UNIVERSIDAD DEL CEMA
Buenos Aires
Argentina

Serie
DOCUMENTOS DE TRABAJO

Área: Economía y Negocios

CONTRACT LINKAGES AND RESOURCE USE IN GRAIN PRODUCTION: THE ARGENTINE *PRADERA PAMPEANA*

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Mayo 2012
Nro. 488

ISBN 978-987-1062-78-2
Queda hecho el depósito que marca la Ley 11.723

www.cema.edu.ar/publicaciones/doc_trabajo.html
UCEMA: Av. Córdoba 374, C1054AAP Buenos Aires, Argentina
ISSN 1668-4575 (impreso), ISSN 1668-4583 (en línea)
Editor: Jorge M. Streb; asistente editorial: Valeria Dowding <jae@cema.edu.ar>

Gallacher, Marcos
Contract linkages and resource use in grain production : the Argentine pradera pampeana.
- 1a ed. - Buenos Aires : Universidad del CEMA, 2012.
27 p. ; 22x15 cm.

ISBN 978-987-1062-78-2

1. Economía Argentina. I. Título.
CDD 330.82

Fecha de catalogación: 06/07/2012

Summary

This paper analyzes contractual arrangements in barley production in the Argentine *pradera pampeana* region. Barley constitutes an interesting case-study: its production and marketing conditions result in some degree of vertical contracting between primary producers and processors. Vertical coordination via contracting, however, is considerably less than that observed for example in poultry or some types of vegetable and fruit production. Barley is thus an intermediate case between coordination via impersonal market transactions and that resulting from different degrees of vertical integration.

The objective of the paper is to determine the impacts of contracting on decisions such as input purchasing agreements, output marketing sharing, vertical integration, risk management and the use of technical know-how. The impact of contracting arrangements on input use and technology choice is also explored.

Findings include the following. First, input purchase sharing, or output marketing sharing arrangements are infrequent amongst farmers. Some evidence exists, however, of barley farmers engaging in these arrangements more than farmers producing alternative crops. The (partial) "asset-specific" nature of the barley crop may explain these differences. Second, a higher proportion of barley farmers engage in different types of vertical arrangements with input suppliers or output purchasers. Third, farmers participating in the barley vertical chain are more likely to use formal insurance instruments than farmers producing other crops. Fourth, significant differences exist in input (fertilizer and ag chemical), and technical-know how between farmers that participate and those that do not participate in vertical arrangements with input suppliers and output purchasers. Formal contracting appears, in general, to have a positive impact on all these dimensions.

The paper shows that contracts between barley producers and processors are relatively simple, relying for compliance on reputation and good-will more than on the formal "written word". Possibly, relatively low benefits from non-compliance result in this type of arrangement working well. The paper also shows, however, that private arbitration, mediation and quality inspection institutions exist in order to reduce both the probability and costs of litigation. The *Camara Arbitral* (in existence since 1905) is an interesting example of this type of institution.

Contract linkages and resource use in grain production: The Argentine *pradera pampeana*

Marcos Gallacher [1]

I. INTRODUCTION

Three reasons account for the increased interest in contractual arrangements in agriculture. The first is related to understanding topics such as changes in farm size, risk-transfer mechanisms, agricultural technology inflows and rural labor markets. All these are affected by different types of contractual arrangements made at the farm level. Of particular importance is the fact that factor- and product-market contracts are not independent of one another: the choice of (for example) a land tenure contract affects and in turn is affected by contracts made with input suppliers and output demanders. Contracts are tools for managing risk and providing incentives, and as such have effects that cannot be studied in isolation.

The second is the need to explain "structural change" occurring in the food sector of many countries. Rural-urban migration, in particular, is resulting in changes in the nature of food chains: rapid urbanization increases the demand for transport, storage, processing and wholesale and retail distribution. Consider Brazil, where rural population as a fraction of total population fell from 32 percent in the 1981 to 14 percent in 2009. In Bolivia and Paraguay relevant figures are respectively 54 and 58 percent in 1981, falling to 34 and 29 percent thirty years later (World Development Indicators). Changes such as these involve a massive shift in linkages between the food production and the food consumption stages. In particular, an increasingly urban

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population results in the development of a transport, storage and distribution system. It also results in changes in the types of foods that are demanded, in particular under a scenario of increasing incomes.

Growth of agricultural trade is the third reason for studying agricultural contracts. Since 1960, world population increased from 3 to more than 6.5 billion (United Nations – World Population Trends). However, trade of agricultural products increased even more: cereals by a factor of 3, fruits and vegetables by 6 and livestock products by nearly 8 (FAOSTAT). Clearly, trade flows are an increasingly important factor in the agricultural and food sector.

While additional trade opens up opportunities for economic growth, challenges have to be met for understanding who benefits and who loses by these trade flows. For example, current economic policy in Argentina attempts to reduce meat exports via export quotas. The stated objective is to keep prices down in order to benefit consumers. Prices paid by consumers, however, depend not only on the farm-level price of meat but on a host of other factors affecting the meat value chain: in particular, on the smoothness with which contractual arrangements are carried out between farmers, middlemen, processor and distributors. An improved understanding of these arrangements appears to have much to offer in order to reduce the negative effects of high international food prices on domestic consumers.

This paper has two objectives. First, to determine the importance of farm- and farmer characteristics in explaining the extent to which selected contractual alternatives are chosen. As explanatory factors of contractual choice, we focus attention on farm size, farmer human capital and the pattern of production specialization on the farm-firm. The second objective is to determine the possible impact of contracting arrangements on selected measures of input use and technology choice. .

Contracting can be seen as a response to less-than-optimal functioning of conventional spot transactions. Forces favoring bilateral contracting may be related to asset specificity (Williamson, 1985), need to assure product quality (Ricketts, 1994) improved coordination, protection of intellectual property, risk sharing, financing, and improved labor and managerial incentives. Different kinds of contracts can be considered “technologies” the adoption of which results in benefits as well as costs. In particular, contract adoption may involve fixed costs and thus be affected by farm size. Adoption may also be dependent on general “managerial skills” and thus on aspects such as farmer education.

