expect, this tax is also the optimal peace-preserving first-period demand that the Crown can make given that it is going to tax at the coercive maximum in the second period.

Since the Subject would accept any lower first-period tax without affecting the second-period payoffs, the Crown cannot profit by reducing taxation. The other possibility, of course, is that the Crown induces a rebellion by making some unacceptable demand: the gives it a chance to expropriate the Subject if the revolt fails, while still yielding the coercive tax in the second period if the revolt succeeds. If a rebellion occurs, the Crown prevails

²⁴The subscript 'd' stands for "delay the revolt". The equation has a unique solution because $p(y)R(y)$ is constant in x while $U(x; y)$ is concave in x , which together imply that $U(x; y)$ and $p(y)R(y)$ will intersect at most twice. Since $U(0; y) > R(y) > p(y)R(y) > 0 = U(y; y)$, it follows that they will intersect once, at some $x_d(y) > 0$.

with probability $1 - p(y)$, in which case it expropriates the entire wealth, and if it loses, which happens with probability $p(y)$, it imposes the single-period violence constrained tax $x_k(y)$. Thus, the expected second-period payoff from a rebellion in the first period is $(1 - p(y))V(y) + p(y)V(x_k(y))$. We now show that the Crown prefers the peaceful security of $x_d(y)$ to this gamble.

LEMMA 2. *The Crown prefers the coercive tax to gambling on revolt: $V(x_d(y)) > G(y)$, where*

$$G(y) = (1 - p(y))V(y) + p(y)V(x_k(y)) \quad (3)$$

is the payoff from the gamble. □

It is important to realize that Lemma 2 does *not* show that the Crown would not induce a rebellion because it only establishes that obtaining $x_d(y)$ in the first period is better than the rebellion gamble in the second period. However, it is enough to enable us to characterize the subgame-perfect equilibrium of the game.

PROPOSITION 2. *In the unique subgame-perfect equilibrium, the Crown demands $x_d(y)$ in the first period and $x_k(y)$ in the second period, and the Subject accepts both.* □

An important question now arises with respect to the two different tax demands: could it be that the Crown's inability to commit not to demand anything less than the coercive tax in the second period forces it to make concessions in the first? The answer turns out to be negative. In fact, as the following result shows, the Crown is even *more* demanding in the first-period. The coercive second-period tax is actually an instance of tax relief!

LEMMA 3. *The first-period tax exceeds the second-period coercive tax: $x_d(y) > x_k(y)$, and is also increasing in the Subject's wealth.* □

The intuition behind this result is straightforward. In the second period the Crown will extract the complete-information maximum represented by the coercive tax. It cannot commit to anything less or demand anything more. Since the post-rebellion and post-acceptance taxes are the same, from Subject's perspective rebellion can only yield tax relief in the current period; it cannot alter the terms Subject would have to agree to in the second period. The attraction of a possible tax relief, however, is seriously dampened by the risk that she will be permanently expropriated. In other words, whereas any possible benefit from rebellion can only accrue in first period, the losses from defeat persist in both. In particular, this means that Subject not only risks losing today but also risks not being around tomorrow, when paying even the onerous tax is strictly better than being expropriated with certainty. This makes the rebellion payoff in the first period strictly worse than the single-period rebellion payoff, and as a result the Crown can demand, and obtain, a higher tax.

Since we stacked the model to the Crown's advantage, it is perhaps to be expected that it should end up in such a superior position in equilibrium:

RESULT 1 *When the Crown knows the wealth of the taxpayers, its superior proposal and coercive powers yield a significant advantage: taxes are high but no revolts occur.*

The Crown gains tremendously from its proposal power — which enables it to extract all wealth up to Subject’s reservation point — and from its coercive advantage — which enables it to demand an even larger tax in the first period than the already high tax in the second. The Crown’s inability to pre-commit does not appear to be much of a problem. All of this, however, changes when we introduce asymmetric information about the wealth of the Subject.

4 Taxation and Revolts under Asymmetric Information

Suppose now that the Subject is perfectly informed about her wealth but the Crown does not observe it. Consider two types of Subject: rich, with income y_H , and poor, with income $y_L < y_H$. Let $q \in (0, 1)$ denote the Crown’s prior belief that the Subject is rich. For ease of exposition, we shall use the following short-hand notation: $x_i \equiv x_k(y_i)$ and $p_i \equiv p(y_i)$. The solution concept is perfect Bayesian equilibrium with refinements about off-the-path beliefs as specified below.

4.1 Strategies in the Second Period

Since the Crown cannot pre-commit to any particular tax in the second period, in any equilibrium its strategy there must be sequentially rational given its updated beliefs. If the Crown believes that the Subject’s wealth is y_i with probability one, then it will simply demand x_i , so consider the cases where it attaches positive probability to both types. Recall that by subgame perfection, y_i will reject any $x > x_i$. Since the Crown’s payoff is increasing in the tax the Subject pays and because $x_L < x_H$ by Lemma 1, there are only two relevant demands that she accepts with positive probability that the Crown needs to consider. First, since both types accept any $x \leq x_L$, the Crown strictly prefers to demand x_L over anything less. Second, since only the rich type accepts $x \in (x_L, x_H]$, the Crown strictly prefers to demand x_H over any other tax in that set.²⁵ Finally, any demand $x > x_H$ is equivalent because neither type would accept it. In other words, the Crown’s choices are: (i) demand a low tax, x_L , that the Subject accepts regardless of her wealth; (ii) demand a high tax, x_H , that the Subject accepts if rich but rejects by rebelling if poor; and (iii) demand a very high tax that the Subject rejects regardless of her wealth.

Even under asymmetric information, the Crown has an incentive to avoid provoking a rebellion: it is always better to demand a tax that has at least some chance of being accepted than to demand one that is sure to be rejected. To see this, let $\hat{q} \in (0, 1)$ denote the Crown’s updated second-period belief, and note that its expected payoff from making the high demand is:

$$(1 - \hat{q})W(y_L) + \hat{q}V(x_H) > (1 - \hat{q})W(y_L) + \hat{q}W(y_H),$$

²⁵In equilibrium, y_L must accept x_L with certainty even though she is indifferent. To see this, suppose that she rejects x_L with positive probability. But then since she accepts any $x < x_L$ with certainty, the Crown’s payoff from demanding such x is strictly increasing, and for x sufficiently close to x_L also strictly better than x_L itself. An analogous argument shows that y_H must accept x_H with certainty as well.

where the inequality follows from Corollary 1 and where the right-hand side is its expected payoff from making an unacceptable demand. This leaves only the low tax that is sure to avoid a revolt to consider. Since the Crown's payoff from this tax is $V(x_L)$, it strictly prefers the risky demand when $(1 - \hat{q})W(y_L) + \hat{q}V(x_H) > V(x_L)$, and strictly prefers the peaceful one when the inequality is reversed. Let

$$q_A = \frac{V(x_L) - W(y_L)}{V(x_H) - W(y_L)}$$

denote the belief that makes the Crown indifferent between these two tax demands. This is a valid probability because $V(x_H) > V(x_L) > W(x_L)$, where the first inequality follows from Lemma 1, and the second from Corollary 1. The Crown's sequentially rational strategy in the second period is to demand

$$x(\hat{q}) = \begin{cases} x_L & \text{if } \hat{q} < q_A \\ x_H & \text{if } \hat{q} > q_A \\ \text{mix between } x_L \text{ and } x_H & \text{if } \hat{q} = q_A. \end{cases}$$

Thus, in the second period the Crown will attempt to impose a high tax only when it is sufficiently convinced that the Subject is wealthy; otherwise, it would settle for a low tax. This means that the Subject is simultaneously threatened by the possibility that the Crown would conclude that she is rich and demand a high tax — the *ratchet effect*, and attracted to the possibility that the Crown would conclude that she is poor and demand a low tax — *tax relief*. This gives the Subject strong incentives to get the Crown to believe that she is poor. Since the Crown is going to attempt to infer her wealth from her behavior in the first period and from the outcome of revolt should one occur, this incentive distorts the Subject's behavior in that period.

If the Subject accepts the initial demand regardless of type, the Crown will be able to infer nothing from observing acceptance, so $\hat{q} = q$. In this situation, its second-period behavior can be formulated simply as a function of its prior belief: it demands x_L if $q < q_A$, x_H if $q > q_A$, and can mix if $q = q_A$.

If the Subject revolts after some demand regardless of type, the Crown will not infer anything from the act of rebelling, but will learn something when the Subject survives the rebellion because the rich type is more likely to do so than the poor type. When both types revolt, Bayes rule pins down the posterior belief to be: $\hat{q} = qp_H/[qp_H + (1 - q)p_L]$. Setting $\hat{q} = q_A$ yields the post-revolt threshold:

$$q_R = \frac{q_A p_L}{q_A p_L + (1 - q_A) p_H} < q_A,$$

so that we can again specify the Crown's second-period behavior as a function of its prior belief: it demands x_L if $q < q_R$, x_H if $q > q_R$, and can mix if $q = q_R$.

To understand q_R , recall that since in this case the act of rebelling itself reveals no new information, the only update the Crown will be able to perform must come from how the rebellion ends. Because y_H is more likely to survive, the posterior belief must increase the weight relative to the prior. The threshold q_R determines whether this update will induce the Crown to offer tax relief. Whether this happens or not depends on how discriminating

the technology of rebellion is; that is, the difference between p_H and p_L . The larger this difference, the greater the discriminating power of successful rebellion, and the more decisive the Crown's update. When p_H and p_L get arbitrarily close to each other, the Crown will not learn much from the outcome of rebellion. Conversely, when p_L goes to zero, the Crown can be fairly certain that the victorious rebel is rich.

We now turn to the general analysis of the strategies in the first period, which will be conveniently divided according to player type and identity.

