

# Do Women Matter? Household Structure, Risk, and Contract Choice\*

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## Abstract

The theoretical and empirical work on contract choice in agriculture argues that a multiplicity of possible factors are at play in the determination of the "optimal contract." Recent work has identified transactions costs, risk, moral hazard, monitoring, capital constraints, and multiple tasks, among others as the leading contenders. In this paper we take into account an additional determinant: household structure. The main testable hypothesis is that family members differentially affect household risk, and therefore contract choice, based on age, gender, and relationship to the household head. Household members (in particular women) who work in activities uncorrelated with agricultural risk reduce overall household risk aversion and therefore increase the likelihood of a fixed-rent contract. We test this hypothesis with data from a sample of over 1000 contracts in fifteenth-century Tuscany and find support for our main predictions.

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# 1 Introduction

In contemporary developed economies, agricultural insurance markets work properly and the structuring of contracts to share risk does not seem to be a critical issue. For example, Allen and Lueck (1999) find no support for the standard principal-agent model with risk aversion as an explanation for contract choice in modern North American farming, while they find some support for models that stress moral hazard and enforcement costs. However, in developing (and in past) economies where insurance markets are imperfect or even perhaps missing, contracts between landlords and tenants can become a mechanism to mitigate risk.

The literature on contract choice in agriculture has examined the implications of factors such as transactions costs, risk-aversion, moral hazard, monitoring ability, capital constraints, and multiple tasks on optimal contracts and the second best outcomes.<sup>1</sup> Much of the work on agrarian contract choice focuses on testing two possible determinants of contract choice. On one hand, risk-sharing models stress that, in the presence of a risk-averse agent who can shirk in the performance of tasks assigned by the principal, share contracts offer insurance and, at the same time, provide incentives for the agent to be diligent.<sup>2</sup> On the other hand, transaction-cost models tend to ignore risk preferences and focus on enforcement costs and transaction specific assets.<sup>3</sup>

Our approach draws on both of these two major strands of the literature. We consider risk sharing and moral hazard as important determinants of contract choice. At the same time, we also take into account informal and formal institutions that may affect the type of contract chosen. Specifically, we focus on an important factor that has been neglected in the literature: whether or not household structure (if a tenant is married, has children and/or other dependents living at home) can provide risk sharing and therefore affect contract choice. The main insight is that family members can help diversify and

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<sup>1</sup>See Rao (1971), Newbery (1977), Hallagan (1978), Braverman and Stiglitz (1982), Shaban, (1987), Holmstrom and Milgrom (1987; 1992; 1995), Milgrom and Roberts (1992), Allen and Lueck (1992; 1993; 1995), Laffont and Matoussi (1995), Lanjouw (1995), and Bandiera (1998).

<sup>2</sup>Stiglitz (1974), Newbery (1977), Holmstrom and Milgrom (1987, 1991, 1995), Milgrom and Roberts (1992), and Otsuka et al (1992).

<sup>3</sup>Alston et al. (1984), Allen and Lueck (1992, 1993, 1995, and 1999), Eswaran and Kotwal (1985), and Hallagan (1978).

mitigate risk by working in activities whose riskiness are uncorrelated.

Rural households now, as in the past, are composed of family members of various ages and genders. It would be unreasonable, a priori, to assume that a 60 year old grandmother performs the same role as a 10 year old son or as a 30 year old daughter-in-law. The question is then: how do different family members affect the type of agrarian contract? Controlling for household size, household members who work in activities uncorrelated with agricultural risk will reduce the overall household risk aversion and will therefore increase the likelihood of a fixed-rent contract. Thus, for example, in Renaissance Tuscany a grandmother or a daughter-in-law who were weavers or spinners for an urban wool merchant helped to diversify risk and to make the overall peasant household less risk averse.<sup>4</sup>

Sons and other male dependents, who usually work on the farm in farm related activities, do not contribute to reduce household risk aversion and therefore do not affect the type of agrarian contract chosen. The effect of daughters is ambiguous. If daughters contribute to the family income by working in non-agricultural activities, they would decrease household risk aversion and increase the likelihood of a fixed-rent contract. On the other hand, if in a society women need dowries in order to marry and if dowry funding is a major issue, such as in contemporary India, the presence of daughters will increase household risk aversion and will therefore increase the probability of a share contract. Daughters-in-law and other adult female dependents (mothers, grandmothers, sisters, aunts) should decrease household risk aversion because dowry funding for them is not an issue.

We test our hypotheses with data from a sample of 1165 contracts in fifteenth-century Tuscany that enable us to include information about family size and structure. Included are three towns (Florence, Pescia, and San Gimignano) and many villages in their respective country-sides. This data set is used primarily because of the impressive amount of information and detail included. However, the issues and findings presented here can also shed new light on the transition from developing economies (in which risk sharing in agriculture is a major issue and intergenerational links can provide a mechanism to insure against risk) to developed economies (in which risk sharing in agriculture is mitigated by market mechanisms).<sup>5</sup>

Consistent with our argument, we find that in Pescia and San Gimignano,

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<sup>4</sup>Brown and Goodman (1980, 78) argue that an extremely high proportion of weavers and virtually all spinners in the countryside were women.

<sup>5</sup>This paper is part of a large research project that examines the role of household

female dependents increased the likelihood of a fixed-rent contract. For Florence, where we can disentangle the differential effect of daughters, daughters-in-law, and adult female dependents (mothers, mothers-in-law, grandmothers, and aunts), we find that an additional adult female dependent increased the likelihood of a fixed-rent contract. Therefore, controlling for household size, peasant households who had more adult female dependents were more likely to choose a fixed-rent contract. In contrast, an additional daughter-in-law decreased the likelihood of a fixed-rent contract. A possible explanation is that daughters-in-law worked in agricultural activities and helped their husbands perform farming tasks, such as harvesting, feeding the animals, and weeding and cultivating the crops. This would suggest an interesting within-gender labor division: mothers, mothers-in-law, and grandmothers were specialized in nonagricultural tasks, while daughters-in-law helped their husbands run the farm.

