TAX ADMINISTRATION AND COMPLIANCE: EVIDENCE FROM MEDIEVAL PARIS

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July, 2018

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Abstract

We analyze the Parisian *taille* of the late 13th century, used to finance periodic major expenditures by the French Crown, including wars. We demonstrate its remarkable success, achieved without the administrative structures used by contemporary governments. The *taille's* essential features were; an agreement between the king and city government to collect a fixed amount of revenue, and a collection process using taxpayer information held by fellow artisans and neighbors. Large sums were collected without social unrest, compliance was high, and administrative costs were low. We argue that its success contains lessons for tax collection and compliance in contemporary less-developed economies.

[1] Sussman would like to thank Merav Avrahami, Karine Gabay, Anna Gutgarts, Nimord Hagiladi for their valuable assistance in coding the data. Sussman would also like to thank the Israeli Science Foundation, the Maurice Falk Institute and Minerva for supporting this research.

Introduction

The problem of tax compliance is as old as is the levying of taxes. High compliance by taxpayers is important to governments for many reasons. Non-compliance limits the resources available for governing, In addition, non-compliance can undermine the legitimacy of the government, and non-compliance that is unevenly distributed across social classes, professions or income levels can lead to political and social unrest, if not violence. Consequently, governments expend considerable resources on reducing tax evasion, and innovations in tax administration that induce high compliance rates at reasonable cost are extremely important. These issues are particularly salient for governments of developing countries, which typically lack administrative capacity but have a pressing need for revenues to spend on infrastructure and other public goods.

In this paper we study a successful tax collection mechanism, the *taille*, that was used in medieval Paris, primarily to finance wars fought by the French king. The *taille's* essential features were an agreement between the crown and city government to collect a fixed amount of revenue and a collection process that included public revelation of individual tax assessments prior to their collection. This mechanism raised compliance by turning the social cost of tax evasion into a private one. It was supported by a social norm that allocated this tax mainly to the elites. The information we uncover from historical tax records indicates that this taxation mechanism allowed the city government to collect the desired revenues at a low cost and with high levels of compliance, despite minimal bureaucratic machinery.

The primary difficulty in collecting taxes has remained constant throughout history. Citizens have superior information about the base on which most taxes are collected, particularly their own income and wealth. In medieval times, and for less-developed economies today, this promotes a reliance on taxes levied on easily observed transactions. However, such indirect taxes have other undesirable features: they are in particular generally regressive and potential triggers for social unrest. Resorting to regressive taxation in contemporary developing

economies, which typically have high income inequality, is particularly unsatisfactory. While direct taxes on personal income and wealth can avoid these difficulties, they are harder to collect because of the asymmetric information problem mentioned. The problems faced by medieval kings were quite similar; modest administrative capabilities, and, of course, none of the third-party record-keeping and reporting that modern governments use, along with highly unequal income distributions.

One method used by many governments in medieval and early modern Europe to collect taxes was to delegate tax assessment and collection to 'private' tax collectors (tax farmers), or to local governments. The variation of this which we study arose in France at the end of the 13th century. First, a given tax liability earmarked for a specific royal initiative was agreed to by the crown and a local government, and then it was left to local authorities to partition that liability among its taxpayers and to collect the agreed sum. Variations of this decentralized tax collection system were used in a variety of times and places in Europe. However, its success varied considerably across its many implementations. The *taille* that worked so well in the self-governing commune of Paris in the 1300s, later became, in royal hands, one of the most hated symbols of the *ancien regime*. Here we focus on the Parisian *taille* of the late 13th century and seek to first illustrate the several dimensions on which it was successful, and secondly to determine the features that made it so.

We do this using a varied set of analyses. A variety of historical evidence, including tax rolls from the Parisian *taille*, is used to lay out as clearly as possible how the mechanism was implemented in Paris between 1292 and 1313. We develop of a highly stylized theoretical model of the *taille* with citizens as strategic players. The model generates an essentially unique equilibrium in which the City collects the desired amount of tax with perfect compliance. More importantly, the model allows us to uncover two key features of the system whose removal causes either reduced tax collection or equilibrium tax evasion and false reporting by citizens.

We also show that the Parisian *taille* was successful on other dimensions. The actual tax rolls are used to show that the tax was in fact progressive, and argue this was partly why its imposition led to no civil unrest. We provide evidence that compliance was high, just as the

model predicts, as well as historical evidence that the Parisian *taille* was later imitated, as a further indication of its success.

The economic and political environment of late 13th century France has much in common with that in modern less-developed economies, giving reason to think the Parisian *taille's* success may be relevant to their contemporary tax collection challenges. We thus review a number of recent experiments aimed at increasing tax revenues and improving compliance in less-developed countries, and argue that their degree of success is positively related to the extent to which they employ features found in the Parisian *taille.*

The lesson from all of this is that the particular implementation of the *taille* that arose in late 13th century Paris was a remarkable success in an environment that was not conducive to generating high tax revenues and in which high compliance could not be assumed. We document that success along several dimensions, and our analysis reveals which features of that implementation were crucial to its success, as well as pointing to ways in which it provides lessons for contemporary tax collection in similar environments.

The paper is organized as follows. Section II places our work in the large literature on tax compliance and reviews other work that has used tax rolls from the same period. Section III lays out in detail what is known about the particular implementation of the *tailles* in medieval Paris. Some of this comes from tax and court records of the time, while some must be inferred from other implementations of the *taille* in other places and times. Section IV then develops a theoretical model of the *taille* mechanism, and uses it to show that two key features were key to its success. These were first, the collection of a pre-determined sum from the City, which was re-apportioned among tax districts (referred to by Wolfe (1972) as an "impot de repartition"), and second, the reliance on information that citizens often had about their neighbors in the crowded city that was Paris. This analysis implies that the *taille* was able to collect a large sum with high compliance. Section V provides evidence that this was indeed the case, while also pointing to evidence of its success along other dimensions, including the absence of tax evasion that goes beyond mere mis-reporting. Section V concludes with an admittedly preliminary consideration of the lessons that can be gleaned

from our analysis to the benefit of tax collection in contemporary LDCs. Section VI concludes.

II. Related Literature

There is a considerable literature devoted to tax compliance issues. The seminal paper on the deterrence of false reporting of an individual's tax base is Allingham and Sandmo (1972), which analyzes the behavior of a single taxpayer with private information about their own income, who makes a report of that income to the tax authority. The tax authority's role is to set a fixed probability of detecting an under-report by the taxpayer, and to set the penalty incurred if an under-report is detected. The tax authority is non-strategic, and the emphasis is on determining the values of these parameters which will deter under-reporting. An advance on this approach was made in a series of papers [see, for example, Reinganum and Wilde (1985), (1986), Chander and Wilde (1998)] which adopted a principal-agent approach to tax compliance by having the tax authority (the principal) as well as the taxpayer act strategically, and derived the equilibrium behavior by both parties. The environment in this literature remains one of a tax authority dealing with a single taxpayer with private information regarding his true income, and the equilibrium strategies inevitably involve randomization.

A recent survey of the literature on tax evasion by Slemrod (2007) cites no research that analyses the use of information held by fellow-taxpayers to aid a tax authority in deterring under-reporting, even though taxation authorities in many countries do make attempts to encourage citizens to report tax evasion by others.[6] Myles and Naylor (1996) develop a multi-taxpayer model of tax evasion, but the mechanisms for improving compliance that are analyzed there are social norms and group conformity, rather than taxpayers' information about one another.

There is, however, a large general literature on the use of 'mutual monitoring' in multiple-agent environments in which the agents have superior information to the principle regarding

[6] See, for example, http://www.endfraud.co.uk/Tax%20Fraud.html.

the behavior of other agents. Knez (2001) analyzes an incentive system adopted by Continental Airlines that relied on mutual monitoring and sanctioning by employees, and Fehr and Simon (2000) show that adding the possibility of mutual punishment by individuals in a public goods game can increase the amount contributed. Besley and Coate (1995) among others analyze the working of micro-financing systems like the Grameen Bank in which groups of lenders are mutually responsible for their loans. However, in the Continental and public-good environments it is the agents themselves who are required to punish/sanction sub-optimal behavior by their colleagues, rather than inducing a separate authority to do so, and in the group-lending context the only recourse available to a single lender is to repay the loan of another lender who would otherwise default. Thus, the central concept analyzed here of giving informed taxpayers appropriate incentives to trigger audits of one another by an uninformed authority, is missing.

A paper whose environment bears some resemblance to that in our formal model of the *taille* is Bandyopadhyay and Chatterjee (2010). They develop a model of criminal activity in which citizens have better information than the police about whether their fellow citizens have committed a crime. The action available to citizens is to report others' criminal activity to the police. The key question analyzed in their paper is how such citizen reporting affects criminal activity in observably distinguishable groups.

The theoretical literature on implementing social choice correspondences (Ma (1988) and Moore and Repullo (1988) are classic references) demonstrates that under quite general conditions one can construct an extensive-form game which will induce a set of agents with superior information to adopt any profile of actions that a principal wishes, as a (unique) subgame perfect equilibrium of that game. Our point here, however, is not to demonstrate that the Parisian authorities of medieval France *could* find a mechanism to collect taxes in such an informational environment, but to show how the incentives inherent in the mechanism they actually used allowed them to solve the problem they faced at minimal administrative cost.

A small number of previous recent studies have made use of the Parisian tax rolls. The tax rolls analyzed in this paper have been studied by Bourlet (1992) mainly for the purpose of an anthro-toponymic study.Herlihy (1995) analyzed the 1292 and 1313 tax rolls and briefly addressed issues related to migration, occupations and gender differences. Bove (2004) also used the tax rolls in his study of the Parisian elites. Desicmon (1989) analyzed the Parisian tax roll of 1571. Rigaudière (1982, 1989, 2002), studied the *tailles* imposed in southern France and more specifically attempted to answer the question of how income and wealth information was verified by tax collectors. The institutional detail we use in the model is derived mainly from his research.

III. The Parisian *Taille* of Philip the Fair

1. Sources

Our data is extracted from the tax rolls of the *taille* imposed by Philip the Fair on Paris beginning in 1292. There are seven existing rolls: 1292, 1296-1300 and 1313. The first six correspond to the same imposition totaling 100,000 *livres parisis* to be paid in installments.[7] The last tax roll, of 1313, was earmarked to pay for the knighting of the prince, the future king Louis X. In addition we have qualitative information on the collection of two additional *taille* of 10,000 *livres* in 1302 (for a war against Bruges) and in 1308 (for the marriage of Isabel, the king's daughter).[8] This tax was levied on the citizens of Paris and excluded the privileged tax exempt classes of the nobility, clergy, students and professors. It included the Italian merchants (*lombards*) and Jews.[9] Who exactly in Paris was classified a citizen – a 'burgher' - is open to debate. According to Duby(1980), only those that enjoyed the privileges of citizens that were related to residency requirements paid these taxes. A court case in the *Parloir* (the city's court) from 1308 defines a citizen (*bourgeois*) as someone living in the city and paying the *taille* and other charges imposed by the city.[10]

[7] There is some doubt as to whether the tax roll of 1292 was actually a roll of collected taxes rather than an initial survey of taxpayers.
[8] Le Roux and Victor (1846).
[9] The privilege to tax the Italian aliens was given to the city by Philip le Hardi in 1282, The royal decree is cited in Le Roux and Victor (1846) Vol. II p. 261.
[10] Le Roux and Victor (1846) Vol. II p. 171.

