

# CONTRACT DURATION AND INVESTMENT INCENTIVES: EVIDENCE FROM LAND TENANCY AGREEMENTS.\*

Oriana Bandiera

October 2005

## Abstract

This paper analyses the empirical determinants of contract length, a key and yet neglected dimension of contractual structure. I estimate contract length and contract type jointly using original data on tenancy agreements signed between 1870 and 1880 in the district of Siracusa, Italy.

The findings indicate that the choice of contract length is driven by the need to provide incentives for non observable investment, taking into account transaction costs and imperfections in the credit markets that make incentive provision costly. The results also illustrate that since both length and the compensation scheme are used to provide incentives within the same contract, joint analysis is important for a correct interpretation of the evidence.

**JEL Classification:** D82, O12, Q15

**Keywords:** contract duration, incentives, tenancy agreements.

---

\*Department of Economics, London School of Economics, Houghton St, LONDON WC2A 2AE. E-mail: o.bandiera@lse.ac.uk. I would like to thank James Anderson, Alexis Arias-Vargas, Richard Arnott, Tim Besley, Maristella Botticini, Peter Gottschalk, Timothy Guinnane, Imran Rasul, Fabio Schiantarelli, participants at seminars at Bocconi, Boston College, LSE, Yale and the NEUDC for useful comments and suggestions; Antonio Bandiera and Nunzia Guzzardi for help with data collection; the Directors and the Staff at the State and Notary archives in Siracusa for their kind cooperation. All errors are mine.

# 1 Introduction.

Contracts regulate most economic transactions and, not surprisingly, the theory of contracts under asymmetric information is a cornerstone of economics. In contrast to the large body of theory, however, evidence on the determinants of contractual structure is limited and typically focuses exclusively on the compensation scheme, namely on the agreed transfers between the parties.<sup>1</sup>

The purpose of this paper is to present evidence on the compensation scheme jointly with contract *duration*, a key and yet neglected dimension of contractual structure. Analyzing contract duration is of interest for two reasons. First, in a principal-agent framework where the agent works with long-lived assets, contract duration determines the agent's stake in future production and hence the incentive to undertake non observable investments. Evidence on the determinants of duration can thus shed light on the extent to which incentives for non observable investments are provided in practice.

Second, since both contract duration and the compensation scheme are used to provide incentives within the same contract, studying them jointly is key to provide an accurate picture of the determinants of contract form. Focusing on one dimension only can, in contrast, mislead the interpretation of the evidence.

To present evidence on the determinants of both contract duration and the compensation scheme, I collected a new data set on land tenancy agreements. The data set was built by coding information from original contract documents and covers seven hundred and five agreements signed between 1870 and 1880 in the district of Siracusa, Italy. In addition to information on duration and the compensation scheme, the data contains information on crops', tenants' and landlords' characteristics that relate directly to the benefits and costs of providing incentives and hence determine the structure of the contract.

Contract theory indicates that the duration of the contract determines incentives for non observable *investment* effort. Long term contracts give the tenant a stake in future output and therefore the incentive to undertake non observable investment

---

<sup>1</sup>Chiappori and Salanie [2003] survey the recent empirical literature on the determinants of contractual structure.

that increases output in future periods. In addition, long term contracts allow the tenant to smooth consumption when he faces imperfect credit markets and they also entail lower transaction costs as they do not need to be negotiated each year. When committing to a long term contract, however, the landlord loses the flexibility to adjust to changes in the environment and forsakes the opportunity to use eviction threats.

Contract theory also indicates that the share of output retained by the tenant, determines incentives for the unobservable effort that the tenant devotes to production in the current period. Fixed rent contracts, whereby the tenant retains all the output and pays a fixed rent to the landlord, provide stronger effort incentives than share-cropping contracts, whereby the tenant and the landlord share the output. Providing incentives via fixed rent contracts, however, is costly when the tenant is risk averse or subject to limited liability, and when the technology has multitasking features.

The empirical findings broadly support the theoretical prediction that contracts are designed to provide incentives, taking into account transaction costs, and the tenants' risk aversion and limited liability.

I find that high powered incentives for both production and investment effort are provided when the cost of doing so is low, namely when the tenant is rich. When incentive provision is costly, as it is for poor tenants, high powered investment incentives via long term contracts are only offered when the benefit is high enough, namely for trees that are more sensitive to investment effort.

Landlords who face higher monitoring and renegotiation costs, namely female and aristocratic landlords who are less likely to be daily in the fields, choose the contract combination that minimizes these costs: long term with fixed rent. Also, these landlords are less likely to ever want to resume direct cultivation and hence place less value on the flexibility given by short term contracts.

Two ideas from the theoretical literature find no support in the data. First, there is no evidence that the main function of contract length is to help the tenant smooth consumption. Long term contracts, which could be used to this purpose, are actually more likely to be offered to wealthy tenants who are more likely to be able to smooth consumption through personal savings.

Second, there is little evidence that sharecropping is used to address multitasking concerns since trees, which need the most maintenance and are more prone to exploitation, are *not* more likely to be sharecropped in general. A plausible explanation is that in this context investment incentives are provided directly through long-term contracts. This illustrates how focusing on one contractual dimension only might mislead the interpretation of the evidence.

This paper brings together two separate strands of literature by providing the first joint analysis of contract type and duration. Empirical evidence on contract duration is thin; only exceptions are Joskow [1987], Crocker and Masten [1988] and Brickley *et al* [2005] who analyse the duration of coal, gas and franchise contracts respectively. In line with these studies I find that investment incentives and flexibility are significant determinants of contract length. In addition, I exploit information on both the cost and benefits of long term contracts.<sup>2</sup> The literature on contract type is more extensive, both in general and for the specific case of land tenancy. The findings in this paper are in line with existing evidence that sharecropping contracts are more likely to be offered to poor tenants and that crop characteristics are a significant determinant of contract type.<sup>3</sup> In contrast to the survey data generally used in the literature, however, the original documents used here contain information on both contracting parties and thus provide a more complete picture of the determinants of contractual structure.<sup>4</sup>

The remainder of the paper is organized as follows. Section 2 draws ideas on the determinants of contractual structure from the existing theoretical literature. Section 3 describes the data set and the methodology. Section 4 presents the main findings. Section 5 reports extensions and discusses econometric concerns. Section 6 concludes.

---

<sup>2</sup>Joskow [1987] shows that contracts between coal suppliers and electric utilities are significantly longer when relationship-specific investment is important. Crocker and Masten [1988] show that natural gas contracts are shorter when flexibility becomes exogenously more relevant. Brickley *et al* [2005] show that length of franchise agreements increases with the importance of non-contractible investments and decreases when the need for flexibility increases. These studies thus focus on either the cost or the benefit of offering long term contracts.

<sup>3</sup>See Akerberg and Botticini [2000, 2002], Allen and Lueck [1996], Dubois [2002], Laffont and Matoussi [1995].

<sup>4</sup>Most empirical studies on tenancy agreements only have information on the tenant (e.g. Laffont and Matoussi 1995) and others only on the landlord (e.g. Dubois 2002). The data set used by Akerberg and Botticini [2000, 2002] is an exception in this regard.

## 2 The Determinants of Contract Structure: Ideas from Theory.

Theories of contractual structure typically analyze contractual choice in a principal-agent framework where the principal chooses the terms of the contract to maximize his payoff for given characteristics of the agent and production function.<sup>5</sup> In the context under study, the principal hires the agent to cultivate his land and chooses two dimensions of contractual structure- the duration of the contract and the agent's compensation scheme.

Within the first dimension, duration, the principal chooses between short term and long term contracts. Short term contracts are one period long, where one period is defined as the length of time within which the agent performs his tasks, the outcome is realized and the agent receives a payment. In the agricultural context studied here, one period typically corresponds to one calendar year. Long term contracts are agreements that last more than one period.

Within the second dimension, type, the principal chooses between sharecropping and fixed rent contracts. The key difference between the two is that under sharecropping the principal and the agent each take half of the output, while under fixed rent the agent retains the whole output and pays the principal a fixed amount at the end of each period.<sup>6</sup>

The choice of contractual structure is driven by three sets of considerations or characteristics of the environment under scrutiny. First are the characteristics of the production function that determine the need to provide incentives. Second are the characteristics of the agent, in particular whether he is risk averse or subject to limited liability and whether he has free access to credit markets. Third are transaction costs.

Below, I use this framework to identify the variables that are likely to affect the choice of contractual structure within each dimension in practice.

---

<sup>5</sup>The principal is thus assumed to have all the bargaining power and matching between principal and agents is assumed to be random.

<sup>6</sup>The principal and the agent can, in principle, agree to other output shares. In practice, however, all sample contracts prescribe a 50-50 split.

### A. Contract Duration: Long Term vs Short Term.

Long term contracts have three main advantages over short term contracts. First, they give the agent a stake in future output and hence provide incentives for non observable investment. This is of crucial importance in agriculture because tasks such as tree maintenance and careful application of fertilizers and pesticides have a strong effect on future output. Other things equal, this implies long term contracts are more likely to be used when, due to the characteristics of the crop, investment is important for productivity, as is the case for trees as opposed to annual crops.<sup>7</sup>

Second, long term contracts can be used to smooth consumption and reduce the risk borne by the agent when he has no access to credit.<sup>8</sup> If risk aversion is decreasing in wealth and poorer tenants are less likely to have access to credit, this implies long term contracts should be more likely to be offered to poorer tenants.<sup>9</sup>

Third, long term contracts entail lower transaction costs because they have to be agreed upon less frequently. An implication is that long term contracts should be more common when the opportunity cost of time of the involved parties is high.

Long term contracts however entail a cost since commitment implies that the principal forsakes eviction threats, which could otherwise be used to elicit effort for current production. The threat of eviction in case of failure is an effective incentive mechanism when the agent's utility from the contract is higher than his reservation utility. Since this is more likely to occur when the agent is poor or has a low outside option, this implies poor tenants should be less likely to be offered a long term contract.<sup>10</sup>

---

<sup>7</sup>See Bardhan [1984], Banerjee *et al* [2002], Bose [1993] for specific applications to tenancy contracts.

<sup>8</sup>Chiappori *et al* [1994] and Rogerson [1985] analyze the case of repeated moral hazard when the agent has no access to credit markets. In this context the optimal long term contract generally exhibits "memory", i.e. payments in each period are a function of past performance. Note that if the agent has access to credit markets the outcome of a long term contract can be replicated by a sequence of spot contracts and this rationale for long term commitment disappears. See Fudenberg *et al* [1990] and Malcomson and Spinnewyn [1988].

