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Organizational Synergy, Dissonance and Spinoffs

by

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Abstract

Spinoff firms are exceptional performers across industries. The causes for the emergence of spinoff firms are widely investigated in the literature. However, the role of teams for spinoffs has received little scholarly attention. On one hand, talented individuals may find it necessary to team up with others to utilize complementary knowledge and generate synergies. On the other hand, some types of team production environments may have dissonance and motivate individuals to leave the team. The present study demonstrates that organizational synergies and dissonance can be incorporated into appropriate specifications of team production functions. This framework explains the necessity to form a team, stability of teams, and the emergence of different types of spinoffs depending on specific organizational arrangements.

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1 Introduction

A team consists of individuals, with different talents, who work together to fulfill a well defined objective. Team production offers several advantages. In particular, individuals within the team acquire deifferent knowledge sets, offer their expertise to others as required, learn from each other, and internalize organizational goals [e.g., deVaro and Kutrulas (2006) and Garicano (2000,p.878)]. In addition to providing access to knowledge for immediate projects, teams may also become important sources of new product ideas.[1] Recent studies suggest that innovations, that require extensive knowledge, are by necessity a result of team effort [e.g., (Wuchty et al., 2007; Jones, 2009)]. Large teams with diverse talents can also prevent other competitive firms from having access to certain types of critical expertise. This provides some monopoly advantages to the team. In general, team members share common goals and are interdependent for achieving these goals. Such an organizational mechanism has become a necessity to attract the requisite diversity of talents for corporate success (Milliken et al., 2003; Jones, 2009).[2]

A team can be said to exhibit organizational synergies if the expected output from team work exceeds the sum of outputs that the individuals can produce on their own. Synergies may arise primarily due to voluntary compliance of team members to organizational goals [e.g., Milliken et al (2003), Cornqvist et al (2006), and Magni et al (2009)]. Another source of synergy may be the experience in founding similar spinoff teams, cooperating with other firms in the commercialization process, or close relationships with other firms.[3] Realizing potential synergies in practice, however, seem to require two preconditions. First, as Garicano and Hubbard (2009) argued, team members prefer autonomy as far as possible. Hence, team members comply readily and create synergies if they know why

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[1]For all practical purposes teams perform an entrepreneurial role in so far as they contribute to innovation, implementation, and risk sharing.

[2] There is a fairly general agreement that teams with diverse talents are often more creative compared to homogeneous teams. Beckman (2006) noted that team composition and members' prior affiliations shape new firm behavior. If team members worked at many different companies they bring unique ideas and contacts that encourage innovation. Homogenous teams manage incremental implementation better while heterogeneous teams are more innovative.

[3] Cohen and Bailey (1997), Wong et al (2007), and Krabel and Mueller (2009) identified many other sources of such synergies.

certain decisions are taken or participate in the decsion making process. Second, the willingness to cooperate depends on the perception of equity in sharing gains. As Dessein et al (2007) pointed out, compensation to team members should depend on their production effort and the time spent on coordination. For all practical purposes potential synergies can be realized only if every team member offers his best effort to do his specific job and all the team members understand, accept, and execute team related work efficiently.

Teams are formed to create synergies. However, some disadvantages of team production are discernible. First, as Danzon et al. (2005) noted, there may be organizational dissonance as the team size increases. Coordination costs increase as team size increases partly due to the energy that must be utilized to resolve disagreements. Team size affects the incidence of spinoffs for another reason. Large teams produce only incremental innovations. For, they have to devote much of their R&D effort to maintain the competitiveness of existing products. Further, their core competencies may limit their efficient product line choice. Small teams are a bigger source of supply of new ideas and products [e.g., Hyytinen and Maliranta (2008), Elfenbein et al (2009), and others]. In general, the low percapita rate of spinoff from large firms is one of the stylized facts that Klepper (2009) acknowledges.

Second, teams that have autonomy of decision making tend to emphasize their satisfaction at work while neglecting the viability of the team. In addition, as Fulghieri and Hodrick (2006) noted, autonomous individuals may choose activities where they cannot be displaced rather than choose the most profitable activities for the team. Third, an increase in team size brings about the possibility of free riding by individual members of the team. Following Alchian and Demsetz (1972) and Klein et al (1978), it may be noted that benefits of shirking accrue to the individual while the disadvantages and expenses must be borne by everybody in the team. Carpenter et al (2009) provide further analysis along these lines.

A team is efficient and stable only when organizational synergies can be achieved. The lack of synergy signals possibilities of spinoffs by team members (Rose, 2002). They may find it advantageous to leave the team and start a firm on their own rather than working in a team exhibiting organizational dissonance. One of the earliest studies of this nature,

Cooper (1985), noted that a worker of any level of talent may leave the team and start a spinoff if he has difficulties of an organizational nature while working in a large team. Similarly, Wiggins (1995) pointed out that there may be limits to team size depending on the occurrence of organizational dissonance.

