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# Governing of Agrarian Innovations

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## Abstract

This paper adapts the principles of the new developing New Institutional and Transaction Cost Economics (integrating Economics, Organization, Law, Political and Behavioral Sciences) to the area of agrarian research and innovations. The major institutional, behavioral, dimensional, technological and transaction costs factors for governing research and innovation activities are determined. The specific market, private, public and hybrid modes for organization of agrarian innovations are specified. The effective boundaries of different governing modes are assessed, and needs and forms for public intervention in agrarian research and innovation are clarified.

**Key words:** governance, agrarian research and innovation, research and innovation institutions, new institutional economics, public, private and hybrid organizations

## Introduction

Newly evolving interdisciplinary *New Institutional and Transaction Cost Economics* provides a powerful framework for understanding the development of governance structures and institutions we can see in the modern world. With few exceptions this new developing concept has not been applied to the sphere of agrarian innovation. *In this paper we try to incorporate this new framework into analysis of agrarian innovations, and to determine the effective boundaries of market, private, public and hybrid organizations for agrarian innovations.*

### *Transaction Cost Economics of Agrarian Innovations*

Agrarian innovation was an indivisible part of production activity (farming) for thousands years. Separation of innovation activity as a specialized economic activity in society became in last century when the first agricultural experimental stations were established. Since then specialization and division of labor in agrarian innovation have increased enormously. The number of different branches of agrarian research and technological development has evolved, and various kinds of farm extension started to exist as a specialized activity.

In a system with developed specialization and division of labor individual agents need to exchange products of their work and owned resources or putting it in another way they have to *transact* with each other. For instance, when a farmer buys a new variety from seed market he uses autonomous *market* mode for organization of his transaction with a seed producer. When a researcher is ordered by the Director of the Experimental Station to move from one project (department) to another the *hierarchical* mode of transacting is in place.

Importance of the "indivisible hand of market" for co-ordination of economic activities and effective allocation of social resources has been among fundamentals of the political economy for more than 200 years. What has been a new insight in recent development of economic theory is the idea that "there are costs of using the price

mechanism". As Coase formulated it: "if production is regulated by price movement, production could be carried out without any organization, well might we ask: Why is there any organization?" (Coase 1937). Would not it be possible all transactions and co-ordination between factors of production to be carried out by market? Why are there organizations for agricultural research, extension service, technological development etc.? Why do experimental stations, co-operatives, corporations, contract research exist in agriculture? *Why are technologically separable stages of innovation activities linked with each other rather to all others (market)?*

Answer is that sometime it is cheaper or possible at all to organize a transaction through *internal mode* rather than in market. Difficulties for technology transfer across market interface have been well recognized in the economic theory. "Fundamental paradox "of information is that "its values for the purchaser is not known until he has the information, but when he has in effect acquired it without costs" (Arrow 1962). Besides, consumption of new knowledge is non rivalry and very frequently associated with high positive externalities (spillovers). It is prohibitly expensive for sellers to control market exchange and appropriate the benefit from transaction, to exclude non-payers to use invention and verify cheating etc. Also there are big opportunities for consumers to "free ride" using non price modes for innovations supply (informal, pirating etc.) without a big risk to be punished. That is why "*market fail*" to organize a great part of agrarian innovation effectively.

If there are costs of using price system no wonder why individuals set up different *private* organizational and contractual devises to minimize costs of their transacting. Very frequently it is more profitable to *co-ordinate division of labor in innovation activity in an organization either through group decision making or under the "visible hand of manager"*.

When for instance, a seed producer (company) hires a researcher to develop new varieties he replaces a set of market transaction for new variety supply with another form for organization of previous transactions such as an employment contract. Initially the labor is hired from market and that is connected with costs for looking for good researcher, negotiations for working conditions, wage level etc. However, ones this transaction occurs labor agrees to follow the orders of the owner (to be directed) during all contracted period. As a result *co-ordination of economic activities between those agents is done not by market price movement but in a centralized manner by authority*. Internalizing transactions gives to the seed producer an opportunity (power) to control innovation process more effectively, and low market risk and uncertainty, and increase his adaptive capacity. This new form of governance allows both parties to save repeated costs for contracting research (or trading new varieties), and for negotiation of the conditions of exchange, and for renegotiations during the execution stage, and for third-party (e.g. court) dispute resolutions etc. Benefits from this new way of transacting take a form of governance rather than production costs savings.

But we might ask: Why is not then all agricultural innovations carried on by one big company? As Williamson puts it: "Why can not a large firm do everything that a collection of smaller firms do and more?" (Williamson 1996). Why are there individual research departments, laboratories, consortiums, and other organizations with different size in agrarian innovation? *What determines the limits of research institutes and innovation organizations in agriculture?*

The answer would be that advantages of an internal organization do not come without cost namely transaction costs for co-ordination and stimulation of innovation through group

decision-making or in a hierarchy. The internal organization has big advantages to control transactions (by collective order or fiat) compare to autonomous market. However, it does not enjoy high powered and self-enforcing incentives of market. *Thus the basic trade-off must be between increased control potential and lost incentives regime of the integral mode.*

*Market and organization are not opposite but two extremes in the continuum of alternative governance modes for transaction (Williamson 1975).* Transacting forms range from spot market, through various short and long-term bilateral and multilateral contractual arrangements, to unified (ownership) integration. Whether a transaction would be executed across market or within an organization depends on differential transaction costs: *a transaction will be carried out from an organization if the costs are less than to carry out the same transaction by market or in other organizations.* Hence one organization becomes bigger if it includes (internalize) additional transaction which previously has been done by market or another organization. The organization becomes smaller if an internal transaction is left to the market or another organization. So we can explain all economic structures in agrarian innovation and distribution of economic activities between different organizational forms on the base of *comparative efficiency* of those governing modes.

