Enforcing Cooperation Amongst Medieval Merchants: The Maghribi Traders Revisited

David Harbord
Market Analysis Ltd, Oxford

Extra-legal Governance and Organized Crime Discussion Group Seminar, Oxford

Jewish Maghribi Traders

- descendants of Jewish traders who left Baghdad and emigrated to North Africa and Western Mediterranean in 10th century
- engaged in long-distance trade all over the Muslim Mediterranean in the 10th to 13th centuries (also later in India and Far East)
- kept a separate identity- operated as a 'closed coalition' (Greif) forming partnerships, 'formal friendships' and agency relations largely with each other
- exact numbers were unknown, but relatively small - several dozen are mentioned in the *Geniza Documents* (1000 + documents deposited in Fustat (Old Cairo), 'on which the name of God was or might have been written'. Letters translated and published by Goitein, 1973)
- more than 150 commodities are mentioned in their letters: textiles, dyes, medicines, spices, perfumes, copper, tin, lead, olive oil, waxes, soaps, sugar, flax, gold, silver, etc.
- legal contracts were rarely used – trade relations were usually based on <u>mutual trust</u>
- courts had difficulty verifying competing claims, or enforcing judgments on traders in other locations. Some merchants attempts to sue were carried on by their heirs…..

Western Mediterranean Basin

Maghribi Traders Coalition I

Trade frequently operated through *agency relationships*:

- enabled some merchants to operate as sedentary traders, saving the cost and risk of sea journeys, and traveling merchants to rely on agents to handle their affairs in their absence
- agents provided many trade-related services: loading and unloading ships; paying customs, bribes, and transportation fees; storing and transferring goods to the market; deciding when, how, and to whom to sell the goods, and at what price

But agents could 'cheat' while handling a merchant's capital, i.e. lie about the price received or abscond with the merchant's goods:

- to be employed agents had to commit *ex ante* to being honest *ex post*, after the goods were sent to them
- without an 'institution' to support honesty, merchants would have anticipated opportunistic behavior and refused to hire agents
- mutually beneficial exchanges would not have occurred

Maghribi Traders Coalition II

Greif (1989; 1993) asked how the Maghribis sustained ‘long-distance trading relationships in the presence of incentives for ‘cheating’:

- posited a “multilateral reputation mechanism”
- an agent who embezzled the goods of ***any*** merchant was branded a "cheater" and not employed thereafter by ***any other*** merchant
- this ‘collective punishment’ of cheaters was made feasible by the transmission of detailed information between merchants on agents’ past behavior
- merchants were motivated not to hire an agent who had cheated (i.e. to participate in the collective punishment) via the wage premium required to keep an agent with a "reputation" for cheating honest
- an agent subject to multilateral punishment was not expected to be hired by any other merchant, so his loss from cheating if re-hired was less for an "honest" agent
- merchants would not hire a ‘cheater’ since it was necessary to pay more than an honest agent to induce cooperation..

Formal Model: One-Period Trading Game

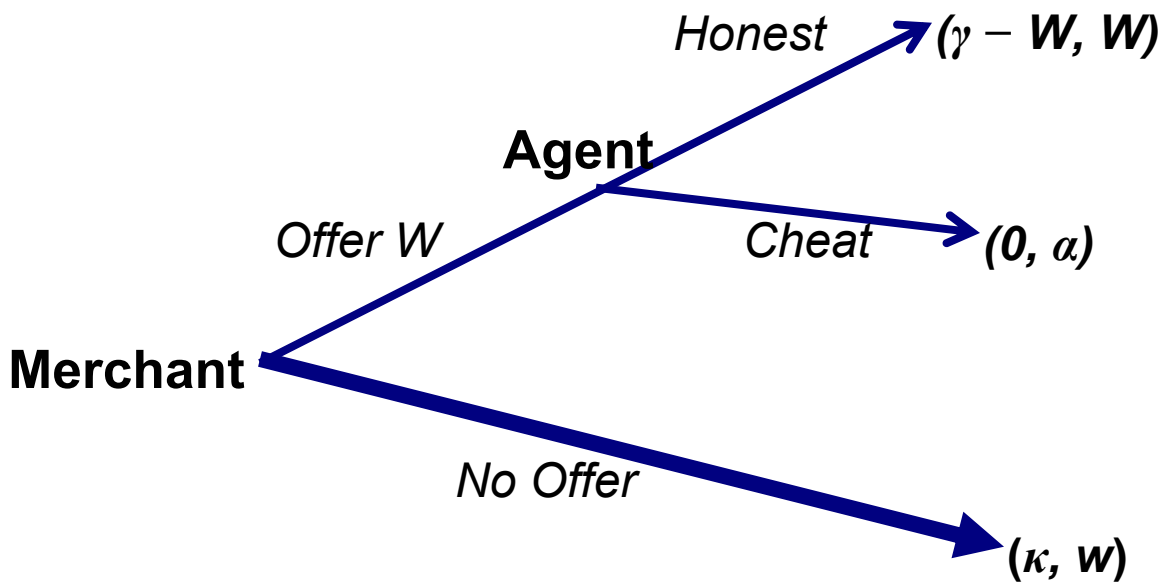
Complete information game with M merchants and A agents and $A > M$:

- each merchant randomly matched with a single agent
- merchants' reservation utility $\kappa > 0$ (from not employing an agent); agents' reservation utility $w \geq 0$; gross payoff from cooperation (i.e. employment) γ.
- a merchant who hires an agent decides what ***employment contract***, i.e. wage $W > 0$, to offer
- since the agent holds the merchant's 'capital', ensured of receiving his wage

An agent who is offered employment decides whether to be honest or to cheat:

- Honest: merchant's one-period payoff is $\gamma - W$, and agent's payoff is W
- Cheats: agent gets $\alpha > 0$, and merchant's payoff is 0
- Assume: $\gamma > \kappa + w$ (cooperation is efficient); $\gamma > \alpha > w$ (cheating entails an efficiency loss and agents prefer cheating to receiving their reservation utility); and $\kappa > \gamma - \alpha$ (merchants prefer not hire an agent over paying a wage as high as the amount that the agent can cheat them by)

One-Period Game: Extensive Form



One-Period Trading Game

A one-sided 'Prisoners' Dilemma' with sequential moves:

- merchants offer employment contract ***W < α,*** or make **no offer**
- an agent accepts any employment contract offered and decides to be *Honest* or *Cheat*
- unique (backwards induction) Nash equilibrium: <*No Offer, Cheat*>

In the absence of *legally enforceable contracts*, cooperation is impossible in one-shot game:

- Greif considered the infinitely repeated merchant - agent game
- traders sons often followed in fathers' footsteps and were held responsible for past business dealings
- value of reputation did not diminish with age

Infinitely Repeated Trading Game

Players live infinite number of periods - common time discount factor $\delta \varepsilon (0,1)$:

- end of every period, merchants decide whether to retain their current agents or search for a new agent
- with probability $\tau > 0$ a merchant is forced to fire his agent, i.e. no guarantee of long-term employment
- merchants can make hiring and retention decisions contingent upon the actions previously taken by an agent

Greif (1993) assumes perfect and complete information economy. Distinguish between two different concepts of perfect information:

- *multilateral perfect information:* each merchant can perfectly monitor the actions of every agent, whether employed by him or not (*'public observability'* – Kandori 1992)
- *bilateral perfect information*: each merchant can perfectly monitor the actions of any agent he employs, but not of agents employed by other merchants ('*local information processing*')

Restrictions on Repeated Game Strategies

Since merchant/agent relationships subject to random dissolution and matching, more can be achieved with 'collective' punishment than with individual punishment:

- could appeal to "folk theorems" Kandori (1992), Dal Bo (2003)
- any feasible individually rational set of payoffs can be achieved for δ large enough

Greif (1993) considers only "historically plausible" ***simple*** repeated game strategies. Defined by three properties:

- **symmetry:** i.e. all merchants/agents follow the same strategy
- **punish only the guilty**: i.e. do not call for the complete cessation of cooperation for extended periods when a group member fails to cooperate (not *trigger strategies*)
- **no 'higher-order' or recursive punishments:** i.e. cheaters do not "collaborate" in their own punishments, by punishing merchants who fail to punish cheating agents, and so on.

Restrictions on Repeated Game Strategies II

Sociobiologists (e.g. McElreath and Boyd, 2006, Gintis, 2004) argue that standard game-theory models can't explain emergence of cooperation in "real" human societies.

