

**Dealing with Coordination Issues
in Rural Development Projects:
Game Theory Insights**

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Executive Summary

Development is a challenging business in large part because many agents have to coordinate actions and many times they fail to do so. Agents are simply unable to coordinate their behavior (choices) which leads to an outcome (equilibrium) that leaves all agents worse off than in an alternative situation that is also an equilibrium. This can occur due to lack of information, inadequate institutional rules, inefficiencies, or differing expectations.

Discussion of coordination failures is extremely relevant because the basic “business model” of development assistance donors is being reconsidered. New intervention strategies, new ways of financing projects and programs, and new strategic alliances are being sought and developed. The rubric of bottom of the pyramid is becoming the new the ideology of “development economics”. Historically, donors provided external finance to budget constrained client governments to undertake specific actions and interventions. Donors and client governments have tended to favor complex institutional arrangements to manage development project interventions often time without a clear understanding of incentives, expectations, good information on impact and effectiveness, and with little real consideration paid to sustainability. In some of the most extreme cases, such as integrated rural development projects, coordination failures were so common that this entire class of projects was abandoned. However, all the proposed new ways of doing “development work” require high levels of cooperation and coordination between multiple agents. If in the past, coordination issues were a major problem in many complex, stand alone project designs, then coordination is bound to be an even more critical issue in the design and implementation of new forms of interventions and public-private alliances that are emerging and becoming more commonplace because the potential collaborators are numerous but also tend to have very different ways of doing business.

This paper attempts to review the literature on coordination issues, apply game theory to the topic in the context of selected rural development projects in order to develop a set of guidelines to avoid and minimize coordination failures. In short, the paper uses game theory insights as a diagnostic and planning tool in project design and management.

Three Inter-American Development Bank (IDB) financed projects were selected for review—a grape value chain in the Cauca Valley in Colombia, a territorial development project in the Rio Chanchan watershed in Ecuador, and a tourism cluster in Patagonia, Argentina. Each project required a high level of coordination among multiple actors in both vertical (regional and municipal governments) and horizontal dimensions (alliances between private businesses, trade associations, civic organizations, and government entities). The setting, the goals, the constraints, and the project activities are described in each case, then the coordination issues are analyzed, using the optics of game theory.

Below are factors that increase the likelihood of a coordination failure. Obviously, the obverse would tend to decrease the likelihood of coordination failure. Project designers should try to choose the most auspicious settings for projects and be conscious of mechanisms that can be used to reduce the likelihood of coordination problems.

Critical Factors:

- *Large Number of Actors*
- *Extreme Social Heterogeneity Among Principal Actors*
- *Unclear Gains of Cooperation*
- *High Transaction Costs*
- *Institutional and Societal Rules that Discourage Information Sharing, Collaboration, Risk Taking Behavior, and Signaling of Commitment*
- *Absence of Risk Mitigation Instruments and Rule of Law*
- *Missing Finance*

Several steps can be undertaken to correct and avoid coordination failures in the course of project execution.

- Promote information sharing to shape common expectations. The free flow of information can serve to unite agents who hitherto did not realize their common interests in cooperating. “Outsiders” to the project area of operations are ideally suited for gathering and distributing information since they can more credibly serve as “honest brokers”.
- Use material and political incentives to obtain coordination among reluctant partners with the hope that over time that the benefits of cooperation and coordination will become self-evident.
- Focus on realizing short-term benefits in order to maintain interest in long-term processes of institutional transformation and upgrading.

Dealing with Coordination Issues in Rural Development Projects: Game Theory Insights

Two neighbors may agree to drain a meadow, which they possess in common; because 'tis easy for them to know each others mind; and each must perceive, that the immediate consequence of his failing in his part, is the abandoning of the whole project. But 'tis very difficult and indeed impossible, that a thousand persons should agree to any such action; it being difficult for them to concert so complicated a design, and still more difficult for them to execute it; while each seeks a pretext to free himself of the trouble and expense, and would lay the whole burden on others.

David Hume, A Treatise of Human Nature, Volume II (1739).

I. Introduction

Problem Statement

Many of the most pressing developmental challenges in low- and middle-income countries require high levels of coordination between various actors—poverty reduction, climate change adaptation, technology development and transfer, improvement in governance and transparency, improvement in natural resource management, more effective disease control (HIV/AIDS and other communicable diseases), development of value chains, strengthening of factor markets just to name a few. Yet, how agents, firms, institutions, and countries coordinate and sustain actions to achieve a common end is little studied and little understood. In practice, coordination in many donor financed and government-led interventions is ineffective, contributing to less than satisfactory results. The common factors cited for lack of coordination and subsequent shortcomings are often poor leadership, weak institutions, personal and institutional rivalries, changing priorities, or a hostile external economic environment that makes the entire intervention non-viable.

In order to attack the central trinity of problems besetting rural areas—low agricultural productivity, natural resource degradation, and income poverty—multisectorial and multidisciplinary approaches and concerted public-private sector actions will be needed. In the last four decades, little progress has been made in transforming rural areas and dramatically reducing rural poverty with the exception of East Asia.¹ Today, approximately 2.1 billion persons, a third of the humanity, subsist on \$2 or less, calculated according to purchasing power parity, and 70% are based in rural areas and most of those are dependent on agriculture. In Latin America and the Caribbean, the incidence of rural poverty has been high and persistent at roughly 61% (CEPAL head count estimate) for decades, the absolute number of rural poor has increased since 1970, and Gini coefficients for land/income inequality remain glaring high. While an emerging consensus exists on the broad prescriptions needed to effect change, that is, (1) enhancing the competitiveness of market-oriented smallholder farmers through technology transfer, better risk man-

¹ Most poverty reduction has occurred in China, Japan, Taiwan, and South Korea. The common and sequential strategies pursued for reducing rural poverty in these success countries has been to engage in land reform, intensify agriculture and enhance on-farm productivity through strong state action, invest in basic rural infrastructure, promote non-farm employment in rural areas, encourage migration from the hinterlands to booming manufacturing and service hubs, then protect the residual agricultural sector.

agement, better market access, better access to factors of production, more secure property rights; (2) improving rural education and skills training because education is the single most valuable asset that one can possess in today's economy; (3) generating non-farm employment opportunities; (4) increasing the quantity and quality of public investments in infrastructure and basic support services; and (5) using differentiated and participant-driven policies to address subsistence livelihoods, remote areas, and the special needs of ethnic and racial minorities. There is less agreement and less certainty on how to implement and coordinate these interventions.

Objective

The purpose of this paper is to review the literature on coordination failures, apply game theory to coordination issues within selected rural development projects in order to develop a set of guidelines to avoid and minimize coordination failures. In short, game theory is used as a diagnostic and planning tool. The ultimate aim is to promote development effectiveness by helping to improve project design.

The intended audience is operational staff of the bank, staff in other donor agencies, policy makers, and academics interested in development effectiveness, enterprise development, and rural development. Case studies concern themselves with the rural agricultural and non-agricultural development in Latin America, but the theoretical insights can be applied to any sector or region of the world.

Policy Relevance

Discussion of coordination failures is extremely relevant because the basic "business model" of development assistance donors is being reconsidered. New intervention strategies, new ways of financing projects and programs, and new strategic alliances are being sought and developed. The rubric of bottom of the pyramid is becoming the new the ideology of "development economics". Historically, donors provided external finance to budget constrained client governments to undertake specific actions and interventions. Donors and client governments have tended to favor complex institutional arrangements to manage development project interventions—without a clear understanding of incentives, expectations, good information on impact and effectiveness, and with little real consideration paid to sustainability. In some of the most extreme cases, such as integrated rural development projects, coordination failures were so common that this entire class of projects was abandoned. However, all the proposed new ways of doing "development work" require high levels of cooperation and coordination between multiple agents. If in the past, coordination issues were a major problem in many complex, stand alone project designs, then coordination is bound to be an even more critical issue in the design and implementation of new forms of interventions and public-private alliances that are emerging and becoming more commonplace because the potential collaborators are numerous but also tend to have divergent interests and different ways of doing business.

Below are four emerging trends in development assistance that underscore the need for a better understanding of coordination issues and mechanisms of how to promote it.

Rise of Bottom of the Pyramid Orientation

In the post-war history of international economic development, most interventions were hierarchical and trickle-down, now there is a movement to support bottom-up, demand driven interventions. Up until recently, low-income governments sought technical assistance and financing from external bilateral and multilateral agencies to develop a limited intervention in a particular area, i.e. an isolated, stand alone project. The design was top-down, developed largely by technical cadre in the responsible line ministry, donor staff, and hired consultants. In recent years, local communities and local actors have been consulted more and in some cases involved quite extensively in design, planning, and implementation (i.e. Community-Driven Development projects). In the older model of grassroots development, the target population or beneficiaries were largely seen as passive objects of pity, not agents of change in and of themselves. The new model views poor people as opportunities, not problems and seeks to enable them to mount and expand their own businesses (microenterprise) and to engage with and subcontract with national businesses and transnational corporations.² The upgrading of supply chains, and the heavy use of contracting, franchising, and licensing to link small entrepreneurs to larger firms require significant coordination.