New ideas are another driver of spinoffs. With the accumulation of knowledge and expertise over time team members get new ideas. These new ideas may be process innovations, i.e., better and more efficient ways of doing existing tasks. In general, a process innovation is likely to be implemented within the team so long as it does not disrupt existing assembly lines extensively. Very good ideas from team members will be generally accepted and implemented within the existing team structure simply due to their superior economic value. Team members with good ideas will be adequately compensated to retain them in the team [e.g., Chaterjee and Rossi-Hansberg (2008)]. New ideas may be new lines of products that can be produced and offered on the market profitably. However, the existing team may not implement new product ideas if they cannibalize the market for their existing product.

If the new idea comes from the most talented individual in the team. He may be inhibited from spinning off if he has to undertake the costly formation of a new team which does not promise an increase in his returns. Lower talented members of the team may not get new ideas. Even if low talented people have ideas, they tend to stay in the team since they do not have the requisite resources to organize a new team. More likely than not, once individuals with intermediate level talents are convinced that spinoff would be more advantageous, they will leave the team.[4]

Thus the literature on spinoffs generally acknowledges the following. The emergence of an innovative idea which is quite distinct from the current activities of the team. There is always a possibility that team management can and does accommodate the innovation. Hence, to justify a spinoff there must be disagreement with the team. This is another

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[4] Cassiman and Ueda (2006) suggest that this pattern emerges whenever the original team does not have the organizational capacity to internalize large innovative projects. The possibility of cannibalization of existing products and the inability to develop new markets add to their decision to reject the implementation of some fairly large innovative ideas [e.g., Klepper and Sleeper (2005).]

important driver of spinoff [e.g., Klepper and Sleeper (2005); Klepper and Thompson (2010)][5].

Neither of these forces, viz., new ideas and disagreements, provide a satisfactory explanation for spinoffs (Shrivastava2010). The individual who contemplates an exit should have the entrepreneurial talent which includes managerial skills and willingness and ability to take risks [e.g., van Praag and Cramer (2001) and Fraser and Greene (2006),Shrivastava2010]. It also includes the ability to manage the supply chain efficiently to reduce the costs of producing a given volume of output. Someone in the team must also understand customer needs and have the marketing capabilities to maximize sales revenue (Van der Panne et al., 2003; Agarwal et al., 2004). The ability to raise requisite finances [e.g., (Gompers et al., 2005; Wong et al., 2007)] and the ability to assemble the requisite team [(Boning et al., 2007; deVaro and Kurtulus, 2006; Jones, 2009)] are other important factors to introduce a new product. All the entrepreneurial characteristics required to undertake an activity constitute entrepreneurial talent.[6]

Another aspect of spinoffs has been noted. An employee, who has a new and innovative idea, may prefer to leave the team and start a new enterprise on his own. Klepper (2009) and elsewhere designates this as involuntary spinoff in so far as the original team did not initiate it. Buenstorf (2009) considers this to be an opportunity spinoff. It is always possible that the individual leaves the team only after his idea is rejected. In a basic sense the original team can be said to have initiated the spinoff voluntarily. This is one aspect of necessity spinoffs in the sense of Buenstorf (2009). A different situation may arise. The original team may decide to implement a new idea. However, the innovator may feel that the implementation is at an inefficient level. This may be one mechanism through which the team forces the individual to form a spinoff. It has dimensions of both an involuntary

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[5] Property rights of the employee and the compensation he receives for innovative ideas do matter both for the generation of new ideas and spinoff. In general, as soon as an individual feels that he has a new and implementable idea, he may leave the team and develop it independently. For, otherwise, covenants may bind him to assign property rights to the team and prevent him from getting an acceptable share of returns. We will examine this in detail in future work.

[6] As Ferrante (2005) suggests, entrepreneurial talent consists of the ability to discover, select, process, interpret and use the data necessary to make decisions under risk.

spinoff and a necessity spinoff. Theoretical explanations of spinoffs must acknowledge all these possibilities.

The team production function captures the extent to which team members are independent or interrelated to each other within the team. This suggests that the nature of team production, viz., whether or not it exhibits synergies, has a crucial role in determining the stability of a team or the likelihood of spinoffs. It also has a determining influence on who leaves the team. Magni et al. (2009) is one of the earlier empirical studies that emphasized the absence of team synergies as possible causes of spinoff even though they did not offer any theoretical analysis to justify it. Hence, section 2 will be devoted to a specification of team production functions. Section 3 then considers the nature of these functions that exhibit organizational synergy or dissonance and identifies organizational dissonance as a determinant of team stability and spinoffs.[7]

Further, the owner of the team may ask some members to leave either because of dissonance or if their contributions to the profit of the team are not satisfactory. The owners may also encourage some members to create an independent spinoff if higher synergies can be achieved.[8] In section 4, the emphasis is on the nature of the production functions prior to spinoffs. It offers a general analysis of the sources and the nature of spinoffs that occur. The differences in the nature of the production functions prior to and after spinoff have been identified as another determining aspect in the spinoff process. Quality of ideas as a source of spinoff will be discussed in section 5. Section 6 presents three classic examples to illustrate the validity of the theoretical results of this study. Therefore the strength of the production function approach of this study is that it encompasses a variety of empirically observed practices. Several aspects of spinoffs from teams which need a different analytical framework are discussed in the concluding section.