As way of introduction, Section II describes contractual arrangements in the value chain leading to the production of beer. Reasons for these arrangements are briefly discussed. The conceptual framework necessary for understanding contractual choice in agriculture is presented in Section III. Empirical analysis of contractual choice in Argentine agricultural production is the basis of Section IV. Lastly, summary and conclusions follow in Section V.

II. THE BARLEY-MALT-BEER VALUE CHAIN

The barley-malt-beer value chain is a good starting point for discussing agricultural contracts in the *pradera pampeana* region. Barley is of course the basic input for the manufacture of beer. The production process involves three basic stages: farm-level production of barley, production of malt using barley as an input and production of beer using malt and other inputs. At the consumer level, the beer market shows high level of concentration: in Argentina the largest company accounts for 2/3 share of the total market, the first two firms total more than 80 percent of the market (Rucci, 1999). High industry concentration suggests either substantial product differentiation or economies of scale either in the production, distribution or consumer marketing stages. Concentration also suggests the possibility of "market power" i.e. non-marginal cost pricing either upstream or downstream.

Despite industry concentration multiple alternatives exist in the beer production value chain (Figure 1). Beer as compared – for example – to the wheat or corn value chain shows a larger number of possible linkages between producers, on the one hand, and users of barley on the other (Gallacher, 2007). Barley – in contrast to other cereals and most oilseeds – is frequently produced under contract with malt or beer producing companies. A "quasi-vertical integration" process results in users of barley contracting with producers. The contracts usually specify type of seed to be used, quantity and type of fertilizer, weed control strategies, timing of harvest and other aspects. Agronomic advice or monitoring is also included in the contract terms. The contract usually specifies an output price for producers taking (harvest-time) wheat price as a reference, wheat being the main winter crop that competes for land with barley.

As shown in Figure 1, the "extent of market transactions" varies substantially. On the left of the figure, beer reaches the consumer after market transactions have taken

place between barley producers, grain handlers, malt-producing firms, beer producing firms and distributers/wholesalers and retailers. The middle "path" of the figure shows vertical integration between malt and beer production: one "market" stage is eliminated. In turn, the "path" on the right of the figure shows vertical integration occurring in the grain handler-malt producing stage: in this case a large multinational grain trade firm (Cargill) vertically integrates forward in order to sell malt instead of barley grain.

The existence of contracts between farmers and downstream market participants has sometimes been rationalized in terms of industry concentration or "market power". In the case of Argentina, mergers occurring in the beer industry have been shown to increase profits of the merged firm above the sum of profits of the pre-merged firms Consumer welfare losses have resulted (Rucci,1999). Despite the above, it is not clear what these changes in industry structure imply for primary producers as these could participate (at least partially) in the surplus transferred from consumers to the production sector.

If farmers are paid a barley price that only covers opportunity costs rents are captured entirely by the manufacturing stage. Producers are then "not worse of" by participating in the beer production process, but they are not "better of" either. However, another possibility is that some portion of rents (understood as returns over opportunity costs) are transferred from the manufacturing to the primary production stage. Indeed, the theory of "efficiency wages" argues that firms may choose to pay salaries above those necessary to recruit workers (Milgrom and Roberts [1992], Ricketts[1994]). The somewhat different theory of "gifts exchange" in employment relationships (Akerlof, 1982) also results in payments above opportunity costs: by paying a "rent", firms create a reciprocity obligation in employees. This concept may well apply to vertical linkages between the agribusiness and farm sector: farmer "loyalty" to agribusiness firms may result from prices paid in vertical transactions that are somewhat above strict opportunity costs.

Rent payment to employees (or in this cases farmers producing barley) can be justified by pointing out that contracts between farmers and barley purchasers are incomplete. In particular, procurement in a timely manner of high-quality barley requires the farmer to supply (partially unobservable) "effort". The probability that this effort will be forthcoming will increase if the farmer receives a payment covering not only opportunity costs but also a "rent". This "rent" constitutes the incentive for contract compliance: if only opportunity costs are offered, the farmer basically

perceives no cost in "shirking" as he always has a "fall-back" option of producing conventional crops free from contractual obligations.

III. COMPETITIVE MARKETS, VERTICAL CONTRACTS AND NETWORKS

Market prices are *the* relevant variable in competitive markets. As pointed out by Hayek 1945) prices summarize the workings of an economic system and economize on the need to gather complex and frequently conflicting information. In contrast, contracting (or in the limit vertically integrating stages in the value chain) results in a dampened (competitive) price setting process. Moreover contracting frequently replaces the "one dimensional" setting of competitive markets (were exogenous price is the principal variable) with a "multiple dimensional" scenario were in addition to exchange prices other requirements (complex quality standards, timing patterns, constraints on information disclosure, labor and agricultural input standards) have to be met.

Decision-making based on prices contrasts with situations where exchange takes place under constraints resulting from vertical contracts. These constraints may transfer decision-authority either away or alternatively towards the farm unit. For example, an egg producer under contract with a large agribusiness firm receives feed, animal stock, veterinary know-how as part of the deal. In a sense, this producer is not an independent entrepreneur but a (piece-rate) "employee" of the agribusiness firm. As compared to the situation where he produces the same output but without contract, scope for individual decision-making has been reduced.[2] On the other hand, a farmer engaged in producing commercial seed for a seed company, or "vertically integrating" by investing in an on-farm storage facility has additional decision-making challenges over and above those of a farmer simply selling his output to a grain handler. Contact choice, in summary, may either reduce or expand opportunities for exercising decision-making discretion.

The multilateral arrangements that characterize networks – as opposed to simple "bilateral" contracting – result in coordination costs. Indeed, if *n* parties separately engage in contracts with a "central contractor", only *n* linkages are needed. However, if these *n* parties are to contract directly among themselves without a central contracting

[2] However, if contracting allows an increase in output (resulting, for example, from expanded operations through financing provided by the agribusiness firm) decision-making scope may well have increased.

agent, a total of *n(n-1)/2* contractual linkages are needed. Arrangements whereby farmers share machinery services, or take part in "group" output marketing or input purchase schemes are examples of arrangements requiring "multilateral" type of arrangements among participating farmers.

Characteristics of the asset subject to exchange determine contract choice. Exchange involving non-specific assets such as grains of cereals or oilseeds do not benefit from contractual protection other than that provided by (in the words of Williamson) "classical" contracting arrangements. In contrast, exchange of assets characterized by specificity will benefit from more detailed contracts. In the absence of these, recourse may be made to "relational" contracting whereby parties rely on reputation and rents from repeated interaction.

