RISK SHARING, DIVERSIFICATION AND MORAL HAZARD IN ROMAN

PALESTINE: EVIDENCE FROM AGRICULTURAL CONTRACT LAW

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Abstract

We investigate the economic rationale for a law pertaining to tenancy in Roman Palestine, found in a Jewish legal text. This law allows for risk-sharing (through rent reduction) between tenant and landlord when the macro-economic situation is severe (*makas medina)*, but not if the particular rental plot has a bad harvest. We consider and critique the possibility that the restriction of risk-sharing to times of *makas medina* can be explained from a moral hazard perspective. Next, we show that this feature of the rental contract can be well explained as an optimal characteristic of rental contracts in an economy characterized by tenants whose income sources are diversified. We provide empirical evidence supporting this possibility.

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I. Risk Sharing and Moral Hazard

Risk is an integral part of most economic environments. The desire to transfer risk is, consequently, an important motivation for many contractual arrangements. However, the efficient transfer of risk is sometimes hindered by the inability of the parties to condition on specific contingencies because they are difficult to observe. These observational difficulties may sometimes lead to moral hazard, i.e. insurance against some risk causes the insured party to take greater risk, or to take less care than is socially optimal in preventing that risk. Such inefficiencies in principal-agent relationships give rise to what are called agency costs. Agency costs in the area of financial economics and the economics of the firm have been intensively studied since the work of Ross (1973) and Jensen and Meckling (1976), and many disparate contracts in this area and in others, have been explained on the basis of these costs.[1]

At the same time, there may also be risk-sharing aspects to contract features that seem, on the face of it, to exist solely to control moral hazard. For example, Green (1984) presents the convertibility feature of some corporate bonds as a means of reducing

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[1] For example, the call options in the compensation packages of firm executives help to reduce the tendency of managers to protect their jobs by being overly conservative. Bond covenants, such as restrictions on dividend payments, can help eliminate agency conflicts between bondholders and stockholders. Share cropping can mitigate the tendency of direct tenants to over-work the field (Alston et al., 1984; Basu, 1992). Other areas in which this concept has been applied are procurement contracting (Cox et al., 1996), labor contracting (Lazear, 1979), deposit insurance (Grubel, 1993) and voting theory (Banks and Sundaram, 1993).

the perverse incentives of debt to induce excessive risk-taking. On the other hand, Frierman and Viswanath (1993) show that convertible debt as a solution to agency conflict is not renegotiation-proof in a market context; hence convertible debt might simply be another way for bondholders and stockholders to share risk.[2]

In this paper, we present the case of an agricultural rental contract in Roman Palestine from a Jewish legal text, the *Mishna*. This contract is essentially a simple rental contract with, however, an insurance-like rent-reduction clause. The interesting aspect of this rent reduction is that it is restricted to extreme situations such as national catastrophes. While this restricted rent reduction may be explained by agency conflict-reduction objectives, we show that it can also be parsimoniously explained by simple risk-sharing motivations. In fact, the evidence seems to show that the farmers were sophisticated enough to diversify their income sources. Such diversification reduced their need for insurance except when the entire economy was affected.

The next section describes the particulars of the rental contract in the *Mishna*. Section III first describes a hypothesis based on moral hazard considerations to account for the restriction in the insurance provided in this rental contract. Evidence from other laws in the Mishna is then presented to show that moral hazard may not be a complete explanation for the phenomenon of interest. Section IV presents a complementary risk-sharing explanation. We argue that the risk-sharing explanation is supported by the

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[2] Another example is provided by the analysis of Grossman and Han (1996) of Confederate War finances. They find that moral hazard is not a viable explanation for the lack of debt financing, as one might have thought through a surface comparison of the Confederacy with other risky enterprises such as pharmaceutical companies. Rather, they find that it was due to a reduced need for risk-sharing. In their own words, "because the Confederacy began the war with large mobilizable resources relative to its expected postwar resource endowment, it required little external borrowing to accomplish the optimal amount of consumption smoothing."

empirical evidence presented in section V and provides a plausible explanation. Section VI concludes.

II. The Rental Contract in the Mishna

The Background

Direct Roman political influence in the land of Israel dates primarily from 63 B.C.E., with Ptolemy's conquest of the region. However, in contrast to other parts of the Roman Empire, the Jews strongly resisted Roman cultural influence. A corollary of this attitude was the maintenance of an independent Jewish legal system, at least in religious and civil matters, if not in criminal matters. The earliest systematic information available to us regarding the Jewish legal system that was in force in those days is to be found in a legal text called the *Mishna*. **3**

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3 The *Mishna* is a quasi-legal text, based on oral tradition, whose redaction was completed in the 2nd century C.E. It consists of six series of tractates dealing with different subjects. The tractate of relevance to us, *Bava Metsia*, is located in the series called *Nezikin* or 'Damages,' and deals with various kinds of civil matters, such as agricultural contracts, labor contracts, loan contracts, etc. *Bava Metsia* consists of 10 chapters or *perakim* (sing. *perek*). The name of our chapter or *perek* is *HaMekabel*, 'One who receives.'

Jewish law from around the 9th century onwards until today, is based on two collections of discussions of the *Mishna*. Of these, one originates in Babylon, and is called the *Talmud Bavli*; another, originating in Palestine, is called the *Talmud Yerushalmi*. Both of these were edited and put in their present form around the 6th century C.E. See Elon (1994), v. 3, pp. 1049 ff. for more details.

There has been very little economic analysis of the laws to be found in the Mishna. However, some articles analyzing later Talmudic law have appeared in the academic literature. See, for example, Aumann (1985), and Liebermann (1981, 1986).

