Coordination, compensation and the expansion of trade: The merchant guilds revisited

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Coordination, Compensation and the Expansion of Trade: The Merchant Guilds Revisited*

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Abstract

Greif, Milgrom and Weingast (1994) argued that the ability of the merchant guilds to encourage trade expansion required an internal mechanism to enforce compliance to trade embargoes, otherwise credible incentives for "embargo breaking" would have rendered them ineffectual. We show that sustaining efficient trade implied an ability of the guilds to restrict their membership but no internal enforcement mechanism was necessary. Our reformulation of the guilds´ strategies - based on the historical evidence - makes trade embargoes self-enforcing and allows us to provide a richer picture of how the guilds could have facilitated trade expansion by controlling merchant trading activities.

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1 Introduction

The role played by the merchant guilds in the expansion of trade that occurred in Europe during the "Commercial Revolution" remains controversial.[1] The "traditionalist" view is that the guilds were institutions designed to enhance the market power of particular merchant groups. By controlling trade, the guilds increased the bargaining power of merchants with the rulers of medieval cities, enabling them to shift some of the fixed gains from trade from rulers to merchants via the extraction of monopoly trading privileges and higher rents.[2]

In a seminal and much-cited contribution, Greif, Milgrom and Weingast (1994) (henceforth GMW) argue for a different interpretation.[3] They view the guilds as arising in response to the commercial insecurity of European merchants trading in foreign countries.[4] Individual merchants engaging in long-distance trade faced high risks resulting from general commercial insecurity and arbitrary confiscations by medieval city rulers. Before a trading center was established, a city's rulers could promise to protect the rights of foreign merchants. But once trade had commenced, the rulers faced the temptation to renege on this pledge, by failing to provide the promised protection or by using their coercive power to confiscate merchants' property. Without a credible commitment by the rulers of a trade center to provide a secure trading environment, alien merchants would have been deterred from trading there - an outcome that was inefficient for both the cities and the merchants. Reducing commercial insecurity and enhancing opportunities for

[1] Long-distance trade in Europe expanded rapidly between the eleventh and fourteenth centuries after an extended period of decline. See Lopez (1976).

[2] Thrupp (1965) and North and Thomas (1973) provide the standard treatment of the guilds as cartels; see also Dessi and Ogilvie (2004) for a recent review of the historical literature.

[3] See also Greif (2006), Ch. 4.

[4] A view presaged much earlier by De Roover (1965). Ogilvie (2011, Ch. 6) emphasizes that ´*because most merchants only traded locally, most merchant guilds were also local.*´ Hence the GMW theory applies to merchants and guilds which engaged in long-distance trade.

expanding trade meant that the cities and the merchants needed a means to overcome the medieval cities' "commitment problem".[5]

GMW use a simple repeated game model to analyze the prospects for both bilateral reputation mechanisms (in which a merchant whose rights were abused ceases trading), and "informal" multilateral reputation mechanisms (in which the cheated merchant and his close associates cease trading), to overcome this commitment problem and support trade expansion. They argue that neither type of mechanism would have been able to support the efficient level of trade, creating a need for institutions which could coordinate the responses of a large fraction of merchants to offenses against merchant property. A key role of the merchant guilds, according to GMW, was to coordinate merchants' responses to 'cheating' by city rulers, by enforcing "trade embargoes" against cities which failed to protect merchants' property rights. The guilds thus allowed mutually beneficial trade to occur at higher levels than would have otherwise been possible. As GMW summarize their argument:

> "*It is our thesis that merchant guilds emerged with the encouragement of the rulers of trading centers to be a countervailing power, enhancing the rulers' ability to commit to the security of alien merchants, and laying an important institutional foundation for the growing trade of that period.*"

The purpose of this paper is to address a number of issues in GMW's analysis of the guilds which deserve reconsideration.[6] Doing so leads to a

[5] More recently, the historians Gelderblom and Grafe (2010) argue that the guilds helped long-distance traders solve two 'fundamental problems of exchange'. They offered protection against crime, warfare, and arbitrary confiscation, and they facilitated the enforcement of contracts.

[6] The historical accuracy of GMW's characterization of the role of the merchant guilds has been disputed by Dessi and Ogilvie (2004) (see also Ogilvie 1995), who offer a third explanation for their emergence. Dessi and Ogilvie (2004) argue that a key function of the guilds was to facilitate "collusion" between merchants and city rulers in order to restrict trade and maximize their joint rents, to the detriment of other groups in society. Gelderblom and Graf (2010) describe this view as 'anachronistic'.

new characterization of how the guilds overcame a medieval city's incentives to cheat foreign merchants (the "commitment problem"), thereby removing a number of lacunae in GMW's own analysis. Specifically, GMW model the guilds as *pure equilibrium coordination devices* whose essential function was to overcome the "informational isolation" of widely-dispersed traders. They conclude that efficient trade may not have been possible if the guilds lacked the ability to enforce compliance to trade embargoes by individual merchants, for example, by imposing commercial sanctions on their member merchants. Otherwise, credible incentives for "embargo breaking" would have potentially rendered the guilds powerless.[7]

We show in this paper that sustaining efficient trade implied an ability on the part of the guilds to restrict their membership, and to condition their punishment strategies accordingly, but that contrary to GMW, no internal enforcement mechanism was necessary. Our reformulation of the guilds' equilibrium strategies - based on the historical evidence - makes the threat to impose a trade boycott self-enforcing in the absence of other enforcement mechanisms, thus resolving the credibility issue noted by GMW. It also allows us to provide a richer picture of how the guilds may have facilitated trade expansion by controlling merchant trading activities, thus bringing the "traditionalist" view of the guilds back into play, albeit for different purposes.

A first issue in GMW's analysis is that they model the guilds purely as "*organizations for communication and coordination*" (or "automata"), which mechanically announce trade embargoes whenever a city is observed to be cheating. All traders learn the guilds' announcements and condition

[7] As Greif (2006, p. 93) has put it in his recent book: "*Paradoxically, abusing the rights of some merchants fostered the ruler's ability to commit to respect the rights of the remaining merchants.... The enhanced ability of the ruler to commit undercut the credibility of the threat of collective punishment. The merchant guild organizations linked information-sharing and coercive transactions between merchants in order to render credible their threat to collectively retaliate following transgression against any merchant. These organizations provided the monitoring, coordination, and internal enforcement required to credibly commit to collectively retaliate following an abuse."* See also Greif (2006, p. 99).

their trading strategies identically in response, i.e. all merchants offer to trade if and only if a trade embargo has not been announced. But this "minimalist" specification of guild organization would have prevented the guilds from restricting trade to the efficient level, as required for GMW's thesis. To fulfill this role, the guilds would have needed to be able to restrict their membership to a subset of traders, and to only punish cities when they violated the rights of guild members. It is also necessary that medieval cities were able to discriminate between merchants, abusing or not protecting them selectively, depending upon their identities, or guild membership.

Secondly, although ostensibly a model of the activities of merchant guilds, in GMW's analysis the guilds rarely come into play. When they do (in their Proposition 3), the authors immediately argue that the hypothesized equilibrium strategies *"contain a counterintuitive element"* since they require a city to cheat embargo breakers even if it is not in its interests to do so. By appealing to considerations of renegotiation-proofness, GMW severely limit the ability of the guilds to enforce trade embargoes or boycotts in the absence of an (unmodelled) internal legal system to allow the guilds to punish noncompliant merchants.