<sup>9</sup>See Bardhan [1983] and Fudenberg *et al.* [1990]. The latter also note that this prediction is in contrast with evidence from firms, since, compared to workers, managers are more likely to be offered a long term contract.

<sup>10</sup>Note that eviction threats provide incentives for both current effort and investment as the latter increases output in the next period and hence the probability of retaining the job in the period after next. See Banerjee *et al* [2002]; Banerjee and Ghatak [2003] and Dutta *et al* [1989]

Moreover, if the principal commits to a long term agreement, he gives up the possibility to adjust the terms of the contract to suit changes in the environment. In particular, the landlord gives up the option of cultivating the land directly for the duration of the contract and the contract reduces the resale value of the land if the buyer is bound to honor the existing tenancy agreement. The opportunity cost in terms of loss of flexibility is higher for landowners who might want or need to resume direct cultivation, implying that these should be more likely to offer short term contracts.

### **B. Contract Type: Fixed Rent vs Sharecropping.**

Compared to share contracts, fixed rent contracts give the agent stronger incentives to exert non observable effort since under fixed rent he gets the full marginal benefit of his effort whereas under sharecropping he only gets a share.<sup>11</sup> Other things equal, fixed rent contracts should therefore be chosen when the moral hazard problem is more severe, for instance because the cultivated crop is very sensitive to effort.

In addition, if the contract is fixed rent the principal does not need to monitor the division of output to make sure he is effectively getting the contracted share. Fixed rent contracts are therefore particularly well suited for landlords whose opportunity cost of time is high.

Fixed rent contracts can however be suboptimal, from the principal's point of view, for the following reasons. First, under fixed rent the agent bears all production risk. If the agent is risk averse, the principal might prefer sharecropping contracts as these strike a compromise between incentives and insurance. Share contracts should then be more common when the crop is risky and, if risk aversion decreases with wealth, when the tenant is poor.<sup>12</sup>

Second, if the agent is subject to limited liability he might not be able to afford to pay rent in case of low output. The principal might then prefer to charge state contingent payments, in other words, offer a share contract.<sup>13</sup> Since the limited

---

<sup>11</sup>Singh [1989], Dutta *et al* [1989] and Otsuka *et al.* [1992] provide excellent surveys of the theoretical literature.

<sup>12</sup>See Stiglitz [1974].

<sup>13</sup>See Shetty [1988], Dutta *et al* [1989], Mookherjee [1997], Banerjee *et al* [2002]. Basu [1992] and Ghatak and Pandey [2000] also allow the tenant to choose the riskiness of the production technique.

liability constraint is more likely to bind for poor tenants and tenants with low outside option, these tenants should be more likely to be hired under share contracts. Share contracts should also be more likely when the spread between output in different states of nature is high.<sup>14</sup>

Finally, if production depends on both non observable effort and non observable investment, share contracts might be preferred because fixed rent provide *too much* incentive for effort at the expense of investment. A similar argument can be made if it is the case that the tenant can increase current production at the expense of future production by overworking the land. This implies that share contracts should be observed when crop characteristics are such that multitasking issues are relevant as in the case of trees compared to annual crops.<sup>15</sup>

### C. Summary.

Table 1 presents a summary of the discussion above. The table lists the main assumptions about the characteristics of the environment and their consequences for the choice of contract duration and type. These are then mapped into observable variables and implications are drawn. The variables and implications have been selected keeping in mind the particular context of nineteenth century rural Sicily and the available data, hence they do not constitute an exhaustive list.

The table highlights two important issues. First, two different models might yield the same prediction regarding the effect of one variable on one contractual dimension but different predictions regarding the effect of the same variable on the other contractual dimension. Information on both dimensions can then be used to assess

---

They show that limited liability leads to an inefficient outcome because it makes the tenant choose techniques that are too risky. In this setting sharecropping contracts might be preferred because they mitigate the incentive to choose risky projects. In the context analysed in this paper, however, considerations of this sort are not relevant as tenants have little discretion over production techniques.

<sup>14</sup>To see this, assume there are only two states of nature, good and bad, and that output in the bad state is zero. In the bad state, the maximum rent the tenant can pay is equal to his wealth minus subsistence consumption. As the output in the good state increases the rent the landlord wants to charge increases as well. For a given level of tenant's wealth, the limited liability constraint is therefore more likely to bind for crops that have a higher return spread. Banerjee *et al* [2002] and Mookherjee [1997] provide a formal analysis.

<sup>15</sup>See Holmstrom and Milgrom [1991], Allen and Lueck [1996], Akerberg and Botticini [2000] and Dubois [2002] for discussion and evidence on multitasking.

which considerations prevail. For instance, both limited liability and risk sharing considerations imply that sharecropping contracts should be used for poor tenants and risky crops. However, limited liability (with risk neutrality) implies that poor tenants should be offered short term contracts while risk sharing points to the opposite. Which effect prevails is ultimately an empirical question.

Second, data on both dimensions of contractual structure allow a better understanding of the evidence. For instance, multitasking considerations would suggest that since fixed rent contracts provide too much incentive for production effort at the expense of investment effort, sharecropping should be used for crops that are more sensitive to investment effort, namely trees. Contract length, however, can be used to provide investment incentives *directly*, thus weakening this rationale for sharecropping.

### 3 Data Description and Methodology

#### A. Data Description: Historical Context and Main Variables.

I use information on seven hundred and five tenancy contracts written in the district of Siracusa, Italy, between 1870 and 1880. Agriculture was the most important economic activity at the time, employing the majority of the work force. Tenancy agreements were common since land was unevenly distributed and rarely cultivated by the owners.<sup>16</sup> Each contract is a legally binding agreement between a landlord, who owns the plot, and a tenant who is hired to cultivate it. Contracts were written by a notary, following the instructions of the parties, and signed by these in his presence.<sup>17</sup>

---

<sup>16</sup>In Sicily, feudalism was officially abrogated in 1812. Feudal fiefs were subsequently divided but most landholdings remained quite large and in the hands of the aristocracy or rich *bourgeoise*, who typically rented out. Their tenants were landless or owned small plots, insufficient for subsistence (Inchiesta Iacini [1881], Inchiesta Parlamentare [1911]).

<sup>17</sup>Compared to verbal agreements or contracts written privately by the two parties, contracts written by notaries had the status of “public” documents, which made them safer for both parties. First, public contracts were binding for third parties implying that, for instance, if the landlord were to sell the land the buyer had to honor the existing tenancy agreement. Also, in case of sale, the tenant would give up the right to demand compensation. Finally, since most tenants were illiterate, notary contracts made sure that the landlord effectively wrote what was verbally agreed upon. See Codice Civile per il Regno d’Italia (1865), no. 1597, 1601.

The time period is chosen to match with an extensive descriptive literature on Sicilian agriculture. In 1881 the Italian Parliament published a detailed survey on the economic and social structure of the agricultural sector in different regions of the country [Inchiesta Iacini, 1881]. A similar survey was also carried out in 1911 [Inchiesta Parlamentare, 1911]. Both surveys describe Sicilian agriculture in great detail and contain information that is relevant for the present work.

#### *Compensation Scheme.*

Each contract specifies the payment from the tenant to the landlord, which can either be a share of the output, a fixed payment (either monetary or in kind) or a combination of both. Most contracts (85% of the sample) are of the fixed rent type, that is the tenant retains all the output and pays a fixed amount to the landlord at the end of every year. The remaining 15% of contracts are of the sharecropping type with share equal to one half.<sup>18, 19</sup>

Interestingly, the fact that under sharecropping the tenant had the incentive to cheat on the division of output was acknowledged by the judicial authorities at the time. To protect the landlord from tenants' opportunism, the law ruled that the tenant could harvest the crop only after giving the landlord notice.<sup>20</sup>

#### *Contract Duration.*

Contracts make precise the duration of the agreement. Figure 1 shows that although duration ranges from one to ten years, most contracts in the sample are either 1 or 4 years long. The fact that the unit of measure of duration is years as opposed to, say, months or days, is due to the fact that all crops in the sample give yearly

---

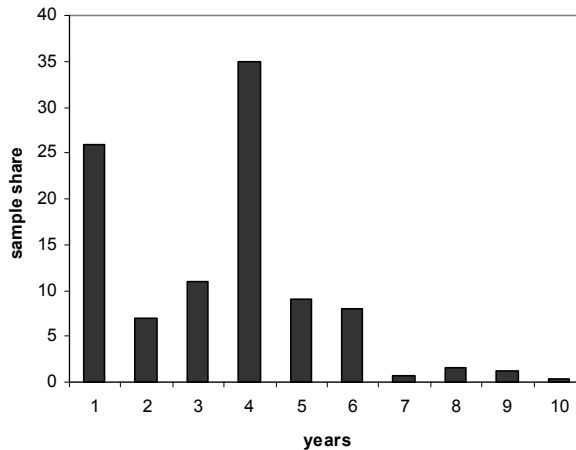
<sup>18</sup>The variation in contract type is much lower than what theory would predict but consistent with observations from many other rural contexts. See Akerberg and Botticini [2002], Dubois [2002], Laffont and Matoussi [1995], Young and Burke [2001].

<sup>19</sup>The existing law ruled that, unless specified otherwise in the sharecropping contract, the tenant was entitled to one half of the output. In addition, the tenant was supposed to provide draft animals, tools, working capital and finance all "ordinary" cultivation expenditures. The landlord was supposed to replace plants, if needed, and to finance "extraordinary expenditures". Finally, the landlord and the tenant each had to provide half of the seeds. See Codice Civile per il Regno d'Italia (1865) no.1654, 1655, 1656, 1657, 1658, 1661. See also Pacifici-Mazzoni and Venzi (1921) p. 343, 352, 353, 355, 356, 365, 366.

<sup>20</sup>Codice Civile per il Regno d'Italia (1865) no.1660. See also Pacifici-Mazzoni and Venzi (1921) p. 367.

yields. The concentration on two values (one and four) is more surprising. This might be due to the same reasons that limit the variation of the output share and is also consistent with evidence from other studies of contract duration.<sup>21</sup>

**Figure 1: Contract Duration**



Given the distribution of the duration variable and for ease of exposition, the analysis focuses on the distinction between short and long term contracts. The former includes one year contracts that give the tenant no stake in future production; the latter includes contracts that are longer than one year and therefore provide some incentives for non observable investment effort. Section 5 extends the analysis to allow the duration variable to take all ten values.

It is important to note that the length variable measures the duration of the contract, which does not necessarily coincide with the duration of the relationship between the landlord and the tenant. This could indeed be much longer if the same parties were to renew the agreement every time it expires.