The Contract

The chapter *HaMekabel* of the Tractate *Bava Metsia* in the *Mishna* deals primarily with agricultural rental laws. The chapter's sixth unit, also called a *mishna*,[4] governs the payment of rent by a person who rents a field from its owner for the purpose of cultivating it (my own translation):

> Regarding the case of one who rents a field from his neighbor, and the crops were eaten by locusts or they were devastated by disease; if the situation is that of a *makas medina*, the tenant can deduct his losses from the rent due. If it is not a *makas medina,* he may not deduct his losses from the rent. R. Yehuda says: "If the rent is payable in money, he may not deduct his losses, in either case."

Briefly described, here is what the *mishna* prescribes: In normal circumstances, the tenant pays a fixed sum either in money or in kind and keeps the excess, if any, for himself. This division holds, even if the yield on the field is disastrous. However, there is one circumstance in which the tenant gets a break. That is the case of a *makas medina*, i.e. if the disaster is widespread. Literally, the term means a 'plague on the land.' The prototypical case that the *mishna* gives is that of a field that is overrun by locusts or devastated by disease, where the same calamity befalls all the fields in the area.[5]

In this case, the tenant is permitted to reduce the amount of his rental. Why should there be such a distinction? A tenant, by the terms of his contract chooses to bear

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[4] Each chapter consists of several units, each unit also being called a *mishna* (lower case, pl. *mishnayos*). A *mishna* usually presents a legal ruling that applies to a given situation or a set of related situations.

[5] Commentators disagree regarding the precise extent of the area affected by a *makas medina*, but all agree that it goes beyond the borders of the one field. It should be kept in mind, however, that traditional commentators use rules of interpretation that are not always consistent with an historical approach. For this purpose, where possible, it is preferable to keep to the literal meaning of the text.

all the risk of fluctuations in yield. Why should the *mishna* set out a different

arrangement, and why just in cases of *makas medina* alone? And, furthermore, if the

tenant wished such an arrangement, why would he not write it into the contract itself?

The gist of the answer that we propose is twofold. Taking the second question

first, we propose that mishnaic law sets out to define a default contract. Civil law, unlike

religious law, can be modified by the parties by mutual consent.[6] However, to the extent

that a set of contracts is optimal for a large set of people, it is efficient to encode it as the

'default' set of contracts.[7] This reduces contracting costs.[8] Furthermore, the optimal

contract may be conditioned on the occurrence of certain events, which may not be

clearly defined. Consequently, it may be worthwhile to involve a third party, namely, a

court, to determine when the event shall be deemed to have occurred. An answer to this

question, once it is determined by the courts in one case, can be used in other cases as

well, through the power of precedent. (This may apply, for example, to the question of

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[6] See discussion, p. 123-127 in Elon (1994), v. 1. The general consensus of the
tannaim (lawgivers cited in the *Mishna*; sing. *tanna*) is that it is possible to contract out
of laws pertaining to monetary matters, but not out of laws pertaining to non-monetary
matters. (Tosefta, Kiddushin 3:7-8; the *Tosefta* is a collection of *tanna*ic traditions that
were not included in the *Mishna*.)

[7] This can be seen very clearly in the first *mishna* in our chapter, *Bava Metsia* 9:1,
where it is stated: "In all things, the local practice governs." There are numerous other
examples of local custom defining the default contract. See *Bava Basra* 1:1-2 for an
example in the area of joint ownership of property, and *Bava Metsia* 7:1 for an example
in the area of employer-employee relations. See also discussion in Elon (1994), pp. 931-
932.

[8] This is, essentially, the law-and-economics approach. Schwartz (1992, p. 277)
states this lucidly: "… the solutions to some problems are public goods. The costs that
any set of parties will incur to devise a term that resolves a possible dispute may exceed
the parties' gain. If many sets of parties can have the dispute, the social cost of drafting a
term that resolves it may be less than the social gain. Thus, the state can increase welfare
by supplying efficient solutions--that is, legal rules--to recurrent contracting problems."

when a *makas medina* has occurred.) In other words, there is a public good aspect here which makes it optimal for the system to enshrine this default contract as general law, rather than have each set of parties engage in an explicit contract.

In seeking to answer the first question of who would prefer such a contract as set out in the *mishna*, we present two possibilities in this article: one based on moral hazard, and the other based on risk-sharing. The next section describes the moral hazard explanation.

III. Moral Hazard as an Explanation for the restriction of risk-sharing to times of *makas medina*

One might argue that the parties would, in fact, prefer not to distinguish between *makas medina* and non-*makas medina* situations at all; that their first-best contract would involve risk sharing in <u>all</u> situations where the yield on the field was disastrously low. Why, then, does the *mishna* restrict risk-sharing to *makas medina* times? One answer to this question might be that the restriction is necessary because of moral hazard concerns.

Even though the parties might indeed wish to share the consequences of all extreme negative yield shocks caused by uncontrollable natural forces, they might not wish to share negative yield shocks directly attributable to the tenant's decisions. If rent relief were provided in all situations, a convexity would be introduced into the payoff function, providing an incentive to the tenant to take unnecessary risks.[9] The problem then comes down to one of distinguishing between negative shocks due to natural forces, and negative shocks attributable to the tenant's actions. During non-*makas medina* times,

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[9] This is similar to the incentive effects of limited liability. See Gollier, Koehl and Rochet (1997).

a reduced yield clearly has a greater chance of being due to the consequences of decisions taken by the tenant himself. Hence the restriction of the risk-sharing in the *mishna* to times of *makas medina*.

This moral hazard explanation is an attractive one, and is in keeping with a lot of the contracting literature. In our context, however, it is not as convincing. The problem with the moral hazard theory is that it assumes that the actions and the strategic decisions of the tenant are unobservable, or observable at great expense.[10] Such an assumption might not be unreasonable in a modern context, where the set of possible strategies for the farmer may be large. This is not necessarily true in ancient times. Furthermore, the relative openness of a farmer's field of operations requires that this assumption be investigated further.