The tax rolls differ in coverage. Table 1 shows the first - 1292 - being the largest, including all segments of the taxable population and suburbs of the city: The rich (*gros*) the poor (*menus*), the Jews (who were expelled by the king in 1306) and the *Lombards* (Italians). Separate lists were drawn for each of these groups, but the tax roll of 1296 is missing the list of the poor. All subsequent tax rolls exclude some of the neighborhoods outside the city walls. All of the rolls include the names of citizens who have died during the year. The tax roll of 1313, which records the fewest tax payers, has fewer parishes included in it than the previous ones. While the coverage of taxpayers in surviving manuscripts is sometimes incomplete, the totals collected show that the annual tax quota of 10,000 *livres* was indeed always collected and sometimes exceeded. The Parisian *taille* was therefore a tax system that actually worked.

(Table 1 about here)

The tax rolls consist of a list of taxpayers recorded according to residency (i.e., street address). In addition to the taxpayer's name we often find information about his or her occupation and place of origin. According to the rolls, the city was divided into geographic tax units associated with a parish church. Larger parishes were further divided into wards. Taxpayers were grouped according to streets or street sections they lived in. Although we have no written record detailing the division of the tax burden by parishes, the division of the rolls into those geographical units suggests that the tax burden was divided among these tax units.

In addition to the tax rolls themselves we used the registers of the merchant court of Paris (the *livre de parloir*) that was transcribed by Le Roux and Victor (1846).[11] The registers provide supporting evidence on the institutional details of the administration of the tax.

2. The main features of the *tailles*

[11] Le Roux and Victor (1846) call attention to the fragmentary nature of the documents, but argue that they are most complete for the period 1290-1315 which conveniently corresponds to the tax tolls studied. Nevertheless, Bove (2004) suggests that their transcription should be used cautiously as there are errors, particularly in dating some of the documents.

In this sub-section we will use what is known about the Parisian *taille* as well as other similar tax systems to establish the key features of its implementation during this period.

Motivation for adopting the taille

According to the history of the *taille* studied here, it was the city of Paris that chose to substitute the *taille* for a sales tax (*aide*) (Bourlet, 1992).[12] The main reason was to preserve the (fiscal) independence of the city.[13]The city negotiated with the crown on the amount to be delivered and the crown left it to the city's government to assess and collect it. It appears that this taxation mechanism was mutually advantageous for the bourgeoisie and the crown. The crown benefitted from this arrangement as it was assured a given tax revenue, thereby reducing fiscal uncertainty. In Burgundy, in contrast, the princely city of Dijon was subject to a wealth tax which was administered by the Duke of Burgundy's men and was calculated at a fixed rate of 2% of the assessed wealth. Tax revenues, therefore, fluctuated from one tax assessment to the next (Dubois, 1984). The king also benefited from the *taille* because administration costs for any direct tax are typically high. The small scale of the king's bureaucracy and his limited political and military powers resulted in a preference for farming out tax collection – the *taille* was no exception. Indeed, a later attempt in 1382 by the king's agents to collect taxes from the city of Paris directly resulted in violent riots (Cohn, 2006).

Adoption of the *taille* in Paris likely appealed to both parties as a way to minimize the likelihood of civil unrest. This can be inferred from the adoption of a similar scheme in the Midi– the region around Toulouse. Wolff (1956) argues that the Count of Toulouse introduced in 1270 the Northern version of the *taille* to the consulates of the South.[14] According to the documents studied by Wolff, the reason behind exchanging indirect taxes for direct ones was to attenuate civil tensions that were widespread in the Southern

[12] Strayer and Taylor (1939) p.12. document that the sales tax (*Aide*) imposed in 1292 by the king on France to finance the war was commuted by a small number of cities (Chalons, Tournai, La Rochelle and \Reims) into fixed tax obligations. However, unlike the Parisian *taille*, the type of tax levied and its method of collection are unknown,

[13] One related potential benefit to the city was that it could use its fiscal independence to issue low interest debt in the form of rents – Luchaire (1911).

[14] The consulates were a governing body of a city that included landed aristocracy.

consulates. The conflicts were a result of the regressive nature of indirect taxation and resentment of the city oligarchies by the lower classes.

Institutional setup

While the tax rolls in our possession provide a great deal of information about the collection of the Parisian *taille*, we lack the details of the institutional setup. There is reason to believe that this is by design, since the main feature of the medieval *taille* was that the crown did not get involved in the process and therefore, unlike the lay subsidies and poll taxes in England, we do not have royal documents or parliamentary records regulating it. According to Descimon (1989), who analyzed a similar Parisian tax roll of 1571, the Parisian city government kept these tax rolls secret from the crown and carefully guarded the detailed information about taxpayers. Descimon suggests that tax rolls were burnt after the taxes were delivered, indicating the importance of fiscal independence to the City's leaders. Therefore, many of the institutional details must be inferred from evidence from the tax rolls themselves and from similar systems used in other times and places. The following account is based on the summary provided by Wolfe (1972) in appendix G to his book

The recourse to a taille was infrequent

The recourse to direct taxation by the crown in medieval Europe, and France was no exception, was infrequent. Generally, the king of France had to finance his expenditures from revenues raised from his feudal domain. On special occasions the king levied extraordinary taxes – the *aide* – usually in the form of a sales tax. These taxes could be levied automatically, or according to feudal custom, as in the case of a marriage of the king's daughters and the naming of his heir. The tax could also be used to finance wars that had to be approved by the parliament. We will argue below that the infrequent and irregular nature of these taxes, along with other features particular to the Parisian case, imply that each instance of the *taille* should be considered a one shot tax game.

The fixed sum (repartition)

The *tailles* in France were divided into two types – the *taille reele* and the *taille personelle*. The former was a property tax often called *'fougae'* - hearth tax - and was levied mainly in the *midi* and the south of France. The latter was a tax on personal wealth that included also moveable wealth and income, and was levied in the north of France. The Paris *tailles* were therefore a tax on all wealth and income from labor and capital. Indeed, the tax rolls include also taxes paid by firms.

We argue that a critical feature of this *taille personelle* was what Wolfe terms an "impot de repartition" – a repartition tax whereby a given amount to be collected is divided amongst taxpayers.[15] Recall that the city negotiated a lump sum tax to be delivered to the king – it therefore turned the tax allocation and collection process into a constant-sum game, whereby a taxpayer who evaded taxation by either falsely declaring his taxable wealth and/or income, or by not paying his assessed tax, imposed a burden on fellow taxpayers. We cans ee clear evidence of this in 1313 (Table 1) when the sum of the tax did not change but the number of taxpayers declined substantially partly as a result of the expulsion of Jews and Italian bankers in 1306 and 1311 respectively.

This was different from other medieval taxation schemes such as the Lay Subsidies in England that were a fixed tax rate on movables or the Poll Tax (1377-1381), with a fixed amount of tax per head.[16] It is also different from modern taxes in which the government sets tax rates and tax revenue is determined by (variable) economic activity and the level of compliance. With the *taille*, the French medieval monarchy made sure that taxpayers internalized the costs of tax evasion and possibly mitigated tax avoidance.

Information collection

The successful implementation of the *tailles personelles* to collect the sum agreed to with the crown depended on the city government's ability to a) extract the necessary wealth

[15] This mode of repartition – the division of a lump sum tax between taxpayers - was common in small rural communities.. This became the norm in Burgundy after 1376 (Leguai 1970)
[16]The levying of lay subsidies in England began in the late 11th century and continued until the 16th century.

information from each taxpayer and b) to enforce the collection of the resulting individual tax liabilities. Clearly, it wished to do this at minimal cost.

After negotiating with the King on the total amount the city should deliver to the crown, the city leaders had to determine how to distribute the tax burden across its citizens. This in turn required a general assessment of the city's wealth and then the allocation of tax quotas to the various parishes, which were the local tax units (with some exceptions, as detailed later).

Little is recorded about the first stage and the information historians have is derived from a few rare examples which survived – none from Paris. However, similar *tailles* were usually levied according to the following principle: the very poor paid a poll tax, the very wealthy, above a certain (variable) cutoff paid a proportional wealth tax that normally ranged from one to ten percent. Most taxpayers paid a proportional income tax.[17]

Assumptions about the information set are crucial for our model of the tax game, and in this section we aim to show that information about highly taxed individuals or neighborhoods was gathered efficiently. This was achieved, in Paris and other large cities, by dividing the city into parishes with some parishes further divided into wards. To ensure that the principles that operated at the city level would also carry through at lower levels, the lump sum levied on the city was divided into quotas for each parish.[18]The actual assessment and collection of the tax was supervised by the city government but carried out by a varying number (between 13 and 24) of unpaid 'worthy' assessors (*Prud'hommes)* elected by the city government. A measure of the low cost of this taxation mechanism, on which we elaborate later, can be deduced from the fact that the process of assessing a city of 200,000 residents was carried out by such a small number of unpaid collectors.[19]

We also know a good deal about those assessors. From the *livre de parloir* transcribed by Le Roux and Victor (1846) we have the names of tax assessors for 5 of the years that the tax was collected [1292, 1298/1300, 1302, 1308, 1313]. We used the tax rolls to match the

[18]Descimon (1989) documents this further sub-division of the tax in 16th century usage.
[18]Descimon (1989) documents this further sub-division of the tax in 16th century usage.
[19] See discussions in Farr (1989) and Desportes(1977) for Dijon and Reims respectively. The collection costs were augmented by paid clerks that wrote up the tax lists and city police that guarded the money collected.

assessors with their tax assessments and identify their residence, occupations and their economic standing in the city. Below we present evidence that clearly shows that the assessors were well informed citizens: they were men of standing drawn from the major professional guilds who had lived in the city for many years.

Assessors were identified by their profession, suggesting that professional affiliation was a key selection criterion. Assessors coming from the professions would be familiar with business conditions generally and particularly those affecting their own profession. This mattered, especially in a medieval world populated with professional guilds that kept secret many of their business practices. Table 2 shows a list of professions ranked by their economic standing (average tax assessment). This ranking is contrasted with the distribution of the assessors' professions. It can be readily seen that the assessors were drawn largely from the wealthier professions. The assessors' relative economic standing in the profession was high. For the 66 tax assessors whose names we are able to determine, Table 3 displays the number of them who appeared as taxpayers in various groupings of the rolls that we have. Assuming these individuals were in Paris and economically active in the years between those in which their names appear as taxpayers, Table 3 implies that 47 of the 66 assessors (those in the first four year groupings) lived and worked in Paris for at least 7 years between 1292 and 1313. Finally, the assessors were amongst the most affluent citizens of Paris. Table 4 shows their rank in the tax distribution. More than half of the assessors belonged to the top 5% of the distribution of tax payments and all but one of these whose assessment we could determine belonged to the top two deciles.

