Economic Institutions in Developing Countries

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ECONOMIC INSTITUTIONS IN DEVELOPING COUNTRIES

a thesis

by

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This thesis is a collection of three essays, each of which analyses an economic institution in one or more developing countries. A careful analysis of institutions is crucial for the understanding of economic performance and for the design of effective policy measures. In the first essay, "On the Structure of Tenancy Contracts" I analyse the effect of crop and tenant characteristics on the form and on the length of tenancy contracts. Using a principal-agent model I show that high-powered incentives are used when, due to the characteristics of the crop, their benefit is high and/or when, due to the characteristics of the tenant, their cost is low. The theoretical predictions are consistent with the empirical evidence from a unique data set of 705 contracts. The purpose of the second essay, "Competing for Protection: Land Fragmentation and the Rise of Mafia in 19th Century Sicily", is to identify the conditions that fostered the development of the mafia. I argue that in the context of 19th century Sicily, land fragmentation was crucial for the rise of mafia. Using a menu-auction model I show that, by inducing landlords' competition for protection, land fragmentation increases the profits of mafia groups even if the assets in need of protection are unchanged. I show that the predictions of the theory are consistent with the available empirical evidence from a sample of 70 Sicilian villages. In the third essay, "Does Financial Reform Raise or Reduce Savings?", we analyse the effect of financial liberalisation on private savings in eight developing countries. To this purpose we construct an index which summarises the reform process and estimate an error correction model for savings. We find that the effect of financial reform on savings is ambiguous.
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1. Introduction

In a world with asymmetric information contracts matter: when the principal cannot observe the level of inputs chosen by the agent, contractual structure determines input choices and ultimately productivity.

This paper analyses tenancy contracts in a rural economy with asymmetric information. The paper stresses the role of crop characteristics as determinants of the structure of tenancy contracts and it focuses on a neglected but important dimension of contractual structure: the choice between short and long-term contracts. The theory is motivated, illustrated, and tested in the context of Sicilian agriculture in the late 19th century, which is interesting in its own right and because of its similarity to modern developing economies. The theory is tested with a unique data-set on tenancy contracts that I have compiled by coding 705 contracts signed between 1870 and 1880 in the province of Syracuse, Sicily.

The structure of the contract is determined within a two period principal-agent model with limited liability in which output depends on the level of unobservable effort devoted to two tasks: current production and maintenance. Effort lowers the utility of the tenant, regardless of the task. In addition, maintenance effort entails a fixed cost that represents the cost of material inputs necessary for maintenance. Since production effort affects current output while maintenance effort affects output in the future, production effort and maintenance effort require different

1 Original copies of tenancy contracts can be found at the State and at the Notary Archives in all major Italian cities.
incentive mechanisms. To provide incentives for current effort the landlord has to condition current pay on current output. To provide incentives for maintenance the landlord has to offer a long term contract so that the tenant's pay can be conditioned on future output, which is the only signal for maintenance effort. The limited liability constraint makes incentive provision costly because it imposes an upper bound on the punishment that can be inflicted on the tenant. Since the limited liability constraint is more likely to bind for poor tenants, incentive provision is costlier for poor tenants. In this setting, I show that long-term contracts are preferred to short-term contracts when, due to the characteristics of the crop, the benefit of maintenance is high or when, due to the personal characteristics of the tenant, the cost of providing incentives for maintenance is low. Since when the crop is not very sensitive to maintenance and the tenant is poor the benefits of maintenance do not cover the cost of giving incentives for it, the landlord will use long-term contracts only when the crop is very sensitive to maintenance and/or when the tenant is rich and/or when his outside opportunity is high. A similar argument shows that sharecropping contracts are preferred to fixed rent contracts when the marginal product of effort is high, when the tenant is poor, and when his outside opportunity is low.

The empirical results are consistent with the predictions of the theory: the probability of observing a long-term contract is higher if the tenant is wealthy and/or his outside opportunity is high, and if crops with high maintenance needs like vines are grown in the rented plot. The probability of observing a fixed rent contract is higher if the tenant is wealthy and/or his outside opportunity is high, and if crops that are not very sensitive to effort like wheat are grown in the rented plot.

This paper offers a novel contribution to both the theoretical and the empirical literature on the structure of tenancy contracts. The theoretical literature has so far neglected the analysis of
maintenance incentives and crop characteristics\(^2\). A notable exception is Botticini(1997) who explores contractual choices in 15th century Tuscany in the framework of the static multi-task principal-agent model of Holmstrom\&Milgrom (1994). In her model, the tenant allocates effort across different tasks which include current production and maintenance. Since the value added of maintenance cannot be measured, the landlord can only provide indirect incentives for maintenance by offering a sharecropping contract. This decreases incentives for current production and, as a consequence, increases incentives for maintenance\(^3\). Allen\&Lueck (1996) present a one-period model in which the tenant can exploit the soil to increase current production. Sharecropping contracts indirectly reduce the incentive to exploit the soil by reducing the incentive to maximise current output.

The use of a two-period model, as the one in this paper, leads to radically different conclusions regarding the rationale of sharecropping. With two periods, the landlord can elicit maintenance effort directly, by offering a long-term contract. In this context, sharecropping actually reduces maintenance incentives, since under sharecropping the tenant receives only a share of future output.

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\(^2\) Rural tenancy contracts and in particular the existence of sharecropping and its coexistence with other forms have received great attention by economists and economic historians. Sharecropping contracts have been used in many regions of the world for quite a long time. Bloch (1970) and Hoffman (1984) analyse sharecropping and other tenurial forms in early modern France. Botticini (1998), Emigh (1997), Epstein (1994) and Galassi, Meally and Pudney (1998) research similar issues in 15th century Tuscany. Alston and Higgs (1982) and Higgs (1974) analyse contractual choice in the Southern United States at the end 19th century. Bliss and Stern (1982) Barhdan (1984) and Shaban (1987) among others study tenancy agreements in contemporary India. Most theory papers examine principal-agent models with one non contractible input; that is, current production effort. Some of these papers employ one-period models to explain the existence of sharecropping and its consequences on agricultural productivity. Others analyse similar issues using multi-period models and focus on the use of eviction threats as an incentive mechanism. In this setting, the results depend only on the fact that the relationship between the tenant and the landlord is repeated over time: long-term agreements are feasible but unnecessary. In contrast, this paper analyses a situation in which a sequence of short-term contracts cannot replicate the outcome of a long-term contract: long-term contracts are necessary because they provide incentives for maintenance. See Singh(1989) and Dutta, Ray\&Sengupta (1989) for excellent surveys.

\(^3\) This argument rests on the assumption that the tenant exerts a positive amount of effort across tasks without incentive pay. Then reducing effort incentives for one task increases incentives for the other tasks. See Holmstrom\&Milgrom(1991) for a discussion.
Bardhan (1984 ch8) analyses the choice between long-term and short-term contracts in a two-period model with non-contractible investment. In his model long-term contracts are costly because by committing to a long-term contract the landlord forgoes the opportunity to elicit effort for current production with eviction threats. The trade-off between giving incentives for non-contractible investment and eliciting effort for current production determines the length of the optimal contract. Since the results depend crucially on the length of the time horizon, eviction threats are best understood in an infinite horizon context while finite horizon models can yield misleading results. In Bhardan's model eviction threats actually give incentives for maintenance if the horizon is longer than two periods because maintenance increases output in the second period, hence the probability that the tenant will keep the job in the third period and so on. In my paper maintenance incentives are costly because the tenant is subject to a limited liability constraint which generates information rents hence the results do not depend on the length of the horizon.


This paper introduces a new data-set and presents some new evidence on the determinants of tenancy contracts, particularly on the effect of crop characteristics on the choice between short- and long-term agreements.
2. The Context: Facts About Sicilian Agriculture

In 1881 and in 1911 the Italian Parliament published two extensive surveys that analysed the conditions of the agricultural sector in different regions of the country. The surveys describe Sicilian agriculture in great detail and contain information on the cultivation methods of the main crops, which is particularly relevant for the present work. The surveys also contain information on tenancy contracts and provide some preliminary evidence in favour of a relationship between crop characteristics and contractual structure.

Until the beginning of this century Sicily was essentially a rural economy; agriculture employed more than 50% of the population and was the basis for industry and commerce. Land was the most important factor of production and its ownership was unevenly distributed. Land in the inner part of the island was concentrated in large properties—latifondi—whose typical extension ranged between 200 and 1000 hectares. Latifondi occupied about 30% of the arable land but accounted for only 16% of total agricultural income. Land along the coast and around the villages in the interior was fragmented in properties as small as 1ha.

Formal credit markets were underdeveloped and accessible only to wealthy landowners since lenders required strong guarantees. Farmers relied on informal lenders and on their landlords for working capital loans; there is also evidence that the landlords sometimes gave out loans after a bad harvest. Rates in the informal markets ranged from 50 to 100%.

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4 The first is the "Inchiesta Jacini: Atti della Giunta per l'inchiesta agraria e sulle condizioni della classe agricola 1881" vol XII, parte I e II, tomo 1-5-rapporto di Abele Damiani per la Sicilia (literally Jacini Inquiry: report by the committee for the study of rural practices and the conditions of the rural classes). The second is Inchiesta Parlamentare sulle Condizioni dei Contadini nelle Provincie Meridionali e della Sicilia"- vol IV tomo I e II- relazione del delegato tecnico per la Sicilia Prof. Lorenzoni- 1909-1911(literally "Parliamentary Inquiry on the Conditions of Farmers in the Southern Provinces and in Sicily"-vol. VI books I and II-report of the agent for Sicily-Prof. Lorenzoni).

5 The pattern of land distribution derived from the feudal system, which was abolished in 1812. Land reforms did not succeed in dividing the feuds evenly. As described above, land was either too concentrated or too fragmented.
Wheat was the most widespread crop, followed by vines, olive trees, and citrus trees. In the province of Syracuse, wheat occupied 73% of the arable land, vines 14%, olive trees 5%, and citrus trees 1.6%.

Wheat was generally cultivated in the latifondi, using primitive techniques. Three year rotation was the most common system: the field produced wheat the first year, was left to pasture the second year and to fallow the third year (sometimes broad beans or barley were grown during the third year). In September the land was tilled. Then the seeds were planted and the soil was tilled again. In July the plants were harvested. There were no agricultural machines, no irrigation and no land manuring. Damiani (1881) reports that this method of cultivation exploited the soil and reduced its productivity. Modern ploughs and, above all, fertilizers were needed to restore the productivity of the soil and increase wheat yields. Depending on the fertility of the soil, wheat yielded a net revenue ranging from L.50 to L.150\(^\text{6}\) per hectare in the province of Syracuse.

Olive trees were usually grown in wheat fields, sometimes in olive yards. To give good yields, olive trees needed regular pruning, careful harvesting, tilling and fertilization of the soil around them. In general olive trees were not well tended: the soil was not fertilised, maintenance was unsatisfactory, pruning was careless and irregular. Nevertheless, because of favorable soil and climate conditions and because of their resistance, olive trees survived and produced high yields. Owner-cultivators, as opposed to tenants, tended their trees better and consequently obtained higher yields and higher quality olives\(^\text{7}\).

Vines were grown in the coastal areas and around villages in the interior. The characteristics of the soil and the temperate weather were ideal for vineyards up to 1200m.

\(^{6}\) Italian Liras in 1881. The average annual wage for permanent workers was about L.400. The average daily wage for casual labourers was about L.1.35; that is L270 per year, assuming 200 working days.

\(^{7}\) For instance, owner-cultivators used an harvesting system called "a pettine" which entailed reaping the fruits from the tree with a instrument shaped like a comb. Tenants generally adopted a system called "abbacchiatura" which consisted in shaking the trees until all the olives fell. Beside damaging part of the
Vineyards required considerable care. The soil around the plants had to be hoed four times a year and fertilized. The plants had to be pruned every year and they needed regular and precise application of pesticides to prevent pest attacks which could be devastating. Net revenues could be as high as L.800 per hectare and were rarely lower than L.300.

Citrus were grown in the coastal regions. Citrus trees were quite delicate and required more working capital than vineyards. The soil in citrus groves had to be irrigated, fertilized and hoed 4 or 5 times per year. The trees needed pesticides and daily inspections. Citrus trees were especially sensitive to irrigation procedures and pesticide usage. Excessive irrigation and/or bad irrigation timing were known to cause the “mal della gomma”, a contagious illness which would make the trees rotten. Citrus groves were very remunerative; with net revenues ranging between L. 500 and L.1300 per hectare.

Tenancy agreements were more common for wheat than for other crops. In general landlords contracted out their wheat fields. If the field contained olive, almond or fruit trees, these were often excluded from the contract. The landlord would either cultivate the trees directly or rent them to a different farmer under a different contract. Landlords rarely rented out vineyards and citrus groves because “the tenant would not take proper care of the plants since they are not his own” (Quoted from Lorenzoni (1910)).

Fixed-rent and sharecropping\(^8\) were the most common forms of tenancy contracts. Wage contracts were employed only for specific tasks: permanent laborers were often hired to guard vineyards and citrus groves, casual laborers to help during the harvest season. Most contracts for tree crops contained special clauses to regulate pruning. “Pruning experts” were hired either to do

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\(^8\) The usual share for the tenant was one half. The existing law ruled that output had to be divided 50-50 unless established local customs prescribed a different split. See Codice Civile per il Regno d'Italia (1865) art.1654
the job themselves or to supervise the tenant. Since the tenant would have had the incentive to over-prune in order to get fuel for the winter, in general the landlord would keep the pruned wood.

Contract length varied across crops. Contracts for wheat and olives could last up to 6 years but most of them were 1 to 2 years long. Contracts for vines and citrus were normally 4 to 6 years long but lasted 29 years if the vineyard had to be created. Contract length was related to the form of the agreement: most sharecropping contracts were one year long.

The above description of cultivation methods shows that the crops had different characteristics in terms of sensitivity to both production and maintenance effort. Wheat and to a lesser extent olive trees were less responsive and resisted well to mistreatment. Vines and citrus trees were more responsive and could not be profitably grown without considerable care.

The description of tenancy contracts, meanwhile, suggests that crop characteristics were an important determinant of the structure of tenancy contracts. That the cultivation of different crops planted in the same field was often regulated by separate contracts supports this view. In particular, there seems to have been a positive relationship between the length of the contract and the maintenance needs of the crop.

Finally, the discussion suggests that providing incentives for maintenance had to be costly. For instance, if more maintenance were devoted to the soil and the trees the yields of both wheat and olive trees would have been higher, yet the cultivation method was sub-optimal especially when the crops were farmed by a tenant.

9 These were called "contratti di miglioria". The tenant had to prepare the soil and plant the vines. No rent was due until the productive life of the plants had started and after that the entire product went to the farmer for at least the first three years. At the end of the arrangement the vineyard belonged to the landlord.
3. A simple model of contract choice.

This section develops a simple model to analyse the structure of optimal tenancy contracts in the presence of asymmetric information and capital market imperfections. The model yields testable predictions regarding the length of the optimal contract and the crop share received by the tenant as a function of crop characteristics and of the personal characteristics of tenant.

3.1 Set up: Production

Production takes place in two periods and is subject to uncertainty. In each period the state of the world can be good or bad; output, net of material inputs cost, is equal to 1 and 0 in the good and in the bad state, respectively.

The tenant's job consists of different tasks which can be grouped into two categories: tasks related to current production and tasks related to soil and plant maintenance. The tenant chooses the level of "production effort" and the level of "maintenance effort". Effort choices are unobservable and, due to the nature of the tasks, cannot be monitored\(^{10}\).

Production effort in each period increases the probability of the good state in that period. Maintenance effort operates with a lag: it increases the probability of the good state next period. Only maintenance tasks, such as the usage of pesticides and fertilizers and the daily care of the plants, whose effect on second period output cannot be distinguished from the effect of second period production effort will be considered. Tasks like pruning and weeding whose outcome is clearly identifiable by a third party can be contracted upon separately.

\(^{10}\) I assume for convenience that there is no monitoring technology. In reality, monitoring is likely to exist but to be unprofitable. Indeed, if the landowner hires another agent to monitor the farmer the two can collude against the landowner. The relevant issue is whether it is convenient for the landowner to supervise labor himself thus becoming actively engaged in the production process. The decision between self-cultivation and delegation is taken at an earlier stage and its analysis goes beyond the scope of this model.
The probability functions are linear in effort, therefore output in the two periods is:

\[
Y_1 = \begin{cases} 
1 & \text{with prob. } he_1 \\
0 & \text{with prob. } 1 - he_1
\end{cases}
\]

\[
Y_2 = \begin{cases} 
1 & \text{with prob. } he_2 + \theta m \\
0 & \text{with prob. } 1 - he_2 - \theta m
\end{cases}
\]

where

\[e_i = \text{production effort in period } i, \ e_i \in (0, 1)\]

\[m = \text{maintenance effort, } m \in (0, 1)\]

\[h = \text{marginal productivity of production effort, } h \in (0, h^*), \ h^* < 1\]

\[\theta = \text{marginal productivity of maintenance effort, relative to production effort. } \theta \in (\theta^*, \theta^{**}) \text{ with } \theta^* = \left(\frac{2c}{h^*}\right)^{1/2} \text{ and } \theta^{**} < \min\{1, \ (1/h^* - 1)\}\]

Maintenance effort entails a fixed cost \(c\) which represents the cost of material inputs like fertilizers and pesticides that are necessary for maintenance\(^{11}\). The cost of material inputs does not depend on the level of maintenance effort; for instance, the cost of pesticides is unrelated to how carefully these are employed. The fixed cost also reflects the fact that by choosing \(m > 0\) the tenant forgoes the opportunity of increasing output in the first period by overexploiting the soil and the plants. The lower bound on \(\theta\) implies that maintenance is always profitable in a first best sense.

3.2 Set up: Payoffs and Constraints

\(^{11}\) In 19th century rural Sicily, pesticides and fertilisers accounted for a substantial share of total costs. Damiani (1881) reports that in the province of Syracuse production costs for wheat, excluding fertilisers, ranged between L.50 and L.150 per hectare while fertilisers costed between L.30 and L.60 per hectare.
The landlord offers the tenant a contract \((s_i, r_i, l)\) where \(l = 1, 2\) is the duration of the agreement, \(s_i \in [0, 1]\) is the share of output received by the tenant and \(r_i\) is the rent the tenant pays to the landlord\(^{12}\) in period \(i\). If \(l = 1\) the relationship between the landlord and the tenant terminates after one period. If \(l = 2\) their agreement lasts 2 periods and the landlord can commit to the terms of the contract at the beginning of the first period\(^{13}\).

Assuming risk neutrality the utility of the landlord is

\[
U_l = (1-s_1)e_1h + (1-s_2)(e_2+ \theta m)h + r_1 + r_2
\]

Both production and maintenance effort lower the utility of the tenant; assuming risk neutrality\(^{14}\) and quadratic disutility of effort, the utility of the tenant is

\[
U_t = \left\{ (1-s_1)e_1h - \frac{1}{2}e_1^2 - \frac{1}{2}m^2 - \delta(m)c + s_2(e_2 + \theta m)h - \frac{1}{2}e_2^2 - r_1 - r_2 \right\}
\]

where \(\delta(m) = 1\) if \(m > 0\) and \(\delta(m) = 0\) if \(m = 0\).