It is then key to assess whether the duration of the contract effectively conveys information on investment incentives, or whether, because of frequent renewals, short term contracts are practically equivalent to long term contracts.

If the tenant expects to leave the plot at the end of the year with positive probability, a sequence of short term contracts is not equivalent to a long term contract

---

<sup>21</sup>For instance, Brickley *et al* [2005] find that most franchise contracts are 5 or 10 years long.

with regards to investment incentives because a positive probability of non-renewal is effectively a tax on the return of the tenant's investment effort.

In this context there are two reasons to believe that the *ex-ante* probability of non-renewal is indeed positive. First, the wording of the contracts makes clear that the tenant is required to leave the land at the end of the lease.<sup>22</sup> Second, since signing new contracts is costly both in terms of time and because the notary charges a fixed fee for his services, the *ex-ante* probability of non-renewal must be positive, otherwise parties could save on renegotiation costs by signing a long term agreement.<sup>23</sup>

It is important to note that the *ex-ante* probability of non-renewal can be positive even if the same landlord-tenant pair sign a short term contract year after year. Indeed, when eviction threats are used as an incentive mechanism, the *ex-post* probability of renewal is high precisely because the *ex-ante* threat of non-renewal provides effort incentives leading to high productivity. As argued in section two, giving up eviction threats is part of what makes long term contracts costly.

In addition to the information on the terms of the agreement, each document also contains information on the type of crop, on the wealth of the tenant and on landlord's characteristics. The remainder of this section describes these in detail.

---

<sup>22</sup>By law, each contract terminates on the last day of agreed lease period. If the duration is not specified the contract is intended to be expire after the first harvest. For both sharecropping and fixed rent contracts, if the tenant remains on the plot with the consent of the landlord the contract is extended until the next harvest but it loses the status of public document unless it is formally renewed in the presence of a notary. See Codice Civile per il Regno d'Italia (1865), no. 1591, 1593, 1622, 1623, 1624, 1651. See also Pacifici-Mazzoni and Venzi (1921), p.202-207, 273-275, 375-377.

<sup>23</sup>In addition, rent reduction rules made long term contracts more convenient for the landlord. The law indeed prescribes that if, due to circumstances beyond the tenant's control, more than half of the harvest got destroyed, the tenant has the right to demand rent reduction in proportion to the loss if the contract is one year long. If the contract is long term, however, the tenant loses the right to demand rent reduction if the loss in one year is compensated by rich harvests either in past or in future years. See Codice Civile per il Regno d'Italia (1865), no. 1617, 1618; Pacifici-Mazzoni and Venzi (1921), p. 256-272.

*Crop Type.*

Crops in the sample are cereals, olive, vines, citrus and fruit trees.<sup>24</sup> With a few exceptions, each contract regulates the cultivation of one crop only. In most cases where annual and tree crops are grown in the same plot, as is sometimes the case with wheat and olive, trees are excluded from the agreement.<sup>25</sup> The typical contract also contains clauses to forbid tenants to change crops or to plant other crops in addition to the existing ones.

Detailed information on crop characteristics can be found in *Inchiesta Iacini* [1881] and *Inchiesta Parlamentare* [1911]. According to these, tree crops were much more sensitive to non observable investment effort than the annual crops in the sample, which is consistent with intuition and with evidence from other times and places.<sup>26</sup>

Fertilizers and/or manure were seldom employed in wheat and barley fields. Instead, the land would be left fallow every three or five years to restore fertility. Fallow land is obviously observable and hence contractible, suggesting that only a few non observable investment tasks (e.g. deep ploughing and weeding) were left to the discretion of the tenant. Non observable investment effort was much more important for vines and citrus trees, which were very sensitive to the timing and dosage of fertilizers and pesticides. Both crops needed regular hoeing (4/5 times a year) and pruning,<sup>27</sup> citrus trees were also very sensitive to irrigation timing. Olive trees also needed regular pruning, careful harvesting, tilling and fertilizing but were apparently more resistant than either vines or citrus.<sup>28</sup>

---

<sup>24</sup>Cereals are wheat and barley, whose cultivation techniques were very similar. Eighty-two percent of cereals contracts are for wheat. Fruit trees include many varieties such as cherries, pears, peaches, apricots and almonds.

<sup>25</sup>This was possible because trees were generally grown on one side of the plot, which the tenant was asked to ignore. Contracts typically contain a detailed description of the location and number of trees to prevent the tenant from cutting them to sell the wood.

<sup>26</sup>Ackerberg and Botticini [2000 and 2002] argue that vines were more sensitive to investment effort than cereals in Renaissance Tuscany. Holmstrom and Milgrom [1991] make a similar point about vines in contemporary California.

<sup>27</sup>To avoid excess pruning motivated by the resale value of the wood, contracts typically established that the pruned woods belonged to the landlord. In some cases pruning was performed by other workers under the direct supervision of the landlord.

<sup>28</sup>Olive yields were particularly sensitive to the harvesting method employed the year before. The quickest system, “*abbacchiatura*”, consisted in shaking the tree until all the olives fell. This system had the serious drawback of destroying many of the buds, thereby reducing the following year’s production. See *Inchiesta Iacini* [1881].

While it is difficult to measure riskiness and spread of each crop precisely, the qualitative evidence indicates a clear ranking. Vines and citrus trees were the riskier crops, olive trees were somewhat less risky and cereals the safest. The ranking in terms of spread between the success and the failure states is similar, namely vines and citrus had the highest. For instance, Inchiesta Iacini [1881] reports that net revenues per hectare under “normal condition”, that is in the success state, ranged between L.50 and L.150 for wheat, between L.300 and L.800 for vines and between L.500 and L.1300 for citrus trees.<sup>29</sup>

In the empirical analysis I group crops in two ways. The most conservative choice, used for the main specification, exploits the natural difference in life span as a measure of investment sensitivity, thus I group all tree crops together and compare them to annual crops. Alternatively I use the available evidence on the difference between vines and citrus on the one hand and olives and fruit on the other to form three crop groups: annual (cereals), low-maintenance/low-risk trees (olive and fruit) and high-maintenance/high-risk trees (vines and citrus).

Table 2B shows the frequency of the different type of contracts by crop type. Contractual structure clearly varies by crop: 89% of annual crop fields are cultivated under fixed rent, with a predominance of short (53%) over long term (36%) contracts. Sharecropping is much more likely for tree crops, especially for vines and citrus. The difference in contract length between annual and tree crops is striking: while about 60% of the contracts for annual crops are one year long, the percentage falls to 8% for all tree crops and only 3% for vines and citrus.<sup>30</sup>

### *Tenants' Wealth.*

In nineteenth century rural Sicily, formal credit markets were seriously underdeveloped and accessible only to wealthy landowners since lenders required strong guarantees. Poor farmers relied on informal lenders and on their landlords for working capital loans. The fact that credit and insurance markets were highly imperfect is especially important because it suggests that risk sharing and limited liability issues,

---

<sup>29</sup>No information on net revenue of either olive or other fruit trees is reported, possibly because these were generally grown for personal consumption rather than commercialization.

<sup>30</sup>Average duration is 2.3 for cereals, 3.85 for olives and fruit trees, 4.15 for vines and citrus trees.

both of which make incentive provision costly, are relevant in this context.

Each contract in the sample specifies the social class of the tenant after mentioning his name. Social class can be reasonably used to proxy wealth and both the Inchiesta Iacini [1881] and the Inchiesta Parlamentare [1911] report a clear ranking of rural social classes according to the wealth of their members.

Tenants in the sample belong to one of three social classes. The lowest class was made of *villici*, poor farmers who owned “only the strength in their arms” [Inchiesta Iacini 1881]; the second lowest were *contadini* or *coloni*, farmers who owned a mule and/or a small house and possibly a small plot of land by the house; the wealthiest class were *possidenti*, that is tenants who owned land of their own.<sup>31</sup> I refer to tenants in the three classes as *poor*, *middle class* and *rich*. The sample shares are 34%, 40% and 26%, respectively.

Table 2C shows the frequency of the different type of contracts by tenant class. The Table reveals that the frequency of long term-fixed rent contracts increases steadily with wealth while the frequency of short term-fixed rent contracts declines dramatically as wealth increases. Also, sharecropping contracts are twice as likely for poor, compared to rich, tenants.

Social class improves over existing wealth measures because it can be taken to be exogenous to the extent that social mobility is low. Such was the case in 19th century Sicily, where, according to Inchiesta Iacini [1881] and Inchiesta Parlamentare [1911], social class was generally determined at birth. However, since social class is quite coarsely defined, the estimate of the wealth effect might be biased downward.

Limited liability models predict that contract choice depends on the tenant’s outside option, in addition to her/his wealth. Contracts do not contain this type of information but Inchiesta Iacini [1881] reports data on the daily wage for rural workers in different towns. I use this as a proxy for the tenants’ outside option. The average wage was L.1.38 with a standard deviation of .27.<sup>32</sup>

---

<sup>31</sup>A small number of tenants (5% of the sample) belonged to the class of *massari*, that is wealthy farmers who owned draft animals, a house and some plots of land. For simplicity, these have been grouped with the wealthiest class of *possidenti*. Moreover, *industriosi*, i.e. artisans, whose wealth, according to Damiani (1881), was comparable to *contadini*’s have been included in that group. Results are robust to alternative definitions.

<sup>32</sup>Italian Liras ca 1881.

### *Landlord's Characteristics.*

Contracts contain information on the gender of the landlord, on whether the landlord's legal residence was in the same town where the plot was located, and on whether the landlord belonged to the aristocracy. These variables proxy for the landlord's participation in the agricultural business and hence for monitoring, transaction and flexibility costs.

Due to social norms, female landlords were not likely to be directly involved in cultivation and, due to the fact that they had to travel from a different town, landlords who resided away from the plot were also less likely to participate in agricultural decisions. Landlords who belonged to the aristocracy were also less likely to be directly involved in agriculture. Female, absentee and aristocratic landlords faced a higher opportunity cost of time and higher monitoring and renegotiation costs. To the extent that they were less likely to either need or want to resume direct cultivation, these landlords were also likely to value flexibility less.

Table 2D shows the frequency of the different type of contracts by landlord's characteristics. Aristocratic and female landlords were clearly different from the average landlord in the sample as they were much more likely to offer long term/fixed rent contracts (88% vs 62% in the overall sample). Landlords whose legal residence was in a different town also seem very different from the average as they are, surprisingly, more likely to offer short term contracts.

Note that "legal residence" identifies the town where the landlord is registered with the records' office rather than the town he lived in. Although most of the times these should coincide, landlords would not change their records if they moved temporarily to another town. To the extent that this happened, "legal residence" is a noisy measure of actual residence.