(Table 2 about here)

(Table 3 about here)

(Table 4 about here)

Moreover, evidence from the tax roll of 1296 suggests that there existed another tier of tax assessors or collectors at the tax unit level. The opening paragraph of the tax roll of 1296 lists names of 5 people responsible for the tax of the first ward of the first parish. Unlike the list of the citywide assessors, they were not listed by their profession. The criteria for their

appointment appears to have been residential, as they all resided in that tax unit. Their tax assessments are lower than that of the citywide assessors; they belonged to the third decile of the income distribution, a rank below the *prud'hommes*. This suggests that the tax administration consisted of two tiers. The upper tier first assessed the citywide tax base and distributed quotas among tax units. The lower tier consisted of residents of each tax unit who were responsible for the assessment and collection within their own units. The critical issue was the extraction of accurate wealth and income information and enforcement of collection.

Verification

How much confidence could the city leaders have that the assessors had obtained truthful wealth and income statements from taxpayers? We know little about how the process was carried out in Paris for the *taille* we analyze, but from other sources we can infer a good deal about the process.

The fact the rolls are constructed according to residence – by the taxpayer's address - alludes to the way the assessment was conducted: through a house to house canvas. The information collected by the assessors during the canvas might, nonetheless, be false. Rigaudiere (1989) has attempted to determine how reports were verified for the *taille* levied in France more generally. The common features of the verification mechanisms he describes relate to the use of neighbors to verify wealth and income declarations. They included measures such as the assessors revisiting the neighbors when they had suspicions about a tax statement, and to call on neighbors to testify before a committee in cases of suspect statements. In Dijon, assessed taxpayers were required to provide the assessors with names of neighbors that can confirm their declaration. Other methods relied on making public the assessments and allowing neighbors to challenge them. Rigaudiere (1982) describes the process of collecting the *taille* in Saint Flour and shows that assessed taxpayers could challenge their assessments and neighbors were involved in the process. Decsimon (1989) alludes to the presentation of the tax rolls before the general assembly of Paris in 1571.[20] Evidence from small communities in the 17th century suggests that the tax rolls were read to the community during

[20]Descimon (1989, p. 76).

mass in the parish church.[21] While most of the documented evidence comes from periods after 1300, it is likely that the evidence drawn from rural communities that retained age old customs in the area around Paris, together with evidence from Paris from the 16th century can be used to infer the customs prevailing in Paris at the time.

One shot game

We noted above that other instances of the *taille* often involved the collection of taxes for infrequent and unpredictable purposes. However, the first six tax rolls we have are known to have been for the purpose of collecting a pre-determined sum in installments. Nonetheless, we argue that the task of collecting information from taxpayers and collecting the resulting taxes in each of these years is best treated as a one-shot game.

An important fact in this regard is that medieval cities' populations were very dynamic. During the 13th century the population of Paris more than doubled. Migration was the most important source of population growth as death rates were high. Indeed, our data show that each tax roll contains numerous variations in taxpayers' vital and economic circumstances. First, the overlap between taxpayers within the years for which we have data is not high: the proportion of taxpayers that appeared in the roll of 1292 that appear in **any** subsequent year is about 40%. Only 50% of those appearing in the tax roll of 1300, which covered fewer citizens, were also listed in earlier rolls. The tax assessed on individuals also varied even over consecutive years. Moreover, over the years, our tax rolls document taxpayers that got married, became widowed, and died. Children reached adulthood and apprentices became masters. Some taxpayers changed residences and sometimes even their occupations. In short, from the data extracted from the rolls it is evident that substantial new information had to be collected every year, suggesting that the *taille* was not a repeated game.

Equally significant is the fact that each tax collection game was played by a different set of tax assessors. Out of the 13 assessors of 1292, 10 were themselves assessed by different assessors in subsequent years. Of the 24 assessors in 1298/1300, 14 were assessed by

[21]Challet for Saint Vert, Lemarchand (2008), Follain and Larguier (2000,2005).

others.[22] All of this suggests that each tax collection can be thought of as a one shot game, as both the taxpayer population and the assessors they dealt with changed substantially from assessment to assessment.

Universality

As mentioned, only the nobility, the clergy, faculty and students were exempt from paying the *taille*. The coverage of the *taille* was otherwise universal. In medieval cities there was a distinction between residents (that included clergy, nobility and aliens) and citizens. The direct taxes were levied on all citizens, including the city elites, the poor and the dead. The records of the Paris *taille* show that in 1292 – 1313poor taxpayers paid less than five percent of the total tax. The wealthier citizens would hardly have noticed if the poor had been excluded from paying (and it may be that in 1296 they were), but it appears to have been important for all citizens to be included. The inclusion on the lists of dead taxpayers is also significant. Since the planning of the tax assessment was based on living taxpayers, a taxpayer that died during the tax year could not be readily absolved. If the dead taxpayers were to be dropped from the list, their burden would have to have been picked up by surviving ones. Since death rates were not low in medieval Europe, a provision for collecting taxes from the survivors of deceased taxpayers was important, sinceone way to evade a direct tax is to avoid being assessed at all. For the *taille,* even (a perhaps fraudulent claim of) death was not a successful way to avoid taxation.

Further, the assessors and the city leaders were neither exempt from the tax nor given preferential treatment. We found that all the Parisian political elite (the mayor - *prevot de marchands,* his lieutenants – *the echevins,* and members of the city parliament –assessments of the wealthy individuals and families before and after assumption of political power and shows that privilege did not favor them: their assessments did not decline with their taking office.

IV. A formal model of the *taille*

[22] The list of assessors for the years 1293-1297 is missing, so we cannot calculate exactly how many times the assessors switched roles with those being assessed.

In this section we lay out a highly stylized model of tax-collection in Paris, intended to capture the key features of that period and of the *taille*. Our first result will be that the model predicts that the *taille* 'works', in the sense that it collects the required amount of revenue with no mis-reporting by citizens and with no resort to costly audits by the City leaders. This result is neither deep nor surprising; the model is constructed to generate this prediction. Of real interest, however, are the two following results that demonstrate how this breaks down if either of two key features of the *taille* in our model is eliminated. This provides a clear understanding of which aspects of the *taille* were key to its success.

We model here the collection of taxes in a particular parish which has been assessed a fixed sum *P* to be collected. As noted previously, the City leaders first negotiated with the Crown as to the total to be collected in Paris, and this was in turn re-partitioned among the tax districts in Paris, which we will refer to as 'parishes'. Thus, we do not attempt here to analyze the initial negotiations between the City and Crown nor the process of apportioning that sum among tax districts.

The tax is levied on what we will refer to as each citizen's 'wealth'. In fact this could instead be or simply include earned income for some citizens. Whatever is the tax base, what matters is our assumption that each citizen knows their own wealth, and that for each citizen *i* there is at least one other citizen *j* who has information about *i*'s wealth. One could of course make *j*'s information about *i* stochastic, but our very stark framework will serve our purposes while minimizing the technical machinery needed. It also captures the key idea that in medieval Paris, citizens lived and worked in close proximity to one another, and knew a great deal about their neighbors.

We further assume that the City sends a collector to each citizen to get a report of their wealth. This process is costly, of course, but we ignore this cost in the model as it is unavoidable, and so plays no strategic role.[23] What is a strategic decision for the City is to respond to a citizen's wealth report with an audit, and we assume that any such audit has a

[23]Collection costs would have a strategic role if the City first decided whether to collect taxes from each individual. As noted above, even the poorest were assessed in the *tailles*, and so we assume the decision to do that has already been made.

fixed cost, C > 0. The City leaders want to collect P from the parish while minimizing audit costs.

We denote citizen *i*'s report of their wealth to the collector by r_i, while their true wealth is w_i. Finally, we assume, consistent with what we know about the *taille*, that citizen reports of their wealth to the tax collector are at some point made common knowledge within the parish, and that any citizen *j* can *challenge* the report of any other citizen *i*.We also assume that such a challenge triggers a (costly) audit by the authorities, and that audit is perfect, in that it reveals the true value of w_i of the audited citizen *i*.

Given all this, we will refer to the following sequence of play as 'the *taille* game'.

1. Each citizen *i* gives a report r_i of their wealth.
2. These reports are made to the parish tax collector, who then makes them common knowledge.
3. Each citizen *j* then observes the list of reports $r = (r_1, r_2, \ldots, r_n)$ and decides the probability with which they will challenge the report of citizen *i.* We will denote this decision for each *j,i* by c_i^j, which is an element of the interval [0,1].
4. An unchallenged citizen *i*'s tax liability is determined by their report, r_i, while that of a challenged and audited citizen is determined by their revealed w_i. For a truthfully reporting citizen, these will of course be the same.

Note that the parish tax collector plays no strategic role. However, those collectors were typically resident in the neighborhood they were assigned, and so played a strategic role at both stage 1 and 3 as *citizens*. They themselves might know that some citizen was under-reporting their wealth.

The final piece needed is the determination of tax liabilities in a way that is consistent with the actual *taille*. The important feature here is that the entire liability of *P* is partitioned up among the citizens of the parish. There are many ways to do this, and we assume here what seems to be the simplest. Citizen *i*'s tax liability T_i is defined as:

(1) $$T_i = \frac{s_i(w_i, r_i, c_i)P}{\sum_j s_j(w_j, r_j, c_j)},$$

Where s_i is either r_i or w_i, depending on what i reported and whether it was challenged.[24] This assigns to each citizen a tax liability that is a share of P that is equal to their share of the parish's reported wealth. We will discuss briefly other possible versions of T_i, all of which result in individual payments that sum to P. We will see below that property is one key to the *taille* working as it did.

Finally, we assume the payoff of taxpayer i is:

(2) $$V_i(w_i,r,c,P) = w_i - T_i(w_i,r,c,P),$$

With T_i defined as above.

The only strategic agents in the sequential *tailles* game above are the citizens, who first choose a report and then, upon observing the vector r of reports, choose their challenge strategies. We assume for each i there is at least one citizen $j \neq i$ who knows the value of w_i as a stark way of capturing the conditions in medieval Paris. We also assume that other citizens who do *not* know the value of w_i believe it comes from a common prior distribution f_i, which in turn means that the equilibrium concept for this game is that of a *Perfect Bayesian Equilibrium* (PBE, henceforth).

As the game is currently formulated, there are a continuum of equilibria which differ from one another in an uninteresting way. Citizens can challenge the reports of others with any probability, whether or not they know their true wealth, and citizens can mis-report their own wealth because even if they are caught, all that happens is their tax liability is adjusted to what it would be if they were truthful.

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[24]Formally, it is defined as $s_i(w_i, r_i, c_i) = \eta^i(c_i)\max\{w_i, r_i\} + (1 - \eta^i(c_i))r_i$ where $\eta^i(c_i) = max_j\{\gamma_i^j\}$, and γ_i^j is the realization of c_i^j.