4.2 Behavior of the Poor Subject

The Crown will only ever make one of two demands in the second period: x_L (which the poor type accepts) or x_H (which she rejects). Since $U(x_L; y_L) = R(y_L)$ by definition, the expected payoff for the poor type in that period is always equivalent to $U(x_L; y_L)$ irrespective of which optimal demand the Crown actually makes. This implies that from her perspective it is irrelevant what the Crown is going to believe after the first period, so her behavior in that period is not distorted. Since she expects the equivalent of x_L whether she agrees to x_1 or revolts, her best responses in the first period are exactly the same as they would have been under complete information:

LEMMA 4. *If the Subject is poor, she accepts any $x_1 < x_d(y_L)$ and rejects any $x_1 > x_d(y_L)$.* □

Since these are strictly dominant strategies that are independent of the Crown's beliefs, Lemma 4 must characterize the behavior of the poor type off the path of play as well. Consequently, henceforth we shall restrict the analysis to require that y_L 's strategy is to accept any $x < x_d(y_L)$ and reject any $x > x_d(y_L)$ irrespective of whether x is the Crown's equilibrium demand. This has consequences for the Crown's beliefs after responses that y_L can never be expected to have. Since rejecting any $x < x_d(y_L)$ is strictly dominated for y_L , the Crown cannot assign positive probability to this type after such a demand results in a revolt: $\hat{q}(x) = 1$. Analogously, since accepting any $x > x_d(y_L)$ is strictly dominated for y_L , the Crown cannot assign positive probability to this type after such a demand results in acceptance: $\hat{q}(x) = 0$. These beliefs pin down the Crown's demands:

REQUIREMENT 1 (NO DOMINATED STRATEGIES). In any equilibrium, y_L accepts any $x < x_d(y_L)$, so $x_R(x) = x_H$; and rejects any $x > x_d(y_L)$, so $x_A(x) = x_H$. Moreover, $x_A(x) = x_R(x) = x_L$ is only possible when $x = x_d(y_L)$.

To see that how these beliefs imply the second claim, observe that $x_R(x) = x_L$ requires that $x \geq x_d(y_L)$, but for all $x > x_d(y_L) \Rightarrow x_A(x) = x_H$, a contradiction. Thus, the only possibility must be that $x = x_d(y_L)$. In this case y_L is indifferent between accepting the Crown's demand and revolting. We know that in the complete information equilibrium she must accept the demand, and we now show that she must do so in the presence of asymmetric information as well. Since it is tedious to write "equilibrium that satisfies Requirement 1", from now on we shall simply refer to "equilibrium" with the understanding that it does satisfy this requirement.

LEMMA 5. *Without loss of generality, y_L accepts $x_d(y_L)$ with certainty both on and off the path of play in any equilibrium.* \square

Since the Crown's lack of information does not distort the behavior of the poor type, all dynamics of any interest must come from the behavior of the rich type, to which analysis we now turn.

4.3 Behavior of the Rich Subject

One consequence of Lemma 5 is that the poor type of Subject plays a pure strategy after any demand the Crown might make in the first period regardless of whether it occurs on or off the equilibrium path. The rich type can limit or altogether eliminate the Crown's ability to infer anything from her behavior by mimicking that strategy — revolting whenever the poor type does or accepting demands that the poor type does. (The Crown will still update its beliefs when both types revolt because the probability of survival depends on wealth.) The rich could also reveal her type (separate) by doing the opposite of what the poor type does or she could obfuscate the Crown's inferences by mimicking the poor type's strategy probabilistically (semi-separate).

We begin by showing that some demands must induce the rich type to behave exactly like the poor type irrespective of the Crown's subsequent actions:

LEMMA 6. *The Subject accepts any $x \leq x_d(y_L)$ and rejects any $x > x_d(y_H)$ in any equilibrium regardless of her type.* \square

Since these strategies are independent of the Crown's behavior in the second period, they are also independent of its beliefs, which implies that any attempted manipulation of its beliefs can occur only after demands $x \in (x_d(y_L), x_d(y_H)]$. Unfortunately, since any demand the Crown makes out of equilibrium leaves these beliefs unspecified, it is very easy to construct all sorts of equilibria by allowing strange off-the-path beliefs. To eliminate these, we impose two consistency requirements on what the Crown's beliefs can be when it deviates from the equilibrium demand in the first period.

REQUIREMENT 2 (NO SELF-DELUSION). The Crown's second-period beliefs cannot be inconsistent with its own beliefs about the Subject's response in the first period and its actions must be sequentially rational even off the path of play.

To understand what this requirement is, consider what it rules out. Without it, we could have the following situation. The Crown makes an out of equilibrium demand x that it expects is going to cause the Subject to revolt if poor and accept if rich. It then observes a revolt (acceptance) but nevertheless concludes that the Subject is rich (poor). This sort of inconsistency should not be admissible by any reasonable specification of beliefs. The second part simply asks that the Crown continue to act optimally given its own beliefs. The next requirement is more demanding.

REQUIREMENT 3 (FULL CONSISTENCY). The the Subject's strategy is optimal given the Crown's responses even off the path of play.

Under Requirement 2, the Crown's updated beliefs must only be consistent with whatever expectations it has about the Subject's responses to its initial demand. Requirement 3 now ensures that these expectations are, in fact, consistent with what the Subject would want to do when she expects the Crown's subsequent beliefs and actions to satisfy Requirement 2. It is again easier to understand this requirement by considering what it rules out. Without it, we could have the following situation. Suppose that $q > q_R$ and the Crown demands $x \in (x_d(y_L), x_d(y_H))$ out of equilibrium and it expects both types to reject it. Recall that under Requirement 1, y_L must reject this demand and that $x_A(x) = x_H$ as well. At issue here is the behavior of y_H . Since the Crown expects both types to revolt, Requirement 2 simply ensures that its posterior belief is consistent with that expectation: $\hat{q} = q_R$ after a revolt. Since $q > q_R$, Requirement 2 further requires that the Crown ratchet its demand: $x_R(x) = x_H$. Thus, under Requirements 1 and 2, the Subject must expect $x_A(x) = x_R(x) = x_H$. But then y_H 's strategy cannot be optimal because we know that she strictly prefers to accept any $x < x_d(y_H)$ in that case. Requirement 3 ensures she does so here, and implies that y_H must accept x . This in turn implies that the Crown's expectation cannot be correct, so it cannot maintain it even off the path of play. These refinements essentially require that both the Subject and the Crown react to out of equilibrium demands as if they could still update their beliefs by Bayes rule even though the latter is undefined.²⁶

Observe now that since both types accept any $x \leq x_d(y_L)$ (by Lemma 6), Requirement 2 pins down

$$x_A(x) = \begin{cases} x_L & \text{if } q \leq q_A \\ x_H & \text{otherwise} \end{cases} \quad \forall x \leq x_d(y_L). \quad (4)$$

Analogously, since both types reject any $x > x_d(y_H)$, we obtain:

$$x_R(x) = \begin{cases} x_L & \text{if } q \leq q_R \\ x_H & \text{otherwise} \end{cases} \quad \forall x > x_d(y_H). \quad (5)$$

Observe further that $q_R < q_A$ implies that if $x_A(x) = x_H$ for $x \leq x_d(y_L)$, then $x_R(x) = x_H$ for $x > x_d(y_H)$; and that if $x_R(x) = x_L$ for $x > x_d(y_H)$, then $x_A(x) = x_L$ for $x \leq x_d(y_L)$. These results simplify a bit the analysis of possible deviations.

Consider now a separating strategy. In principle, the rich type could accept a demand that causes the poor type to revolt or revolt after a demand that the poor type accepts. We now show that the latter cannot occur in equilibrium.

LEMMA 7. *If y_H rejects x_1 with positive probability, then y_L must reject it with certainty in any equilibrium.* \square

Thus, whenever y_L accepts the equilibrium demand, it must be the case that y_H accepts it as well because this is merely the contrapositive of the claim in the lemma. The only possibility for separation must involve the rich type accepting a tax demand that causes the poor type to revolt. Suppose that x_1 is a separating demand, so that observing a revolt must lead the Crown to conclude that the Subject is poor: $x_R(x_1) = x_L$; whereas observing acceptance must lead it to conclude that she is rich: $x_A(x_1) = x_H$. If y_H accepts x_1 , her

²⁶We conjecture these requirements essentially ensure that the equilibrium is sequential.

payoff is $U(x_1; y_H) + U(x_H; y_H) = U(x_1; y_H) + R(y_H)$, and if she rejects it, her payoff is $R(y_H) + p_H U(x_L; y_H)$. Therefore, she strictly prefers to accept when $U(x_1; y_H) > p_H U(x_L; y_H)$, and strictly prefers to revolt if the inequality is reversed. Let x_w be the larger root of²⁷

$$U(x_w; y_H) = p_H U(x_L; y_H). \quad (6)$$

As one might expect, since the poor type must be willing to revolt when the Crown demands x_w , it is the case that this demand exceeds $x_d(y_L)$. We now show that the separating tax must be intermediate:

LEMMA 8. *The tax demands are ordered as follows: $x_L < x_d(y_L) < x_w < x_d(y_H)$. Moreover, if y_L is sufficiently smaller than y_H , then $x_w < x_H$ as well.* \square

This shows that if the Crown is to get the rich the Subject to agree to a tax that exceeds the tax that the poor Subject is willing to pay, it cannot hope to get that tax as high as it would have been able to under complete information. The fact that the tax is separating implies ratcheting after acceptance and relief after rebellion, so the Crown must provide an incentive for the rich Subject not to revolt. Since it cannot commit not to offer relief after the revolt and because the rich Subject is more likely to survive that revolt, the only inducement the Crown can offer is in the form of a considerably lower tax in the first period.