Third, GMW appeal to the concept of renegotiation-proofness to justify the formulation of the strategies in their Proposition 4, in which trade is supported solely by bilateral punishment strategies. The specified strategies are not renegotiation-proof in every relevant subgame, however.[8] While renegotiation-proofness arguments are used to explain why the ruler of a medieval city would not punish violators of a merchant embargo when *"trade on terms which the ruler would credibly respect"* was possible, no explanation is offered for why the city should cheat any merchant it has cheated in the past, as required to sustain the equilibrium. Once this assumption is removed, the equilibrium described in their Proposition 4 unravels, leading

[8] At least when we apply the natural generalization of Farrell and Maskin's (1989) definition of weakly renegotiation-proof strategies as proposed in Farrell (2000), or in Aramendia, Larrea and Ruiz (2005).

to the conclusion that no trade will occur.

Although GMW's analysis is concerned with the effectiveness of trade embargoes or boycotts by the merchant guilds, the historical evidence they present suggests that these were only used when cities refused to pay compensation to merchants whose property had not been protected. As shown in Harbord's (2006) reconsideration of the methods used by the Maghribi traders to support cooperative trade, this can make a major difference to the formulation of the equilibrium strategies, and to their 'credibility'. We therefore reformulate the guilds' equilibrium strategies, to include a demand for compensation, and show that this can make the threat to impose a trade boycott self-enforcing for individual merchants. It thus resolves the credibility issue noted by GMW, and makes both bilateral and multilateral punishment strategies renegotiation-proof. By making the imposition of a trade embargo self-enforcing, our analysis suggests that the role of the guilds may have been primarily to collect and disseminate information concerning breaches of trust by medieval cities (i.e. a coordination function), rather than the enforcement of boycotts *per se*. The guilds did not need the power to coerce individual merchants to take part in the punishment of cities, since they could rely on their private equilibrium incentives to do so.

Finally, GMW's focus is on repeated-game strategies which allow the 'efficient' level of trade to be supported as an equilibrium. But they do not consider whether the merchants and the cities would have agreed on the level of trade that they wished to support. If the guilds had the power to restrict the equilibrium volume of trade, they would likely have wished to impose a sub-optimal level of trade from the cities' point of view. The same ability to restrict trade, however, could also have been used to negotiate favorable tax treatment for guild members in return for an agreement to expand trade towards the efficient level. As such, our reformulation goes some way towards reconciling the two opposing views of the function of the guilds mentioned above.

In the remainder of this paper we reformulate GMW's theory of guilds to address these issues. Section 2 describes the GMW model and results, and considers some natural alternative formulations of trading costs which alter their conclusions. Section 3 introduces demands for compensation into the guilds' equilibrium strategies, and demonstrates that these would have been sufficient to sustain efficient trade even in the absence of formal enforcement mechanisms, or sanctions, to deter embargo breaking. Section 4 considers the volumes of trade which merchants and cities would have wished to support. Section 5 concludes.

2 The GMW Theory

In the GMW theory, merchants are identified by points in an interval $[0, \overline{x}]$. If the number of traders in any period is $x \leq \overline{x}$, the gross value of trade is given by a function $f(x)$. The city's costs of providing protection to merchants are $c > 0$ *per unit of value traded*, and each merchant's trading costs are $\kappa > 0$ *per unit of value traded*. Hence the net value of trade in any period is $[1 - c - \kappa] f(x)$, where it is assumed that $c + k < 1$. GMW also assume that f is nonnegative and continuously differentiable, $f(0) = 0$ and f achieves a maximum at a unique value $x^* \leq \overline{x}$ (the 'efficient volume of trade').[9] The city benefits from trade by taxing merchants at a rate $\tau \geq c$ per unit of value traded.

In any given period, if the number of traders is x and the city follows an 'honest' strategy (i.e. protects all merchants), its net revenues are $[\tau - c] f(x)$. If the city 'cheats' by failing to protect a fraction $0 < \epsilon \leq 1$ of merchants, its net payoff is $\{\tau - c[1 - \epsilon]\} f(x)$. A merchant's payoff when protected by the city is $\frac{1}{x}[1 - \kappa - \tau] f(x)$. Merchants who are not protected pay taxes and incur trading costs but collect no revenues, so earn

[9] x^* is 'efficient' in the sense that it maximizes the net *value* of trade $[1 - c - \kappa] f(x)$. Without further significant loss of generality, we will also assume in what follows that f is nondecreasing in the range $[0, x^*]$, and nonincreasing in the range $[x^*, \overline{x}]$.

$-\frac{1}{x}[\kappa+\tau]f(x)$.[10]

In the repeated game, each player - the city and a continuum of merchants - discounts future payoffs at rate $\delta \in (0,1)$. The city's lifetime payoff when the volume of trade in period t is denoted x_t and a fraction ϵ_t of merchants is cheated is

$$\sum_{t=0}^{\infty} \delta^t \{\tau - c[1-\epsilon_t]\} f(x_t). \tag{1}$$

Merchants' long-run payoffs are defined similarly.

2.1 Bilateral Reputation Mechanisms with Informationally Isolated Traders

In their first model, GMW assume that merchants' responses are uncoordinated, and that each merchant responds to being cheated by the city's rulers by refusing to trade with the city in all future periods.[11] Merchants' strategies are thus to trade until cheated, and then never to trade with the city again. The city's hypothesized equilibrium strategy is to trade with, and provide protection to, any merchant it hasn't cheated in the past. The city's lifetime payoff when the equilibrium level of trade is x and it cheats a fraction ϵ of merchants (and subsequently returns to equilibrium play) is

$$V^{\epsilon}(x) = \{\tau - c[1-\epsilon]\} f(x) + \gamma[\tau - c] f([1-\epsilon]x), \tag{2}$$

where $\gamma = \frac{\delta}{1-\delta}$. Differentiating with respect to ϵ yields

$$\frac{\partial V^{\epsilon}(x)}{\partial \epsilon} = cf(x) - \gamma[\tau - c] x f'([1-\epsilon]x), \tag{3}$$

and evaluating this expression at the efficient level of trade with $\epsilon = 0$ gives

$$\frac{\partial V^{\epsilon=0}(x^*)}{\partial \epsilon} = cf(x^*) - \gamma[\tau - c] x^* f'([1-\epsilon]x^*) = cf(x^*) > 0, \tag{4}$$

[10] The natural interpretation is that unprotected merchants suffer losses post trade, i.e. after the value of trade $f(x)$ has been realized, rather than pre trade.

[11] This is justified by the assumption that merchants were 'informationally isolated', so that at most a small fraction of traders ever becomes aware of cheating by the city when they are not personally affected by it. See GMW, pp. 766-767, for a discussion.

since $f'(x^*) = 0$. At the efficient level of trade the city will always wish to cheat some fraction $\epsilon > 0$ of merchants, so efficient trade cannot be sustained by purely bilateral punishment strategies. It is this, according to GMW, which creates an essential role for the merchant guilds.