Innovation transaction, say extension supply for beef breeding, could be organized in quite different ways: a farmer can do it himself (ownership mode), he can buy an extension service from market for fee (free market transaction), farmer can contract extension supply with an university (long-term contract mode), a big farmer may hire an extension expert (employment contract), he can lease his stock to another farmer practicing new methods (share tenancy or fix-rent lease contract), several farmers may buy extension service (joint ownership), farmer can joint a co-operative which provide extension service (non-for-profit organization), farmer may sell extension service to other farmers (profit-making organization), farmer could integrate with a processing company and get extension supplied by the industry (interlinked contracts), farmer could be hired by a processing company to work on his farm having all input supplied by the industry (labor providing contract), farmer can lobby for public extension supply and get it for free (public mode), farmers organization for extension could get public or private subsidy (hybrid mode), extension supply may be got from another farmer or extension officer over a drink (informal mode), extension service provided for a neighbor could be copied in own farm (pirating). All these alternative forms for transacting have quite different costs and incentive advantages. Which mode will be chosen depends on costs for carrying out this transaction through each alternative governance form. That is why it is suggested that *organizational design is comparative and predominantly transaction costs economizing undertaking* (Williamson 1996).

*When a transaction is turned in the basic unit of economic analysis then innovation organization is a mode for governing of innovation related activities and transactions.* There is not internal transacting in an individual (one person) farm. The level of outside transactions depends on degree of self-sufficiency of the farm and it could be close to zero (e.g. in traditional agriculture when farmer occasionally spent time to study progressive practice of his neighbors). When a farmer hires a worker then level of internal transactions increases. Accordingly costs associated with internal transactions get bigger and decision has to be taken: whether is more economical to buy from spot market (e.g. new variety seed), or to use internal (employment) or outside contract. The later also offers different cost minimizing alternatives such as whether to contract service work (contract research) or to join innovation organization (e.g. cooperative or joint venture). The economic description of innovation organization which comes out is: that is a devise (mode) for organization of

*internal* and *outside* transactions at minimum costs.

Transaction Cost Economics overcomes *zero* transaction costs assumption of the Neo-classical economy. It puts the “costs of running the economic system” along the technological (production) costs when defining the effective boundaries of different governance modes for organization of economic activities. As Arrow approaches it: “Market failure is not absolute. It is better to consider a broader category, that of transaction costs which in general impede and in particular cases block the formation of markets” (Arrow 1969). As specialization and diversification of economic activity increase then exchange between economic agents become complex. Consequently the costs for co-ordination and motivation of activities of specialized agents take an increasing part of all social expenditures.

Concept of “market failure” is not a new one in the economic theory. *Traditional* Economics for instance describes cases of market failure in order to justify the Government interventions. However, it misses all variety of effective private governance organizations which can substitute market as well as possibility for a “government failure”.

When a big dairy farmer hires a veterinarian instead of relying on market for veterinarian services; or when a farmer enters in a long-term contract with an university professor or processing company for direct innovation supply; and when an agro-firm or cooperative opens up a technology division or research laboratory instead of buying innovations from market, it means that economic agents replace price system with different forms of *non-market organizations* of agrarian transactions (such as employment contract, long-term contract, strategic alliance or vertical integration). *Thus structure of activities in agrarian area is defined not only by prices in the free market but also by negotiations between partners and by bilateral or multilateral arrangements, or from authority in a hierarchy.*

Sometime a *third-party involvement* in individual transacting is necessary to make it possible or more efficient. Very frequently this comes out as a result of a private mediation in bilateral (multilateral) transactions. For instance, a private consultancy or development firms assist innovation supply between public research institutes and farming. It is also common when an effective third-part involvement comes up as a result of community efforts and done by local authority (e.g. extension and development organization).

*When all types of economic organizations in private sector do not work satisfactorily there is necessary condition for the Government intervention or third part Government involvement in agrarian transactions.* Organization and provision of basic and pre-technology agricultural research is a typical example for inefficiency of market governance. Those activities might be carried out as private organizations for collective good supply. However, the transaction costs for organizing of ten and thousands farmers would be very big, it may take a long time to build such an organization, and most likely this organization would not be sustainable because of the small relationship between individuals contribution and benefit (“free riding” problem). Also because of the low frequency of transacting between the same parties (innovator-individual farmer) the efforts to develop a special private mode would not be justified. That is why the Government intervenes in these transactions to make them more cost effective or possible at all. It is, for instance, when mandatory levies on agricultural output are introduced in order to finance applied research and development.

The biggest problem here is that when market or private sectors seem working ineffectively that does not mean that the Government intervention always is more effective.

There are likely to be a major problem for bureaucracy to identify cases of suboptimality and device appropriate policy to correct them. Also it could be problem of monitoring the agents to whom execution of legislative power is delegated. And last but not at least important, the Government may be influenced by special interests groups and failed in organizing transactions in most effective for all parties way.