In fact, evidence from the same tractate of the *Mishna*, suggests that the tenant may not have been allowed much latitude to make strategic production decisions. The tractate *Bava Metsia*, itself, records other *mishnayos* that strictly regulate the actions of the tenant. This suggests, further, that these actions must have been observable, in order to be subject to legislation.

Consider the following *mishnayo*s:

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[10] If they are observable at reasonable cost, then the contract could be conditioned on them.

Mishna 1:

In the case of one who rents a field from his fellow man (is bound by the following conditions). In places where it is the custom to harvest with a scythe, he must so harvest. In places where it is the custom to pull up the roots while harvesting, he must so harvest. In places where it is the custom to plough the field after the harvest, he must do so. Everything follows the custom of the land.**11**

Mishna 4:

In the case of one who rents a field from his fellow man in return for a fixed amount of grain, and does not want to weed. If he says (to the owner): "What does it matter to you, since I have agreed to pay you a fixed amount?" we do not listen to him (the tenant), since he (the owner) can say: "Tomorrow, you will leave this field and it will be covered with weeds!"

Mishna 5:

One who rents a field from his fellow man, and the field does not yield much of a harvest; if there is enough of the crop to gather a sheaf's worth, he is obliged to attend to it. R. Yehuda says: Why set the limit at a sheaf's worth? Rather, if there is as much grain as the amount of seed that he sowed.

Mishna 8:

One who rents a field from his fellow man in order to plant it with barley, he may not plant it with wheat; in order to plant it with wheat, he may plant it with barley. R. Shimon ben Gamliel prohibits it. (If he rented it to plant it with) grain, he may not plant it with beans; (in order to plant it with) beans, he may plant it with grain. R. Shimon ben Gamliel prohibits it.

We see in *Mishna* 1 that the harvesting method is regulated by the law of custom; this implies clearly that the tenant's actions at the end of the growing season, during harvest-time are observable. *Mishna* 4 regulates the actions of the tenant during the growing season in terms of the requirement to weed the field; clearly the tenant's actions during the growing season are observable. *Mishna* 8 regulates the tenant's choice of crops, while *Mishna* 5 regulates the tenant's effort. Furthermore, it would appear that the

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11 *Mishna* 1 continues with a discussion of other situations where custom affects the conditions of rental, but they are not relevant for our purposes.

technology used by farmers in those times was fairly standard, and did not brook much variation.

There is another reason, a textual one, that casts doubt on the moral hazard theory. If the moral hazard theory were correct, we would expect to find the restriction on rent-reduction only to situations where the renter had no control of the outcomes. Certainly negative macro-economic shocks that affect the entire province fall within this category. But so do more localized negative shocks that extend beyond the renter's field, but fail to affect the entire region. The *mishna*, however, uses the broader term *medina*, to describe the area affected by the negative shock. Now the term *medina* is normally used to refer to a province or a state; in other words, a fairly large area. The *mishna*'s use of the broader term *medina* thus does not fit the theory well.

Moral hazard, therefore, seems, at the very least, to be an incomplete explanation for the restriction of the rent reduction to times of *makas medina*. The next section proposes a risk-sharing explanation for this phenomenon.

IV. A Risk-Sharing Explanation for the Mishna

The essence of the risk-sharing model is that tenants are able to diversify away idiosyncratic risk, and hence are not interested in insuring them. On the other hand, they <u>are</u> interested in insuring *makas medina* risk, which is economy-wide and non-diversifiable. Landlords, being wealthier, and hence less risk-averse are willing to sell the tenants the insurance that they seek. We now present the details of the model, and prove the optimality of the contract specified in the *mishna*. [12]

There are two economic agents in our model, a landlord and a tenant. The landlord owns a field that he leases out to the tenant. We make the following assumption regarding the yield from the field:

> Assumption 1: The yield on the field has three components: one, a mean yield, $\bar{y}$; the second, a shock that is highly correlated with economy-wide forces $\tilde{\varepsilon}_m$; and the third, an idiosyncratic shock that is peculiar to the field in question, $\tilde{\varepsilon}_0$:[13]
> $$\tilde{y} = \bar{y} + \tilde{\varepsilon}_m + \tilde{\varepsilon}_0, \ \mathrm{E}(\varepsilon_m) = \mathrm{E}(\varepsilon_0) = 0, \ \mathrm{Cov}(\varepsilon_m, \varepsilon_0) = 0$$

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[12] Our model differs from standard models in this area, which assume a risk-neutral landlord and a risk-averse tenant, and unobservable effort. These models typically produce an optimal contract that trades off farmer moral hazard against the farmer's desire to avoid risk. In our model, we avoid moral hazard (and variable effort) for the reasons described in the previous chapter; our objective is to present a set-up that derives the rent-reduction restriction from risk-aversion motives.

[13] We assume that this yield is specified in money terms. It would be useful in future work to specify the yield in quantities and explicitly take into account the impact of a *makas medina* on the price of the commodity, and hence on the yield of the field in money terms. As regards the payment terms of the rental contract, it would seem that payment in kind would induce greater income volatility for the tenant. This would increase the need for the risk-sharing provided for in the *mishna*. This may also explain why R. Yehuda feels that a rent reduction is not necessary if payment is in money.

The landlord obtains his rental in two forms: one, a sum of money, P, that is independent of the yield from the field and, two, the monetary value of an in-kind payment, $\alpha(\varepsilon_m, \varepsilon_0)$, which is potentially a function of both economy-related and idiosyncratic shocks.

We assume that at least ex post, it is possible to distinguish between economy-wide and idiosyncratic shocks.