Rise of Spatial Approaches

Before, most donors focused on sectoral interventions, i.e. the construction of a road or the strengthening of a line ministry, now spatial approaches are gaining more currency and imply coordinating the actions of national, regional, and local government as well as community and business actors in a particular territory. Spatial approaches focus on promoting rapid economic development in a particular area by either focusing investments on a particular pole or cluster of businesses with high potential and systematically removing obstacles to their development or by systematically strengthening local governments and private sector actors to plan and initiate locally controlled projects that are highly valued by a majority. The approach expanded on the social investment fund concept popularized in the early 1990s by allowing a community to access funds to finance not only a set of small infrastructure investments but also a wider variety of small-scale income-generating activities. Whereas the sectoral and spatial approaches are complementary, what is noteworthy is that the latter places a premium of coordinating mechanisms.

Rise of Donor Harmonization and Programmatic Approaches

Multiple donor agencies often time operate in the same country in a very disjointed manner. The poorer and smaller the country, the worst the situation tends to be. For example, official development assistance constitutes a large share of public budgets in countries such as Bolivia, Nicaragua, Haiti, Honduras and more international private voluntary organizations and bilateral donor agencies are present compared to the more middle-income countries such as Costa Rica, Uruguay, Mexico, Brazil, Argentine, and Chile. As a result, the limited technical cadre of the recipient host government tends to be overwhelmed managing a multiplicity of donor programs with different focal points, different reporting requirements, and different procurement procedures. Donors and several aid recipient countries are now collaborating and trying to have a single harmonized and coordinated program for a sector in order to reduce transaction costs for the reci-

² See C. K. Prahalad's book, Fortune at the Bottom of the Pyramid.

ent government, to improve impact, and to improve local institutional capacity building. Each donor contributes money to a common pool that is used by the national execution agency to pursue a set of agreed upon goals for an entire sector. Further replenishments to the pool are made based upon attainment of pre-negotiated measurable goals.³ Over forty countries have Sector Wide Approach Programs (SWAps) in execution or advance stages of design/negotiation, most of them in Sub-Saharan Africa. In the case of Latin America, SWAps are occurring in Bolivia (agriculture) and Colombia (health)⁴

Rise of Public-Private Partnerships

Before the principal partners in the “development business” were public sector actors, either a bilateral donor agency or a multilateral development agency owned by several governments dealing with a low-income client government. Now the principal actors are changing. In recent years, Public-Private Partnerships (PPPs) emerged as a means to build and finance basic infrastructure. A government, for example, would grant a concession on a road or water system to a private company who would build and operate the facility and receive a stream of revenue for a specific time frame.⁵ Now PPPs are being used in other areas, namely competitiveness development. Councils that include the representatives of governments and the private sector are working together to develop strategic plans and implement changes in trade and regulatory policy regimes, improve the provision of public goods, and promote the marketing of certain products so that revenue and employment can be bolstered. Prior to the mid 1990s, public institutions were the principal source of financing for developing countries. Now the reality has changed. . Whereas net official development flows to low-income countries globally for the period 2000-2004 were in the range of \$35 billion per year, foreign direct investments (FDI) were in the range of \$162 billion per year, and remittances were approximately \$99 billion per year (World Bank, 2005) In the case of Latin America, the pattern is consistent with the world pattern, FDI (\$56 billion annual average) and remittances (\$28 billion annual average) dwarf foreign aid (\$7.6 billion annual average) for the same period 2000-2004 (ibid). These numbers will force donor agencies and governments to consider developing strategic alliances and finding ways to more effectively leverage their resources.

³ Alternative variations have each donor financing a set of non-overlapping but coordinated activities but with disbursements matched to attainment of verifiable and measurable goals.

⁴ See Peter Pfaumann’s presentation, “Pueden funcionar los SWAps en el Desarrollo Rural-Agropecuario”.

⁵ Note: There is a wide spectrum of public-private participation in a given infrastructure project. The allocation of responsibility for construction, operation, maintenance, asset ownership, and assumption of commercial and financial risk varies by modality. The modalities range from management contracts, concessions, to construction by the public sector then privatization.

II. Literature Review

Definition

“Coordination Failure” in an economic context is a state of affairs in which agents' inability to coordinate their behavior (choices) leads to an outcome (equilibrium) that leaves all agents worse off than in an alternative situation that is also an equilibrium. This can occur due to lack of information, inadequate institutional rules, inefficiencies, or differing expectations⁶.

Historical Evolution of Economic Thought on Coordination: From Walras to Game Theory

The overarching concern of the great classical economists was how could social interactions be so structured so that people would be free to choose their own actions while avoiding outcomes that none would have chosen—the constitutional conundrum. The father of modern economics, Adam Smith, used the metaphor of the “as if led by an Invisible Hand” to describe how agents pursuing their own self-interest in a competitive free market setting can obtain socially desirous outcomes—high levels of aggregate demand, high levels of employment, low prices, and the production of a wide assortment of pleasing consumer goods. In short, specialization, free exchange, and the pursuit of greed and self-interest resolved the problem of the constitutional conundrum. As a result, Adam Smith, David Ricardo, John Stuart Mill and other classical economists strenuously advocated for “free markets and free trade.” Later on, Leon Walras and Alfred Marshall developed the neoclassical economic paradigm that showed under what conditions markets cleared and how allocational efficiency was achieved. No central planning or control was deemed necessary to effect the countless acts of coordination necessary to make markets clear. Unregulated prices were the signals of relative scarcity and they alone were sufficient to motivate agents to act and to exchange.

The principal assumptions underlying the paradigm were that economic agents were fully informed, made exchanges in a setting of complete and enforceable contracts, and made decisions based on self-regarding, maximizing preferences. Moreover, the founding fathers argued that increasing returns to scale and institutions could be ignored for the most part.⁷ Since decentralized, market-based economies outgrew and outperformed centrally planned economies, it was assumed that the underlying neoclassical paradigm and its assumptions were sound and robust. The principal weakness of capitalist economies was seen as distribution. Personal income could vary widely due to differing initial endowments, native abilities, and opportunities afforded.

Needless to say, seamless coordination does not seem to be a given. People seem to act in ways that result in poor outcomes. In both mature, decentralized market economies and emerging or transitional ones, there are many examples of overuse of common pool natural resources that reduces incomes for all and even threaten livelihoods; failures to adopt new technology because no

⁶Wikipedia Encyclopedia. (http://en.wikipedia.org/wiki/Coordination_failureDefinition of Coordination Failure).

⁷The caricature of the neoclassical paradigm is the Robinson Crusoe economy, which used in most doctoral programs to illustrate the concepts of general equilibrium and maximization. Shipwrecked Crusoe is faced with a constrained optimization problem, has no institutions to contend with, and is fully informed. All of “nature” is his property, prices are given, and time in a given day is his budget constraint.

what wants to be the first mover although the technology is clearly beneficial; economic recessions due to self-fulfilling prophecies about weak demand; and persistent regional economic underdevelopment and poverty in the face of abundant natural and human resources. What is significant, however, is that in developing and transition economies, coordination failures seem to be more pervasive and frequent than in more developed economies and helps to explain the persistence of underdevelopment traps.

With the advent of game theory and information economics in the 1980's, the unrealistic underlying assumptions of the traditional Walrasian model have been relaxed. In the context of most developing countries and most developing projects, it is quite obvious that institutions, history, customary behavioral norms, increasing returns to scale, and adaptive preferences do matter. For example, path dependency has become to be recognized as important for economies. Economies that began with plantations, resource extractive industries, and exclusive institutions in colonial times now tend to contend with lower economic growth and more income inequality than ones where relatively more yeoman agriculture and inclusive institutions prevailed. Preferences can also be other-regarding and altruistic. Many persons who play repeated versions of the prisoner dilemma game chose the cooperative strategy even though it is not dominant (Fehr and Rischbacher, 2002). In many aboriginal cultures, the welfare of the group and what appears fair are dominant preferences, not maximization of individual interest. Increasing returns to scale is integral to understanding the "knowledge economy" and is the basis of new theories of economic growth and competitiveness, not constant returns to scale. Many luxury goods are desired and purchased, not for innate utility, but rather just to impress others which shows that behavioral norms do count. Thorsten Veblen back in 1899 first noted the preference for positional goods—"keeping up with the Joneses". Today in the U.S, kitchens with expensive, professional grade stainless appliances are becoming "standard" in new house construction and highly demanded in remodeling projects of existing homes (Kitchen and Bath Design News website). This is occurring while "food away from home" expenditures are increasing. In 1999, the typical American household spent, \$2,116 in restaurants. In 2004, the figure rose to \$2,434. (National Restaurant Association of America, 2004).

III. Game Theoretic Framework

Theory

The importance of externalities, multiple equilibria, and increasing returns in explaining the persistence of underdevelopment has been a perennial theme in the development literature.⁸ Modeling of multiple Pareto-ranked equilibria exist due to increasing returns and pecuniary externalities. Therefore, an economy or a region can be trapped in a low-level equilibrium has gained wide acceptance in recent theoretical literature. However, the extant literature has not paid adequate attention to the role of coordination failures. The literature is much more developed on increasing returns and externalities.