Therefore, *for every Government involvement in agrarian transactions benefits must be judged in relation to the costs (including transacting costs)*. This covers the general case of public intervention in agrarian sphere as well as selection of the specific modes for its organization (direct financing or in-house production of public goods, various regulations etc.) in comparative transaction costs minimizing way (Bachev 2007). For example, sustainable agrarian development is in big demand now. Apparently market mechanisms would not serve this public demand effectively. Interested individuals may develop different kind of private organizations to meet their demand for safe food, animal welfare, protecting environmental resources etc. However, it would be very time consuming and expensive because of the little appropriability and high externalities. Government involvement in these transactions could be more cost effective. However, there would be various ways to organize such a *trilateral* transaction: Government could organize in-house research in state institutions; it may finance research projects in autonomous public institutes on pork barrel or competitive bases; Government can open up public funds for competition for private sector and foreign institutions; it could introduce agrarian intellectual property rights for national (and multinational) investors, and set up institutions to enforce these new rights; it can introduce some regulations and standards for protection of environmental resources; Government may promote projects and give subsidy, tax preferences etc. for agents involved in innovation activities etc. Apparently different modes for governing of innovation activities would have quite different control, decision-making, adaptive and incentive futures, and therefore unlike costs for participants and general taxpayers.

Thus *in the market based economy individual agents need and develop non-market forms for governing of their activities and the real agrarian economy consists of many co-coordinating subsections. Given competitive setting the tendency will be to adapt those organizational modes that best economize on transaction costs*. It means that, there is not a single form for organization of all kinds and types of agrarian transactions nor universal governance modes exist forever. Economic agents will chose and improve the forms for organization of their activity along with the *development of technology* (e.g. introduction of new scientific methods such as hybridisation, improvement of communication technologies) and changing *conditions of exchange* (improvement of contract enforcement system). Governance modes will emerge and evolve as long as any transaction economizing potential exists, and they eventually die when more effective forms for organization occur. *In the long run the most transaction costs minimizing organization for each particular transaction will prevail (efficiency principle)*. *Ultimately available for individuals continuum of alternative modes for agrarian transactions finds its base in dominant legal system*. For instance, if agrarian intellectual property rights are not introduced and properly enforced then trade secrets, and (or) technology import will be implied by private sector as well as strong pressure for public innovation supply would develop as alternative although not the most efficient form for organization.

So far we have examined the *Current Transaction Economics* of agrarian innovative activities. Besides that, each society has to bear the *Long-term* transaction costs for setting up one or another organizational form (Bachev 2004). Those are significant preliminary

entrepreneurial costs in private sector, and political entrepreneurship and collective action costs for collective/public goods supply or institutional development. They are different from the current transaction costs for using alternative modes and thus long-term investments which are to return from the transaction economizing potential of the new forms. Let us suppose that a transaction requires a high level of specific for a particular partner investments but it is occasional. The trade with the intellectual agrarian products (e.g. patent) can be included in this class of transactions. Market mediation would not be effective because of the little appropriability, divisibility, and measurability, and the high uncertainty of innovation activity. At the same time set up costs for a special bilateral private structure to secure effective transacting may not be covered since frequency of the transacting between the same parties is low. Consequently, agents would not invest in transacting specific assets and this transaction would fail to occur. Hence, a third-part involvement (assistance, arbitration, enforcement etc.) is needed for an effective organization of such transactions. In the later case, the Government role in new property rights development and enforcement would be crucial.

There are two types set up transaction costs: for establishing “institution of governance like firms, hybrids, bureaus” and for changing “institutional environment of which property rights are part” (North 1994). Factors and mechanism for the “induced” institutional innovation in agrarian area have been well developed in the Public Choice literature (Hayami and Ruttan 1985). Moreover, the efficiency of mobilizing factors for institutional modernization depends on tradition; cultural endowments etc. and are quite specific for each country (North’s remarks that it is “not possible to import institutions”). Besides, public preferences at any stage of the development and the admissible social costs for institutional modernization are quite specific for each society. *They are very important economic parameters but they come to the economic system outside - from the political system of the society.* Economic analysis could less contribute in defining those levels since this is the area of the *political decision-making* (if that is not so it would be very difficult to explain why level of return to public agricultural research has been so high since last century now). *Essential economists role here would be to evaluate alternative ways and to choose the most effective (transacting minimizing) modes for achieving the social goals.*

### ***Economic characteristics of agents in agrarian innovations***

*What determines the boundaries of innovation organizations and what determines the boundaries of innovation markets?* In order to understand when agrarian agents mediate their transactions by market and when they manage them through private modes, we have to start making more realistic assumptions about the behavioral attributes of individuals involved; *next*, we are to define the character of transactions in agrarian innovation; *third*, we have to determine microeconomics factors (critical dimensions) for transaction costs differences; and *lastly*, we are to match attributes of transactions (which differ for each transaction) with alternative governance structures (which transaction cost minimizing capacity differ) in discriminating way (Williamson 1985).

*There are two behavioral assumptions about economic agents the transaction cost economizing is based on: bounded rationality and opportunism.* The first is *cognitive assumptions* according to which human agents are assumed to be “intendedly rational” but they experience “limits in formulating and solving complex problems, and in processing information” (Simon 1957). Because of the high “natural” uncertainty or asymmetry of

information between transacting parties it is impossible or extremely expensive to formulate in written language the novelty of innovation, to predict all future circumstances of development of transacting and specify consecutive actions of parties, to monitor and measure performance of counterparts, to recognize possible applications of innovations, to exclude pirating of innovations and enforced appropriate payments etc. *The economic ramification of this assumption is that practically all forms for contracting of complex transactions are incomplete (Williamson 1996).* Therefore, most innovation transactions would be governed by implicit or rational rather than the elaborate contracts. Even when competitive grant funding is applied it is only accompanied by the general statements that some advance in knowledge in particular area is to be attained. Restricted rationality also makes it difficult for a third-party to be efficiently involved in innovation transactions. Chronicle “underinvestment” in public agrarian research (government failure) is a classical example. Wide-spread practicing of the “excuse doctrine” is another instance since no failed innovation contract has ever been brought to a court dispute resolution.