Two arguments typically cited:

i. Standard repeated game models support cooperation by 'trigger strategies' i.e. complete cessation of cooperation when one or more group members fails to cooperate

ii. 'Higher-order' or recursive punishment strategies required to sustain punishment of noncooperators are implausibly demanding, and not observed in actual human societies

Gintis (2004):

- *"Sophisticated repeated game-theoretic models have strongly advanced our understanding of the theory of social cooperation, but no attempt has ever been made to show that such models apply to the major forms of non-market-mediated economic cooperation. There is considerable doubt that they could so apply, since neither trigger strategies nor second order punishment are commonly observed in socially efficient cooperative groups."*

Greif's Repeated Game Strategies

Merchants:

- offer a wage *W**
- retain the agent if honest (unless forced separation occurs)
- fire the agent if he cheats
- never hire an agent who has ever cheated
- randomly choose an agent from the unemployed honest agents if forced separation occurs

"Honest" agents (i.e. an agent who has never cheated in the past):

- are honest if offered a wage weakly exceeding W*
- cheat if offered a wage less than W*

"Cheaters" (i.e. an agent who has *ever* cheated in the past):

- cheat unless offered a wage $W_c > W^*$

Greif's Repeated Game Strategies …

These strategies support a subgame perfect (SGP) equilibrium in which merchants never hire a cheater and agents never cheat.

To see this let:

- h = probability that an unemployed "honest" agent will be rehired in any period;
- V_h the lifetime expected utility of an employed honest agent; and
- V_h^u the lifetime expected utility of an unemployed honest agent
- V_c and V_c^u denote the expected lifetime utilities of an employed and unemployed "cheater" *who behaves honestly when employed*

Repeated-Game Equilibrium Strategies

Proposition 1 in Greif (1993) solves for the lowest wage W* for which an agent's best response is to be honest in any period.

Proposition 1 Assume *δ, τ , h ε (0, 1)*. The lowest wage for which an "honest" agent's best response is to be honest is *W** = w*(δ, h, τ , w, α)* > *w* , where w*(·)* is decreasing in δ and *h* and increasing in *τ , w , and α*.

Proof. For a given wage offer *W*, agents' lifetime expected utilities are,

$$V_i = W + \delta\left\{(1-\tau)V_i + \tau V_i^u\right\}, i = h, c$$

$$V_h^u = hV_h + (1-h)(w + \delta V_h^u)$$

$$V_c^u = w + \delta V_c^u$$

Repeated Game Equilibrium Strategies

The payoff from cheating once and then becoming an unemployed "cheater" is $\alpha+\delta V_c^u$. Setting $V_h(W^*) = \alpha+\delta V_c^u$ and solving for W^* yields:

$$W^* = [T - \delta\tau H]\left[\alpha + \frac{\delta w}{1-\delta}\right] - \tau\delta P w$$

where,

$$T = 1-\delta(1-\tau),\ldots H = \frac{h}{1-\delta(1-h)},\ldots P = \frac{1-h}{1-\delta(1-h)}$$

The properties of $w(\ )$ can be derived directly from this expression.

Repeated Game Equilibrium Strategies …

W* is the minimum wage required to induce cooperation from agents who have never cheated.

- setting $h = 0$ defines W_c , the minimum wage required to induce honesty in an agent who has a 'reputation' for cheating
- since $W_c > W^*$, the wage required to induce honesty from an agent who has cheated in the past is higher than that required to induce cooperation from honest agents

Hence, so long as $A > M$, merchants will always prefer to hire an honest agent.

- i.e. the collective punishment strategy is 'self-enforcing'
- there will only be trade if $W^* \leq \gamma - \kappa$, requiring an additional restriction on the parameters
- offering any higher stationary wage $W^{**} > W^*$ can never be a (SGP) equilibrium given the restrictions on the strategies
- autarky (or no trade) can always be an equilibrium

(Subgame Perfect) Equilibrium

- For uniqueness need to assume that cheating by an agent when offered a wage *lower* than $W^{**} > W^{*}$ is sufficient to invoke the multilateral punishment strategy
- Otherwise there is a continuum of subgame perfect equilibria supported by wage offers in the range $W^{*} \leq W^{**} \leq W_c$.
- Autarky is implemented by the strategies: merchants never hire agents and fire any agent they have hired at the end of each period, whether the agent has cheated or not. Agents always cheat if offered a wage less than α.
- Permanent reversion to autarky in response to any agent cheating could have been used to sustain the same equilibrium outcome as that obtained in Proposition 1 (trigger strategy approach).
- For subgame perfectness, need the specified strategies to be an equilibrium after every possible history, which they are not (see Fudenberg and Tirole 1991, pp. 108-110).
- Relevant histories are those in which $A^h < M$, so the collective punishment strategy is no longer self-enforcing
- Can simply specify a permanent reversion to the autarky after every such history.