### **B. Methodology.**

The analysis focuses on the determinants of the choice between long term and short term contracts and between fixed rent and sharecropping contracts. To begin with, I classify all contracts that last one year as "short term" while longer durations are classified as "long term". The classification is motivated by the consideration

that, in contrast to longer contracts, one year contracts give the tenant no stake in future production. In section 5, I extend the framework to allow contract duration to take multiple values.

The landlord chooses the length of the contract and the compensation scheme to maximize his payoff for given tenant's and crop's characteristics.<sup>33</sup> As discussed above, under fixed rent contracts the tenant's output share is equal to one while under sharecropping contracts the share is one half. The two first order conditions of the landlord's maximization problem yield the optimal length ( $l^*$ ) and output share ( $f^*$ ) as a function of each other and of the exogenous variables. Assuming linearity, the model is;

$$\begin{cases} l^* = \alpha_l f^* + X\beta_l + \epsilon_l \\ f^* = \alpha_f l^* + X\beta_f + \epsilon_f \end{cases} \quad (1)$$

where  $X'$  is the vector of observable tenant, landlord and crop characteristics while  $\epsilon_l, \epsilon_f$  capture the effect of variables that affect the landlord's choice but are not observed by the econometrician. Variables in  $X$  include the tenant's social class, the landlord's gender, social class and town of residence and the type of crop cultivated on the rented plot. Variables in  $\epsilon_l, \epsilon_f$  include for instance soil quality and the tenant's degree of risk aversion.

The data does not contain information on  $l^*$  and  $f^*$ . Instead, we observe two discrete variables  $l$  and  $f$ ; where  $l$  equals one when the contract is long term and zero otherwise and  $f$  equals one when the contract is fixed rent and zero otherwise. If  $l^*$  and  $f^*$  are global maxima, the landlord will choose a long term contract if the optimal length is above a threshold  $\bar{l}$  and similarly choose a fixed rent contract if the optimal share is above a given threshold  $\bar{f}$ . The decision rule then is;

$$\begin{cases} l = 1 & \text{if } l^* > \bar{l} \\ l = 0 & \text{if } l^* \leq \bar{l} \end{cases} \quad \text{and} \quad \begin{cases} f = 1 & \text{if } f^* > \bar{f} \\ f = 0 & \text{if } f^* \leq \bar{f} \end{cases} \quad (2)$$

---

<sup>33</sup>In line with most literature, the landlord is assumed to have all the bargaining power. The assumption is sensible in light of the abundance of labor relative to land in the context under study. Furthermore, it is assumed that unobservables that affect the matching of landlords and tenants pairs are not correlated with the length and type decisions. Section 5 discusses the matching of landlords and tenants in detail.

The discussion in section 2 makes clear that none of variables in  $X$  can be reasonably excluded from either the length or the type equation in (1). In addition, neither contract law nor other exogenous factors that could affect contractual structure exhibit geographical or time variation in the sample. Following standard practice in the empirical contract literature,<sup>34</sup> I therefore estimate the reduced form of (1) ;

$$\begin{cases} l^* = \gamma_l + X\pi_l + \nu_l, & l = 1 & \text{if } l^* > 0, & l = 0 & \text{otherwise} \\ f^* = \gamma_f + X\pi_f + \nu_f, & f = 1 & \text{if } f^* > 0, & f = 0 & \text{otherwise} \end{cases} \quad (3)$$

where  $\gamma_l, \gamma_f$  are constants,  $X$  is the vector of tenant, landlord and production function characteristics. To take into account that some unobserved determinants might be common to both equations in (2), I assume that the disturbances  $\nu_l$  and  $\nu_f$  are jointly normally distributed with  $E[\nu_l] = E[\nu_f] = 0$ ,  $Var[\nu_l] = Var[\nu_f] = 1$ ,  $Cov[\nu_l, \nu_f] = \rho$  and estimate the system by bivariate probit.

The reduced form coefficients are consistently estimated as long as the right hand side variables are not correlated with the error term. The assumption that crop choice is exogenous to contract type is supported by the fact that the life span of the sample trees is much longer than the typical contract duration. Vines and citrus trees have a productive life of at least thirty years, while olive trees can last over one hundred years. Contracts in the sample are typically one or four years long. In this sense it is safe to assume that the landlord chose the contract to fit the crop rather than *vice versa*.<sup>35</sup>

Second, the assumption that the type of contract does not affect the social class of the tenant is supported by the fact that social mobility at the time was extremely low. Wealth estimates might however be biased if tenants and crops are endogenously matched; I address this issue in Section 5.

Third, it is necessary to assume that contract type does not determine the landlord's characteristics either. Of these, two are clearly predetermined (gender and aristocracy) and legal residence would only be affected if crop choice would cause the

---

<sup>34</sup>See the numerous studies reviewed in Chiappori and Salanie [2003].

<sup>35</sup>Endogeneity is a much more serious concern when all crops are annual, and can therefore be chosen at the same time as the contract (Dubois 2002).

landlord to move indefinitely to another town. Even if the landlord's characteristics are predetermined, sample selection and measurement problem could still create a spurious link between contract type and the other independent variables. Section 5 discusses these issues in detail.

## 4 Empirical Analysis: Main Findings.

### A. Basic Specification

Table 3 reports the estimates of model (3). Columns type (a) report estimates of the probability of observing a long term contract, columns type (b) report estimates of the probability of observing a fixed rent contract. Each pair of equations is estimated simultaneously as explained above.

For each of the independent variables, Table 3 reports the reduced form coefficients, their standard errors and the marginal effects on the probabilities of observing a long term and a fixed rent contract respectively.

Columns 1a and 1b analyze the effect of crop type, columns 2a and 2b add information on the tenant's social class, while columns 3a and 3b also include landlords' characteristics. Contracts were signed in eleven different towns (all in the district of Siracusa) and ten different years (1870-1880).<sup>36</sup> The effect of the variables of interest is thus identified from the variation both within and across towns. To the extent that town and year specific unobservables affect both contractual structure and the right hand side variables, the coefficients might be biased. Columns 4a and 4b include town and year dummies to address this concern. The results are qualitatively similar to those in columns 3a and 3b but, not surprisingly given sample size, coefficients are smaller and the estimated marginal effects are between one half and one quarter of their previous values. Further results, not reported for reasons of space, show that changes are mostly due to the inclusion of the town dummies while including year controls is of little consequence. Both town and year dummies are jointly significant in both equations. In what follows, I take the most conservative strategy and include town and year controls throughout.

---

<sup>36</sup>The eleven towns are: Augusta, Buccheri, Buscemi, Carlentini, Ferla, Francofonte, Lentini, Noto, Pachino, Rosolini and Siracusa.

### *Crop Type.*

The coefficients on crop type indicate that trees make long term contracts more likely but have no effect on contract type.

Column 3a shows that tree cultivation increases the probability of observing a long term contract by .40, that is more than half of the sample mean (.74). When the estimate relies exclusively on within town and year variation (column 4a), the marginal effect is .14.

Columns 3b and 4b show that when town and year effects are not controlled for, there is some evidence that trees reduce the probability of observing a fixed rent contract (by .06, significant at the 10% level) however this effect loses significance when towns and years effects are included.

### *Tenant Wealth*

Columns 3a and 4a, Table 3, show that when the tenant belongs to the lowest social class the probability of observing a long term contract falls by .3 when town and year effects are not controlled for and by .07 when they are. The estimated marginal effect is between 40% and 10% of sample mean. When the tenant belongs to the middle class, the probability of observing a long term contract falls by .22 in column 3a but the effect loses significance when I control for town and year effects (column 4a).

Results in column 3b and 4b indicate that the tenant's social class is the most important determinant of contract type. The probability of observing a fixed rent contract falls by .15 if the tenant belongs to the lowest compared to the richest class, and by .08 if he belongs to the middle compared to the richest class. With town and year controls, column 4b, the estimated marginal effects are .08 and .05 respectively.

### *Landlord Characteristics*

The probability of observing a long term contract is higher when the landlord is female or belongs to the aristocracy. The magnitude of these effects is similar (.17 vs .16 in column 3a and .05 vs .06 in column 4a) while the coefficient of landlord's residence is not precisely estimated.<sup>37</sup>

---

<sup>37</sup>The coefficient is negative when cross-town and cross-year variation is not controlled for and

Columns 3b and 4b reveal a similar pattern for contract type. The probability of observing a fixed rent contract is higher when the landlord is female or belongs to the aristocracy and the effects are similar in size (.09 vs .08 in column 3b and .03 in column 4b) while landlord's residence has a positive and significant effect only when town and year effects are not controlled for.

Finally, Table 3 also reports the estimated correlation coefficient between the disturbance terms of the contract length and contract type equations. The estimate is positive (.08) indicating that omitted factors push for high powered incentives in both contractual dimensions but the Wald test cannot reject the null hypothesis of zero correlation. Since the correlation coefficient between the disturbance terms in the reduced form equations measures the correlation of the observed outcomes after controlling for exogenous variables, this finding does not contradict the idea that the choices over the two contractual dimensions are correlated in the underlying model.<sup>38</sup>

#### *Summary and Interpretation*

The theories reviewed in Section 2 yield the following predictions on the determinants of contract length:

- (i) *crop type*: trees, which are more sensitive to investment than annual crops, should be more likely to be cultivated under a long term contract;
- (ii) *tenant type*: if risk sharing considerations prevail, the probability of observing a long term contract should be decreasing in tenants' wealth; on the other hand, if limited liability binds, the probability of observing a long term contract should be increasing in tenants' wealth;
- (iii) *landlord type*: landlords who are less likely to be directly involved in cultivation should be more likely to offer long term fixed rent contracts to minimize transaction costs.

---

zero when it is. As discussed above, measurement error in this variable is likely to be high because "legal residence" does not necessarily coincide with the town the landlord lives in.

<sup>38</sup>Note that since  $\nu_i = \frac{\epsilon_i + \alpha_i \epsilon_j}{1 - \alpha_i \alpha_j}$ , where  $\epsilon_i$  are the disturbances of the structural equations,

$$Cov(\nu_l, \nu_f) = \frac{1}{(1 - \alpha_l \alpha_f)^2} [\alpha_f Var(\epsilon_l) + \alpha_l Var(\epsilon_f) + (1 + \alpha_l \alpha_f) Cov(\epsilon_l, \epsilon_f)]$$

that is  $Cov(\nu_l, \nu_f) = 0$  does not imply  $Cov(\epsilon_l, \epsilon_f) = 0$ .