The second assumption is that *economic agents are given to opportunism* as a “deep condition of self-interest seeking with guile” (Williamson 1985). This means that *transacting counterparts are less thrust worthy and not reliable in actions.* Accordingly, if there is an opportunity for one of the transacting sides to get an extra rent from the exchange he/she will do so. For instance, since uncertainty is high in research and the monitoring is difficult (bounded rationality of principle is high) a researcher would devote a part of the working time and resources for unrelated to his assignments activities (e.g. private project). Also we hardly could expect that a farmer would pay royalty for a new variety (or technology) if it is not naturally protected and could be acquired (reproduced) freely. Even for the technical innovation where imitation is so obvious the “neighborhood” inventions are broadly patented in order to avoid the license payment. Thus *if uncertainty is great and a party may suffer severe loses from opportunism (investments are highly specific to the transaction) he would govern (control) the transaction through an internal mode rather than transacting across autonomous market.*

Those two behavioral assumptions have been broadly used in the *Agency literature* to analyze (inter) organizational failure. Williamson puts them as a base for solving the problem of any economic organization: “assess alternative governance structure in term of their capacity to economize on bounded rationality while simultaneously safeguarding transactions against opportunism” (Williamson 1985). The public good character of agrarian innovations (non-rivalry, non divisibility, and non excludability) would not be important if there were unrestricted cognitive competence and full self-enforcement of transactions. The high “natural” uncertainty surrounding innovation and the asymmetry of information would be overcome easily by transacting parties through current adjustment in their mutual benefits. However, when bounded rationality and opportunism coincides, then market transacting (trade with know-how, classical contracting of invention activities etc.) becomes very expensive or impossible. The facelace market transacting is replaced by the specially designed private modes (private ordering, brand names), and personal rather than institutional relationships start to dominate. Besides, unique for the innovation area costs minimizing forms of transacting evolve such as comprehensive (free) public access to scientific information, granting exclusive private rights on invention against public disclosure etc.



### *Critical dimensions of transactions in agrarian innovations*

Under certain circumstances the *market prices* provide individuals with all relevant information about the economy and with powerful incentives to use available resources effectively while maximizing their profit and utility (Milgrom and Roberts 1992). Free market is a perfect mode for organization of agrarian transactions when neither sellers nor buyers can affect prices (agents are price-takers and they lack bargaining power); when barriers to exit or entry in different activities are low (no monopoly exists); when information is fully available in the same degree for all partners (lack of information asymmetry and possibility for opportunism); when products are homogeneous or standardized (minimum costs for finding partners, negotiating, exchange and contract enforcement); when no externality exists (parties bear all costs and benefits associated with their choices). That is how a researcher buys (instead of making) all necessary materials for his experiments from spot (or specialized) market.

*In a low (zero) transaction costs world the initial assignment of property rights does not matter and the economic agents trade property rights on resources up to the pattern of their effective Neo-classical equilibrium* (Coase 1960). In a real (positive) transaction costs world the initial assignment of property rights between individuals could substantially deformed the total outcome efficiency. For instance, market transacting would oversupply chemical intensive innovations and undersupply environmentally friendly technologies because the relative price levels do not take into account the (negative) externalities and no third-party regulation was in place.

*Firstly*, the agrarian innovation is a result of a large *combination* of activities in the area of agricultural research, product (technology) development, agrarian extension and farming. Researchers from different branches and disciplines, and a great number of support personal, extension officers, farmers, and consumers of agrarian innovations participate in the process. Just one typical example is the development of new alfalfa variety with enhanced nitrogen fixation which involved contribution from science-oriented research in biochemistry, genetics, microbiology, plant physiology together with technology oriented research in plant breeding and farm management. The efforts took more than 30 years before to get to the commercialization stage and relied on both disciplinary and cross disciplinary research in several institutes (Heichel 1987).

*Co-ordination of activities in such a large scale and time horizon could hardly be a "side" result of market competition.* It usually requires complex (program, strategic alliances, collaborative private-public actions etc.) organization of these polyvalent links. That is why the role of the national and transnational co-ordination bodies (Academies, Joint Councils, Priority Boards etc.) becomes bigger. Besides, specific for the area modes (conferences, workshops etc.), formal governance bodies (representation committees), and informal organizations (informal Colleges) develop to facilitate transactions in different directions. In private companies the research laboratories are usually organized at the top hierarchical level where the possibility for direct control of the activity is highest.

*Secondly*, because of the *small market appropriability* (high spillovers) of some intellectual agrarian products the agents set up private modes in order to protect property rights and capture higher return on their investments. For instance, the trade secrets are broadly used to overcome inefficiency of market transacting. Besides, private partners develop variety of profit (risk) sharing arrangements (joint ventures, strategic alliances, cross equity financing of innovations etc.) to secure returns of their investments in innovation

activities. Namely the large firm size is associated with successful research and development programs since only big (monopolistic) companies are able to absorb failure by innovating across broad technological front, and they have market power to reap rewards of innovations (Shumpeter 1942). Recent boom in direct investments, mergers and take-overs of agrarian innovation firms is the form of internalizing transactions and overcoming market risk. When uncertainty and therefore possibility for moral hazard in technology transfer is high (developing countries) then the lump-sum instead of output-based royalty payment is the preferred mode for organization of transaction (Larson and Anderson 1994).