Since we are particularly interested in y_H behavior after a demand $x \in (x_d(y_L), x_d(y_H)]$, the fact that the separating tax is in this set suggests that we should split this set into two subsets.

Consider first some $x \in (x_d(y_L), x_w)$. By Requirement 1, y_L rejects such demands and $x_A(x) = x_H$. The best y_H could expect after a revolt is tax relief with x_L . Requirement 3 then implies that she would accept any x such that $U(x; y_H) > p_H U(x_L; y_H) = U(x_w; y_H)$. Since $x < x_w$ satisfies this inequality, it follows that y_H must accept x . Since this makes this demand separating, it follows that $x_R(x) = x_L$ as well. Thus,

$$x_A(x) = x_H, x_R(x) = x_L \quad \forall x \in (x_d(y_L), x_w). \quad (7)$$

Since these demands induce the Subject to separate through its optimal behavior, the Crown's second-period demands are independent of its priors.

Consider now some $x \in (x_w, x_d(y_H))$. By Requirement 1, y_L rejects such demands and $x_A(x) = x_H$. What is the Crown's post-rebellion tax demand? It cannot be $x_R(x) = x_H$ because if it were to set this tax, y_H would be facing the same situation as she does under complete information, in which case we know she strictly prefers to accept any $x < x_d(y_H)$. But then x would be separating and Requirements Requirement 2 and 3 would pin down $x_R(x) = x_L$, a contradiction.

Suppose now that the Crown were to demand $x_R(x) = x_L$. Since $x_A(x) = x_H$, it follows that y_H would reject x whenever $U(x; y_H) < p_H U(x_L; y_H) = U(x_w; y_H)$, and since $x > x_w$, this inequality is satisfied. With both types revolting, the Crown's posterior belief is q_R , and we know that it would only be willing to offer relief if $q \leq q_R$. Thus, tax relief can be optimal but only if the Crown's prior is sufficiently low.

²⁷The subscript 'w' stands for "wait for a better deal". (6) either has one solution that is greater than $x_e(y_H)$ or two, with one on each side of $x_e(y_H)$. We are always interested in the solution that exceeds the unconstrained optimum $x_e(y_H)$ because anything less than it requires no coercion by the Crown.

The remaining possibility is for the Crown to mix. Suppose it offers $x_R(x) = x_H$ with probability $h(x)$ and offers $x_R(x) = x_L$ with probability $1 - h(x)$. Since the Crown only does this when indifferent, it must be that its post-revolt belief is precisely q_A , which implies that y_H must be mixing as well:

$$r(x) = \frac{(1-q)q_A p_L}{q(1-q_A)p_H} = \left(\frac{1-q}{q}\right)\zeta \equiv r^*, \quad (8)$$

where

$$\zeta = \left(\frac{p_L}{p_H}\right) \left[\frac{V(x_L) - W(y_L)}{V(x_H) - V(x_L)} \right] > 0. \quad (9)$$

Clearly, r^* is only a valid probability if $q > q_R$. We denote the mixing probability simply by r^* to emphasize the fact that it does not depend on the initial offer. Since y_H is willing to mix, it must be the she is also indifferent between accepting the Crown's initial demand and revolting:

$$U(x; y_H) + U(x_H; y_H) = R(y_H) + p_H[h(x)U(x_H; y_H) + (1-h(x))U(x_L; y_H)],$$

which yields:

$$h(x) = \frac{U(x_w; y_H) - U(x; y_H)}{U(x_w; y_H) - U(x_d(y_H); y_H)}. \quad (10)$$

This is a valid probability for any $x \in (x_w, x_d(y_H))$, as required. We conclude that

$$x_A(x) = x_H, \Pr(x_R(x) = x_H) = \begin{cases} 0 & \text{if } q \leq q_R \\ h(x) & \text{otherwise} \end{cases} \quad \forall x \in (x_w, x_d(y_H)). \quad (11)$$

It is worth noting that the rich type's semi-separating strategy is independent of the Crown's initial tax demand. This might seem puzzling at first: why does she revolt with the same probability after different demands? After all, accepting a higher tax is making her worse off. The reason, then, must be that rebelling must also be getting worse as the initial demand increases. This is indeed so because the probability that the Crown offers tax relief after a revolt is decreasing in its initial demand. (That $h(x)$ is increasing follows from the fact that $U(x; y_H)$ is decreasing in x for $x > x_w$.) The rate at which the Crown is making rebellion less attractive is precisely calibrated to ensure that the rich Subject remains indifferent and is thus willing to play the semi-separating strategy that rationalizes the Crown's behavior.

Observe finally that $h(x_w) = 0$ and $h(x_d(y_H)) = 1$; that is, the probability of tax relief goes to zero as demands approach $x_d(y_H)$. As we shall see, this implies that in equilibrium the rich type would still revolt with positive probability after $x_d(y_H)$ even though the Crown will be offering no tax relief after such a demand (recall that she would not do so under complete information).

Figure 2 illustrates the optimal strategies that are consistent with the three requirements we have imposed.

4.4 The Initial Tax Demand of the Crown

Having established what the Subject's behavior must be in any equilibrium that satisfies our requirements on off-the-path beliefs and behavior, we now turn to the Crown's choice

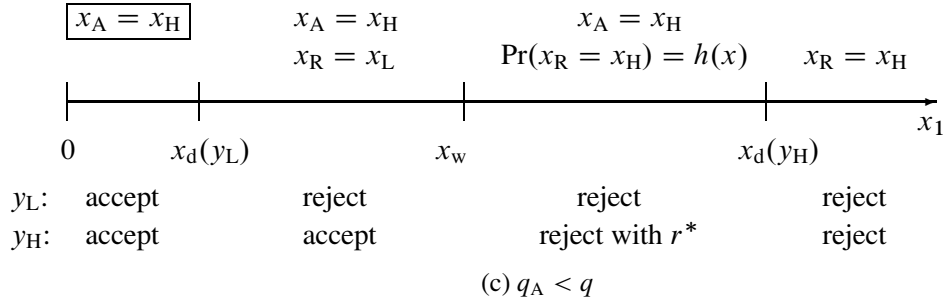
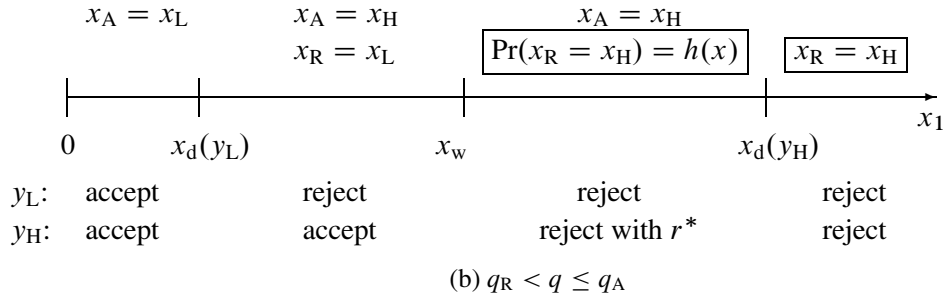
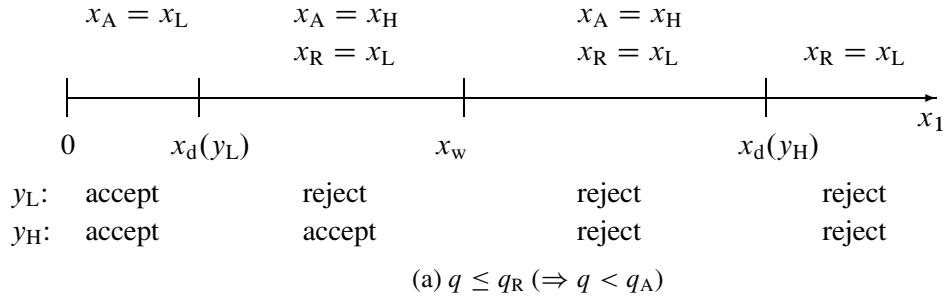


Figure 2: The Strategies that satisfy Requirements 1, 2, and 3. (Boxes highlight changes.)

of first-period tax demand, x_1 . We begin by showing that the Crown will never demand x_1 that the Subject is sure to reject in equilibrium. The intuition here is similar to the analogous result for the second period: the Crown is always strictly better off making a demand that has at least some positive probability of being accepted. Since the rich type can accept some demands that the poor type rejects, this means that certain rejection should always be dominated by some demand that the rich type accepts with positive probability. The following lemma establishes that this is indeed the case.

To simplify notation we shall denote the fact that the Crown strictly prefers some demand x to another demand x' by writing $x \succ x'$. Also let x_u denote an unacceptable first-period demand that provokes certain rebellion. Thus, $x \succ x_u$ means that the Crown strictly prefers to demand x than to cause the Subject to revolt with certainty.

LEMMA 9. *In any equilibrium, $x_w \succ x_u$ when $q \leq q_R$, and $x_d(y_H) \succ x_u$ otherwise.* □

Since y_L does not mix in equilibrium (Lemma 5) and the Subject cannot pool on the certain rejection of the first-period demand (Lemma 9), the equilibrium can only take the following forms: (i) pooling: both accept x_1 , (ii) separating: y_L rejects and y_H accepts, or (iii) semi-separating: y_L rejects and y_H mixes. We now further simplify our task by establishing that we only should concern ourselves with at most three particular demands, both as candidates for equilibrium and when considering possible deviations.