However, what is also true in *all* of these PBE is that any under-report of wealth by any citizen is challenged. That is the equilibrium outcome we focus on, and so to do that without overly complicating the game, we analyze a parallel *taille* game in which there is a (small) cost to a citizen who is caught under-reporting their wealth as well as a small cost incurred by any citizen who challenges a truthful wealth report.
We then look at the limit of the set of equilibria as these costs go to zero, and that gives us this first result[25].

Proposition 1: *The limit of the set of PBE of the taille game as the under-reporting and improper challenge costs go to zero all have the following properties:*

a) at Stage 2, for any set of Stage 1 reports r, we have that:

- *if $r_i < wi$ then at least one citizen j that knows w_i challenges r_i for certain*
- *if $r_i = w_i$ then no citizen j challenges i.*
- *no citizen challenges the report of another citizen whose w_i they do not know.*

b) in Stage 1, all i report $r_i = w_i$.

All of this implies that *P* is collected, but of course the mechanism is set up to insure that. More importantly, it means that there is no mis-reporting and the tax burden is distributed among the citizens based on their truthfully reported wealth.

The informational assumptions made here are stark, of course, and one could formulate a more complex and perhaps more realistic model in which citizens have only probabilistic information about their neighbors' true w_i, and in which citizens are not sure how much their fellows know about them. We stay with this simple formulation to show clearly and simply below what happens to the game's equilibria if we alter two key features.

Removing the 're-partition'

[25] Formal statements and proofs of the three following Propositions are in the Appendix.

We consider an alternative tax-liability function that has been common throughout history: the application of a fixed tax rate to an imperfectly known tax base. We denote that rate as τ so that the tax liability for parishioner *i* is:

$$T^{\tau}(w_i,r_i,c_i) = \tau s_i(w_i,r_i,c_i),$$

with the s_i functions defined as before, and *i*'s payoff function now:

$$V_i^{\tau}(w_i,r_i,c_i) = w_i - \tau s_i(w_i,r_i,c_i)$$

The game is otherwise the same as before, and we again look at PBE that are the limit as the 'minor costs' go to zero.

This gives us the next result.

Proposition 2: *If the payoff functions in the taille game are replaced with the functions V_i^{τ} above, then there is a limit PBE of the resulting game with the following properties:*

a) At Stage 2, no citizen challenges any other citizen's report.

b) At Stage 1 every citizen reports the minimal value of the support of f_i

The key is in a). No citizen has any incentive to challenge any report, as under-reporting by one's neighbors now does not impact one's own tax liability or payoff. This is why citizens at stage 1 are willing to minimize their tax liability with under-reporting. Minimal taxes are collected.

There is another limit PBE with much the same strategies as in Proposition 1: citizens report the truth and at Stage 2 citizens' strategies commit them to challenge any under-report that they know about. This is only because challenging a report known to be false is always in every situation a matter of indifference for citizens. Governments go to some trouble to convince taxpayers that reporting tax cheats is a good thing to do, but when the revenues are known to be going toward something the taxpayer does not desire (as with the knighting of a Crown Prince) this may not work well. Our point is that a key feature of the *taille* is that it has built into it an incentive to challenge under-reporting of wealth, because such under-reporting directly increases the tax liability of others.

Removing public revelation of reports

We now want to remove from the game any possibility for parishioners to observe their neighbors' reports before taxes are assessed. We do not alter the informational environment, so each citizen still has others who know his true w_i, and we also retain the ability of parishioners to challenge. We do this by replacing the sequential *taille* game above with a one-shot game in which each parishioner i simultaneously chooses a strategy pair $\{r_i, c^i\}$. That is, a report of their own wealth and a vector of probabilities of challenging others' reports. The payoff functions remain as in the original *taille* game above, so the positive incentive to challenge under-reported wealth remains intact. We investigate the Bayes-Nash equilibria of this simultaneous-move game. Challenge strategies in equilibrium now will be best-responses to the equilibrium reporting strategies of their fellow citizens.

Proposition 3: *The one-shot taille game has no limit Bayes-Nash Equilibrium in pure strategies. In particular, in any BNE, all citizens under-report with positive probability, while honest reports are challenged with positive probability and under-reports are challenged with probability less than one.*

These types of equilibria are familiar from the literature on single-individual tax evasion and compliance as a principal-agent problem.[26] The difference is that in our formulation there are individuals other than citizen i who know his true wealth, which is not true in that literature. Still, there are needless audits and tax liabilities based on under-reporting with positive probability. While it is true that the amount P is collected in the parish, the authorities will incur the costs of the audits, and individual tax liabilities will not necessarily be based on the true w_i.

Proposition 1 still holds if the *taille* mechanism in (1) is altered to:

$$T_i^* = \frac{s_i(w_i, r_i, c_i)P^*}{\sum_{j \in N_W} s_j(w_j, r_j, c_j)} \qquad (3)$$

[26] See, for example Reinganum and Wilde (1985, 1986)

Where N_W is the subset of 'wealthy' parishioners. If, as seemed to be the case with the *taille*, the poor were made to pay a small 'head tax', then no assessment of wealth would be necessary for them, and P^* is the original value P with the minor contributions by the poor subtracted out. This leaves only the wealthier taxpayers in N_W as strategic players[27]. The truly small amounts that were collected from the poor, if not collected, would not alter the tax liability of the wealthy enough for them to notice; it seems clear that the group N_W were indeed who mattered for the *taille's* success.

In the Theory Appendix we also provide a version of (3) which is progressive; individuals with higher s_i are assessed a larger proportion of P.

V. Additional Evidence of the *Taille's* Success

In this section we present additional evidence of the *taille's* advantages, gleaned from a variety of sources

We have argued that the *taille* taxation mechanism used in Paris from 1292 to 1313 had distinct advantages for both the crown and the city. It eliminated uncertainty in tax revenues for the crown, and avoided arousing civil unrest, which would surely have been desirable for both the crown and the city leaders. Administrative and enforcement costs for the crown were clearly negligible, due to the devolution of these tasks to the city, and the theoretical results of the previous section indicate that its built-in incentives allowed the city to minimize its costs, also.

Civil unrest and progressivity

We noted above the claim that the *taille* system was adopted partly to avoid the civil unrest that was sometimes sparked by other means of taxation in medieval and early modern Europe, and that the regressivity of other, indirect taxes was a trigger for such unrest. The mechanism analyzed in detail in Section IV results in proportional taxation, but we also

[27]There is now good reason for citizens to portray themselves deceptively as not members of N_W. We assume it would not be difficult for the collectors to detect this sort of deception.

described a variation of it which would work the same and result in a progressive 'tax bracket' structure. So were the actual *taille* progressive, or at least, not regressive?

Wolfe (1972) highlights the principle that in taxes based on repartition, such as the *taille,* "Le fort portant le faible." – the strong should carry the weak. The information provided in the tax rolls allows us to compute the distribution of tax payments by taxpayer. Table 5 shows the contribution by the top decile of taxpayers (defined at the city level)to the tax paid in each parish in 1292. It is clear that the principle was not an empty one: the economic elite of Paris provided more than 60 percent of the tax collected in 1292. The top one percent of taxpayers (not shown) provided 22 percent of the tax revenue that year.

Without precise information on wealth and income for the entire population, we cannot say how progressive this is. These figures are, however, striking in their similarity to those in the United States: In 2010, the top decile provided 53 percent of total Federal taxes and the top percentile 24 percent.[28] The OECD writes "Taxation is most progressively distributed in the United States…..Australia and the United States collect the most tax from people in the top decile relative to the share of market income that they earn."[29]

(Table 5 about here)

These findings can also be contrasted with those from the English poll tax of 1381. The English Parliament agreed to pay the poll tax to finance the English war effort against France in The Hundred Years' War. The tax rate was set at one Shilling per head. The English Parliament also proclaimed that it followed the principle that the rich should carry the poor. It set the tax of wealthier taxpayers as a multiple of the per-head tax and that of the very poor as a fraction of the per-head tax. The contribution of the wealthiest taxpayers was capped at 10 times the base poll tax and that of the very poor bounded from below at half of the base poll tax.[30] This meant that the ratio of the tax paid by the very rich to the poor was 20:1.Data on pre-industrial inequality (Van Zanden, 1995) imply that income or wealth ratios of the

[28] CBO (2013), "The Distribution of household income and Federal taxes 2010" Table 3, p. 13. http://www.cbo.gov/publication/44604
[29]OECD. (2008), Growing Unequal: Income Distribution and Poverty in OECD Countries, pp. 104-106.
[30] Oman (1905), pp. 20-25.

most wealthy to the most poor significantly exceeded this number. Therefore, while the rich paid more in England the tax was not progressive. In contrast, in Paris the ratio of highest tax paid to the lowest tax paid was 2290:1. The 1381 Poll tax ended in a bloody tax revolt.

Administrative costs

Our argument that the *taille* collected the agreed-upon revenues at low cost has so far been based on the model's result that the threat of challenges and audits was enough to eliminate the need to act on those threats. The information provided above regarding the small number of individuals employed in the collection of the *tailles* indicates this theoretical prediction is correct. However, we have additional data suggesting administrative costs were quite low. For the *taille* of 1313 we have a detailed list of the direct costs of collecting the *taille*. The person in charge of the collection was Jehan de Montreuil, one of the assessors elected by the city government, who received 10 *livres* for his efforts[31]. Other expenses included supplies, such as paper, parchment, binding of the books etc., totaling 33 *livres*. Salaries of clerks and sergeants totaled 120 *livres*. Most clerks and sergeants were employed for 170 to 177 days. Interestingly, 40 *livres* were deducted against an expenditure associated with sending the *prevot* and other *prud'hommes* to the *Parlement* at *Pontoise* to bargain with the king. The total expenditure was about 200 *livres* which represented about 1.5% of the amount collected. As a comparison, the US IRS estimates administrative costs on all the taxes it administers at 0.6% of taxes collected, in an environment in which there is substantial legally mandated information reporting by taxpayers and third parties.[32]Such tax administration efficiency statistics are difficult to compare across countries, due to cross-country differences in the way they are defined recorded.

An OECD report from 2006 of self-reported proportions of tax revenues devoted to tax collection and administration indicate that across its member countries, administrative costs as a percentage of net revenues collected in 2004 ranged from a low of 0.56% for the

[31] It is clear that the task of assessment was not considered a full time job, as the compensation for the assessor (10 *livres*) was lower than that of the sergeants or clerks that worked full time during the collection of the tax and received between 15 to 17 *livres*. Other than the head assessor, other assessors were not paid.
[32]Slemrod (1996) estimated the cost of compliance incurred by taxpayers in the US to be 10% of taxes paid.

US and Sweden[33] to a high of 1.89% for Belgium. A perhaps more relevant comparison is with the numbers reported to the OECD by a set of small, less-developed countries for the same year. Cyprus reports 1.39% for direct taxes only (excluding social contributions) and Lithuania and Slovenia, both also excluding social contributions, report 2.11% and 1.05%, respectively. South Africa, not so small, reports a figure of 1.25% for tax collection that includes customs operations and import and VAT tax collection in its numbers. The lowest reported administrative cost percentage from the set of non-OECD countries in the report were 0.83% of tax revenues by Argentina, a figure that also included VAT collection on imports.