⁸ The literature can be traced back at least to the presidential address of Allen Young to the Royal Economic Society (1928). The recent revival in interest owes much to Murphy et. al. (1989), and Matsuyama (1996), Eswaran and Kotwal (1996), Rodriquez-Clare (1996), and Hoff and Stiglitz (2000).

Coordination failures exist because of (1) asymmetric information coupled with inappropriate institutional rules, (2) other regarding preferences, (3) generalized increasing returns to scale, and the (4) predominance of noncontractual social interactions. They persist over time for the following reasons: (1) large number of agents tend to make the dominant strategy noncooperation; (2) nonverifiable information; (3) inability to change the rules of the game; (4) a risk dominant equilibrium may supercede and be preferred to a payoff dominant equilibrium, and (5) insufficient common interest may exist.

The standard model in conventional neoclassical economics assumes full information, complete and enforceable contracts, and fixed, self-interested preferences. Recent work in information and game theory relaxes these restrictive and unrealistic assumptions and focuses on incomplete markets, especially labor and credit ones. Games are ways of modeling strategic interactions wherein the mutual interdependence of two or more players are recognized and taken into account in deciding individual actions. The use of game theory helps us fathom social structure underpinning economic exchanges and decisions. However, game theory cannot provide an overarching general theory. It does not lend itself to empirical prediction or comparative static analysis. The value of a game theory approach lays in the valuable insights on what motivates agents and illumination of how the institutional environment and rules shape and affect the solution concept. The analysis of the rules helps inform policy interventions. It helps to inform whether the interventions should be one-time or permanent. It can also pinpoint changes in institutional rules that could lead to a desired outcome.

The most crucial assumptions in game theory follow.

Basic Assumption 1: Asymmetric information

Many coordination problems are not resolved because of nonverifiable information. One party cannot observe and monitor the other party and or can not determine how to divide the gains from possible cooperation. The risks associated with entering into a relationship with a number of unknowns could lead to non-cooperation.

Basic Assumption 2: Noncontractual social interactions

Most social interactions are not governed by enforceable contracts. Complete and enforceable contracts are the exception, not the rule. Most interactions between individuals, communities, firms, families, environmental commons, political groups, and markets are noncontractual. Most economic interactions are informal (no written binding contracts) and are governed by social norms and power. Interactions are largely governed by trust and incentives to maintain mutually beneficial long-term relationships. The more underdeveloped the economy, the more incomplete contracts and the more common noncontractual relationships tend to be. For example, Masai and Ghanaian herdmen move cattle long distances to sell in urban consumer markets. The middlemen in the chain are trusted persons from either the same ethnic group, village, or religion. Little is ever written or recorded but these patterns of trade have persisted for millennia. (Wenner and Mooney, 1995). In contrast, livestock marketing in developed countries is impersonal and long distance, based on many written contracts and common standards of weights, measures, and

grading. Most employers expect employees will put forth good work effort even though it is not easily observable. For example, the employee fears termination by the employer or negative reports from coworkers that damages his or her reputation and chances for promotion if shirking is excessive. A food processor in a competitive situation wants to cultivate and maintain good and reliable suppliers so s/he deals “fairly” with them. On the other hand, if a monopsonistic situation prevails, the food processor can be tempted to exercise market power and “exploit” the supplier with little or no consequences.

Basic Assumption 3: Institutions Matter Significantly

By institutions, we mean all the official laws, informal rules, and conventions that give structure to a game. Changing the rules that govern an interaction can shape outcomes. For example, fisheries lend themselves to overexploitation (tragedy of the commons) yet either government imposed regulations (catch limits, licensing, tradeable permits) or voluntarily imposed limits can serve to protect the resource and prevent degradation.

Basic Assumption 4: Generalized Increasing Returns to Scale and Strategic Complementarity

Benefits that accrue to an individual depend on the actions of others. For example, deciding what word processing program to learn depends on how many other users there are of the word processing program. The same applies for learning a new language or acquiring a particular type of technology. Increasing returns to scale may not be the norm in the manufacturing of mouse traps but it is quite common in sectors driven by rapid technological change and where a premium is placed on knowledge management.

Basic Assumption 5: Adaptive Preferences

Work that is more recent challenges the self-interested utility maximization of homo economicus in the Walrasian paradigm. People in experiments do not act like the farsighted, super cognitive, rational, agents. Rather they tend to have bounded rationality, limited capacity to perform calculations, use backward-looking learning processes, and use rule of thumb decision-making approaches. While self-interest is a strong motivating factor, they still regard others and have tendencies of altruism and notions of “fairness”. More importantly, preferences can change over time as “practices and strategies” of more successful individuals, groups, or firms are emulated.

Illustrations of Coordination Failures Using Game Theory

Three simple games illustrate the continuum from coordination failure to coordination success.

Prisoner's Dilemma: Coordination Failure

Table 1: Prisoner's Dilemma

		Fisherman 2	
		Fish 6 Hours	Fish 8 Hours
Fisherman 1	Fish 6 Hours	2,2	0, $1+\infty$
	Fish 8 Hours	$1+\infty, 0$	1, 1 (Pareto Inferior Nash Equilibrium)
		Where $0 < \infty < 1$	

In this game two identical fishermen have the choice of fishing 6 or 8 hours. Fisherman 1 moves first and if he decides to fish 6 hours will receive a payoff of 2 if Fisherman 2 also fishes 6 hours but 0 if Fisherman 2 decides to fish 8 hours. Likewise, if Fisherman 1 fishes 8 hours he will receive a payoff of 1 plus a fraction while Fisherman 2 would receive 0. When each fisherman opts for 8 hours, the stock of fish is rapidly reduced in the body of water, reducing the payoff to 1 for each.

There are no other rules or conditioning factors. Therefore, the clear optimum would be for each to fish 6 hours, maximize their catch and still have an additional 2 hours of leisure, assuming an 8 hour day. However, it is not best strategic response because of enforceability and verification issues. The two fishermen cannot observe how many hours the other will fish and even if an agreement was made, they could not enforce it (lack of police or court system). Some of the reasons that a voluntary commitment will not appear, even in a repeated game, is that it is difficult to allocate work effort (one can fish 4 hours one day and the other could fish 8 for the optimal sum of 12 hours given our level of technology but who will decide) and even if the work effort was divided how would the fishermen decide to distribute the gains (lacking institutional rules). The best response is to “defect” and not cooperate. The result is that both receive a payoff that is inferior to the “cooperation” solution. Both fishermen fish 8 hours and receive a payoff of 1 each which is half of the ideal solution.

Assurance Game: Partially Successful Coordination

Table 2: Assurance Game

		Farmer 2	
		Plant Seed Early	Plant Seed Later
Farmer 1	Plant Seed Early	4,4 (Pareto Superior Equilibrium)	0,3
	Plant Seed Late	3,0	2,2 (Pareto Inferior Nash Equilibrium)

Imagine a setting wherein two identical farmers have to make a choice as when to plant spring seed. If one farmer plants early and the other farmer doesn't birds may consume most of his seed leading to a sub par harvest. If both plant early or late, then the birds are satiated quickly and while both suffer loses, enough seed is left to germinate. However, if both plant early, the yield will be higher than if both planted late due to more rainfall. In this game, there are two equilibria. However, of indeterminacy about how to play depends on the beliefs about how the other will play could lead to a sub-optimal result. If the players are both risk averse, then both will plant late. This is a Nash equilibrium in the sense that this is the best strategy for both to pursue. If either risk planting early and the other decides to be noncooperative, then the first mover loses. If they are not risk averse and are both motivated by maximum payoff, then the Pareto superior overcome would obtain, both will plan early and receive a payoff of 4.

Invisible Hand: Successful Coordination

Table 3: Invisible Hand Game

		Farmer 2	
		Process Corn	Process Tomato
Agroindustry 1	Process Corn	2,4	4,3
	Process Tomatoes	5,5 (Pareto Optimum Nash Equilibrium)	3,2

In this game, the self-interested actions of both parties(i.e. pursuit of maximum return) result in an outcome that maximizes welfare for both. The iterated dominant strategy would be for agroindustry 1 to process corn and for agroindustry 2 to process tomatoes. This game has a single Nash equilibrium that is also Pareto optimal. This is the ideal case and represents coordination success.

The challenge is transform prisoner dilemma and assurance games to the invisible hand game. How to do you intervene by either changing the “institutional rules” or by “changing the payoff” in order to obtain desired outcomes? The interventions can be of the “one-shot” variety, i.e. change in property rules, for example, to issue trading permits for fishermen or permanent and repeated one, i.e. have the government compensate parties for potential crop losses or establish a regulatory agency to issue fishing licenses and to punish violators for poaching or over fishing. Three critical steps are necessary. First, the “game” has to be identified. All the limiting factors, i.e. “rules and institutions” underlying the interaction have to be well understood. Second, the relevant payoffs and costs for each strategic interaction have to be estimated. Relative magnitudes are more important than absolute numbers. Third, the interventions chosen have to be feasible given the technology, social norms, and institutional enforcement capacity.