An additional finding is that, controlling for household size, daughters had a positive effect on the probability of a fixed-rent contract. The positive coefficient for daughters seems to indicate that dowry funding was not the major issue for rural households that it was for urban households in the city of Florence.

While studying the effect of family structure on contract choice, we also test the main hypotheses suggested in the literature. Consistent with findings in previous work (Hoffman 1984; Botticini 1997; Galassi, Mealli, and Pudney 1998; Akerberg and Botticini 1999 and forthcoming), vines (and other perennial crops) appear associated with sharecropping. This could have resulted from both risk sharing considerations (being that vines were more risky crops) and/or from multitasking issues (being that vines were more sensitive to damage due to overproduction). Similarly, when landlords provided livestock and draft animals to their tenants, the likelihood of a fixed-rent contract decreased because, like with vines, livestock and draft animals were valuable assets that landlords wanted to preserve. This finding is also consistent with the transactions costs literature. For example, Allen and Lueck (1992) present evidence that soil-exploitation problems explains the choice between cash-rent and crop-share in the Midwest.

Monitoring costs, proxied by the landlord's occupation do not seem to have had a clear effect on contract choice. Contracts also seem to have been structure in agricultural development and ultimately will include the early twentieth-century U.S. South and contemporary India.

affected by a tenant's risk aversion as measured by his wealth. Wealthier, and therefore less risk averse, tenants were more likely to choose a fixed-rent contract.

The paper is organized in the following way. Section II summarizes previous work on agrarian contracts, risk sharing, and the role of women in agriculture. Section III presents the hypotheses regarding the impact of household structure on tenant risk aversion and contract choice. Section IV describes the data. Section V illustrates the estimation. Section VI concludes.

## 2 The Economics of Contract Choice

In many Asian countries, share contracts represent the dominant agrarian arrangement. In contrast, Latin American countries show a preference for fixed rent contracts (Ray 1998, 419). In the past, the predominance of sharecropping in some regions of Western Europe, and the almost complete absence of share contracts in other regions is a striking feature that characterizes the agrarian history of Western Europe from the Middle Ages to the nineteenth century. For example, since the thirteenth century share contracts had become the predominant agrarian arrangement in some regions of northern and central Italy and for over seven centuries it remained the main tenure arrangement.<sup>6</sup> Between the close of the Middle Ages and roughly 1700, the French countryside also witnessed a dramatic expansion of sharecropping (Bloch 1966; Hoffman 1984). Share contracts also spread in modern Catalan agriculture (Carmona and Simpson 1999). In contrast, in other places in Europe, such as England and Ireland, landlords preferred to lease their estates out for fixed-rent contracts (Mokyr 1981). What is remarkable is that a variety of types of contracts can be seen within relatively small areas in which soil-type, climate, transportation networks, and relative prices are very similar. For example, on individual plantations in the post-bellum U.S. South a variety of agricultural contracts existed.<sup>7</sup>

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<sup>6</sup>Rerolle (1888), Solmi (1923), Luzzatto (1948), Imberciadori (1961), Jones (1964; 1968), Conti (1965), Herlihy (1967), Desplanques (1969), Giorgetti (1974), Ugolini (1978), Cammarosano (1979), Cherubini (1979), Pinto (1979), Byres (1983), Pinto and Pirillo (1987), Muzzi and Nenci (1988), Cohen and Galassi (1990), Epstein (1986; 1994a, 1994b), Emigh (1996), Luporini and Parigi (1996), and Galassi, Mealli, and Pudney (1998).

<sup>7</sup>In many cases it was a matter of monitoring. Woofter (1936) noted that on plantations with a variety of contract types, those who worked the land closest to the main house (and hence least costly to monitor) were the wage hands and those furthest away were the fixed-

There is a vast literature on contract choice in general and on agrarian contract choice in particular. The latter has been one of the earliest topics dealt with in economics going all the way back to the Classical economists, yet many of the central questions still have incomplete answers.<sup>8</sup> Recently, development economists and economic historians have tried to come to grips with the question of why there exists (and existed) a mix of contracts and also the question of whether or not the mix is (was) efficient.<sup>9</sup> Risk sharing has been a central factor in the debate over the existence and distribution of various forms of agricultural contracts. Cheung (1968, 1969a, 1969b) argued that an advantage of sharecropping lays in the associated saving in transactions costs and risk mitigating factors. Stiglitz (1974), however, showed that the risk function of share contracts could just as easily be performed by an optimal combination of wage and fixed-rent contracts. The main advantage of a share contract, according to Stiglitz, is to reduce the moral hazard problem in the presence of a risk averse tenant. Thus, sharecropping exists as a compromise between the risk and incentive effects of the pure wage and pure fixed-rent contracts. Fixed-rent contracts provide perfect incentives as the tenant is the residual claimant of the output, but the tenant bears the entire risk. Conversely, wage contracts present enormous incentives to shirk unless the tenant is monitored closely by the landlord who also absorbs all the risk.

More recently, attention has turned to refining or expanding the basic theory of sharecropping. Among other things, recent work has examined the implications of factors such as risk-aversion, monitoring ability, moral hazard, capital constraints, transactions costs, and multiple tasks on optimal contracts and the second best outcomes.<sup>10</sup> Much of the work on agrarian contract choice focuses on testing two possible determinants of contract

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rent tenants, with sharecroppers and share tenants dispersed in between. Yet, even in cases where monitoring costs were extremely high (absentee landlord) or extremely low (working side-by-side the landlord) we still see a variety of contracts.