*Next*, when some of the party makes highly *specific to a transaction investments* he/she either *can lose their value (if transaction does not occur or prematurely terminated)* or *he may face unfavorable trading conditions when the transacting recurrent time comes* (Williamson 1996). When investments are “lock up” with a particular transaction they are usually protected by some form of a long-term contract or ownership integration. For instance, investments in human capital of scientists are highly specific to a particular area of research or even a project. Productivity of idiosyncratic to a person (firm) capital is much smaller under alternative use and it can not be transferred to other uses without big lost in value. Researchers would not invest in highly specific to the transactions capital if they are not governed by a stable organization such as a permanent employment contract. Also specific forms develop to secure long-term commitment of transacting sides (e.g. sharing of training costs between employee and employer) and to stimulate individual investments in the specific capital (regulation of researchers salary, tenure contracts etc.).

In the same way, when a private company finances public research or acquires know-how from a private laboratory it would secure pay-back of its specific investments by a license contract for exclusive commercial use. *When assets are in high bilateral dependency then tight vertical integration of transaction is the common mode.* For instance, if innovation investments are in high symmetrical inter-dependency with manufacturing, marketing etc. assets of a company then they are always integrated in a common structure. Studies also show that the full ownership integration through in-house research (in-sourcing) is the dominant mode for major (core) projects of private firms, and out-sourcing form is used for complementary projects and topping in superior knowledge (Ulset 1996). That is also the reason why equity rather than debt (e.g. bank loan) financing is the most likely form for funding of the risky investments in specific intangible assets (patents, trade secrets, know-how, organizational culture etc.).

*Forth*, because of the *information asymmetry and the high uncertainty a party can be exposed to opportunistic behavior before or during execution of transactions* (e.g. the difficulties to verify quality of new agro-chemical, the proper expertise of researcher competing for a project grant or for a position etc.). In order to overcome transacting difficulties partners would prefer to rely on more effective than (spot) market form of organization such as brand name, demonstration, guarantee in the first case, or reputation consideration, peer review, or apprenticeship in the second.

The interlinked mode of transacting with the industry is a common mode for introduction of new technologies in farming and “free” extension service is supplied in a package with input supply transactions. When there is a mutual (capacity, technology, quality, timing of delivery) assets dependency a long-term contract is preferable form to govern transactions. Such strong bilateral co-ordination between farmers and processor exist in beef, swan, and poultry industries, and it is supported by tight interlinked marketing, inputs, innovation and extension supply contracts, and a total production management or even a

complete vertical integration by a processor (Sporleder 1992). Similarly, in public institutions more “market like” mechanisms are extensively introduced (direct financing from industry, fees for service etc.) to interlink incentives (transactions) to real demand of ultimate customers of agrarian innovations.

*Fifth*, very frequently participants in the innovation process face *missing market* for some products and services - e.g. highly specialized scientific equipment, qualified labor, know-how etc. That is why they have to develop these activities as internal or joint (non-for-profit or professional) organization. For instance, on-job training is usually a part of the innovation project; scientific equipment design is a sub-project or involves a strong contribution by researchers who will eventually use it. Also various consortiums and joint ventures are organized in a large multinational scale for mutual exchange of know how, biological materials etc.

*Sixth*, otherwise beneficial for all parties innovation transactions would fail to occur at optimal scale if there is no agrarian intellectual property rights protection or its enforcement is very expensive (e.g. new self-pollinated varieties), or if monopoly rights on some innovations bring a market distortion. In this case *participants in the agrarian innovations (farmers, researchers etc.) have to develop an organization for public good demand for a third party* (local authority, central Government, foreign assistance programs) *involvement in innovation transactions*. The outcome could be some kind of regulations of transactions (price ceilings, mandatory testing for safety standards), introduction of new monopoly rights on intellectual agrarian products in order to increase incentive for ownership organization, enforcement of special modes for organization of private transacting (e.g. mandatory licensing), introduction incentives (subsidies, tax breaks, international transfer liberalization) for private investment in innovation, assisting “quasi” public organization of innovation (e.g. mandatory levies for collective supply of research and development), public financing of innovation activities, in-house organization and direct public provision of agrarian research and extension service.

*It is always necessary to asses various alternative modes for third-party involvement in particular innovation in comparative (transaction costs minimizing) way*. For instance, when costs for introduction and enforcement of agrarian intellectual property rights are enormous for all parties then other options for intervention have to be considered. The experience shows that while property right modernization on biological innovation has had a significant impact on private research and development in the USA and Europe, in many Latin American countries there is no or only weak evidence for such an impact (Perrin 1994).

If transaction cost for organizing of competitive funding of public institutions is high (for writing and evaluating proposals, rent-seeking and lobbying, avoiding friendships, finding buyers for research products, and lost opportunity as a result of unproductive use of researchers time) then core funding is to be undertaken. Moreover, if intensity of transacting is not big (a small country size) and foreigners are not allowed in competition that mode would involve only additional costs without any benefits. *Specialized research market exists only in large countries, and usually a small numbers (quasi monopoly) condition prevails*. Bidding participants with highly specialized for a project human, infrastructure etc. capital always will win. Even if there is a big number competition initially it would turn to a small number condition when project extension time comes (“*Fundamental process transformation*” in Williamson’s term).