(Subgame Perfect) Equilibrium …

- If the probability of forced separation is zero ($\tau = 0$), then $W_c = W^*$, so merchants are indifferent between hiring an honest agent or a former cheater
- i.e. under *simple* punishment strategies, an agent's strategy does not call on him to cheat any merchant who hires him because he has cheated in the past
- agents do not punish merchants for not following the collective punishment strategy.
- As Greif (1993) observes, the equilibrium would then rest on a "knife-edge" in which merchants only carried out the punishment strategy because of indifference.
- The role of the exogenous probability of forced separation is to break this indifference
- Makes the expected lifetime utility of an employed honest agent exceed that of an employed cheater, even if the "cheater" intends to play honest in the future, resulting in $W_c > W^*$

The Problem

In Proposition 1, merchants strictly prefer not to *hire* a "cheater" since $W_c > W^*$.

- why should a merchant *fire* an agent who has cheated and search for a new agent?
- i.e. nothing is learned from observing off-the-equilibrium-path (i.e. cheating) behavior – complete information assumption
- and agents do not punish merchants who violate the collective punishment strategy
- an agent's "continuation" strategy after cheating is to be "honest" thereafter if not fired and branded a "cheater"

In the absence of switching costs, merchants should be indifferent between retaining or firing a cheater:

- for any small switching cost merchants will strictly prefer to retain their current agent, whether he has cheated them or not
- e.g. Greif, Milgrom and Weingast (1994) appeal to the concept of renegotiation-proofness to explain why the ruler of a medieval city could not have been relied upon to punish violators of a merchant embargo by cheating them, when mutually profitable trade was possible on terms which the ruler would credibly respect

The Problem II

Greif's (1993) equilibrium requires either:

i. multilateral perfect information or
ii. zero switching costs

- under *multilateral perfect information* an agent who cheats is automatically branded a "cheater" and punished by *all* merchants, so $W_c > W^*$ for that agent
- under *zero switching costs* merchants follow equilibrium strategies out of indifference

Are either realistic? Severing relations with a formerly trusted agent was costly to the Maghribis, as Greif (1993)(2006) makes clear:

- *(p. 534): "When switching agents does not impose any cost–as assumed here–merchants may as well punish a cheater, hence the multilateral punishment strategy is a subgame perfect equilibrium. Having the credibility of multilateral punishment rest on a knife-edge result, however, is unsatisfactory. Clearly, Maymun be Khalpha considered that punishing the Sicilian agent was costly."*

The Problem III

Greif provides evidence that the Maghribis shared information, but not that they could perfectly observe the actions of all agents, or all transactions.

- Maghribis sometimes kept their affairs secret from other traders, and *informed* their trading partners of the transgressions or good behavior of other agents
- e.g in Letter 8 of Goitein (1973) a trader acting as an agent informed his correspondent that the consignment he was in charge of was the property of a certain other trader, *"...but no one knows this except myself*"
- the agent was confiding in his correspondent partly to avoid any risk of being accused of having absconded with the merchant's goods
- he added that another trader had acted honorably when acting as an agent for him, so *"... no heedlessness is permissible with regard to his rights.*"
- in Letter 17, a trader involved in a lawsuit before the rabbinical court of Fustat wished that his opponent would have returned "*to the right way...so that I would not be forced to make known his doings to the communities of Israel in east and west*."

Hence merchants did not directly observe the actions of other merchants' agents, but needed to be informed of them.

The Problem IV

Real issue is not degree of multilateral as opposed to bilateral perfect information:

- information transmission and monitoring was imperfect, full stop,
- i.e. Greif 2006, p. 65: "t*he ability to monitor, however, was imperfect; a merchant could mistakenly conclude that an agent was dishonest"*

Issue is whether an agent would be branded a cheater if the merchant in question did not accuse him?

- Maghribis transmitted information about good and bad behavior of their agents (Letters 8 and 17) - why do this if information is perfect?
- historical evidence indicates that other merchants needed to be told of accusations of cheating

And they sometimes disagreed (Greif 2006, p. 65):

- *"… around the middle of the century Maymun ben Khalpha of Palermo sent a letter to Naharay ben Nissim of Fustat. Discussing a conflict that Naharay had with one of his agents, Maymun makes clear that in contrast to Naharay he contends that the agent was honest and should not be accused of cheating."*

Assumption of publicly observable actions seems untenable as an approach to sustaining multilateral punishment strategies as an equilibrium.