The ability of Paris to collect substantial sums in the 13th century, for purposes that cannot have been universally popular among its residents, with something like 1.5% of those revenues going to administration, looks quite good in comparison to all of these figures. An important factor in determining such administrative costs is the level of compliance that can be expected; enforcing compliance takes resources. We present evidence on evasion and compliance for the *taille* in what follows.

Compliance and evasion issues

a) Taxpayer collusion

The result in Proposition 1 comes from a model in which parishioners are assumed to behave non-cooperatively, and the only strategies available are reporting and challenging. In particular, there is no consideration of the possibility that there are `bullies' – parishioners who can intimidate their fellow parishioners into not challenging their reports. We have to acknowledge that we cannot rule out that this might have occurred, but the rules of the *taille* greatly limited the potential for such behavior. The nobility and the clergy – the two groups whose members would surely find it easiest to intimidate potential challengers – were exempt from paying the *taille*. As to tax assessors and collectors under-reporting themselves and employing intimidation to deter challenges, recall that the lower tier of assessors/collectors were residents of the parishes in which they worked, making both lying

[33]Actually, Italy reported a figure of 0.52%, but the OECD notes that this number omits substantial work on tax fraud carried out by the national 'tax police'.

and intimidation difficult. The upper tier of assessors came from the most highly-taxed groups. Within the city government, the mayor (the *prevot de marchands*) was aided by only 4 officials – the *echevins* – who were also drawn from the city's economic elite.[34] Information from the tax rolls shows that the *echevins* and their families paid taxes that place them in the top 5% of the tax payment distribution.

Recall that any taxpayer *j*'s tax liability T_i in the full *taille* system is decreasing in the assessment (i.e., the s_i) of any other taxpayer. Also, however, the size of the impact on j's tax liability of a change in s_i is increasing in s_j. That is, the negative derivative $\partial T_j/\partial s_i$becomes more negative as s_j increases. Thus, the paradigm that the 'rich carry the poor' had an additional benefit: being among the highest taxed, the governors and high-level assessors had the greatest stake in the functioning of the mechanism and in particular, the pursuit of wealthy tax evaders. Further, the city governors served short terms and rotated frequently, and we have cited data from Bove(2004) that indicates their assessments didn't fall once they took office.

The general principle that the 'rich carry the poor' in itself would imply that the rich not collude to pass their tax burden onto the poor, but this doesn't rule out the possibility of a collusive arrangement among a group of the highest-taxed citizens designed to lower their payments and so pass some of their burden (mostly) onto other highly-taxed citizens. That is, the model doesn't encompass the possibility of a group of wealthy citizens (or any other group) agreeing to mutually under-report and to not challenge one another. Notice, however, that this can work only if the group that undertakes it is 'informationally self-contained'; the group must be sure that there is no one outside the group that has sufficient information about one of them to make a challenge. Such an outsider challenge of even one group member's false report could bring down the entire group, as the challenged member would then lose his incentive to stick to the no-challenge agreement.

Because the very rich were responsible for providing most of the tax revenue and thus had the greatest incentives to cheat, the city assigned most of the assessors to the parishes where

[34]Bove (2004) pp. 55-70.

the rich lived. Table 5 shows the distribution of assessors by Parish for the years for which we have data. This clearly shows that indeed, the parishes with largest populations but also with the highest number of rich taxpayers were assigned more (informed) assessors.

b) Use of the courts

That recorded direct administrative costs were low does not imply that there were no challenges and re-assessments. In fact, we found an almost complete absence of any disputes in the historical record, which cannot prove definitively that none occurred, but we do have some direct evidence that the city government did not deal with many cases that required (costly) legal procedures.

The city government had legal jurisdiction over matters related to the city governance. The municipal court – the *parloir* – was convened to settle legal disputes related to the privileges of the city. Le Roux and Victor (1846) transcribed the *livre de parloir*, which includes legal disputes and testimonies before the municipal court. While historians agree that the full document did not survive the ages (Bove, 2004), the coverage for the years 1285 to 1320 seems to be more complete than for other periods. We searched the court records for any dispute related to the collection of the *taille*, and could find only one case, related to the *taille* of 1308 raised to pay the traditional tribute to the king on the occasion of the marriage of his daughter Isabel. This suggests that legal disputes involving recourse to the legal system that arose from the administration of the *taille* were rare.

The lone court case involved a *lombard* (Italian banker or moneylender) by the name of Raimbaut (Romband) who apparently refused to pay his assessment for 1308. Italian moneylenders enjoyed a royal privilege of money lending (practicing usury). In 1282 the French king declared that the *lombards* contribute to the city taxes without enjoying the privileges of citizenship. They appear in separate lists in the tax rolls of 1292 to 1300, but these special lists no longer existed in the tax roll from 1313 that we analyzed. Apparently, sometime after 1300 the king revoked the royal decree of 1282 and the Italians were taxed directly by the crown rather than by the city. Our friend Raimbaut was one of a relatively

small number of Italians that were citizens and were included in the regular tax units.[35] It appears that when the king decided to change the tax status of the Italian aliens and they were no longer taxed by the city, Raimbaut thought it advantageous to try and change his tax status from a citizen to an alien and thus evade taxation. The court ruled that since he enjoyed the privileges of a burgher in the past he should pay the tax assessed on him.

Note however, that the single court case we found pertained to an attempt to evade taxation based on tax status rather than a dispute on a challenged income report.[36]At the same time it is worthwhile to note that Raimbaut's tax assessment put him in the top 5% of tax payers – exactly the sort of wealthy taxpayer that our analysis predicts the city government did not want to lose.[37]

c) Strategic movement by taxpayers

Citizens move for a variety of reasons, but in the *taille* system reducing one's tax liability is one possibility. Members of a tax district will know less about a new arrival's wealth, and it is even possible that – due to the re-partition of the total City tax liability across districts – a citizen can lower the tax liability based on their true wealth by moving to another district.

Assume that the tax paid by a taxpayer *i* in a particular year *t* - $T_{i,t}$ – is a fraction ρ of her true income, $w_{i,t}$, and a possible undetected deviation of his reported income,$r_{i,t}$, from his true income.

$$(1) T_{i,t} = \rho w_{i,t} + \rho\left(r_{i,t} - w_{i,t}\right)$$

[35] In 1300 there were only 25 Italians recorded as regular citizens versus 127 as Aliens.

[36]The text reads: pronunciatum fuit contra ipsum quod ipse talliam a civibus parisiensibus sibi impositam a tempore quo fuit adeptus privilegium burgensium parisiensium solvet tanquam burgense parisiense. Et nichilominus solvet terminis assignatis financiam quam fecit antequam factus fuisset burgensem cum gentibus nostris, quia contra prohibitionem domini regis mutuaverat sub usuris sub regno. Le Roux and Victor (1846) p. 171.

[37] From the tax rolls we found that he paid 75soldiin each of the tax years 1298, 9 and 1300 and lived in the second ward of St Huitace.

Under the assumption that the incentive to evade taxation is increasing in the tax paid, $T_{i,t}$, and under the *taille* mechanism also in the relative tax burden carried by the individual taxpayer, $s_i / \sum_i s$, and her risk aversion or desire to signal status, θ_i, then the deviation of the report from the true income can be written as :

$$(2) r_{i,t} - w_{i,t} = f\left(\underset{(+)}{E_{t-1}(T_{i,t})}, \underset{(+)}{E_{t-1}(s_i / \sum_i s)}, \theta_i \right)$$

Since assessors had information about individual's observable characteristics such as place of residence, occupation, occupational status, demographics, etc. they could have a pretty good idea about the expected income of taxpayers. However, an individual's income is affected by unobservable characteristics and idiosyncratic income shocks. In a modified version of equation (1) we divide true income into an observable part, $\overline{w}_{i,t}$, and unobservable one, $\widetilde{w}_{i,t}^{T}$, and assume that a taxpayer can only misrepresent the unobservable part.

$$(3)\ T_{i,t} = \rho\left(\overline{w}_{i,t} + \widetilde{w}_{i,t}^{T}\right) + \rho\left(\tilde{r}_{i,t} - \widetilde{w}_{i,t}^{T}\right)$$

$$(4)\ T_{i,t} = \rho\left(\overline{w}_{i,t}\right) + \rho\left(\tilde{r}_{i,t}\right)$$

Since our data does not include information about the true income we focus on one source of potential evasion for which we have data. Our tax game suggests that neighbors have full information about neighboring taxpayers so that equilibrium behavior is not to cheat. However, when a taxpayer moves to a different location, some of the information might get lost. We consider the following model of the choice to move to a different location; moving to a different location is a function a change in the economic situation of the taxpayer, her incentive to evade taxation and her idiosyncratic cost of moving *Ci*:

$$(5)\quad p\left(move_{i,t}\right) = g\left\{\Delta w_{i,t}, f\left(\underset{(+)}{E_{t-1}(T_{i,t})}, \underset{(+)}{E_{t-1}(s_i / \sum_i s)}, \theta_i, \right), C_i(move\ \ )\right\}$$

Since we have data on taxpayer moves, their history of tax payments and their relative contribution to the tax collection in their respective tax unit we can test whether the

probability to move is motivated by the incentive to misrepresent true income. We assume that shocks to true income are random and independent of the ex-ante choice to evade or the fixed cost to relocate.

We classify moves into three categories according to their degree of information loss and cost of relocation: i) A move to a different parish provides the greatest loss of information, but also a greater cost of moving, ii) A move to different ward within a large parish has lower information costs and perhaps lower relocation costs, iii) A move to a different street within the same ward probably entails little loss of information and is probably also less costly. According to the paradigm that the 'rich carry the poor', the higher is a taxpayer's tax status, the greater is the potential tax burden in case of shortfalls in tax revenues. Individuals who contemplate moving to a different parish or ward in order to affect their tax status in the next tax game can compute, based on their tax assessment, the tax status in their parish and compare it with a counterfactual tax status in another parish. We therefore further divide moves into two categories: to moves that ex-ante lower the tax status and to those that raise it[38].

For the analysis of moves we select only taxpayers which we identified for three consecutive tax rolls 1292, 1295, 1297[39]. Table 6 details the distribution of moves in our data. Naturally, because of differences in time elapsed there are more moves between 1292 and 1296 than between 1296 to 1297. The moves are distributed quite evenly between all types of moves (panel (A)) suggesting there is no systematic bias towards strategic moves. Moreover the top decile of taxpayers does not exhibit a different pattern than the rest of the population (panel B) There is no discernable to move to a tax unit where the taxpayers status would be lower (Panel C) and finally, when we examine moves that are strategically more likely, i.e. moving

[38] The historical records do not allow us to determine whether the fixed quotas were assigned only at the pariah level or whether in large parishes the parish quota was further subdivided into wards. The informational requirements in our model suggest for large parishes it made sense to allocate fixed tax quotes to each ward..

