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

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(Draft 01)

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-bearing and risk-transfer mechanisms, agricultural technology inflows and labor markets in rural areas. 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

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Indicators). Clearly, changes such as these involve a massive shift in linkages between the food production and the food consumption stages. An increasingly urban population not only 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 is affected negatively 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 Sections III and IV. Empirical analysis of contractual choice in Argentine agricultural production is the basis of Section V. Lastly, summary and conclusions follow in Section VI.

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 distributors/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. **THE AGRICULTURAL VALUE CHAIN**

Beginning in the 1950’s agricultural economics research was increasingly influenced by the neoclassical economics paradigm. In particular, Earl Heady’s excellent text *Agricultural Production Economics and Resource Use* focused on the farm firm as the basic unit of analysis. Industry, regional and national issues were analyzed with a similar approach: throughout, emphasis was on marginal analysis as a tool for understanding resource allocation problems. The “production economics” paradigm spawned by Heady (see for example Doll and Orazem, 1978) focused attention on *production*: i.e. the transformation of inputs into outputs.

In contrast to the above, alternative ways of looking at firms and at the linkages between firms and other market participants were being developed. Probably because of the small size of the agricultural firm, and of the fact that significant part of agricultural output was of a “commodity” or undifferentiated type these alternative approaches were somewhat slowly incorporated into mainstream agricultural economic analysis. Coase’s paper (Coase 1937) on “why firms exist” is probably more important for understanding General Motors than a farm where labor is provided by the farm family. This paper, however, is central if a wider perspective of the food sector is adopted: the existence of large agribusiness firms, of mergers or divestments, of organized exchanges and of various type of contracts can be better understood if attention is focused on the “cost of using the price system”, a basic issue raised by Coase.

As pointed out by Ricketts in the introduction of his text on the theory of the firm the analytical tool better adapted to understand firms is the Edgeworth Box and not the production function (Ricketts, 1979 p. xii). Exchange, and not production *per-se* is the basic issue to be addressed.

A party entering into a contract voluntarily agrees to a reduction in resource-use flexibility. Delivery of a product meeting certain characteristics at time $t$ to buyer $Z$ implies sacrifice in terms of possible product choice, product timing or exchange
partner. Loss of flexibility results in costs in terms of reduced possibility of adaptation to changing circumstances.

Several factors may result in the costs due to loss of flexibility being smaller than the advantages resulting from contractual terms. Williamson (1985) emphasizes that contracting helps reduce problems of opportunism, in particular in situations where asset specificity results in “hold-up” situations. In agriculture, for example, farmers producing seed for seed companies enter into detailed contracts: both parties seek “protection” due to relatively strong mutual dependence that results from this type of arrangement. The farmer, for example, incurs in higher costs in producing seed as compared to grain. Further, the output obtained can only be legally marketed by the contracting seed company. Without a detailed contract - or alternatively without strong “relational” type of arrangement - opportunism could well be present. As shown by Tirole, asset specificity in the presence of incomplete contracts leads to underinvestment – and thus to inefficiency - in the vertical chain (Tirole, 1990 p.24). Some kind of “vertical arrangement” (ranging from contracts to outright vertical integration) is needed for these inefficiencies to be countered.

Information asymmetries can also lead to “quasi-vertical” integration: i.e. to a situation where firms remain legally separate, but where interactions among them somewhat blur the boundary that separates them. In particular, when product quality can be only imperfectly ascertained at the time of purchase, the buyer may propose to participate in the sellers´ production process. This may be done by transferring inputs such as seeds, animal stocks or animal feeds. It may also be done by requiring the seller to allow on-site supervisory and technical visits (with varying decision-making capacities). In the beer value chain discussed earlier, agronomists employed by the breweries supervise production technology used by contracting farmers.

IV. 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 (where 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, his scope for individual decision-making has been reduced. 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 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

\[2\] 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.
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 aspect 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. The normally involve 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.

V. **EMPIRICAL ANALYSIS**

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 the figure of *agricultural contractors* (supplying farm machinery services to landowners or to firms renting land) is 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.

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 highly concentrated 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 farmers. 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 farmers 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 farmers 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, vertical 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.