GMW's formulation of the trading technology is special, however, and in more than one way. Note first that when the city cheats a fraction ϵ of merchants, it saves the 'average cost' $\epsilon c f(x)$ of protecting trade of value $f(x)$, rather than the 'marginal cost' $c[f(x) - f([1-\epsilon]x)]$. But in all subsequent periods, when only $[1-\epsilon]x$ merchants remain, the city's costs are $cf([1-\epsilon])x$. While not necessarily inconsistent, it is not particularly easy to reconcile these assumptions.[12] If the city saved 'marginal' rather than 'average' costs when it cheats, its payoff in (2) would become

$$\widehat{V^{\epsilon}}(x) = \tau f(x) - cf([1-\epsilon]x) + \gamma[\tau - c] f([1-\epsilon]x), \tag{5}$$

while its payoff from playing the honest strategy is

$$\widehat{V}(x) = (1+\gamma)[\tau - c] f(x). \tag{6}$$

Hence $\widehat{V^{\epsilon}}(x) \leq \widehat{V}(x)$ for all $0 < \epsilon \leq 1$ requires

$$\{c - \gamma[\tau - c]\}\{f(x) - f([1-\epsilon]x)\} \leq 0 \tag{7}$$

for all $0 < \epsilon \leq 1$. Since f achieves a unique maximum at x^*, $c \leq \gamma[\tau - c]$ is a sufficient condition for sustaining the efficient level of trade as an equilibrium.[13] But this is also the condition for sustaining the level of trade x^* for a guild with coordinating ability specified in Proposition 3 in GMW (see condition (16) below). Hence bilateral punishment strategies are equally effective under these assumptions, leaving no essential function for the guilds.

[12] If $f(x)$ is concave, as GMW assume in their Proposition 4, then $cf([1-\epsilon]x) \geq c[1-\epsilon]f(x)$, so it costs the city (weakly) more to protect $[1-\epsilon]x$ merchants when only $[1-\epsilon]x$ merchants offer to trade than to protect a proportion $[1-\epsilon]x$ of merchants when x merchants offer to trade.

[13] Given the assumption that f is nondecreasing in the range $[0, x^*]$, $c \leq \gamma[\tau - c]$ is also a sufficient condition for sustaining any value of x within this range as an equilibrium.

Another oddity of the GMW formulation is that the marginal cost of protecting an additional unit of trade decreases towards zero as the efficient level of trade is approached, and becomes negative at higher levels of trade $x > x^*$. A natural alternative assumption would be that the costs of trade - including the city's protection cost c and the merchants' costs κ - are functions of the quantity of trade, x, rather than its value $f(x)$. When this formulation is adopted, the city's payoff when the level of trade is x and it cheats a fraction ϵ of merchants is

$$\widetilde{V^{\epsilon}}(x) = \tau f(x) - c[1-\epsilon]x + \gamma\{\tau f([1-\epsilon]x) - c[1-\epsilon]x\}. \tag{8}$$

Differentiating with respect to ϵ gives

$$\frac{\partial \widetilde{V^{\epsilon}}(x)}{\partial \epsilon} = [1+\gamma]cx - \gamma\tau x f'([1-\epsilon]x). \tag{9}$$

Evaluating this expression with $\epsilon = 0$ yields

$$\frac{\partial \widetilde{V^{\epsilon=0}}(x)}{\partial \epsilon} = [1+\gamma]cx - \gamma\tau x f'(x). \tag{10}$$

The efficient volume of trade given this formulation of trading costs is now defined by the condition

$$f'(x^*) = c + \kappa. \tag{11}$$

Hence we require

$$[1+\gamma]c \leq \gamma\tau[c+\kappa] \tag{12}$$

to support the efficient level of trade as an equilibrium (as opposed to the less restrictive condition $[1+\gamma]c \leq \gamma\tau$ in the immediately preceding formulation).[14] Observe, though, that with per-merchant trading costs of this type neither the city nor the merchants would typically wish to implement the efficient level of trade.[15] GMW's particular specification of the costs of

[14] If we assume that f is concave, (11) is then a necessary and sufficient condition for sustaining x^* as an equilibrium.

[15] See Section 4 below for a more detailed discussion.

trade, and the savings a city obtains when it fails to protect a fraction of merchants, appears to have been crucial to their conclusion that a multilateral enforcement mechanism (i.e. the merchant guild) was needed to sustain the efficient volume of trade.[16,17]

Despite our reservations concerning GMW's formulation of trading costs, we will adopt their specification in the remainder of the paper to simplify the exposition and comparisons with their analysis. It should be clear that all of our results can be obtained using any of the alternative formulations considered above, however.

2.2 Guild with Coordinating Ability

In their third model,[18] GMW suppose that merchants' responses to being cheated are coordinated by a guild which acts purely as an information gathering and transmission mechanism. Specifically, the guild is modelled as "*an organization for communication and coordination*," which mechanically announces a trade boycott if the city cheats a subset of traders in any period, but lacks any means of enforcement. All traders learn the guild's announcement in each period, but may choose to ignore it. In the hypothesized equilibrium, the city's strategy is not to cheat any trader until a boycott is

[16] GMW (p. 765, footnote 19) argue that if the costs borne by the city include some fixed costs per trader, then the city would have an even stronger incentive to reduce the number of traders (i.e. cheat), because *"it would bear only a fraction of the resulting loss of value but save all of the costs"*. This argument appears to ignore the effect of fixed (per-merchant) trading costs in reducing the efficient volume of trade.

[17] There is some historical evidence to support the assumption that a city's gain from cheating alien merchants was associated with savings on protection costs. For example, in 1407 the English government was threatened with a trade boycott by Hanseatic merchants which it had failed to protect from English pirates (Pedersen 2006, p 169; see also Kohn 2003). But other evidence points in different directions. The conflict in the 1340's between Tabriz and Genoa, for example, arose when Tabriz's ruler confiscated the goods of Genoese traders (GMW, pp. 755-756). Thus in some cases cities gained by directly expropriating merchants' goods. If we assume that cities gain from expropriating the value of trade, it is easy to show that, as in GMW's original formulation, the efficient level of trade cannot be sustained as an equilibrium.

[18] GMW's second model considers trade supported by bilateral punishment strategies when the assumption of strict informational isolation is relaxed.

announced, and then to cheat any merchant who offers to trade. Merchants' strategies are to offer to trade in any period if and only if no boycott has been announced in the past. Given these strategies, the city's payoff from cooperation at the efficient volume of trade x^* is

$$V(x^*) = [1+\gamma][\tau - c] f(x^*), \tag{13}$$

and its payoff from cheating every trader is

$$V^{\epsilon=1}(x^*) = \tau f(x^*). \tag{14}$$

Cheating is thus unprofitable if

$$\tau f(x^*) \leq [1+\gamma][\tau - c] f(x^*), \tag{15}$$

or

$$c \leq \gamma[\tau - c]. \tag{16}$$

Hence, according to GMW's Proposition 3, the efficient level of trade can be sustained if (16) is satisfied.[19]

It is not clear, however, how the strategies specified in GMW's Proposition 3 can support the efficient level of trade x^* without first limiting the number of merchants who offer to trade in any period, i.e. without a mechanism for exogenously limiting the volume of trade to the desired level.[20] That is, since the city's strategy is not to cheat *any* trader unless a boycott has been announced, and the guild's strategy is to announce a boycott when *any* trader is cheated, trade at $\overline{x}$ should result. Sustaining the efficient volume of trade would seem to require that the guild limit its membership to x^* traders, and to announce a boycott if and only if the rights of guild members have been violated. Similarly, the city must be able to condition

[19] GMW's description of their Proposition 3 is slightly different. They assume that that the guild observes cheating and mechanically announces a boycott with probability $\alpha(T) \geq \mu(T)$, where $\mu(T)$ is the fraction of cheated traders. We have assumed that $\alpha(T) = 1$ for simplicity.