<u>Assumption 2</u>: Both ε_m and ε_0 are observable after the fact.

This allows us to identify the ε_m shock with a *makas medina* shock. However, as discussed in section II, the reality of the shocks being very imperfectly observable, would make some third-party intervention, such as that of the court, necessary to decide when a particular situation would be deemed a *makas medina* for purposes of contract implementation.

We also make specific assumptions regarding the economic agents in our model.

<u>Assumption 3</u>: Both landlord and tenant share the same utility function of wealth, U, which has the following characteristics: $U' > 0, U'' < 0, U''' > 0$.

This implies that both landlord and tenant are risk-averse and furthermore, their absolute risk-aversion is decreasing in wealth. In addition,

<u>Assumption 4</u>: Both landlord and tenant are assumed to have other income, z_l and z_t respectively, that is assumed to be highly correlated with economy-wide forces.[14]

Since z_l and z_t are both correlated with the economy-related shock to the yield, we can write out the regression equations of the outside incomes on the economy-related

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14 See Section V for evidence on the pervasive importance of agriculture in the economy. This supports the idea that most income sources were ultimately dependent on agriculture.

component of the yield: $\tilde{z}_l = a_l + b_l\tilde{\varepsilon}_m + \tilde{\eta}_l$ and $\tilde{z}_t = a_t + b_t\tilde{\varepsilon}_m + \tilde{\eta}_t$.[15] It follows

from the properties of regression equations, that $Cov(\varepsilon_m, \eta) = 0$. To make the situations

of the landlord and tenant as similar as possible, we assume

> Assumption 5: $b_l = b_t$, and $\eta_l = \eta_t$.

However,

> Assumption 6: We assume that landlords are wealthier than tenants in all
> states. Specifically, we assume that $a_l > a_t$.[16,17]

In other words, the expected value of the landlord's outside income is greater than that of

the tenant. The important implication of this assumption, combined with the assumption

of utility functions with decreasing risk-aversion is that landlords are less risk-averse than

tenants in all states.

We now derive the optimal form of the payment function $\alpha(.,.)$. We consider the

problem from the viewpoint of the tenant, who must choose the rental payment $\alpha(.,.)$ to

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[15] There may be advantages to trading with respect to the realization of η as well as ε_i, but that is ignored here. There may also be greater issues of moral hazard with respect to such trades, since they require verification of the realizations on all investments made by the agent.

[16] In fact, we only require that $P+\alpha+z_l > z_t-\alpha-P+\varepsilon_m+\varepsilon_0+\bar{y}$ for all realizations of ε_m and ε_0.

[17] On p. 333, Safrai (1994) writes: "The estate system served as the economic foundation for the social and economic structure of the Roman Empire (and of most Hellenistic kingdoms). The rich landowners who lived in the cities together with their slaves enjoyed rather respectable incomes from the rural sphere." This suggests that landlords were quite wealthy.

Tenant farmers, on the other hand, were probably not well-to-do. Hamel (1990) mentions that sharecroppers were frequently in debt. She brings evidence from the New Testament (Luke 7.41-42, 6.34, 12.58-59 and 16.1-9; Matthew 5.25-26) to support her statement: "Debt was a permanent feature of the economic structure, as in any agriculture making great use of sharecropping arrangements."

offer the landlord, subject to the landlord obtaining his reservation rental.[18] The

tenant's problem can be formulated as:

$$\underset{\alpha}{Max}\, EU(w_t) \qquad\qquad\qquad (1a)$$

subject to the landlord's Individual Rationality constraint,

$$EU(w_l) = E[U(\tilde{z}_l + P + \alpha(\tilde{\varepsilon}_m, \tilde{\varepsilon}_0))] = u_l \qquad\qquad\qquad (1b)$$

where $w_t = \bar{y} + \tilde{\varepsilon}_m + \tilde{\varepsilon}_0 + \tilde{z}_t - P - \alpha(\tilde{\varepsilon}_m, \tilde{\varepsilon}_0)$ and by definition,

$w_l = \tilde{z}_l + P + \alpha(\tilde{\varepsilon}_m, \tilde{\varepsilon}_0)$ and the expectation in (1) is taken over ε_m, ε_0, z_l and z_t.

We can now state the following theorem:

Theorem 1: If assumptions 1-6 hold, then, under the optimal rental

contract, $\dfrac{\partial \alpha}{\partial \varepsilon_m} > \dfrac{\partial \alpha}{\partial \varepsilon_0}$.**19**

In economic terms, this means that the tenant shares more of the economy-related risk

with the landlord than of the idiosyncratic risk. Since *makas medina* risk is economy-

related, we are close to the contract specified in the *mishna*. However, such risk-sharing

of the economy-wide can be accomplished more directly through sharing a fraction of the

economy-wide yield component, ε_m, in good times and in bad. Our *mishna*, in contrast,

seems to provide for sharing of the economy-wide component only during times of

makas medina, i.e. during bad times, but not during good times. The optimality of this

aspect of the contract is established in the next theorem.

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18 The problem can also be formulated from the landlord's point of view, such
that he decides on the rent to charge the tenant, subject to the reservation value of the
tenant's effort. While the choice of formulation is important in a moral hazard
framework, it does not make any difference in our setting.

19 See Appendix.

Theorem 2: If we assume, in addition, that $A'' > 0$, where A is a modified version of the coefficient of absolute risk-aversion, and is defined as

$-E_\eta U''/ E_\eta U'$, then $\dfrac{\partial^2 \alpha}{\partial \varepsilon_m^{\,2}} < 0$.