*Seventh*, the technological *nonseparability* of activities is not an important factor which could determine the *minimal size* of innovation organization. It is almost impossible to

give examples in research and innovation where organization form is unilaterally determined by the technology. Usually *there are plenty of alternative modes for organization of agrarian activity under the same research (innovation) technology and methodology*. For instance, development of new variety could be organized by the state research institute, university department, stand-alone or in-house private laboratory, by contract with a research team, by collective (farmers) organization, by hybrid mode, imported (transferred) from abroad through license agreement or from international research centre.

Thus the *individual agent (basic unit of transacting) also determines the minimal possible size of innovation organization. Beyond this size various private, public, and mix (hybrid) organizations develop to realize technological and transaction economy of scale and scope in the innovation process*. For instance, size of internal organization of activity (transactions) in specialized or related activities will increase as far as some potential to realize *technological* economy of size/scale exists (overhead, building, library etc.). The potential for *managerial* economy is also great in innovations. Instead of transacting with each individual (high asymmetry of information) the funding agency signs a contract with a leading scientist or delegates executive rights to an administrator. In this way all sides save large costs for finding best partners, negotiating conditions of exchange, writing and disputing contracts, current adjustment during contract execution stage etc. That is how program (project) organization develops in the innovation area. It combines top-down direction (long-term co-ordination) with the decentralized bottom-up management (“self-organization” of research). Besides, research (innovation) management separates in a condition of funding crisis of research and development, and it is a specialized activity of proposal writing, lobbying for success, subcontracting execution etc.

Very frequently modern research projects require minimum size and team efforts to be successful at all. Moreover, the ideal (non rival) character of the scientific knowledge allows the maximum economy to be realized at national and more commonly at international scale. Innovation also becomes increasingly an expensive venture and requires reducing unnecessary duplication (competition) of activities. The strong co-operation to enhance productivity and share risk (natural “dry holes”) is a norm rather than exception in the innovation process. Much private company practice tapping in the university or public research through joint venture and collaborative agreements. In this way they use outside capacity without extending transactions through expensive internal modes (e.g. employment contracts). Also various hybrid modes such as strategic alliances, develop to increase managers control on the innovation process without losing incentives for innovation as it is in hierarchical modes. Alliance organization has big advantages in conditions of high uncertainty since they allow flexibility in exploring (outside) economy of scale without involving big idiosyncratic investments (low exit cost).

Since pre-patent competition is a large public waste, a new trilateral form for organization of transactions has been invented. Here public subsidy is given to productive researchers and they are allowed to patent publicly funded inventions. In this way the competition (and unnecessary duplication) is restricted only to proposal writing stage since afterward winning (subsidized) researchers have comparative advantages in getting positive results. This mode preserves the powerful (“market like”) incentives in competing for the public grants and for obtaining the private property rights on output.

*When frequency of transactions in horizontal or vertical directions is very high then an internal organization saves repeated costs of market transacting*. Instead of renting a land plot for research experiments year after year, a long lease or ownership mode is used. In this

way, different functional, problem, location specific, commodity or customer oriented organizations for innovation are developed. The internalization of transacting is pushed ahead when specificity of investments increases. Here continuation of relationships with a particular partner(s) has high value. *Also efforts (long-term costs) to design a special mode are justified since they can be recovered for repeated transacting (current costs saving)*. For instance, the extension supply transactions become highly location and farm specific. That is why these transactions are broadly internalized by a joint ownership mode (e.g. farm associations) as a form for exploring the economy of scale on a highly specific to members capital.

When frequency of internal transacting is not very high and assets are not in a bilateral dependency, then the internal organization occurs only additional management costs without any extra benefits. This is why *innovation activities in agriculture is to be distributed between a number of specialized organizations instead of carrying out all transacting in a nation-wide company*.

*Technology and its development is very important for determining the effective size of innovation organization. That is particularly important in transaction cost minimizing respect.* The development in information and communication technologies revolutionaries organizations for transactions as well. The introduction of Internet for instance, makes the costs close to zero for a large part of innovation related transacting. It intensifies research and development through cheap direct transactions between individuals and on-line arrangements of informal modes in a big (practically world-wide) scale. It also decreases time and costs of finding best partners for co-operation and trade, for access to innovation data base, for searching for the best prices of agrarian innovations, for invention promotion, for public disclosure of cheating etc. All these development started to replace the traditional (old) model for innovation organization bringing to life effective small-size operations both in public and private sector.

### ***Effective modes for organization of transactions in agrarian innovations***

*The governance matrix for organization of various input supply and marketing transactions in agrarian innovations is summarized in Table 1. Most effective modes differ according to the type of transacting, and depends on combination of appropriability, assets specificity, uncertainty and frequency of transactions* (Bachev and Labonne, 2000). When appropriability is high, there is no asset dependency, uncertainty is low, and frequency is high then market is the best mode for organization of innovation transacting. When appropriability is high, but assets are on increase specificity regime, and transaction is characterized by high uncertainty and frequency then private organization based on ownership or tight integration comes up to be the most effective. However, when appropriability decreases, and assets specificity and uncertainty is high, then market and private transactions fail to occur at effective scale. Then a strong necessity for a third part (government) involvement in innovation transacting comes to agenda. The development of agrarian innovation system would be substantially deformed if effective modes for public involvement (assistance, regulation, public provision etc.) are not introduced in due time (Bachev 2004).