<sup>8</sup>Sharecropping and other agrarian contracts are mentioned in Smith (1776), Mill (1848), and Marshall (1890). For a summary see Jaynes (1984).

<sup>9</sup>The development literature is summarized nicely in Singh (1989), Binswanger and Rosenzweig (1984), and Newbery and Stiglitz (1979) while the economic history literature is summarized in Alston (1981), Alston and Higgs (1982), Alston and Kauffman (1997, 1998), Galassi (2000), Galassi and Cohen (1990), Shlomowitz (1979), and Wright (1986).

<sup>10</sup>See Rao (1971), Newbery (1977), Hallagan (1978), Braverman and Stiglitz (1982), Shaban, (1987), Holmstrom and Milgrom (1987; 1992; 1995), Milgrom and Roberts (1992), Allen and Lueck (1992; 1993; 1995), Laffont and Matoussi (1995), Lanjouw (1995), and Bandiera (1998).

choice. On one hand, risk-sharing models stress that, in the presence of a risk-averse agent who can shirk in the performance of tasks assigned by the principal, share contracts offer insurance and, at the same time, provide incentives for the agent to be diligent.<sup>11</sup> On the other hand, transaction-cost models tend to ignore risk preferences and focus on enforcement costs and transaction specific assets.<sup>12</sup> Our approach draws on both of these two major strands of the literature. On one hand, we consider risk sharing and moral hazard as major determinants of contract choice. On the other hand, we also take into account informal and formal institutions that may affect the type of contract chosen. Among these institutions the traditional gender division of labor and, for our case of Renaissance Florence, dowry building and the distinct residency patterns of married sons and daughters seem to have been particularly significant.

There has been virtually no work linking contract choice and household structure. This is not to say that the institutional and contract choice literature has completely ignored the role of household structure in agriculture. Most of it has centered on farm organization, household production, resource allocation, and the division of labor. For example, Allen and Lueck (1998) argue that the seasonal and random nature of agriculture explains why farming has not converted from small, family-based firms into large, factory-style corporate firms. Rosenzweig (1977) investigates the role of children as productive assets in agriculture and the decline in the U.S. farm birth rate. Rosenzweig and Schultz (1982; 1984) argue that differences in intra-family resource distribution can explain differences in relative female-male infant mortality levels in India. Folbre (1984) emphasizes the possible conflicting interests between male and female household heads in determining intra-family resource allocation. Rosenzweig and Wolpin (1985) maintain that in land-scarce developing countries there are cost advantages of family labor over hired labor and that extended families are the predominant household structure. Rosenzweig (1988) studies informal contracts, such as income transfers among families connected by marriage and living in different villages, which are used in India to mitigate agricultural output risk. Udry (1996) shows that women farm land plots less intensively than men in West

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<sup>11</sup>Stiglitz (1974), Newbery (1977), Holmstrom and Milgrom (1987, 1991, 1995), Milgrom and Roberts (1992), and Otsuka et al (1992).

<sup>12</sup>Alston et al. (1984), Allen and Lueck (1992, 1993, 1995, and 1999), Eswaran and Kotwal (1985), and Hallagan (1978).

Africa.<sup>13</sup>

However, the issue of contract choice (formal or informal) as affected by household structure has yet to be addressed. Risk is the intermediate link in the causality chain. A family may have certain risk preferences because of its structure (e. g. marital status of the household head, number and gender of children, and presence of grandparents) and this structure in concert with indigenous formal and informal institutions (types of acceptable work for each gender, need for dowries, etc.) produces a certain risk preference for the household. Given the tenant's desire to mitigate risk, he decides which type of contract is optimal. In what follows we discuss how household structure plays into contract choice more explicitly.

### 3 Household Structure and Agrarian Contracts

Drawing on recent work in information economics (Holmstrom and Milgrom 1991), an optimal contract share  $\alpha^*$  is given by:

$$\alpha^* = \frac{1}{1 + R\sigma^2} \quad (1)$$

where  $R$  is the coefficient of the tenant's risk aversion and  $\sigma^2$  is the variance of the agricultural output (assuming a mean equal to 1). From (1), some predictions can be drawn. If  $\sigma^2$  gets large, for example in the case of vines or other perennial crops, it is less likely that a fixed-rent contract is chosen. Notice that here the discussion is only in terms of crop variability. A complementary argument is the multitasking story. A landlord who wants to ensure that the tenant does not damage the assets on the farm (vines and other perennial crops, or livestock and draft animals) will offer a share contract because it "taxes" current production and gives the tenant an incentive not to overproduce and damage the assets. Also, a wealthier, and therefore less risk averse tenant (small  $R$ ), will be more likely to accept a fixed-rent contract.

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<sup>13</sup>There is some work on the link between sharecropping and household size. For example, Rebecca Emigh (1998) argues that large tenant families in early Renaissance Tuscany were designed to increase household income and that share contracts were, in some degree, contracts "forced" on tenants by landlords during this period. However, this explanation does not account for why large peasant households were highly likely to work under a share contract.

Where does household structure enter into equation (1)? Households now, as in the past, are composed of family members of various ages and genders. It would be unreasonable, a priori, to assume that a 60 year old grandmother perform the same tasks as a 10 year old son or a 30 year old daughter-in-law. The question then is: How do different family members affect agrarian contract type? What can one say about the effect of brothers, sisters, daughters, sons, daughters-in-law, mothers, fathers, grandmothers, grandfathers, uncles, and aunts on the type of agrarian contract chosen?

### 3.1 Age and Gender Roles

Suppose we want to estimate the optimal contract choice where we let

$$C = \gamma_0 V + \gamma_1 R + \gamma_2 S + \varepsilon \quad (2)$$

be the optimal contract, where  $C$  is the contract chosen,  $V$  is a dummy that takes on the value of 1 if vines and other perennial crops are planted on the farm,  $R$  is the tenant risk aversion,  $S$  is the farm size, and  $\varepsilon$  is the error term.