[20] Assuming that $x^* < \overline{x}$.

its strategy on the identities of the traders, i.e. whether or not they are guild members. We return to this issue immediately below.

GMW point out that the strategies specified in their Proposition 3 lack credibility. Why should the city cheat all merchants who offer to trade during a boycott whether it has cheated them before or not? And why should merchants refuse to trade with a city which has cheated others when mutually profitable trade is possible on terms which the city would credibly respect? As noted by GMW:

> *"Although the strategies described in Proposition 3 constitute an equilibrium, the expectations and behavior that they entail seem implausible. The equilibrium requires, for example, that no matter how desperate the city may be for renewed trade relationships, once a boycott has been announced, it nevertheless cheats anyone who trades with it. In addition, traders expect that behavior. By the equilibrium logic, the city behaves in this manner because it expects the boycott to take full hold in the next round whatever it does, so it anticipates that any cooperation it offers will be fruitless."*

In the literature on renegotiation-proofness, similar criticisms have been leveled at the equilibria of other repeated game models, see e.g. Bernheim and Ray (1989) and Farrell and Maskin (1989), and more recently by sociobiologists, e.g. McElreath and Boyd (2007) and Gintis (2004).[21]

In response to this, GMW allow for reversion to trade supported by purely bilateral punishment strategies. That is, they allow for the possibility that mutually profitable bilateral trade agreements between the city and individual merchants may be reached during a boycott. Their Proposition 4 is intended to establish the highest level of trade - $\widehat{x}$ - which can be supported

[21] It has become commonplace in the sociobiology literature to argue that the use of 'higher-order' or recursive punishment strategies to sustain cooperation is implausibly demanding and not observed in real human societies.

in this way. Proposition 4 specifies strategies under which the city trades with just those merchants that it has not cheated in the past, and each merchant offers to trade if and only if he has never been cheated. For a given volume of trade x, if the city cheats $x - y$ traders, then it can trade honestly with the remaining y merchants if

$$cf(y) - \gamma[\tau - c]yf'(y) \leq 0. \tag{17}$$

Trade can be sustained by these strategies up to the highest level of x, denoted $\widehat{x}$, that satisfies (17). Thus a guild lacking enforcement ability could not credibly threaten to reduce the city's per period income to less than $[\tau - c] f(\widehat{x})$.[22]

But are the strategies specified in GMW's Proposition 4 themselves credible? Why should the city cheat any trader it has cheated in the past? And why should merchants refuse to trade with a city which has cheated them in the past when *"mutually profitable trade is possible on terms which the city would credibly respect"*? Suppose, for example, that a subgame is reached in which $\frac{\partial V^{\epsilon=0}(y)}{\partial \epsilon} < 0$: that is, the city has cheated $x - y$ of traders, with $y < \widehat{x}$. Then a merchant who was cheated in the past will know that the city's incentive, under the specified strategies, is not to cheat on additional trade agreements until $y = \widehat{x}$. (Alternatively, at $y = \widehat{x}$ a merchant who was cheated in the past will know that by offering a higher share of profits to the city, i.e. $\widehat{\tau} > \tau$, it can induce mutually profitable cooperation from the city). Thus the strategies specified are not renegotiation-proof, as both merchants and the city will, in some subgames, prefer to return to the equilibrium path of play rather than carry out the required punishment strategies.

Observe also that the equilibrium specified in GMW's Proposition 4 requires that at most $\widehat{x}$ merchants offer to trade in any period, so at least $\overline{x} - \widehat{x}$ merchants must have been cheated in the past. But the equilibrium

[22] Existence of a equilibrium is guaranteed by the assumptions that f is concave, and that: (i) $cf(\widehat{x}) \leq \gamma[\tau - c]\widehat{x}f'(\widehat{x})$; and (ii) the 'elasticity' $e(x) = xf'(x)/f(x)$ is a decreasing function of x.

strategies do not allow for this to occur. That is, the process by which the equilibrium level of trade is reached is not specified, making it unclear how a city could elicit the specified volume of trade during a boycott. We address these issues in our own formulation immediately below.

3 Sustaining Equilibrium Trade: Exclusion and Compensation

Sustaining any particular level of equilibrium trade, either through bilateral or multilateral punishment strategies, would appear to require a more detailed specification of how trade was limited to particular groups, or subgroups, of traders, than provided for in the GMW analysis. And renegotiation-proofness arguments suggest not only that GMW's Proposition 3 strategies may not be credibly sustained, but as noted above, apply equally to the strategies prescribed in GMW's Proposition 4. In both cases merchants and cities are required to carry out costly punishment strategies in some subgames which they would mutually prefer to avoid. We resolve these issues in this section.

First, we assume that medieval cities could elicit trade from specified subgroups of traders, and could condition their strategies accordingly. That is, cities could offer protection to just those merchants in a specified subgroup, and leave all other merchants unprotected. This assumption would appear to be in accord with the historical evidence. It was not unusual for the rulers of medieval cities to guarantee safe passage to particular merchants, or groups of merchants, travelling through their territories for trade. Gelderblom (2005) details many such instances,[23] and GMW (p. 752) note that, "*in medieval trade ... a city could discriminate among merchants,*

[23] Gelderblom (2005) tells us, for example, that: "*In 1243 – ten years earlier than in Flanders – merchants from Lübeck and Hamburg already received letters of safe-conduct from the Count of Holland, who hoped they would use Dutch inland waterways to reach Bruges.*" See also Lopez et. al. (2001).

abusing or not protecting them selectively."[24] And Gelderblom and Grafe (2010), noting the ability of the English Company of Merchant Adventurers in Antwerp and Middelburg to exclude merchants from participation in the cloth trade, suggest that "*the ability of a mercantile organization to prevent free-riding, and reserve the economic benefits of its operations to the membership*" was an important and distinctive development in the organization of the guilds.[25]

Second, we resolve the 'credibility' issues raised above (i.e. renegotiation-proofness) by including demands for compensation in merchants' strategies. The historical evidence presented by GMW suggests that medieval merchants only attempted to enforce trade embargoes on cities after they had refused to pay compensation to traders whose property had not been protected. The resumption of trade also appeared to depend upon merchants first being indemnified for past losses.