Maximizing \(U_t\) with respect to \((e_1, e_2, m)\) yields the incentive compatibility constraints (IC).

Note that if the tenant is offered a short term contract he will choose \(m = 0\), since he would incur the costs but not reap the benefits of maintenance. In this framework, long term contracts are strictly necessary to provide incentives for maintenance effort, but in some cases they are not

---

\(^{12}\) The restriction to linear contracts is without loss of generality, since with two states of the world all contracts can be rewritten as linear contracts.

\(^{13}\) This assumption receives mixed support in the existing literature. On the one hand, it can be argued that there is a problem of dynamic inconsistency since once the tenant has invested in maintenance, the landlord is better off by evicting him and retaining the benefit of his investment. On the other, reputation effects can help the landlord "tie his hands" thus making his commitment credible. Moreover, the existence of courts within a well established legal framework obviously enhances the credibility of the commitment, especially if the contracts are written. I believe that the assumption is a sensible one in the case of rural Sicily, both because the reputation effects were likely to be strong (close-knit villages) and because of the existing law enforcement system.

\(^{14}\) Many explanations of sharecropping rely on the fact that the tenant is more risk adverse than the landlord because he is poorer therefore what matters for the results is the wealth difference between the two parties. In this paper I assume that both agents are risk neutral for simplicity and account for difference in wealth.
sufficient. Indeed if \(s_2\) is small the tenant will choose \(m=0\) even with a long term contract. Note that because the effect of maintenance effort on second period output cannot be differentiated from the effect of production effort the choice of \(m\) and of \(e_2\) are both driven by the same instrument - the output share in period 2.

Due to imperfections in the capital market, the tenant is subject to a limited liability constraint which ensures that in any period and in any state the tenant is left with enough resources to survive. To satisfy the limited liability constraint the equilibrium rent must be smaller than the tenant's residual wealth, that is the amount of liquid assets he owns after paying for input costs and subsistence consumption. The limited liability constraint imposes an upper bound to the penalty the landowner can inflict on the tenant. Furthermore, the limited liability constraint guarantees that the contract is renegotiation-proof. If it was not met the parties would have to renegotiate in the bad state because the tenant could not afford to pay the rent. It is implicitly assumed that, in case of renegotiation, the landlord can correctly measure and expropriate the tenant's wealth, which is realistic in the institutional setting under consideration.

Finally, the optimal long-term contract must satisfy a "no take the money and run" (MR) constraint which guarantees that the contract is subgame perfect for the tenant; that is, when (MR) is satisfied the tenant prefers to stay in the relationship for two periods, rather than to accept a two period contract, stay one period and then leave. Since maintenance benefits accrue in the second period whereas the costs are incurred in the first, the landlord might want to give a loan to poor tenants who could not otherwise afford to pay the cost. A loan is equivalent to charge a low rent in the first period and a high rent in the second. This, however, could give the tenant the incentive to stay for the first period, pay the low rent and leave in the second period without supplying maintenance effort. The "no take the money and run" constraint, which guarantees that the second
period is attractive for the tenant, is needed to rule out this possibility. Sicilian landlords realised that loans could push the tenant to take the money and run; indeed: “the owner carefully limits the size of the loans because there is the danger that the tenant leave the field(...) the owner has to make sure that the tenant prefers to stay and get his share of output” (quoted from Lorenzoni (1911)). (MR) reflects the fact that the contract is effectively binding only for the landlord, mostly because the tenant can leave the relationship without being punished\textsuperscript{15}

\textbf{3.3 Optimal short-term and long-term contracts.}

It is convenient to solve for the optimal short term and long term contract separately. The comparison of the landlord's payoffs in the two cases will determine the optimal length\textsuperscript{16}.

The optimal short term contract $(s,r)$ solves

$$\max \{sh^2(1-s) + r\}$$

\text{s.t.} \quad \frac{1}{2}sh^2 - u \geq 0 \quad \text{(PC)}$$

$$w - r \geq S \quad \text{(LL)}$$

where $u$ is the tenant's reservation utility, $w$ is the tenant's initial wealth in both periods and $S$ is his subsistence level of consumption, which is assumed equal to zero.

The objective function is obtained by plugging (IC) into the landlord's payoff function.

(\text{PC}) is a standard participation constraint. It requires that the contract provides the tenant with utility level at least as high as his reservation utility. (LL) is the limited liability constraint.

\textsuperscript{15} One could argue that the landlord can sue the tenant for breach of contract and recover the money he lost plus a fine. Because of limited liability, however, it would not be worthwhile for a landlord to take a poor tenant to court. And the MR constraint is not binding for wealthy tenants.

\textsuperscript{16} This model analyses contract length only as a device to give incentives for maintenance effort. It does not deal with other issues related to the duration of the relationship between the landlord and the tenant. Landlord's strategies that involve conditioning the terms of the current contract on past performance and those that involve eviction threats are ruled out. The first were not used in practice. The second should be analysed in an infinite horizon context.
The optimal spot contract is the same in every period since all the relevant parameters are assumed invariant through time.

The solution to the maximization problem is algebraically cumbersome. Lemmas 1 and 2 state the properties of the optimal short-term contract with respect to the technological characteristics of the crop $h$ and $\theta$ and to the personal characteristics of the tenant, summarized by the variable $W = w + u$.

**Lemma 1.** There exist $W^*$ and $W^{**}$ such that:

(i) for $W \geq W^{**}$ the tenant's share is equal to one, i.e. fixed rent contracts are chosen (only PC binds)

(ii) for $W^{**} > W \geq W^*$ the tenant receives a share of the output that is increasing in wealth and earns no information rent (PC and LL bind)

(iii) for $W < W^*$ the tenant receives a constant share of the output and earns more than his reservation utility (PC does not bind).

**Lemma 2.** $W^{**}$ is increasing in $h$; that is, the higher the marginal product of effort the more likely the limited liability is to bind. $W^*$ too is increasing in $h$, that is, if the crop exhibits high marginal product of effort the tenant is more likely to earn information rents.

The intuition for Lemma 1 is as follows: if the tenant is "rich" or his outside opportunity is very high, the landlord can offer him a fixed rent contract that induces the maximum level of effort and therefore maximizes the rent that satisfies the participation constraint. But if the tenant's wealth is lower than the rent defined above, the contract is infeasible since it does not satisfy the limited liability constraint. In the constrained optimum consistent with the limited liability constraint, the landlord charges the highest possible rent (i.e. $w$) and lowers the share so
that the participation constraint binds. Finally, if the tenant is extremely poor the landlord will prefer to pay some information rents (PC does not bind) in order to induce effort. Intuitively, it is not optimal to push the tenant down to his reservation level because doing so would result in a very low level of effort, lower for poorer tenants: the landlord is better off by giving the tenant a little extra in terms of utility in order to get a higher level of effort.

Lemma 2 is easy to understand in the light of the above discussion. An increase in $h$ increases the first best level of rent and thus alters the borders of the three regions in the solution space.

The optimal long term contract that provides incentives for maintenance is the quadruplet $(s_1, s_2, r_1, r_2)$ that solves

\[
\max \{ s_1 h^2 (1-s_1) + s_2 h^2 (1-s_2)(1+\theta) + r_1 + r_2 \}
\]

s.t.

\[
\frac{1}{2} s_1^2 h^2 (1+\theta) - r_1 - r_2 - c - 2u \geq 0 \quad \text{(PC)}
\]

\[
\frac{1}{2} s_2^2 h^2 (1+\theta) - r_2 - c - u \geq 0 \quad \text{(MR)}
\]

\[
s_1^2 h^2 \theta /2 \geq c \quad \text{(IC)}
\]

\[
w - r_1 - c \geq S \quad \text{(LL_1)}
\]

\[
w - r_2 \geq S \quad \text{(LL_2)}
\]

(PC) is the participation constraint. It requires that the contract provides the tenant with utility level at least as high as his reservation utility over the two periods; (MR) is the "no take the money and run" constraint; (IC) is the incentive compatibility constraint. It is needed to guarantee that the tenant will choose $m>0$. (IC) implies that the share of maintenance benefits received by the tenant is high enough to make $m>0$ profitable. Note that (IC) is more likely to bind when $\theta$ is low relative to $c$, i.e. when maintenance is not very profitable. (LL_1) and (LL_2) are the limited liability constraints.
The solution for the optimal long term contract has the same structure with respect to $W$ and $h$, but it is complicated by the presence of the (MR) and the (IC) constraints, and depends on the magnitude of $\theta$. Figure 1 illustrates the solution in the $(\theta^2 - W)$ space as a function of the binding constraints.

Lemmas 3 to 7 describe the properties of the optimal long-term contract:

**Lemma 3.** Lemma 1 and 2 hold for all $\theta$. That is, for every $\theta$ there exist $W^*$ and $W^{**}$ such that for $W \geq W^{**}$ only the participation constraint binds and the contract is fixed rent; for $W^{**} > W > W^*$ the tenant receives a share of the output that is increasing in wealth (PC and LL bind); for $W < W^*$ the tenant receives a constant share of the output and earns more than his reservation utility (PC does not bind, LLs do).

Intuition: see Lemma 1

**Lemma 4.** $W^{**}$ is non decreasing in $\theta$; that is, sharecropping contracts are more likely for crops that are very sensitive to maintenance effort.

Intuition: $W^{**}$ is non decreasing in $\theta$ because the first best rent increases with $\theta$. This effect is analogous to the effect of $h$ on $W^{**}$.

**Lemma 5.** There exists $\theta'$ such that:

(i) for $\theta < \theta'$, $W^*$ is decreasing in $\theta$; that is, the range of $W$ over which the tenant earns information rents is decreasing in $\theta$.

(ii) for $\theta \geq \theta'$, $W^*$ is increasing in $\theta$, i.e. the range of $W$ over which the tenant earns information rents is increasing in $\theta$. 

16
Intuition: an increase in $e$ has two effects on $W^*$, one positive and one negative. The first is analogous to the effect of $h$ on $W^*$ (see Lemma 2) hence $W^*$ increases with $e$. The second comes from the incentive compatibility constraint: when $\theta$ is low the tenant chooses a positive level of maintenance effort (i.e. IC is met) only if $s_2$ is high enough. The participation constraint, however, is less likely to bind when $s_2$ is high therefore the tenant is more likely to earn information rents when $\theta$ is low than when $\theta$ is high. For $\theta < \theta'$ the second effect prevails. For $\theta \geq \theta'$ the IC does not bind thus the second effect disappears and the first prevails.

**Corollary 1.** When the tenant is poor (i.e. $W < W^*$) and the crop is not very sensitive to maintenance effort (i.e. $\theta < \theta'$) the information rent received by the tenant increases as the sensitivity to maintenance decreases; that is the cost of providing incentives for maintenance is higher for lower $\theta$s.

**Corollary 2.** When the tenant is poor poor (i.e. $W < W^*$) and the crop is not very sensitive to maintenance effort (i.e. $\theta < \theta'$), providing incentives for maintenance effort distorts incentives for second period production effort because the same instrument is used for both activities. The distortion is larger for lower $\theta$s.

**Lemma 6.** The range of wealth over which the MR constraint binds in decreasing in $\theta$.

Intuition: recall that the MR constraint guarantees that the tenant does not 'take the money and run' i.e. that the tenant prefers to stay in both periods rather leaving after the first period without providing maintenance effort. Since period two is 'attractive' for the tenant when maintenance is very profitable, when $\theta$ is low the MR constraint is more likely to bind.
Lemma 7. When MR binds both $s_1$ and $s_2$ are distorted.

Intuition: when $\theta$ is low, $s_2$ must be increased in order to meet MR; as a consequence $s_1$ must be decreased to meet the participation constraint.

Corollary 3. For intermediate levels of the tenant's wealth (i.e. $W^* > W > W^*$) providing incentives for maintenance might distort the choice of production effort in both periods. As the crop sensitivity to maintenance decreases the likelihood of this distortion increases.

3.4 Results

The corollaries above illustrate that when capital markets are imperfect providing incentives for maintenance effort is costly: it raises the information rents that the landlord has to pay to poor tenants and it distorts the choice of production effort both for poor and for middle-income tenants. Since these costs are decreasing in $\theta$ while the benefit of providing maintenance incentives is increasing in $\theta$ it is reasonable to expect that for low levels of $\theta$ the costs outweigh the benefits and short term contracts are preferred to long term contracts that give incentive for maintenance. Indeed, direct comparison of the landlord's payoffs yields:

Proposition 1 About contract duration:

There exists a $\theta^*$ such that for $\theta < \theta^*$ there exists a $W^*$ such that short term contracts are preferred to long term contracts for all $W < W^*$ and long term contracts are preferred to short term contracts for all $W > W^*$. Moreover $W^*$ is decreasing in $\theta$. For $\theta \geq \theta^*$ long term contracts are preferred to short term contracts for all $W$.

Proof: by direct comparison of the landlord's payoff functions\(^{17}\).

Intuitively, the landlord will offer a long term contract that gives incentives for maintenance when the benefit of maintenance effort exceeds the cost of providing incentives for

\(^{17}\) Algebraic results are available from the author upon request.
it; otherwise the landlord will offer a short-term contract. The relevant issue is whether
maintenance incentives are provided in equilibrium, rather than the duration of the contract per
se. The model shows that in some cases providing maintenance incentives is not profitable, which
justifies the use of short term contracts that were observed in reality. The model explains the
choice between short-term contracts and long-term contracts that provide maintenance incentives,
rather than the more general choice between short and long-term contracts. In some instances, a
long term contract that does not provide maintenance incentives can do better than a long-term
contract that does provide maintenance incentives because the first can replicate the outcome of a
short-term contract. Still, there are cases in which a long-term contract is always worse than a
short-term contract because the former inevitably provides incentives for maintenance (when IC
does not bind) hence it cannot replicate the outcome of the latter.

Figure 2 illustrates the choice between short- and long-term contracts in the ($\theta^2$-$W$) space.

The model shows that in some cases inducing maintenance effort is suboptimal even if
maintenance is profitable in a first best sense; that is, if there were no asymmetric information
and capital market imperfections, the optimal level of maintenance effort would be always
positive, regardless of the value of the other parameters. Indeed, when capital market
imperfections are not relevant, that is when the limited liability constraint does not bind ($W \geq \hat{W}$),
long-term contract are preferred to short-term contracts for every value of $\theta$.

Lemmas 1, 2 and 3 yield:

**Proposition 2. About the Output Share:**

The share of output received by the tenant is always non-decreasing in $W$ and non-increasing in $\theta$
and $h$. Moreover, $W^{**}$ is non decreasing in $\theta$ and $h$. That is, share contracts are more likely to be
observed when the tenant is poor and/or his outside opportunity is low and/or the marginal
productivity of production effort is high and/or the crop has high maintenance needs.
Proof: by direct differentiation of s w.r.t. W, h and θ.

Intuitively if W is low and/or θ and h are high the limited liability constraint is more likely to bind; as a result sharecropping arrangements are preferred to fixed-rent.

3.5 Related Issues

It is important to note that financing of material inputs by the landlord and/or lending are implicitly considered here. Neither lending nor provision of material inputs can improve matters. The size of the feasible loan the tenant can receive is limited by the (MR) constraint, indeed a loan is equivalent to a reduction in r₁ combined with an increase in r₂. If the landlord pays for material inputs, the first order conditions of the problem are the same, since he will give the tenant the incentive to literally take the money and run. If the landlord provides the optimal quantity of material inputs the choice of m will be efficient (if the tenant does not breach the contract) but the tenant can still sell the inputs on the market and keep the money¹⁸, thus also in this case the first order conditions are unchanged.

It is often argued that land sales are Pareto improving because the tenant would have better incentives to invest in the land if he owned it. In this model a long term contract is equivalent to a land sale since the landlord can commit to the terms of the contract and ownership does not carry any additional benefits. It follows that whenever long term contracts are not profitable, land sales are not either. The intuition is that poor tenants would have to borrow to purchase the land and this would reduce incentives for investment. Indeed, because of limited

¹⁸ Although the last assumption may sound extreme, the data I collected seem to support it. Indeed, in the few cases material inputs were provided by the landlord, the contract contained a clause forbidding the tenant to sell them on the market or employ them outside the plot.
liability, the tenant knows that he will default on the loan in the bad state, thus he will want to increase the probability of the bad state by reducing investment.

In this model the same results can be obtained by offering contracts that are not renegotiation-proof. A fixed rent contact that does not satisfy the limited liability constraint has the same effect on incentives as the optimal sharecropping contract. Indeed, if the bad state happens, the parties will have to negotiate a different payment. The equilibrium payment will then be equal to the tenant's wealth since this is the most he can pay. When the tenant chooses the levels of effort, he takes into account the outcome of the renegotiation and his incentives are reduced accordingly. The landlord can give the same incentives either by using a sharecropping contract, where the share is the solution of the maximization problem above, or by offering the a contract with an implied renegotiation clause. This point is particularly important to understand the empirical predictions of the theory. Indeed, both contracts sharecropping and fixed rent with renegotiation were used in practice. In Sicily the share was established by law and by common customs. Given this limitation, the landlord would then offer sharecropping contracts only when the optimal share was close to a feasible one and use contracts with renegotiation in the other cases.

Finally it is important to note that the assumption of limited liability is consistent with observed facts, hence appropriate for the institutional context under study. Damiani (1881)'s analysis of farmers' saving behaviour and of social relationship between farmers and landowners can be used to assess the empirical relevance of limited liability in 19th century rural Sicily. The description of saving behaviour shows that in general whealty farmers could and did save, whereas poor farmers could save only in good years and had "just enough to survive" in bad years. Since the limited liability constraint binds only for poor tenants and implies that in the bad state the tenant has "just enough to survive", the assumption of limited liability is consistent with
the evidence on saving behaviour. It can be argued that if the landlord could use mechanisms like threats of physical punishment to give incentives, limited liability would not matter. The analysis of social relationships between farmers and landowners, however, shows that those mechanisms were not used in practice. In the province of Syracuse the relationship was characterised by "friendship", "reciprocity" and "respect" in the best cases; by "exploitation" and "unfairness" in the worst. Physical mistreatments or threats thereof were not observed in any village\textsuperscript{19}.

4. \textbf{Empirical Evidence.}

The theoretical analysis yields some predictions about the form and the duration of tenancy contracts that will be tested empirically. The predictions are:

P1) The probability of observing long term contracts is higher if the crop has strong maintenance needs, if the tenant is wealthy and/or if his outside opportunity is high.

P2) For a given crop, the wealth and the outside opportunity of the tenant matter for contract length only if the crop has low maintenance needs. In this case both long and short term contracts are observed and the likelihood of observing a long-term contract is increasing in tenants' wealth and outside opportunity. If the crop has high maintenance needs, wealth does not matter.

P3) The probability of observing sharecropping contracts is higher if the tenant is poor, if his outside opportunity is low and if the crop is very sensitive to effort.