This theorem establishes that there is greater sharing of the economy-related outcomes in bad states than in good states.
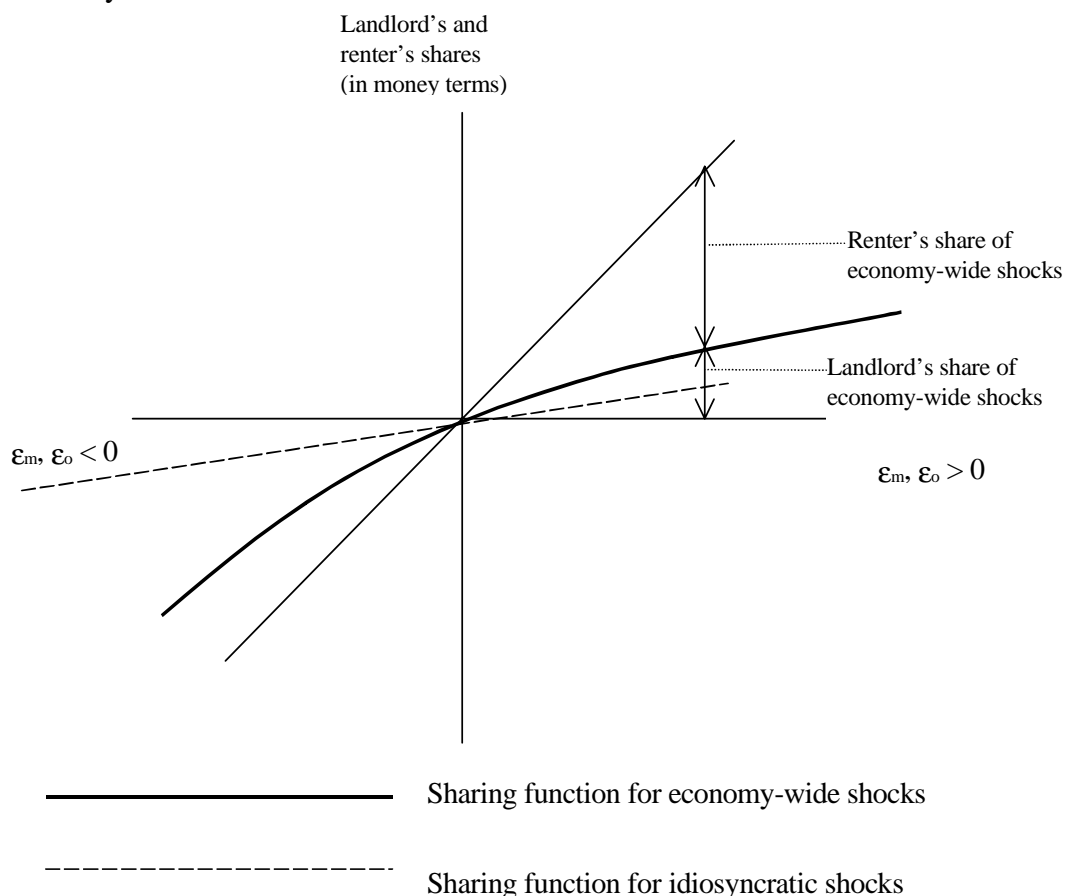
What does it mean to assume that $A'' > 0$? As shown in the graph below, the assumption on A" corresponds to a downward sloping A curve such that the slope does not increase for higher values of consumption. This, incidentally, guarantees that risk-sharing of the idiosyncratic risk, if any, is also greater in bad states. Under the conditions of Theorem 2, we see that the share of the shock that is given to the landlord is higher for lower values of ε_m and ε_0. In other words, the landlord bears a larger share of the risk in those states.
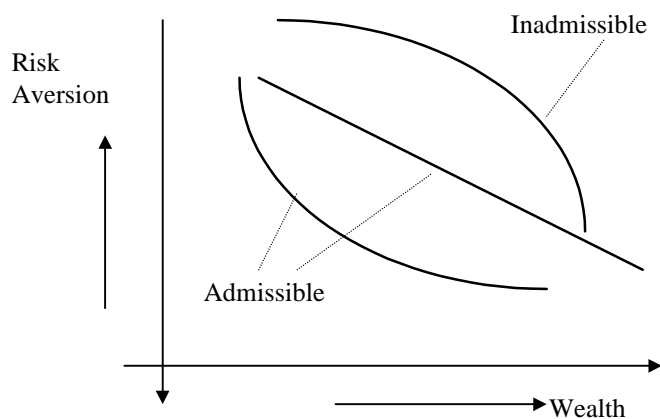
Admissible and Inadmissible shapes of the absolute risk aversion function

The graph below shows the gains and the losses to the tenant and landlord as a function of the size of the economy-related shock. Note that the sharing function curve for the idiosyncratic risk is less steep everywhere. Furthermore, the slope does not drop off as dramatically, for higher values of the shock. This is because an idiosyncratic shock

only affects the yield of the rented field whereas an economy-related shock affects

both the yield on the field as well as outside income.

Landlord's and
renter's shares
(in money terms)

Renter's share of
economy-wide shocks

Landlord's share of
economy-wide shocks

$\varepsilon_m, \varepsilon_o < 0$

$\varepsilon_m, \varepsilon_o > 0$

———————— Sharing function for economy-wide shocks

– – – – – – – – – – Sharing function for idiosyncratic shocks

Sharing vs. Straight Rental

A further question that needs to be answered is the following. The optimal

contract as derived above requires the tenant and the landlord to share in good states.