[39] Some taxpayers that we could not identify may have moved which would create a significant measurement error problem. Note, however, that the requirement for consecutive identification in the three tax rolls may cause a selection bias towards the higher income individuals. Since the incentive to evade is related to higher incomes, this selection bias should not affect pour results.

to a different parish (Panel D) we see that top decile taxpayers move less. When we examine a matrix of inflows and outflows out of parishes, the net flows are insignificant.

(Table 6 about here)

We now turn to formally estimate equation (5).Using panel probit regressions we estimate the probability of any move and the probability to move to a different parish, different ward within the parish or a different street within the ward as a function of taxpayer lagged share of the tax paid in his tax unit, his lagged (log) tax and a vector of controls C that includes year effects and parish effects and potential costs of relocation such the taxpayer's economic sector, his level of education, ownership of fixed capital, gender and whether she was a foreigner.

$$(6)\ p(move)_{i,t} = \alpha + \beta_1 \left({}^{T_{i,t-1}}\Big/ {}_{\sum_i T_{t-1}} \right) + \beta_2 lnT_{i,t-1} + \boldsymbol{\gamma C_{i,t}} + \boldsymbol{v_{i,t}}$$

Results reported in Table 7 show that the coefficient on the tax status, β_1, is insignificant for any type of move and that the coefficient on lagged income,β_2, is significantly negative for any sort of move. Suggesting that the higher was a taxpayer's income the less likely she was to move. Therefore, the evidence presented in table 6 together with our regression results suggests that tax evasion by those that contributed most to the tax collection was not a concern. If anything, there was a negative selection (in terms of income) into moves. It seems that relocation was largely driven by economic shocks rather than by strategic behavior. Estimating the model for moves to a lower ex-ante tax status parish shows similar results.

(Table 7 about here)

For robustness, we test a modified version of the tax evasion decision where what matters is the unobservable part of a taxpayer's income (equation (3)). In the first stage we estimate equation (4) and regress taxpayers' tax payment on all observable variables and use the residual as the fraction of the tax based $\tilde{T}_{i,t-1}$on the unobservable part of income. We then re-estimate equation (6) using instead of lagged tax payment $lnT_{i,t-1}$, the residual obtained from regressing equation (4) $ln\tilde{T}_{i,t-1}$. The results (Table 8) show that for all moves we obtain

similar results to that of total tax estimation. Taken together, the results of this section strengthen our qualitative assessment and allow us reject the hypothesis of significant strategic moves.

(Table 8 about here)

Imitation and Lessons for Contemporary LDCs

An important bit of evidence that the use of taxes based on repartition was regarded as a success may be the fact that it was used often. As mentioned in Section III, variations of the Parisian *taille* system were used throughout France in the years leading up to the period we study, and continued to be used into the 16th century. Beyond that, in England the Lay Subsidies imposed by the crown were converted from the standard tax rates system to a *taille*-like mechanism in 1334[40] - this importation from France seems a particularly sincere form of flattery of the *taille*.

We have argued that the *taille's* success was particularly impressive because of the environment in which it was used; the Crown had little administrative capability, and previous attempts to use troops to enforce compliance had ended badly. Besley and Persson (2014), among others, document the fact that both tax revenues as a proportion of GDP and income tax revenues as a proportion of total tax revenues rise with GDP per capita in a long time series of data that includes most countries. The clear implication is that low-income countries have difficulty collecting taxes on income and wealth and that this in turn reduces their ability to fund government services. 14thcentury France resembles in many ways LDCs of the 21st century, and there is a small but growing literature devoted to field experiments seeking ways to improve tax compliance and increase tax revenues in LDCs. Here we briefly outline 5 recent studies of this type which we believe offer further evidence that what we have argued made the *taille* successful in medieval Paris is of value in similar environments.

We noted that the use of 'tax farmers' during the medieval period was not uncommon, and these were not employed by the leaders of Paris. One difficulty with tax farming is

[40] Glascock (1975).

motivating and monitoring the farmers. Kahn et al (2015) report on a field experiment designed to improve the efficacy of a tax-farming regime for the collection of property taxes in Punjab, Pakistan. A set of tax-farmers were put under one of three pay-for-performance schemes, and the authors find that the scheme that rewarded the farmers with increased payments when tax collections increased did increase tax revenues. However, all of the increase came from higher payments from a few properties that had been paying less than the statutory amount. Most properties paid no more in taxes, but were found to be paying greater bribes to the tax farmers than they had before the new program was put in place. In the Parisian *taille*, a bribe to the neighbor who did your assessment would do no good if any other neighbors know that your assessment is understated.

It is often suggested that 'positive incentives' are more effective at increasing tax compliance than are sanctions.[See, e.g., Luttmer and Sinhal(2014) on 'tax morale'] However, Dunning, et al (2015) report on a field experiment to increase compliance for municipal tax payments in Montevideo, Uruguay, where some 25% of taxpayers are in delinquency on their tax bills despite the fact that tax authorities know precisely who they are. The authors suggest this is because the judicial process for collecting from such delinquents is slow and costly for the city, and generally results in '…. changing an 'administrative' debt into a 'negotiated' debt'. The cities in question instituted a program in which taxpayers who were up-to-date on their tax payments were entered into a lottery that randomly awarded tax holidays. The authors find the program had only a weak effect on tax compliance.

Some field experiments have been more successful, and have also featured characteristics that are shared by the *taille* system. Del Carpio (2013) reports on a field experiment in two municipalities in the Lima province of Peru, in which subsets of taxpayers received letters informing them of one or more of the following: the average level of enforcement, the average rate of tax compliance or a reminder of the deadline for payment. Interestingly, information on compliance increased compliance by 20% over the control group that received no letter, but a reminder of the deadline also increased compliance by 10%. We

note here that the *taille* system made compliance within a parish pretty much a matter of common knowledge.

Even when the state has some administrative capacity, the lessons of the *taille* can be relevant. Kumler et al (2013) investigate payroll taxes collected from Mexican firms that operate within the formal sector. They found these firms often under-reported the wages paid out to workers as a means of reducing their own required tax payments. The extent of such under-reporting decreased when the government instituted a reform that put one of the key features of the *taille* in place in this environment; they tied workers' benefits to the taxes collected from their employers, giving workers an incentive to monitor the wages employers were reporting to the government.

In another innovation that utilizes a type of 'third party verification', Naritomi (2013) assesses an anti-tax evasion program from Sao Paulo, Brazil, 'Nota Fiscal Paulista', that created monetary rewards for consumers to ask for receipts. It is estimated that the program increased the revenue reported in retail sectors by at least 22% over four years, with no effects on exit rates or formal employment decisions.

Finally, we note a recent example from a highly developed country. The Obama administration's health care reform bill (H.R. 3590) imposed a fixed annual tax on US pharmaceutical companies that is calculated in much the same way as was the *taille*.[41] These companies are collectively liable for a fixed tax of $2.3 Billion per year, with each year's total payment divided among the firms on the basis of their sales for the year. Similar taxes are imposed on medical device manufacturers ($2 Billion in total) and health insurance providers ($6.7 Billion), and the portion each company pays is calculated similarly. Clearly each of these firms has an incentive to understate its sales in order to reduce its share of the total tax liability, and each firm has a clear incentive to challenge any under-reporting of

[41] The Patient Protection and Affordable Care Act (H.R 3590); Title IX- Revenue Provisions of the bill SEC. 9008. IMPOSITION OF ANNUAL FEE ON BRANDED PRESCRIPTION PHARMACEUTICAL MANUFACTURERS AND IMPORTERS.
http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=111_cong_bills&docid=f:h3590enr.txt.pdf

those figures by its rivals. General under-reporting by all firms in the group has no impact on tax liability due to the fixed sum being collected, and it seems very likely that these firms know enough about their rivals that any serious under-report by any subset of firms would be detected and challenged by the others. And we can only speculate, but it seems likely that the motivation for this being in the bill is similar to that of the French Crown in the 14th century; revenue certainty.

VI. Conclusions

In this paper we documented and analyzed the Parisian *taille* of the late 13th century. Our analysis demonstrated that this tax system was remarkably successful, and that its success derived from the fact that it was based on two indispensable principles: i) partition of a fixed tax liability among taxpayers and ii) a process that revealed each taxpayer's claimed tax liability to their neighbors. In the environment of medieval Paris, with each citizen living and working in close proximity to their neighbors, this resulted in a tax collection game in which taxpayers have an incentive to challenge false claims by others, which in turn induces truthful reporting, resulting in an efficient tax assessment and collection procedure. We provide evidence from the Parisian *taille* levied between 1292 and 1313 and other historical records that indicates that these royal taxes were collected from the city of Paris at a remarkably low cost, without violence and with limited recourse to legal action against tax evaders.

The lessons we draw from the Parisian *taille* may be useful in modern situations. In lesser developed economies, tax collection could be entrusted in a similar fashion to local communities. In developed economies, in sectors where governments have inferior information about economic activity, tax collection could be delegated along similar principles to well informed business associations. An additional feature of the Parisian *taille*, that allocated most of the tax burden to the affluent taxpayers, could have generated a sentiment of fairness that facilitated its collection. In lesser developed economies with high inequality, perceived fairness of the tax system might also increase compliance. We leave this aspect of the *taille* for future research.

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A.N. KK 283 (tax rolls for 1298,9,1300)

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Appendices

A.1 – Tables

Table 1

Number of taxpayers and tax collected in Parisian tax rolls

Year	Number of taxpayers	Tax to be collected (*livres parisis*)	Tax collected (*livres parisis*)	Share of top decile in tax revenues
1292	14,566	10,000	12,287	68%
1296	5,703	10,000	10,024	65%
1297	9,930	10,000	10,372	61%
1300	10,656	10,000	11,479	62%
1313	6,352	10,000	10,394	84%

Source: A.N. KK 283, Michaelsson (1951, 1958, 1952)

Table 2
Professions of Assessors compared with professions of taxpayers

	Data from tax roll		Data from Assessor list	
profession	**Taxpayers' Average tax**	**Taxpayers**	**Assessor's Average tax**	**Assessors**
changer	6.11	37	8	6
draper	5.49	94	11	6
spice merchant	3.31	79	4	2
firewood merchant	3.22	53		
tanner	3.00	31	1	1
wholeseller	2.29	159	6	4
saddler	1.99	67	4	1
hotelier	1.80	111	1	1
butcher	1.46	79	4	5
taverner	1.30	678	2	1
goldsmith	1.27	271	7	3
Merchant	1.12	24	6	7
grain merchant	1.06	18	3	1
boot maker	1.00	53		
baker	1.00	144	4	4
fishmonger	0.92	102	7	2
seaman	0.85	49		
harness maker	0.82	51		
Sargent	0.62	237		
used clothes merchant	0.60	191	1	4
weaver	0.60	368	2	5
candle maker	0.60	71		
skinner	0.59	368	9	2
agent	0.56	65		
crate maker	0.56	56	1	1
belt maker	0.53	161	2	2
tailor	0.51	157		
barber	0.44	121		
barrel maker	0.44	96		
pastry maker	0.44	58		
buckle maker	0.44	77	2	2
shoe maker	0.43	284	1	3
carpenter	0.38	116		
builder	0.36	138		
fuller	0.34	85		
oven guard	0.34	83		
wine merchant	0.27	81		
food merchant	0.27	267		
porter	0.26	119		
longshoremen	0.24	59		
footwear	0.18	179		
tailor women's clothes	0.17	149		