For example (see GMW, pp. 755-756), in 1340 Tabriz's ruler confiscated the goods of many Genoese traders, and Genoa responded by declaring a commercial embargo (a *devetum*). In 1344 Tabriz's ruler sent ambassadors to Genoa promising to indemnify the traders for everything that had been taken from them. As a consequence, the *devetum* was removed and Genoese traders flocked to Iran. In another example (Pedersen 2006, p. 169), in 1407 the government of England was forced to negotiate compensation for the losses of Hanseatic merchants in the hands of English pirates, to prevent a potentially devastating trade embargo which would have *"closed the continent to English cloth"*. Similar examples of demands for compensation to avoid, or end, trade embargoes can be found in GMW and elsewhere.[26]

[24] And Greif (2006), p. 92 tells us: "*...the ruler could discriminate among merchants respecting the rights of some but not others. Protection of rights was a private good rather than a public one, as a ruler could respect the rights of some merchants but not others.*"

[25] Gelderblom and Graf describe this as the "*power of exclusion*" and consider it the highest form of control, defined by an ability to exclude non-members (and members who infringed on their own rules) from a particular market.

[26] GMW, p. 756; p. 757; p. 760; p. 761. See also Postel (1996) and Kohn (2003). Kohn (2003), p. 36, for instance, tells us that, *"by the middle of the 13th century some maritime*

3.1 Using Compensation to Support Bilateral Punishment Strategies

To model the above points, we assume that a city can elicit trade from a subset $[0, x]$ of the $[0, \overline{x}]$ merchants, and can condition its behavior on whether traders are in this subset or not, i.e. the city offers protection to just those merchants in $[0, x]$, and all other merchants are left unprotected. The strategy of individual merchants in $[0, x]$ is to offer to trade in each period until cheated, and then to refuse to trade further until the compensation $\frac{1}{x}C$ is paid to them. Merchants in $(x, \overline{x}]$ do not offer to trade. The city's strategy is: (i) to provide protection to just those merchants in $[0, x]$, and leave all other merchants unprotected; (ii) if the city has cheated (i.e. failed to protect) a fraction ϵx of the merchants in $[0, x]$ in any period, pay the compensation ϵC to the offended merchants at the first opportunity, and never pay compensation to merchants in $(x, \overline{x}]$. We have the following result.

Proposition 1 *Assume* $cf(x) \leq \gamma[\tau - c]xf'(x)$ *and that the tax rate that satisfies* $1 - c - \kappa \leq \tau \leq 1 - \kappa$. *Then trade of at most* $\widehat{x}$ *can be sustained by the compensation payment* $\delta C = cf(\widehat{x})$.

Proof. *If the city cheats a fraction* ϵ *of merchants in* $[0, x]$ *in some period* t *and pays the compensation* ϵC *at the first opportunity (i.e. in period* $t + 1$*), trade at* x *is resumed immediately, while if the city refuses to pay compensation it trades with the remaining* $[1 - \epsilon]\, x$ *merchants.*[27] *The city's*

cities were imposing a tax on goods moving through their ports to pay compensation to foreigners who might otherwise have taken reprisals," and that, *"Genoa established a Robbery Office to compensate foreigners who had been robbed by a Genoese (usually at sea)."* And Gelderblom (2005) tells us: "*Besides defense and deterrence, protection also implied the ability of traders to get compensation if their person and goods are damaged. In medieval Europe merchant guilds took to collective action, often with the support of their home government, to claim damages from host rulers. Soon enough host rulers set up a court system to allow local and foreign traders to recoup losses from privateering, wrongful arrests, corruption, and commercial disputes."*

[27] We assume the following order of moves in any period: first, the city has the opportunity to pay compensation to any merchant in $[0, x]$ it has cheated in the past; second, merchants decide whether or not to trade; third, the city decides whether to cheat any of the current traders; and finally, payoffs are realized.

payoff from cheating and then refusing to pay compensation indefinitely is

$$\{\tau - [1-\epsilon]\, c\}\, f(x) + \gamma[\tau - c] f([1-\epsilon]\, x), \tag{18}$$

whereas if it pays the compensation ϵC *in period* $t+1$ *it receives*

$$\{\tau - [1-\epsilon]\, c\}\, f(x) - \delta\epsilon C + \gamma[\tau - c] f(x). \tag{19}$$

Hence a necessary condition for compensation to be paid in period $t+1$ *is*

$$\delta C \leq \frac{\gamma[\tau - c][f(x) - f([1-\epsilon]\, x)]}{\epsilon}. \tag{20}$$

For the city to prefer playing the honest strategy in period t *over cheating a fraction* ϵ *of merchants and then paying compensation* ϵC *in period* $t+1$ *requires*

$$[1+\gamma]\,[\tau - c] f(x) \geq \{\tau - [1-\epsilon]\, c\}\, f(x) - \delta\epsilon C + \gamma[\tau - c] f(x), \tag{21}$$

which yields

$$\delta C \geq c f(x). \tag{22}$$

We thus have

$$c f(x) \leq \delta C \leq \frac{\gamma[\tau - c][f(x) - f([1-\epsilon]\, x)]}{\epsilon}. \tag{23}$$

It follows that an upper bound on the level of trade that can be sustained in period t *is given by largest value of* x, $\widehat{x}$, *that satisfies the condition*

$$c f((x) \leq \frac{\gamma[\tau - c][f(x) - f([1-\epsilon]\, x)]}{\epsilon}, \tag{24}$$

for all $0 < \epsilon \leq 1$. *Letting the fraction of merchants cheated in period* t *approach zero (i.e. letting* $\epsilon \to 0$*), condition (20) becomes*

$$\delta C \leq \gamma[\tau - c] x f'(x). \tag{25}$$

Hence, in the limit (24) becomes

$$c f((x) \leq \gamma[\tau - c] x f'(x), \tag{26}$$

which is just GMW's Proposition 4 condition, i.e. (17) above. Hence trade of at most $\widehat{x}$ *can be sustained by the compensation payment* $\delta C = cf(\widehat{x})$.[28] *But is a cheated merchant's demand that the city pay compensation itself credible? Each merchant's strategy is to discontinue trade until compensation* $\frac{1}{x}C$ *is paid in some period* $t+n$ *if cheated in period* t. *This is credible if: (i) the cheated merchant expects to receive the compensation* $\frac{1}{x}C$ *in period* $t+n$ *if it was refused in period* $t+n-1$; *and (ii) refusing to renegotiate (i.e. by returning to the level of trade* x *without first receiving compensation) is preferable to renegotiation. The first condition requires that in any period* $t+n$, $n = 1, 2,...$, *the city prefers to pay compensation immediately rather than waiting one period, i.e.*

$$-\epsilon C + [1+\gamma]\,[\tau - c]f\,(x) \geq [\tau - c]f\,([1-\epsilon]\,x) - \delta\epsilon C + \gamma[\tau - c]f\,(x)\,, \quad (27)$$

which is guaranteed by the condition (20). The second condition requires that merchants who have been cheated prefer to wait to obtain compensation over renegotiation, i.e.

$$\delta\frac{1}{x}C + \gamma[1-\tau-\kappa]\frac{1}{x}f\,(x) \geq [1+\gamma]\,[1-\tau-\kappa]\frac{1}{x}f\,(x)\,, \quad (28)$$

or

$$\delta C \geq [1-\tau-\kappa]f\,(x)\,. \quad (29)$$

This condition will be satisfied for the compensation level $\delta C = cf\,(x)$ *if*

$$cf(x) \geq [1-\tau-\kappa]f\,(x)\,, \quad (30)$$

or

$$\tau \geq 1 - c - \kappa. \quad (31)$$

Thus an equilibrium of this type can be sustained by a tax rate that satisfies

$$1 - c - \kappa \leq \tau \leq 1 - \kappa, \quad (32)$$

[28] If we follow GMW's Proposition 4 and assume that f is concave, then (25) implies (20), so (26) becomes a sufficient condition for sustaining $\widehat{x}$ as an equilibrium if the elasticity $e(x) = xf'(x)/f(x)$ is a decreasing function of x.

where $\tau = 1 - \kappa$ is the highest tax rate consistent with trade occurring (i.e. which results in merchant payoffs of zero). ■

3.2 Using Compensation to Support Merchant Trade Embargoes

In the preceding subsection compensation payments were used to credibly sustain trade via bilateral punishment strategies, i.e. punishment strategies in which only traders who have been cheated refuse to trade until compensation has been paid. But demands for compensation can also be used to sustain the efficient level of trade, by making a merchant guild's threat to impose a trade boycott self-enforcing for individual merchants. They thus resolve the credibility issue noted by GMW in their discussion of their Proposition 3.