A tenant's risk aversion can be affected by several factors. First, a tenant's wealth can be used as a proxy for his risk aversion (Laffont and Matoussi 1995). The wealthier the tenant, the smaller his risk aversion. Second, risk preferences can be affected by household structure. For example, adult female dependents who work in activities whose risk is uncorrelated with farm activities can help the household spread risk, make the tenant less risk averse, and increase the likelihood of a fixed-rent contract. One can then write:

$$R = \theta_0 W + \theta_1 adultfemdep + \theta_2 daug + \theta_3 dauginlaw + \theta_4 sons + \theta_5 maledep + \eta \quad (3)$$

where  $W$  is the tenant wealth,  $adultfemdep$  is the percent of adult female dependents (mothers, grandmothers, aunts),  $daug$  is the percent of daughters and other young women,  $dauginlaw$  is the percent of daughters-in-law,  $sons$  is the percent of sons,  $maledep$  is the percent of male dependents except sons, and  $\eta$  is the unobservable component of risk aversion.

Family members can also influence contract choice by affecting farm size. Therefore, farm size,  $S$ , can be proxied by

$$S = \beta_0 householdsize + \nu \quad (4)$$

where  $\nu$  are unobservable variables that can affect farm size.

Substituting (3) and (4) into (2), we obtain:

$$C = \gamma_0 V + \gamma_1 \theta_0 W + \gamma_1 \theta_1 \text{adultfemdep} + \gamma_1 \theta_2 \text{daug} + \gamma_1 \theta_3 \text{dauginlaw} + \gamma_1 \theta_4 \text{sons} + \gamma_1 \theta_5 \text{maleddep} + \gamma_2 \beta_0 \text{householdsize} + \varepsilon + \nu + \eta \quad (5)$$

or

$$C = \alpha_0 V + \alpha_1 W + \alpha_2 \text{adultfemdep} + \alpha_3 \text{daug} + \alpha_4 \text{dauginlaw} + \alpha_5 \text{sons} + \alpha_6 \text{maleddep} + \alpha_7 \text{householdsize} + u \quad (6)$$

where

$$\alpha_0 = \gamma_0, \alpha_1 = \gamma_1 \theta_0, \alpha_2 = \gamma_1 \theta_1, \alpha_3 = \gamma_1 \theta_2, \alpha_4 = \gamma_1 \theta_3, \alpha_5 = \gamma_1 \theta_4, \alpha_6 = \gamma_1 \theta_5, \alpha_7 = \gamma_2 \beta_0, \text{ and } u = \varepsilon + \nu + \eta.$$

This is the reduced form equation that will be estimated. Notice that because equation (6) includes household size, we have to exclude the variables "sons" and "depmale" because otherwise we would have perfect collinearity.<sup>14</sup> Therefore, the regression that will be estimated is the following:

$$C = \alpha_0 V + \alpha_1 W + \alpha_2 \text{adultfemdep} + \alpha_3 \text{daug} + \alpha_4 \text{dauginlaw} + \alpha_7 \text{householdsize} + u \quad (7)$$

Household structure can therefore affect contract choice in the following way. Controlling for family (farm) size, those family members who work in activities whose risk is not correlated with agricultural risk will reduce the overall household risk aversion and therefore will increase the likelihood of a fixed-rent contract. A grandmother weaving or spinning for an urban wool merchant, a daughter working as a servant in town, or a daughter-in-law acting as a wet nurse for a notary's child, would all help diversify risk and would make a peasant household less risk averse. Therefore, theory predicts  $\alpha_2$  and  $\alpha_4$  to be positive. Meanwhile, the effect of daughters on household risk aversion is ambiguous. If daughters contribute to the family income by working in non-agricultural activities, they would decrease household risk aversion and increase the likelihood of a fixed-rent contract. On the other hand, if dowry funding is a major issue, the presence of daughters will increase a household's risk aversion and therefore will decrease the probability of a fixed-rent contract.

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<sup>14</sup>  $\text{Adfemdep} + \text{daug} + \text{daug-in-law} + \text{sons} + \text{maleddep} = \text{total household size}.$

Based on the argument outlined above, we also expect  $\alpha_0 < 0$  (farms with vines should be more likely to be cultivated by sharecroppers because of risk sharing and/or multitasking considerations) and  $\alpha_1 > 0$  (wealthier and therefore less risk averse tenants should be more likely to work under fixed-rent contracts).

## 4 The Sample

The data we use come from the 1427 Florentine catasto housed at the State Archives of Florence. In 1427, the Florentine city government, pressed by urgent financial needs due to continuous warfare with other Italian cities, tried to increase its tax revenues. To ascertain the wealth of the citizens living in all its domains, Florence undertook the catasto a comprehensive census and property survey including 60,000 households. Each head of household had to declare: the houses, lands, and draft animals he owned; the crops grown and the agrarian contracts used; the average crop yields of the previous three years; his debts and credits; his shares of commercial partnerships; and his profession. Furthermore, he had to report the composition of his family by name, age, sex, and relationship to himself.

Among other things, landlords compiling their declarations had to indicate all the lands they owned, the types of crops grown on them, the average output over the past three years, whether they owned and/or leased livestock, whether they cultivated the lands by themselves and/or with the help of wage laborers, or whether they leased out their lands to fixed-rent tenants and sharecroppers. They also had to declare whether they provided livestock, seeds, and loans to their tenants. On the other hand, peasant tenants had to declare whose farms they cultivated, the crops grown and the average output, and whether they owned and/or leased livestock.