IV. Application of Game Theory to Selected Bank Projects

Three Bank projects will be summarized and the specific issues of coordination will be analyzed in a game theoretic framework in order to glean insights of how to assure better coordination in future projects by transforming rules of interaction and better defining roles. All of the selected projects involve the consolidation and or the upgrading of value chains and clusters.

Case Study 1: Building of Strategic Alliances and Upgrading the Isabella Grape Supply Chain, Colombia

Project Description: The Multilateral Investment Fund approved a US\$1.1 million grant in November 2000 to strengthen and consolidate the functioning of a value chain dedicated to the production, marketing, and processing of the Isabella grape in the municipalities of Ginebra, El Cerrito, y Guacarí in the Cuaca valley of Colombia. The principal beneficiaries were 385 small farmer households.

The objectives of the project were threefold: (1) encourage grape producers to engage in collective action, form strategic alliances, and strengthen a marketing cooperative; (2) transfer improved technology and management practices that would increase grape quality and productivity; and (3) to improve the bargaining and negotiation powers of the producers and their cooperative vis-à-vis other actors in the chain, especially buyers.

The program of actions called for hiring expert technical assistance to provide the following services; (1) training farmers in basic business skills; (2) helping farmers adopt of new technological packages on 800 hectares that incorporate environmentally sound techniques which would not only increase yields from 22 MT per ha to above 30MT but also allow individual producers to obtain zero pathogens, zero chemical residue, Brix measures of sugar content greater than 18 degree, acidity levels of 3.5-4.2, and uniformity in 50% of all fruit; (3) train the farmers to use Hazard Analysis Critical Control Point (HACCP); (4) improve the capacity of the producer cooperative, CorpoGinebra to handle the marketing of 50% of the product of members by building databases on markets, improving collection and storage capacity, and identifying new strategic allies.

The executing agency was Fundación Carvajal, a Colombian non-governmental organization, but was supported by a number of other actors. The list includes the State Ministry of Agriculture, the Chamber of Commerce of Cali, a trade promotion group, Proexport Colombia, the mayor offices of all the municipalities involved; a research institute, CeniUva; technical service providers-Biotec and Manuelita S.A.; and a host of commercial agricultural input suppliers.

Background: In the central part of the Cauca Valley a grape cluster had developed over the last 60 years. In the late 1990s, approximately 400 medium- and small-scale producers were involved, cultivating 500 has and producing 11 metric tons per year. Production conditions are

heterogeneous. On the valley floor, larger and richer farms predominate and are capable of producing industrial grapes. On the hillsides, smaller and poorer farmers predominate in producing table grapes. Small farmers tend not to have secure land tenure whereas larger farmers do. Tenure facilitates access to credit. Eighty percent of output was marketed as fresh table grapes and 20% was processed into juice, alcohol, wine, and pulp. However, given the agroclimatic conditions and the quality of the soils, the cluster was underachieving. According to agronomic and marketing studies, 17 to 18 metric tons could be easily produced and sold per year. Even export opportunities existed in neighboring Venezuela and Ecuador, during the Chilean off-season. The main reason for the underachievement was lack of joint action. A series of bottlenecks existed in the chain that required high levels of collaboration and joint investments in order to overcome them. A cooperative existed, Corpoginebra, but it had only 22 members. A high level of mistrust prevailed among the farmers.

Project Results: The project team was successful in many respects. By March 2005, it had succeeded in getting 103 farmers to use production calendars, 135 to keep books, and 119 to track production costs; in transferring modern and “clean” technology to 96 farm households; in increasing yield per ha by 4 metric tons on average; in increasing sales revenue per ha by \$1,650; in increasing area cultivated by 189 ha; in attracting 156 new grape producers; in generating 85 day labor positions on farms and 106 skilled jobs in technical service providers; in increasing the membership of Corpoginebra from 22 to 237; and in creating a consortium of private and public sector strategic allies—Fundación Carvajal, Corpoginebra, Biotec, Cenivua, Manuelita, Sena, Chamber of Commerce of Cali, Ministry of Agriculture, and three municipal governments. Where it fell short was in marketing and institutional development of the cooperative. Corpoginebra was able to market only 18% of the output of its members and to obtain three permanent contracts. The supply chain had not become fully articulated as had been planned. More importantly, the cooperative still lagged in using management information systems, obtaining consistent quality standards in marketed output, collecting enough fee income to begin to capitalize the institution, and in obtaining economies of scale in both the purchasing of inputs and the negotiation of sale contracts (Ecodesarrollo y Gestión, Ltda, 2005).

Game Theoretic Analysis of Project Actions: The two principal problems were mistrust and high transactions costs. The producers did not want to engage in joint action because they feared that “free-riding” would occur and that larger farmers or the elite members of the cooperative would benefit disproportionately from the project interventions compared to smaller farmers. No one individual farmer had the wherewithal to monitor the whole valley. The involvement of an external agent, Fundación Carajaval, and the availability of external financial resources, changed the rules of the game. Information was now verifiable. Eligibility rules were transparent. Someone had the financial wherewithal to organize all the grape producers in the valley and to make all the contacts with power brokers. The training provided was open to all and there was no rationing of technical support services. At first, all services were free and over time a modest contribution was requested to offset the costs.

According to project supervisors, the biggest challenge was not organizing the farmers as was contemplated in project design phases, but was getting the technical service providers and research institutes to focus on solving farmer problems and stop from pursuing their own agendas. At the start of the project, many of the service providers viewed the “project” as an additional

source of income. Each of the entities in the consortium had its own agenda and preconceived notions of what needed to be done. What had to be achieved was a “common vision”. The vision was to build an efficient and cost competitive chain. This meant adopting a service orientation. The “client” was the farmer, not the executing agency or the donor. In the day-to-day routine, that meant solving a series of mundane problems such as treating fungal inspections, arranging transportation, assuring common and efficient ways of testing for quality, negotiating sales etc., not necessarily pushing one variety of grape or one business training method. The process of building commonality took approximately a year and a half.⁹

The other issue was transaction costs. Each of the parties had different time horizons, different motivations, and different capacities. The endless round of meetings, the interminable attempts to define roles etc. required Herculean efforts and patience. The main success factor was the credibility and integrity of the project team leader. After some initial successes in placing products, the level of distrust fell and subsequently transaction costs.

Table 4a: Stage 1 of Interdependent, Concatenated Strategic Game

		Farmer 2	
		Fully Commit to Project	Partially Commit to Project
Farmer 1	Fully Commit to Value Chain Upgrading Project (receive training, apply all training, adopt in entirety the technology packets, participate in cooperative, pay for services)	10,10 (Pareto Superior)	2,4
	Partially Commit to Project (receive training, adopt only some of technology, apply only some of training, do not participate in cooperative, do not pay for services)	4,2	6,6 (Pareto Inferior)

Assumptions:

- Increasing and generalized returns to scale
- Free-riding (Farmer who pays fees is subsidizing non-paying farmer and sacrificing leisure by participating in cooperative building meetings)
- No means of exacting penalty for “defection” or partial commitment

⁹ Phone interview with Fernando Balcazar, natural resource specialist in Colombia Country Office.

Table 4b: Stage 2 of Interdependent Concatenated Strategic Game

	Action	Buyer	
		Sign Formal Marketing Agreement	Do not Sign Formal Marketing Agreement but continue to buy on ad hoc terms
Cooperative	Seek to Sign Formal Marketing Agreement [Conditional: Stage 1 Result, Pareto Superior Outcome, 10,10]	4, 4	2, 2
	Seek to Sign Formal Marketing Agreement [Conditional on Stage 1 Result: Pareto inferior Outcome (6,6)]	-1, 0	0, -1
	Sell on Ad hoc [Conditional on Stage 1 Pareto Superior Outcome]	$1+\Phi, 1-\Phi$ $0 < \Phi < 1$	$1-\Phi, 1+\Phi$
	Sell Ad hoc [Conditional on Stage 1 Pareto Inferior Outcome]	1,0	0,1

Assumptions:

- Buyer can not observe the amount of cooperation between farmers and the resulting marketable surplus in Stage 1 but seller who has obtained maximum output level can “signal” by offering a multiyear deal at a reduced price. When the seller has obtained less than the maximum output level, will signal the state by being less willing to negotiate downward on prices. The first signal implies maximizing return based on volume of production, the second signal implies maximizing return based on price received.
- Buyer prefers to purchase the highest output level (Pareto Superior Outcome) because would incur additional costs in sourcing from other agents.
- Buyer can use market power and the perishable nature of the product to offer only “spot contracts” without fear of retaliation
- Buyer has little legal recourse if seller fails to deliver stipulated quantity and quality in a signed formal contract.
- Spot or ad hoc prices are less than signed market contract amounts

Conclusion: In this case the role of institutional *rules* are primordial. The eleven support agencies were forced to act in a certain way. The project administrators were partially successful in converting a prisoner’s dilemma game to an assurance game by getting the support organizations to see the grape producers and cooperatives as clients. However, due to remaining institutional

weaknesses (lack of sufficient cold storage, lack of financing, lack of marketing credibility) a Pareto inferior equilibrium was obtained. If the institutional weaknesses could be resolved, farmers could have marketed more products on better terms and earn even more income. The multiplier effects on the greater regional economy would even be greater.