To demonstrate this, we consider a guild with x members, where $\widehat{\widehat{x}} \leq x \leq \overline{x}$, and $\widehat{\widehat{x}} = \widehat{x} > 0$ defined by Proposition 1 above when such an $\widehat{x}$ constitutes an equilibrium, and $\widehat{\widehat{x}} = 0$ otherwise.[29] We then specify the following strategies in any trading period. The guild's strategy is to announce a trade boycott until the compensation $\epsilon C(x)$ has been paid if the city ever cheats a fraction ϵ of guild members, with $0 < \epsilon \leq 1$. Merchants *who are guild members* offer to trade if and only if no boycott has been announced by the guild. Merchants who are not guild members do not offer to trade with the city.

The city's strategy is: (i) to protect trade with x guild members unless a boycott has been announced by the guild; (ii) to cheat any merchant who offers to trade that is not a guild member; (iii) if a boycott is announced by the guild at the end of period t, pay the demanded compensation $\epsilon C(x)$ at the first opportunity (i.e. the beginning of period $t+1$); and (iv) cheat any merchant that offers to trade during a boycott before compensation has

[29] Recall that there may be no $\widehat{x}$ which is an equilibrium if f is not concave, or if (32) is not satisfied.

been paid.[30] We then have the following result.

Proposition 2 *Assume $c \leq \gamma[\tau - c]x$ and a compensation payment of $C = cf(x^*)/\ \delta$. Then the efficient level of trade can be sustained by the strategies described above.*

We provide an informal proof. For the given volume of trade x, the city prefers playing honestly over cheating a fraction ϵ of traders and paying compensation ϵC at the first opportunity if

$$[1+\gamma]\,[\tau - c]f\,(x) \geq \{\tau - [1-\epsilon]\,c\}\,f\,(x) - \delta\epsilon C + \gamma[\tau - c]f\,(x)\,, \tag{33}$$

which implies

$$\delta C \geq cf\,(x)\,. \tag{34}$$

For the city to prefer paying compensation ϵC at the first opportunity when a boycott has been announced, to facing an indefinite trade embargo requires

$$-\delta\epsilon C + \gamma\,[\tau - c]\,f\,(x) \geq 0, \tag{35}$$

or

$$\delta\epsilon C \leq \gamma\,[\tau - c]\,f\,(x)\,, \tag{36}$$

for all $0 < \epsilon \leq 1$. These two conditions together require

$$c \leq \gamma\,[\tau - c]\,, \tag{37}$$

which is the same condition found in GMW's Proposition 3 (condition (16) above). Clearly guild members will wish to offer to trade under these circumstances. Non-guild members will not offer to trade under a bilateral

[30] That is, we assume the following order of moves in any period t. **If no boycott is in force at the beginning of period t:** first, individual merchants decide whether to offer to trade; second, the city decides whether to cheat any of the current traders; third, the guild decides whether to announce a trade boycott; and finally, payoffs are realized. **If a boycott is in force at the beginning of period t:** first, the city has the opportunity to pay the compensation demanded by the guild; second, the guild decides whether to discontinue the boycott; third individual merchants decide whether to offer to trade; fourth, the city decides whether to cheat any of the current traders; fifth, the guild decides whether to announce a trade boycott; and finally, payoffs are realized.

trade agreement, however, since the city's 'threat' to cheat them is credible when $\widehat{\widehat{x}} \leq x \leq \overline{x}$. Thus trade at x can be sustained by these strategies so long as the guild's threat to impose a trade boycott when compensation is not paid is credible, i.e. not subject to embargo breaking by individual merchants.

For a boycott to be credible in this sense, we need to show that individual merchants will not profit from breaking a guild-imposed trade embargo, because they expect the city to cheat them.[31] That is, we need to show that the city will prefer to follow its equilibrium strategy of paying compensation over reverting to bilateral trade agreements with embargo breakers. We adopt the natural assumption that the guild does not protect embargo breakers by imposing a further trade boycott when they are cheated by the city.[32]

Three types of embargo breaking can be considered. First, embargo breaking by individual merchants who do not coordinate their trading strategies; second, embargo breaking by "coalitions" of individual merchants who coordinate on their offers to trade, but not on their punishment strategies; and finally, embargo breaking by alternative guilds. To keep things simple, it is easiest to think of the set of non-guild merchants as being 'large' relative to the size of the original guild, so that coalitions of any size can form.[33]

Given that the guild has announced a boycott, an offer of a bilateral trade agreement by an individual merchant is of no value to the city, since $f(0) = 0$. If, on the other hand, the city pays the compensation ϵC demanded by the guild at the next opportunity and resumes trade at x, its payoff is given

[31] We are following Farrell's (2000) definition of a 'quasi-symmetrically weakly renegotiation-proof equilibrium' here.

[32] As Kohn (2003) notes, a guild *"provided its members with protection against predation"*, and ignoring a trade embargo meant *"becoming an outlaw, with no such protection."*

[33] This will not always, or even typically, be literally true. When it is not, some merchants who are considering making an offer to trade during a boycott will need to take account of the loss in compensation that they would have received if the putative equilibrium strategies had been followed. Taking this into account makes embargo breaking less profitable for at least some individual merchants.

by (35).[34] Assuming that (36) is satisfied, the city is better off cheating any such merchant and paying the required compensation. Therefore, when (37) is satisfied, a compensation level $\delta C \leq \gamma [\tau - c] f(x)$ is sufficient to ensure that the city will always prefer to cheat an individual embargo breaker and return to the equilibrium level of trade x. This is sufficient to deter embargo breaking because individual merchants expect every other merchant to follow the equilibrium strategy, and not offer to trade. Incentives for embargo breaking are alleviated, and any volume of trade $\widehat{\widehat{x}} \leq x \leq \overline{x}$ can be supported as an equilibrium.[35]

A stronger condition on the equilibrium strategies would require that they be immune to 'renegotiation' by coalitions of individual embargo breakers and the city. We assume that the embargo breakers do not form an alternative guild, however, i.e. they do not coordinate their strategies in response to cheating by the city. So the maximum size of an embargo-breaking coalition is $\widehat{\widehat{x}}$ as defined above, since this is the maximum volume of trade that be sustained by purely bilateral trade agreements.