Increase in decision-making skills may result in a shift from "simple" to "more complex" contractual arrangements. For a farmer, the relevant choice may therefore not be between "producing wheat" and "producing green peas" but between interacting via spot markets (the case of wheat) or, alternatively, interacting via more complex contractual forms. Indeed, the acquisition of knowledge regarding agronomic practices of one crop versus the other may be of secondary importance as compared to the acquisition of knowledge of one contractual environment versus the other. In other words, the wheat farmer attempting to produce a higher-valued crop (green peas) may find it easier to learn green pea production technology than contractual subtleties and alternatives for the marketing of peas as compared to the simpler (spot price) wheat.

Adoption of certain contractual forms may thus be compared to adoption of production technologies: higher-skilled decision-makers may adopt earlier, or to a larger extent potentially profitable but relatively complex contractual arrangements. As pointed out by Schultz (1975) human capital (both acquired in formal schooling as well as a result of learning-by doing) is crucial for improving decision-making capabilities – contract choice may well be an arena over which these decision-making skills are exercised.

Contract adoption is also a function of the potential volume of transactions to be channeled through the contract. The reason for this is that both ex-ante as well as ex-post per-unit contract costs are a decreasing function of contract volume: i.e. fixed costs are involved in contracting. These may take the form of search costs, compliance with production technology standards, provisions for contract non-compliance etc. Indeed,

for large agribusiness firms volume transacted with individual suppliers may be a crucial aspects determining cost of inputs used in the value chain.

Output contracting alternatives include the use of futures and options, farmer group sales and different vertical integration arrangements. Futures and option transactions are impersonal; however they involve time-dependent contingent obligations. In contrast, group sales and vertical integration constitute personalized arrangements involving a greater number of dimensions than futures and options and (particularly) spot transactions. These dimensions may include input use requirements, agreements for outside monitoring, alternatives for contract termination and arrangements for the use of loaned assets. Group sales and vertical integration may thus require more complex implicit or formal contractual arrangements. For these alternatives "relational" contracting may of particular importance.

Input interfaces alternatives include spot market purchases, farmer group purchases, and different vertical integration arrangements with input suppliers. Again, the extent of contract commitment increases when moving from spot purchases to group purchases and to vertical integration.

IV. EMPIRICAL ANALYSIS

IV.1 The market for barley in Argentina

Consumption of beer in Argentina increased 60 percent during the last decade (INDEC, 2011). This increase contrasts with the 20 percent decrease in the consumption of wine, a close substitute. Per-capita beer consumption (41 lts/year) remains substantially below that observed in the U.S (84 lts), Spain (86 lt) and Great Britain (94 lt) (CICA, 2011). Different consumption patterns result from different relative prices between beer and other alcoholic beverages (in particular wine); however they also possibly result from lower per-capita income in Argentina. If this is the case, an increase in beer consumption could well occur if the current trend in increase in per-capita income continues in the near future. An increase in the size of the domestic market could result in substantial changes in the production of barley at the farm level. In particular, and as pointed out by Stigler (1951), a larger market opens up the possibility of increased specialization, in this case both of barley farmers as well as of malt and beer producers.

Growth in the market should also result in a reduction in the concentration observed in the market for beer, and a move towards reduced price-setting by the dominant firm.

Cereal and oilseed production technology in the *pradera pampeana* (pampean prairie) region shares similarities to that employed in comparable areas of the U.S., Canada and Australia. Several reasons account for this. First, "medium" to "large" size (in general, larger than 200-300 hectares) units account for a large share of output are of. Second, in grain production extensive substitution of capital for labor has taken place. Third, a significant portion of total output is channeled to the international market. Fourth and last, the fact that all these areas are of temperate climate allows technology developed in one place (mainly the U.S.) to be adapted relatively easily to conditions in other countries. Argentine crop production presents however some differences with the other countries mentioned. In particular, as compared to the U.S., Canada and Australia in Argentina a smaller share of total labor input is supplied by family members – hired labor is comparatively more important. Preliminary evidence also suggests that in Argentina *agricultural contractors* (supplying farm machinery services to landowners or to firms renting land) are of considerable more importance than in the more developed economies. These different patterns of resource use are the result of - and in turn determine – contractual arrangements at the farm level.

Contract alternatives do not occur in a vacuum but are a result of the market linking farmers with barley processors. In particular, aspects such as degree of market concentration, substitution possibilities in the production of barley vis-à-vis other crops, substitution of different barley varieties in the production of beer play a role in transactions occurring between primary producers and processors. Agricultural production in the Argentine *pampas* allows significant substitution among crops and among these and livestock activities. Barley production (a winter crop) competes for resources, in particular, with wheat but also with crops such as soybeans and sunflower. Substitution possibilities result in the marginal cost of barley production being closely linked to profitability of alternative crops. Even if farmers face a single-buyer scenario, the possibilities of farmers being "exploited" by this single buyer are limited: the farmer can always "exit" by allocating resources to an alternative crop.

During the last two decades barley and wheat yields have followed the same general trend (Figure 2); however land allocated to barley has increased six-fold, while that of wheat has decreased (Figure 3). As shown in the figure, area allocated to barley increased slowly until 2005, and rapidly thereafter. A possible reason for this shift is the

increasing regulation imposed on wheat producers: as shown by Passero (2011) beginning in 2006 export quotas and other interventions imposed on the wheat crop resulted in wheat domestic prices some 10 percent below the equilibrium price that exporters could pay domestic producers. The result is the domestic wheat/barley price ratio being lower than the wheat/barley price ratio prevailing in international market. This factor accounts for part of the increase in the barley planted area. As discussed in more detail below, growth in the barley crop has resulted in changes in the contractual linkages between farmers and demanders of barley.