Another Solution?

Greif (1993) (2006) tells us that a cheater could have his record wiped clean by paying compensation to the cheated merchant:

- *"The geniza … suggests that a multilateral reputation mechanism governed agency relations; merchants conditioned future employment on past conduct, practiced community punishment, and ostracized agents who were considered cheaters until they compensated the injured party."*

- *"In 1055 Abuh ben Zedaka embezzled the money of a Maghribi trader. … Merchants as far away as Sicily ostracized him. Only after a compromise was achieved and he had compensated the offended merchant were commercial relations with him resumed."*

- *"My master mentioned that you approached the kardal gently in order to get something back from him. Perhaps you should threaten him that here we excommunicate anyone who owes us something and does not fulfill his commitments." (Goitein, Letter 28)*

This compensation scheme plays no role in Greif's own model, but it can solve the problem with the equilibrium strategies identified above.

Another Solution …

A merchant's lifetime expected profits - V^M - from engaging agents are:

$$V^M = \frac{\gamma - W^*}{1 - \delta}$$

if not cheated; and

$$V^M = \frac{\delta(\gamma - W^*)}{1 - \delta} - \varsigma$$

if cheated once and returns to the equilibrium path of play with a different agent, where $\varsigma > 0$ is his switching cost.

- if he returns to the equilibrium path of play with the same agent, saves the switching cost ς
- strictly prefers retaining the agent who cheated him over incurring the cost of finding a new agent

Another Solution …

Suppose instead that a merchant who fires a cheating agent can expect to receive a compensation payment with a present discounted value of *C*. Profits from switching agents are then,

$$V^M = \frac{\delta(\gamma - W^*)}{1-\delta} - \varsigma + C$$

If $C > \varsigma$, merchant strictly prefers to fire the agent as required by the equilibrium strategies

Can compensation sustain both the agents' and merchants' incentives so that agents are hired in equilibrium?

- note first that for any level of compensation *C*, a merchant prefers to retain an agent who cheats and then immediately pays compensation over firing the agent
- need to find a wage rate and levels of compensation which induce agents to act honestly, and which induce agents who have cheated to pay compensation immediately over becoming unemployed forever (or paying compensation later)

Proposition 2 establishes the required wage and compensation levels

Equilibrium with Compensation I

Proposition 2 There exists a minimum wage rate $\tilde{W}$ and maximum compensation levels, $\tilde{C}_0$, $\tilde{C}_1$, such that:

i. agents (weakly) prefer playing honest over cheating and paying the compensation $\tilde{C}_0$ immediately;
ii. agents (weakly) prefer paying the compensation $\tilde{C}_0$ immediately over becoming unemployed forever;
iii. an agent who has cheated in period *t* will (weakly) prefer to pay the compensation $\tilde{C}_0$ immediately over waiting one period and paying compensation $\tilde{C}_1$ in period *t+1*;
iv. an agent who has cheated in period *t* and not paid the compensation $\tilde{C}_0$ will (weakly) prefer to pay the compensation $\tilde{C}_1$ immediately over staying unemployed forever; and

In addition, $\tilde{W}c > \tilde{W}$, so the wage required to induce cooperation from agents who have cheated and not paid compensation exceeds the wage required to induce cooperation from 'honest' agents.

Further, $\tilde{W} = W^*$ as defined in Proposition 1, so the "same" level of trade is sustained in equilibrium.

Equilibrium with Compensation II

Why two compensation levels? An agent's expected payoffs differ once fired for cheating:

- $\tilde{C}_0 = (1-\tau)\delta V_h + \tau\delta V_h^u - \delta V_c^u$, i.e. the gain from not being fired and becoming an unemployed cheater
- $\tilde{C}_1 = V_h^u - V_c^u$, i.e. the gain from becoming an unemployed honest agent again
- since $\tilde{C}_1 < \tilde{C}_0/\delta$, merchants prefer immediate compensation, so will retain cheating agents who pay them $\tilde{C}_0$

Equilibrium strategies with compensation are then:

- honest agents matched with a merchant are offered $(\tilde{W}, \tilde{C}_0, \tilde{C}_1)$;
- an agent who cheats in any period is fired unless he immediately pays compensation $\tilde{C}_0$;
- an unemployed cheater is never employed by any merchant until he pays compensation $\tilde{C}_1$ to the original merchant; and
- agents are honest if offered $\tilde{W}$, pay $\tilde{C}_0$ immediately if they cheat, and pay $\tilde{C}_1$ to a cheated uncompensated merchant at the first opportunity