4.1 Data Description

\textsuperscript{19} The information on social relationships is extracted from interviews with the Chief Prosecutor in each village. The answer of the Prosecutors did not show any favouritism towards landowners, as one might fear. Indeed, most Prosecutors openly accused the landowners of exploiting the peasants, of charging high interest rates on loans, of paying low wages, and of charging rents that were too high.
The data set contains information on 705 contracts written in Syracuse and in thirteen neighbouring villages during the period 1870-1880. The data set contains two groups of variables. The first group includes variables relative to specific contracts: the form of the contract (sharecropping or fixed rent), the rent the tenant has to pay, the crop that has to be cultivated, the duration of the agreement, the location of the plot and the social class of the tenant. Since social classes were characterised by the wealth of their members, the tenant's social class is a good proxy for his wealth. Tenants in the sample belong to three social classes which are:

1. villici, poor farmers who own “only the strength in their arms”;
2. contadini or coloni, wealthier farmers who own a mule and/or a small house;
3. massari wealthy farmers who own draft animals and, generally, some plots of land and possidenti, landowners.

The second group are variables that summarize relevant characteristics of the different villages. The variables are: geographical location, daily wage for rural workers in the local market, conditions in the local labour market for rural workers (excess supply, equilibrium, excess demand).

Data sources are described in the Appendix. Table 1 contains a detailed list of variables; descriptive statistics are presented in Table 2. Tables 3 and 4 summarise the empirical results; table 3 present the probit estimates of contract length, table 4 shows the probit estimates of contract type.

The model in Table 3 estimates the probability that a contract is long-term, i.e. longer than 1 year, versus short-term, i.e. one year long. The first and second columns of table 3 show that Prediction 1 is consistent with the empirical evidence. Indeed:

- vines and citrus trees, the most maintenance intensive crops, have a positive and significant effect on the probability of observing a long-term contract;
- if the tenant is poor, that is if he belongs to one of the lower classes, the probability of observing a long-term contract is lower; furthermore the poorer the tenant the lower the probability since the coefficient of the variable poor is significantly larger (in absolute value) than the coefficient of middle.

The second column of table 3 includes estimates of the effect of the tenant's outside opportunity, proxied by the logarithm of the wage for casual workers in the local labour market. Since the wage is a good proxy for the outside opportunity of tenants belonging to lower classes only, the regression includes interaction terms between the wage and the poor and middle dummies. The results show that:

- the higher the outside opportunity of the tenant, the higher the probability of observing a long-term contract, indeed the coefficients of both interaction terms (poor*wage and middle*wage) are positive although only the coefficient of poor*wage is significant.

Prediction 2 finds support in the data as well. The third through fifth columns in Table 3 show that:

- tenant's wealth and outside opportunity matters for the duration of contracts that regulate the cultivation of wheat, which was the least maintenance intensive crop (column 3);

---

20 Geographical dummies and time dummies are included in the regression to control for area-specific and period-specific effects. In particular it might be that tenants belonging to the same social class are richer in some area because the area is richer (same with time). The exact way to test for this effect is to include both the dummies and their interaction with the social class variables; the test is not feasible because there are not enough degrees of freedom. The results are robust to the exclusions of the time and area dummies. All the results that are not reported for reasons of space are available upon request.

21 The survey on Sicilian agriculture contains data on the wage rate but it does not say in which year these were collected. Since the survey was started in 1876 and published in 1881 the wage data can be from any of those years. Taking the logarithm of the wage allows to control for its changes through time and across villages, even if it is reasonable to believe that the changes were small. The log of the wage in each year can be written as the log of the wage in any other year plus the change through time plus the change through villages. The last two effects will be captured by the area and the time dummies. It would be optimal to include dummies for each year and each village but this would eat up too many degrees of freedom.
- tenants' wealth does not matter, the coefficients of the social class dummies is not significant, for the duration of contracts that regulate the cultivation of vines, citrus and fruit trees, which were the most maintenance intensive crops. The result is robust to the exclusion of fruit trees. Furthermore, since only 2\% of contracts for tree crops are 1 year long, I also estimated the probability that a contract is longer than 2 years (in the sample, 10\% of the contracts are 1 or 2 year long); results are robust to this different definition of "short-term". (column 5);

- tenants' wealth matters somewhat (the coefficient of poor is significant at the 10\% level, the coefficient of middle is not significant) if olive trees are included in the sample, which is not surprising since olive trees did not need maintenance as badly as the other tree crops. As discussed in section 2, olive trees survived mistreatment (column 4)

Table 4 reports the probit model for contract type. The model estimates the probability that the contract is fixed-rent (opposed to sharecropping). The results in the first two columns provide empirical support for Proposition 3. They show that:

- the probability of observing a sharecropping contract is higher the poorer the tenant since the coefficients on both social class dummies are negative and significant and the coefficient of poor is larger (in absolute value) than the coefficient of middle;

- the probability of observing a sharecropping contract is higher if the tenant grows vines and citrus trees that are the crops for which the marginal product of effort is higher$^{22}$;

- the probability of observing a sharecropping contract is higher the lower the outside opportunity of the tenant if he belongs to the middle class; that is, the coefficient of middle\*wage is positive.

The estimates in the third and fourth column of table 4 present some additional evidence about the effect of the tenant's outside opportunity on the choice between sharecropping and fixed rent contracts. Column 3 estimates the effect of the wage, column 4 of the condition of the labor
market at a village level as a proxies for the tenants' outside opportunity. Since both variables are a reasonable proxy for alternative employment for tenants belonging to the lower classes only, I exclude wealthy tenants in this regression. The results show that the coefficient of wage and that of Imarket are positive and significant. That is, an increase in the tenants' outside opportunity, proxied by the wage and the tightness of the labour market, increases the probability of observing a fixed rent contract.

Finally, all regression include dummy variables to control for the residency and the sex of the landlord (Results are robust to the exclusion of these variables). Eswaran & Kotwal (1985) present a model of sharecropping in which both the landlord and the tenant supply non contractible inputs. The model predicts that fixed-rent contracts are used if the landlord cannot participate to the agricultural business. The prediction finds some support in the data: the sex of the landlord - female landlords could not participate to the business for social reasons - has a positive and significant effect on the probability of observing a fixed rent contract in three cases out of four; the residency of the landlord, that is whether the landlord lived in the same village, has a positive and significant effect only if the tenant is poor.

5. Conclusions.

In a world with asymmetric information and capital market imperfections, crop characteristics and the wealth of the tenant play an important role in determining the choice between short and long-term contracts and between sharecropping and fixed-rent contracts. It has been shown that long term contracts are more likely when the crop is very sensitive to maintenance and when the tenant is wealthy and that sharecropping contracts are more likely when the crop is very sensitive to effort and when the tenant is poor.

22 The surveys do not report precise information on the cultivation of fruit trees hence it is impossible to
The analysis of crop characteristics provides new insights into understanding tenancy contracts and suggests new questions for future research. A closely related issue is crop choice: Do the crops chosen by an owner-cultivator differ from those chosen by a landowner who delegates the cultivation of his plots? and if so, how and why? Intuitively, maintenance needs and other crops characteristics might create a wedge between the profits received by the two parties so that the owner cultivator and the landowner would optimally choose to grow different crops. In 19th century rural Sicily land ownership mattered for crop choice. Owner-cultivators preferred vines and citrus trees over wheat, while the opposite was true for landowners. Since owner-cultivators often replaced wheat with vines when they bought the land, the difference in preferences cannot be entirely ascribed to differences in land characteristics.

Understanding crop choice might provide an additional explanation for the widely observed inverse relationship between farm size and productivity: family farms could be more productive because they choose more profitable crops. Some favourable empirical evidence in this regard is found in Bharadwaj(1974) who analyses Indian survey data and shows that after controlling for crop choice the inverse relationship disappears.

Above all, a thorough understanding of these issues is crucial in order to identify the effects of land distribution on agricultural productivity, hence to assess the benefits of land reforms and other policy measures.
**Table 1. List of Variables.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>poor</td>
<td>dummy variable, equals 1 when the tenant belongs to the lowest class</td>
</tr>
<tr>
<td>middle</td>
<td>dummy variable, equals 1 when the tenant belongs to the middle class</td>
</tr>
<tr>
<td>crop</td>
<td>dummy variable, equals 1 when crop = i; i = olives, vines, citrus, fruit</td>
</tr>
<tr>
<td>wage</td>
<td>daily wage for male rural workers in the local labour market</td>
</tr>
<tr>
<td>vines&amp;citrus</td>
<td>dummy variable, equals 1 when the crop is vines or citrus</td>
</tr>
<tr>
<td>llres</td>
<td>dummy variable, equals 1 when the landlord lives in another town</td>
</tr>
<tr>
<td>llsex</td>
<td>dummy variable, equals 1 when the landlord is female</td>
</tr>
<tr>
<td>lmkt</td>
<td>dummy variable, equals 1 when there is excess demand in the market for casual workers</td>
</tr>
</tbody>
</table>

**Table 2. Descriptive Statistics**

<table>
<thead>
<tr>
<th>Crop</th>
<th>% Contract</th>
<th>% Length</th>
<th>% Class</th>
<th>% Lmkt</th>
<th>% Wage</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>grains</td>
<td>37</td>
<td>rent</td>
<td>85</td>
<td>1 yr</td>
<td>26</td>
<td>low</td>
</tr>
<tr>
<td>olives</td>
<td>16</td>
<td>share</td>
<td>15</td>
<td>2 yrs</td>
<td>7</td>
<td>middle</td>
</tr>
<tr>
<td>vines</td>
<td>18</td>
<td></td>
<td>3 yrs</td>
<td>11</td>
<td>high</td>
<td>26</td>
</tr>
<tr>
<td>citrus</td>
<td>17</td>
<td></td>
<td>4 yrs</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fruit</td>
<td>12</td>
<td></td>
<td>5+</td>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3. Probit Estimates of Contract Length (Long (1) vs. Short (0))

<table>
<thead>
<tr>
<th></th>
<th>all sample</th>
<th>all sample</th>
<th>wheat</th>
<th>all trees</th>
<th>all trees but olive</th>
</tr>
</thead>
<tbody>
<tr>
<td>poor</td>
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<td>-.67</td>
<td>-12.26</td>
<td>-.48</td>
<td>.52</td>
</tr>
<tr>
<td></td>
<td>(-3.72)</td>
<td>(-3.46)</td>
<td>(-4.37)</td>
<td>(-1.77)</td>
<td>(1.26)</td>
</tr>
<tr>
<td>middle</td>
<td>-.50</td>
<td>-3.23</td>
<td>-11.71</td>
<td>-.34</td>
<td>.66</td>
</tr>
<tr>
<td></td>
<td>(-2.07)</td>
<td>(-1.46)</td>
<td>(-3.34)</td>
<td>(-1.22)</td>
<td>(.19)</td>
</tr>
<tr>
<td>olives</td>
<td>.09</td>
<td>.08</td>
<td>1.19</td>
<td>.43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.42)</td>
<td>(.39)</td>
<td></td>
<td>(4.39)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[.01]</td>
<td>[.01]</td>
<td></td>
<td>[.13]</td>
<td></td>
</tr>
<tr>
<td>vines</td>
<td>1.36</td>
<td>1.37</td>
<td>1.54</td>
<td>.62</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(5.00)</td>
<td>(5.10)</td>
<td>(3.76)</td>
<td>(1.45)</td>
<td></td>
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<tr>
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<td>[.23]</td>
<td>[.23]</td>
<td>[.13]</td>
<td>[.03]</td>
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</tr>
<tr>
<td>citrus trees</td>
<td>1.74</td>
<td>1.79</td>
<td>1.49</td>
<td>.15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.80)</td>
<td>(3.74)</td>
<td>(4.47)</td>
<td>(.47)</td>
<td></td>
</tr>
<tr>
<td>fruit trees</td>
<td>1.70</td>
<td>1.68</td>
<td>4.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4.55)</td>
<td>(4.46)</td>
<td>(3.88)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>poor*wage</td>
<td>2.17</td>
<td>2.01</td>
<td>3.96</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.02)</td>
<td>(2.98)</td>
<td>(2.90)</td>
<td></td>
<td></td>
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<td></td>
<td>[.37]</td>
<td>[.90]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>middle*wage</td>
<td>.99</td>
<td>.99</td>
<td>434</td>
<td>326</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.17)</td>
<td>(1.17)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOBS</td>
<td>705</td>
<td>705</td>
<td>.41</td>
<td>.24</td>
<td>.06</td>
</tr>
<tr>
<td>Pseudo-R²</td>
<td>.46</td>
<td>.47</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

T-stats (robust SE) in parenthesis. Marginal effects in brackets. Marginal effects are computed as the sample average of individual effects.
Table 4. Probit Estimate of Contract Type (Rent(1) vs. Share(0))

<table>
<thead>
<tr>
<th></th>
<th>all tenants</th>
<th>all tenants</th>
<th>poor</th>
<th>poor</th>
<th>low class tenants</th>
<th>low class tenants</th>
</tr>
</thead>
<tbody>
<tr>
<td>poor</td>
<td>-.74</td>
<td>2.05</td>
<td>-.33</td>
<td>-.13</td>
<td>-.33</td>
<td>-.13</td>
</tr>
<tr>
<td></td>
<td>(-4.00)</td>
<td>(0.63)</td>
<td>(-2.10)</td>
<td>(-.95)</td>
<td>[-.07]</td>
<td>[-.02]</td>
</tr>
<tr>
<td>middle</td>
<td>-.62</td>
<td>-7.51</td>
<td>-.12</td>
<td>-.25</td>
<td>-.42</td>
<td>-.25</td>
</tr>
<tr>
<td></td>
<td>(-3.76)</td>
<td>(-3.17)</td>
<td>[-.07]</td>
<td>[-.04]</td>
<td>(-2.60)</td>
<td>(-1.07)</td>
</tr>
<tr>
<td>vines&amp;citrus</td>
<td>-.34</td>
<td>-.41</td>
<td>-.34</td>
<td>-.41</td>
<td>-.42</td>
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T-stats (robust SE) in parenthesis. Marginal effects in brackets. Marginal effects are computed as the sample average of individual effects.
FIGURE 1 SHORT-TERM VS. LONG-TERM CONTRACTS
FIGURE 2 THE OPTIMAL LONG TERM CONTRACT
References.

[9] Cohen and Galassi (1994) ”The Economics of Tenancy in early 20th Century Southern Italy” Economic History Review, 47
[16] Giunta per l'inchiesta agraria e sulle condizioni della classe agricola (1881-6) “Atti della Giunta per l'inchiesta agraria e sulle condizioni della classe agricola” Vol XIII part I and II, books 1 to 5- relazione del delegato tecnico per la Sicilia Abele Damiani
2. Competing for Protection: Land Fragmentation and the Rise of the Sicilian Mafia

1. Introduction.

The mafia is an institution that emerged in the rural areas of Western Sicily in the 19th century, during the transition between feudalism and capitalism. The mafia is a set of rules that constrain and dictate the actions of mafia-men or "mafiosi". "Mafia is a philosophy of life, a moral code... (Sicilians) are taught that they must help one another, stay by their friends and fight common enemies, even when friends are in the wrong and enemies are in the right. Every man must defend his dignity under all circumstances and must not let the slightest disrespect or affront go unavenged. They must not divulge secrets and always keep clear of official authority." (Barzini (1965))

Mafiosi are generally organised in groups, which are known as "cosche" or mafia-groups, whose main activity originally was to sell "protection". The mafia itself cannot be defined as an organisation since a formal and centralised co-ordination among mafia-groups never existed.

The aim of this paper is to model and test the conditions that fostered the initial development of mafia-groups and promoted the rise of the mafia. Understanding the origin of the mafia is useful to explain the economic development of Sicily and to identify the "potential" for mafia in societies that are facing institutional transitions nowadays. Indeed, the presence of this kind of institution is not unique to Sicily: similar phenomena have been observed in Japan and have recently emerged in Russia and Eastern Europe.

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1 "Mafioso" is a single man who operates in the framework of a mafia-group. Plural: "mafiosi".
In order to gain an understanding of the conditions that favoured the formation of the first mafia-groups I investigate the evolution of Sicily's society and economy during the nineteenth century. The analysis shows that mafia emerged at the time when formal authority was weak, banditry was strong and, due to the abrogation of feudalism, landholdings had been fragmented. The absence of publicly provided security and the presence of thieves and bandits generated a strong demand for protection. The rise of the mafia, however, cannot be explained on the basis of these conditions alone. Since both conditions had been present for a much longer time, the third, that is land fragmentation, must have played a role. I argue that, even if it did not increase the assets in need of protection, land fragmentation increased the demand for protection and hence fostered the rise of mafia.

In the context of a menu-auction model I will show that, for a given level of assets in need of protection, land fragmentation favours the development of mafia by increasing the profits of mafia-groups. Land fragmentation generates an increase in the number of landowners, which, in turn, increases the competition for protection. Interestingly, the model shows that landlords compete for protection even if the assets in need of protection are unchanged. The result follows from the fact that when a landlord buys protection he imposes a negative externality on the other landlords. Since for a protected landlord protection is more valuable if only a few landlords are protected, each landlord will pay a higher price if he is the only one or one of the few to receive protection\(^2\). Therefore, given the level of assets in need of protection, more landlords imply more competition and a higher surplus for the mafia-group. Moreover, given the number of landlords, more assets in need of protection imply a higher surplus for the mafia-group, as one would expect. Finally, mafia-

\(^2\) Car alarms are a nice illustration of the idea that protection involves an externality: a car is less likely to get stolen if it is the only one that has an alarm installed. If all the cars in the neighbourhood have alarms the probability that a particular car gets stolen is higher.
groups choose to be "more active", i.e to offer more protection, in areas where land is more fragmented.

Although data on mafia-groups' profits are, not surprisingly, unavailable, the model can be tested using data on the presence of mafia-groups. To the extent that higher potential profits increase the probability that a mafia-group is active in a region, the variables that in the model increase profits should positively affect the presence of mafia-groups in that region. Using a survey published in 1881-6 by the Italian Parliament, I was able to build a qualitative data set that contains information on the presence of mafia, the "intensity" of mafia activity, and the distribution of landholdings for 70 Western Sicilian villages. The predictions of the model are consistent with the available empirical evidence: mafia-groups are more likely to be active in villages where land is more fragmented and where there are more assets in need for protection (as proxied by the frequency of thefts and by the presence of highly valued crops). Moreover mafia activity is more intense where land is more fragmented.

2. Some Facts about the Mafia

Since the end of the last century the Sicilian mafia has received considerable attention from a broad range of scholars and has been depicted, more or less accurately, in countless movies and novels. Despite this, consensus has been reached on only a few points. Even the definition of the mafia is controversial. Much confusion has arisen from the fact that the same word is used to refer both to the institution and to the activities that characterise all mafia-groups. Mafia has been variously identified as an "industry of violence" (Franchetti 1925), a "protection agency" (Gambetta 1993) or as a "way of being" (Pitre' 1889) and as a "sentiment" (Lorenzoni 1910). There is agreement that the mafia entailed a private monopoly over physical violence, which was used to
defend own interests and to sell protection to others. Mafia-groups were a "private police" that enforced property rights in exchange for compensation.