LEMMA 10. *On and off the path of play, the following obtain:*

- for any $x < x_d(y_L)$, $x_d(y_L) > x$ whenever y_L is certain to accept $x_d(y_L)$;
- for any $x \in (x_d(y_L), x_w)$, $x_w > x$ whenever y_H is certain to accept x_w ;
- if $q > q_R$, then for any $x \in (x_w, x_d(y_H))$, $x_d(y_H) > x$ whenever y_H accepts $x_d(y_H)$ with probability $1 - r^*$. □

To understand what this lemma gives us, note that since either $x_w > x_u$ or $x_d(y_H) > x_u$, we know that the equilibrium demand must be one of the three identified in Lemma 10. More importantly, this lemma also allows us to restrict attention to these three demands when we consider deviations from the equilibrium first-period demand. Since it establishes strict dominance under our requirements for off-the-path beliefs, if deviating to one of them is not profitable, then it certainly will not be profitable to deviate to any of the strictly dominated demands as well.

We now turn to identifying when one of these demands is preferable to the other(s). The Crown's expected payoff from $x_d(y_L)$, which both types accept, depends on whether its second-period demand is x_L , and so also accepted for sure, or x_H , and so only accepted by the rich type. Since the conditions on these demands are given by (4), its payoff from the pooling tax demand is:

$$V_1(x_d(y_L)) = \begin{cases} V(x_d(y_L)) + V(x_L) & \text{if } q \leq q_A \\ V(x_d(y_L)) + (1 - q)W(y_L) + qV(x_H) & \text{otherwise.} \end{cases} \quad (12)$$

Consider now the Crown's expected payoff from x_w . Since $x_w > x_d(y_L)$ implies that $x_A(x_w) = x_H$ by Requirement 1, and since y_H must accept x_w with certainty (from (7), (11), and the fact that $h(x_w) = 0$), which further implies that $x_R(x_w) = x_L$, its payoff from the separating tax demand is:

$$V_1(x_w) = (1 - q)[W(y_L) + G(y_L)] + q[V(x_w) + V(x_H)]. \quad (13)$$

Finally consider the Crown's expected payoff from $x_d(y_H)$. Since only y_H accepts this with positive probability, $x_A(x_d(y_H)) = x_H$. Moreover, by (11), y_H 's probability of revolt is r^* , and since $h(x_d(y_H)) = 1$, the Crown offers no tax relief, so $x_R(x_d(y_H)) = x_H$, which of course implies that y_L revolts in the second period as well. The expected payoff from this semi-separating tax demand is:

$$V_1(x_d(y_H)) = (1 - q)[W(y_L) + G(y_L)] + q[r^*(2W(y_H) + p_H V(x_L)) + (1 - r^*)(V(x_d(y_H)) + V(x_H))],$$

where we recall that $q > q_R$ is a necessary condition for this strategy to exist (if $q < q_R$, then this demand provokes certain revolt). A little algebra then establishes the following:

$$\begin{aligned} x_d(y_L) > x_w & \Leftrightarrow q < q_L \\ x_w > x_d(y_H) & \Leftrightarrow q < q_H \\ x_d(y_L) > x_d(y_H) & \Leftrightarrow q < q_M, \end{aligned}$$

where all cut-points are defined in the appendix and where the last two require that $q > q_R$. As it turns out, these definitions are sufficient to establish the form the equilibrium will take as a function of the Crown's prior beliefs about the Subject's wealth.

PROPOSITION 3. *The equilibrium that satisfies Requirements 1, 2, and 3 is unique:*

1. *If $q_L < q_H$, then the strategies are as follows:*

- *if $q \leq q_L$, the Crown demands $x_d(y_L)$, which the Subject always accepts; in the second period the Crown provides tax relief ($x_A = x_L$) if $q \leq q_A$, and demands a higher tax ($x_A = x_H$) otherwise; the rich Subject accepts both demands, but the poor Subject accepts only the tax relief;*
- *if $q \in (q_L, q_H)$, the Crown demands x_w , which the Subject accepts only if rich; in the second period the Crown provides tax relief after revolt ($x_R = x_L$) and ratchets the tax after acceptance ($x_A = x_H$); both these taxes are accepted;*
- *if $q \geq q_H$, the Crown demands $x_d(y_H)$, which the Subject accepts with probability $1 - r^*$ only if rich; in the second period the Crown demands the same tax regardless of the outcome: $x_A = x_R = x_H$; only the rich Subject accepts these taxes.*

2. *Otherwise, the strategies are as follows:*

- *if $q \leq q_M$, the Crown demands $x_d(y_L)$, which the Subject always accepts; in the second period the Crown provides tax relief ($x_A = x_L$) if $q \leq q_A$, and demands a higher tax ($x_A = x_H$) otherwise; the rich Subject accepts both demands, but the poor Subject accepts only the tax relief;*
- *if $q > q_M$, the Crown demands $x_d(y_H)$, which the Subject accepts with probability $1 - r^*$ only if rich; in the second period the Crown demands the same tax regardless of the outcome: $x_A = x_R = x_H$; only the rich Subject accepts these taxes. \square*

5 Discussion

Our model conceives of revolts as a (primitive but effective) form of communication in a political environment where signaling that the burden of taxation is unacceptable is otherwise very difficult because there exist no useful channels through which such signals can be sent (e.g., limited, if any, representation), because the use of such channels is prohibitively costly (e.g., submitting petitions to the sovereign), or because the signal is too easily manipulable to be meaningful. The view of revolts as communication whose goal is to alter

undesirable (in this case, tax) policy is consistent with the empirical record, which shows fairly unambiguously that revolts almost never aim at overturning the social order or even removing the ruler and that they are almost always suppressed. One is then left to wonder what the point of these revolts was. Our model reveals one such role:

RESULT 2 Even when a revolt has no chance of overthrowing the Crown or impose any limit on subsequent policy, it can nevertheless occur because it can induce the Crown — through the information it reveals — to change policy in its wake. Moreover, the fact that a revolt can potentially occur influences the Crown’s present policy as well.

In other words, revolts can succeed in the sense of causing the Crown to alter its policies because they can signal to the Crown that its attempted policies are so unacceptable that the subjects are willing to revolt despite the severe handicap they face. The Crown then has an incentive to react to this new information by adjusting its policies even when it suppresses the revolt itself. This possibility of influencing future policy provides an incentive for the revolt, and because this incentive exists, the Crown will take it into account even in its current policy. By explaining how this communication, policy revision, and choice of current policy happen the model can rationalize the otherwise puzzlingly large number of revolts.

The model also reveals that the vast majority of revolts would tend to originate in the poorer strata of society, which will only occasionally be joined by the wealthier elites. When the equilibrium is separating, it is only the poor that revolt (and only in the first period), and when it is semi-separating, the poor revolt in both periods while the rich sometimes revolt but only in the first period. Inducing the wealthy to acquiesce to the demanded tax boils down to providing them with privileges in the sense that the tax is much lower than what it would have been had the Crown been certain of their wealth ($x_w < x_d(y_L)$), and even the weaker incentive that sometimes provokes them into rebellion is accompanied by a tax reduction in the next period ($x_H < x_d(y_H)$). Whenever these elites expect the Crown to ratchet its future tax demand, the present tax must offer them sufficient compensation for not joining the poor in a revolt and obtaining the tax relief they expect. In other words, the model can explain the following patterns:

RESULT 3 Most tax revolts will involve the poorer segments of society, and only rarely the wealthier ones. Moreover, when the wealthy accept a given level of taxation, it will often be outright privilege (proportionally much lower than what the poor pay) or be accompanied with the (credible) expectation of a reduction in the future. A post-acceptance ratchet for the wealthy is possible but it requires a larger present compensation.

These privileges for the wealthy that the Crown has to offer because of uncertainty over the taxable wealth depress its ability to extract wealth from society more generally. To see this, consider two sets of comparisons. If the Crown knows that Subject’s wealth is y_L , then it will peacefully obtain $x_d(y_L)$ in the first period and x_L in the second. Compare this to the situation under complete information when the true wealth is y_L :

- if $q \leq q_L$, the Crown’s demands are the same as in the complete information case (same payoff);
- if $q \in (q_L, q_H)$, the Crown’s demand induces a revolt in the first period, and is the same in the second (worse payoff);

- if $q \geq q_H$, the Crown's demands induce revolts in both periods (worst payoff).

If the Crown knows that Subject's wealth is y_H , then it will peacefully obtain $x_d(y_H)$ in the first period and x_H in the second. Compare this to the situation under incomplete information when the true wealth is y_H :

- if $q \geq q_H$, the Crown's demands are the same as in the complete information case, but the first-period demand induces a revolt with positive probability (worse payoff);
- if $q \in (q_L, q_H)$, the Crown's demand is lower in the first period, and the same in the second (even worse payoff);
- if $q \leq q_L$, the Crown's demands are much lower in both periods (worst payoff).

In this way, asymmetric information about wealth proves to be a significant obstacle to the Crown in its quest for money.

RESULT 4 Even when the Crown enjoys agenda-setting and coercive advantages, its ability to extract wealth from society is seriously hindered by its lack of information about the wealth it is trying to tax. The Crown is forced into taxation that is either low (but peaceful), moderate (but riddled with exemptions for the wealthy and still provoking the poor into resistance), or high but risky (because it not only causes the poor to revolt but also sometimes provokes the wealthy as well).

One might be tempted to think that the most relevant problem of the Crown's relative lack of constraint would manifest itself through the ratchet effect: the rich do not want to reveal their wealth by accepting a high tax demand because doing so would cause the Crown to saddle them with even more burdensome taxes; and as a result they sometimes revolt, which in turn causes the Crown to lower its demands. For this logic to work, however, there must be some benefit of rebelling — after all, it is a fairly risky activity. This benefit must come in the form of possible tax relief that would not have occurred without the violence. But this suggests that the Crown does have a strategy that would severely reduce the incentives to revolt: it has to threaten to keep the taxes high when it fails to expropriate the rebels. Ironically, this is when the Crown's lack of constraint acquires a bite for the Crown cannot commit not to provide tax relief when it concludes that its subjects are likely poorer than it initially thought.