Source: Authors calculations based A.N. KK 283, Michaelsson (1951, 1958, 1952) and Le Roux and Victor (1846)

Table 3
Time frame of known economic activity of tax assessors

Years of Activity	Number of Assessors
1292 - 13	8
1296 - 13	7
1292-9	1
1292-00	31
1292	1
1296-00	1
1292 - 7	7
1297-00	1
1298-00	1
1300	2
1308-13	1
1313	3
unknown	2
Total	66

Source: Authors calculations based A.N. KK 283, Michaelsson (1951, 1958, 1952) and Le Roux and Victor (1846)

Table 4
Rank of assessors in the tax distribution

Rank in tax distribution	Number of Assessors
0.5%	3
1.0 – 0.5%	6
5 – 1%	27
10 – 5%	8
20 - 10%	15
30 - 20%	1

Source: Authors calculations based A.N. KK 283, Michaelsson (1951, 1958, 1952) and Le Roux and Victor (1846)

Table 5
Distribution of taxpayers and tax payments and assessors by Parish – Paris 1292

Parish number	Tax collected (pounds)	Number of taxpayers	Number of elite taxpayers	Share of elite taxpayers	Share of elite in tax collected	Number of assessors*
1	2420	2474	377	0.15	0.70	13
10	1497	1445	236	0.16	0.73	20
2	1167	1335	182	0.14	0.64	9
14	998	1222	141	0.12	0.63	4
12	878	836	87	0.1	0.75	1
9	755	1455	94	0.06	0.53	7
11	669	964	100	0.10	0.62	7
8	381	848	34	0.04	0.39	2
13	363	924	45	0.05	0.40	2
15	330	674	45	0.07	0.46	2
24	214	384	27	0.07	0.37	
4	194	440	26	0.06	0.54	
21	171	408	20	0.05	0.33	
18	159	225	25	0.11	0.63	
6	79	214	8	0.04	0.27	
3	70	231	5	0.02	0.16	1
5	54	85	8	0.09	0.48	2
16	48	149	5	0.03	0.32	1
23	45	234	5	0.02	0.20	
7	43	73	6	0.08	0.41	
17	23	62	4	0.06	0.36	
20	22	79	2	0.03	0.22	
22	17	62	1	0.02	0.12	
19	8	21	0	0	0	
Sum	**10606**	**14844**	**1483**	**0.1**	**0.62**	

*The number of assessors for all the years we have data for.

Source: Authors calculations based A.N. KK 283, Michaelsson (1951, 1958, 1952) and Le Roux and Victor (1846)

Table 6
Distribution of taxpayers that moved, Paris 1292 and 1296

Panel (A)

	Year		
Moves by type	**1292**	**1296**	Total
Stay	3,318	3,858	7,176
	40%	47%	87%
Within ward	298	80	378
	4%	1%	5%
Between wards	199	65	264
	2%	1%	3%
Between parish	293	105	398
	4%	1%	5%
Total	4,108	4,108	8,216

Panel (B)

	Status		
Moves by type	**9 deciles**	**Top decile**	Total
Stay	6,015	1,161	7,176
	73%	14%	87%
Within ward	337	41	378
	4%	1%	5%
Between wards	234	30	264
	3%	0%	3%
Between parish	337	61	398
	4%	1%	5%
Total	6,923	1,293	8,216
	84%	16%	100%

Pearson chi2(3) = 11.7325 Pr = 0.008

Panel (C)

	Status		
All moves	**9 deciles**	**Top decile**	Total
moved down	283	45	328
	3%	1%	4%
stayed	6,352	1,202	7,554
	77%	15%	92%
moved up	288	46	334
	4%	1%	4%
Total	6,923	1,293	8,216
	84%	16%	100%

Pearson chi2(2) = 2.1535 Pr = 0.341

Panel (D)

	Status		
Moved parish	**9 deciles**	**Top decile**	Total
moved down	171	28	199
	2%	0%	2%
stayed	6,586	1,232	7,818
	80%	15%	95%
moved up	166	33	199
	2%	0%	2%
Total	6,923	1,293	8,216
	84%	16%	100%

Pearson chi2(2) = 0.5269 Pr = 0.768

Table 7

The probability of moving:
panel probit estimations

	(1) Move anywhere	(2) Move within ward	(3) Moved ward	(4) Moved parish	(5) Moved down
Contribution to parish tax (percent)	16.29	40.46*	0.302	-6.668	19.56
	(0.76)	(1.94)	(0.06)	(-0.17)	(0.68)
Log tax paid	-0.302***	-0.253***	-0.349***	-0.180*	-0.237***
	(-4.40)	(-3.01)	(-3.35)	(-1.66)	(-2.60)
Observations	3832	3760	3664	3781	3732
chi2	112.7	71.67	66.76	57.77	41.41
method	*xtprobit*	*xtprobit*	*xtprobit*	*xtprobit*	*xtprobit*

Controlling for year and parish fixed effects, occupations, human capital, physical capital, gender, foreign status.
Sample excludes taxpayers classified as poor (*menuz*) and parishes that were too small to be partitioned into wards.
z statistics in parentheses
Standard errors clustered by taxpayer
$^{*}p< 0.10$, $^{**}p< 0.05$, $^{***}p< 0.01$

Table 8

The probability of moving:
panel probit estimations

	(1) Move anywhere	(2) Move within ward	(3) Moved ward	(4) Moved parish	(5) Moved down
Contribution to parish tax (percent)	-17.26	-11.77	-8.778	9.294	13.96
	(-0.80)	(-0.50)	(-1.07)	(0.32)	(0.54)
Log tax based on unobservable income	-0.215***	-0.005	-0.205**	-0.356***	-0.300***
	(-3.42)	(-0.06)	(-2.00)	(-3.84)	(-3.64)
Observations	3832	3760	3664	3781	3732
chi2	107.9	64.77	65.05	67.62	46.85
method	*xtprobit*	*xtprobit*	*xtprobit*	*xtprobit*	*xtprobit*

Controlling for year and parish fixed effects, occupations, human capital, physical capital, gender, foreign status

Sample excludes taxpayers classified as poor (*menuz*) and parishes that were too small to be partitioned into wards.

z statistics in parentheses

Standard errors clustered by taxpayer

$^{*}p< 0.10$, $^{**}p< 0.05$, $^{***}p< 0.01$

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A2 - Theoretical Appendix: Formal statements and proofs of Propositions 1 - 3

Preliminaries

The environment: a set $N = \{1, 2, ..., n\}$ of parishioners, each of whom draws their true wealth w_i from a non-degenerate distribution f_i with support $[a_i, b_i]$. For each $j \in N$ there is a set $N_j \subset N$ of individuals who observe w_j, and we assume that for all j, $j \in N_j$ and $N_j \backslash \{j\} \neq \phi$.

At Stage II, after observing the set $r = (r_i)_{i=1}^n$ of realized Stage I reports, each parishioner i chooses a vector $c_{ij}(r) \in [0,1]^n$ of probabilities of challenging each other parishioner, with $c_{ii} = 0$ always. The Stage I report realizations r determine the node of the game at Stage II, and, coupled with the priors f_i, the Stage 1 strategies $\rho_i(r|w_i)$ determine each parishioner's beliefs about the realized wealth of parishioners whose w_j they don't observe, denoted as $\psi_{ij}(w_j|r_j, \rho_j)$.

For any Stage 2 strategy profile c, we can define $\mu_j(c, r)$ as the probability that r_j is challenged by *some* other parishioner, and $\mu_{j-i}(c, r)$ as the probability that r_j will be challenged by some parishioner other than i. Note that $\mu_j(c, r), \mu_{j-i}(c, r) \in [0, 1]$, but each is 1 only if *at least one* (other) parishioner is challenging r_j with probability 1, and is 0 only if *all (*other) parishioners are challenging r_j with probability 0.

Define the following two indicator functions:

$$h(x; e) = \begin{cases} 0, \text{ if } x \leq 0 \\ e, \text{ if } x > 0 \end{cases}$$

and

$$f(x; d) = \begin{cases} 0, \text{ if } x > 0 \\ d, \text{ if } x \leq 0 \end{cases}$$

with $e, d > 0$.

The payoff function for parishioner i in the two-stage game above is now redefined as:

$$U_i(w_i, r, c, P, e, d) = w_i - T_i(w_i, r, c, P) - h(w_i - r_i; e)\,\eta^i(c_i) - \sum_j c_{ij} f(w_j - r_j; d)$$

The functions h and f capture the idea in the text that citizen i pays a 'utility penalty' of e iff he under-reports his wealth and at least one other citizen reports him, and pays a penalty of d for every citizen he challenges that in fact reported their wealth truthfully. To ease notation we will write overall strategy profiles as $\rho(r|w)$ for $[\rho_i(r|w_i)]_{i\in N}$ and $c(r)$ for $[c_{ij}(r)]_{i,j\in N}$

Proposition 1 *For any $d, e > 0$, any Perfect Bayesian Equilibrium of the two-stage taille game with payoff functions U_i has a strategy profile $\{\rho(r|w), c(r)\}$ which satisfies the following:*

a) In Stage 2. for any r and for any pair i, j we have that:

if $i \in N_j, r_j < w_j$ and $\mu_{i-j}(c(r)) < 1$,then $c_{ij}(r) = 1$: i challenges j with certainty

if $i \in N_j, r_j < w_j$ and $\mu_{i-j}(c(r)) = 1$, then $c_{ij}(r)$ can be any value between 0 and 1, and

for all other i, j $c_{ij}(r) = 0$

b) in Stage 1, for all i and for all realizations of w_i, $\rho_i(w_i|w_i) = 1$: parishioners report the truth with certainty.

The beliefs that support this are that any $i \notin N_j$ believes that $w_j = r_j$ with certainty so long as $r_j \in [a_j, b_j]$.

Proof of Proposition 1:

Proof of a)

Consider the Stage 2 challenge strategy $c_{ij}(r)$ of some $i \in N_j$, following the realization r of Stage 1 strategies. We claim it must be of the following form:

$$c_{ij}(r) = \begin{cases} 1, \text{ if } r_j < w_j \text{ and } \mu_{j-i}(\gamma) < 1 \\ 0, \text{ if } r_j = w_j \\ \text{any } \gamma_{ij} \in [0,1], \text{ otherwise} \end{cases}$$

The first line follows from that fact if $i \in N_j$ and observes $r_j < w_j$, then $\mu_{j-i}(\gamma) < 1$ implies that i's expected payoff is increasing in c_{ij}, because it is increasing in s_j.

The second line follows from that fact that choosing $c_j^i > 0$ when $r_j = w_j$ does not change i's tax liability but does cost him the expected penalty $ec_{ij} > 0$ for challenging an honest report.