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.  

**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 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.

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3 But note that average farm size of the “small” size group is still significant: 349 hectares for barley and 310 for peanut farmers.
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 the factors leading 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.
VI. 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.

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 will be 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 may be seen as mechanisms that allow improved financing, risk-sharing and access to know-how and organizational capabilities. Population growth, urbanization and increased international trade all result in changes in the linkages between farms and consumer markets. The study of contracts in the agricultural value chain can contribute important insights for understanding food and agriculture in the XXIst century.

VII. REFERENCES


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Figure 1: The Barley-Malt-Beer Value Chain
Table 1: Contractual Arrangements

<table>
<thead>
<tr>
<th>Cereals and Oilseeds (*)</th>
<th>Barley for Malt (*)</th>
<th>Peanuts (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (20 - 100 ha barley)</td>
<td>Large &lt; 100 ha barley</td>
<td>Small (20 - 100 ha peanuts)</td>
</tr>
<tr>
<td><strong>Farmers reporting &quot;sharing&quot; arrangements:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input acquirement sharing</td>
<td>7.9</td>
<td>9.5</td>
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<tr>
<td>Output marketing sharing</td>
<td>0.8</td>
<td>0.5</td>
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<tr>
<td>All sharing</td>
<td>9.5</td>
<td>11.3</td>
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<tr>
<td><strong>Farmers reporting &quot;vertical integration&quot; arrangements:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With service providing firms (seeds, machinery, contractors, transport)</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>With agribusiness firms (cereal mills, oilseed crushers, malt barley processors)</td>
<td>0.9</td>
<td>19.4</td>
</tr>
<tr>
<td>With trade firms (seeds, ag chemicals, grain handlers)</td>
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<td>1.9</td>
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<tr>
<td>All VI</td>
<td>3.7</td>
<td>21.6</td>
</tr>
<tr>
<td><strong>Risk Management</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insurance use</td>
<td>58.9</td>
<td>64.1</td>
</tr>
<tr>
<td>Futures &amp; Options use</td>
<td>9.8</td>
<td>8.5</td>
</tr>
<tr>
<td><strong>Agronomic consulting/extension</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>68.2</td>
<td>68.8</td>
</tr>
<tr>
<td>Public</td>
<td>5.9</td>
<td>5.4</td>
</tr>
<tr>
<td>Cooperative</td>
<td>17.6</td>
<td>15.5</td>
</tr>
<tr>
<td>Agribusiness</td>
<td>1.0</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Crop Area (total crop hectares):</strong></td>
<td>405</td>
<td>349</td>
</tr>
<tr>
<td><strong>Number of farms:</strong></td>
<td>41928</td>
<td>1120</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>E.T.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hectares Barley</td>
<td>0.00</td>
<td>0.00</td>
<td>37.40</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
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<tr>
<td>Farmer education</td>
<td>0.03</td>
<td>0.01</td>
<td>4.38</td>
<td>1.00</td>
<td>0.04</td>
<td>1.03</td>
</tr>
<tr>
<td>Specilization in Barley</td>
<td>-0.01</td>
<td>0.00</td>
<td>5.54</td>
<td>1.00</td>
<td>0.02</td>
<td>0.99</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.62</td>
<td>0.17</td>
<td>89.78</td>
<td>1.00</td>
<td>0.00</td>
<td>0.20</td>
</tr>
</tbody>
</table>

N observations: 2043
Table 3: Input/Technology Use by Contract Choice

<table>
<thead>
<tr>
<th>Share</th>
<th>Number of Farms</th>
<th>Indexes of Input/Technology Use (&quot;No&quot; = 100)</th>
<th>Consultant/Extension Service Use (% farms)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>All Crops Fertilizer Use</td>
<td>AgChem Use</td>
</tr>
<tr>
<td>No</td>
<td>1810</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Yes</td>
<td>233</td>
<td>107</td>
<td>121</td>
</tr>
<tr>
<td>VI</td>
<td>1547</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Yes</td>
<td>496</td>
<td>149</td>
<td>112</td>
</tr>
</tbody>
</table>

Source: Censo Nacional Agropecuario 2002