RESULT 5 The seemingly benign aspect of the Crown's behavior — reducing taxes when informed by revolt that its subjects are being taxed beyond their endurance — that is furnishing the incentive to the rich to conceal their wealth by hiding behind the same grievance and in the end leads to under-taxation.

Since the rich are more likely to survive the rebellion, the Crown can infer that rebels it has failed to defeat are also more likely to be wealthy, which does impart credibility to its threat to keep post-rebellion taxes high. This, however, comes at a very high price: if the Crown is wrong and its subjects are in fact poor, this strategy produces endemic strife; if the Crown is right, then this strategy induces the rich to rebel with positive probability as well. Thus, the Crown would only pursue such a strategy if it is sufficiently convinced that these risks are low — in all other circumstances it opts for safer and (much) lower taxes.

It is interesting to inquire whether the ratchet effect shows up at all. It certainly does not when the equilibrium is pooling or semi-separating because in both instances the Crown actually provides tax relief upon acceptance ($x_L < x_d(y_L)$ and $x_H < x_d(y_H)$, respectively). The second-period demand can only exceed the first-period demand when the equilibrium is separating, and then only when the difference between the wealth of the rich and the poor types is substantial ($x_H > x_w$ per Lemma 8). Thus, while the ratchet is indeed possible, it never causes the rich to revolt in order to hide the information and prevent it. Instead, it causes the Crown to offer a first-period tax that the rich are willing to accept. One anecdote consistent with this comes from 1772, when the *vintièmes* for the district of Tours was increased by 100,000 *livres*, which prompted a complaint from the local administrator who wrote that “It is the facility with which the 250,000 *livres* were obtained by the last increase which has doubtless suggested that cruel step.”²⁸

As we have now seen, the difficulty of assessing the subjects’ wealth can lead to persistent under-taxation and to frequent tax revolts. It was not merely evasion that reduced the taxes but the strategic constraints of their extraction in the shadow of threats of violence. An important implication of this analysis is that as the ability to conceal taxable wealth decreases (e.g., due to increased state capacity to inquire into the wealth of the subjects or the development of actuarial techniques to estimate it more reliably), the problems caused by asymmetric information should also decrease.

Consider what happens if the true wealth is y_L and the Crown’s information improves (q decreases). The incidence of revolts will decrease (from occurring in both periods, to occurring only in the first period, to not occurring at all), and the successful first-period tax will become $x_d(y_L)$. This is the highest tax that the Crown can extract, and it will do so without risking rebellion.

Consider now what happens if the true wealth is y_H and the Crown’s information improves (q increases). The first-period tax will increase to the highest possible level $x_d(y_H) > x_w > x_d(y_L)$ while the probability that it provokes resistance will decrease significantly (in the limit, as $q \rightarrow 1$, the probability of a revolt goes to 0).

Thus, as its information improves, the Crown simultaneously extracts taxes closer to the maximum possible and runs lower chances of resistance. This improvement in the Crown’s finances is neither due to an increase in its coercive powers (as much of the state-formation literature would have it) nor to it providing better inducements in the form of more service or public goods provision (as much of the literature on voluntary taxation would have it).²⁹

RESULT 6 *As the Crown’s administrative capacity grows, taxes would tend to increase while at the same time the incidence and severity of tax revolts would tend to decrease. This effect will occur even if the state does not develop more extensive coercive powers and even if it does not offer more goods and services to its citizens.*

relate to:

- crisis bargaining (higher types get better deals) - ratchet in planned economies
- temporary taxes can become permanent as willingness to pay revealed

²⁸Alexis de Tocqueville, *The Old Regime and the French Revolution*, note 70, p. 287.

²⁹CITES

lit review: - hart & tirole rental model, etc. (see slides) - fearon

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A Proofs

Proof (Lemma 1). Take some $y_L < y_H$ and let $x_L = x_k(y_L) > 0$ and $x_H = x_k(y_H) > 0$. We need to show that $x_L < x_H$.

Observe that $c(y) = U(0; y) - R(y)$ and recall that under our assumption about p , it is strictly increasing, so $c(y_L) < c(y_H)$. Define $\hat{U}(x; y) = U(x; y) - c(y)$ and note that it inherits the concavity in x and the supermodularity of $U(x; y)$. By supermodularity, we have:

$$\hat{U}(x_L; y_H) - \hat{U}(x_L; y_L) > \hat{U}(0; y_H) - \hat{U}(0; y_L).$$

By definition, $\hat{U}(0; y_H) = R(y_H)$, $\hat{U}(0; y_L) = R(y_L)$, and $\hat{U}(x_L; y_L) = U(x_L; y_L) - c(y_L)$. Moreover, since x_L is such that $U(x_L; y_L) = R(y_L)$, we can write $\hat{U}(x_L; y_L) = R(y_L) - c(y_L)$. Using these identities, we can write the inequality above as:

$$\hat{U}(x_L; y_H) - R(y_L) + c(y_L) > R(y_H) - R(y_L),$$

which simplifies to

$$\hat{U}(x_L; y_H) + c(y_L) > R(y_H).$$

But now we obtain:

$$U(x_L; y_H) = \hat{U}(x_L; y_H) + c(y_H) > \hat{U}(x_L; y_H) + c(y_L) > R(y_H),$$

where the first inequality follows from $c(y)$ increasing. But since $U(0; y_H) > R(y_H)$, the definition of x_H tells us that $U(x; y_H) > R(y_H)$ for all $x < x_H$ while $U(x; y_H) < R(y_H)$ for all $x > x_H$. This means the our finding of $U(x_L; y_H) > R(y_H)$ implies that $x_L < x_H$. ■

Proof (Proposition 1). We first show that with complete information rebellion never occurs. This in turn implies that the Crown's optimal demand must be $x_k(y)$.

Consider the demand $x = c(y)$, and observe that the Crown does not prefer to provoke a rebellion by making an unacceptable demand:

$$\begin{aligned} V(c(y)) &= V(p(y)(0) + (1 - p(y))y) \\ &\geq p(y)V(0) + (1 - p(y))V(y) = W(y), \end{aligned}$$

where the inequality follows from the concavity of V and $V(0) = 0$. Moreover, Subject also does not prefer to rebel given that tax demand:

$$\begin{aligned} U(c(y); y) &= U(p(y)(0) + (1 - p(y))y; y) \\ &> p(y)U(0; y) + (1 - p(y))U(y; y) = R(y), \end{aligned}$$

where the inequality follows from the strict concavity of U in x and $U(y; y) = 0$. We conclude that $c(y)$ is a mutually acceptable demand. Since we know that $x_k(y)$ is also acceptable but makes Subject indifferent between rebelling and paying while paying $c(y)$ is strictly preferable to rebelling, it follows that $x_k(y) > c(y)$. Since the Crown's payoff is increasing in the tax demanded, it follows that he must demand $x_k(y)$ in equilibrium. Since $x_k(y)$ is strictly increasing by Lemma 1, the equilibrium is unique. ■

Proof (Claim 1). Since $x_k(y) > c(y)$, we obtain $V(x_k(y)) > V(c(y)) \geq W(y)$, where the first inequality follows from V strictly increasing and the second inequality was established in the proof of Proposition 1. ■

Proof (Lemma 2). By concavity, we know that $G(y) = (1-p(y))V(y) + p(y)V(x_k(y)) \leq V((1-p(y))y + p(y)x_k(y))$, and since V is increasing it will be sufficient to show that $x_d(y) > (1-p(y))y + p(y)x_k(y)$. Since U is decreasing in x in this region, this is equivalent to showing that $U(x_d(y); y) < U((1-p(y))y + p(y)x_k(y); y)$. But now the strict concavity of U implies that

$$\begin{aligned} U((1-p(y))y + p(y)x_k(y); y) &> (1-p(y))U(y; y) + p(y)U(x_k(y); y) \\ &= p(y)U(x_k(y); y) = p(y)R(y) = U(x_d(y); y). \end{aligned}$$

where the first equality follows from $U(y; y) = 0$, and the rest from the definitions of $x_k(y)$ and $x_d(y)$. ■

Proof (Proposition 2). In the second period Subject accepts only $x \leq x_k(y)$, and since by Corollary 1 the Crown is always strictly better off taxing at the violence-constrained maximum than inducing rebellion, the strategies in the second period are optimal. The definition of $x_d(y)$ is such that it is the highest tax Subject would accept in the first period when expecting $x_k(y)$ in the second, so it is also the optimal peaceful demand for the Crown. The payoff from making this demand is

$$V_1(x_d(y)) = V(x_d(y)) + V(x_k(y)).$$

The only remaining possibility is that the Crown makes an unacceptable first-period demand and so induces a rebellion in that period. Consider some $x > x_d(y)$ that Subject rejects, so the Crown's payoff would be:

$$V_1(x) = W(y) + [(1-p(y))V(y) + p(y)V(x_k(y))] = W(y) + G(y).$$

Observe now that $V_1(x) < V_1(x_d)$ obtains because $V(x_k(y)) > W(y)$ by Corollary 1 and $V(x_d(y)) > G(y)$ by Lemma 2. We conclude that the Crown cannot prefer to induce rebellion in the first period, which implies that the unique peaceful equilibrium is also the unique equilibrium. ■

Proof (Lemma 3). Since $U(x_k(y); y) = R(y) > p(y)R(y) = U(x_d(y); y)$ and $U(x; y)$ is decreasing at $x_k(y)$, the fact that $x_d(y)$ is unique implies that $x_k(y) < x_d(y)$. Define

$$\hat{c}(y) = U(0; y) - p(y)R(y) = (1-p^2(y))y = (1+p(y))c(y),$$

and observe that since $c(y)$ and $p(y)$ are both increasing in y , so is $\hat{c}(y)$. Define now $\hat{U}(x; y) = U(x; y) - \hat{c}(y)$. The rest of the proof replicates the proof of Lemma 1. ■