The only possibilities left for any $i \in N_j$ are that $r_j < w_j$ and it is certain that r_j will be challenged by someone else; $\mu_{j-i}(\gamma) = 1$. In this case $i \in N_j$ is indifferent about challenging r_j.

This implies that the probability in equilibrium that any j who reports $r_j < w_j$ will be challenged by a member of N_j is 1. Given that, a dominant strategy for any $i \notin N_j$ is $c_{ij}(r) = 0$. This proves a).

Proof of b) No PBE strategy $\rho_j()$ can attach positive probability to any $r_j < w_j$. If it does and such a report is realized, the logic above implies that it will be challenged with certainty. That report is therefore dominated by reporting $r_j = w_j$, since both result in the same tax payment T_i and the former incurs the penalty d.Thus, i's expected payoff can be increased by setting the probability of reporting any $r_i < w_i$ equal to 0.

b) then immediately implies that any $r_i \in [a_i, b_i]$ has a positive probability of being realized in equilibrium, and so Bayes Rule implies that the beliefs $\psi_{ij}(w_j|r_j, \rho_j)$ for $i \notin N_j$ in any equilibrium are:

$$\psi_{ij}(w_j|r_j, \rho_j) = \begin{cases} 1, \text{ for } w_j = r_j \\ 0, \text{ otherwise} \end{cases}$$

■

Note that this implies that there is an 'essentially unique' PBE in which some $i \in N_j$ challenges $r_j < w_j$ with certainty and all parishioners report truthfully. The 'essentially' arises because of the second part of a). If N_j has two members other than j, then all the PBE requires is that one of them choose $c_{ij} = 1$ if $r_j < w_j$. The other can challenge randomly. As this is the only PBE for any $d, e > 0$, the Proposition in the text follows.

Observation 1:

Example of a PBE with $e = d = 0$: (Assume for this example that the set $N \backslash N_j$ is non-empty for each j, so that for each parishioner there is some other parishioner who is ignorant about w_j). At Stage I, each $\rho_i(r_i|w_i)$ puts probability mass of 1/2 on $r_i = w_i$, 0 on any $r_i > w_i$, and

$$\rho_i(r_i|w_i) = \begin{cases} \frac{1}{2(w_i - a_i)} \text{ for } a_i \leq r_i < w_i \\ 0, \text{ for } r_i < a_i \text{ and } r_i > w_i \end{cases}$$

Beliefs about w_j for any $i \notin N_j$ can therefore be derived from any observed r_j using Bayes Rule, and all such i will attach positive probability to the event $r_j < w_j$ for any observed r_j (other than $r_j = b_j$, which is reported with probability 0).

At Stage II, let

$$\gamma_{ij}(r) = \begin{cases} 1 \text{ for any } r_j \text{ if } i \notin N_j \\ 0 \text{ for any } r_j \text{ if } i \in N_j \end{cases}$$

In this PBE, for any parishioner $i \notin N_j$ to challenge j for sure is optimal, because there is no cost to i of doing so, and it might increase i's payoff. It is therefore also sequentially rational for those $i \in N_j$ to not challenge j ever because they know in equilibrium every report will be challenged for certain, so there is no impact on i's own tax liability. On the other hand, at Stage I the fact that every report is challenged is no deterrent, as that means every report generates the same payoff for the reporter, as there is no cost to being found to have under-reported.

An analogous PBE can be constructed for any strategies $\rho(r_i|w_i)$ that attach any probability mass to $r_i = w_i$, including 0.

As to the observation that necessarily $s_i = w_i$ in *any* PBE with these payoffs, note first that any Stage I strategy for i that attaches positive probability to reporting $r_i > w_i$ is weakly dominated by one that attaches zero probability to it. Thus $s_i > w_i$ will not occur in any PBE Suppose then that $s_i < w_i$ occurs in some PBE. The definition of s_i implies that this can only occur if $r_i < w_i$ and i's report was not challenged. This in turn means that $\gamma_{ji}(r) < 1$ for all j and in particular for all $j \in N_i$. This cannot be part of an PBE then, as each of the $j \in N_i$ can increase their payoff by setting $\gamma_{ji}(r) = 1$ when $r_j < w_j$.

■

Proposition 2 *In the taille game of Proposition 1, replace the payoff functions U_i with the functions:*

$$U_i^{\tau}(w_i, r, c, d, e) = w_i - \tau s_i(w_i, r_i, c_i)) - h(w_i - r_i; e)\eta^i[c_i] - \sum_{j \neq i} c_j^i f(w_j - r_j; d).$$

Then for all $d, e > 0$ the following strategies are a PBE:

In stage 1, for all i and for all $w_i \in [a_i, b_i]$, $\rho_i(r_i|w_i) = \begin{cases} 1, \text{ for } r_i = a_i \\ 0, \text{ otherwise} \end{cases}$

In stage 2, $c_{ij}(r) \equiv 0$

Proof of Proposition 2:

Consider Stage II, and a pair i, j such that $i \notin N_j$. Then it is a dominant strategy for i to set $c_{ij}(r) = 0$ since there is 0 payoff to i from a challenge if $r_j < w_j$ and a negative payoff if $r_j \geq w_j$. If $i \in N_j$ then $\gamma_{ij}(r) = 0$ is a dominant strategy whenever i observes $r_j \geq w_j$, and when i observes $r_i = w_i$ all values of $c_{ij}(r)$ have the same payoff, so 0 is sequentially rational.

At Stage I, given the Stage II strategies above, it's clear that for every i, $r_i = a_i$ is the tax-minimizing strategy, and so is optimal.

As to beliefs for $i \notin N_j$, whatever they are they don't alter the fact that $\gamma_{ij}(r) = 0$ is weakly dominant, and so they can be set as anything in the PBE.

■

The simultaneous-move *taille game*.

The game is now simultaneous. Each parishioner j simultaneously chooses a reporting strategy $\rho_j(r_j|w_j)$, and a challenge strategy $[c_{ji}] \in [0,1]^{n-1}$; the latter cannot now depend on r, but if $i \in N_j$, γ_{ji} can depend on the value of w_j that i observed, and must be a best response to $j's$ reporting strategy, $\rho_j(r_j|w_j)$. The payoff functions are as in the full taille game, and the equilibrium concept is now that of a Bayes Nash equilibrium, in which each parishioner again calculates expected payoffs using the BNE strategies of their opponents and (for any $i \notin N_j$) their priors over w_j for each j.

Proposition 3 *The simultaneous-move taille game has no BNE in pure strategies. In particular, in any BNE, for any i and any $w_i > a_i$,*

$$\int_{a_i}^{w_i} \rho_i(r|w_i)dr > 0$$

Also, if $r_i = w_i$ then $\mu_i(c) > 0$, and if $r_i < w_i$ then $\mu_i(c) < 1$

Proof of Proposition 3:

Claim 1: A BNE cannot involve ρ_j that are purely truthful for any j. That is, it cannot be true for any j that $\rho_j(r_j|w_j)$ puts probability 1 on $r_j = w_j$ for all $w_j > a_j$. Suppose, by way of contradiction, that this is the case. Then every $i \in N$ must choose $\gamma_{ij} = 0$ as part of their equilibrium strategy, since any challenge of j will only incur the cost e. However, this implies that parishioner j can profitably deviate from the truthful ρ_j and report a_j with probability 1 for every realization of w_j, so that reporting $r_j = w_j$ for all w_j cannot be the BNE strategy for any j. Thus, there must be a positive measure of w_j for each j such that the probability that $r_j = w_j$ is less than 1.

Claim 2: A BNE cannot involve ρ_j that under-reports with probability 1 for all $w_j > a_j$. Suppose it does, which implies that for some j, ρ_j has the property that for all $w_j > a_j$, $\Pr\left\{r_j < w_j|\rho_j, w_j\right\} = \lim_{x \to w_j} \int_{a_j}^{x} \rho_j(r_j|w_j)dr_j = 1$. Then it must be that $[c_{ij}]$ is such that the probability that j is challenged is 1 (that is, $\Pr\left\{\eta^j[c^j] = 1\right\} = 1$), which means that it must be that $c_{ij} = 1$ for at least 1 i. If this were not so, then any $i \neq j$ could lower their expected tax liability with no cost by raising their γ_{ij} to 1. This then implies that the posited ρ_j cannot be part of a BNE, since a purely truthful strategy for j yields a higher payoff, as it results in the same tax liability without paying d.

Now, consider a $j \in N$ and a realization $w'_j \in [a_j, b_j]$ such that $\Pr\left\{r_j < w'_j|\rho_j, w'_j\right\} > 0$. Claim 1 implies such a w'_j must exist for every ρ_j.

Claim 3: For any such w'_j for any j, it cannot be that the BNE $[c_{ij}]$ is such that $\Pr\left\{\eta^j[c^j] = 1|w'_j\right\} = 1$.

This follows because if this probability is 1, then $c_{ij} = 1$ for some $i \in N$, from which it follows that j's claimed BNE strategy when $w_j = w'_j$ is dominated by reporting $r_j = w'_j$ with probability 1 when w'_j is realized. Thus, it must be that for any such w'_j, $\Pr\left\{\eta^j[c^j] = 1|w'_j\right\} < 1$, so whenever there is a positive probability j under-reports, there is also a positive probability that report is not challenged.

Suppose now that for some j and some realization w'_j, $\rho_j(r_j|w'_j)$ is such that $\Pr\left\{r_j = w'_j|\rho_j, w'_j\right\} > 0$; claim 2 implies that such a w'_j exists for each j (and the probability may be 1).

Claim 4: Given any j and any such w'_j, it cannot be that $\Pr\left\{\eta^j[c^j] = 1|w'_j\right\} = 0$.

Suppose this is true, bwoc, which must then imply that $c_{ij} = 0$ for all $i \in N$. This then means that j can increase his payoff by deviating to a strategy ρ^0 such that $\Pr\left\{r_j = a_j | \rho_j^0, w_j'\right\} = 1$, so the original strategy could not have been part of a BNE.

This then implies that when j realizes a w_j' which he reports honestly with positive probability, that report will be challenged with positive probability.

These four Claims prove the Proposition.

■

A Progressive Version of the taille tax function:

Leaving the $s_i()$ functions defined as before, now define citizen i's tax liability as:

$$T_i^p(P) = \frac{\theta(s_i)s_i()P}{\sum_{j\in N}\theta(s_i)s_j()}$$

with

$$\theta(s_i) = \begin{cases} \beta \leq 1, \text{ if } s_i \leq s^o \\ \delta > 1, \text{ if } s_i > s^o \end{cases}$$

where s^o is some cut-off level of reported wealth. This clearly still has the key property that $\sum_i T_i = P$ and it means that those assessed to be above the cut-off pay a greater share than those below. This can clearly be extended to more 'brackets' and it can also accommodate the idea that the very poor pay only a miniscule head tax, but changing P to P^o, the amount of P left after subtracting the sum of those head taxes, and changing N to N^o, the set of non-poor parishioners.