When the modes for government interventions are designed then the critical dimensions of transactions, and the comparative advantages of different forms (to improve incentives, decrease information asymmetry and overcome the possibilities for opportunism in the innovation process) are to be taken into account.

**Table 1 Alternative Modes for Organization of Agrarian Innovation Transactions**

<i>Type of transaction</i>	<b>Critical dimensions of transaction</b>															
	<i>Appropriability</i>															
	Low								High							
	<i>Asset Specificity</i>															
	High				Low				High				Low			
	<i>Uncertainty</i>															
	High		Low		High		Low		High		Low		High		Low	
	<i>Frequency</i>															
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
Knowledge supply	PS	PS	CC	CC	RC	RC	NPO	NPO	O	SA	VI	SA	SA	SA	M	M
Labor supply	PC	C	PC	C	TBC	C	OBC	C	PC	SA	PC	P	TBC	M	OBC	M
Capital supply	CF	PF	CF	PF	PF	PF	FS	FS	O	JV	O	JV	O	JV	M	M
Input supply	C	RC	C	CC	RC	RC	CC	CC	O	C	VI	CC	RC	BN	M	M
Marketing	PP	PP	CC	CC	RC	RC	NPO	NPO	O	TPA	I	SA	RC	TPA	CC	M

*Modes of transacting:* M - market, CC - classical contract, RC - rational contract, I - interlinked contract, O - ownership, JO - joint ownership, P - partnership, C - co-operative (corporation), VI -vertical integration, SA - strategic alliance, PC - permanent employment contract, TBC c- time based employment contract, OBC - output based employment contract, BN - brand name, TPA - third part arbitration, PS - public supply, PP - public provision, PF - public financing, CF- collective financing, FS - fee for service financing, NPO - non profit organization

### *Effective modes for public intervention*

There is a big variety of possible *forms for public intervention* in market and private transacting. The comparative institutional analysis of public modes is to include: *firstly*, the *correspondence* of the public involvement to the real needs of agrarian innovation and development (identified needs for a third-party intervention in Table 1). *Secondly*, the *comparative* advantages of alternative modes for public involvements comprising *all costs* - direct (tax payer, assistance agency) expenses, *and* transacting costs of bureaucracy (coordination, stimulation, mismanagement), *and* costs for individuals' participation and usage of public modes (expenses for information, paper works, payments of fees, bribes, etc.), *and* costs for public control and reorganization of bureaucracy. *And third*, the *comparative efficiency* of selected form and other feasible modes of governance - partnerships with private sector; property rights modernization etc. Accordingly, public intervention is to be initiated *only if there is a net benefit* - when effects are greater than additional (individual and social) costs for the third-party involvement (Bachev 2007).

Depending on the *uncertainty, frequency, and necessity for specific investment* of public involvement there will be different the most effective forms. Principally, the interventions with low uncertainty and assets specificity would require *smaller* Government organizations (more regulatory modes; general laws and contract enforcement). When uncertainty and assets specificity of transactions increases then a *special contract mode* would be necessary - public contracts for provision of private services, public funding (subsidies) of private activities, temporary labor contract for carrying out special public programs, leasing out public assets for private management etc. And when transactions are characterized with high assets specificity, uncertainty and frequency, then an *internal mode* and *bigger public organization* would be necessary – e.g. permanent employment contracts, in-house integration of crucial assets in a specialized state agency or public institute.

In the beginning, the existing problems (difficulties, costs, failures) in organization of market and private transactions have to be specified. The appropriate government involvement would be to create environment for: decreasing uncertainty surrounding transactions, increasing their intensity; protecting and making less dependent private investment. For instance, State establishes quality and safety standards for agrarian inputs, technologies and produces, certifies service providers, regulates employment relations, etc. All that facilitates and intensifies (market and private) transactions.

Next, practically possible modes for increasing appropriability of transactions have to be considered. The low appropriability is often caused by unspecified or badly specified private rights. In some cases, the most effective government intervention would be to

introduce and enforce *new private property rights* – e.g. rights on natural, biological, and environmental resources; private rights on intellectual agrarian property and innovation etc. The later would be efficient when privatization of resources or introduction (and enforcement) of new rights is not associated with significant costs (uncertainty, recurrence and level of specific investment is low). That Government intervention effectively transfers the organization of transactions into market and private governance, liberalize market competition and induce private incentives (and investments) in certain activities .

In other instances, it would be efficient to put in place *regulations* for activity, trade and utilization of resources – e.g. standards for labor, product quality, environmental performance, animal welfare; norms for using natural resources, GM crops, and (water, soil, air, comfort) contamination; ban on application of certain chemicals or technologies; foreign trade regimes; mandatory training and licensing of farm operators etc. In other instances, using the incentives and restrictions of *tax system* would be the most effective form for intervention. Different sorts of tax preferences (exception, breaks, credits) are widely used to create a favorable condition for agrarian research and innovation. On the other hand, the taxation on emissions or products is broadly applied to reduce negative externalities (environmental degradation and pollution).

In some cases, *public assistance and support* to private organizations in the best mode for intervention. Large agrarian research and development programs have been widely used in all industrialized countries. They let “proportional” development of agriculture, and improvement of farmers welfare (“income parity”) etc. For instance, public *financial* support for research, extension and innovation activities of universities, and collective and private organizations is commonly used instrument for improving economic and eco-performance of farmers and accelerate agrarian development. Often providing *public information, recommendations, training and education* to farmers, other agrarian agents, and consumers are the most efficient. In some cases, *pure public organization* (in-house production, public provision) will be the most effective as in the case of basic agrarian research, education, agro-market information, agro-meteorological forecasts, border sanitary and veterinary control etc.