The evidence in Table 3 is consistent with the two unambiguous predictions (i) and (iii). Regarding prediction (ii) the findings indicate that risk sharing considerations do not prevail in the choice of contract length. Poor tenants, who would need insurance against unemployment risk and income fluctuations the most, are actually less likely to be offered a long term contract. To the contrary, the findings are in line with the implications of limited liability, namely, poor tenants for whom long term contracts are more costly in terms of forgone eviction threats, are less likely to be offered a long term contract.

Regarding the determinants of the compensation scheme, theory yields the following predictions:

(i) *crop type*: the effect of crop type on contract type is ambiguous; on the one hand, trees should be more likely to be cultivated under a fixed rent contract as they are more sensitive to effort. On the other hand, they are more prone to being overexploited and hence should be more likely to be sharecropped if these multitasking considerations prevail. Similarly, their yields are more variable, suggesting again that they should be cultivated under a sharecropping contract;

(ii) *tenant type*: because of both risk sharing and limited liability considerations, the probability of observing a fixed rent contract should be decreasing in tenants' wealth;

(iii) *landlord type*: landlords who are less likely to be directly involved in cultivation should be more likely to offer fixed rent contracts to minimize monitoring and transaction costs.

The evidence in Table 3 is again consistent with the two unambiguous predictions (ii) and (iii). Regarding prediction (i), the findings provide some support to the idea that trees are more likely to be sharecropped, although the estimated coefficient loses precision when town dummies are included in the regressions. The section below provides some evidence to distinguish between the multitasking and the risk explanation.

Overall the results suggest that crop type primarily drives the choice between long and short term while tenant's wealth appears to be the main determinant of the choice between fixed rent and sharecropping. The following sections analyses their

interaction.

### **B. Interactions.**

Table 4 augments the model by allowing the effect of tenant class to depend on crop type and *vice-versa*. Two findings emerge.

First, poor tenants are less likely to be offered long term contracts, unless they are cultivating trees, in which case poor tenants are as likely as other tenants to be offered a long term contract. Indeed, column (1a) shows that the interaction term  $poor * tree$  is positive, significant and equal in magnitude but opposite in sign to the  $poor$  variable. This also implies that, compared to poor tenants, rich and middle class tenants are more likely to get long term contracts regardless of crop type.

Second, tenants belonging to the two lower classes are as likely as rich tenants to get a fixed rent contract when they cultivate annual crops, whereas they are significantly more likely to get a share contract when they cultivate trees. Indeed, the  $poor$  and  $middle class$  variables by themselves do not have a significant effect on contract type (column 1b) while they are negative and significant when interacted with  $tree$ .

This finding also speaks to the relationship between crop type and contract type. Trees are indeed, and as expected, more likely to be cultivated under share agreements but only if the tenant is not rich. This is consistent with the idea that tree yields have both higher mean and higher variance and that poorer tenants are offered insurance, or, alternatively that because of binding limited liability poorer tenants cannot afford to pay the rental value of tree in case of output failure.

In contrast, the evidence indicates that, in this context, multitasking considerations do not play a major role in determining the choice between fixed rent and share contracts. If they did, we would expect trees to be cultivated under share contracts regardless of the wealth of the tenant. A plausible explanation is that since trees are generally cultivated under long-term contracts, share contracts are not necessary to reduce the incentive to overexploit them. This illustrates how analysing all dimensions of contractual structure allows a more complete interpretation of the evidence.

Overall the balance of evidence indicates that investment incentives (via long

term contracts) are always provided for tree crops but not for annual crops and poor tenants. High powered incentives for both investment and effort are always offered when the tenant is rich, and when the landlord faces high monitoring and renegotiation costs.

## 5 Empirical Analysis: Extensions.

### *Alternative Definition of Contract Length.*

The analysis of contract length as a dichotomous variable highlighted the difference between one-year contracts that give the tenant no stake in future production, and longer contracts that, instead, make the tenant's pay conditional on future performance.

Since sample contracts are between one and ten years long, the data also allows to analyze the choice among all the different duration outcomes. The exercise is of interest in itself and because it allows to establish whether the results of the previous section are due to the particular classification of length employed there.

To capture the fact that the choice of length is discrete, I estimate the following model;

$$\begin{cases} d^* = X\pi_d + \nu_d, & d = j & \text{if } k_{j-1} < d^* < k_j, & j = 1..10 & k_0 = -\infty; k_{10} = \infty \\ f^* = X\pi_f + \nu_f, & f = 1 & \text{if } f^* > 0, & 0 & \text{otherwise} \end{cases} \quad (4)$$

As in the previous section, I assume that the disturbances  $\nu_d$  and  $\nu_f$  are jointly normally distributed with  $E[\nu_d] = E[\nu_f] = 0$ ,  $Var[\nu_d] = Var[\nu_f] = 1$  and  $Cov[\nu_d, \nu_f] = \eta$  to take into account that some unobserved determinants might be common to both equations. I then estimate the two equations in (4) jointly by full information maximum likelihood.

Table 5 presents the findings for both the basic specification and the model with interactions. Columns 1a and 2a report findings on duration, columns 1b and 2b on type. The corresponding results for the dichotomous length variable were presented in tables 3 and 4.

The estimated coefficients in the duration equations suggest that, in line with the previous findings, one year contracts are less likely to be used for trees, by landlords who do not belong to the aristocracy and for rich tenants. In contrast to previous findings, however, the landlord's gender is not a significant determinant of contract length.

To illustrate the effect of the exogenous variables on the choice of duration between one and ten, Table A1 reports the marginal effect of each variable on the probability of observing each of the ten outcomes. Two findings are noteworthy.

First, the comparison of these results to the ones for the dichotomous length variable used in tables 3 and 4 reveals that the estimates are identical in sign and very close in magnitude. To be precise, the marginal effects on the probability of observing a one year contract in Table A1, are equivalent to the marginal effects on the probability of observing a short term contract when the length variable is dichotomous as in tables 3 and 4. Using all information on contract length does not therefore alter the previous findings.

Second, Table A1 shows that the marginal effects on the probability of observing a one, two or three year long contract have the same sign and that the sign of the marginal effects switches for the probabilities of observing all durations larger or equal to four. For instance, tree cultivation increases the probability of observing contracts that are longer than three years and decreases the probability of observing contracts that are three years or shorter.

A plausible reason is that wheat was often cultivated in a two or three year rotation with fallow and legumes and the plot was rented out for the entire duration of the cycle. On a three year rotation, plots were divided into three parts and in each year a different part would be cultivated with wheat, one with legumes and the third left fallow. A three year contract would then be needed to complete the cycle on the plot. The two year rotation was similar but no part was left fallow.<sup>39</sup>

In these cases it would take, respectively, three or two years for wheat to be harvested throughout the plot so that a three or two year contract would be effectively

---

<sup>39</sup>Under the latter system the whole plot would generally be left fallow after two cycles, i.e. every fifth year.

be "short term" by the definition above. Richer data would be needed to explore this issue further. For the purpose of this paper, it is reassuring to note that the marginal effects on the probabilities of observing a two or three year long contract are very small, so that the estimates of the dichotomous length variable are the same regardless of whether two and three year contracts are classified as long or as short term.

Finally, Table 5 shows that allowing contract length to take ten values does not affect the findings on the determinants of contract type. The comparison of columns 1b and 2b (Table 5) to columns 4b (Table 3) and 1b (Table 4) reveals that the magnitude of the coefficients in the contract type equation is identical.

#### *Alternative Definitions of Crop Type*

As discussed in section 3, while their longer life span makes trees naturally more sensitive to investment than annual crops, trees do not constitute an homogeneous group. Agronomic evidence suggest that vines and citrus trees might be more sensitive both to production and investment effort than olives and fruit trees. In addition, vines and citrus trees are likely to be riskier and have a larger spread between good and bad state outcomes. Columns 1a and 1b, Table 6, exploit this information and estimates model (1) keeping olives and fruit trees separate from vines and citrus trees.

Results in column 1a indicate that both types of trees increase the probability of observing a long term contract but the marginal effect of vines and citrus trees is about three times larger than the effect of olive and fruit trees (.13 compared to .04). The difference is statistically significant and consistent with vines and citrus trees being more sensitive to non observable investment. Column 1b shows that while vines and citrus trees decrease the probability of a fixed rent contract (and hence increase the probability of a share contract), olive and fruit trees increase it. However, neither effect is significant at conventional levels. Further analysis, not reported for reasons of space, reveals that, as with the previous definition of trees, share contracts are more likely to be observed when vines or citrus are cultivated *and* the tenant belongs to the two lowest classes. Finally, the comparison with the basic specification reported in Table 3, reveals that the estimated effects of all other variables are unchanged.

Although trees are often found in wheat fields, they are generally excluded from

the contract. Only 15% of sample contracts for wheat also required the tenant to tend to trees as a secondary crop.<sup>40</sup> In columns 2a and 2b, Table 6, the tree variable equals one both when trees are the primary crop and when they are a secondary crop in a wheat field. Coefficient estimates are generally unchanged except that the marginal effect of crop type on contract length doubles (.26 vs .13), which suggests that neglecting the information on secondary crops biases the coefficient of *tree* downwards.<sup>41</sup>

*Tenants' Outside Opportunity.*

If the tenant is subject to limited liability, the structure of the optimal contract depends on his outside option in addition to his wealth. In particular, fixed rent contracts should be more likely when the tenant's outside option is high. Columns 3a and 3b, Table 6, include the daily wage for adult male rural workers in the local labor market as a proxy for the tenant's outside option. Data on wages were collected from interviews with the towns' mayors and reported in Inchiesta Iacini [1881] for each town.

To the extent that farmers are unwillingly or unable to move between towns the wage captures the differences in the value of the outside option among farmers residing in different towns.<sup>42</sup> Given that wage does not vary within town, in columns 3a and 3b, Table 6, I use information from the Inchiesta Iacini [1881] to group towns in regions with similar climate and soil characteristics.<sup>43</sup>

Caveats notwithstanding, results in columns 3a and 3b indicate that a fall in wage

---

<sup>40</sup>There are 41 such contracts in the sample. Of these, 11 had olive trees as a secondary crop, 5 had vines and 25 had fruit trees.

<sup>41</sup>The estimated coefficient is the same if wheat contracts with trees as a secondary crop are dropped from the sample. The symmetric case (i.e. tree contracts with wheat as secondary crop) cannot be analysed because there are only 5 such contracts in the sample.

<sup>42</sup>The wage data was collected only at one point in time during the second half of the decade but according to the Mayors the wage had hardly changed during the preceding *twenty* years. Since the effect of wages on contractual structure is identified from the variation across towns, the wage is a reasonable measure of the tenants' alternative option as long as the towns' relative ranking remained unchanged during the period analyzed here.