Why then do the parties in the *mishna* agree to a straight rental, without any sharing in

good states? A simple answer to this question is that the optimal contract in our model

may be considered an approximation to the straight rental contract of the mishna, as far as

the good states are concerned.[20] This is because risk-sharing is, in any case, less important in the good states. Hence, a modest amount of measurement and transactions costs could make it optimal to replace the more precise sharing result of the model with a straight rental contract in good states. In bad states, on the other hand, risk-sharing is much more important, and it would not do to replace it by a fixed payment rule.[21] Cosgel (1990), in his analysis of medieval English agriculture, provides another answer. He shows that a combination of land rentals and sale of his labor can provide optimal risk-sharing for the tenant. And, in fact, Safrai (1994; p. 353) provides evidence that farmers also functioned as occasional laborers.[22] From this point of view, tenants who had excess labor, perhaps due to large families, might have opted for rental contracts.

The next section provides empirical support for the risk-sharing explanation.

V. Empirical Support for the Risk-Sharing Explanation

The risk-sharing model, presented above, can be tested by looking at the economic history of the areas in which, and during the times in which the mishnaic laws

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[20] We emphasize that our objective in this paper is not to lay out in detail, a theory of contract choice. There is a large literature on this question. See, for example, Cheung (1969), Alston, Datta and Nugent (1984), Eswaran and Kotwal (1985), Newbery and Stiglitz (1979) and Allen and Lueck (1992). Transactions costs, moral hazard and risk-sharing are the main factors used in these models to explain contract choice.

[21] For example, it would be necessary to measure the harvest precisely and to the satisfaction of both parties. Note that the assumption of these measurement costs is quite consistent with the assumption that the tenant's effort is observable. The size of the harvest, while depending on the tenant's effort is, nevertheless, dependent on other factors as well.

[22]   See the discussion in Section V below for more details on the alternative occupations of farmers.

are presumed to have been applied. We discuss below some aspects of economic life in Roman Palestine that could be used to evaluate the model presented in this paper.

Volatility of Agricultural Prices and Incomes:

Clearly, it would be worthwhile to incorporate risk-sharing in a default contract, only if incomes were sufficiently volatile to warrant a means of risk-transfer. Unfortunately, we have little direct and reliable evidence of price volatility from longitudinal price data, and even less for income data.[23] On the other hand, given the importance of agriculture in the economy, [24] we can indirectly infer price instability from evidence regarding the frequency of famines.[25]

Hamel (1990, p. 50), using evidence from Josephus and the *Mishnaic* texts, estimates that droughts must have occurred, on average, every twenty years or so, during

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[23] While prices of items are frequently mentioned in the rabbinic literature, it is unclear as to whether these prices are realistic (Safrai, 1994; p. 432). Sometimes, important auxiliary information necessary to make sense of prices is often missing (such as the size of the area being rented in the case of a mention of rental fees; Safrai, 1994, p. 432). Finally, the different sources are often contradictory (ibid.).

[24] Safrai (1994, p. 352) argues that agriculture was the economic basis of the Land of Israel, and that most residents of the province engaged in an agriculture-related occupation. He adduces the following proofs:
- The majority of examples cited in the cases in halachic literature refer to agriculture. Many people sages and commoners, rich and poor, made their living from the various branches of agriculture. R. Tarfon, e.g. had agricultural estates. R. Eliezer b. Hyrcanus came from a family, which owned land. Rabban Gamaliel also possessed land, etc.
- Land alone was considered to be a stable possession that one could depend upon either to pay taxes or to earn a living (Gulak, 1929, p. 94-131).

[25] Josephus (Jewish Antiquities, 15.300-10) describes a particularly terrible drought in 25/24 BCE (quoted in Hamel, 1990). Elsewhere (Jewish Antiquities, 15.299), he refers to the cyclical occurrence of famines.

the first two centuries of the millennium. Mishna *Avos* 5.8, even comes up with a typology of three types of famine.[26] In addition, landowners frequently hoarded grain, thus causing prices to run up during famines. Hamel (1990) tells us that during times of famine, "In cities, prices shot up as long as those hungry had money (or other valuables) to buy it."

Tendency of tenants to have multiple sources of income:

The main thrust of the model is that tenants did not find it worthwhile to insure risks in normal times, because the idiosyncratic risks could be diversified away, and only non-diversifiable risk had to be borne. For diversification to take place, tenants must have had multiple sources of income. There are two ways in which this may have occurred. One, they may have simultaneously rented several fields at different locations. This would ensure a kind of diversification of idiosyncratic risks. Two, they may have obtained income from sources other than the cultivation of their rented fields. There is support for both possibilities.

Of the latter possibility, Safrai (1994; p. 353) says explicitly, "the accepted reality was usually that the farmer also functioned as an occasional artisan or laborer and at least part of his time was devoted to non-agricultural work." He provides several pieces of evidence in support of this contention, mostly from the Mishna, from the *Tosefta*,[27] from

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[26] In addition, *Tosefta Ketubos 4.5* even legislates the permissibility of divorcing one's wife in times of famine, if the husband were not able to support his wife. The implication is that famines were frequent enough to be taken into account in divorce law.

[27] See footnote 6 for an explanation of the *Tosefta*.

collections of *midrashim*[28] the Talmud,[29] or from other textual sources of the period. Some of the alternative occupations of a farmer that are attested in texts are production of flax and woolen thread,[30] donkey transport,[31] ritual slaughtering,[32] store-keeping,[33] trading in wine,[34] manufacture of wine and lime,[35] working as a hired laborer,[36] and baking.[37]

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[28] A *midrash* is a creative interpretation of a canonical text that has a homiletic (a *midrash aggada*) or a legal (a *midrash halakha*) application.

[29] See footnote 3 for a brief explanation of the Talmud.