Equilibrium with Compensation III

- merchants receives at most $\alpha - \tilde{W}$ from an agent who has cheated, so merchants are not fully compensated
- hence no incentive to induce cheating by offering a low wage
- merchants will never hire a "compensation cheater" for the same reason that merchants don't hire cheating agents in Greif's model, i.e. because $\tilde{W}c > \tilde{W}$
- compensation payments have resolved the issue of why a merchant should fire a cheating agent who hasn't paid compensation
- i.e. if the agent has cheated and hasn't paid compensation in period *t*, the agent's best response to being fired and unemployed in period *t+1* is to pay compensation in period *t + 1*.

The remaining issue with the equilibrium strategies is that merchants now strictly prefer to declare their current agent a cheater in order to receive the compensation $\tilde{C}_0$

- no incentives for false accusations in Greif's model with exclusion strategies
- if disputes over whether or not an agent had cheated could be adjudicated with reasonable accuracy, false accusations of cheating were unlikely to occur

Preventing False Accusations of Cheating

- Greif (2006) argues that making false declarations of cheating would have been very costly to merchants:

  > *"an insider merchant puts his own reputation on the line in accusing an agent."* (2006, p.82)
  >
  > *"false accusations of cheating were curtailed by the extensive use of witnesses to testify to one's honesty.*"

- Further, a merchant who made a false accusation would be unable to hire agents in the future, because they would cheat him and not pay compensation.
- Greif (1993) notes traders who had been accused of cheating could in turn be cheated by other Maghribi traders without their being subject to community retaliation
- 'cheat the cheater' strategies
- similar forms of punishment strategy are found among the Orma herders of East Africa (Ensminger 1992, Chapter 4; Dixit 2004, p. 62), and the Ju/'hoansi bushmen (Wiessner 2005)
- None of this fits in exclusionary strategy equilibrium story.

Preventing False Accusations of Cheating …

Assume that a merchant who made a dishonest report would be discovered with some probability ρ ε (0, 1).

A merchant who makes a false accusation of cheating would then have an expected payoff $V_c^M(\rho)$ given by,

$$V_c^M(\rho) = (1-\rho)\left[\gamma - \tilde{W} + \tilde{C}_0 + \frac{\delta(\gamma - \tilde{W})}{1-\delta}\right] + \rho\left[\gamma - \tilde{W} + \frac{\delta^2(\gamma - \tilde{W})}{1-\delta}\right]$$

since a merchant's payoff from being cheated once is just 0.

Ensuring that cheating by making a false declaration is unprofitable requires that $V^M > V_c^M(\rho)$, or:

$$(1-\rho)\tilde{C}_0 \leq \rho\delta(\gamma - \tilde{W})$$

Hence for a probability of detection in the range ρ ε [ρ', 1), where ρ* is defined by $V^M = V_c^M(\rho^*)$, making a false declaration will be unprofitable.

Who Did the Monitoring?

The above introduces an element of multilateral monitoring back into the model. Was Greif's story was right after all?

- under exclusion strategies, merchants would do the monitoring to deter cheating, i.e. facilitate transmission of multilateral perfect information
- with compensation strategies, agents would do the monitoring to deter false accusations of cheating

Greif (2006), p. 63:

- *"eleventh century Maghribi agents generally conducted important business in the presence of other coalition members. In their reports they included the names of witnesses the merchant knew, thus enabling the merchant to verify the agent's report."*

Summary

Trade supported by compensation strategies seems to more accurately reflect actual Maghribi practices and the informational constraints they operated under. A number of desirable properties:

- utilizes the Maghribi's actual 'punishment strategies' to resolve the issue of why traders should fire cheating agents
- dispenses with assumptions of multilateral perfect information and/or zero switching costs
- explains the role of 'cheat the cheater' strategies to discourage merchants from making false declarations of cheating
- explains why merchants' incentives to make false declarations of cheating (in order to obtain compensation) needed to be as closely monitored as agents' incentives to cheat merchants
- i.e. the purpose of witnesses was as much to protect agents from false accusations, as to protect merchants from being embezzled.
- a more efficient institution in a world of imperfect information and imperfect monitoring in which some "mistakes" or transgressions" were likely to occur