Usually, the specific modes are effective if they are applied *alone with other modes* of public intervention. The necessity of *combined* intervention (*governance mix*) is caused by the complementarities (joint effect) of individual forms; possibility to get extra benefits (e.g. “cross-compliance” requirement for participation in support programs); particularity of problems to be tackle; specific critical dimensions of governed transactions; uncertainty (little knowledge, experience) associated with the impact of new forms; capability of the Government to organize (administrative potential to control, implement) and fund (budget



resources and/or international assistance) different modes; and not least important the dominating (right, left) policy doctrine in each country.

Besides, the *level* of effective public intervention (governance) depends on kind of the innovation. There are public involvements which are to be executed at *local* (community, regional) level, while other requires *nationwide* governance. And finally, there are activities, which are to be initiated and coordinated (governed) by *international* (regional, European Union, worldwide) level due to the strong necessity for *trans-border actions* (needs for cooperation in research and innovation, exploration of economies of scale/scale, governing of spill-overs) or consistent (national, local) *government failures*.

The public (regulatory, inspecting, provision) modes must have built *special mechanisms* for increasing *competency* (decrease bounded rationality and powerlessness) of bureaucrats, beneficiaries, interests groups and public at large as well as restricting possible *opportunism* (mismanagement, cheating, interlinking, abuse of power) of public officers and other participants. It could be made by training, introducing new assessment and communication technologies, increasing transparency (independent assessment, audit), and involving experts, beneficiaries, and interests groups in management of public modes at all levels. Furthermore, applying “*market like*” mechanisms (competition, actions, licensing etc.) in public projects design, selection and implementation would significantly increase incentives and decrease overall costs.

Principally, *pure* public organizations should be used as a *last resort* when all other modes do not work effectively. The “in-house” organization has higher (direct and indirect) costs for setting up, running, controlling, reorganization, and liquidation. Unlike market and private forms there is *not an automatic mechanism* (competition) for selecting the most effective modes. *Public “decision making”* is required which is associated with high costs and time, and it is often influenced by strong private interests (power of lobbying groups, policy makers and their associates, employed bureaucrats)<sup>1</sup>. Along with the development of the general *institutional environment* (“The Rule of Law”) and measurement, communication etc. *technologies*, the efficiency of pro-market modes (regulation, information, recommendation) and contract forms would get bigger advantages over the internal less flexible public arrangements.

Usually *hybrid modes* (public-collective-private partnership) are much more efficient than pure public forms given the coordination, incentives, and control advantages. In majority of cases, involvement of researchers, stake-holders and other beneficiaries increase

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<sup>1</sup> Once set up “organization has life its own“ (Williamson, 1996). It is not rare to see highly inefficient but still “sustainable“ public organizations around the world.

efficiency - decrease asymmetry of information, restrict opportunisms, increase incentives for private costs-sharing, reduce management costs etc. Principally, researchers and innovators possess information superiority, and exist strong interlinks of activity (economy of scope), high assets specificity to person, team or organization (competence, high site-specificity of investments). Furthermore, outside directing and/or enforcement of most part of innovation activities is often very difficult or impossible at all. In all these cases, stimulating and supporting (assisting, funding) collective and private actions are much more effective than mandatory public modes in terms of incentive, coordination, enforcement, and disputing costs (Bachev 2007).

Anyway, if there is a strong need for a third-party *public* involvement but an *effective* government intervention is not introduced in a due time then the agrarian “development” would be substantially deformed (*Government failure is possible*). As a matter of fact, the latter is quite common in agrarian research and development across the world – most studies show a high return on investment in R&D and thus constant public under-investment in that important area of social activity since last century now.

### **Conclusions:**

In the traditional framework there is only one mechanism for governing of whole innovation activity. “Free market prices” (and market competition) effectively coordinate entire activity of resource owners, entrepreneurs, and consumers. Rare cases of market “failures” are recognized but perfect “government intervention” is seen as a remedy. In the real agrarian economy, there are additional important factors affecting individual choice and agrarian innovation (namely institutions and transacting costs), and a great variety of effective governing mechanisms. The specific institutional environment (distribution of property rights and the system of enforcement of these rights) is a crucial factor, which eventually determines the “type” of agrarian innovation and development.

The analyses of institutional, behavioral, dimensional, and technological factors of transaction costs identify an immense range of “market failures” associated with unspecified or badly specified property rights; inefficient public contract enforcement system; high uncertainty and asset specificity, and low appropriability of transactions in innovation process. The economic agents deal with market deficiencies developing different private (bilateral, trilateral, multilateral) forms for effective transacting. Private sector also “fails” to organize some transactions at effective scale. Thus, there is a strong need for a third-party public (government, international assistance etc.) involvement in agrarian innovation. Different modes of public intervention (property rights modernization, regulations, support,

public funding, public provision and organization, hybrid modes) are with unequal efficiency in the specific conditions of a particular country. Therefore, diverse set of institutions and governing arrangements could lead to socially effective innovation and development. On the other hand, sustainability could be significantly compromised if both market and private sector fails, and no effective public intervention takes place (government failure is feasible).

The comparative institutional (and transaction costs) analysis gives new tools to better understand driving factors, modes, and prospects of agrarian innovation and development. What is more, it provides powerful means to assist the design of public policies and modes for public intervention as well as private contracts, organizations, and collective actions in agrarian innovations.

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