Proof (Lemma 4). If y_L accepts x_1 , her payoff is $U(x_1; y_L) + R(y_L)$, and if she rejects it her payoff is $R(y_L) + p_L R(y_L)$. Accepting is strictly better than rejecting when $U(x_1; y_L) > p_L R(y_L) \Leftrightarrow x_1 < x_d(y_L)$. The claims follow immediately. ■

Proof (Lemma 5). We begin by considering the responses on the path of play. Let $\alpha_H(x)$ and $\rho_H(x)$ be the updated beliefs that Subject is rich after acceptance and rejection of some first-period demand x . Observe that y_L will only be willing to mix in equilibrium if $x_1 = x_d(y_L)$. In this case, y_H must strictly prefer to accept for the following reasons. The *best* y_H can expect from rebellion is $x_R(x_d(y_L)) = x_L$ and the *worst* she can expect from acceptance is $x_A(x_d(y_L)) = x_H$. But then her acceptance payoff is *at least* $U(x_d(y_L); y_H) + U(x_H; y_H) = U(x_d(y_L); y_H) + R(y_H)$, whereas her rejection payoff is *at most* $R(y_H) + p_H U(x_L; y_H)$. She strictly prefers to accept as long as $U(x_d(y_L); y_H) > p_H U(x_L; y_H)$, which is shown to hold in Lemma 8. Bayes rule then pins down $\rho_H(x_1) = 0$, which implies $x_R(x_1) = x_L$. Let r denote the probability with which y_L rejects x_1 . Recalling that the Crown expropriates the loser of a rebellion, if the Crown happens to face y and she rejects his demand his payoff would be

$$\begin{aligned}\hat{W}(y) &= (1 - p(y))[V(y) + V(y)] + p(y)[V(0) + E[V(x_R); y]] \\ &= 2W(y) + p(y) E[V(x_R); y],\end{aligned}$$

where we slightly abuse notation with $E[V(x_R); y]$ to denote the Crown's expected payoff from demanding x_R from type y in the second period. Since $x_R(x_1) = x_L$, which both types would accept, we obtain $E[V(x_R); y] = V(x_L)$, so in this case

$$\hat{W}(y_L) = W(y_L) + G(y_L).$$

The Crown's payoff from demanding x_1 then is

$$(1 - q)[r\hat{W}(y_L) + (1 - r)(V(x_1) + E[V(x_A); y_L])] + q[V(x_1) + V(x_A)],$$

where we made use of the fact that $x_A \leq x_H$ means that y_H will always accept the second-period demand, so $E[V(x_A); y_H] = V(x_A)$. Note now that Bayes rule also tells us that

$$\alpha_H(x_1) = \frac{q}{q + (1 - r)(1 - q)} > q.$$

CASE I: Suppose first that $q \geq q_A$, which implies that $\alpha_H(x_1) > q_A$, so that $x_A(x_1) = x_H$. Since y_L rejects this, $E[V(x_A); y_L] = W(y_L)$, so the Crown's equilibrium payoff is

$$qV(x_1) + qV(x_H) + (1 - q)W(y_L) + (1 - q)[rG(y_L) + (1 - r)V(x_1)]. \quad (14)$$

Consider a deviation to some $x < x_1$. Since both types accept this, $\alpha_H(x) = q$, so the fact that $q \geq q_A$ implies that $x_A(x) = x_H$, which only y_H accepts. The Crown's payoff from such a deviation is then

$$V(x) + qV(x_H) + (1 - q)W(y_L).$$

Since deviation must not be profitable, it follows that for all $x < x_d(y_L)$ it must be the case that

$$V(x) \leq qV(x_1) + (1 - q)[rG(y_L) + (1 - r)V(x_1)].$$

By Lemma 2, $G(y_L) < V(x_1)$, which implies that the right-hand side is strictly less than $V(x_1)$. Thus, taking x close enough to x_1 would violate this inequality. Intuitively, since

$G(y_L) < V(x_1)$ means that the Crown does not gain from provoking y_L to rebel, the profitable deviation is to some x slightly smaller than x_1 that she would accept for sure. Thus, when $q \geq q_A$ there exists a profitable deviation for the Crown, contradicting the equilibrium supposition.

CASE II: Suppose now that $q < q_A$, in which case we have two possibilities to consider. Assume first that $\alpha_H(x_1) \in (q, q_A]$ so that $x_A(x_1) = x_L$, which both types accept, so $E[V(x_A); y_L] = V(x_L)$. The Crown's equilibrium payoff can then be written as

$$(1 - q)[r(G(y_L) + W(y_L)) + (1 - r)(V(x_1) + V(x_L))] + q[V(x_1) + V(x_L)]$$

By Corollary 1 and Lemma 2, $G(y_L) + W(y_L) < V(x_1) + V(x_L)$ so the equilibrium payoff is *strictly less* than

$$(1 - q)[V(x_1) + V(x_L)] + q[V(x_1) + V(x_L)] = V(x_1) + V(x_L),$$

and consider a deviation to some $x < x_1$. Since both types accept this, $\alpha_H(x) = q$, so the fact that $q < q_A$ implies that $x_A(x) = x_L$, which both accept. The Crown's payoff from x is then

$$V(x) + V(x_L).$$

Clearly, by taking x sufficiently close to x_1 , the deviation payoff can be made arbitrarily close to $V(x_1) + V(x_L)$, which we know is strictly greater than the equilibrium payoff. Thus, a profitable deviation exists.

Assume now that $\alpha_H(x_1) > q_A$, so that $x_A(x_1) = x_H$, which y_L rejects, so $E[V(x_A); y_L] = W(y_L)$. The Crown's equilibrium payoff is then given by (14). Consider a deviation to some $x < x_1$. Since both types accept this, $\alpha_H(x) = q$, so the fact that $q < q_A$ implies that $x_A(x) = x_L$, which both types accept. The Crown's payoff from such a deviation is then

$$V(x) + V(x_L) > V(x) + qV(x_H) + (1 - q)W(y_L),$$

where the inequality follows from $q < q_A$, which implies that $V(x_L) > qV(x_H) + (1 - q)W(y_L)$. But we already know that for x close enough to x_1 makes $V(x) + qV(x_H) + (1 - q)W(y_L)$ strictly better than the equilibrium payoff, which means that a profitable deviation exists in this case too.

This exhausts all the possibilities, and we conclude that y_L cannot be mixing in equilibrium when $x_1 = x_d(y_L)$. The only possibility, then, is that she mixes when the $x_d(y_L)$ demand occurs off the path of play. We have seen that when the Crown does not want to provoke y_L into rebelling, he can profitably deviate to some $x < x_d(y_L)$ that is sufficiently close to $x_d(y_L)$ in order to get y_L to accept for sure. But then the strategy of her accepting $x_d(y_L)$ with certainty would yield the highest possible payoff for this type a deviation, so there is no loss of generality in considering this strategy instead of mixing. If, on the other hand, the Crown does profit from provoking y_L , then whether y_L mixes at $x_d(y_L)$ is immaterial since any deviation to $x > x_d(y_L)$ that causes y_L to reject it for sure (while y_H still accepts) yields a higher deviation payoff. Thus, there is no loss of generality in assuming that y_L accepts $x_d(y_L)$ both on and off the path of play with certainty. ■

Proof (Lemma 6). Consider first some demand $x \leq x_d(y_L)$. By Requirement 1 and Lemma 5, the poor type accepts this with certainty, so $x_R(x) = x_H$. The worst that the rich type can expect after accepting is $x_A(x) = x_H$ as well. From the complete information case, however, we know that when the second-period demand is unconditionally x_H , the rich type would strictly prefer to accept any $x < x_d(y_H)$. By Lemma 8, she must strictly prefer to accept $x \leq x_d(y_L)$. Since any other demand the Crown could be making after acceptance is bound to be no worse than x_H , this means that y_H must strictly prefer to accept such demands irrespective to the Crown's beliefs.

Consider now some demand $x > x_d(y_H)$. By Requirement 1 and Lemma 5, the poor type rejects this with certainty, so $x_A(x) = x_H$. The worst that the rich type could expect after revolting is $x_R(x) = x_H$ as well, in which case we know that she strictly prefers to revolt for any $x > x_d(y_H)$. Since any other demand the Crown could be making after a rebellion can be no worse than x_H , it follows that y_H must strictly prefer to reject such demands irrespective of the Crown's beliefs. ■

Proof (Lemma 7). We begin by establishing the first claim. Consider an equilibrium in which y_H rejects x_1 with positive probability. Since Lemma 5 tells us that y_L cannot be mixing, the only possibility that contradicts the claim is that y_L accepts x_1 with certainty. By Bayes rule, $\rho_H(x_1) = 1$, which implies that $x_R = x_H$. By Lemma 4, $x_1 \leq x_d(y_L)$. Consider now y_H . If she rejects x_1 , her payoff is $R(y_H) + p_H U(x_H; y_H) = R(y_H) + p_H R(y_H)$. If she accepts, her payoff is $U(x_1; y_H) + U(x_A; y_H) \geq U(x_1; y_H) + U(x_H; y_H) = U(x_1; y_H) + R(y_H)$, where the inequality follows from $x_A \leq x_H$. Since she rejects x_1 , it must be the case that $p_H R(y_H) \geq U(x_1; y_H)$, which implies that $x_1 \geq x_d(y_H)$, a contradiction because $x_d(y)$ is increasing (Lemma 3). ■