The preference of the project administrators would have been to for the farmers via their cooperative to sell directly to supermarkets. Currently, producers are receiving \$150 pesos for each kilo sold through indirect means (farmer-cooperative or local buyer who grades and stores product—consolidator/middleman in Bogotá who pays for transportation and accumulates necessary volumes to satisfy the demands of food distributors, supermarkets, and institutional clients). With a direct sale to a supermarket, the producer could earn \$900 pesos per kilo but would have to be responsible for transport and cold storage (Ecodesarrollo y Gestion Ltd, 2005 (pp 97-98)). The cooperative has not been able to finalize many formal sales contracts.

In many respects, we have a two-stage game. On one level, the protagonists are farmers who among themselves have to decide if they are going to adopt technologies and practices in common so that a particular volume with a certain level of quality will be produced. If they partially commit they derive some benefits but not the full amount. More importantly, partial commitment generates “bad feelings” and retards the institutional development of the cooperative. Those who fully commit pay money to subsidize the free riders and lose leisure time due to the many cooperative meetings and activities that are necessary to build a strong organization. The cooperative takes longer to modernize and to obtain financial sustainability as a result. We assume that “free-riders” can not be readily punished because the cooperative wants as much marketed surplus as possible in order to pursue large contracts and donors who back the “project” do not want to “set up exclusionary policies” because they fear that those likely to be excluded would be the smallest and poorest farmers. At the second level, there is also a game between the marketing cooperative representing all the individual producers and distributors-buyers. Distributors-buyers may not want to commit to a formal contract with the cooperative because of inability to verify information on the current yield, storage and packing capacity, reliability of quality testing procedures of the seller and weaknesses in the court system to effectively enforce contracts. Accordingly, distributors prefer to have informal, spot market buying arrangements that protect them and give them flexibility to find alternative sellers. Buyers tend to often lower prices because they are penalizing for lack of uniform quality and sufficient volume. Therefore, in the second stage of analysis we have a risk dominant strategy resulting in a low-level Nash equilibrium, mirroring the equilibrium in the first stage. The project designers did not seem to fully explore and make provisions for these “credibility problems”. In future similar projects or even in a second phase of this project, parties have to focus on mechanisms that will either improve legal enforceability (i.e. alternative dispute resolution), exclusionary policies that try to limit membership in the cooperative to like-minded and equally capable members, or a noncompliance fund possibly funded by public sector entities that can be used to compensate the buyers for failure of producers to honor marketing contracts. Possibly with these incentives as well as invitations for large buyers to visit the production zone can lead to additional signed contracts.

In summary, the project administrators were able to convert this game from a prisoner dilemma to something else by paying institutional support service providers based on responsiveness to

farmers and not personal agendas. The preexisting norm was to get donors and governments to pay for effort expended regardless of results. The intervention was to use a “material incentive”.

Case Study 2: Territorial Rural Development Pilot Project (EXPIDER)

Project Description: In May 2003, the Bank approved a technical cooperation valued at Euros 450,000 to conduct a pilot experiment on a reformulated spatial approach to rural development called territorial development in three sites in Latin America—Valles Crueños in Bolivia, Reitoca and Verdugo watersheds in Honduras, and Río Chanchán watershed in Ecuador. The project name was EXPIDER.

The objective of the project was to evaluate and validate the viability of using a rural territorial development approach first attempted in the European Union, *Liaisons entre activités de développement de L’Economie Rural* (Leader Project). The approach seeks the institutional and economic transformation of a particular geographic space. The methodology involves building mostly horizontal partnerships and alliances. First, a territory that shared a strong common social and economic identity was delimited. Note the territory may or may not overlap distinct political jurisdictions. Second step was to use community-wide participative planning to develop strategies and intervention plans. Third step entailed constituting a legally recognized local development organization representative of all sectors and constituencies within the region to act as executing agency. Fourth step was to mobilize funds and then fifth step was to implement institutional strengthening and income-generating activities. The Leader project started in the early 90s and was successful in reducing rural poverty in marginal and rural areas of Western Europe. The question was whether the concept would be made operative in the more trying environment of Latin America.

The Latin American pilot project activities were divided into three components: (1) providing technical assistance and support for the creation and strengthening of local development agencies representative of the territory/community; (2) elaboration of strategies; (3) monitoring; and (4) compilation of lessons learned.

Background: Rural development by its very nature is a multisectorial and multidimensional. In the 70s and 80s, many attempts to undertake integrated rural development (IRDs) had failed miserably. These “big push interventions” contemplated building schools, roads, health clinics, water supply systems as well as transferring new agricultural technologies and providing agricultural extension services simultaneously in one region. They invariably failed due to rigid, top-down approaches and problems with coordination. Realities on the ground changed faster than the meticulously developed plans causing lack of acceptance by beneficiaries. For example, market research would indicate that a particular crop should be considered high potential but by the time, adaptive research was completed years later, the profit margins had decreased or overproduction led to market saturation and a price collapse. Other times roads would be built to sites where clinics/schools/collection centers failed to materialize or clinic and schools would be completed but not staffed. Other times farmers would show great interest in adopting a new cultivar or changing technology but would not receive credit from a state bank at an opportune time resulting in less than expected yields and loan defaults. Disillusionment set in with the approach.

In the 1990s, interest was rekindled in spatial approaches. Leader in Europe functioned in large part due to high levels of subsidies in agricultural and rural policies (Common Agricultural Policy (CAP)), and the ready availability of financing from the European Union (EU). In Latin America, the approach is faced with many operational challenges. What incentives to use to obtain high levels of cooperation both vertically and horizontally? How do you finance development plans? How do you avoid the local development agencies from being captured by local elites?

For the sake of economy, only one of the three pilot test sites would be reported on Río Chanchán, Ecuador.

Chanchán At A Glance: The Río Chanchán watershed (13,500 km²) is located in the Chimborazo Province of Ecuador, heterogenous conditions complicated coordination. The original idea was to use the river to unify four municipalities (Guamote, Alausí, Chunchi, Cumandá) with a total population of 110,000, of whom 70% were rural and dependent on agriculture. In practice the river and associated water use issues divided more than unified the population. The population in the higher elevations (>2,800 meters) had little in common with the population in the lower elevations (sea level to 800 meters). The population in the higher elevations faced water scarcity, were predominately populated by indigenous peoples who engaged in subsistence agriculture and livestock rearing (llamas) while the population in the lower elevations were predominately mestizo and depended more on commercial agriculture (cacao, coffee, sugar, and banana). The mestizo communities were generally richer than the indigenous communities. Besides the racial and economic divisions, there were also political and religious one. In the predominately indigenous communities of Guamote and Alausí, the leadership changed from one political party to the other forcing a change in the technical cadre that was vital for the project. Moreover, sharp differences existed between Catholics and evangelical Protestants. The latter group were politically and economically ascendant, making collaboration and the development of trust more challenging. Still to further complicate matters, a host of civil society organizations and NGOs operated in the communities and in many instances competed with each other in the execution of overlapping donor financed projects. At the national level, instability reigned. Between 2004 and 2006, the life of the project, Ecuador had three presidents. Invariably each change of president precipitated a change at the ministerial level which resulted in delays and discontinuities in agricultural and rural development programs.

Chanchán Project Results: The EXPIDER project was able to create an institutional framework for collective action despite the aforementioned challenging circumstances. The following was achieved.

1. Signing of an accord with the Prefecture of the Chimborazo (Governor) and Ministry of Agriculture to collaborate and coordinate activities. The political and practical significant cannot be underestimated. The Governor of the Province essentially took personal interest and became a champion of the project in government circles (April 2004).
2. Organizing two workshops on tourism development in Guamote, and Riobamba, the provincial seat. Instead of water or agriculture being the focal point, the participants in the process agreed that tourism was the productive pole to prioritize since it would generate

the widest range of benefits for all in the watershed, regardless of location (July and September 2004).

3. Sending the mayors in the watershed on an exchange trip to Galicia to see first hand the results of the European Union's Leader project (November 2004).
4. Constituting a local development agency, Corporación para el Desarrollo de la Cuenca del Río Chanchán (CODECH). The Board of Directors is comprised of representatives from public and private sectors and has 14 working committees. Nonetheless, mayors dominate the Board (January-April 2005).
5. Signing a Cooperation Agreement between CODECH and the Galician Agency for Rural Development (AGADER), which promises to provide financial and technical support for several years (October 2005).
6. Implementing a monitoring and evaluation system with assistance from AGADER (October 2005).