The debate over the identity of the first mafiosi is unsettled as well. Most likely, they were the armed guards formerly employed on feudal estates (see e.g. Blok 1968). Some authors (e.g. Sereni (1971)) identify as mafiosi all the tenants who managed large estates (gabelotti). Others (Dalla Chiesa 1976) identify as "mafia-class" both the protectors and those willing to buy protection, usually the upper classes. The latter should, however, be included in the "number of people who, not being themselves mafiosi, co-operates with the mafia-groups (...) this co-operation cannot be explained as the result of coercion. Those who cooperate expect certain advantages." (confession of the mafia-boss T. Buscetta, quoted in Gambetta (1993)).

The mafia most likely appeared in the second quarter of the 19th century, after the abrogation of feudalism (e.g. Franchetti (1925) and Gambetta (1993)). Some scholars trace its origins back to the 17th and 18th centuries, identifying as mafiosi the armed guards who were paid by the barons to patrol their estates. Still, these guards were essentially employees of the barons and the practice of hiring criminals as private guards was not uncommon in other areas of Italy, where the mafia did not develop. Other scholars maintain that the mafia emerged only after Italian Unification (1860). This view is inconsistent with the fact that the first reports on mafia-groups by Italian prosecutors already describe well-established organisations that could not possibly have

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3 The word itself was first used in a drama written by Giuseppe Rizzotto (1863) "I mafiusi de la Vicaria" which describes the behaviour and the activities of a group of "mafiosi", momentarily imprisoned in Palermo's jail (the Vicaria). The word "mafia" made its first official appearance in a report by the chief prosecutor in Palermo, Filippo Gualtiero, in 1865.

4 For example Frosini (1969) claims that the work of Brydone (1773) contains the first proof of mafia existence. Brydone was a Scotsman who travelled around Sicily in 1770. His book contains 29 letters in which he describes the natural and social characteristics of the island. In one of these letters he reports that his host, the governor of Messina, had him escorted by two members of his private army who were former bandits.
developed in a few years. Furthermore, in 1838 the chief prosecutor in Trapani, don Pietro Ulloa, notified the Minister of Justice of the existence of mafia-groups.

Finally, there is unanimous agreement that mafia developed almost exclusively in Western Sicily: Official documents dated as early as 1874 (see Russo (1962)) state that Eastern Sicily was not affected.


At the beginning of the 19th century Sicilian society still had a feudal structure. Since the foreign governments that ruled Sicily during the previous centuries always relied on the local upper classes to manage public affairs in the island, power resided traditionally in the hands of a few noble families. Agriculture was the most important economic activity and the noble families owned most of the land, which they farmed on an extensive basis. Since most barons lived in Palermo or Naples, they generally appointed wealthy tenants, called gabelloti, to manage their land.

Feudalism was officially abolished in 1812 but the land-owning aristocracy retained most of the old privileges, such as imposing taxes on the peasants, who were made even poorer by the abolition of common rights. The Bourbons, who ruled from 1816 to 1860, tried to ameliorate this situation by promulgating laws to effectively remove feudal institutions and by promoting land redistribution to create a new class of small landowners to replace the powerful aristocracy. To the same purpose in 1862 the Italian State promulgated land reforms.

Although they were partially successful at reducing the size of landholdings, in Western Sicily the land reforms did not succeed in creating a class of "rural entrepreneurs". Huge fiefs were

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5 The most relevant laws to eliminate feudalism were promulgated in 1820 (abolition of primogeniture and seizure of land in settlement of debts) and in 1841 (order of giving to the peasants at least one fifth of the land where common rights were enjoyed before 1812).
divided into smaller properties but few farmers managed to purchase land. Those who did succeed generally bought small plots nearby the villages. In the inner part of the island, wealthy bourgeoisie and former gabellotti purchased most of the land. The new owners often lived far from the land and in most cases they successfully tried to enter the ranks of the aristocracy, imitating their dislike for productive activities. Since the new owners did not improve the old production methods, land reform did not enhance efficiency. The plots were still farmed on an extensive basis and rented to new gabellotti. The gabellotti usually subleased the land to small farmers and lived as far from the countryside as they could. Since they were appointed for a short period of time, gabellotti had no incentive for long-term investment in the land; in general they invested their earnings in loans to the peasants (at rates as high as 100%) and in land purchases that allowed them to enter the class of the landowners and entrust the land to other gabellotti.

The situation of the landless peasants worsened rapidly after the abrogation of feudalism: they were deprived of common rights without receiving compensation and were still treated as serfs by the new land-owning class. Even those who owned a small plot of land often had to work on the large estates at the service of the gabellotti. Since the farming techniques did not require permanent workers, most workers were employed daily. Those who owned a mule and a plough were hired seasonally to cultivate some small plots often distant from each other. Since they had to travel

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6 It has been estimated that the number of large landowners increased from 2,000 to 20,000 in the period 1812-1860 (see Mack Smith 1968). Damiani (1881) reports that large properties (more than 200ha) were predominant only in 15 villages out of 71.

7 The social disapproval attached to productive work and the deriving habit of living exclusively off rents among the Western Sicilian upper classes has been witnessed by many foreigners who visited the island and by the Sicilian economist Ferrara.

8 There were exceptions. Some landlords planted more remunerative crops, introduced modern systems of cultivation and promoted fixed settlement on the land by building houses for the peasants. Others engaged in wine production. Still, these were isolated examples that the majority did not imitate.

9 Improvements like irrigation and land manuring, would have notably increased the land value (according to Mack Smith (1968) up to twenty times), still the gabelloto would not invest since his investment would mainly benefit those who came after him. Similarly shifting from cereals to more profitable cultivation
between the different plots and had to be physically present at the market for daily workers the peasants lived in the closest village and travelled daily to the fields. The life standard of the peasants declined steadily during the 19\textsuperscript{th} century; Mack Smith (1960) reports that between 1798 and 1861 population increased by 0.4 millions while, due to the unchanged production structure, agricultural output remained fairly constant.

Many of the peasants turned to banditry, especially during the periods of high unemployment. Banditry strongly increased during the 19th century with six major risings in 1820, 1837, 1848, 1860, 1866 and 1893. The most common crime was cattle rustling, favoured by the lack of a permanent presence on the land, especially during the night. Publicly provided security was quite insufficient: "Twenty-five "Companies at Arms" policed the countryside, but altogether there were usually less than 350 policemen for the whole island. Two or three times a year a company of troops would arrive in each village and round up a token number of malefactors, but this would be followed by another few months of complete impunity" (quoted from Mack Smith 1960). The situation did not improve when the Italian State took over.

In this framework mafiosi made their first appearance; they offered the policing services that the State did not offer, and that the landowners, or their gabelloti, would not provide. The first mafiosi were the armed guards formerly employed by the barons. Land fragmentation was a crucial factor for the development of the Mafia: after the abrogation of feudalism mafiosi gained autonomy and offered their services to a larger number of new clients (see Gambetta (1993)).

In conclusion, the conditions that promoted the rise of the mafia in Western Sicily can be summarised as follows:

- Land fragmentation, hence more landlords in need of protection.

(like vines or oranges) was not an attractive option for the gabelloto since these cultivation would not bring
- Inability of the State to guarantee effective protection of persons and property.
- Landlords absenteeism
- No fixed settlement on land
- Poor peasants who often resorted to banditry.

Note that none of the above conditions is sufficient, if taken alone. For example, land fragmentation is necessary for mafiosi to gain from landlords’ competition but it is not sufficient by itself. Land was fragmented in Eastern Sicily but no mafia emerged there.

In Eastern Sicily the land reforms had different effects. The new class of landowners immediately promoted the transition to a capitalistic structure of production: capital was invested on the land, crops were diversified and tenancies were longer.\textsuperscript{10} Landowners often lived on the land and managed it directly\textsuperscript{11}, social tensions were almost irrelevant, and banditry was rare. Because of low demand for protection there was no market for mafia-groups\textsuperscript{12}.

4. The model: land division and the rise of the Mafia.

This section analyses the effect of land division on the development of the mafia in the context of two-stage game in which the landlords offer mafiosi a monetary reward in exchange for protection and the mafiosi decides who to protect in order to maximise their surplus. I show that even if the assets in need of protection do not increase, land division generates competition for

\footnotesize
\textsuperscript{10} I am not aware of any theory that convincingly explains the difference in landlords’ behaviour.
\textsuperscript{11} A curiosity: the Eastern provinces, especially Syracuse (the most peaceful), were mockingly defined "provincia babba" (i.e. stupid province) by the Western people. The reason for this kind of ironic nickname was, most probably, the absence of the parasitism (intended as making a living without being involved in any productive activity) characteristic of Western Sicily.
\textsuperscript{12} Franchetti (1925) first noted that the different behaviour of the landlords in the East could account for the lack of Mafia activity there. Other so-called "naturalistic" explanations stress the different cultures in
protection, which promotes Mafia activity. In particular I show that: (i) for a given level of protection, the surplus of the Mafia-group generally increases as the number of landlords increases; (ii) the optimal level of protection offered by the Mafia-group increases as the number of landlords increases.

4a. Set up.

There is a fixed amount of land that yields income \( Y \). I assume that the land is divided equally between \( n \) landlords each of whom gets a share \( y = Y/n \) of total income. I assume that as the number of landlords rises total land income remains constant, which is consistent with the evidence presented in section 2. Below I show that if land income were to increase, land fragmentation would increase the demand for protection even further.

Each landlord faces a positive probability of getting his income stolen and he can buy protection from mafiosi to decrease this probability. I assume that:

(i) if a landlord is not protected all his income is stolen\(^{13}\)

(ii) the mafia-group can successfully protect an exogenously fixed share \( \ast \) of total land income.

As shown below, (i) and (ii) imply that if a landlord buys protection the probability of having his income stolen depends on how much of total income the mafia-group can successfully protect and on the number of landlords who are protected.

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\(^{13}\) I assume that this is true for every choice of the other landlords. Assuming that when nobody buys protection, everybody is stolen with the same probability (different than one) yields similar results. For convenience here I normalise that probability to one.
Denote by $p^k$ the vector of protection\(^{14}\) such that $k$ landlords are not protected and $(n-k)$ are. Denote by $(1-\pi_{n-k}(p^k))$ the probability that one of the $(n-k)$ protected landlords gets his income stolen. Since landlords who are not protected get all their income stolen and since the Mafia-group can at most protect a share $\pi^*$ of total income, the income stolen from the unprotected landlords plus the income stolen from the protected landlords must be at least $(1-\pi^*)Y$. Thus when $k$ landlords are not protected it must be true that:

$$ky + (n-k)(1 - \pi_{n-k}(p^{-k}))y \geq (1 - \pi^*)Y$$

(1) implies that if a landlord buys protection his income is stolen with probability:

$$\left(1 - \pi_{n-k}(p^{-k})\right) = \max\left\{0, 1 - \frac{n}{n-k} \pi^*\right\} \quad k = 0, \ldots, n-1$$

That is, if a landlord is protected and there are many unprotected landlords (that is if $k > (1-\pi^*)n$) then the probability of his income being stolen is zero. If many landlords are protected (that is if $k < (1-\pi^*)n$) each protected landlord gets his income stolen with probability $(1-n/(n-k)\pi^*)$ which is higher the lower the number of unprotected landlords. The constraint in (1) reflects the fact that each landlord values protection more if he is the only one or one of the few to be protected. This implies that landlords compete for protection because every protected landlord imposes a negative externality on the others, making their protection less valuable.

\(^{14}\) A protection vector is a vector $(n \times 1)$ whose elements are 0s and 1s; 0 for the unprotected landlords, 1 for the protected ones.
To buy protection, a landlord must pay a non-negative contribution \( f(p) \) to the mafia-group; the landlord’s net payoff is equal to \( q = \pi (p)y - f(p) \), where \( p \) is the vector of protection chosen by the mafia-group.

Finally, I assume that the cost of providing protection does not depend on the number of landlords that actually get it. Since the protection offered by mafia-groups was more a matter of reputation rather than of effective patrolling the assumption is quite realistic. An interview with a former gabelloto about the situation in the early 1900 (reported in Blok 1968, p.146) provides an illuminating example: "...cattle rustling were rampant at the time (...) when we employed a campiere-mafioso\(^{15} \) the robberies stopped. We paid the man a regular yearly salary, but he only rarely inspected our farm. Now and again he would turn up. (...) he did not need to bother about much more than just these occasional visits, since he let it be known that he kept watch over that particular estate."

The model does not deal with the acquisition of reputation, it assumes that it is exogenously determined by the previous activity of the mafiosi as armed guards of the baron on the same land. Indeed: "...frequently a field guard enjoys the reputation of having already committed one or two murders. Once he is surrounded by this aura his career is made and he has become a person who must be feared. A necessary and therefore better paid person" (Cutrera 1900) and "...once the mafioso has succeeded in successfully playing the part of protector he is soon regarded as competent in those things...The smooth progress of his enterprise is guaranteed less by actual physical force and increasingly by this competence attributed to him" (Hess 1973).

4.b Solution and Results.

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\(^{15}\) "Campiere" is the traditional name for the armed guard.
The timing of the game is as follows: in the first stage landlords make offers conditional to the vector of protection chosen by the mafia-group in period two, in the second stage the mafia-group decides how many landlords they will protect in order to maximise the sum of contributions. The equilibrium concept used here is that of coalition-proof Nash equilibrium. The analysis is based on Bernheim&Whinston (1986)'s work on menu auctions. Following Bernheim&Whinston (1986), \((\{f_i\}_{i=1}^n, p^*)\) is a Nash Equilibrium if and only if\(^{16}\):

(i) \(f_i(p) \geq 0\) for every \(i\) and \(p\);

(ii) \(p^* = \arg\max \sum_{i=1}^n f_i(p)\)

(iii) \(p^* = \arg\max \left( \pi_i(p)y_i + \sum_{j \neq i} f_j(p) \right), \forall i, p\)

(iv) there exists \(p_i\) that satisfy (ii) such that \(f_i(p_i) = 0\) for all \(i = 1, ..., n\).

Condition (ii) must hold since the mafia-group is assumed to maximise its payoff. Condition (iii) must hold otherwise landlord \(i\) could be better off by offering an infinitesimally bigger contribution for the \(p\) in which (iii) is violated. Finally condition (iv) is needed because if there was not such a value, landlord \(i\) could be strictly better off by lowering his offers for every choice without affecting the mafiosi's decision.

\(^{16}\) For the formal proofs of this and other general results see Bernheim&Whinston (1986)
Bernheim&Whinston (1986) show that every truthful Nash Equilibrium, defined as a Nash Equilibrium supported by truthful strategies\(^{17}\), is coalition-proof; that essentially truthful equilibria are the only coalition-proof equilibria; and that players can choose to play truthful strategies at no cost (i.e. every player’s best response correspondence contains a truthful strategy). Formally, \( f_i () \) is a truthful contribution schedule if and only if:

\[ f_i (p, W_i) = \max (0, \pi_i (p) y - W_i) \]

Where \( W_i \) is some base level of welfare.

A truthful strategy is such that for every \( p \) the landlords offer their “net willingness to pay” that is, for every \( p \) they offer an amount that is equal to the difference between their gross payoff at \( p \) and some base level gross payoff.

Bernheim&Whinston (1986) provide a characterisation of the set \( \Phi(p) \) of net payoffs \( (q) \) that bidders receive in a truthful Nash equilibrium. Since landlords are identical in this model the set of payoffs is:

\[ \Phi(p) \equiv \left\{ q \in R^n \mid \forall k = 1...n, kq \leq n\pi(p)y - (n - k)\pi(p^{-k})y \right\} \]

(3)

and its Pareto efficient frontier:

\[ E(p) \equiv \{ q \in R^n \mid q \in \Phi (p) \ and \ there \ does \ not \ exist \ q' \in \Phi (p), \ with \ q' \geq q \} \]

(4)

The following lemmas characterise the solution.

**Lemma 1.** The TNE vector of protection must satisfy:

\(^{17}\) Formally, \( \left\{ f_i \right\}_{i=1}^n, p^* \) is a Truthful Nash Equilibrium (TNE) if it is a Nash equilibrium and \( \left\{ f_i \right\}_{i=1}^n \) are truthful strategies with respect to \( p^* \).
\[ p^* = \arg \max \sum_{i=1}^{n} \pi_i(p)y \]  

(5)

**Lemma 2** The protection vector \( p=[1,1..1] \) (every landlord buys protection) is always a TNE protection vector.

**Lemma 3** If \( \pi^*>(n-1)/n \), \( p=[1,1..1] \) is the unique TNE. If \( \exists k' \) s.t. for all \( k<k' \) \( \pi^*<(n-k)/n \); then all the vectors such that \( k (<k') \) landlords are protected are TNE protection vectors.

**Lemma 4** The sum of landlords' contributions is the same in any TNE.

In what follows I will focus on the equilibrium where every landlord is protected. This is without loss of generality since the equilibria are equivalent with respect to the sum of the contributions the mafia-group receives.

**Lemma 5**: The equilibrium contributions are uniquely determined. In the equilibrium where every landlord is protected, each landlord pays:

\[ f(p^*) = (n-1) \left( \min \left\{ 1, \frac{n}{n-1} \pi^* \right\} - \pi^* \right) y \]

Proof: see Appendix.

Intuitively, the last landlord has to pay enough to make the mafia-group indifferent between protecting everybody and protecting everybody but him. That is, he has to compensate for the fact that the \( (n-1) \) protected landlords are willing to pay more to leave him out. The term on the RHS represents the difference between what the \( (n-1) \) protected landlords would pay if the last landlord
were left out and what the \((n-1)\) protected landlords would pay if the last landlord were protected as well.

Lemma 1 to 5 yield the following:

**Proposition 1:** The payoff of the mafia-group is always non-decreasing in the number of landlords. For given \(Y\) and \(\pi^*\), mafiosi's payoff is increasing in \(n\) until \(n = 1/(1-\pi^*)\), and constant thereafter.

Proof:

From lemma 3 mafiosi's payoff in the TNE is given by:

\[
S(p^*) = \sum_{i=1}^{n} f_i(p^*) = (n - 1)(1 - \pi^*)Y \quad n < \frac{1}{1 - \pi^*} \\
= \pi^* Y \quad n \geq \frac{1}{1 - \pi^*}
\]

(6)

Taking the derivative of (6) with respect to \(n\) proves the result.

**Figure 1. The mafia-group's payoff (when \(\pi^*\) is exogenous).**

Intuitively, mafiosi's payoff depends on \(n\) in two ways. First, as \(n\) increases the number of landlords willing to pay to keep just one without protection increases (this is captured by the \((n-1)\) term in
Second, the probability of getting one's income stolen when all but one landlord are protected is increasing in \( n \) for \( n \) large. That is, when the land is divided among a few, the share of each is such that if only \((n-1)\) are protected their probability of being robbed is zero. In other words the income of the unprotected landlord is high enough to satisfy the constraint in (1). Then, the difference in gross payoff for each of the \((n-1)\) protected landlords in the case when the \(n^{th}\) is not protected and when he is, is given by \((1-\pi^*)y_i\). For \( n \) sufficiently large the share of the last unprotected landlord is too small and something must get stolen from those who are protected. In this case the difference in gross payoffs is equal to \(\left(\frac{n}{n-1}\pi^* - \pi^*\right)y\), which is decreasing in \( n \).