Proof (Lemma 8). First, $x_L < x_d(y_L)$ is just $x_k(y) < x_d(y)$, which we established in Lemma 3. We now show that $x_d(y_L) < x_w$. We show first that $U(x_d(y_L); y_H) > p_H U(x_L; y_H) = U(x_w; y_H)$. Since $x_d(y_L) > x_L$, supermodularity yields

$$U(x_d(y_L); y_H) - U(x_L; y_L) > U(x_L; y_H) - U(x_L; y_L),$$

and since $U(x_d(y_L); y_L) = p_L R(y_L)$ and $U(x_L; y_L) = R(y_L)$, we can write this inequality as

$$U(x_d(y_L); y_H) > U(x_L; y_H) - (1 - p_L)R(y_L).$$

Thus, it will be sufficient to show that

$$U(x_L; y_H) - (1 - p_L)R(y_L) > p_H U(x_L; y_H).$$

We can rewrite this as:

$$(1 - p_H)U(x_L; y_H) > (1 - p_L)R(y_L) = p_L c(y_L).$$

Since $p_H c(y_H) > p_L c(y_L)$, it will be sufficient to show that

$$(1 - p_H)U(x_L; y_H) > p_H c(y_H) = (1 - p_H)R(y_H),$$

which holds because $x_L < x_H$ implies that $U(x_L; y_H) > U(x_H; y_H) = R(y_H)$. Thus, $U(x_d(y_L); y_H) > U(x_w; y_H)$. Since $U(x; y_H)$ is decreasing for all $x \geq x_w$, this implies

that $x_d(y_L) < x_w$, as required. We finally need to show that $x_w < x_d(y_H)$. But since $x_L < x_H$ implies that $U(x_w; y_H) = p_H U(x_L; y_H) > p_H U(x_H; y_H) = U(x_d(y_H); y_H)$, the result follows.

Consider now the relationship between x_w and x_H :

$$\begin{aligned} U(x_w; y_H) &= p_H U(x_L; y_H) \geq p_H U(0; y_H) = U(x_H; y_H) \\ U(x_L; y_H) &\geq U(0; y_H). \end{aligned}$$

Recalling that $U(x; y)$ is concave in x and noting that

$$\begin{aligned} \lim_{y_L \rightarrow 0} U(x_L; y_H) &= U(0; y_H) \\ \lim_{y_L \rightarrow y_H} U(x_L; y_H) &= U(x_H; y_H) < U(0; y_H), \end{aligned}$$

we conclude that there exists $\tilde{y}_L \in (0, y_H)$ such that $U(x_k(\tilde{y}_L); y_H) = U(0; y_H)$ with the property that $U(x_k(y); y_H) > U(0; y_H)$ for all $y < \tilde{y}_L$ and $U(x_k(y); y_H) < U(0; y_H)$ for all $y > \tilde{y}_L$.³⁰ In other words, for y_L sufficiently smaller than y_H , the inequality $U(x_L; y_H) > U(0; y_H)$ obtains, which implies that $U(x_w; y_H) > U(x_H; y_H)$. Since $U(x; y_H)$ is strictly decreasing for any $x > x_H$, it follows that $x_w < x_H$ must be the case. ■

LEMMA 11. *The following inequalities obtain:*

$$x_L > (1 - p_L)y_L \qquad x_H > (1 - p_H)y_H \qquad (15)$$

$$x_d(y_L) \geq p_L x_L + (1 - p_L)y_L \qquad x_d(y_H) \geq p_H x_H + (1 - p_H)y_H \qquad (16)$$

$$x_w \geq p_H x_L + (1 - p_H)y_H \qquad (17)$$

□

Proof. Consider the inequalities in (15). By the definition of $x_k(y)$ and the concavity of U , we know that $U(x_k(y); y) = p(y)U(0; y) + (1 - p(y))U(y; y) \leq U(p(y)0 + (1 - p(y))y; y) = U((1 - p(y))y; y)$. But since $U(x; y) > U(x_k(y); y)$ only for all $x < x_k(y)$, the result follows. Consider (16). Again, from the definition of $x_d(y)$ and the concavity of U , we know that $U(x_d(y); y) = p(y)R(y) = p(y)U(x_k(y); y) + (1 - p(y))U(y; y) \leq U(p(y)x_k(y) + (1 - p(y))y; y)$. Since U is decreasing for $x > x_d(y) > x_k(y)$, this can only hold if $p(y)x_k(y) + (1 - p(y))y \leq x_d(y)$, as claimed. Consider (17). Since $U(x_w; y_H) = p_H U(x_L; y_H) + (1 - p_H)U(y_H; y_H) \leq U(p_H x_L + (1 - p_H)y_H; y_H)$ by concavity of U , but $U(x; y_H)$ is decreasing for all $x > x_w$, the result obtains. ■

Proof (Lemma 9). Suppose there is an equilibrium in which the Crown makes a demand that induces a certain rebellion; e.g., some $x_u > x_d(y_H)$.

Assume that $q \leq q_R$, in which case $x_R(x_u) = x_L$ by (5). The Crown's equilibrium payoff is

$$V_1(x_u) = (1 - q)[W(y_L) + G(y_L)] + q[2W(y_H) + p_H V(x_L)].$$

³⁰Using our functional form, we can easily find this analytically. Solving $U(x; y_H) = U(0; y_H) = y_H$ requires solving $y_H - x + \lambda\sqrt{x(y_H - x)} = y_H$, so $x = \left(\frac{\lambda}{1+\lambda}\right)y_H$. We then need to find y such that $x_k(y) = x$.

Under Requirements 2 and 3, when $q \leq q_R$, y_H strictly prefers to accept any $x < x_w$ and is indifferent at x_w . Without loss of generality, assume that she accepts x_w so that $x_R(x_w) = x_L$ and $x_A(x_w) = x_H$. (There is no loss of generality because we can simply consider some $x < x_w$ that is arbitrarily close to x_w and that is accepted for sure, to make the argument work.) The Crown's payoff from a deviation to x_w then is:

$$V_1(x_w) = (1 - q)[W(y_L) + G(y_L)] + q[V(x_w) + V(x_H)].$$

The deviation would be profitable if

$$V(x_w) + V(x_H) > 2W(y_H) + p_H V(x_L).$$

Since $V(x_H) > W(y_H)$ by Corollary 1, it is sufficient to show that

$$\begin{aligned} W(y_H) + p_H V(x_L) &= (1 - p_H)V(y_H) + p_H V(x_L) \\ &\leq V((1 - p_H)y_H + p_H x_L) && \text{(concavity of } V) \\ &\leq V(x_w). && \text{(Lemma 11, } V \text{ increasing)} \end{aligned}$$

But this contradicts the supposition that x_u is an equilibrium demand.

Assume now that $q > q_R$, in which case $x_R(x_u) = x_H$ by (5). Since only y_H accepts this, the Crown's equilibrium payoff is

$$V_1(x_u) = (1 - q)[2W(y_L) + p_L W(y_L)] + q[W(y_H) + G(y_H)].$$

Consider now a deviation to $x_d(y_H)$, which y_L still rejects. Under Requirements 2 and 3, when $q > q_R$, y_H rejects this demand with probability r^* , and the Crown's second-period demands are $x_A(x_d(y_H)) = x_R(x_d(y_H)) = x_H$. (The post-rebellion demand is x_H because the Crown's mixing probability is $h(x_d(y_H)) = 1$.) Clearly, this deviation is profitable: the second-period demand is the same after rebellion and there's a chance that y_H will accept the high first-period tax. Formally, the payoff from the deviation is

$$\begin{aligned} V_1(x_d(y_H)) &= (1 - q)[2W(y_L) + p_L W(y_L)] \\ &\quad + q[r^*(W(y_H) + G(y_H)) + (1 - r^*)(V(x_d(y_H)) + V(x_H))]. \end{aligned} \quad (18)$$

We can reduce $V_1(x_d(y_H)) > V_1(x_u)$ to

$$W(y_H) + G(y_H) < r^*[W(y_H) + G(y_H)] + (1 - r^*)(V(x_d(y_H)) + V(x_H)),$$

which holds for any $r^* > 0$ because $V(x_d(y_H)) > G(y_H)$ by Lemma 2 and $V(x_H) > W(y_H)$ by Corollary 1. This contradicts the supposition that x_u is an equilibrium demand. ■

Proof (Lemma 10). Consider $x \leq x_d(y_L)$. Assume that $q \leq q_R$. Since both types accept x and $x_A(x) = x_L$, it follows that $V_1(x) = V(x) + V(x_L)$, which is strictly increasing in x . Assume that $q_R < q$. Consider $x \leq x_d(y_L)$. Since both types accept x and $x_A(x) = x_H$, it follows that $V_1(x) = V(x) + V(x_H)$, which is strictly increasing in x .

Consider $x \in (x_d(y_L), x_w)$ and assume that y_H accepts x_w (recall that she is indifferent at this demand). Since y_L accepts x but y_H rejects it, $x_R(x) = x_L$ and $x_A(x) = x_H$, so that $V_1(x) = (1 - q)[W(y_L) + G(y_L)] + q[V(x) + V(x_H)]$, which is strictly increasing in x .