<sup>43</sup>The three regions are: northeastern coastal (Augusta, Carlentini, Francofonte, Lentini, Siracusa), southeastern coastal (Noto, Pachino, Rosolini) and western interior (Buccheri, Buscemi, Ferla).

significantly reduces the probability of observing a fixed rent contract. The marginal effect of a decrease in wage by one standard deviation is equal to  $-0.04$ , that is about one third of the effect of the tenant being middle class, instead of rich, and about one fourth of the effect of tenant being poor, again instead of rich.

*Endogenous Matching and Other Issues.*

The empirical analysis relies on the assumption that the unobservables that determine the matching process between landlords and tenants, are uncorrelated with other unobservable determinants of contractual structure.

In their study of tenancy contracts in Renaissance Tuscany, Akerberg and Botticini [2002] argue that when this assumption fails, endogenous matching of tenants and crops can lead to biases in both the crop and the risk aversion variable when the latter is not observed by the econometrician and a proxy needs to be used. They find strong evidence of matching, in particular that poorer tenants are more likely to farm vines instead of cereals. Controlling for matching changes their estimates considerably, most notably tenant's wealth becomes a significant determinant of the choice between sharecropping and fixed rent contracts.

To assess whether matching of tenants and crops is of concern in this setting I follow Akerberg and Botticini [2002] and estimate the relationship between crop type and tenants wealth. Intuitively, if tenants of a given class systematically end up cultivating a given type of crop, tenants' class should be significantly correlated with crop type. Table 7 shows that in this sample there is no correlation between the two variables. Compared to rich tenants, tenants belonging to the two lowest classes are neither more likely nor less likely to cultivate a given type of crop. The result is robust to alternative crop classifications. In column (1) all tree crops are grouped together and compared to annual crops whereas in column (2) the riskier and more investment intensive crops (vines and citrus) are compared to annual and other tree crops. The coefficients of tenant's social class are not significant in either column, indicating that in this sample there is no evidence of matching between tenants and crops.

A further concern would arise if social class, the proxy for tenants' wealth, were

to capture tenant's unobservable characteristics other than the cost of providing incentives, either because of risk aversion or limited liability. For instance, if social class were a proxy for farming ability, less able, hence lower class, tenants could be offered short term contracts because landlords would not want to commit long term to a bad tenant. Also, high class, and hence more able, tenants could prefer to be residual claimants and get a fixed rent contract. In the setting under study, however, social mobility was extremely low and social class was mostly determined at birth. This makes it unlikely to be uncorrelated with innate individual traits, such as farming ability, to the extent that these are randomly distributed across classes.

Finally, since the landlord chooses both the crop and the contract, landlords unobserved characteristics might mislead the interpretation of the link between trees and contractual structure. To the extent that the available information on landlords' characteristics does not precisely capture the variables of interest, the results could be due to the residual variation in landlords' unobservable traits.

For instance, it could be argued that only landlords whose outside opportunity is very high would rent out trees instead of managing them personally. The observed correlation between trees and contract length could then be due to a selection bias if, at the same time, landlords with a higher outside option prefer to save on renegotiation costs and offer long term contracts. The fact that long term contracts are offered to rich tenants also when they cultivate annual crops however suggests that landlords' unobservable characteristics are not the sole determinant of contract length.

Information on the other contractual dimension sheds more light on this point. Based on the argument above, landlords whose outside opportunity is so high that they prefer to rent out their trees and to offer long term contracts to minimize renegotiation costs should, for the same reasons, avoid share contracts as these need the landlord to monitor the division of output and to sell their share of the agricultural produce. The empirical findings, in contrast, indicate that trees are more likely to be cultivated under share agreements, at least when the tenant is poor. This, in turn, is *not* consistent with the idea that the link between tree and contract type is due to unobservable landlords' characteristics.

## 6 Conclusions.

This paper uses data on land tenancy agreements to present new evidence on the empirical determinants of contract form. The main novelty is the availability of evidence on contract length, an important and yet typically neglected dimension of contractual structure.

The evidence indicates that long term contracts are used for trees or when the tenant is rich, while poor tenants who cultivate annual crops are typically offered short term contracts. Evidence on the determinants of the compensation scheme suggests that fixed rent contracts are offered when the crop is annual or when the tenant is rich, while poor tenants who cultivate tree crops are typically offered sharecropping contracts. In addition, landlords who face higher renegotiation and monitoring costs are more likely to use long term and fixed rent contracts.

The findings provide evidence on the relevance of asymmetric information and on the factors that prevent the use of high powered incentives contracts. The fact that high powered investment incentives, via long term contracts, are always used for trees which are more sensitive to investment indeed suggests that asymmetric information plays an important role in contract design. Moreover, that poorer tenants are less likely to be offered high powered incentives is suggestive of the fact that credit market imperfections combined with either risk aversion or limited liability make incentive provision costly.

Importantly, the use of short term contracts and, hence, low powered investment incentives indicates that asymmetric information might effectively lead to less investment and lower productivity in the long run.

APPENDIX: DATA SOURCES.

**Contracts.**

Contracts are written by notaries, who, by law, were required to store all contracts they wrote and bind them in volumes by year. When the notary retired he was required to deliver all bound contracts to the Notary Archives, where they would be stored for roughly one hundred years and eventually transferred to the State Archives. Contracts in the sample were written by the following notaries and can be found at the State and Notary Archives in Siracusa, Italy:

STATE ARCHIVES		NOTARY ARCHIVES	
Notary Name	Sample Years	Notary Name	Sample Years
Baiona, Giovanni Battista	1870-74	Maxeo, Rosario	1875-80
Giarracca, Domenico	1870-77	Perricone, Alessandro	1875-77
Casaccio, Gaetano	1870-72	Tribulato, Antonino	1876
Di Giovanni, Ignazio	1870-75	Amico, Pietro	1870-79
Milito, Virgilio	1870-72	Tribulato Giuseppe	1873-75
Pancari, Vito	1870-75	Santuccio, Francesco	1873-80
Lenares, Giovanni	1872-74	Cultrera, Francesco	1873-75
Motta, Giuseppe	1872-77	Pisana, Pietro	1875-76
Pupillo, Giuseppe	1870-75	Sofia, Luigi	1876-77
Blasco, Francesco	1870-71	Sbano, Francesco	1875-80
Piccione, Rosario	1870-76	Tavana, Eustachio	1876-80
Terranova, Carmelo	1870-77	Nuzzo, Vincenzo	1878-80
Giardina, Gaetano	1870-72	Carbonaro, Raffaele	1878-80
		Scalia, Gaetano	1878-80
		Italia, Francesco	1878-79
		Leone, Gaetano	1880
		Zivillica, Alfonso	1879-80

**Town Variables.**

From “Inchiesta Jacini:Atti della Giunta per l’inchiesta agraria e sulle condizioni della classe agricola 1881” vol XIII, parte I e II, tomo 1-5-rapporto di Abele Damiani per la Sicilia. Wage data: Book 2 A pages 303 and 311, Crop Revenues Data: Book 2 A pages 298 and 307.

## References

- [1] Akerberg, Dan and Botticini, Maristella, “Endogenous Matching and The Empirical Determinants of Contract Form,” *Journal of Political Economy*, 110[3], June 2002, 564-91.
- [2] \_\_\_\_\_, and \_\_\_\_\_, “The Choice of Agrarian Contracts in Early Renaissance Tuscany: Risk Sharing, Moral Hazard, or Capital Market Imperfections?”, *Explorations in Economic History*, 37[3], July 2000, 241-57.
- [3] Allen, Douglas and Lueck, Dean, “The Transaction Cost Approach” in Martimor, ed., *Agricultural Markets: Mechanisms, Failures and Regulations*, North Holland, 1996.
- [4] Banerjee, Abhijit, Ghatak, Maitreesh and Gertler Paul, “Empowerment and Efficiency: Tenancy Reform in West Bengal”, *Journal of Political Economy*, 110[2], April 2002, 239-80.
- [5] Banerjee, Abhijit and Ghatak, Maitreesh, “Eviction Threats and Investment Incentives”, *Journal of Development Economics*, forthcoming 2003.
- [6] Bardhan, Pranab, “Labor-Tying in a Poor Agrarian Economy: A Theoretical and Empirical Analysis”, *Quarterly Journal of Economics*, 98[3], August 1983, 501-14.
- [7] \_\_\_\_\_, “Land, Labor and Rural Poverty: Essays in Development Economics,” Columbia University Press, 1984.
- [8] Basu, Kaushik, “Limited Liability and the Existence of Share Tenancy” *Journal of Development Economics*, 38[1], January 1992, 203-20.
- [9] Bose Gautam, “Interlinked Contracts and Moral Hazard in Investment” *Journal of Development Economics*, 41[2], August 1993, 247-73.

- [10] Brickley James, Misra, Sanjog and Van Horn, Lawrence, "Contract Duration: Evidence from Franchise Contracts" *Journal of Law and Economics*, forthcoming 2005.
- [11] Chiappori, Pierre Andre, Ines Macho, Patrick Rey, and Salanie Bernard "Repeated Moral Hazard: The Role of Memory, Commitment, and the Access to Credit Markets" *European Economic Review*, 38[8], October 1994; 1527-53
- [12] Chiappori, Pierre Andre and Salanie Bernard, "Testing Contract Theory: a Survey of Some Recent Work", Mathias Dewaripont, Lars Peter Hansen and Stephen Turnovsky eds. *Advances in economics and econometrics : theory and applications, eighth world conference*, Cambridge: Cambridge University Press, 2003.
- [13] Crawford, David, Pollak Robert and Vella, Francis (1998) "Simple Inference in Multinomial and Ordered Logit" *Econometric Reviews* 17(3), 289-299
- [14] Crocker, Keith and Masten, Scott, "Mitigating Contractual Hazards: Unilateral Options and Contract Length", *Rand Journal of Economics*, 19[3], Autumn 1988, 327-43.
- [15] Dubois, Pierre, "Moral Hazard, Land Fertility and Sharecropping in a Rural Area of the Philippines" *Journal of Development Economics*, 68[1], June 2002, 35-64.
- [16] Dutta, Bhaskar, Ray, Debraj and Sengupta, Kunal, "Contracts with Eviction in Infinitely Repeated Principal-Agent Relationships," in P. Bardhan, ed., *The Economic Theory of Agrarian Institutions*, Oxford; New York; Toronto and Melbourne: Oxford University Press, 1989.
- [17] Eswaran, Mukesh and Kotwal, Ashok "A Theory of Contractual Structure in Agriculture" *American Economic Review*, 75[3], June 1985, 352-67.
- [18] Fudenberg, Drew, Holmstrom, Bengt and Milgrom, Paul, "Short -Term Contracts and long term Agency Relationships", *Journal of Economic Theory*, June 1990, 51[1], 1-31.