Game Theoretic Analysis of Project Actions: The strategic interaction of significance was commitment conditioned on availability of financing. The private sector participants in the watershed coalesced around the notion that tourism could be a powerful motor of growth. The watershed is particularly scenic and a "trail system" was to be developed wherein tourists could spend a week or ten days, visiting different locales of interest, patronizing different hotels-guest houses, restaurants, arts-crafts markets along a route. The attractions in the watershed are picturesque, perfectly shaped, snow capped volcanoes in the uplands, a rail line, a series of Indian market days, a tradition of producing high quality textiles and art, and a few of relatively unspoiled nature areas in the lowlands. The market would be a foreign tourist interested in outdoor adventures, Indian culture, photography, and arts and crafts. The missing ingredients were basic infrastructure, marketing, and organization. Most all the residents would stand to benefit---farmers could supply fresh produce, artisans would have a larger market to sell to, restaurants-hotels-guest houses would generate higher revenue streams and more job, and the demand for transport and tour guides would increase.

The local development agency provided a vehicle by which to organize and coordinate all the disparate parts but the real challenge was to obtain financing. Moreover, financing was needed both for the day-to-day operating of the local development agency but also for collective and individual investment projects. The solution came via a temporary transfer arrangement made with AGADER. AGADER agreed to support operational staff and to finance some proposals.

The politicians saw the local development agency as a prime means to generate income in the area of influence and thus garner more political support. Mayors dominated the board and leadership positions (municipal officials held the office of president, vice president, secretary, treasurer while private sector and civil society types were heads of working committees). However, the local politicians and the private sector business people needed each other. The private sector needed some basic infrastructure investments that they can not do or were not willing to do by themselves and the politicians needed the tourism value chain to be quickly developed in order to win votes.

The issue of coordination in this context can be modeled as a game with some asymmetric information properties, wherein a prototypical private sector business person would commit to co-

ordinate and participate in larger strategic plans and collective action only if assured access to finance to support an income generating activity of personal interest. The other agent, the politician, is interested in committing to the venture in order to garner public recognition and increase popularity among the electorate based on association with a local development agency that was active and delivering tangible goods and services to the community. However, the politician is privy to more information about the likelihood of obtaining external financing. Politicians are better situated to mobilize public funds from municipal, regional, and central governments as well as international donors than private businessmen. Donors and governments are more willing to allocate public monies for collective actions that benefit a large number of people than to allocate it to activities that just benefit one or a few private business people. Moreover, politicians are very insensitive to transaction costs associated with searching for funds (attending meetings, submitting proposals, making phone calls, making oral “pitches”) whereas businessmen are much more sensitive. The opportunity cost of time for a businessman is high. Attending local development agency meetings takes away time from managing their businesses. The more time a businessman is away, the greater the likelihood, his or her business will suffer. This is especially the case with medium, small, and micro entrepreneurs. All the business people in the Chanchán setting, with the exception of one could be considered small (less than 20 employees) or micro (less than 5). Therefore, politicians will have better formed notions as to what is the likelihood of obtaining funding than business men because they invest much more time in fundraising activities and they do have some control over small budgets as elected municipal officials. The situation is modeled in the following payoff matrix.

Table 5: Commitment Conditioned on Asymmetric Information

		Politician	
		Commit to Group (Probability of Obtaining Financing is Truly Low)	Commit to Group [Probability of Obtaining Financing is Truly High)
Private Sector Businessperson	Commit to Group [Probability of Obtaining Financing Perceived to be Low]	3, 3	3, 8
	Do not Commit to Group [Probability of Obtaining Financing Perceived to be Low]	2, 2	2, 4
	Commit to Group [Probability of Obtaining Financing Perceived to be High]	5, 5	7, 9
	Do not Commit to Group [Probability of Obtaining Financing Perceived to be High]	4, 5	4, 5

The first and third rows (colored numerals) are likely outcomes. If the politicians can signal or communicate to the business community the true likelihood of obtaining funding, then the higher outcomes of line three will result. Note that the higher payoff to a businessperson even though they have a mistaken belief (line 3 box 1) results because they can benefit from networking with others.

Politicians reap greater benefits across the board when business people commit because they can always claim that they got the “private sector to participate in an activity for the benefit of all” even though concrete results may not be forthcoming.

Conclusions: In this setting, the role of *finance is critical*. In practice, when the group learned that the Government of Galicia, Spain would finance the local development agency, interest and participation improved. In short, the politicians were more willing to “bet” on an under funded initiative because the upside payoff was high. Politicians could take credit for any positive result, however modest. Businessmen were not too keen on committing to an under funded initiative because of the high opportunity costs of attending meetings. They were less interested in projects partially financed. The practical recommendation for the future is to design the project with an assured source of funding to avoid frustration and delay from the very start.

Case Study 3: Province of Río Negro Competitiveness Project, Argentina

Project Description: In June 2003, the IBD approved a 20-year loan up to \$51.9 million (total cost estimated to be \$86 million with local counterpart funding included) to increase the economic competitiveness in three clusters—tourism, fruit, and technology—in the Province of Río

Negro in the south-central part of Argentina. The project has four components: (1) modernization of public sector support services (\$4.6 m); (2) attraction of investments to three subsectors in the province (fruits, technology, and tourism) (\$3.7 m); (3) strengthening of SMEs in the selected clusters through the provision of business development services and access to a fund for financing of investments and working capital (\$69 m); (4) and the establishment of a monitoring and evaluation unit (\$1.1 m).

Background: Argentina suffered macroeconomic imbalances from 1995 onward and then experienced a painful financial crisis in 2000-2001. Since then, the economy has recovered and grown. The Province of Río Negro has a history of solid economic achievements. The region is famous for apple and pear exports, accounting for 39% of the country's total fruit exports and generating 56,000 jobs. San Carlos de Bariloche, the largest city in the province, is the premier tourist destination in Patagonia, receiving 2.4 million visitors in 2005. The sector generates 13,000 jobs and contributes 5% to the Gross Product of the Province. The Peronist Government in the 1950s established a research center for physics, Instituto Balseiro. Over time, the center developed and spawned several spin-off companies in related areas: information technology, aeronautical and space sciences, engineering, and alternative energy. Now Bariloche has a high concentration of scientists with advanced degrees and a reputation for producing world-class experimental reactors (\$188 million OPAL reactor in Australia) and providing goods and services to NASA, Lucent Technologies, Halliburton, and other leading international and national institutes and companies.

Despite the solid economic achievements, these promising clusters have not been able to realize their full potential due to a number of structural barriers, namely, the lack of quality support services, limited public spending due to fiscal constraints stemming from accumulated high debt loads, problems with access to finance by small and medium-sized enterprises (SMEs), lack of aggressive and concerted marketing, and the high cost of international travel due to distance from major tourist originating markets in the rest of Latin America, outside of Chile and southern Brazil, North America, Western Europe, and Japan. For example in the case of the fruit sector, little investment has been made in new fruit varieties, packing facilities, and irrigation systems. Improvements in these areas would open new markets, improve post-harvest quality that could earn price premiums, and bolster productivity. In the case of tourism, Bariloche receives 2.4 million visitors per year but has just 14,000 beds, of which only 3,100 are in hotels of 4 and 5 star ranking. There is tremendous potential for a convention center but more beds would have to be added and quality of hotel service upgraded for the most part. In addition, the sheer physical beauty of the surrounding area and possibilities for active vacationing would have to be more aggressively and strategically marketed in order to generate higher revenue flows and more jobs. The cost of marketing would be exorbitant for any one entity to undertake. A marketing campaign would have to be a collective action and common messages would have to be sent and a joint commitment made by all involved to follow-through and improve the quality of the tourist product(s) marketed. Lastly, the highly trained scientists could be better utilized and contribute to a larger and more vibrant high technology economy that just numbers 20 firms at the present. Bariloche for its size has a disproportionate number of doctorates in its population of university educated persons (3.5% v. 1% for the nation's capital).

The executing unit of the project hired Competitiveness, a Spanish firm, that specializes in cluster development to develop three subsector strategies, to foster public-private alliances, to help implement the plans adopted, and to monitor and evaluate results. The firm started activities in 2006. Diagnoses and visioning exercises have been completed and the project is entering its third phase, implementation of actions.

Project Results—Focus on Tourism Cluster: To simplify matters, the discussion will only focus on the tourism cluster. As of May 2007, the hired consultant firm had organized a number of tourism committees in four strategic areas (developing special interest tourism: corporate retreats and wellness therapy; restructuring and upgrading the small hotels/guest houses; extending the “season” from Winter and Summer to being year round; and improving information coordination to present a timely, accurate, and complete travel-related data base of the region). Each committee was tasked with making a diagnosis of principal constraints for the given topic, engaging in a SWOT exercise, picking priority areas for intervention and then developing a strategy and plan of action. The deadline for the plans of action to start is June 2007.