Assume $q > q_R$ and consider $x \in (x_w, x_d(y_H))$. These demands are rejected by y_L with certainty and by y_H with probability r^* . Since the Crown's beliefs after rebellion render him indifferent, his expected payoff in the second period after rebellion is $V(x_L)$. Moreover, since only y_H ever accepts x with positive probability, $x_A(x) = x_H$. The payoff from such a demand, then, is

$$V_1(x) = (1 - q)[W(y_L) + G(y_L)] \\ + q[r^*(2W(y_H) + p_H V(x_L)) + (1 - r^*)(V(x) + V(x_H))],$$

which is strictly increasing in x . ■

LEMMA 12. *The equilibrium payoffs are linear in q and strictly increasing. The semi-separating payoff increases the fastest, followed by the separating payoff, which is trailed by the pooling one. Moreover, at $q = 1$, $V_1(x_d(y_H)) > V_1(x_w) > V_1(x_d(y_L))$, whereas at $q = 0$, $V_1(x_d(y_H)) < V_1(x_w) < V_1(x_d(y_L))$.* □

Proof. That the payoffs are linear in q is clear from inspection of (12), (13), and (??). The derivatives are

$$\begin{aligned} \frac{d V_1(x_d(y_L))}{d q} &= V(x_H) - W(y_L) \\ &< \frac{d V_1(x_w)}{d q} = V(x_w) + V(x_H) - W(y_L) - G(y_L) \\ &< \frac{d V_1(x_d(y_H))}{d q} = V(x_d(y_H)) + V(x_H) - W(y_L) - G(y_L) \\ &\quad + \zeta[V(x_d(y_H)) + V(x_H) - 2W(y_H) - p_H V(x_L)], \end{aligned}$$

and the ordering is established with simple arithmetic. The ordering at the end-points is obvious, although care should be taken to note that the hybrid equilibrium cannot exist if $q < \zeta/(1 + \zeta)$ because $r^* > 1$ for these values. (Since the payoff is linear, however, it is useful to establish a second point there.) ■

Define now the following short-hand notation:

$$\begin{aligned} A &= V(x_d(y_L)) - G(y_L) & C &= V(x_L) - W(y_L) \\ B &= V(x_w) - G(y_L) & D &= V(x_H) - W(y_L) \\ F &= V(x_d(y_H)) - G(y_L) & E &= V(x_d(y_H)) + V(x_H) - [2W(y_H) + p_H V(x_L)]. \end{aligned}$$

It is straightforward to verify that all these quantities are positive, that $F > B > A$, $D > C$, and $E > F - B$, and that $q_A = C/D$. A little algebra then establishes the following:³¹

$$x_d(y_L) > x_w \quad \Leftrightarrow \quad q < q_L = \begin{cases} \frac{A+C}{B+D} & \text{if } q \leq q_A \\ \frac{A}{B} & \text{otherwise,} \end{cases} \quad (19)$$

³¹The second case obtains because $G(y_L) < V(x_d(y_L)) < V(x_w)$, where the first inequality follows from Lemma 2 and the second from Lemma 8.

In a similar manner, and only when $q > q_R$, we also obtain³²

$$x_w > x_d(y_H) \quad \Leftrightarrow \quad q < q_H = \frac{\zeta E}{F - B + \zeta E}, \quad (20)$$

Finally, and again provided that $q > q_R$, we also obtain

$$x_d(y_L) > x_d(y_H) \quad \Leftrightarrow \quad q < q_M = \begin{cases} \frac{A+C+\zeta E}{F+D+\zeta E} & \text{if } q \leq q_A \\ \frac{A+\zeta E}{F+\zeta E} & \text{otherwise,} \end{cases} \quad (21)$$

COROLLARY 2. *The only possible configurations of the cut-points are $q_L < q_M < q_H$ or $q_H < q_M < q_L$.* \square

Proof. Follows directly from Lemma 12. Figure 3 illustrates the proof. Since at $q = 0$ the preferences are $x_d(y_L) > x_w > x_d(y_H)$ but at $q = 1$ they are $x_d(y_H) > x_w > x_d(y_L)$ and the functions are linear and either strictly increasing or, in the case of the pooling payoff for $q < q_A$, constant, in q , it follows that (1) the separating payoff must intersect the pooling payoff precisely once, at q_L , (2) whenever the semi-separating payoff exists but is less than the pooling payoff, it must intersect the latter precisely once, at q_M , and (3) whenever the semi-separating payoff exists but is less than the separating payoff, it must intersect the latter precisely once, at q_H . There are only two possibilities when the semi-separating payoff exists but is smaller than at least one of the other two: the intersection with the separating payoff happens before the intersection with the pooling payoff ($q_H < q_M$), or after ($q_M < q_H$). If $q_H < q_M$, then the fact that the semi-separating payoff increases faster than the separating payoff implies that $q_M < q_L$ (the separating payoff will intersect the pooling one at a larger value of q than the semi-separating one). Thus, the configuration must be $q_H < q_M < q_L$. If, on the other hand, $q_M < q_H$, then the fact that the semi-separating payoff is better than the pooling one but worse than the separating one for all $q \in (q_M, q_H)$ implies that the separating payoff is also better than the pooling one over that range. But since it rises more slowly than the semi-separating payoff, it must be that the separating payoff has started to dominate the pooling one at $q_L < q_M$. Thus, the configuration must be $q_L < q_M < q_H$. \blacksquare

Proof (Proposition 3). By Corollary 2, we only need to look at two configurations.

CASE I: $q_L < q_H$, which implies that $q_L < q_M < q_H$, so we can infer that:

- if $q \leq q_L$, then $x_d(y_L) > x_w > x_d(y_H)$;
- if $q_L < q \leq q_M$, then $x_w > x_d(y_L) > x_d(y_H)$;
- if $q_M < q < q_H$, then $x_w > x_d(y_H) > x_d(y_L)$;
- if $q_H \leq q$, then $x_d(y_H) > x_w > x_d(y_L)$.

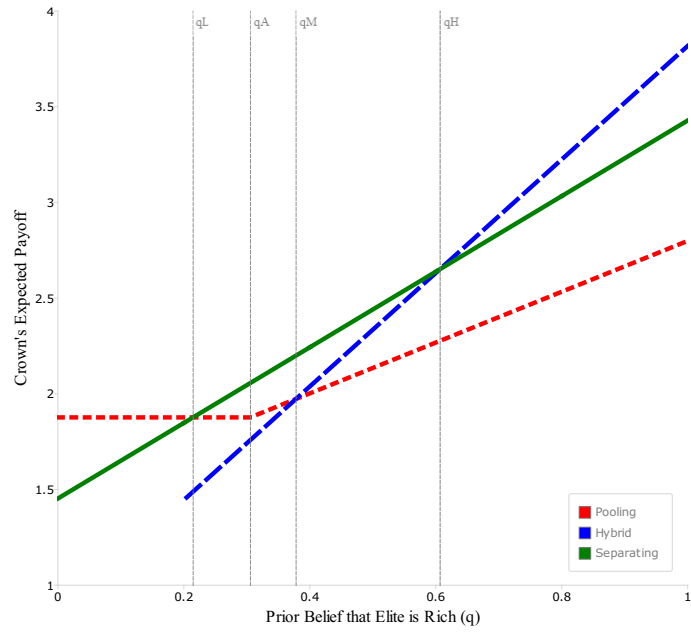
In other words, the pooling demand is optimal for $q \leq q_L$, the separating demand is optimal for $q \in (q_L, q_H)$, and the semi-separating demand is optimal for $q \geq q_H$.

CASE II: $q_H < q_L$, which implies that $q_H < q_M < q_L$, so we can infer that:

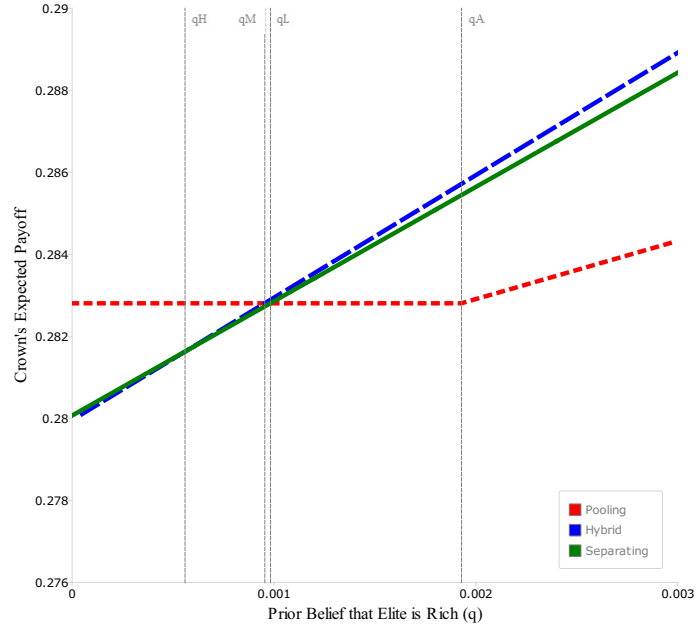
³²The expression obtains because $V(x_d(y_H)) + V(x_H) > V(x_w) + V(x_H) > 2W(y_H) + p_H V(x_L)$, where the second inequality follows from $V(x_w) \geq V(p_H x_L + (1 - p_H)y_H) > p_H V(x_L) + (1 - p_H)V(y_H) = W(y_L) + p_H V(x_L)$ by Lemma 11, V increasing and concave. We can then write $q_H = \zeta/(\zeta + S)$, where $S = \frac{V(x_d(y_H)) - V(x_w)}{V(x_d(y_H)) + V(x_H) - [2W(y_H) + p_H V(x_L)]}$, and where we observe that $S = (F - B)/E$.

- if $q \leq q_H$, then $x_d(y_L) > x_w > x_d(y_H)$;
- if $q_H < q \leq q_M$, then $x_d(y_L) > x_d(y_H) > x_w$;
- if $q_M < q < q_L$, then $x_d(y_H) > x_d(y_L) > x_w$;
- if $q_L \leq q$, then $x_d(y_H) > x_w > x_d(y_L)$.

In other words, the pooling demand is optimal for $q \leq q_M$, and the semi-separating demand is optimal for $q > q_M$. ■



(a) Separating Equilibrium Exists ($y_L = 0.02$, $y_H = 4$)



(b) No Separating Equilibrium ($y_L = 1$, $y_H = 6$)

Figure 3: The Two Possible Cut-Point Configurations.