To see that the efficient level of trade can still be supported as an equilibrium, assume there are $\widetilde{x} \leq \widehat{\widehat{x}}$ embargo breakers, i.e. merchants who collectively offer to trade under bilateral trade agreements with the city during a boycott. For the city to prefer to cheat them, pay the compensation ϵC demanded by the guild, and then resume trade at x^* requires

$$\tau f(\widetilde{x}) - \delta \epsilon C + \gamma [\tau - c] f(x^*) \geq [1 + \gamma] [\tau - c] f(\widetilde{x}), \tag{38}$$

[34] That is, we are considering the subgame in which in period t, the city has cheated in some period $t - n$, $n \geq 1$, has not yet offered to pay compensation, and receives an offer to trade from an individual merchant. It is only necessary to consider individual offers of embargo breaking because each merchant expects all other merchants to adhere to their equilibrium strategies. But see below.

[35] If the guild attempted to enforce a volume of trade x' less than $\widehat{\widehat{x}}$, the part of the city's strategy which calls on it to cheat any merchant who is not a guild member would not be sustainable, since it can credibly and profitably enter into bilateral trade agreements a further $\widehat{\widehat{x}} - x'$ traders.

or

$$\delta\epsilon C \leq cf\left(\widetilde{x}\right) + \gamma\left[\tau - c\right]\left[f\left(x^*\right) - f\left(\widetilde{x}\right)\right], \tag{39}$$

for all $0 < \epsilon \leq 1$. Under condition (37), the right-hand side of (39) is minimized by choosing $\widetilde{x}$ to maximize $f(x)$ in the range $[0, \widehat{\widetilde{x}}]$, i.e. $\widetilde{x} = \widehat{\widetilde{x}}$. Note that if we set $\widetilde{x} = x^*$ in (39), then by choosing $\delta C = cf(x^*)$ we would obtain the compensation level for which the city will always wish to cheat embargo breakers and return to the efficient level of trade. But this level of compensation also works equally well for any value of $\widetilde{x} < x^*$. Thus the compensation level $C = cf(x^*)/\ \delta$ makes efficient trade immune to offers to trade under bilateral trade agreements from coalitions of embargo breakers. Trade at all levels of x such that $x > x^*$ can no longer necessarily be supported, however.[36]

Finally, what if alternative guilds can form and offer to trade under the strategies specified above after a boycott has been announced? Under condition (37), it is easy to see from the immediately preceding argument that the original guild must then contain exactly x^* members. Otherwise, an alternative guild containing exactly x^* members can form during a boycott and replace the original guild by offering to trade at the city's preferred level. This restricts the levels of trade which the original guild can implement.

4 What Level of Trade?

The preceding sections have followed GMW in considering merchant strategies which allow the 'efficient' level of trade to be supported as a repeated-game equilibrium. We have shown that by including a demand for compensation in their equilibrium strategies, the guilds would have been able to resolve the "commitment problem" noted in GMW by making trade embargoes (or multilateral punishments) self-enforcing. They would thus have

[36] Any level of trade $\widehat{\widetilde{x}} \leq x \leq x^*$ can be supported in this case if f is nondecreasing in x everywhere in this range. Trade in the range $[x^*, x'')$ can be supported where x'' is the smallest value of x in $[x^*, \overline{x}]$ such that $f(x'') \leq f(\widehat{\widetilde{x}})$.

been able to support trade at the efficient level even in the absence of an internal enforcement mechanism to punish "embargo breakers". A question so far neglected, however, is whether the merchants and the cities would have agreed on the level of trade which they wished to support. We consider this issue here.

With trade supported by purely *bilateral* punishment strategies, the city rulers could control the level of trade (subject to their own incentives to cheat individual merchants), since merchants are informationally isolated and do not coordinate their responses to cheating by the city. As we have seen in Sections 2.1 and 3.1 above, given GMW's specification of trading costs a city would like to support trade at the value-maximizing level x^*, but incentive-compatible trade can only occur up to the highest level $\widehat{x}$ consistent with (17) and (26). Bilateral punishments result in too little trade in equilibrium.

When trading costs depend on the volume, as opposed to the value, of trade, however, the city will no longer necessarily wish to support the efficient level of trade. With per-merchant trading costs (see Section 2.1), a city would wish to support trade up to the level x_c^* given by

$$f'(x_c^*) = \frac{c}{\tau}, \tag{40}$$

which is typically not equal to the efficient level of trade x^* defined by (11) above. For example, when f is concave and (12) is satisfied, it is easy to show that $x_c^* > x^*$, so the city's preferred level of trade exceeds the efficient level. Substituting into (9) we obtain $\frac{\partial \widetilde{V^{\epsilon=0}}(x_c^*)}{\partial \epsilon} = cx_c^* > 0$. The city's preferred level of trade cannot be supported as an equilibrium, although the efficient level of trade can be.[37]

[37] With per-merchant trading costs, a guild wishing to maximize the total profits would prefer the level of trade x_g^* defined by

$$f'(x_g^*) = \frac{\kappa}{1-\tau},$$

where x_g^* in general differs from both the efficient level of trade and the level of trade preferred by the city. When (12) is satisfied it is easy to see that $x_g^* < x^*$.

When trade is supported by multilateral punishment strategies (i.e. by a guild), higher levels of trade can be supported by the appropriate punishment strategies, as shown in Section 3.2. The issue then becomes the volumes of trade which the guild is able to enforce, and whether it would wish to support trade at the "efficient" level. This in turn depends upon the precise role that guilds played in regulating or controlling merchant activities.[38]

One possibility is to assume, as in GMW, that all a guild does is to coordinate merchant responses to cheating by city rulers, by mechanically announcing trade boycotts, but otherwise makes no attempt to control the number of merchants trading with a city. That is, assume that the guild protects *all* merchants entering a city by calling for a trade embargo (and demanding compensation) whenever it learns that *any* merchant has been cheated by the city rulers. As noted in Section 3.1 above, the volume of trade would increase until the average payoff per merchant $\overline{\pi}(x) = \frac{1}{x}[1-\kappa-\tau]f(x)$ becomes nonpositive, or until $x = \overline{x}$, whichever comes first. Thus the volume of trade would exceed the efficient level.

If the guild is also able to exert control over the number of merchants trading with a city, as described in Section 3.2 above, then more can be achieved. Assume now that the guild can restrict its membership to a subgroup of traders $x_g < \overline{x}$, and only punishes the city when it violates the rights of traders who are guild members. Would the guild then wish to control entry so as to maximize the total value of trade to its members (i.e. at $x_g = x^*$)? Or would it want to further limit trade to increase the profits of individual guild members? Under GMW's formulation of trading costs, a guild that wished to maximize the payoffs of individual guild members would attempt to restrict trade to the level x_g^* given by the condition

[38] For the purposes of this discussion we assume that the guilds determine their punishment strategies independently, and cities respond optimally to them. The more complex issues that arise in bargaining over exclusive trading arrangements are discussed briefly at the end of the section.

$$f'\left(x_g^*\right) = \frac{f\left(x_g^*\right)}{x_g^*} > 0, \tag{41}$$

implying that $x_g^* < x^*$. In other words, the guild would prefer to implement a sub-optimal level of trade from the city's point of view.