Since when \( n \) is small relative to \( \pi^* \) the first effect prevails, for \( n \) small mafiosi's payoff is increasing in \( n \). When \( n \) is large the surplus received by the mafia-group is constant in \( n \) because the increase in the number of landlords who are willing to pay to keep just one out is exactly matched by the decrease in the difference of gross payoffs.

From (6) it is possible to infer the following:

**Fact 1.** Given \( n \) and \( \pi^* \), an increase in the assets in need of protection \((Y)\) increases the payoff of the mafia-group.

Fact 1 implies that if as a consequence of land fragmentation the assets in need of protection increase, the effect of land fragmentation on the profits of the mafia-group is even stronger.

**4.c. The level of Mafia activity.**

The model can be modified to take into account that, even if in the short run the Mafia's policing technology has an exogenous upper limit, in the long run the Mafia-group will choose \( \pi^* \) in order to
maximise its profits. Formally $\pi^*$ can be endogenised by transforming the game into a three stage game in which the mafia-group chooses $\pi^*$ in the first stage. From equation (6) we have:

**Proposition 2.** For any $Y$, the mafia-group’s payoff is maximised when $\pi^* = (n-1)/n$. Hence the mafia-group will offer more protection (higher $\pi^*$) when there are more landlords.

Intuitively, mafiosi’s surplus is increasing in the level of competition between landlords, which, in turn, is maximised when up to $(n-1)$ landlords can receive their full income.

Proposition 2 leads to:

**Fact 2.** The surplus of the mafia-group is equal to $S = (n-1)Y/n$, which is increasing in $n$ and $Y$. Moreover, the effect of an increase in the number of landlords on the profits of the mafia-group is stronger if there are many assets in need of protection. Similarly, the effect of an increase in the assets in need of protection is stronger if there are many landlords.

---

**Figure 2** The mafia-group’s payoff (when $\pi^*$ is endogenous)
4.d. Related Issues

The model is "demand" driven, in the sense that by offering contributions the landlords play an active role. Alternatively one could assume that the mafiosi behaved as a monopolist, setting the price and forcing payment. I believe that since at the time mafiosi were not as powerful as they were to become later, a model in which landlords play an "active" role is better suited to explain the rise of the Mafia than a model in which mafiosi impose their decisions on others.

In the model, the mafia-group is treated as a single agent. This assumption rules out the analysis of the internal structure of the mafia-groups and of the competition among different groups. The internal dynamics of the group bear no consequence for the analysis since the mafia-group interacted like a single entity with the outside world. Each mafia-group was characterised by a well defined hierarchical structure, norms for "career advancement" were very precise, as were punishment for betrayal or failure. Generally members of the same family covered the most important positions, while common criminals or desperate peasants were occasionally employed for casual, often "dirty", jobs. The management of the Mafia-group was transferred from father to sons to maintain the "name" and hence the reputation. Ruling out competition among different groups is of no consequence either. Indeed, although groups often competed for the control of a certain territory, the landlords could not benefit from it. Competition ended quite rapidly and landlords in a given area would always face only one mafia-group, even if a different one from time to time.

5.Predictions and empirical evidence.

The model predicts that the profits of the mafia-group depend positively on the number of landlords (n) and on the quantity of assets in need of protection (Y). Since landlords compete for protection, an increase in the number of landlords increases the mafia-group's profits for any
level of Y. Moreover, the effect of land fragmentation on the mafia-group’s profits is stronger the higher the need for protection; i.e. the higher Y.

Data on profits are unavailable but since higher profits increase the probability that a mafia-group is active in a region, the predictions of the model can be tested with data on the presence of mafia in different regions. Using a survey published in 1881-6 by the Italian Parliament (also known as “Inchiesta Jacini”), I was able to build a qualitative data set that contains information on mafia activity and on the other relevant variables for 70 Western Sicilian villages. The variables in the data set are:

(i) **presence of mafia-groups (mafiad).** Mafiad=1 if there is evidence of mafia activity in the village. This information was collected through interviews with the Chief Prosecutor of each village.

(ii) **intensity of mafia activity (mafia).** Mafia=0,1,2,3 if there is no mafia activity, if there is some mafia activity, if there is mafia activity and if mafia activity is very strong. This information was collected through interviews with the Chief Prosecutor of each village as well.

(iii) **proxy for number of landlords (frag).** The survey does not report how many landlords there were in each village but the variable can be proxied with the available information on the degree of land fragmentation. The mayor of each village was asked to report whether most of the land was concentrated in small, medium or large landholdings. The data are well suited for the purpose of this paper because it is possible to separate villages in which land was divided, that is where “small” and “medium” holdings prevailed, from villages in which land still belonged to a few –sometimes just one- noble families (“large” landholdings). Unfortunately, since different mayors had different opinions
about the size of “small” and “medium” landholdings, this distinction might not be very reliable. Therefore I set $frag = 1$ if the mayor reported that most of the land was concentrated in small or medium holdings\(^{19}\).

**proxies for the need of protection (thefts and vines).** Thefts=1 if thefts in the countryside are frequent. The information was collected through interviews with the village Chief Prosecutor and it is used as a proxy for $Y$, since the need for protection should be stronger in villages where thefts are frequent. $Vines$ is a continuous variable that is equal to the ratio of vineyard to total cultivated land. The variable is used as a proxy for $Y$ since the need of protection is stronger for vines than for grain crops.

**province dummies (prov.)** The villages are located in 4 different provinces. Province dummies are included to take into account possible spreading and “contagion” effects.

Table 1 reports mafia activity by province and shows that, as expected, mafia activity was not common in Eastern Sicily. In this section I will therefore focus exclusively on the Western villages. Table 2 presents some descriptive statistics for the Western villages: it shows that mafia-groups were active in more than half of the villages and very active in eleven cases. It also shows that mafia-groups did not generally exist in those villages where large landholdings prevailed. Indeed there is evidence of significant mafiosi’s activity only in 3 villages out of 15. Conversely, mafiosi were quite active in about 50% of the villages with medium and small landholdings.

The first column of Table 3 estimates the probability of a mafia-group being active as a function of the number of landlords and of the presence of thefts to proxy the need of protection. In

---

\(^{18}\) Since they were not asked to name names, the Prosecutors had little incentive to lie about the existence of Mafia because of fear.

\(^{19}\) The author of the survey reports that on average small landholdings were smaller than 20ha, medium were larger than 20ha and smaller than 200ha and large were larger than 200ha (often larger than 1000ha). Unfortunately many of the mayors who used a different criterion did not report it precisely enough.
the model both variables have a positive effect on the profits of the mafia-group and the effect is stronger if the variables increase jointly. The presence of mafia in a village is a signal that the profits of the mafia-groups are high enough to make the enterprise viable; hence the effect of land fragmentation and of the need of protection on profits is partially reflected on their effect on the probability of observing mafia activity in a village. The results show that mafia-groups are more likely to be active in villages where both the competition for protection (many landlords) and the need for protection (proxied by thefts) are strong; that is the coefficient on the interaction term \( \text{frag} \times \text{thefts} \) is positive and significant. Since both the coefficients on the number of landlords and on thefts are not significant separately, the data suggest that if there is not much need for protection (thefts=0) the competition among landlords is not strong enough to generate mafia activity. In other words, if there is not much need for protection the competition among landlords might still increase the profits of the mafia-group but not enough to make the enterprise viable. At the same time, if there is no competition for protection (frag=0) the need for protection per se does not generate mafia activity either.

In the third and fourth column of Table 3, I also include the other proxy for “assets in need of protection”, that is the variable vines. The results show that, as predicted by the model, an increase in the need for protection magnifies the effect of land fragmentation on the profits of the mafia-group; that is the coefficient of the interaction term is positive and significant. The coefficient on vines alone is not significant, which suggests that if there is no competition for protection an increase in the need of protection does not increase the mafia-group’s profits enough to generate mafia activity.

Table 4 estimates the intensity of mafia activity as function of the variables above. The results are similar but the estimates are less precise.
Finally, Table 5 estimates the intensity of mafia activity in the sub-sample of villages where mafia-groups are active. The results show that, as predicted by the model, mafia-groups are more active where land is more fragmented; that is the coefficient of $\text{frag}$ is positive and significant. Interestingly, thefts seem to matter for the existence but not for the intensity of mafia activity: the coefficient on the variable $\text{thefts}$ is never significant in the sub-sample with positive mafia activity. The results suggest that, conditional on mafia-groups being active, their level of activity mostly depends on the competition among landlords. Column (2) uses $\text{vines}$ instead of $\text{thefts}$ as a proxy of the need of protection. The results show that, again, the coefficient of $\text{frag}$ is positive and significant. The coefficient of $\text{vines}$ is positive, as expected, but not significant.

6. Conclusions

In nineteenth century Western Sicily, where formal authority was weak and the need for protection strong, land fragmentation increased the demand for protection and fostered the rise of the mafia. This paper has investigated the link between land fragmentation and the demand for protection. It has presented a model in which, since by buying protection a landlord imposes a negative externality on the others, an increase in the number of landlords generates competition for protection and increases the profits of the mafia-group. The model shows that land fragmentation generates competition for protection even if the assets in need of protection do not increase and that the competitive effect of land fragmentation is larger where the need of protection is stronger. The model also shows that to maximise profits mafia-groups are more active in areas where land is more fragmented. The predictions of the model are consistent with the evidence from a sample of 70 Western Sicilian villages in 1881. Using qualitative data on mafia activity and proxies for the level of land fragmentation and for the need of protection, I show that mafia-groups were more likely to
be active in villages where land was fragmented and the need of protection was strong. Land fragmentation also had a positive effect on the intensity of mafia activity.

This paper illustrates how monopoly over violence was voluntarily transferred from landlords to mafia-groups. This is in contrast with theories that maintain that the mafia emerged because landlords lost their power after the abolition of feudalism. I believe these theories are not consistent with observed facts. There is indeed no evidence that the abolition of feudalism curtailed the power of the landlords: the aristocracy did not lose their ancient privileges and the new landlords rapidly acquired them. A radical decline in landlords’ power only started after World War II. Western landlords, consistent with their negligent attitude concerning management of land matters, continued the old tradition of paying a private army for protection. But, with land fragmentation, the same army could serve more than one party and gain from landlords’ competition. Thus there was a transfer of the monopoly power over violence with mutual advantage to both parties, rather than usurpation by mafia-groups. In this sense some authors include in the “mafia-class” also the landlords.

There are many other unsettled issues regarding the mafia that should be addressed in future research. Among these, I think two are most interesting, namely the analysis of the mafia as an institution and the effect of the mafia on economic development. The first entails the study of the rules and the reason of their success. Over the years the rules have proven easy to adapt to new situations so that the mafia has managed to survive the end of the conditions that promoted its development in the first place. The second is closely related to investment incentives. It is commonly accepted that the mafia deterred investment in Western Sicily since mafiosi would capture a considerable share of the potential returns. This has often been offered as an explanation for the lack of productive investments and the consequent economic under-development of Western Sicily. Still, if the increase in income was to be captured by mafia-groups, one should wonder why
mafiosi did not promote investment on the land. It is known that, instead, mafiosi used the proceedings of their activity to rent land or to buy some of their own. Indeed "...the mafia-bosses can always be found among the big tenants and landowners" (Cutrera 1900), but mafiosi had always poor origins (see Hess 1973 for some good examples). I suspect that not to invest was a rational choice for the mafia-groups because investment would have undermined the conditions that were at the basis of their existence. More productive farming methods required workers to reside permanently on the land hence patrolling needs and the demand for protection would have been reduced if these methods were adopted. Also, investment would have improved the living standards of the peasants thus reducing their need to steal. Since as a consequence of economic development mafia-groups would have lost their power, promoting development was not in their best interest.
### TABLE 1 - MAFIA ACTIVITY BY PROVINCE

<table>
<thead>
<tr>
<th>Province</th>
<th>Number of villages with Mafia activity</th>
<th>Number of villages with data</th>
<th>Villages with Mafia as % of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catania (East)</td>
<td>2</td>
<td>24</td>
<td>8%</td>
</tr>
<tr>
<td>Siracusa (East)</td>
<td>2</td>
<td>20</td>
<td>10%</td>
</tr>
<tr>
<td>Messina (East)</td>
<td>3</td>
<td>25</td>
<td>12%</td>
</tr>
<tr>
<td>Palermo (West)</td>
<td>8</td>
<td>23</td>
<td>35%</td>
</tr>
<tr>
<td>Caltanissetta (West)</td>
<td>6</td>
<td>15</td>
<td>40%</td>
</tr>
<tr>
<td>Trapani (West)</td>
<td>6</td>
<td>13</td>
<td>46%</td>
</tr>
<tr>
<td>Girgenti (West)</td>
<td>11</td>
<td>19</td>
<td>58%</td>
</tr>
</tbody>
</table>

1) Villages in which Mafia activity is reported to be medium or strong.

### TABLE 2 MAFIA ACTIVITY AND LANDSIZE

<table>
<thead>
<tr>
<th>Land Distribution → Mafia Activity ↓</th>
<th>Small/ Medium</th>
<th>Large</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>22 (40%)</td>
<td>9 (60%)</td>
<td>31 (44.3%)</td>
</tr>
<tr>
<td>Some</td>
<td>5 (9%)</td>
<td>3 (20%)</td>
<td>8 (11.4%)</td>
</tr>
<tr>
<td>Medium</td>
<td>17 (31%)</td>
<td>3 (20%)</td>
<td>20 (28.6%)</td>
</tr>
<tr>
<td>Strong</td>
<td>11 (20%)</td>
<td>0 (0%)</td>
<td>11 (15.7%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>55 (78.6%)</td>
<td>15 (21.4%)</td>
<td>70 (100%)</td>
</tr>
</tbody>
</table>

### TABLE 3 THE PRESENCE OF MAFIA ACTIVITY

Probit Estimates. Dependent Variable Mafia=1 if there is mafia activity in the village

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>frag</td>
<td>-.22</td>
<td>(.96)</td>
<td>-.99</td>
<td>(.26)</td>
</tr>
<tr>
<td>thefts</td>
<td>.24</td>
<td>(.32)</td>
<td>-1.02</td>
<td>(.28)</td>
</tr>
<tr>
<td>frag*thefts</td>
<td>1.54</td>
<td>(1.72)</td>
<td>1.62</td>
<td>(3.52)</td>
</tr>
<tr>
<td>vines</td>
<td></td>
<td></td>
<td>1.98</td>
<td>(.99)</td>
</tr>
<tr>
<td>frag<em>thefts</em>vines</td>
<td></td>
<td></td>
<td>5.29</td>
<td>(1.94)</td>
</tr>
<tr>
<td>prov1</td>
<td>.60</td>
<td>.44</td>
<td>.44</td>
<td>.44</td>
</tr>
<tr>
<td>prov2</td>
<td>-.99</td>
<td>-1.02</td>
<td>-1.09</td>
<td>-1.13</td>
</tr>
<tr>
<td>prov3</td>
<td>-1.14</td>
<td>-1.18</td>
<td>-1.09</td>
<td>-1.15</td>
</tr>
<tr>
<td>Pseudo-R²</td>
<td>.31</td>
<td>.30</td>
<td>.33</td>
<td>.33</td>
</tr>
<tr>
<td>NOBS</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

T-stats (based on robust standard errors) in parenthesis.
### TABLE 4 THE PRESENCE & INTENSITY OF MAFIA ACTIVITY
Ordered Probit Estimates. Dependent Variable: Mafia=0,1,2,3 if mafia activity in the village is zero, weak, medium, or strong.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>frag</td>
<td>.09 (.18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>thefts</td>
<td>.38 (.59)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frag*thefts</td>
<td>1.07 (1.46)</td>
<td>1.42 (4.60)</td>
<td>1.08 (2.41)</td>
<td>1.07 (2.72)</td>
</tr>
<tr>
<td>vines</td>
<td></td>
<td>.03 (.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>frag<em>thefts</em>vines</td>
<td></td>
<td>2.10 (.94)</td>
<td>2.14 (1.45)</td>
<td></td>
</tr>
<tr>
<td>prov₁</td>
<td>.66 (1.59)</td>
<td>.64 (1.65)</td>
<td>.72 (1.83)</td>
<td>.72 (1.83)</td>
</tr>
<tr>
<td>prov₂</td>
<td>-.37 (-.93)</td>
<td>-.33 (-.86)</td>
<td>-.37 (-.94)</td>
<td>-.37 (-.94)</td>
</tr>
<tr>
<td>prov₃</td>
<td>-.80 (-1.72)</td>
<td>-.78 (-1.72)</td>
<td>-.80 (-1.71)</td>
<td>-.80 (-1.73)</td>
</tr>
<tr>
<td>Pseudo-R²</td>
<td>.16</td>
<td>.16</td>
<td>.17</td>
<td>.17</td>
</tr>
<tr>
<td>NOBS</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

T-stats in parenthesis.

### TABLE 5 THE INTENSITY OF MAFIA ACTIVITY
Ordered Probit Estimates. Dependent Variable: Mafia=1,2,3 if mafia activity in the village is weak, medium, or strong.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>frag</td>
<td>1.62 (1.88)</td>
<td>1.53 (2.54)</td>
<td>1.39 (2.41)</td>
</tr>
<tr>
<td>thefts</td>
<td>.35 (.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>frag*thefts</td>
<td>-.30 (-.22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vines*</td>
<td></td>
<td>1.70 (1.11)</td>
<td></td>
</tr>
<tr>
<td>prov₁</td>
<td>.15 (.27)</td>
<td>.16 (.31)</td>
<td>.34 (.65)</td>
</tr>
<tr>
<td>prov₂</td>
<td>1.22 (1.79)</td>
<td>1.32 (2.51)</td>
<td>1.28 (2.17)</td>
</tr>
<tr>
<td>prov₃</td>
<td>-.09 (-.14)</td>
<td>-.05 (-.08)</td>
<td>-.10 (-.17)</td>
</tr>
<tr>
<td>Pseudo-R²</td>
<td>.15</td>
<td>.15</td>
<td>.16</td>
</tr>
<tr>
<td>NOBS</td>
<td>39</td>
<td>39</td>
<td>39</td>
</tr>
</tbody>
</table>

T-stats in parenthesis. * I could not use the interaction term frag*vines because it is strongly (.95) correlated with vines.
APPENDIX

1. PROOFS

Proof of Lemma 1:

From condition (ii) we know that $p^* = \arg\max \sum_{i=1}^{n} f_i(p)$ which implies: $\sum_{i=1}^{n} f_i(p^*) \geq \sum_{i=1}^{n} f_i(p)$.