[30] The textile industry was based on the farmer raising flax or sheep who used his free time to weave thread and to sew (Chapter 2.I.7, I.8 and 2.II of Safrai, 1994). The Palestinian *Talmud* (*Megilla* IV, 74b) depicts R. Hiyya as a farmer who grows flax and turns it into a net. The *Tosefta* (*Bava Metsia*, 9:19) requires a tenant farmer who cultivates flax to treat it until the stage of preparation of the stalks (Lieberman, 1988; p. 114). Since most of the profit from the flax and wool industries went to the person producing thread or fabric from the fibers, it made sense for the farmer to engage in the processing of the fibers, particularly in the winter months, when he had more time available (Safrai, 1994; p. 193).

[31] A *midrash* on Psalms 12:1 (Buber, 1966; pp. 104-5 quoted in Safrai, 1994) tells of a group of donkey-drivers whose leader was also a farmer. According to the tradition, his agricultural pursuits were of more importance than his transport tasks.

[32] The slaughterers in a town plied their official trade rather infrequently. If so, it was impossible that they made their living exclusively from such an occupation.

[33] The *Tosefta* (Bava Metsia 5:12) mentions the case of a hired worker in a store, who is an "artisan," but who is forbidden to ply his trade at the store. It is inferred that the store-owner must not be in the store some of the time, else how would the artisan be able to at all get away with plying his trade. Presumably the store-owner went out to work on his field.

[34] A *midrash* on Lamentations 1:1 mentions a wine merchant who also grew grapes.

[35] Many lime pits have been discovered within an agricultural context (in a field or in a terrace). Moreover, in many instances, a wine press or lime pit have been

Regarding the possibility of a single farmer cultivating more than one plot of land, Hamel (1990, p. 109) says explicitly "The scattering of plots in areas with different soil and climatic conditions also increased safety. This latter possibility was not necessarily restricted to the more important land-owners but could be practiced to some degree by small tenants through complex community and family arrangements."

Sperber (1978, Chapter X) provides two different kinds of evidence for fragmentation of land holdings. First, he cites textual evidence from the early third century[38] that relates this fragmentation to the sale of lands by farmers in increasing poverty, to pay off their loans. This led to estates that comprised of scattered properties. Second, he cites another early third century text,[39] where a Rabbi Yohanan is quoted as listing three different properties that he used to own: a (wheat) field, close to Tiberias, a vineyard in the Galilean foothills and an olive grove, higher up in the mountains. The text does not mention the precise location of these holdings, but Sperber argues convincingly that they must have been separated plots. He further argues that the reason

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discovered next to an agricultural tower (Dar, 1986, p. 111-13). These finds show that the farmer worked at labors associated with the wine press or lime pit in addition to his agricultural work in the field.

[36] The *Tosefta* (*Bava Metsia* 8:2) says "a laborer is not permitted to do his own work at night and then to hire himself out during the day to … on account of stealing the labor of the employer." This suggests that the tradition recognizes the possibility of farmers who were hired laborers as well.

[37] The *Tosefta* (*Pesahim* 1(2):13 (2:3) and parallels) indicates that the baker in a village usually baked only once a day and it is clear that this was not sufficient to support his family. Again, he presumably worked in the fields the rest of the time.

[38] The Palestinian Talmud, in the chapter, Nedarim 9.7.

[39] Pesikta de R. Kahana.

for this separation was to diversify the risks involved in the cultivation of different kinds of agricultural procedure.

There is some indirect evidence, as well, that farmers may indeed have cultivated more than a single plot. First of all, Safrai (1994; p. 330-1) points out that there were no economic forces pushing for the consolidation of small plots.[40] Secondly, while the minimum economic size of a holding, from Talmudic evidence,[41] was about 1.5 *dunam*s, the size of a subsistence holding was closer to 20 *dunam*s (Safrai, 1994; p. 355). This means that a farmer could easily have ten or more different viable plots making up his total land holding. The actual sizes of plots seem to have varied quite a bit from region to region. Several researchers have done field-work on ancient sites to determine the sizes of agricultural plots. Dar (1986) found that the average plot in one village in Samaria was 25 *dunam*s, while the range of plots at another village was from 39.7 to 45.6 *dunam*s. Safrai found plot sizes varying from 6 to 11 *dunam*s in the Galilee (Safrai, 1985; p. 129 cited in Safrai, 1994) and from 15 to 18 *dunam*s in the Shekhem region (Safrai, 1986; p. 99-100 cited in Safrai, 1994). Golomb and Kedar (1971) cite holdings ranging from 4 to 60 dunams. Thus, the evidence, though far from clear, certainly supports a reasonable probability of multiple holdings.

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[40] He points out that in hilly areas, terrace farming is necessary or was practiced, and having a large tract in this context is not necessarily useful. As he points out elsewhere, one who ploughs with the aid of a cow is limited to the size of the plot that the beast can plow. Economies of scale in financing were probably also not very important given that the main factor of production, in the ancient world, was labor and hence the advantage enjoyed by estate owners in such matters was not all that great.

[41] According to the Babylonian *Talmud*, (*Bava Basra*, 12a), this area is approximately nine kabs or less than 1.5 *dunam*s (1 kab = approx. 1/6 *dunam*). The *Tosefta* (*Bava Metsia*, 11:9) has 9.5 *kab*s).

There is also evidence of similar income diversification through scattered land holdings in medieval England. McCloskey (1976) documents the tendency for peasants to have as many as twenty strips of land, each less than an acre, scattered over the village's arable land. He relates this to the variability of yields "even over the two miles square or so of the typical village," and views this scattering as a risk-allocation and sharing mechanism, akin to shareholders diversifying their portfolio holdings to insure against disaster.

In summary, there is a reasonable amount of evidence that suggests that farmers diversified their incomes in several ways: first, by practicing agricultural and non-agricultural occupations; second, by cultivating different kinds of agricultural products; and third, by holding plots of land that were geographically scattered.

Was the Palestinian Economy a Closed or an Open One?