The domestic market for malt barley is highly concentrated. In the mid-1990´s the largest firm (Cervecería y Maltería Quilmes) accounted for 2/3 of total beer production, the second and third largest for 10-11 percent each. The remaining market share is supplied by several firms (Rucci (1999, p. 34). More recent results report a market share of 69 percent for the largest firm (Cervecería y Maltería Quilmes) and of 12 percent for the second largest (Ministerio de Economía y Producción, 2008). In the Argentine beer industry, mergers result in increased market power and thus increased firm profits (Rucci, 1999). However, when smaller firms merge, consumers may benefit due to the reduction in market power of the largest firm, or as a result of operational advantages. Economies of scale in distribution and advertising are two important factors in the market power of dominant firms.

Evidence exists of the growing importance of the export market for Argentine barley production: exports increased from 15 percent of total output in 1990 to nearly 60 percent in 2009 (FAOSTAT). Nicolás Murphy, a barley trader, has pointed out to the author that the increasing importance of exports, coupled with the high price of barley for forage is changing the nature of the malt barley market: a market with few and large participants may give way to a more competitive scenario. The gradual emergence of a "price discovery" process for barley – resulting from increasing exports and competition from buyers - may result in the future in decreased emphasis on barley contracts based on wheat prices, and increased importance of spot market transactions.

In contrast with the vigorous increase in barley exports, trade in beer remains low: the "trade intensity" metric (Export+Import)/(2*Production) has hovered around 1-2 percent during the last two decades (FAOSTAT). The price setting process for barley, as pointed previously, is thus increasingly affected by barley trade; however transactions costs possibly limit possibilities of beer exports and imports playing an important role. These transactions costs imply that demand for barley at the farm level

will be determined both by the international price of barley as well as domestic supply/demand conditions of barley for the local production of beer.

IV.2 The barley contract

The contract that links barley producers with purchasers results in the following constraints to participants:

- Seed is delivered to the farmer, to be paid for in-kind at the ratio of 2 kg of grain for every kg of seed received. The farmer is under obligation to deliver crop production resulting from the seed contract. This obligation is enforced more by reputation than by strictly legal procedures.

- Different pricing alternatives exist; however the bottom line is that the price paid for barley is a weighted average of the export price for wheat (minus export taxes) and the prevailing price of wheat in the spot market. Prices may be locked-in during the growing season: up to 20 percent of agreed production may be sold 6 months prior to harvest or later, 4 months prior to harvest or later up to 50 percent may be sold.

- Discounts (premiums) are charged (paid) according to a detailed schedule that takes into account: (i) germination, (ii) moisture, (iii) protein, (iv) grain size, (v) damaged grain, (vi) inert matter (dust, straw, etc). Price paid increases with the protein content reaching a maximum for protein content ranging from 10.5 to 12.0 percent and decreasing thereafter. The schedule of price discounts/premiums is available prior to contractual commitment.

- In some cases barley purchasers finance part of the fertilizer and ag-chemical inputs used by the farmers. If this occurs, the farmer is required to purchase a hail and frost insurance policy endorsed to the barley purchaser.

The agreement is thus basically a contract where price is contingent on the price of a substitute crop for which vigorous spot and futures market exists. Clauses incorporated in the contract result in an obligation of the purchaser to pay a higher price in the case of premiums, and the option to pay a lower price in the case of discounts. If barley is below certain standard, the purchaser is freed of contractual obligations.

As mentioned above, contractual compliance between farmers and barley purchasers rests in a large measure on reputational factors. Contracts are also “self-

enforcing" in the sense that rents from non-compliance are possibly quite low, both for the farmer as well as for the barley purchaser. There exist, however, private mechanisms to settle possible disputes. An important one is the *Cámara Arbitral* (Arbitration Chamber) a grain testing and arbitration service organized by private grain exchanges located in several cities. The oldest of these ("*Cámara Arbitral de la Bolsa de Cereales de Buenos Aires*") has been in existence since 1905. Procedures used by the *Cámara* are quite detailed. They include not only (binding) arbitration, but also mediation, quality control and other aspects. Arbitration procedures (in contrasts with commercial law) are extremely agile; moreover results from this private arbitration can be enforced through the normal judicial process.

The existence of the *Cámara* institution is of considerable importance as a facilitator of exchange. It is possible that the mere existence of this institution in some cases deters opportunism. In particular, and as pointed out by Williamson: "…contractual disputes and ambiguities are more often settled by private ordering than by appeal to the courts – which is in sharp contrast with the neoclassical assumptions of both law and economics" (Williamson, 1985 p.10).

¿What is achieved by contracting that cannot be achieved by spot transactions? Price premiums and discounts such as presented here for barley do not explain ex-ante contracting between the farmer and the barley purchaser. Indeed, spot transactions usually include this type of clauses: a farmer selling wheat to a grain elevator will receive a price that is contingent with aspects such as moisture content, inert matter and other factors. The farmer only needs to know the premium/discount schedule of one grain elevator vis-à-vis another in order to decide where to send his grain – no ex-ante contract is required months prior to the delivery period for grain. The point made is that a *price differential due to quality* does not explain the existence of contracting in barley production.

Contracts prior to planting that exist for barley production can be explained on the basis of two factors. The first relates to the non-homogeneous characteristic of barley used for malting: barley used for beer by one firm is not a perfect substitute for that used by another. Moreover, beer producers use certain varieties in certain proportions thus a (partial) "lock-in" situation arises between the farmer and the malt producer. For the farmer, this lock-in implies dependence on a given purchaser, with potential losses associated in the case of re-directing output to alternative purchasers.

The second reason is the need of brewers to reduce uncertainty with respect to total input (barley grain) supply. The concentrated nature of the demand for barley results in purchasing firms posting a price schedule with farmers reacting to this schedule. Barley purchasers do not take price as given but set prices. Price offered must of course be sufficiently attractive to cover opportunity costs (e.g. returns from barley must be at least as high as returns to wheat). If a given brewer has (i) partial monopsony power due to geographical location, and (ii) partial monopoly power due to product branding, then posted prices should maximize brewer net revenue subject to the constraint that farmer earnings are as good as in alternative production activities. In the absence of contracts, farmer expectations will lead to variation in output with corresponding efficiency losses: if output is larger than the ex-ante optimum, farmers will lose and barley producers will gain. The opposite occurs if barley output is less than the optimum needed by malt producers. Output variability thus results in risk-adjusted net revenue loss for the value chain.