From the definition of truthful strategy we know that: $\pi_i(p^*)y_i - \pi_i(p)y_i \geq f_i(p^*) - f_i(p)$ for all $i, p$. Therefore the condition above implies that $p^* = \arg\max \sum_{i=1}^{n} \pi_i(p)y$.

Proof of Lemma 2:

It must be proved that $p=[1,1,1,..1]$ satisfies (5). That is, for every $k=1,...,n$ it must be true that:

$$n\pi^*y_i \geq (n-k)\min\left\{1, \frac{n}{n-k}\pi^*\right\}y_i$$

(6)

Indeed, for $\pi^* \geq \frac{n-k}{n}$ (6) reduces to $n\pi^* \geq n - k$ which is verified.

For $\pi^* < \frac{n-k}{n}$, (6) requires $n\pi^* \geq n\pi^*$

Proof of Lemma 3.

If $\pi^* > (n-1)/n$ then $n\pi^*y_i > (n-k)\min\left\{1, \frac{n}{n-k}\pi^*\right\}y_i$ thus $p=[1,1,..1]$ is the unique TNE. If $\exists k'$ s.t. for all $k < k'$ $\pi^* < (n-k)/n$; then for all $k < k'$ (6) is verified with equality thus all the vectors such that $k (< k')$ landlords are protected are TNE protection vectors.
Proof of Lemma 5

The constraints in (3) can be written as:

\[ kf(p^*) \geq (n-k)(\pi_{n-k}(p^*) - \pi^*)y_i \]  \hspace{1cm} (7)
for \( k = 1, \ldots, n \)

The intuition is that when \( k \) landlords are not receiving protection, to receive it they must pay enough to make Mafia-groups indifferent between receiving higher contributions by the \((n-k)\) protected and receiving lower contributions from everybody. (7) derives from (1), (3) and the definition of truthful strategy.

I show that if (7) is satisfied for \( k=1 \), it is satisfied for all \( k \).

Using (1) and \( k=1 \), (7) implies:

\[ f_i(p^*) \geq (n-1)\left( \min \left\{ 1, \frac{n}{n-1} \pi^* \right\} - \pi^* \right) y_i \]  \hspace{1cm} (8)

There are 3 cases depending on the magnitude of \( \pi^* \):

Case I

\[ \pi^* > \frac{n-1}{n} \Rightarrow \pi^* > \frac{n-k}{n}, \forall k \]

(8) implies:

\[ f_i(p^*) \geq (n-1)(1-\pi^*)y_i \Rightarrow kf_i(p^*) \geq k(n-1)(1-\pi^*)y_i \]

Thus (7) is satisfied for every \( k>1 \) since:

\[ k(n-1)(1-\pi^*)y_i > (n-k)(1-\pi^*)y_i \]

Case II
\[ \pi^* < \frac{n - k}{n}, \forall k \]

(8) implies:

\[ f_i (p^*) \geq \pi^* y_i \Rightarrow kf_i (p^*) \geq k\pi^* y_i \]

(7) is satisfied since its RHS is equal to \( k_\pi y \).

Case III

\[ \pi^* < \frac{n - 1}{n} \]

\[ \exists k' | \forall k > k', \pi^* > \frac{n - k}{n} \]

for all \( k < k' \) see case II.

For \( k > k' \), (7) is satisfied since:

\[ k\pi^* y_i > (n - k)(1 - \pi^*) y_i \]

\[ \text{for } \pi^* > \frac{n - k}{n} \]

Fact 3 follows from (4).

**Proof of Lemma 4**

I will show that for any TNE, the sum of total contributions is the same as in the TNE where every landlord is protected. Take the TNE protection vector \( p'' \) in which \( k'' \) landlords are not protected.

Equilibrium offers are uniquely determined and are equal to:

\[ f(p'') = \frac{n}{n - k''} \pi^* y \]

Therefore since only \( (n - k'') \) landlords pay, the mafia-group's surplus is equal to \( S(p'') = \pi^* Y \), which is equal to \( S(p^*) \), as required.

To prove that \( f(p'') \) are the equilibrium offers for \( p'' \), rewrite the constraints in (3) as:
\[(k - k'') f(p') \geq (n - k') \frac{n}{n - k'} \pi * y - n \pi * y + (n - k) \min \left\{ 1, \frac{n}{n - k} \pi * y \right\}\]

then one can prove that if the expression above holds for \(k'' + 1\), it holds for any \(k\).

2. DATA SOURCES

I have coded the information contained in the “Inchiesta Iacini: Atti della Giunta per l’inchiesta agraria e sulle condizioni della classe agricola” -Vol XIII part I and II, books 1 to 5- relazione del delegato tecnico per la Sicilia Abele Damiani.

Pages and volumes number as reported below.

1. Data on mafia activity, mafia activity intensity, and thefts

2. Data on land fragmentation
Vol XII, part 1, book B: summary tables.

3. Data on vineyards
Vol XII, part 1, book B: summary tables.
References


[8] Giunta per l'inchiesta agraria e sulle condizioni della classe agricola (1881-6) "Atti della Giunta per l'inchiesta agraria e sulle condizioni della classe agricola" Vol XIII part I and II, books 1 to 5- relazione del delegato tecnico per la Sicilia Abele Damiani


3. Does Financial Reform Raise or Reduce Savings?

with Gerard Caprio Jr., Patrick Honohan, and Fabio Schiantarelli

1. Introduction

A wave of liberalization of financial markets has swept over much of the developing world, especially since the mid-1980s. This liberalization has been characterized by greater scope being granted to market forces in determining interest rates and in allocating credit (Caprio, Atiyas and Hanson 1994). Although this has occurred under the pressure of increased globalization of financial markets, and following the example of many industrial countries, there has been an expectation that financial liberalization would help economic development. In particular, the early literature on financial repression, following McKinnon (1973) and Shaw (1973), stressed the potential role of higher interest rates in mobilizing savings that could be put to productive use.

But it is far from clear that financial liberalization actually does increase private savings. One obvious and important consideration is that the effect of interest rates on savings is itself ambiguous, as the income effect might offset substitution effects. In addition, one must recognize that financial liberalization involves more than just a change in interest rates. Other dimensions of financial liberalization, such as increased household access to consumer credit or housing finance, might also work to reduce private savings rather than increasing them (Muellbauer and Murphy, 1990, Jappelli and Pagano, 1994). Furthermore, there is also the view, stressed in the neo-structuralist contributions of Taylor (1983) and Van Wijnbergen (1982) that the effect of reduced taxation on formal financial intermediaries might actually reduce the flow of credit to the private sector to the extent that reserve requirements captured funds for the government that had been substituted away from the curb market.
the long-term effect of liberalization on savings may differ substantially from the impact effect. Lastly, financial liberalization is a process rather than a one-shot event.

The purpose of this paper is to provide an empirical examination of the total effect of the financial reform on aggregate private savings based on eight case studies: Chile, Ghana, Indonesia, Korea, Malaysia, Mexico, Turkey and Zimbabwe. These countries have all significantly liberalized their financial sector policies, but they differ in the nature and phasing of financial liberalization, in other aspects of their policy reform program, and in the macroeconomic context in which liberalization took place. This variety allows us to explore the degree to which the savings response differs from country to country, as well as to test whether the response is a common one.

Financial reform typically comprises several key phases, often separated by several years. Reform measures are introduced in a number of different dimensions: interest rates, credit allocation, bank ownership, prudential regulation, security markets and openness of the capital account. There have been frequent debates as to the best sequencing of these various elements. In practice, reform has not been a monotonic process: in some cases there have been setbacks involving temporary policy reversals.

A thorough quantitative assessment of the impact of such a process must take account of its gradual and reversible nature. Based on an analysis of the historical evolution in each case we have identified the timing of major moves on eight different dimensions towards a more liberalized system. Using the principal components of the resulting matrices of zero-one variables (ones correspond to the years after a particular reform is introduced) we obtain a continuous financial liberalization index for each of our countries. Our data extends over a quarter of a century, a period long enough to allow us to model the dynamic response to liberalization in each country separately.

Visual inspection of the time series of the main relevant variables - the financial liberalization index, the real interest rate, monetary depth (either M2 or total credit to the
private sector expressed as a percentage of GNDI) and the private savings ratio - reveals little evidence of a clear-cut relationship between saving and liberalization.

We estimate an econometric relationship expressing the private saving ratio as a function of the real interest rate and the index of financial liberalization, along with income, inflation and the savings of the public sector. In addition to directly measuring the contribution of liberalization to the volume of aggregate savings, our procedure improves on earlier estimates of the saving-interest relation, which omitted any role for financial sector liberalization other than the real interest rate channel.

Although they cannot be solved-out for a net effect on the level of savings, Euler equations can be helpful in detecting the extent of credit rationing. In this spirit we also assess the impact of financial reform on the extent of liquidity constraints by estimating an augmented Euler equation for consumption, in which it is assumed (in an extension of the model of Campbell and Mankiw, 1989, 1991) that the fraction of the consumers are liquidity constrained varies with the degree of financial liberalization.

The structure of the paper is as follows. Section 2 describes the main channels through which financial liberalization may affect savings and briefly reviews the relevant empirical literature. Section 3 describes the financial reform process as it occurred in each of the eight countries being studied here. This section also explains and graphs our index of financial liberalization and provides summary statistics and bivariate correlations with financial depth and savings. Sections 4 and 5 present the econometric results based on the saving function and on the augmented Euler equation for consumption, respectively. Section 6 concludes.

2. Financial Liberalization and Savings: Theoretical Background and Review of the Empirical Evidence
Although financial liberalization can enhance the efficiency with which saved resources are channeled into productive use, the effect on the quantity of savings is theoretically ambiguous. The mechanisms at work here include both long-term and short-term effects. Once it has settled down, a competitive liberalized financial system will typically be characterized by improved savings opportunities, including higher deposit interest rates, a wider range of savings media with improved risk-return characteristics, and in many cases more banks and bank branches, as well as other financial intermediaries. Bank lending rates will typically be higher for those borrowers who had privileged access in the restricted regime, but access to borrowing should be wider. These long-term effects of liberalization on aggregate private saving will be felt through changes in rates of return and in the degree of credit restrictions. Moreover, if financial liberalization also has a favorable effect on the allocation of resources this will generate increases in income that will, in turn, increase savings.

The process of financial liberalization also unleashes a series of short run effects. Not only can the process of domestic portfolio adjustment lead to transitory changes in the volume of domestic saving, but (especially when combined with liberalization of the foreign exchange market) it may also induce large capital inflows, largely but not exclusively attributable to a return flow of past flight capital. If not sterilized, such inflows can result in a credit boom leading to real income surges, which in turn have a direct, but transitory, effect

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2 It should be stressed at the outset that our evidence is based chiefly on national accounts definitions of saving. These need to be distinguished from intermediated saving or from capital flows. Dornbusch and Reynoso (1989) observe that capital flight through mis-invoicing of trade serves to conceal saving that is being hidden abroad: an apparent increase in saving may really be a reduction in capital flight. Furthermore, they note that, as durable goods purchases are usually treated as consumption in the data, a shift from these to accumulation of financial assets tends to be misleadingly recorded as saving.

3 It should be noted that increased household borrowing may not all go to consumption or housing. A relaxation of borrowing constraints could promote human capital formation, though this will normally be measured as consumption in the National Accounts.
on the volume of saving. Modeling of the effect of financial liberalization on saving needs to take account of these short run effects, as well as the long-run effect. It is also important to recognize that some of the overall effects can come through the effect of income on saving.

2.1 Steady State Effects

If financial liberalization improves the rate of return for savers, then knowledge of the interest elasticity of saving can help predict the long-term impact of liberalization on saving. However, because of the wealth and current income effects that will generally be present, there is no presumption as to the direction of the aggregate saving response to an exogenous interest rate change. Despite many studies, this remains an empirically controversial area - partly because of a surprising shortage of reliable and comparable cross-country data on retail interest rates. Recent reviews by Balassa (1990), Srinivasan (1993), and Fry (1995) conclude that more studies have found a positive interest elasticity of savings than a negative one, but the coefficients have generally been small and often insignificant.4

Possibly of greater importance for aggregate saving may be the availability of a variety of alternative non-financial assets, the return on which may not be captured by deposit interest rates. While the use of real interest rates implicitly acknowledges that goods inventories are an alternative to financial assets, in principle it would be very useful to take explicit account of alternative investment opportunities, notably the rate of return on owner-occupied housing and other real estate investment. Many developing countries have

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4 The effect of interest rates on saving could be non-linear, perhaps involving threshold effects. Reynoso (1989) presents some evidence that the response of savings to the interest rate may be represented by a parabola, with savings increasing most significantly when interest rates go from sharply negative to just below zero, then leveling off, and finally declining as real interest rates become very large and positive, in which case they may reflect political uncertainty, peso-effects, bank insolvency, and the like. Interestingly, Levine (1994) finds that the greatest improvement in growth comes from eliminating significantly negative real interest rates, with small gains to further increases.
experienced property booms, and household saving may have been very sensitive to the after-tax rate of return on investment in real estate (see for example, Koskela and Virén, 1994). Unfortunately, in most cases data on such rates of return are not available for developing countries.

Published interest rates may not reflect capital market realities if households and small enterprises are constrained from borrowing what they would wish because of financial repression or for other reasons. To the extent that liberalization reduces these borrowing constraints, saving ratios could be lowered (Jappelli and Pagano (1989), (1994)). There are two mechanisms at work here. First, when the borrowing constraint binds, it induces the individual to consume less. Second, even when the constraints are not binding in the current period, the expectation that they may bind in the future reduces today’s consumption.

A very large literature, in response to Hall’s (1978) original contribution, has attempted to gauge the importance of borrowing constraints by inferring that any dependence of the change in consumption on income might reflect the inability of households to smooth the intertemporal pattern of their consumption through borrowing (see for instance, Campbell and Mankiw, 1989, 1991; Zeldes, 1989). The developing country literature here generally confirms the importance of such dependence - with some indication that it has been higher for developing countries (see for instance, Rossi, 1988, Haque and Montiel, 1989, Corbo and Schmidt-Hebbel, 1991).

2.2 Transitional effects of liberalization

5The household’s inability to borrow at wholesale market interest rates may be a rationing phenomenon, or it may reflect a large wedge between retail deposit and borrowing rates (e.g. money-lender rates). A lower wedge would reduce saving, as King (1986) found for the UK. See also Alessie, Devereux, and Weber (1993) for an analysis of the effects of abolition of credit controls on the demand for cars in the U.K.
The impact effect of financial liberalization on saving could be larger than the sustained long-term effect. This is because households will be able to revise target precautionary balances, allowing for example some middle-aged households that had hitherto been constrained from life-cycle borrowing to consume at a higher rate than they would have over a full-lifetime of unconstrained access to borrowing. These transitional effects suggest that aggregate household saving could dip below its steady state level, and that a surge in consumption may be observed (Muellbauer, 1994). Moreover, as noted above, financial liberalization has been accompanied by real estate booms in some countries; the resulting increase in real wealth also may have a temporarily negative impact on saving.6

The large capital inflows that have been associated with recent liberalizations have also had complex short-term macroeconomic consequences. Liberalization of the domestic financial system has typically been only one element of a package of reforms that have been associated with these inflows, and the inflows have proved to be easily reversible. The impact on saving comes through the associated changes in availability and cost of credit, revised expectations of income growth, and increases in financial wealth, especially due to upward movements in property prices. All this may lead to consumption booms and to a fall in the saving rate.

2.3 Quantifying the effects of financial liberalization on saving

Most empirical examinations of the effects of financial liberalization or, more generally, of financial development on saving have involved adding one or more variables to

6 Financial liberalization could affect the value of human and non-human wealth in a variety of ways. An increase in the value of non-human wealth will normally, ceteris paribus, reduce saving as consumption out of income can now be permanently higher. However, it is hard to isolate such wealth effects on saving of financial liberalization, not only because of the difficulty of measuring human and nonhuman wealth, but also because other reforms affecting wealth are usually being undertaken at the same time.
established econometric specifications either of saving or of the rate of change in consumption. The simplest specifications identify pre- and post- liberalization periods with a dummy variable (an early example is de Melo and Tybout, 1986, for Uruguay); an alternative is to specify a linear trend reflecting gradual liberalization (Muellbauer and Murphy, 1993 for the UK).

Others have employed such proxy variables as the volume of consumer credit (e.g. Jappelli and Pagano 1989, 1994). Ostry and Levy (1995) used this variable both on its own and in interaction with an interest rate, and concluded that liberalization had not only lowered saving in France, but had transformed a negative association between saving and interest rates into a positive one (cf. Bayoumi, 1993 for the UK). An easing of credit market conditions facing households was also detected for the 1980s in Scandinavian countries by Koskela et al. (1992), and Lehmussaari (1990). Here the effect on savings came indirectly through the impact of increased housing finance on house prices.

In their 30-country study, Jappelli and Pagano (1994) also found another type of credit availability variable to be highly significant, namely the normal loan-to-value ratio obtainable from mortgage finance institutions: a 15 percentage point increase in the loan-to-value ratio reducing the national savings rate by 2.6 percentage points. This substantial effect may not be entirely housing-related, as the variable may be capturing movements in wider credit availability.

Other proxy measures of the prevalence of credit constraints that have been used include the percentage of home-owners in certain age-groups, the interest rate wedge on consumer and mortgage loans (Jappelli and Pagano, 1989), and the rate of consumer credit delinquencies (Carroll, 1992). Confirming the evidence for industrial countries, Vaidyanathan (1993) shows that international variations in the sensitivity of consumption to income are positively related to financial depth (measured by the ratio of M2 to GDP), suggesting again the importance of liquidity constraints. More directly, Miles (1992) estimated that 80 per
cent of the total amount of home equity withdrawn by UK households each year in the 1980s was consumed (rather than involving just a portfolio shift), accounting for essentially all of the collapse in the UK personal savings ratio from 12 per cent to less than 5 per cent.

The existence of well-functioning stock markets could also be a factor influencing saving by offering an improved risk-return frontier while retaining liquidity. But again, the predicted impact on aggregate saving is theoretically ambiguous and recent empirical evidence suggests that funds attracted to liquid stock markets in developing countries come mainly as a switch from other assets.\footnote{Levine and Zervos, 1996; see also Bonser-Neal and Dewenter, 1996. This conclusion was drawn from the insignificance of indicators of stock market development in cross-section regressions where the dependent variable was the ratio of private saving to GDP.}
3. Financial Reform: Measurement and Effects

3.1 Financial repression and the process of reform

The multifaceted nature of financial reform -- involving deregulation, liberalization, globalization, privatization -- complicates the measurement of its effects. In addition, the reforms undertaken in each country have reflected the perceived problems of the pre-reform environment. Prior to reform, most countries experienced a period of mild or severe financial repression: intervention by governments in allocating and pricing credit, controlling what banks and other intermediaries could do, using intermediaries as tax collection devices, and often limiting competition, in particular from foreign institutions. These interventions varied by country, and in some countries included government ownership of banks as a very direct way of influencing how they did business.  