- [19] Galassi, Francesco, Mealli, Fabrizia and Pudney, Stephen “An Econometric Model of Farm Tenures in Fifteenth-Century Florence”, *Economica*, 65[260], November 1998, 535-56.
- [20] Ghatak, Maitreesh and Pandey, Priyanka “Contract Choice in Agriculture with Joint Moral Hazard in Effort and Risk”, *Journal of Development Economics*; 63[2], December 2000, 303-26.
- [21] Giunta per l’Inchiesta Agraria, *Inchiesta Jacini: Atti della Giunta per l’inchiesta agraria e sulle condizioni della classe agricola XII*, parte I e II, tomo 1-5, Relazione del delegato tecnico per la Sicilia Abele Damiani, 1881.
- [22] Giunta d’Inchiesta Parlamentare, *Inchiesta Parlamentare sulle Condizioni dei Contadini nelle Province Meridionali e della Sicilia*, IV, tomo I e II, Relazione del delegato tecnico per la Sicilia Giovanni Lorenzoni, 1909-1911.
- [23] Holmstrom, Bengt and Milgrom, Paul “Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design”, *Journal of Law, Economics and Organization*, 7[0], Special Issue, 1991, 24-52.
- [24] Joskow, Paul, “Contract Duration and Relationship-Specific Investments: Empirical Evidence from Coal Markets”, *American Economic Review*, 77[1], March 1987, 168-85.
- [25] Laffont, Jean-Jacques and Matoussi, Mohamed, “Moral Hazard, Financial Constraints and Sharecropping in El Oulja”, *The Review of Economic Studies*, 62[3], July 1995, 381-99.
- [26] Malcomson, James M. and Spinnewyn, Frans, “The multiperiod Principal Agent Problem”, *Review of Economic Studies*, July 1988, 55[3], 391-407.
- [27] Mookherjee, Dilip, “Informational Rents and Property Rights in Land,” in J. Roemer, ed., *Property Rights, Incentives and Welfare*, New York: MacMillan Press, 1997.

- [28] Otsuka, Keijiro, Chuma, Hiroyuk and Hayami, Yujiro “Land and Labor Contracts in Agrarian Economies: Theories and Facts” *Journal of Economic Literature*, December 1992, 30[4], 1965-2018.
- [29] Pacifici-Mazzoni, Emidio and Venzi, Giulio *Il Codice Civile Italiano Commentato. Volume Quarto, Trattato delle Locazioni*. Torino: Unione Tipografico- Editrice Torinese, 1921.
- [30] Rogerson, William, “Repeated Moral Hazard”, *Econometrica*, 53[1], January 1985, 69-76.
- [31] Shetty, Sudhir, “Limited Liability, Wealth Differences and the Tenancy Ladder in Agrarian Economies,” *Journal of Development Economics*, July 1988, 9[1], 1-22.
- [32] Singh, Nirvikar, “Theories of Sharecropping,” in P. Bardhan, ed., *The Economic Theory of Agrarian Institutions*, Oxford; New York; Toronto and Melbourne: Oxford University Press, 1989.
- [33] Stiglitz, Joseph E., “Incentives and Risk Sharing in Sharecropping,” *Review of Economic Studies*, April 1974, 41[2], 219-55.
- [34] Young, Peyton H and Burke, Mary “Competition and Custom in Economic Contracts: A Case Study of Illinois Agriculture”, *American Economic Review*, 91(3), June 2001, 559-73
- [35] White, Halbert, “Maximum Likelihood Estimation of Misspecified Models” *Econometrica*, January 1982, [50:1], 1-26.

**TABLE 1 DETERMINANTS OF CONTRACTUAL STRUCTURE: THEORY**

	ASSUMPTIONS	CONSEQUENCES FOR CONTRACTUAL STRUCTURE		RELATED VARIABLES	PREDICTIONS
		Long Term (LT) vs. Short Term (ST)	Fixed Rent (FR) vs. Sharecropping (SC)		
Characteristics of the Production Function	Current output depends on the tenant's non observable effort.		FR provides stronger incentives for production effort.	Crop's sensitivity to effort.	<i>Other things equal, FR is more likely to be chosen the higher the crop's sensitivity to effort and the lower the tenant's cost of effort.</i>
	Future output depends on the tenant's non observable investment effort (e.g. soil and plant maintenance).	LT provides stronger incentives for investment effort.	Under multi-tasking, FR provides strong incentives for production effort at the expense of investment effort.	Crop's sensitivity to investment effort.	<i>Other things equal, LT is more likely the higher the crop's sensitivity to investment and the lower the tenant's cost of investment. Because of multitasking, FR is less likely for crops that are more sensitive to investment.</i>
Characteristics of the Tenant and Credit Markets	Tenant is subject to limited liability and credit markets are imperfect.	By committing to LT, the landlord gives up eviction threats as an instrument to elicit effort.	Limited liability imposes an upper bound to the feasible rent payment in a FR contract. SC allows the landlord to extract more surplus through state-contingent payments.	Tenant's wealth, outside option and crop's characteristics (difference in returns between the good and the bad state) determine whether the limited liability constraint binds.	<i>Other things equal, FR/LT is more likely to be chosen for rich tenant, for crops with low return spread and when the outside option of the tenant is high.</i>
	Tenant is risk averse and credit markets are imperfect.	LT guarantees employment and allows the tenant to smooth consumption.	Under FR the tenant bears all the risk. SC allows the landlord to extract more surplus by insuring the tenant against production risk.	Tenant's wealth and crop's riskiness determines the trade-off between risk and insurance.	<i>Other things equal, LT is more likely to be chosen for poor tenants and risky crops. FR is more likely to be chosen for rich tenants and low-risk crops.</i>
Transaction Costs		LT entails lower transaction costs because ST has to be negotiated every year. On the other hand, LT reduces flexibility.	FR entails lower transaction costs because under SC the landlord must monitor output measurement and division to prevent opportunism.	Landlord's opportunity cost of time and flexibility needs.	<i>Other things equal, LT is more likely to be chosen when the landlord's opportunity cost of time is high and the need for flexibility is low. FR is more likely to be chosen when the landlord's opportunity cost of time is high.</i>

## TABLE 2 DESCRIPTIVE STATISTICS

### PART A: CONTRACTS

	fixed rent	share	total
long term	435 (62)	85 (12)	520 (74)
short term	166 (24)	19 (3)	185 (26)
total	601 (85)	104 (15)	705 (100)

Source: State and Notary Archives, Siracusa, Italy. Volumes and years reported in table A1. Numbers in parenthesis are percentages of the total sample.

### PART C: TENANTS AND CONTRACTS

	poor	middle class	rich
long term/fixed rent	100 (42)	176 (62)	159 (88)
long term/ share	39 (16)	34 (12)	12 (7)
short term/fixed rent	91 (38)	68 (24)	7 (4)
short term/share	8 (3)	8 (3)	3 (2)
total	238	286	181

Number in parenthesis are percentages of the total by class. For instance, 42% of contracts with poor tenants are long term/ fixed rent.

### PART B: CROPS AND CONTRACTS

	annual	all trees	vines & citrus trees
long term/fixed rent	94 (36)	341 (76)	194 (78)
long term/ share	15 (6)	70 (16)	50 (20)
short term/fixed rent	137 (53)	29 (6.5)	4 (2)
short term/share	13 (5)	6 (1.5)	2 (1)
total	259	196	250

Number in parenthesis are percentages of the total by crop. For instance, 36% of annual crop contracts are long term/ fixed rent.

### PART D: LANDLORDS AND CONTRACTS

	absentee	aristocrat	female	all landlords
long term/fixed rent	77 (43)	28 (88)	110 (86)	435 (62)
long term/ share	14 (8)	2 (6)	8 (6)	85 (12)
short term/fixed rent	89 (49)	2 (6)	8 (6)	166 (24)
short term/share	0 (0)	0 (0)	2 (2)	19 (3)
total	180	32	128	705

Number in parenthesis are percentages of the total by landlord type. For instance, 43% of contracts signed by landlords who live in a different town are long term/ fixed rent.

**TABLE 3. DETERMINANTS OF CONTRACTUAL STRUCTURE**

Bivariate Probit Estimates

Dependent Variables: contract duration (cols. a) and contract type (cols. b)

Standard Errors in parenthesis, marginal effects (evaluated at sample mean) in brackets.

	duration	type	duration	type	duration	type	duration	type
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
crop is tree	1.61*** (.117) [.500]	-.286** (.125) [-.063]	1.50*** (.119) [.452]	-.379*** (.136) [-.079]	1.39*** (.132) [.405]	-.296* (.154) [-.060]	.975*** (.210) [.144]	-.044 (.211) [-.004]
tenant is poor			-1.03*** (.210) [-.314]	-.621*** (.176) [-.153]	-1.02** (.219) [-.298]	-.646*** (.187) [-.153]	-.547*** (.228) [-.074]	-.780*** (.207) [-.085]
tenant is middle class			-.728*** (.211) [-.208]	-.375** (.169) [-.087]	-.813*** (.226) [-.223]	-.380** (.170) [-.084]	-.160 (.237) [-.019]	-.592*** (.187) [-.056]
landlord is female					.888*** (.213) [.172]	.502*** (.178) [.088]	.635*** (.207) [.055]	.561*** (.208) [.035]
landlord belongs to the aristocracy					1.04** (.527) [.161]	.476 (.357) [.078]	1.36*** (.471) [.064]	.659* (.410) [.033]
landlord lives in a different town					-.360*** (.137) [-.100]	.458*** (.182) [.085]	-.234 (.236) [-.029]	.310 (.213) [.023]
correlation coefficient								
wald test, p-value								
town controls								
joint F-test, p-value								
year controls								
joint F-test, p-value								
joint log likelihood								

**Notes.** Source: see T2. **Number of observations** is 705 in all specifications. **Standard Errors** are based on White (1982)'s robust "sandwich" estimator for the asymptotic covariance matrix. **Marginal Effects** are computed as the change in the probability of the positive outcome when the variable of interest changes from 0 to 1. The **Wald test** statistics is the t ratio of the correlation coefficient squared and has a chi-squared distribution with 1 degree of freedom. **Omitted categories** are: *annual* for crop type and *rich* for tenant's class. \*, \*\*, and \*\*\* indicates significance at the 10%, 5% and 1% level.