The "need to reduce uncertainty" mentioned above is a valid reason for contracting only if costs are associated with supply variability. This occurs, in particular, in situations where costs exist in order to access the international market. In contrast, if barley or malt exports (imports) can act as a buffer for excess supply (demand), supply uncertainty need not be a problem: a perfectly elastic demand (supply) in the world market can be accessed for selling (purchasing) barley. However, transactions costs such as export/import taxes and transport costs may result in the export market not being a perfect substitute for the domestic market. In this case, a premium is put on accurate matching of domestic supply and demand. Ex-ante price postings by brewers contribute to this purpose.

Production of malt – as the already mentioned production of beer – is subject to significant concentration. Five plants account for most of the malt produced in Argentina. Distances between malt plants of competing firms are significant: in at least one case more than 900 km. Lock-in in the barley market thus results both from malt producers demanding certain barley varieties, as well as from transport costs reducing net prices for farmers choosing to sell their output to an alternative malt producer. This lock-in is probably the most important reason for contracts being used to link farmers with the agribusiness sector.

IV.3 Empirical analysis

We analyze contractual patterns in three crops of the Argentine *pampa* region: "cereals and oilseeds" (C&O), peanuts and barley used as an input for malt production. Wheat, corn, soybeans and sunflower comprise what we call here "cereals and oilseeds". As a first approximation, crops included in this group are channeled through "impersonal" markets: quality determination is relatively simple, further as a class they are highly "non-specific" and thus do not benefit from personalized contractual linkages between sellers (farmers) and purchasers (grain handlers, ag industry, export sector). The peanut crop also shares "non-specific" characteristics with the C&O group; however the fact that an important part of output is used for direct human consumption results in quality standards (bean size, harvest methods and timing) somewhat stricter that the C&O group. Further, peanut production requires more specialized machinery than that required by crops included here in C&O.

Barley for the production of malt and subsequently beer is generally subject to closer specifications that the other crops mentioned. The concentrated (and "asset specific") nature of the malt purchasing market implies that "bilateral dependence" exists between sellers (farmers) and purchasers (malt or beer producers).

We analyze the extent of "contract use" at the farm level. We focus on several groups of contracts. The 2002 *Censo Nacional Agropecuario* (Agricultural Census for the year 2002) was used as data-source. Micro (farm-level) data from the Census is summarized in Table 1. From the table we highlight the following:

Input purchase sharing: Farmers may share ("pool-in") for input purchases, for training services, machinery/facility use and other input procurement decisions. These arrangements require considerable "coordination effort" on the part of participating famers. Indeed, the "network" nature of share relationships implies lack of hierarchical discipline and increase in the number (and hence cost) of communication linkages. As shown in the table, some 8 – 12 percent of farmers participate in some type of input sharing relationship. Differences in participation among different farmer groups are small; however evidence exists of increased sharing in barley and peanuts as compared to C&O. These results highlight the difficulties of one farmer coordinating his activities with other farmers. They also point out that expected benefits of sharing activities are relatively small – otherwise sharing would be more prevalent.

Output marketing sharing: These sharing arrangements refer to several farmers coordinating the sale of their output in order to jointly market their crop. The reasons for doing this may be related to the possibility of improved sales prices, either due to better "bargaining" or reduced transactions (e.g. transport, middlemen) costs. In some cases groups of farmers jointly marketing their crop may avoid "short transport" (i.e. having to transport grain to the local intermediary instead of directly to the grain processor or to the export purchaser). Results show that these arrangements are very infrequent: they used by no more than 1 percent of farmers. This suggests that the frequent claims of "significant" output price differentials between smaller and larger farmers may be exaggerated as the existence of such differentials would lead smaller famers to "join up" in the marketing of their crop.

The fact that (input and output) sharing arrangements are infrequent also points out in the direction to "other" mechanisms that are in place allowing farmers to coordinate their activities. In particular, *firms* substitute for informal sharing or network mechanisms: input retailers, agricultural contractors, grain traders carry out (for profit) a "middlemen" function that in essence results in *n* famers coordinating activities through a single contractual intermediary. Coordination is thus not a result of conscious effort by farmers integrating a "network" or "sharing group" but by incentives leading to one firm to supply "coordination services" for all these farmers. As pointed out by Alchian and Demsetz (1972), the fact that the proprietor of this firm is the residual claimant to excess rents leads to efficiency. Network and sharing arrangements, then, "compete" with conventional firms as coordinating devices.

Vertical integration: as defined here**, v**ertical integration (VI) includes (formal or "relational") arrangements with (a) service firms (technical support, machinery, contractors, transport), (b) ag industries (grain processors) and (c) trade firms (seed, ag chemical, grain handlers). Table 1 shows considerable differences in vertical integration arrangements between farmer groups. As expected, VI as a whole ("All VI") is lowest (4 percent) in the C&O group. In the case of barley, 1/5 to 1/3 of farmers participate in these arrangements. Participation is higher for "large" as compared to "small" barley producers. For most crop/size groups, the most important VI arrangements involve linkages between the farm and agro-industries; linkages with service or with trade firms are much less prevalent. Census data therefore supports the notion that vertical linkages between farmers and agribusiness firms (both at the input as well as the output interface) are only justified when additional "contractual guarantees" are deemed

necessary – such is the case of barley production but not of C&O. Peanuts are an intermediate case.

Risk management: Formal insurance and the use of futures and options (F&O) markets constitute two (among many other) contractual alternatives for risk management. Results show than some 55 – 80 percent of farmers purchase some type of insurance (insurance types considered here are hail, hail + additional damages, multirisk and labor liability). Clearly, insurance is a significant issue for farmers in the region. For both the barley as well as the peanut group, insurance use appears to be positively associated with farm size. Available data only allows inferences to be made on the percentage of farmers using some type of insurance, and not on total premiums paid. However the finding that a smaller proportion of smaller farms adopt insurance points out to the possibility of higher delivery costs to these farms as compared to those of larger size. Indeed, *a-priori* one would expect smaller producing to be strong demanders of insurance given that these units to be more affected by production risk than those of larger size. Insurance use is also more prevalent in barley as compared to peanut and C&O crops. Several reasons may account for this: barley purchasers possibly require insurance as part of the contract; in particular given that a significant portion of barley acreage is located in relatively high (hail) risk production area.