In developing countries, intervention in the financial sector went considerably further than the regulation of interest rates and of credit expansion that characterized industrial country policy. In some countries banks were required to hold as much as one-half or more of their liabilities in the form of reserve or liquid assets (often deposits at the central bank) and another large part of the portfolio was dominated by directed credit. Although the latter might have been structured so as to leave significant discretion to the banks for credit assessment and monitoring (as in Japan), in practice in many cases little power or responsibility was left to the banks. In such cases, with most of their balance sheet

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8 In addition to concerns about an inherent instability of finance, these interventions were often rationalized by a view that finance was not decisive for growth unless harnessed by a benevolent planner. Levine (1997) discusses some of the historical context and developments of attitudes about the financial system, and Caprio, Atiyas, and Hanson (1994) describe financial reforms in Chile, Malaysia, Indonesia, Korea, Turkey, and New Zealand. See also Caprio and Klingebiel (1996).

9 In some cases, the small size of the economy meant that a government requirement to provide financial support for a sector such as steel-making meant in practice lending to a single steel company, with the result that the banks viewed the risk as belonging to the authorities.
effectively out of their own control, banks invested little in credit assessment, monitoring, or asset-liability skills, and in the extreme cases -- formerly socialist economies -- the result was a low skill base in finance and little of the infrastructure that supports market-based financial intermediaries.10

Beginning in many countries in the 1970s and accelerating subsequently, governments began to reconsider more direct interventions, and financial reform programs have included attempts to reduce or re-direct the government’s role, most noticeably in the area of pricing and directing credit. The path of reforms often was influenced both by government views, initial conditions, and political pressures for reform. For example in Chile, real interest rates had been negative for decades prior to the removal of controls in 1974, and this de-control was quite sudden. In contrast, following mild repression in the 1960s, Malaysian authorities in early 1973 -- like their Japanese counterparts much later -- began deregulating some longer term interest deposit rates but let several years pass before all controls were removed. A very gradual process also characterized the Korean experience. At times, the process was rather bumpy with re-imposition of controls after an initial bout of liberalization, as in Chile and Malaysia. Often the re-imposition of controls was a consequence of a severe banking crisis that developed in an unstable macro context, characterized by large capital inflows, and excessive risk taking in the absence of effective prudential regulation, as in Chile in the early 1980s.

Reforms in general include two parts: outright de-regulation, limiting the government’s direct intervention, and putting in its place a system of prudential regulation aimed at ensuring the safety and soundness of banking. In addition there is an institution-

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10 See Caprio and Claessens (1997) for a discussion of initial conditions in reforming financial systems. They argue that long periods of financial repression greatly weakened the skills, incentives, and infrastructure in finance and therefore complicated the reform process.
building component. The latter likely is a key component of the reform process: during periods of substantial intervention, especially where most risk is born by government, the demand for financial infrastructure -- accounting, auditing, legal systems, and other finance-related skills -- is quite limited. When this intervention is lessened, and if the incentive structure is right, intermediaries start devoting more resources to risk and credit analysis, for example, and spend more to upgrade the quality of their staff.

3.2 Measuring financial reform

The ideal index of financial reform would attempt to measure both the de-regulatory and the institution building aspects of the process. Unfortunately, short of using outcome measures such as the development of markets as a proxy -- an approach leading in the present context to unacceptable endogeneity difficulties -- it seems impossible at present to find useful measures of institutional development. For these reasons we have chosen to build our index of reform from explicit policy changes which, though not wholly independent of wider economic conditions, should be less subject to endogeneity problems.

Our index thus summarizes exogenous changes in interest rate regulation, reserve requirements, directed credit, bank ownership (moves toward privatization), liberalization of securities markets, prudential regulation, and international financial liberalization. Based on an analysis of the historical evolution in each case we have identified the timing of major moves towards, and sometimes away from, a more liberalized system under each of these headings (Appendix 1 gives the details). This yields a matrix of zero-one variables for each country. Rather than attempting to use all of these variables in the econometrics -- that would use up too many of the available degrees of freedom -- we have constructed for each country the principal components of the matrix. We use the first principal component as our main liberalization index in the regressions of Section IV below. (As an alternative, we also experiment below with a weighted average of the more important principal components,
using as weights the fraction of the total standard deviation explained by each component.)

In all cases, a higher value of the index in a given year captures an overall more market oriented regime.\textsuperscript{11}

The resulting index is shown in Figures 1-8, with data on financial depth (M2 or total credit to the private sector as a percentage of Gross National Disposable Income, GNDI), real interest rates, and the private saving rate (measured as a share of GNDI). We have used a definition of the private saving rate, both unadjusted and adjusted for capital losses due to inflation on domestic assets denominated in local currency. For example in Figure 1a, the index (both versions) captures the partial reversal of reforms in Chile resulting from the twin banking and debt crises of 1982.\textsuperscript{12} Likewise, Figure 5a clearly charts the fact that de-control was initially short-lived in Malaysia (see Figure 5a), in part because banks were observed to be slow to reduce rates as their cost of funds declined, but also because a moderately severe banking crisis led Malaysian authorities to re-impose interest rate controls for several years in the mid-1980s.\textsuperscript{13}

Significant but different reforms were introduced in all of the countries under review. As seen in the data for Chile and Malaysia, reform can see significant reversals, and more generally is not a linear process, but proceeds in fits and starts.

3.3 Visual evidence on savings and reform

\textsuperscript{11} See also Demetriades and Luintel (1997) for an application to India of the principal components approach to aggregating the information contained in a combination of policy changes and outcome variables.

\textsuperscript{12} The Chilean reforms had begun in 1974 with the freeing of interest rates and the beginning of the easing of reserve requirements, and continued in the mid- and late-1970s with bank privatization and the raising of ceilings on foreign borrowing. After the reversals of 1982, liberalization resumed in 1986.

\textsuperscript{13} Caprio, Atiyas, and Hanson (1994) describe financial reforms in Chile, Malaysia, Indonesia, Korea, Turkey, and New Zealand. See also Caprio and Klingebiel (1996, 1996a) for a further discussion of the Malaysian experience.
The figures provide no visual evidence of a clear positive association between either index (or real interest rates) and private saving for most countries. This is also confirmed by the bivariate correlation coefficient between saving and the index (contemporaneous or lagged) reported in Table 1, which is positive and significant only for Turkey and Korea. For some periods and in some of the countries there appears to be a negative relationship between saving and the index. For instance, saving plummets in Chile (Figure 1a and 1d) with the onset of reform -- perhaps reflecting the easing of credit constraints -- then recovers gradually until a more significant increase starting in 1985, associated in part with the introduction of a fully funded pension system. In Mexico (Figures 6a and 6d), we observe a protracted decline in the savings since reforms began.\textsuperscript{14} A lack of correlation between the index of financial reform and savings is evident in the cases of Ghana (Figures 2a and 2d) and Zimbabwe (Figures 8a and 8d), where savings first rose then fell, while the index was registering continuing gains.\textsuperscript{15} In Malaysia, savings did rise in the 1970s as reforms began, but then leveled off and fell back to their original level subsequently. In contrast, there is a clearer positive association between the index and saving in Korea (Figures 4a and 4d), particularly until the late 1980s, Turkey (Figures 7a and 7d), and to a lesser extent Indonesia, where, however, part of the increase in savings occurred before domestic financial reforms began (see Figures 3a and 3d).

It is noteworthy that the figures and bivariate correlation suggest a closer association between the behavior of the index and measures of financial depth for a majority of the countries. The exceptions are Turkey, Ghana and Zimbabwe. There also appears to be a

\textsuperscript{14} The sharp drop in the adjusted series in 1988 is due to a large increase in the measured stock of debt to which the adjustment applies in that year.

\textsuperscript{15} Albeit with continued negative interest rates. The persistence of negative real interest rates, notably in the cases of Ghana and Zimbabwe, after the onset of reform measures calls into question how real reforms have been. Even though interest rates were deregulated, in some countries they continue to be controlled by a cartel of banks, often at the informal behest of the authorities.
generally positive association between our index and real interest rates, which is statistically significant in half of the countries.

4. Econometric Evidence: Savings Functions

We begin by estimating the long run and short run relationship between savings and its determinants separately for each country over the period 1970-1994. In the basic specification, the (unadjusted) private saving rate $s/y$, is modeled as a function of the natural log of real per capita GNDI $ln y$, the real interest rate $r$, our index of financial liberalization $flit$, the inflation rate $\pi$, and the government saving rate, $govs$. The choice of variables included in the equation is limited partly by series availability and partly by the length of the sample period. In particular we would like to have included a satisfactory proxy for non-human wealth, but available ones, such as the stock of high-powered money or government debt, are more likely to be misleading than helpful.

We have tested the order of integration of the variables both country by country, using the ADF test, and by panel, using the Im, Pesaran and Shin (1996) test. The results of the tests suggest that we cannot reject the hypothesis that $s/y$, $ln y$, $flit$, and $govs$, are integrated of order one (see Table 2, Part I for the panel tests; the country by country ADF tests are not reported for reasons of space). However for some countries there is evidence


17 Gross national disposable income is used as a proxy for income. The real interest rate is defined as a short term rate (continuously compounded) minus the inflation rate (calculated as the forward log difference). The conclusions reached below are not sensitive to the definition of the real interest rate and of the inflation rate. See the data appendix for further details on variable constructions and on the data sources.
against the unit root hypothesis for $r$, and $\pi$. For instance, when a trend is included, the hypothesis that $r$, has a unit root is rejected at the 5% significance level in Malaysia, Korea and Indonesia. Also, a unit root in _, is rejected for Malaysia, Indonesia and Turkey. The panel test suggests the rejection of the unit root hypothesis for both variables.

Using the Dickey Fuller (DF) or the Adjusted Dickey Fuller (ADF) tests on the residuals of the cointegrating regressions, country by country, and the critical values calculated as suggested by MacKinnon (1990) to adjust for sample size, we cannot reject the hypothesis of no cointegration between the vector of variables mentioned above (including or excluding the real interest rate and inflation). These cointegration tests must be treated with a healthy dose of caution both because of the low power of such tests against reasonable alternatives and because of the small number of observations available relative to the number of variables. As shown in Table 2, Part II, however, the panel cointegration test proposed by Pedroni (1997a, b), and the Im, Pesaran and Shin test applied to the residuals of the cointegrating vector are consistent with the existence of a cointegrating relationship between $s_t y_t$, $ln y_t$, $fli_t$, and $govs_t$ (or between $s_t y_t$, $ln y_t$, $fli_t$, $govs_t$, $r_t$, and $\pi_t$, if the troublesome unit root tests on the last two variables are disregarded).

In Table 3 we present two estimates of the cointegrating vector, when $r_t$ and $\pi_t$ are included. The estimates of Part I are OLS. Since the conventional OLS standard errors are not valid in this context, Part II shows approximate GLS estimates obtained by including the contemporaneous differences of the right hand side variables as additional regressors and allowing for an AR(1) error term.\textsuperscript{18} The main drawback of the Dynamic GLS estimates is the small number of degrees of freedom available, so that it is probably wise to consider both

\textsuperscript{18} Ideally one would have wanted to include additional leads and lags of the differences, however the length of our sample precludes us from doing that. Our procedure can be seen as an approximation to the DGLS procedure in Stock and Watson (1993).
sets of results. Because the estimates of the coefficients of $r_n$ and $\pi$, are problematic if those variables are truly stationary, and although their inclusion does not invalidate the consistency for the coefficients (and associated inference) for the other non-stationary variables, we also report (Part III) Dynamic GLS estimates when $r_n$ and $\pi$ are both excluded.

In order to assess also the short run effects of liberalization, Table 4 reports an estimated error correction model for saving. The reported estimates are OLS; unreported GMM estimates lead to the same conclusions concerning the effect of $fli$ and $r$. Despite the fact that we have here corrected the omission of other dimensions of financial liberalization, there is -- except for the OLS estimate for Mexico -- no evidence from the country-by-country estimates of a significant distinct positive effect of the real interest rate on savings. In most cases the long run point relationship is negative, and significantly so in the case of Ghana and Indonesia. The evidence based on the time series for individual developing countries confirms, therefore, the general conclusion derived from previous studies using pooled time series-cross country data that it is not possible to pin down a systematic positive effect of increases in the interest rate on savings.

So far as the effect of financial liberalization itself is concerned, the picture is mixed. For Korea and Mexico (and Zimbabwe when $r_n$ and $\pi$ are excluded) the coefficient of the index of financial liberalization is negative and significant in the long run (using the Dynamic GLS estimates). For Korea, there is also evidence of a significant negative short run effect. On the other hand, for Turkey and Ghana (only Turkey, when $r_n$ and $\pi$, are excluded) there is evidence of a positive and significant long-run effect.

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19 $r_t$ and $\pi_t$ are included in the cointegrating vector.

20 Note that these are also the two countries where $fli_t$ is uncorrelated with private credit, suggesting that borrowing constraints may not have been much eased.
The estimated impacts of the index on private savings are sizable; for example, the results of Table 3 Part II imply that liberalization in Korea and Mexico has permanently lowered savings by 12% and 6% of GNDI respectively. On the other hand we estimate that liberalization has raised the savings rate in Turkey by 13% and in Ghana by 6%.

So far as the other variables are concerned, the income variable is significant in most cases (both in the long and short run). The sign of the coefficient of the inflation rate differs across countries - significantly negative in Ghana, Indonesia and Malaysia; significantly positive in Mexico. Finally, there is evidence that an increase in government savings leads to a decrease in private savings. Actually for Korea, Malaysia and Mexico (and, depending upon the specification, Chile and Zimbabwe) the estimates are consistent with Ricardian equivalence, in that the coefficient of govs, is not significantly different from minus one.

If the coefficients are truly the same across countries, then a more efficient estimate can be obtained by imposing that restriction and estimating the cointegrating vector by the SURE method. The drawback may be that one may be imposing invalid restrictions, because of differences in preferences, institutional settings and nature of the liberalization. Moreover, the construction of the index does not guarantee comparability of scale across countries. Table 5 shows the results of this approach: the regression of column (1) includes only the levels of the explanatory variables, while the regression of column (2) also included their first difference and an AR(1) error. (The estimated coefficients on these dynamic terms were not restricted and are not reported.)

These constrained SURE estimates imply that the real interest rate has a significant positive effect and financial liberalization a significant negative effect on saving. However, the likelihood ratio test suggests that the assumed equality of coefficients can be rejected at
conventional significance levels, which implies that imposing equality across countries is inappropriate. If that problem can be finessed by taking the constrained estimates to be some form of 'typical' response then we find that combining the interest rate and index effects, the typical financial liberalization would have lowered saving. For instance, using the results in column (2), the predicted long-run effect of an increase in the value of the index by 7 points (equal to its median change between the initial and final year of the sample) accompanied by a simultaneous increase in the interest rate from \textit{minus} 10\% per annum to \textit{plus} 5\% (also a "typical" change excluding the inflationary episodes during some of the year in Chile and Ghana), results in a decrease of saving equal to 5.5\% of GNDI.

The general conclusions we have reached concerning the effects of financial liberalization in individual countries are robust to several changes in the specification. For instance, we obtain similar results if we use a weighted average of the first few principal components (with the ratio of the standard deviation relative to the total standard deviation) as an index of financial liberalization. This is equivalent to including the principal components separately and imposing the restriction that their coefficient is proportional to the fraction of the total variance explained by each one of them. We experimented with adjusted private and public saving rates and income to allow for capital gains and losses induced by inflation on assets denominated in local currency (see Table 6 for estimates of the cointegrating vector in this case). We also re-estimated the model by using a "backward" real interest rate, defined as the nominal interest rate minus the inflation rate over the preceding period. We tried adding the dependency ratio to the cointegrating vector; we included an interaction term between the interest rate and the financial liberalization index to allow for the interest rate effect to differ depending upon the degree of liberalization; we used

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\footnote{A variety of effects may be associated with inflation, including the fact that it is positively correlated with the private sector's capital loss on monetary assets, the relative-price confusion effect of Deaton (1977),}
both linear and quadratic interest rate terms to capture the idea that the effect on savings may depend upon the value of the interest rate itself. These additional variables did not have significant coefficients. In all of these cases the general conclusions concerning the effect of the liberalization index and of the interest rate on saving remain unaltered.

5. Econometric Evidence: Augmented Euler Equations

The negative impact of financial liberalization on saving found for some countries above suggests that liberalization may have weakened credit or liquidity constraints. Curiously, despite dramatic changes in financial structure worldwide, the Euler equation literature on liquidity constrained consumption has not focussed on time-varying constraints.

Here we start with the Campbell-Mankiw (1989), (1991) approach of estimating an Euler equation augmented by the presence of liquidity constrained consumers, and attempt to estimate variation in the proportion of constrained consumers as liberalization proceeds. Thus, let $\phi$ be the proportion of unconstrained consumers and assume that the remainder consume all their income. If $\phi$ is constant then two standard Euler equations are:

For constant interest and quadratic utility:

$$\Delta c_i = (1-\phi)\Delta y_i^c + \phi \varepsilon_i$$

For time-varying interest and CRRA utility:

$$\Delta \ln c_i = \mu \phi + \Delta \ln y_i^c + \phi \sigma_i + \phi \varepsilon_i$$

\[ (1) \]
\[ (2) \]

substitution of consumer durables for financial assets as an inflation hedge, or various forms of uncertainty.

where $\mu = -\sigma \ln(1 + \delta)$. $\delta$ is the subjective discount rate, $\sigma$ is the intertemporal elasticity of substitution and $y^c$ is the per-capita income of the constrained consumers, assumed to be a constant fraction $\eta$ of per-capita income in the economy.

If we allow $\phi$ to change through time then (1) and (2) become:

$$
\Delta c_i = (1 - \phi_i) \Delta y_i - \frac{\Delta \phi_i}{\phi_i} (\eta y_{i-1} - c_{i-1}) + \xi_i \\
\Delta \ln c_i = (1 - \phi_i) \Delta \ln y_i + \phi_i \sigma r_i - \frac{\Delta \phi_i}{\phi_i} (\ln y_{i-1} - \ln c_{i-1} + \ln \eta) + \phi_i \mu + \xi_i
$$

where $\xi_i = \phi_i \epsilon_i$.

Equations (3) and (4) emphasize that the sensitivity of consumption to income varies over time, as the share of liquidity constrained consumers varies. Indeed, the sensitivity of aggregate consumption to current income is due to the fact that some consumers consume their income, and as such is proportional to the relative size of the credit constrained group. The sensitivity of consumption to the interest rate also changes over time in (4). But the main novelty is that the time-variation of $\phi$ introduces additional regressors in (3) and (4).

In particular, there is a new term of error-correction type involving lagged consumption and income, whose coefficient is equal to the rate of change in the proportion of unconstrained consumers. This consequence of time varying liquidity constraints seems to have been overlooked in the literature.