Our data set is similar to the one used by Galassi, Mealli, and Pudney (1998) and Galassi (2000) with the important addition of tenant characteristics, which enable us to test the effect of household structure on contract choice. Our random sample contains 37 Florentine landlords who owned a total of 513 farms, and 111 landlords living in Pescia and San Gimignano who owned 652 farms.<sup>15</sup> Matching the corresponding 1165 tenants in the catasto took an enormous amount of time and effort. People in medieval Tuscany had no last names, but were identified by their first name and their

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<sup>15</sup>Pescia and San Gimignano were two towns belonging to the Florentine dominion.

father's name. Common names such as Giovanni made it difficult to identify the tenants. Moreover, for Florence the problem was complicated by the fact that there were roughly 25,000 households who lived in hundreds of villages in the Florentine countryside in 1427.

The volumes of the catasto provide a wealth of information on agrarian contracts, crop choice, livestock, and economic and demographic characteristics of landlords and tenants. In the estimation, the dependent variable is the agrarian contract chosen: fixed-rent or share contract (1=fixed-rent, 0=share contract). We do not consider wage contracts for several reasons. First, only a tiny percentage of contracts (7 percent) were wage contracts. Also, when listing expenses for wage workers, landlords did not report their names by making it impossible to match the corresponding agricultural workers in the census. More important, because agricultural wage laborers were hired for very short periods of time to perform specific tasks (unlike share croppers and fixed-rent tenants who lived and worked on the farm during the entire year), it seems inappropriate to consider them in the same category of fixed-rent tenants and share croppers.

Various independent variables are included. Production technology is represented by crop mix (0=cereals, 1=cereals and vines, 2=vines). The landlord's characteristics are his occupation and the number of male and female dependents. The variable *occupation* should capture the fact that people engaged in nonagricultural activities, such as artisans, merchants, notaries, and medical doctors, had less time to take care of their land holdings and monitor their peasant tenants' diligence. The variable is coded as a dummy that takes on the value of one if the landlord practiced a nonagricultural occupation. The *number of dependents* should capture the fact that adult children can help the landlord monitor his/her tenants.

Tenant characteristics include his age, and land ownership (a dummy variable equal to one if the tenant owned land) as a proxy for the tenant wealth. For Florence we also coded the number of sons, number of daughters, number of daughters-in-law, number of other male dependents living in the tenant household (brothers, grandfathers, grandsons, nephews, and uncles), and number of adult female dependents living in the tenant household (mothers, grandmothers, sisters, and aunts). For Pescia and San Gimignano, we have only available so far the number of all male dependents (with no distinction between sons and other male dependents) and the number of all female dependents (with no distinction between daughters, daughters-in-law, and other female dependents). For these two towns we also have information

on whether landlords provided their tenants with livestock and draft animals.

## 4.1 Summary Statistics

Tables 1 and 2 present summary statistics regarding landlords and tenants in the sample. We keep Florence distinct from Pescia and San Gimignano given that Florence was much larger and its population was wealthier than the two towns belonging to its domains. Meanwhile, Pescia and San Gimignano had similar population size and wealth characteristics.<sup>16</sup> Therefore while Florence is considered separately, Pescia and San Gimignano are not. In the two smaller towns, share contracts were chosen on 61 percent of land plots. Perennial crops represent 18 percent of the sample, annual crops were grown on 42 percent of land plots, while the remaining farms had both annual and perennial crops. Two-thirds of landlords held non-agricultural occupations; 57 percent of the landlords lived in San Gimignano and owned land plots in the surrounding countryside. Sixty-five percent of tenants owned land and 34 percent also owned livestock and draft animals. Tenants tended to have larger families than their landlords.

As for Florence, seventy-two percent of the farms were under a share contract, and on sixty-three percent of the farms vines and other perennial crops were planted. Sixty percent of the landlords had a nonagricultural occupation (i. e. notaries, merchants, artisans, and medical doctors). Tenants' mean age was 54. Sixty-three percent of the tenants owned land on their own in addition to farming their landlords' plots. On average, a peasant household consisted of 6.08 members; the median and mode were equal to 5 members. Besides the household head (and in most cases his wife), there were on average 2.38 male dependents and 1.78 female dependents. It was common in this period that people lived in extended households, with two or more adult brothers living with their wives and children under the same roof. Compared with Herlihy and Klapisch-Zuber (1978), the average household size in our sample is larger, but the mode and median size is the same. This suggests that our sample contains a few very large households.

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<sup>16</sup>In Florence there were 9,780 households and over 25,000 households in the countryside. By contrast, Pescia and San Gimignano including their countryside had 532 and 576 households, respectively.

## 5 The Estimation

The impact of the number of female dependents, number of daughters, and number of daughters-in-law on agrarian contract choice is first estimated by a probit regression in which the dependent variable is a dummy equal to one if the contract chosen is a fixed-rent contract and zero otherwise. The control variables include crop mix to account for different production technologies and risk characteristics of various crops, landlord's occupation and number of dependents as proxies for his monitoring costs, tenant's characteristics (wealth, land ownership), and the tenant's household size to control for farm size. The choice between share contract and fixed-rent contract is determined by the difference between the income flows associated with each option. Let  $I^*(X\beta + u)$  be such a difference, where  $X$  is a vector containing the landlord's characteristics, the tenant's characteristics, and the crop mix variable, and  $u$  is a standard normal error term. Although the value of  $I^*$  is not observed, a discrete contract choice is observed, given by

$$I = \begin{cases} 0 & \text{if } I^* < 0 \\ 1 & \text{otherwise} \end{cases}$$

where 1 represents a fixed-rent contract and 0 a share contract. The probit equation that is then estimated is:

$$Prob(I = 1) = Prob(u < X\beta) = \Phi(X)$$

where  $\Phi()$  is a standard normal cumulative distribution function.