As relates to F&O, participation is low (10 percent) for the C&O group as well as for the smaller peanut and barley producers. It increases substantially for the larger producers of these crops. Risk management strategies are therefore contingent on both crop type as well as farm size. Census data used here corresponds to 2002, only one year after abrupt changes in macroeconomic policies resulted in a large devaluation, abandonment of the fixed exchange rate and imposition of export taxes for grains. All these developments had severe consequences on local F&O markets, and may thus explain low participation rates. Nevertheless, the positive relationship between (peanut and barley) farm size and F&O use is evident. Clearly, larger farmers "manage things differently" than their smaller counterparts. [3]

Technical knowledge: During the last decades, Argentine agriculture has experienced a vigorous inflow of new technologies (Lema, 2000). Technology adoption requires significant "on farm" know how. What kind of contractual arrangements are made between farmers and those who have access to relevant know-how? Table 1 shows that

[3] But note that average farm size of the "small" size group is still significant: 349 hectares for barley and 310 for peanut farmers.

private-sector consultants (generally agronomist advisors) are by far the most important purveyors of production knowledge. No less than 2/3 of farmers report having contact with private advisors. Again, as in the case of insurance, available data does not allow inferences to be made on "how much" private consulting is used. The public extension service appears next-to-last in relation to farm-level advising (the last category being advice supplied by input sale firms (e.g. seed companies, fertilizer dealers, etc). Technical advice originating in cooperatives reaches 8 – 18 percent of farmers. Somewhat surprisingly, linkages to cooperatives are not more prevalent for barley and peanut farmers as compared to those in the C&O group. The finding reported here on the importance of private vis-à-vis public agronomic advisory services raises important question related to policy, and in particular to the design of information delivery systems. Indeed, these results run counter to the widespread opinion that the public-good nature of most agronomic advice implies that the only way of delivering is via publicly-financed endeavors.

Results from Table 1 show that the barley crop is by far the "most intensive" as relates to contract use This is particularly true for VI arrangements between the farm and agribusiness firms: 1/5 to 1/3 of barley producers participate in these arrangements, versus no more than 1/100 for the C&O group and 1/14 for the large peanut producers. It is of interest to explore the issue of the factors determining – for barley producers – two aspects related to VI arrangements. The first is what factor lead to VI being chosen over conventional spot market arrangements. The second is whether these arrangements have an impact on input and technology choice.

In relation to the first issue, VI arrangements are widespread. However a significant portion of barley producers *do not* vertically integrate. Why the difference? The following factors would appear to have some significance on the decision of the farmer and agribusiness firm to engage in some type of vertical arrangement:

1. Size of the barley crop: very small barley producers impose transactions costs on the agribusiness purchaser. Within limits defined by the need to diversify suppliers, this purchaser will prefer to deal with less as compared to more suppliers.

2. Farmer managerial skills: the production of barley of a consistent high quality requires farmer managerial skills. Managerial skills are also needed in order to coordinate activities between the farm and the agribusiness client.

3. Production specialization: production specialization may increase efficiency, and thus constitute an attractive asset for in the agribusiness vertical chain.

We test whether items 1 – 3 are related to the probability of a farm choosing to vertically integrate with an agribusiness firm. A LOGIT regression is used for this test, where the dependent variable takes a value of "0" if the farm is not vertically integrated with agribusiness, and a value of "1" if the farm is indeed integrated. Results are shown in Table 2. Farm size (hectares planted with barley) and farmer education are positively associated with the decision to vertically integrate. Controlling for farm size, managerial skills (proxied here by years of schooling) appear to be a relevant variable explaining choice of contract. Whether the higher participation in vertical contracts of more educated farmers is due to these farmers being "preferred" by the agribusiness purchaser, or alternatively a result of more educated farmers having different perceptions on the advantages of vertical contracts is an issue worth exploring in future work. Both reasons – the "supply" of contracts by agribusiness firms to a given firm as well as the "demand" for contracts by farmers can be affected by farmer decision-making skills.

The "barley specialization" variable (barley area/total crop area) appears to be inversely correlated with contract choice. Thus (in a one-sided test) the hypothesis of no relationship between specialization and the decision to vertically integrate cannot be rejected. This result can be rationalized by arguing that it "does not matter" to both the farmer as well as to the agribusiness firm whether other crop activities are carried out besides barley.

Table 3 presents evidence on the possible impact of contract form (farms participating and not participating in "sharing" arrangements, and farms choosing or not choosing VI) on selected dimensions of input and technology use. The following can be noted:

Sharing arrangements: farmers participating in sharing arrangements show higher level of input use, both in "all crops" as well as in the barley crop. They also show higher level of "general" adoption of agricultural technology. The extent to which

farmers avail themselves of agronomic consultants increases when comparing farmers participating versus those not participating in sharing arrangements.

Vertical integration: the impact of VI on input, technology and consultant use is of the same general direction as that of sharing arrangements: farmers participating in these contracts generally show higher levels of all variables. The impact of VI, however, in many cases appears "stronger" to that of sharing. For example, fertilizer use increases with vertical integration 46 percent ("all crops") and 34 (barley) as compared to 7 and 11 percent for farms participating versus not participating in sharing arrangements.

Higher input use for farmers adopting sharing or vertical integration arrangements, as compared to those not using these contracts may be the result of (i) lower input/output price rations for these farmers (the agribusiness firm shares part of input cost or pays a premium price for output?), (ii) higher marginal productivity of inputs (know-how transfer from the agribusiness firm?) or (iii) lower financial or risk-related constraints in farmers participating in these contracts.

V. CONCLUSIONS

The design of contracts linking farmers, input suppliers and output demanders has as an important objective increasing efficiency in the agricultural value chain. "Efficiency" as understood here refers to maximizing the difference between the value of output produced by the value chain, and the costs of inputs necessary for this output to be forthcoming. Additional objectives such as meeting environmental standards, or contributing to increased equity may be considered when analyzing value chains in agriculture. These are certainly important issues for public policy.

This paper shows that contract use is highly dependent on crop type: for pure "commodity" crops the use of (input or output) "sharing" (or "farmer network") arrangements is quite low. Vertical integration, understood as contractual linkages between a farmer and an input or output firm is also infrequent in commodity-type crops. For crops characterized by more specific quality or overall procurement standards, both sharing and (particularly) vertical integration arrangements are more common. Clearly, "something is going on" in the production of barley as opposed to (for example) wheat that calls for a shift from impersonal to more personalized exchange.