If $x_g^* > \widehat{x}$, with $\widehat{x}$ defined by (26) above, the guild could enforce the level x_g^* by affording protection to only x_g^* traders. If $x_g^* < \widehat{x}$, and f is concave, then the best the guild can do would be to limit the number of traders entering a city to $\widehat{x}$, since trade below this level would provide the city with an incentive to elicit trade from non-guild members.[39] In either case, a guild with the power to control its membership would want to impose an inefficient level of trade from the city's point of view.[40] This may be seen as providing some support for the arguments of Ogilvie (1995) (see also Dessi and Ogilvie 2004), for instance, as it is no longer clear that the levels of trade supported by guilds would be superior to the levels that would arise in their absence.

Would a guild seek to maximize the total value of trade accruing to its members, or the average value? Certainly individual merchants within a guild would have had strong incentives to restrict further membership so as to limit trade and increase their own profits. There is some historical evidence in favor of this view. Lane (1973), for example, tells us that the *"frankly avowed purpose"* of the guild of the merchant nobles of Venice was *"to help Venetian merchants make profits."* And Postel (1996) notes that, *"from the middle of the 14th century ... the Hanseatic meetings had to decide on formal applications; their decision depended on whether admission was advantageous to the Hansa or not."* Writing on merchant associations in pre-industrial Europe, Kohn (2003) summarizes the evidence as follows:

[39] If $\overline{\pi}(x)$ is concave then $x_g^* \leq \widehat{x}$, where the inequality is strict if $c < \gamma[\tau - c]$. In this case, the city's credible threat to trade with non-guild members acts as a constraint on the monopoly power of the guild, as noted in Proposition 2.

[40] With per-merchant trading costs, a guild wishing to maximize average profits would also want to implement the level of trade x_g^* defined by (41).

"Some guilds, especially earlier on, were very loosely defined and included all sorts of merchants, tradesmen, and artisans... Later, guilds became more exclusive, with membership limited to merchants alone or even to particular categories of merchant trading in particular types of merchandise or to particular destinations. At the same time, it became more difficult to join a guild, with membership generally descending from father to eldest son, and outsiders having to purchase entry at considerable cost. The reason for the greater exclusiveness was that over time many guilds acquired valuable rights—monopolies over particular forms of trade or exemptions from various tolls and taxes. Naturally the members wished to keep these hard-won benefits to themselves."

Thus while the guilds may have been capable of supporting more trade than could have been achieved in their absence, the historical evidence suggests that they would not necessarily have considered it in their interests to do so.

A final possibility is that the guilds could enter into exclusive trade arrangements with cities in order to control the overall level of trade. From the historical evidence referred to above, acquiring such exclusive trading privileges was evidently a common aim of the medieval merchant guilds.[41] This could in theory result in even lower levels of trade being supported (e.g. at $x_g^* < \widehat{x}, $), by the city agreeing not to trade with non-guild members. Since the city rulers would still prefer trade up to x^*, compensation of some kind would presumably have been required to obtain their agreement, either in the form of a higher *ad valorem* tax rate, or a lump-sum transfer. But this is ruled out in the current model since, under GMW's specification of trading costs, any reduction in trade below $\widehat{x}$ results in a lower net value

[41] As Ogilvie (2011, Ch 6) puts it, a "*universal shared purpose of merchant guilds was to get monopoly privileges for their members.*"

of trade. Thus compensating the city to implement such a reduction would not be possible.[42]

An alternative would be for the guild to agree on *an expansion of trade* beyond the level which could be supported by bilateral punishment strategies (i.e. $\widehat{x} < x \leq x^*$), in return for favorable tax treatment from the city. This may be more consistent with the historical evidence concerning the trading privileges acquired by guilds, and also accords with the GMW thesis that the establishment of guilds led to trade expansion. Indeed, as GMW (p. 749) argue:

> *"If the purpose of the guilds was to create monopoly power for the merchants and to increase their bargaining power with the rulers, why did powerful rulers during the late medieval period cooperate with alien merchants to establish guilds in the first place? What offsetting advantages did the rulers enjoy? The puzzle is resolved if the guild's power enabled trade to expand to the benefit of the merchants and rulers alike."*

As we have pointed out above, however, a guild whose role was merely to coordinate merchant responses to cheating would not have been in a position to negotiate trade expansion and tax privileges with medieval city rulers. For this, the guilds needed to be able to control the number of merchants trading with a city. Analyzing the bargaining game between cities and guilds over tax privileges and exclusive levels of trade takes us beyond the scope of the current paper.[43]

[42] With per-merchant trading costs, the guild's preferred level of trade is less than the efficient level, while the city's exceeds it, at least when we assume that (12) is satisfied. Since this assumption implies that the efficient level of trade can be supported with purely bilateral punishment strategies, the city can insist on trade of at least this level. So once again it would not be possible for the guild to compensate the city for reducing trade any further.

[43] Such an analysis would need to specify what the city and the guild were bargaining over (e.g. levels of trade and *ad valorem* tax rates, or levels of trade and lump-sum transfers), and the parties 'inside' and 'outside' options (see Muthoo 1999 for the definitions of these

5 Conclusion

GMW's analysis is concerned with the establishment of an historical 'institution' - the medieval merchant guild - capable of supporting efficient trade between alien merchants and medieval city-states. They conclude that efficient trade would only have been possible if guilds had the ability to coordinate merchant responses to cheating by enforcing compliance to trade boycotts by individual traders. Incentives for embargo breaking would have otherwise made the guilds ineffectual.

As we have demonstrated in this paper, once the guilds' demands for compensation are taken into account, no such internal enforcement mechanism would have been necessary. Our reformulation of the guilds' equilibrium strategies, based on the historical evidence, makes the threat to impose a trade boycott self-enforcing, and resolves the credibility issue noted by GMW. Further, demands for compensation make both bilateral and multilateral punishment strategies renegotiation-proof. Thus the guilds did not need the power to coerce individual merchants into taking part in the punishment of cities in order to support efficient trade, since they could rely on traders' private equilibrium incentives to do so.

Implementing particular levels of trade would have required that guilds did more than merely coordinate merchant responses to cheating, however. In the absence of any ability to control the number of merchants trading with a city, the incentives of individual traders could easily have led to volumes of trade well above the levels desired by either cities or guilds. An ability to control their own membership (and to only punish cities when they violated the rights of guild members), gave the guilds the power to restrict

terms). For instance, would the city continue to benefit from trade at level $\widehat{x}$ while bargaining was taking place (making it an 'inside' option)? Would this trade occur with potential guild members, or with 'outsiders'? And so on. Dessi and Ogilvie (2004) consider a game in which the guild makes lump-sum transfers to city rulers in exchange for exclusive trading privileges. They assume that the city makes take-it-or-leave-it offers to the guild however, which simplifies the bargaining problem.

the equilibrium level of trade. A guild which aimed to maximize the average profits of its members would then have wished to implement a sub-optimal level of trade from the city's point of view. But the same ability to restrict trade could also have been used to negotiate favorable treatment for guild members, in return for an agreement to expand trade towards the levels desired by cities. This may provide some support for the GMW thesis that the establishment of the merchant guilds led to trade expansion in the late middle ages.

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