Tables 3 and 4 report probit estimates, which control for landlord random effects that are uncorrelated with the explanatory variables for Pescia/San Gimignano and Florence, respectively. We also run fixed effect logit (conditional logit) regressions, which allow for effects that may or may not be correlated with explanatory variables. To compare marginal effects across logit and probit specifications, the logit results should be divided by approximately 1.6.

Consistent with findings in previous work (Hoffman 1984; Botticini 1997; Galassi, Mealli, and Pudney 1998; Akerberg and Botticini 1999 and forthcoming), vines appear associated with sharecropping. This could have resulted from both risk sharing considerations (being that vines were more risky crops) and/or from multitasking issues (being that vines were more

sensitive to damage due to overproduction). When landlords provided livestock and draft animals to their tenants, the likelihood of a fixed-rent contract decreased because, like with vines, livestock and draft animals were valuable assets that landlords wanted to preserve. This is consistent with findings in the early twentieth-century U.S. South and nineteenth-century Italy where landlords provided draft animals to their sharecroppers, but were less likely to do so for their fixed-rent tenants (Kauffman 1993; Galassi and Kauffman 1997).

Monitoring costs, proxied by the landlord's occupation do not seem to have had a clear effect on contract choice. In Pescia and San Gimignano, a landlord who practiced a nonagricultural occupation (and therefore had higher monitoring costs) was less likely to choose a fixed-rent contract. The opposite was true in Florence. The rationale could be that in Pescia and San Gimignano landlords lived relatively close to their farms and therefore their monitoring costs were small, whereas the distance between Florence and its large countryside made monitoring costs an issue.

Contracts also seem to have been affected by a tenant's risk aversion as measured by his wealth (proxied by land ownership) in the Florentine countryside. Wealthier, and therefore less risk averse, tenants were more likely to choose a fixed-rent contract. In Pescia and San Gimignano, however, the effect of tenant wealth on contract choice is less clear: the sign of the coefficient on tenant wealth changes depending on the regression specification and is not statistically significant in any of the regressions.

Concordant with arguments made by other scholars (Herlihy and Klapisch-Zuber 1978; Emigh 1998), in the Florentine countryside sharecroppers had larger families who could help in various agricultural tasks (Table 4). Interestingly, we find the opposite effect in Pescia and San Gimignano where larger households were associated with fixed-rent contracts (Table 3). At this stage we do not have a good story to explain the link between overall household size and contract choice. One might conjecture that the larger the household, the larger the farm that is needed to support the family members. On larger farms, it is more likely that both annual crops and perennial crops (e. g. vines) are planted. Since perennial crops display higher output variability, their presence on a farm increases a tenant's risk aversion and the likelihood of a share contract.

Contrary to previous studies, we can disentangle *(i)* the differential impact of male dependents and female dependents, and *(ii)* for Florence even the differential impact of daughters, daughters-in-law, and adult female de-

pendents which included mothers, grandmothers, mothers-in-law, aunts, and adult sisters. In so doing, we find that in Pescia and San Gimignano (Table 3) an additional female dependent increased the likelihood of a fixed-rent contract (the coefficient is 1.68 with a standard error of 0.56, and the marginal effect calculated at the sample mean is 0.46; in the conditional logit, the coefficient is 3.01 with a standard error of 1.18). This is consistent with the argument that women would decrease household risk aversion (and therefore increase the likelihood of a fixed-rent contract) by working in jobs whose riskiness was uncorrelated with agricultural risk.

As for Florence (Table 4), controlling for household size, the coefficient on percent of adult female dependents is positive (0.37) and statistically significant (standard error equal to 0.19). The marginal effect is 0.11. Adult female dependents who worked in nonagricultural activities, such as spinners and weavers, helped mitigate household risk and seem to have affected contract choice. Historical evidence confirms that an extremely high proportion of weavers and virtually all spinners in the countryside were women (Brown and Goodman 1980, 78). In contrast, the sign on the coefficient of daughters-in-law is the opposite of that predicted by the theory (though not statistically significant). One may have thought daughters-in-law help diversify risk in a rural household (and therefore increase the likelihood of a fixed-rent contract) by working in nonagricultural activities just as mothers, grandmothers, adult sisters, and aunts seem to have done. Instead, controlling for household size, an additional daughter-in-law decreased the likelihood of a fixed-rent contract. A possible explanation is that daughters-in-law worked in agricultural activities by helping their husbands perform some farm tasks such as harvesting, feeding the animals, and weeding and cultivating the crops. This would suggest an interesting within-gender labor division: mothers, mothers-in-law, and grandmothers were specialized in nonagricultural tasks, while daughters-in-law helped their husbands run the farm. An alternative argument would be that daughters-in-law who were relatively young women in their fertile years devoted more time to bearing and taking care of children—activities that did not help the household spread the risk inherent in farm production.

As for daughters, we argued that a priori their effect on household risk aversion and contract choice is ambiguous. If daughters (and young female dependents) contributed to the family income by working in non-agricultural activities, they would decrease household risk aversion and increase the likelihood of a fixed-rent contract. However, if dowry funding was a major issue, the presence of daughters would increase household risk aversion and

would therefore decrease the probability of a fixed-rent contract. The positive (though not statistically significant) coefficient on "percent of daughters" seems to indicate that dowry funding was not the major issue for rural households that it was for urban households in Florence. This is consistent with other evidence based on dowry contracts: the median dowry in the city of Florence amounted to 200 gold florins while in the Florentine countryside the median dowry was 35 florins (Botticini 1999). Dowries were a burden for parents, but it is clear that the problem in the countryside was less severe than in the city.