To date the greatest coordination challenges have arisen within the committee dominated by the public sector support and regulatory agencies (municipal government, Department of Tourism, Ecology and Environment Council, national park service, public works, etc.) that deals with information coordination. For example, one of the identified problems is inability to put at the disposal of a potential or actual visitor accurate, complete, and useful information on activities, tours available, park hours, availability of lodging, pricing of lodging, bus schedules etc. Many of the current brochures and websites vary greatly in quality and accuracy. Moreover, many parties in the sector do not know or cannot readily obtain up-to-date information from other entities in the cluster. The result is that visitors have to contact multiple sources to obtain necessary information for planning and reservation purposes and sometimes receives erroneous or conflicting information causing needless frustration, disappointment in value received, and lost vacation time in arriving at tourist sites that are closed. Part of the reason for the lack of up-to-date information has to do with looming provincial elections and another has to do with a lack of an integral, client-focused vision. The challenge of the project team is convince individual operators and supporting government agencies that they are marketing “One Patagonia” and that the “Message” must be clear.

Game Theoretic Analysis of Project Actions: The significant strategic interaction here is getting the public sector support agencies to modernize and openly share information since they are the largest repository of information and can more easily gather the necessary information than any other entity. During the crisis period, many of the agencies were not properly staffed yet functions were duplicated. Each agency has some information that needs to be shared and the “obvious solution” would be to create a one-shop tourism website for the entire province, a protocol to constantly up-date relevant information, and produce a set of brochures that are coordinated, uniform, and high quality. This is what has been agreed too. The main website will have many links to relevant service providers but serve the immediate need to communicate accurate information to visitors quickly and in a user friendly manner.

The main problem seems to be how to make the “gains from cooperation” clear for the public sector. Whereas the gains for private sector hotel, travel agencies, and tour guide operators are

abundantly clear, they are not so for the public sector. Bettering marketing, a more differentiated set of tourist products, and a higher level of hotel service should translate into higher profits for private sector operators. A high number of visitors will generate high user fee income for some public agencies such as the park service but not for others like the Department of Tourism, a line ministry. The Department of Tourism licenses hotels but generates no substantial flow of recurrent income. Most of the benefits or gains for cooperation will be realized through indirect channels. Namely, more tourist arrivals will translate into higher taxes collected and increase the hope of receiving a larger budget allocation in out years. In general, the budgets of the public agencies are constrained and are not likely to grow substantially due to the high level of provincial indebtedness. In essence, these agencies are being asked, “to do more for less” for the foreseeable future.

In a worse case scenario, the game between the n public agencies could result in a prisoner’s dilemma game (See Table 1), where there is no cooperation, because in the setting of severely constrained budgets, no one gains directly from investing highly in more information sharing with the other agencies. Staff and monies will have to be dedicated to gathering and updating information and maintaining websites, which is not necessarily the “core mission” of any of the involved agencies. The agencies can “beg their neighbor for forgiveness, and promise to deliver the information at a later date when they have the staff resources”.

Fortunately, the project has set aside monies to strengthen the Department of Tourism, especially in development and application of a new regulation and licensing systems for hotels, the managing of the supply of tourists, improvement of tourist services, and comprehensive management of Cerro Cathedral, a major landmark and tourist attraction. The project also has a fund to finance the medium- and small-scale tourist operators in their upgrading activities. Therefore, significant material incentives exist, at least during the life of the project, to encourage collaboration. Those public institutions receiving project money will have an incentive to comply with the “information-sharing mandate”. Those receiving fee income will also have another independent incentive to collaborate. A third incentive, would be the lobbying role the project team can play to sensitize the decision-makers of rewarding the support agencies with additional funds based and their contributions in attracting more tourists to the province. Thus, the prisoner dilemma game can be converted into an invisible hand game and coordination success be obtained. At present, the project team seems to be convincing agency managers, politicians, and staff that there are indeed real gains to cooperation.

Table 6: Invisible Hand Game: Sharing Information

		Public Sector Support Agency 2	
		Share Information	Do not Share Information
Public Sector Support Agency 1	Share All Information	5,5 (Pareto Optimum Nash Equilibrium)	4,3
	Don't Share Information	3,4	3,2

Conclusion: In this case the role of *gains to cooperation* is fundamental. The benefits for sharing information was clear to the private sector but less so to public sector actors. Even though the ostensible mission of the public sector institutions is to facilitate the exchange of information, set standards and regulate, and market the entire region as a tourist destination, budget constraints and the lack of immediate payoffs for the public sector may limit the willingness and ability to fully comply with their stated missions. The project team was able to entice the public sector and private sector entities to begin to share information through a combination of supplementary budget and the promise of higher user fees. Since the project is still on going, observations about sustainability and effectiveness cannot be made.

V. Guidelines and Recommendations

Based on the aforementioned case studies, a set of rudimentary guidelines and recommendations has been developed using game theory approaches. Game theory, in short, has been used to help diagnose the likely coordination issues that can arise in a project with multiple agents, then used to model the strategic interactions and then use to identify actions or interventions that may be necessary to minimize coordination problems and encourage cooperation. First, factors that can either increase or decrease the likelihood of a coordination failure are identified and discussed. Obviously, the project designer or social planner should try to develop projects in the most auspicious setting possible. Second, once the project is approved and in execution, certain steps that can be taken to facilitate coordination and mitigate against the centrifugal forces are presented. Below are factors that increase (decrease) the likelihood of a coordination failure. Please note that the factors are obverses.

- *Large Number of Actors*

Obviously, the large the number of significant actors the more difficult the efforts at coordination will be. The number of stakeholders can be large but the agents that control financial resources, manpower, and legal authority necessary to execute actions should be small. Many times, a “multisectoral project” has to confront the reality of being executed in the context of many “sectoral line agencies”. A common fix is an inter-institutional committee. In such a setting a “champion agency” with clout and influence will be necessary to minimize coordination failure. Nonetheless, every effort should be made to involve only the most essential actors that can make an impact so as to minimize the need for excessive coordination and consultation.

- *Extreme Social Heterogeneity Among Principal Actors*

The more heterogeneous the “project area of operations” is in terms of ethnic/racial/religious/linguistic differences the more difficult it will be to coordinate. This is further exacerbated if no single group is the majority and there is a history of conflict, discrimination, mistrust, and strife among the groups in question. The ideal case is to have one homogeneous group or a majority/minority grouping wherein the interests of

the minority group(s) are well represented and well protected. Likewise, it is easier if there is common language used in the region or among the actors.

- *Unclear Gains of Cooperation*

As long as there is mutual gain to be derived from coordinated, collective action, there is scope for cooperation. However, if the gains, be them economic, social, or political, are not immediately apparent and achievable within a reasonable timeframe, different agents are likely not to commit and be fully cooperative. A key challenge for social planners and project designers is to make clear and preferably estimate in quantitative terms the likely gains and the time horizon. The proverbial question, “what is in it for me” has to be answered for each of the stakeholders. On other hand, likely gains should not be exaggerated because gaining credibility and trust are vital assets for project designers and planners at the start of the project. It should be noted that different groups might have different payoff preferences. Private sector actors and poor people are more interested in monetary and material gains. Politicians, public sector bureaucracies, and leaders of non-profit organizations are more interested in non-economic gains such as being able to garner “electoral votes” among a satisfied constituency and to claim “leadership or intellectual authorship” credit.

- *High Transaction Costs*

The higher the transaction cost of organizing work committees, finalizing plans, mobilizing resources, and undertaking collective action, the greater the chance of a coordination failure. Factors that exacerbate transaction costs are spatial dispersion of key stakeholders and key actors, poor and/or expensive communications and transport links, language/cultural differences, overly centralized and bureaucratic structures for approval of work plans, business plans, or subprojects.

- *Institutional and Societal Rules that Discourage Information Sharing, Collaboration, Risk Taking Behavior, and Signaling of Commitment*

Institutions, groups, and key individual actors who do not like to share information, assume risks, and commit fully to a set of medium- and long term goals will not be able to coordinate well. Many times, coordination failure is due to the lack of information at the right time that leads to a mistimed or misinformed decision that results in a “loss”. When a string of “losses” occur, motivation to continue engaging in collective action is diminished. The most sophisticated logistical supply chains are distinguished by rapid and accurate movement of information and full accessibility to all along the chain. Not only does a partner receive instruction as to when an action must be taken but there is a reason given, a “why”. Some cultures or actors may view “information” as a good to be hoarded and not shared. Some cultures or key actors may be very individualistic. Some may be very risk averse. In the latter cases, coordination probably will not occur.

- *Absence of Risk Mitigation Instruments and Rule of Law*

The lack of accessible, affordable, and effective risk mitigation and transfer instruments (insurance, price hedging, credit guarantees, etc.) combined with risk aversion can dampen interest in participating in collective action. Likewise regulatory uncertainty stemming from arbitrary interpretation of laws by governing authorities or capricious changes in rules and contracts or inadequate legal frameworks for the situation at hand (e.g. biotechnology, parametric insurance, mobile-commerce etc.) may serve to inhibit investment and the will to collaborate. The more risk averse the parties the more likely a coordination failure will result. The risk dominant low but certain economic return outcome may easily outweigh the benefits of the high but uncertain economic outcome associated with collective action.

- *Missing Finance*

Elaborate plans and consensus will come to nothing without access to affordable financing for critical needs. The financing does not necessarily have to be from a formal intermediary, it can be mobilize internally from within the group, an angel investor, a government, or a donor, but regardless of the source it has to be mobilized and be made available in an opportune manner.