Contracts linking farmers producing barley with barley processors are relatively simple. Contract compliance seems to be based – at least partially – on reputational factors. Having said this, it is important to note the following. First, in many cases non-compliance probably does not result in large gains for the defecting party. Further study of this issue is needed, however a priori it appears that alternatives open for the farmer to improve ex-post upon the initial contract are limited. In turn, for the barley purchaser very large downward shifts in the demand for beer would be needed for non-compliance to be a relevant option – excess supply of barley can always be exported. The second point is that a private-ordering arbitration institution has long existed to further inhibit non-compliance. The *Camara Arbitral* described in this paper is such an institution. Whether these institutions play an important role in agricultural development, and what public policy measures can be taken to further these institutions are issues worth exploring.

We show here that the vertical integration is more prevalent in larger than in smaller barley-producing farms. Also, we show that even when controlling for farm size, the farmers´ managerial ability (measured here by the years of formal education) increases the probability that some type of integration will be chosen. Decision-making skills are then an important factor in negotiating and carrying out contracts. Results presented here point out – at least for some production activities – to increasingly sophisticated value chains linking farmers with both input suppliers as well as output processors. Managerial skills are an important input for the smooth functioning of these value chains.

Evidence presented in this paper lends support to the hypothesis that factor use is affected by contract choice. In particular, barley farms integrating activities with agribusiness purchasers show considerably higher fertilizer, agricultural chemical and general agronomic technology use than those choosing not to integrate. They also show higher use of private consulting services. Whether higher input use is a result of the decision to vertically integrate, or whether it is simply a consequence of the overall higher general ability (education) of the farm manager remains to be determined. If the former is the case, interesting issues arise. In particular: does vertical integration allow capital constraints (or subjective risk premiums) to be reduced, therefore leading to higher levels of input use? Does vertical integration lead to an increase in allocative efficiency, as compared to the situation where no integration takes place? Who captures the benefits of the increased efficiency: farmers, processors or consumers?

Vertical linkages between farmers and agribusiness firms, as well as "sharing" (network) linkages between farmers themselves allow improved financing, risk-sharing and access to know-how and organizational capabilities. All of these are important for efficiency and agricultural growth. Summarizing, the study of contracts can contribute important insights for understanding food and agriculture in the XXIst century.

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Figure 1: The Barley-Malt-Beer Value Chain