23 Assuming $\eta$ constant is necessary to have (3) and (4) below in a tractable form.

24 To derive (3), define per capita consumption $c_i = (1 - \phi_i) c_i^u + \phi_i c_i^c$, where the superscripts $u$ and $c$ denote unconstrained and constrained consumers respectively. Then take first differences to obtain:

$$
\Delta (1 - \phi_i) c_i^u + \Delta \phi_i c_i^c = (1 - \phi_i) \Delta c_i^u + c_i^{u_{i-1}} \Delta (1 - \phi_i) + \phi_i \Delta c_i^c + c_i^{c_{i-1}} \Delta \phi_i
$$

Substituting the definition of $c_{i-1}$ and using $c_i^c = \eta y_i$ gives (3). The derivation of (4) proceeds along similar lines, using a geometric mean with population weights for average per capita consumption (whereas in the empirical implementation we substitute a simple mean consumption).
The error term in (3) and (4) also depends on $\phi_t$ giving rise to a need to seek consistent estimates by IV or GMM techniques. For instance, assume that the set of instruments used, $z_{t-1}$, belongs to the information set available at time $t-1$. If $\phi_t$ is also a function of variables known at time $t-1$, then $E(z_{t-1} \xi_t)=0$ since the forecast error $\varepsilon_t$ is by definition uncorrelated with variables at $t-1$. More precisely:

$$E(z_{t-1} \xi_t) = E(z_{t-1} \phi_t, \varepsilon_t) = E_z [E(z_{t-1}\phi_t, \varepsilon_t | z_{t-1}, \phi_t)] = E_z [E[\xi_t | z_{t-1}, \phi_t]] = 0$$

if $E(\varepsilon_t | z_{t-1}, \phi_t) = 0$

The last assumption is plausible if financial liberalization measures are actually effective one period after being implemented so that $\phi_t$ depends upon the lagged value of the liberalization index.

The final step is to relate $\phi_t$ to financial liberalization. We will assume that $\phi_t$ is an increasing function of the index of financial liberalization lagged one period, $fli_{t-1}$. In Table 7 we summarize the empirical results for the specification that includes the interest rate, estimated by GMM (past values of the included variables are used as instruments). In the first part of the table we present the estimates of the model under the assumption of a constant $\phi_t$ (see equation (2)). For the majority of countries the coefficient of income is significant at conventional levels. This is evidence in favor of the presence of liquidity constraints. In the second part of the table we have adopted a logistic specification for $\phi_t$, so that $\phi_t = 1/(1 + \exp(-\alpha_0 - \alpha_1 fli_{t-1}))$ and we have estimated model (4). If financial liberalization relaxes financial constraints $\alpha_1$ would be positive. For two countries (Ghana and Zimbabwe), we have not succeeded in obtaining convergence. For the remaining six countries, the results,
on the whole, show lack of a significant relationship between $\pi_t$ and the index.\textsuperscript{25} In the only case, Turkey, in which $\alpha_1$ is significant at conventional levels, it is indeed positive. However, Turkey was the country in which the saving function results suggested a positive direct effect of liberalization on savings.

The Euler equation results suggest that financial liberalization has had little impact on the amount of credit available to consumers through the formal financial sector. Alternatively, the inconclusive results may stem from the econometric problem of pinning down what is essentially the coefficient of the product of a non-stationary variable ($fi_t$), with a stationary one ($\Delta ln y_t$). More generally, one might question the adequacy of the instruments used in estimating the augmented Euler equations.

A further reason for us to expect to find (as we do) a stronger influence of liberalization in our savings equation by comparison with the Euler equation, is that the dependent variable of the former relates to total private saving (business as well as household sectors) while the latter relates in principle only to household sector behavior. Just as it is more sensitive to exogenous shocks (Honohan and Atiyas, 1993), business saving in developing countries may be more influenced by liberalization than household behavior, especially as the latter may be more conditioned by informal finance than by reforms that affect mainly the formal sector.

6. Conclusions

Our econometric results confirm the visual impression from the figures, as well as much previous literature, that there is no strong reliable interest rate effect on savings. Only when the data is pooled and one assumes that the long-run coefficients are equal across countries (a

\textsuperscript{25} The basic sense of the results does not change if we allow $\alpha_0$ to be different when the growth rate of income is negative, or if we choose a different functional form (such as the Gumbel) for $\phi$.}
restriction that the data rejects) can we find evidence of a significant positive interest rate effect on saving -- and even then the effect is small.

Our index of financial liberalization captures several aspects of reform that are not fully represented by changes in the interest rate, such as the increased availability of a variety of saving media with better risk-return characteristics or the relaxation of borrowing constraints, following financial reform. But here too, the econometric evidence on the impact of reform on saving is very mixed. When savings functions are estimated for each of the countries separately, the long-run effect is found to be significantly negative for two (Korea and Mexico), positive for two (Ghana and Turkey), with no clear effect is discernible in the others. When the long run responses are constrained to be equal, the effect of the financial liberalization index is significantly negative and large enough to offset in these constrained estimates the positive effect of the interest rate increases that have accompanied the reforms.

Estimation of the augmented Euler equation for consumption confirms previous evidence of excess sensitivity of consumption to income. However, with the exception of Turkey, there is not much evidence that such sensitivity has decreased with financial liberalization, although this may due to the econometric difficulty of obtaining precise estimates of the parameters.

This tentative finding of a negative average value for the effect of liberalization on saving suggests that the negative impact of relaxation of borrowing constraints is the dominant factor. The fact that the estimated effect varies from country to country suggests that the process of financial liberalization may have increased consumers' access to credit in differing degrees from country to country to an extent not fully captured by our index. In this context it would be of interest to try to decompose the effects of the reform package further, but our data here is not rich enough to do that.
Another important distinctive characteristic at the country-level is the macro-management that followed the liberalization. As already mentioned, countries undertaking financial reform are prone to an excessive transitory boom in credit, often linked with a surge in property prices. The degree to which this occurs depends on macroeconomic and monetary policy. Thus contrasting monetary policy may have the effect of contaminating the estimated impact of liberalization \textit{per se}. Further evidence on the accompanying macroeconomic policies for a larger sample of countries would be needed to resolve this issue.

For the present, our results suggest that, while financial liberalization may sometimes increase private saving, the opposite can also be the case. Considering that government saving can also be adversely affected,\footnote{As noted earlier, financial liberalization includes reducing below market financing for government, and may also increase expenditures by requiring that subsidies be explicit. However, in addition to longer term gains in revenue due to more rapid growth, in the near bank privatization, at least in the right regulatory environment, can save substantial sums, as in Argentina (Clarke and Cull, 1997).} it would be unwise to rely on an increase in savings as the channel through which financial liberalization can be expected to increase growth.

Even if financial liberalization does not increase private saving, it does not follow that the process contracts the volume of funds applied to productive investment. For one thing, liberalization can increase the inflow of capital, including the return of flight capital (Bartolini and Drazen, 1997). For another, by strengthening market discipline and increasing the autonomy of banks and other financial institutions, the various elements of the reform process can have the effect of eliminating less productive uses of loanable funds. These two potentially important aspects are not considered in the present paper.
<table>
<thead>
<tr>
<th></th>
<th>M2/ private</th>
<th>rₜ</th>
<th>(s/y)ₜ</th>
<th>M2/ private</th>
<th>rₜ</th>
<th>(s/y)ₜ</th>
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<td>GNDI credit/ GNDI</td>
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Notes: t statistics in parenthesis. Private credit denotes the stock of credit to the private sector.
Table 2: Panel Integration and Cointegration Tests

Part I

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<tr>
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<th>$(s/y)_t$</th>
<th>$\ln y_t$</th>
<th>$r_t$</th>
<th>$fli_t$</th>
<th>$\pi_t$</th>
<th>$\text{gov}_t$</th>
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<td>-0.859</td>
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<tr>
<td>with trend</td>
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</tr>
<tr>
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<td>-3.892</td>
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Part II

cointegrating vector 1: $[(s/y)_t, \ln y_t, r_t, fli_t, \pi_t, \text{gov}_t]$

cointegrating vector 2: $[(s/y)_t, \ln y_t, fli_t, \text{gov}_t]$

Panel conintegration test

<table>
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<th>cointegrating vector 2</th>
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<td>Panel ADF</td>
<td>-4.677</td>
<td>-4.95</td>
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(Im, Pesaran, Shin on residuals)

Notes:
1. $P$ denotes the number of lags in the country specific ADF test.
2. The Panel Integration test is based on Im, Pesaran, Shin (1995). The test is distributed as $N(0,1)$. The unit root hypothesis is rejected at the 5% significance level for values below -1.645.
3. The panel ADF t test is based on Pedroni (1997, a b). The test is distributed as $N(0,1)$. 
Table 3: Estimating the Cointegrating Vector for Savings

Part I: OLS for \( (s'/y)_t = \beta_0 + \beta_1 \ln y_t + \beta_2 r_t + \beta_3 fli_t + \beta_4 \pi_t + \beta_5 \text{govs}, + u_t \)

<table>
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<th>GHA</th>
<th>IDN</th>
<th>KOR</th>
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</table>
Table 3: Estimating the Cointegrating Vector for Savings

Part II: Dynamic GLS for \( (s/y) = \beta_0 + \beta_1 \ln y_t + \beta_2 r_t + \beta_3 f_{lt} + \beta_4 \pi_t + \beta_5 g_{ovs_t} + u_t \)

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Part III: Dynamic GLS for \( (s/y) = \beta_0 + \beta_1 \ln y_t + \beta_2 f_{lt} + \beta_3 g_{ovs_t} + u_t \)

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Notes:
1. t-statistics in parenthesis.
2. The dynamic GLS estimates have been obtained by adding the contemporaneous changes of all the RHS variables as additional regressors and by allowing for AR (1) errors.
Table 4: Error Correction Model for Savings

\[
\Delta(s/y)_t = \alpha_0 + \psi_1 \Delta(s/y)_{t-1} + \alpha_2 \Delta \ln y_t + \alpha_3 \Delta r_t + \alpha_4 \Delta fli_t + \alpha_5 \Delta \pi_t + \alpha_6 \Delta govs_t + \phi_1 ec_{t-1} + u_t
\]

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<th>KOR</th>
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<th>MEX</th>
<th>TUR</th>
<th>ZWE</th>
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<td>0.001</td>
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| \(\Delta(s/y)_{t-1}\) | -0.082 | 0.072 | 0.149 | 0.110 | -0.077 | 0.297 | 0.172 | -0.023 |
|                        | (-0.471) | (0.420) | (1.214) | (1.064) | (-0.624) | (2.281) | (0.722) | (-0.068) |

| \(\ln y_t\) | 0.166 | 0.100 | 0.215 | 0.465 | 0.430 | 0.125 | 0.015 | 0.186 |
|             | (3.216) | (1.432) | (3.269) | (8.747) | (5.463) | (1.886) | (0.176) | (0.681) |

| \(r_t\) | -0.005 | -0.336 | -0.318 | -0.128 | -0.908 | 0.216 | 0.030 | -0.263 |
|          | (-0.076) | (0.788) | (-1.486) | (1.368) | (-3.092) | (4.911) | (0.358) | (-0.533) |

| \(fli_t\) | -0.010 | 0.011 | -0.003 | -0.013 | 0.000 | 0.006 | 0.010 | -0.014 |
|           | (-0.862) | (1.212) | (0.470) | (-2.388) | (-0.068) | (0.791) | (1.145) | (-0.436) |

| \(\pi_t\) | -0.033 | -0.279 | -0.478 | -0.107 | -1.360 | 0.271 | 0.036 | -0.371 |
|           | (-0.482) | (-0.824) | (-2.827) | (-1.083) | (-4.429) | (5.417) | (0.386) | (-0.749) |

| \(govi_t\) | 0.146 | -0.745 | -0.983 | -1.297 | -1.319 | -0.159 | -0.239 | -0.091 |
|            | (-0.586) | (-3.104) | (-2.332) | (-6.897) | (-9.548) | (-8.885) | (-0.847) | (-0.304) |

| \(ec_{t-1}\) | -0.344 | -1.071 | -0.890 | -0.429 | -0.856 | -0.779 | -0.697 | -0.274 |
|              | (-1.612) | (-3.473) | (-4.893) | (-3.078) | (-3.398) | (-3.644) | (-2.485) | (-0.806) |

| R2 | 0.500 | 0.583 | 0.730 | 0.872 | 0.864 | 0.897 | 0.176 | 0.000 |

| BG test | 0.088 | 0.085 | 0.179 | 0.167 | 0.57 | 0.126 | 0.619 | 0.025 |

| NOBS | 23 | 23 | 22 | 22 | 23 | 23 | 23 | 18 |

Notes:
1. \(t\)-statistics in parenthesis.
2. BG denotes the marginal significance level for the Breusch-Godfrey test for serial correlation up to the second order.

Table 5: Restricted SURE Estimates
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Notes:
1. t-statistics in parenthesis.
2. LR denotes the marginal significance level of the likelihood ratio test on the equality across countries of the long run coefficients.
Table 6: Cointegrating Vector for Savings Adjusting for Domestic Capital Gains

Part I: OLS for

\[
\frac{s}{y} = \beta_0 + \beta_1 \ln y^*_t + \beta_2 r_t + \beta_3 fli_t + \beta_4 \pi_t + \beta_5 \text{govs}^*_t + \mu_t
\]

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Part II: Dynamic GLS for

\[
\frac{s}{y} = \beta_0 + \beta_1 \ln y^*_t + \beta_2 r_t + \beta_3 fli_t + \beta_4 \pi_t + \beta_5 \text{govs}^*_t + \mu_t
\]

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Notes:
1. t-statistics in parenthesis.
2. \((s/y)^*_t, \ln y^*_t, \text{govs}^*_t\) have been adjusted for capital gains (losses) on nominally denominated domestic assets due to inflation.
Table 7: Excess Sensitivity Tests and the Augmented Euler Equation for Consumption (GMM Estimates)

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<th>MYS</th>
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<td>(3.222)</td>
<td>(1.056)</td>
<td>(1.113)</td>
<td>(2.089)</td>
<td>(2.593)</td>
<td>(3.127)</td>
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<td>(3.392)</td>
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<td>(r_t)</td>
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<td>(2.688)</td>
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Part II

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Notes:
1. t-statistics in parenthesis.
2. The instruments used are
3. BG denotes the marginal significance level for the Breusche-Godfrey test for serial correlation up to the second order.
3. OR denotes the marginal significance level of the test of over-identifying restrictions.

Financial liberalization packages generally consist of a wide range of different measures. As explained in the text we summarize all the information available on the liberalization process by a single index. One way of building the overall index of financial liberalization is to use principal components methods. The idea is to associate a dummy variable to each reform measure. Its value equals one in the years characterized by the liberalized regime, and zero otherwise. We collect all the dummy variables as columns of a matrix X, and then compute the principal components of X. In the text we use two different indexes. One is just the first principal component (i.e. the vector that explains the greater portion of variance). The second one is computed as a weighted average of the more relevant components that explain, cumulatively, 95% of the total variation of X. We use the fraction of the total standard deviation explained by each component as weights, so that the first principal component is weighted more than the second and so on.

The columns of X representing the timing of the most important liberalization measures and are ordered according to the following scheme:

1. Domestic Financial Liberalization.
   1.a Interest rates.
   Dummies for the timing of liberalization of interest rates (Dr=1 when interest rates are freed)
   1.b Pro-competition measures.
   Includes lowering of entry barriers, permissions to offer new services and other measures intended to foster competition in the financial markets. (Dco=1 when measures are taken)
   1.c Reserve requirements.
   Most financial liberalization packages include a reduction in reserve requirements, which increases the funds available for lending. (Dres=1 when reserve requirements are reduced)
   1.d Directed Credit
   This set of variables includes all the measures aimed to reduce the amount of preferential loans, or loans at a preferential rate, banks are forced to make. (Dpr=1 when directed credit is reduced)
   1.e Banks' ownership
   Dpriv=1 when banks are privatized or government controls are reduced.
   1.f Prudential Regulation.
   Typically financial liberalization programs include a strengthening of prudential regulation and supervisory powers of the CB. This is relevant in which it can increase the trust in the financial system and hence attract more deposits. (Dreg=1 when prudential regulation measures are in force)

2. Securities Markets
   These variables capture the measures aimed at deregulating and developing the securities and stock markets (Dst=1 when markets are deregulated)

   Domestic financial liberalization is generally paired with international liberalization both in the capital and in the current account. Here we use the information relative to the capital account and the exchange rate. (Df=1 when capital movements and/or the exchange rate are liberalized).
APPENDIX 2- Variables Definitions and Data Sources.

\[(s/y)_t = \text{private saving rate} = (\text{private savings}/ \text{GNDI})_t\]

private savings = gross national savings - public sector savings

gross national savings, Source: WB “World Savings Database” Rev. 3.00.

public sector savings = (1) for CHL, KOR, MEX, MYS, TUR - savings of the non-financial public sector (= consolidated central government + state and local governments + non financial public enterprises) computed as revenues minus consumption - Source: WB “World Savings Database” Rev. 3.00. (2) for IDN savings of the consolidated central government computed as revenues minus consumption - Source: WB “World Savings Database” Rev. 3.00. (3) for Ghana - savings of the consolidated central government computed as budget surplus plus public investment - Source: Ghana-Quarterly Digest of Statistics (4) for Zimbabwe - savings of the consolidated central government computed as budget surplus plus public investment - Source: World Bank National Accounts + Easterly database.

GNDI: GNP + External Transfers - Source: WB “World Savings Database” Rev. 3.00.

\[y_t = \log \text{of real per-capita income} = \ln(\text{GNDI/ population} \times \text{defl})_t\]

population: Source WB BESD database.

\[\pi_t = \text{inflation rate} = \Delta \ln(\text{defl}_{t+1})\]

defl: implicit consumption price deflator - year average- Source: WB “World Savings Database” Rev. 3.00.

\[r_t = \text{real interest rate} = (1) \text{for IDN, KOR, MYS} r_t = \ln (1+ i^*_t) - \Delta \ln(\text{defl}_{t+1}) \text{ (2) for CHL, GHA, MEX, TUR, ZWE} r_t = 0.5(\ln (1+ i^*_t) + 0.5( \ln (1+ i^*_t) + \Delta \ln(\text{defl}_{t+1})))\]

\[i^* = \text{nominal interest rate} = \text{short term deposit rate, year average} - \text{Source: Central Banks Bulletins.}\]

\[i^d = \text{nominal interest rate} = \text{short term deposit rate, December value} - \text{Source: Central Banks Bulletins.}\]

\[fli_t = \text{index of financial liberalisation} - \text{Source: our calculations}\]

govs_t = public sector saving rate (relative to GNDI) - Source: WB “World Savings Database” Rev. 3.00.

\[(s/y)_t^* = \text{private savings ratio adjusted for domestic capital gains} - \text{Source: WB “World Savings Database” Rev. 3.00.}\]

\[y_t^* = \text{GNDI adjusted for domestic capital gains} - \text{Source: WB “World Savings Database” Rev. 3.00 + our calculations}\]

govs_t^* = public sector saving rate adjusted for domestic capital gains - Source: WB “World Savings Database” Rev. 3.00.
References


[33] Lehmussaari, O.P. (1990), "Deregulation and Consumption Saving Dynamics in the Nordic Countries", IMF Staff Papers, 37, 71-93.