Several steps can be undertaken to correct and avoid coordination failures.

- *Promote information sharing and use it to shape common expectations*

The free flow of information can serve to unite agents who hitherto did not realize their common interests in cooperating. Many times the information has to be gathered, processed, and transmitted in a timely fashion. “Outsiders” to the project area of operations are ideally suited for this task since they tend to be viewed as more credibly independent and objective. Interested parties in the project area may have special and vested interests to protect or short-run opportunities to take advantage of by withholding or distorting “information flows”. Project designers and planners need to pay special attention to this aspect.

- *Use material (monetary) incentives to promote coordination*

Reluctant partners can be initially paid to cooperate and coordinate with the intent that with time the benefits of cooperation and coordination will become self-evident. This external subsidy, however, should be reduced overtime.

- *Realize short-term benefits in order to maintain interest in long-term processes of institutional transformation and upgrading*

In order to win and sustain support of the stakeholders and key actors, early material gains must be had. These “early gains” or “early wins” serve to motivate.

- *Use simple institutional structures that albeit provide good governance*

Convoluting inter-institutional committees that have representatives from all the agencies that need to cooperate plus elaborate procedures for submitting “business plans” or work proposals from “client or beneficiary” groups on a periodic basis for approval in theory are inclusive and participative but seldom work. Too often the representatives are not senior enough to command respect in their home organizations, many times it is difficult to get a quorum, many times more emphasis is placed on process and not on substance, many times the speed that decisions need to be made do not coincide with the frequency of committee meetings. Therefore, a small executive body that is empowered to act by the larger body to implement a strategic plan and to directly request specific “coordination actions” may be superior for effectiveness. The risks associated with delegated or “managerial system” is increased possibility for fraud, favoritism, and agency problems. These weaknesses can be countered with adequate internal controls, external audits, and decisive enforcement actions when wrongdoing and mismanagement are discovered.

- *Assure high quality provision of technical support and capacity building*

Many rural entrepreneurs, rural communities, and local governments have clear ideas of what they want to achieve but lack the technical know-how and knowledge that would allow them to achieve their ends. The “external project intervention” promises to supply this technical knowledge and capacity, but how it is structured and delivered is very important in determining lasting impact and helping to promote long-run sustainability and beneficiary empowerment. The emphasis has to be on transferring skills and serving client needs, not on process.

Recommendations

Based on the aforementioned, project planners and designers should keep in the mind the following recommendations.

- *Keep Project Designs Simple*

Planners should always try to limit the number of structures (groups/committee, councils) and lines of authority in projects. Inter-institutional committees expressly set up for coordination usually work best when there is a clear and tangible incentive for them to continue to exist, i.e. the project must generate a reward for each of the constituent member organizations.

- *Maintain Information Loops*

The rapid and transparent dissemination of information is key to maintaining a chain or collective.

- *Manage Expectations Shrewdly*

Planners need to motivate clients/beneficiaries but spectacular changes or gains should not be promised. The process of building and/or reforming institutions is slow and painstaking.

- *Clarify and emphasize that the role of government is vital but albeit one of Facilitator/Regulator/Communicator.*
- *Clarify and emphasize the role of private sector agents is to be protagonists in clusters, productive chains, and networks.*

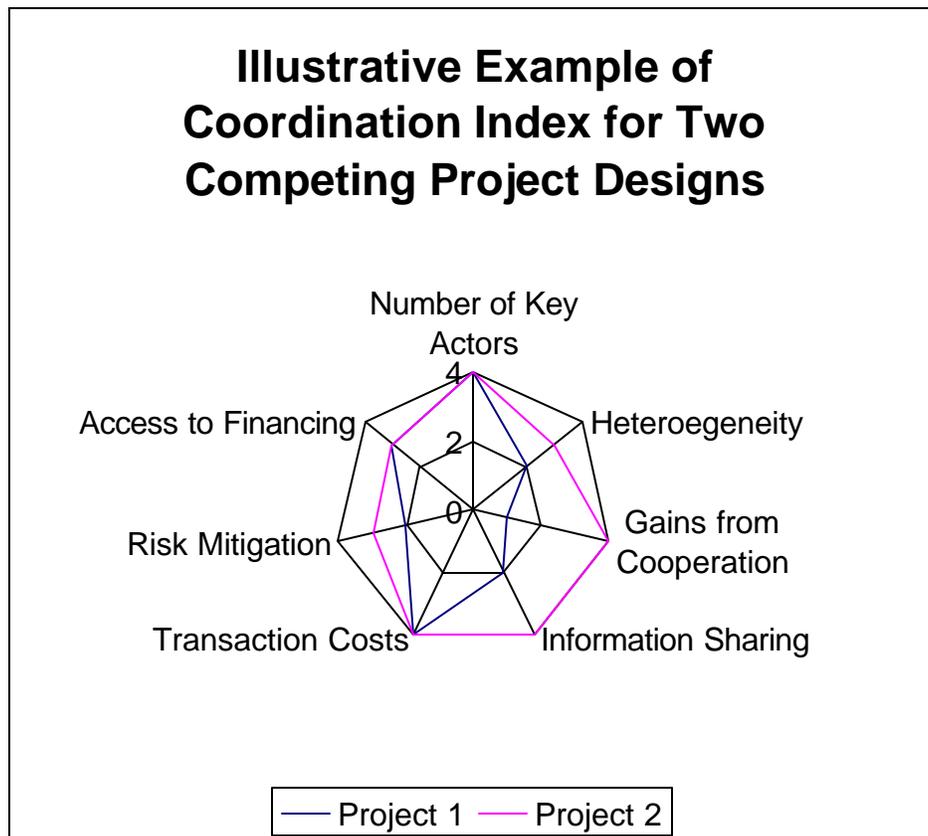
In developing new projects the following checklist or index could be used to help think about strategic interactions among multiple agents and to attenuate the likelihood of a coordination failure.

Table 7: Tentative Checklist for Minimizing Coordination Failure in Projects and Index

Critical Factor	Desirable	Passable	Marginal	Danger	Coordination Index (Sum of Column)
Number of Key Actors	<4 (1 Point)	5-10 (2 points)	10-14 (3-4 points)	>15 (5 points)	
Sociocultural Heterogeneity	One Dominant (> 80% of pop. Adheres to one (1 Point)	Two Dominant (Each more than 40%) (2 points)	One dominant, several minor (one >50%, others <50%) (3-4 points)	Plurality (none > 50%) (5 points)	Cardinal Ranking
Religion	(1 Point)	(2 points)	(3-4 points)	(5 points)	Assign Points
Ethnicity	(1 Point)	(2 points)	(3-4 points)	(5 points)	
Race	(1 Point)	(2 points)	(3-4 points)	(5 points)	
Languages	(1 Point)	(2 points)	(3-4 points)	(5 points)	
Perceived Positive Gain of Co-operating for all Parties	High (All parties can realize short-term monetary gains) (1 point)	Moderate (Some parties benefit monetarily, others in terms of prestige or power. Time horizons vary) (2 points)	Low (Some benefit, a few realize no gain or very modest gains over a long time frame) (3-4 points)	Nonexistent (5 points)	
Information Sharing Proclivity and Capacity	Fluid or likely to be Fluid. Key actors have history of sharing information. Value free exchange. Good communication infrastructure. (1 point)	Somewhat Fluid. Key actors believe in sharing information but communication failures may occur due to poor infrastructure (2 points)	Erratic. Key actors can not get relevant information or are not willing to share it in a timely manner (3-4 points)	Little or no Sharing. Key actors mistrust each other; they see information as power. No history of sharing. And/or very poor means of communication. (5 points)	
Transaction Costs	Low: The fewer committees and procedures to approve projects, the less the chance of a coordination failure e.g. 2-3 steps for project approval—3 or 4 levels of organization structure. (1 point)	Moderate Cumbersome governance and approval procedures. e.g. 4-6 steps for project approval, 2-6 levels of organization structure. (2 points)	High (3-4 points) Governance and approval procedures cumbersome. e.g. 3-6 steps for approval but very cumbersome governance structure > 6 levels. (3-4 points)	Prohibitive Governance and approval processes generate extremely high opportunity costs and monetary costs for project participants, e.g. >10 approval steps and > 6 governance levels of structure. (5 points)	
Risk Mitigation Instruments	High (1 point)	Moderate (2 points)	Low (3-4 points)	Unavailable (5 points)	
Access to Financing	High (1 point)	Moderate (2 points)	Low (3-4 points)	Unattainable (5 points)	
SUM					

The above checklist can be used to compare different competing project designs. When points are assigned and summed, they can be plotted in a radar graph (figure 1) to help visualize the likely difficulty of coordination. The project design team can then iterate to minimize the total number of points assigned in the coordination index. From the figure below, it is clear that project 1 is a better design should have less coordination problems than project 2.

Figure 1:



The next step for this research would be to test and validate the checklist on a large number of randomly sampled projects. The proposed concepts, checklist, and index need to be applied by operational staff to a large number of projects to determine validity and usefulness.

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