## 5.1 The Endogeneity Issue

The regressions above do not take into account a possible endogeneity problem. If landlords and tenants do not match randomly but match endogenously (i.e. a tenant with more female dependents matches with a landlord who owns land plots with cereals), and household structure is not a perfect proxy for tenant risk aversion, the coefficients on both cropmix and percent of dependents can be biased.<sup>17</sup> For Pescia and San Gimignano, the endogeneity problem exists: a regression of cropmix on percent of female dependents indicates that tenant households with more female dependents were more likely to end up matching with land plots in which annual crops (i. e. cereals) were grown (the coefficient is -0.59 with a standard error of 0.09). A possible explanation is that vines were very labor intensive crops, which required male agricultural workers who knew how to prune and take care of these plants. The endogeneity is not a problem for Florence.

A possible solution to the endogeneity problem is to instrument using cross-region differences in the matching equation. Significant cross-region differences can provide instruments for the cropmix variable. Table 5 contains IV estimates. The first stage regression indicates that the instrument (percent of female dependents interacted with the residence dummy) performs well, being significant at the 10 percent level. The second stage regression shows that when controlling for endogeneity, the main findings still hold: the percent of female dependents has a positive effect on the likelihood of a fixed-rent contract and is statistically significant in both the probit regression, which controls for landlord random effects, and in the conditional

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<sup>17</sup>See Akerberg and Botticini (1999) for a discussion of this endogeneity problem and possible solutions.

logit regression, which controls for landlord fixed-effects.

## 6 Concluding Remarks

The parameters of all arrangements between individuals are spelled out in either formal or informal contracts. A number of factors influence a contract's structure and design. We identify household structure as an important factor. Household structure may affect risk aversion, which in turn can influence the type of contract chosen. In the case of agricultural contracts this would include: fixed, share, and wage. Because of the data set used, we focused on the first two options.

Using a detailed data set from early fifteenth century Florence, we find strong evidence that, controlling for other factors, the presence of an additional adult female dependent in the household made it more likely that the tenant chose a fixed-rent contract. We argue this is because the majority of these women worked in jobs that were uncorrelated with agricultural risk factors (such as weaving for an urban wool merchant). This allowed the tenant to choose the more risky, and potentially higher payoff, option of a fixed-rent contract in which he was the residual claimant of the output. The addition of daughters-in-law made it more likely that a share contract was chosen, perhaps because these women were either helping their husbands work on the farm by tending the animals or they were engaging in household activities such as caring for their own young children; neither of which substantially reduced household output risk. Finally, the addition of daughters to these peasant families has a theoretically ambiguous sign because as young women they may be working outside of the household (and thus make the farmer likely to choose a fixed contract), but the father also needed to build dowries for these daughters and so could ill afford lean years (and thus made the farmer likely to choose a share contract). Empirically we find that the addition of daughters made farmers more likely to choose a fixed-rent contract suggesting that since rural dowries were much lower in value compared to urban dowries, the burden scarcely affected a farmer's contractual decisions.

Our findings suggest that family structure had an important effect on the type of agricultural contract chosen in Renaissance Florence. However, there are clear parallel lessons that can be learned for today. It may be argued that household structure and intergenerational links also affect contract choice in contemporary developing countries in which formal insurance markets are

missing or are imperfect. Moreover, in developed countries, it could be the case that in families where two or more family members work, family structure could very well determine "job choice." For instance, in cases where one spouse is engaged in low risk employment (for example a tenured academic job, or an otherwise low-turnover job), the other spouse may be more likely to accept a job in a higher risk (and potentially higher payoff) sector.

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TABLE 1  
SUMMARY STATISTICS: PESCIA AND SAN GIMIGNANO

Variables	Mean	Standard Deviation
Share contracts	0.61	—
Fixed-rent contracts	0.39	—
Farms with only perennial crops (e. g. vines)	0.18	—
Farms with only annual crops (e.g. cereals)	0.42	—
Farms with both crops	0.40	—
Landlord occupation (= 1 if nonag. occupation)	0.67	—
Landlord: Male dependents	0.81	0.96
Landlord: Female dependents	1.19	0.88
Tenant land ownership (=1 if owns land)	0.65	—
Tenant owns livestock (=1 if yes)	0.34	—
Tenant: All male dependents <sup>a</sup>	1.05	1.06
Tenant: All female dependents <sup>b</sup>	1.29	0.85
Tenant: Household size <sup>c</sup>	4.34	1.61
Residence and location (=1 if San Gimignano) <sup>d</sup>	0.57	—
<i>N</i>	652	

*Sources:* ASF, Catasto 213, 214, 215, 216, 233, 234, 235, 236, 252, 253, 254, 235, 258, 266, and 269.

<sup>a</sup> Includes sons, brothers, grandfathers, and uncles.

<sup>b</sup> Includes the wife of the household head, daughters, sisters, grandmothers, and aunts.

<sup>c</sup> We added the household head and his wife to the mean number of “all men” and “all women”.

<sup>d</sup> The land plot location indicates the residence of the landlord (Pescia or San Gimignano), the residence of the tenant and the location of the land plot (the countryside of Pescia or the countryside of San Gimignano).

TABLE 2  
SUMMARY STATISTICS: FLORENCE

Variables	Mean	Std. Deviation
Share contracts	0.72	—
Fixed-rent contracts	0.28	—
Farms with only perennial crops (e. g. vines)	0.08	—
Farms with only annual crops (e.g. cereals)	0.37	—
Farms with both crops	0.55	—
Landlord occupation (= 1 if nonagricultural occupation)	0.60	—
Landlord: Male dependents	1.42	0.98
Landlord: Female dependents	1.30	0.79
Tenant land ownership (=1 if owns land)	0.63	—
Tenant's age	54.06	15.15
Tenant: Sons	1.53	1.40
Tenant: Male dependents	0.84	1.68
Tenant: Daughters <sup>a</sup>	0.70	0.95
Tenant: Female dependents (dau-in-law + adult fems.)	1.08	1.61
Tenant: All men (sons + male dependents)	2.38	2.25
Tenant: All women (daughters + female dependents)	1.78	1.74
Tenant: Household size (men + women) <sup>b</sup>	6.08	3.56
<i>N</i>	513	

*Sources:* State Archives of Florence (henceforth ASF), Catasto 64, 67, 68, 72, 75, 76, 77, 78, 79, 80, 81.