This question has some bearing in terms of support for the model presented here. Obviously, the driving force for laws such as incorporated in our *mishna* is income volatility. To the extent that the economy in which the tenant lived and operated is a closed one, income volatility would be relatively low, even if price volatility were high. Since prices are normally inversely correlated with quantity, there will not be much volatility in income, which is the product of price and quantity. In order to have greater income volatility, there must be some mechanism that reduces the correlation between the domestic agricultural product and the price. The ability to export and import commodities constitutes such a mechanism. Evidence on this is presented in Safrai (1994). After evaluating the evidence, he concludes that the Palestinian economy in the Roman period was, indeed, an open one. He presents evidence that wine and oil was

exported to Egypt and other countries, while grain (especially wheat) was imported, particularly during times of famine.

VI. Conclusion

In many contracts that deal with the division of future values, there is a tension between risk-sharing aspects and incentive aspects, particularly moral hazard. At times, contract characteristics that seem to be motivated by moral hazard considerations may sometimes be equally well explained as risk-sharing responses.

We investigate the economic rationale for a law found in a Jewish legal text, pertaining to agricultural rentals in Roman Palestine. This law allows for risk-sharing (through rent reduction) between tenant and landlord when the macro-economic situation is severe (*makas medina)*, but not if the particular rental plot has a bad harvest. We consider the possibility that the restriction of rent reduction to times of *makas medina* can be explained from a moral hazard perspective, and show that this explanation is not entirely satisfactory. We then show that this feature of the rental contract can be well explained as an optimal characteristic of rental contracts in an economy characterized by tenants whose income sources are diversified.

Although detailed quantitative evidence is difficult to obtain for this period, we are able to find considerable indirect evidence of the economic circumstances of the peasantry to support the risk-sharing hypothesis. The law that we examine in this paper is, however, only one of a series of laws in the classical Jewish texts, that pertain to agricultural tenancy. It would be interesting to investigate further the internal coherence of these laws as well as their consistency with the empirical evidence. Finally, comparison of agricultural rental contracts across countries and across time would also be interesting.

Appendix: Proofs of Theorems I and II

Theorem 1: If assumptions 1-6 hold, then, under the optimal rental contract, the tenant

shares more of the economy-related risk with the landlord than of the idiosyncratic risk.

Proof: Following Rees (1985), the asset owner's problem can be solved through the

pointwise maximization of the function $h(\varepsilon_m,\varepsilon_0) = E_\eta[\{U(w_t(\varepsilon_m,\varepsilon_0)) + \lambda[U(w_l(\varepsilon_m,\varepsilon_0))-$

$u_l]\}f_m(\varepsilon_m)f_0(\varepsilon_0)]$ with respect to $\alpha(\varepsilon_m,\varepsilon_0)$, where E_η is the expectation with respect to η, λ

is the Lagrange multiplier and $f_m(.)$ and $f_0(.)$ are the probability density functions for ε_m

and ε_0. As a result, the solution, $\alpha^*(\varepsilon_m,\varepsilon_0)$, specifying a payment from the tenant to the

landlord is characterized by the following first order condition:

$$[\partial E_\eta U(\bar{y} +\varepsilon_m+\varepsilon_0+z_t-P-\alpha^*(\varepsilon_m,\varepsilon_0))/\partial w_t] - \lambda[\partial E_\eta U(z_l+P+\alpha^*(\varepsilon_m,\varepsilon_0))/\partial w_l] = 0 \qquad (3)$$

which must hold for every $(\varepsilon_m,\varepsilon_0)$ combination. Equation (3) implies that the multiplier,

λ, is equal to the ratio of the expected marginal utilities of income for the two agents.

Differentiating condition (3) with respect to ε_m and then with respect to ε_0, and

substituting for λ, we get:

$$\frac{A_t}{A_l}\left[1 - \frac{\partial\alpha}{\partial\varepsilon_i} + \frac{\partial z_t}{\partial\varepsilon_i}\right] = \frac{\partial\alpha}{\partial\varepsilon_i} + \frac{\partial z_l}{\partial\varepsilon_i}\text{ , for i = m, 0,}$$

where A_i is a modified version of the coefficient of absolute risk-aversion, defined as A_i

$= -E_\eta U''/ E_\eta U'$, where the derivatives are evaluated at w_i. Using the assumptions laid out

above, we see that

$$\frac{\partial\alpha}{\partial\varepsilon_m} = \frac{A_t + b(A_t - A_l)}{A_t + A_l} \qquad (4a),$$

whereas

$$\frac{\partial\alpha}{\partial\varepsilon_0} = \frac{A_t}{A_t + A_l} \qquad (4b).$$

Since $w_l > w_t$ in all states of the world, decreasing absolute risk aversion implies that $A_l <$

A_t; hence, $\dfrac{\partial\alpha}{\partial\varepsilon_m} > \dfrac{\partial\alpha}{\partial\varepsilon_0}$. In other words, the tenant shares more of the economy-related

risk with the landlord than the idiosyncratic risk. **Q.E.D.**

<u>Theorem 2</u>: If we assume, in addition, that $A'' > 0$, where A is a modified version of the coefficient of absolute risk-aversion, and is defined as $-E_\eta U''/ E_\eta U'$, then $\dfrac{\partial^2 \alpha}{\partial \varepsilon_m^{\ 2}} < 0$.

<u>Proof</u>: If we differentiate (4a) with respect to ε_m, we see that

$\text{sgn}\left[\dfrac{\partial^2 \alpha}{\partial \varepsilon_m^{\ 2}}\right] = \text{sgn}\left[A_l A_t{}' - A_t A_l{}'\right]$. A sufficient condition for $A_l A_t{}' - A_t A_l{}' < 0$ is that A''

≥ 0. **Q.E.D.**

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