**TABLE 4. DETERMINANTS OF CONTRACTUAL STRUCTURE: INTERACTIONS**

Bivariate Probit Estimates

Dependent Variables: contract duration (col 1a) and contract type (cols 1b)

Standard Errors in parenthesis, marginal effects (evaluated at sample mean) in brackets.

	duration (1a)	type (1b)
crop is tree	.472 (.495) [.068]	.528 (.371) [.052]
tenant is poor	-1.09** (.477) [-.187]	-.224 (.370) [-.020]
tenant is middle class	-.214 (.478) [-.029]	-.001 (.418) [-.001]
crop is tree*tenant is poor	.875* (.524) [.075]	-.730* (.429) [-.095]
crop is tree*tenant is middle class	.043 (.534) [.006]	-.764* (.473) [-.092]
landlord is female	.671*** (.204) [.064]	.539*** (.209) [.034]
landlord belongs to the aristocracy	1.34*** (.467) [.072]	.681* (.405) [.034]
landlord lives in a different town	-.161 (.231) [-.022]	.313 (.213) [.023]
test 1, p-value	.415	
correlation coefficient		.054
wald test, p-value		.654
town controls		yes
year controls		yes
joint log likelihood		-391.7

**Source:** see T2. **Notes:** see T4. The null hypothesis for Test 1 is that the coefficients of "tree" and that of "tree\*poor" are equal.

**TABLE 5 JOINT ESTIMATES OF LENGTH (Continuous) AND TYPE**

FIML estimates: joint ordered probit (for length) and probit (for type) estimates

Dependent Variables: contract length (cols. 1a,2a) and contract type (cols. 1b,2b)

Standard Errors in parenthesis.

	duration	type	duration	type
	(1a)	(1b)	(2a)	(2b)
crop is tree	.678*** (.143)	-.042 (.211)	.465* (.242)	.522 (.371)
tenant is poor	-.238* (.130)	-.782*** (.206)	-.646** (.280)	-.237 (.372)
tenant is middle class	-.018 (.105)	-.591*** (.186)	.053 (.277)	-.002 (.418)
crop is tree*tenant is poor			.597** (.303)	-.714* (.431)
crop is tree*tenant is middle class			-.094 (.293)	-.761* (.473)
landlord is female	-.123 (.106)	.560*** (.208)	-.116 (.105)	.538*** (.209)
landlord belongs to the aristocracy	.687*** (.222)	.647 (.407)	.665*** (.232)	.668* (.402)
landlord lives in a different town	-.052 (.141)	.299 (.213)	-.024 (.138)	.302 (.213)
correlation coefficient	.059		.057	
wald test, p-value	.421		.432	
town controls	yes		yes	
year controls	yes		yes	
joint log likelihood	-1248.27		-1241.55	

Source: see T2. Notes: see T4.

**TABLE 6. EXTENSIONS AND ALTERNATIVE VARIABLES DEFINITIONS**

Bivariate Probit Estimates, Dependent Variables: contract duration (cols. a) and contract type (cols. b)  
 Standard Errors in parenthesis, marginal effects (evaluated at sample mean) in brackets.

	duration (1a)	type (1b)	duration (2a)	type (2b)	duration (3a)	type (3b)
crop is tree					1.17*** (.200) [.261]	-.117 (.199) [-.018]
crop is olive or fruit tree	.570*** (.224) [.046]	.301 (.234) [.021]				
crop is vines or citrus tree	1.61*** (.266) [.131]	-.319 (.232) [-.028]				
crop is tree (either main or secondary)			1.56*** (.214) [.265]	.271 (.210) [.026]		
tenant is poor	-.537*** (.231) [-.062]	-.817*** (.205) [-.086]	-.466** (.226) [-.054]	-.763*** (.206) [-.085]	-.643*** (.218) [-.136]	-.783*** (.197) [-.147]
tenant is middle class	-.213 (.247) [-.022]	-.562*** (.189) [-.051]	-.055 (.243) [-.005]	-.596*** (.187) [-.058]	-.280 (.231) [-.054]	-.618*** (.174) [-.106]
landlord is female	.618*** (.219) [.044]	.583*** (.214) [.034]	.719*** (.476) [.051]	.574*** (.211) [.037]	.511** (.208) [.077]	.651*** (.206) [.077]
landlord belongs to the aristocracy	1.57*** (.473) [.054]	.711* (.407) [.032]	1.42*** (.476) [.055]	.702* (.424) [.035]	.968** (.489) [.010]	.608 (.384) [.064]
landlord lives in a different town	-.279 (.243) [-.031]	.335 (.208) [.023]	-.214 (.239) [-.024]	.346 (.214) [.026]	-.439** (.187) [-.093]	.323 (.209) [.045]
daily wage for adult male casual workers					-.601 (.636) [-.113]	1.06** (.511) [.166]
test 1, p-value	.000	.000				
correlation coefficient	.221	.221	-.012	-.012	.032	.032
wald test, p-value	.075	.075	.924	.924	.774	.774
town controls	yes	yes	yes	yes	no	no
region controls	no	no	no	no	yes	yes
year controls	yes	yes	yes	yes	yes	yes
joint log likelihood	-377.6	-377.6	-381.7	-381.7	-433.2	-433.2

Source: see T2. The null hypothesis for **Test 1** is that the coefficients of "olives and fruit" and that of "vines and citrus" are equal.

**TABLE 7. MATCHING OF TENANTS AND CROPS**

Probit Estimates; Standard Errors in parenthesis.

	crop is tree	crop is vines or citrus
tenant is poor	-.228 (.193)	-.076 (.160)
tenant is middle class	.159 (.199)	.194 (.144)
town controls	yes	yes
year controls	yes	yes
log likelihood	-211.5	-353.1

Source: see T2. **Standard Errors** are based on White (1982)'s robust "sandwich" estimator for the asymptotic covariance matrix.

**TABLE A1. MARGINAL EFFECTS ON DURATION OUTCOMES**

**BASIC SPECIFICATION (from column 1a, Table 5)**

	Pr(d=1)	Pr(d=2)	Pr(d=3)	Pr(d=4)	Pr(d=5)	Pr(d=6)	Pr(d=7)	Pr(d=8)	Pr(d=9)	Pr(d=10)
crop is tree	<b>-0.209***</b> (0.046)	-0.040*** (0.009)	-0.016*** (0.006)	0.141*** (0.032)	0.055*** (0.012)	0.049*** (0.010)	0.004** (0.002)	0.008*** (0.003)	0.006** (0.002)	0.0017 (0.0012)
tenant is poor	<b>0.071*</b> (0.040)	0.016* (0.009)	0.008* (0.004)	-0.049* (0.028)	-0.020* (0.011)	-0.018* (0.009)	-0.001 (0.001)	-0.003* (0.0017)	-0.002 (0.0015)	-0.0006 (0.0005)
tenant is middle class	<b>0.005</b> (0.031)	0.001 (0.007)	0.0007 (0.004)	-0.004 (0.021)	-0.002 (0.009)	-0.001 (0.008)	-0.0001 (0.0007)	-0.0002 (0.001)	-0.0002 (0.001)	-0.0001 (0.0003)
landlord is female	<b>0.037</b> (0.033)	0.008 (0.007)	0.004 (0.003)	-0.026 (0.023)	-0.011 (0.009)	-0.009 (0.008)	-0.0008 (0.0007)	-0.0016 (0.0013)	-0.001 (0.001)	-0.0003 (0.0003)
landlord belongs to the aristocracy	<b>-0.149***</b> (0.034)	-0.054*** (0.018)	-0.051** (0.022)	0.065*** (0.014)	0.065*** (0.022)	0.077** (0.033)	0.008 (0.005)	0.017* (0.010)	0.016 (0.010)	0.006 (0.005)
landlord lives in a different town	<b>0.015</b> (0.041)	0.004 (0.010)	0.002 (0.005)	-0.010 (0.028)	-0.004 (0.012)	-0.004 (0.011)	-0.0003 (0.0009)	-0.0007 (0.0018)	-0.0005 (0.001)	-0.0001 (0.0004)

**INTERACTIONS (from column 2a, Table 5)**

	Pr(d=1)	Pr(d=2)	Pr(d=3)	Pr(d=4)	Pr(d=5)	Pr(d=6)	Pr(d=7)	Pr(d=8)	Pr(d=9)	Pr(d=10)
crop is tree	<b>-.141*</b> (.076)	-.030** (.014)	-.012** (.005)	.097* (.052)	.038** (.019)	.034** (.017)	.003 (.002)	.006* (.003)	.004 (.003)	.001 (.009)
tenant is poor	<b>.201**</b> (.092)	.038*** (.013)	.013** (.006)	-.138** (.062)	-.051** (.021)	-.044** (.018)	-.0036* (.0021)	-.007** (.003)	-.005* (.003)	-.001 (.001)
tenant is middle class	<b>-.015</b> (.080)	-.004 (.019)	-.002 (.010)	.010 (.054)	.004 (.024)	.004 (.024)	.0003 (.0018)	.0007 (.004)	.0005 (.0023)	.0001 (.0007)
crop is tree*tenant is poor	<b>-.146***</b> (.060)	-.046** (.025)	-.037 (.025)	.082*** (.022)	.055 (.030)	.059 (.038)	.005 (.004)	.012 (.009)	.010 (.008)	.003 (.003)
crop is tree*tenant is middle class	<b>.028</b> (.088)	.006 (.019)	.003 (.009)	-.019 (.061)	-.008 (.024)	-.007 (.021)	-.0006 (.002)	-.001 (.003)	-.001 (.002)	-.0002 (.0006)
landlord is female	<b>.034</b> (.032)	.008 (.007)	.003 (.003)	-.024 (.022)	-.009 (.008)	-.009 (.008)	-.0007 (.0007)	-.001 (.001)	-.001 (.001)	-.0002 (.0003)
landlord belongs to the aristocracy	<b>-.141***</b> (.036)	-.053*** (.019)	-.047** (.023)	.068*** (.011)	.063 (.022)	.073** (.034)	.007 (.005)	.016* (.009)	.014 (.009)	.005 (.004)
landlord lives in a different town	<b>.007</b> (.040)	.001 (.009)	.0008 (.005)	-.005 (.027)	-.073 (.011)	-.001 (.010)	-.0001 (.0008)	-.0003 (.001)	-.0002 (.001)	-.0001 (.0003)

Source: see T.2. Marginal effects are computed from the ordered probit estimates in cols 1a and 2a Table 5. Standard Errors are bootstrapped using 1000 replications. Omitted categories are: annual for crop type and rich for tenant's class. \*, \*\*, and \*\*\* indicate significance at the 10%,5% and 1% level.