<sup>a</sup> Includes daughters of all ages.

<sup>b</sup> We added the household head and his wife (who was present in roughly 90 percent of the observations) to the mean number of “all men” and “all women” (4.16). Median, as well as the modal, household size was 5.

TABLE 3  
 PROBIT AND CONDITIONAL LOGIT ESTIMATES  
 (PESCIA AND SAN GIMIGNANO)

Dependent Variable: Contract Choice (1 = fixed rent)	Probit			Conditional Logit	
	Coeff.	Standard Error <sup>a</sup>	Marginal Effect <sup>b</sup>	Coeff.	Standard Error
Crop mix (0=cereals, 1=mix, 2= vines)	-1.64	0.20	-0.45	-3.04	0.41
Landlord occupation (= 1 if nonagric)	-0.30	0.26	-0.09	—	—
Landlord # of male dependents	0.10	0.11	0.03	—	—
Landlord # of female dependents	-0.27	0.15	-0.07	—	—
Tenant owns land (= 1 if yes)	0.36	0.26	0.09	0.92	0.85
Tenant household size	0.20	0.07	0.05	0.21	0.27
Tenant percent of female dependents	1.68	0.56	0.46	3.01	1.18
LL provides livestock to TT (=1 if yes)	-1.59	0.46	-0.30	-2.40	2.14
Residence (= 1 if in San Gimignano)	-1.45	0.29	-0.37	—	—
Constant	0.12	0.62	—	—	—
Pseudo R <sup>2</sup>		0.73		0.76	
Log		-113.92		-34.47	
<i>N</i>		627		354	

*Sources:* See Table 1.

<sup>a</sup> Standard errors are Huber-White standard errors and include a correction for observations which are not independent within cluster (those observations on landlord's characteristics, which are repeated across different tenants).

<sup>b</sup> Marginal effects (dP/dX) are evaluated at the sample mean.

TABLE 4  
 PROBIT AND CONDITIONAL LOGIT ESTIMATES  
 (FLORENCE)

Dependent Variable: Contract Choice (1 = fixed rent)	Probit			Conditional Logit	
	Coeff.	Standard Error <sup>a</sup>	Marginal Effect <sup>b</sup>	Coeff.	Standard Error
Crop mix (0=cereals, 1= mix, 2= vines)	-1.43	0.23	-0.40	-2.63	0.32
Landlord occupation (= 1 if nonagric)	0.45	0.31	0.12	—	—
Landlord: # of male dependents	-0.13	0.15	-0.04	—	—
Landlord: # of female dependents	0.13	0.15	0.04	—	—
Tenant owns land (= 1 if yes)	0.79	0.21	0.20	1.16	0.35
Tenant age	-0.01	0.02	-0.004	-0.01	0.07
Tenant age <sup>2</sup>	0.00	0.00	0.00	0.00	0.00
Tenant: Percent of adult female dep.	0.37	0.19	0.11	0.66	0.49
Tenant: Percent of daughters	0.17	0.15	0.05	0.13	0.50
Tenant: Percent of daughters-in-law	-0.29	0.36	-0.08	-0.47	0.80
Tenant household size	-0.05	0.01	-0.01	-0.08	0.04
Constant	-0.50	0.63	—	—	—
Pseudo R <sup>2</sup>		0.34		0.33	
Log		-200.74		-120.92	
N		513		414	

*Sources:* See Table 2.

<sup>a</sup>Standard errors are Huber-White standard errors and include a correction for observations which are not independent within cluster (those observations on landlord's characteristics, which are repeated across different tenants).

<sup>b</sup> Marginal effects (dP/dX) are evaluated at the sample mean.

TABLE 5  
IV ESTIMATES  
(PESCIA AND SAN GIMIGNANO)

	First Stage Random Effects Linear Probability Model (Dependent Variable: Cropmix)		Second Stage Probit (Dependent Variable: Contract Choice, 1=fixed rent)			Second Stage Conditional Logit (Dependent Variable: Contract Choice, 1=fixed rent)	
	Coeff.	Standard Error	Coeff.	Standard Error	Marginal Effect	Coeff.	Standard Error
Cropmix	—	—	-4.10	3.38	-1.09	-4.62	10.06
Landlord occupation	-0.21	0.07	-0.84	0.72	-0.26	—	—
Landlord: Male dependents	0.05	0.03	0.22	0.20	0.06	—	—
Landlord: Female dependents	-0.10	0.04	-0.52	0.36	-0.14	—	—
Tenant owns land	-0.17	0.07	-0.06	0.63	-0.02	0.63	2.04
Tenant: % female dependents	—	—	1.59	0.62	0.42	2.92	1.30
Tenant household size	-0.04	0.02	0.11	0.14	0.03	0.16	0.44
LL provides livestock to TT	0.01	0.09	-1.52	0.47	-0.28	-2.39	2.19
Residence (=1 if San Gimign.)	0.45	0.12	-0.83	0.89	-0.21	—	—
Residence*Tenant %female dep	-0.25	0.14	—	—	—	—	—
Constant	1.87	0.12	2.77	3.80	—	—	—
Chi2 (8)	66.84		—			—	
Log L	—		-113.64			-34.46	
N	627		627			354	

Sources: See Table 1.

Notes. Marginal effects (dP/dX) are estimated at the sample means.