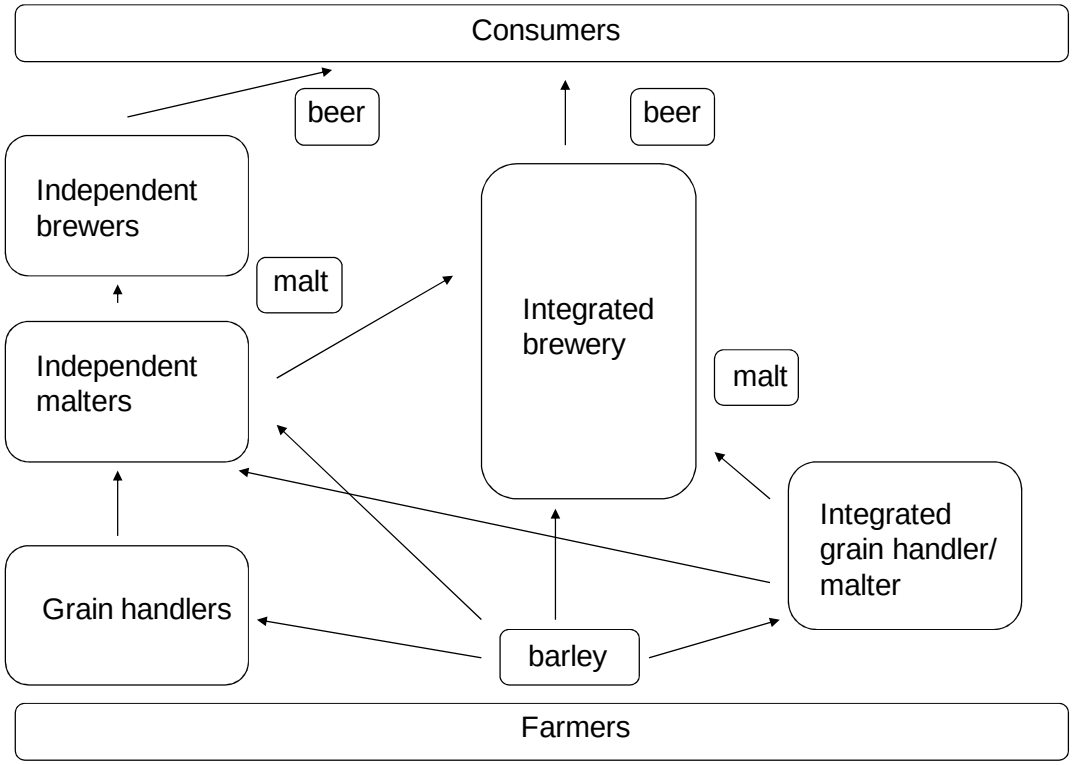

Figure 2: Wheat and Barley Yields

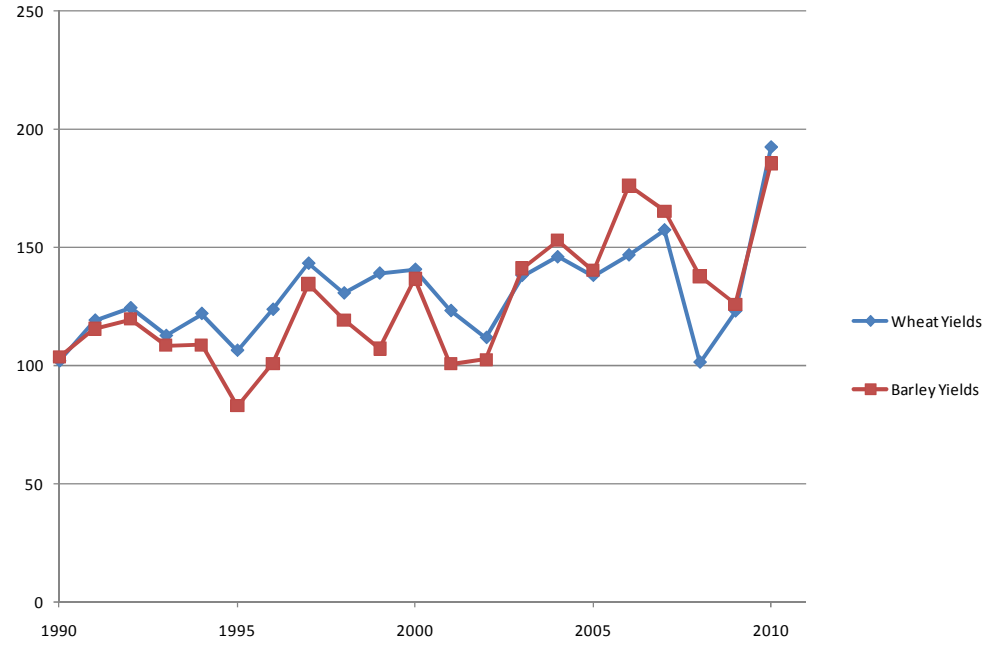

Figure 3: Wheat and Barley Planted Area

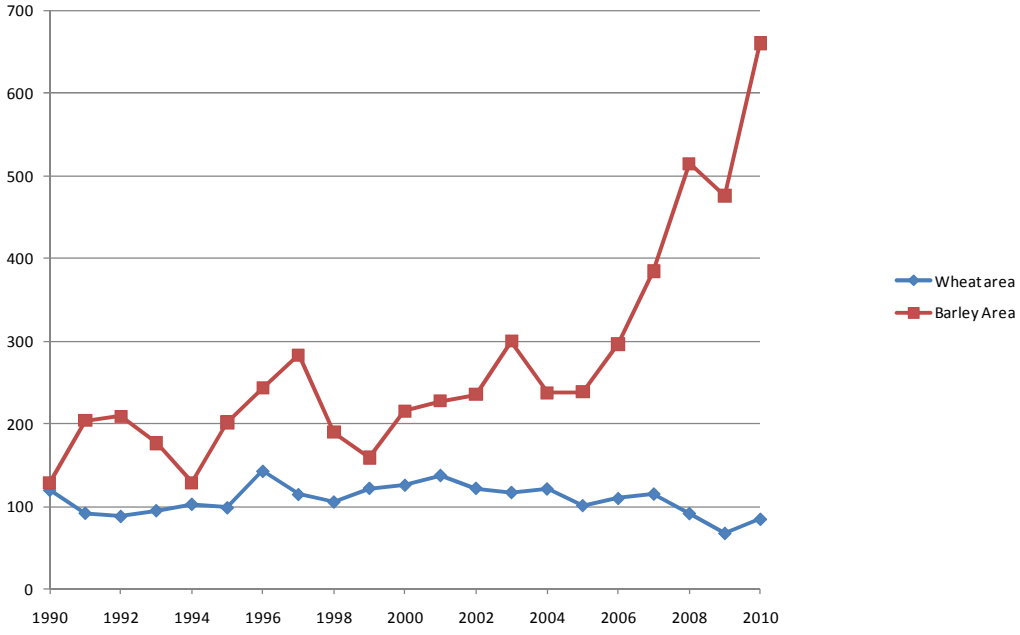

Table 1: Contractual Arrangements

	Cereals and Oilseeds (*)	Barley for Malt (*)		Peanuts (*)	
		Small (20 - 100 ha barley)	Large < 100 ha barley	Small (20 - 100 ha peanuts)	Large < 100 ha peanuts
Farmers reporting "sharing" arrangements:	%	%	%	%	%
Input acquirement sharing	7.9	9.5	10.1	12.1	10.6
Output marketing sharing	0.8	0.5	1.0	0.8	2.1
All sharing	9.5	11.3	12.2	14.1	13.8
Farmers reporting "vertical integration" arrangements"					
With service providing firms (seeds, machinery, contractors, transport)	2.0	2.0	3.0	2.4	4.6
With agribusiness firms (cereal mills, oilseed crushers, malt barley processors)	0.9	19.4	32.9	1.8	6.7
With trade firms seeds, ag chemicals, grain handlers)	1.7	1.9	4.9	1.4	5.3
All VI	3.7	21.6	35.1	4.6	11.7
Risk Management					
Insurance use	58.9	64.1	79.0	56.2	69.9
Futures & Options use	9.8	8.5	19.1	7.5	18.8
Agronomic consulting/extension					
Private	68.2	68.8	81.1	66.5	76.2
Public	5.9	5.4	5.8	3.0	8.2
Cooperative	17.6	15.5	11.4	16.4	8.2
Agribusiness	1.0	0.7	0.9	5.1	2.8
Crop Area (total crop hectares)	405	349	1071	310	1635
Number of farms	41928	1120	572	495	282

Source: Computed from 2002 Censo Nacional Agropecuario

(*) Farms included in the sample: 50 hectares or more of crops and with less than 5 hectares of barley or peanuts

Table 2: Results from LOGIT estimation

	B	E.T.	Wald	df	Sig.	Exp(B)
Hectares Barley	0.00	0.00	37.40	1.00	0.00	1.00
Farmer education	0.03	0.01	4.38	1.00	0.04	1.03
Specilization in Barley	-0.01	0.00	5.54	1.00	0.02	0.99
Constant	-1.62	0.17	89.78	1.00	0.00	0.20

N observations: 2043

Table 3: Input/Technology Use by Contract Choice

			Indexes of Input/Technology Use ("No" = 100)						Consultant/Extension Service Use (% farms)			
			All Crops		Barley							
		Number of Farms	Fertilizer Use	AgChem Use	Fertilizer Use	AgChem Use	No Till	Technology	Private	Public	Cooperative	Ag Industry
									%	%	%	%
Share	**No**	1810	100	100	100	100	100	100	70	5	14	1
	Yes	233	107	121	111	112	134	116	82	10	18	2
VI	**No**	1547	100	100	100	100	100	100	67	5	16	0
	Yes	496	149	112	134	128	95	108	85	6	10	2

Source: Censo Nacional Agropecuario 2002