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[7] There may be no essential synergies or dissonance if different talents are working together. Buenstorf and Fornahl (2009) call this feature modularity. Under these conditions all the talents working together have no essential gains. Each of them can operate on their own.

[8] The original firm may, on its own, split the team, leave essential management to the individual teams, and derive profits from the new organizational structure. This is also a form of spinoff. See, for example, Barrett (2003) and Mireault (2003).

2 Team Production

The primary interest in developing an organizational production function is to explain stability of teams or spinoffs from it[9]. Hence, a short run specification, assuming that capital equipment is already in place and not substitutable with labor, is more appropriate. Owners of capital will be residual claimants of profits generated by the team[10]. However, the team consists of individuals of diverse talents and they may be substitutable to varying degrees. Team members may be predisposed to cooperate, contribute to team goals, and generate synergies. Similarly, the possibility of substitution may motivate them to comply with team goals and contribute to the expected synergies. In general, a combination of these two forces explains the emergence of synergies or the lack of it.

Assume that a team comprises of individuals with n talents. It is reasonable to postulate that there will only be few persons at the highest level of talent (n) and the largest number of workers will have the lowest talent. Let x_j; j = 1,2,…,n denote the number of individuals with talent j. Then, by assumption, $x_{j-1} > x_j$ for all j = 2,3,…,n. Further, $x_n = 1$ will be postulated.[11]

The organizational production function can be written as

$$y = (\sum x_j^\beta)^{\alpha/\beta}$$

where y = output, and $0 < \alpha,\beta < 1$.

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[9] It will be assumed that the team is producing only one product. Such an assumption enables us to focus on team formation and the resulting synergies. If the team produces many products some synergies will be due to an appropriate choice of product range. It poses a different set of problems.

[10] The results will hold even if one member of the team owns these assets. This aspect destracts us from theme of the study and increases the complexity in making comparisons of teams before and after spinoff.

[11] It may be argued that individuals from group j will have a productivity a_j and that it will not be the same for all j. In such a case replace x_j by $z_j = a_j x_j$. $z_{j-1} > z_j$ for all j = 2,3,…,n can still be maintained without any loss of generality. Another way of justifying the specification is to measure the units of x_j in such a way that the productivity of x_j is the same for all j. The results that we develop in the rest of the study will not change in any way.

This production function exhibits an elasticity of substitution $\sigma_{ij} = 1/(1-\beta)$ for all $i \neq j = 1,2,\ldots,n$. See Uzawa (1962)[12].

If there is an indication that two or more individuals working together will be more beneficial[13]. Under such conditions the production process is such that the degree of substitution between them is low. They may generate synergies on their own volition in order to share the gains. Similarly, if the elasticity of substitution is greater than 1 team members tend to cooperate for fear of being displaced. This may also be a source of synergy. However, if $\sigma = 1$ team members do not have any motivation to cooperate and the management of the team may consider it cheaper to displace errant workers rather than coordinate their work and hope that synergies can be achieved.

In general, this production function exhibits synergies whenever $\sigma \neq 1$. The Cobb-Douglas function represents the lowest possible level of output for given x_j; $j = 1,2,\ldots,n$[14]. A general proof of this result can be developed as follows. Note that

$(\sum x_j^\beta)^{1/\beta} > \pi \, x_j^{1/n}$ whenever $(\sum x_j^\beta) > \pi \, x_j^{\beta/n}$. However, $(\sum x_j^\beta) > (\sum x_j^\beta)/n > \pi x_j^{\beta/n}$

for the simple reason that the arithmetic mean of x_j^β; $j = 1,2,\ldots,n$ is always greater than their geometric mean when $x_j \neq 1$ for all j.

Consider the possibility that some shirking and free riding is possible whatever may be the value of β. Output will then decrease. This can be reflected by the specification of α[15]. For, notice that if team members are not predisposed to cooperation and/or cannot be

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[12] Observe that this embeds the Cobb-Douglas functional form. For, σ tends to 1 when β tends to zero.

[13] Following Adam Smith's notions of division of labor it may be claimed that individuals, pursuing their self interest, improve the efficiency of the organization. On the other hand, Alchian and Demsetz (1972) argued that two or more individuals working together create synergies. As their example suggests, each one of two individuals may not be in a position to lift heavy equipment from a truck but they can do so collectively. For analytical purposes this implies that neither the composition of x_j nor the size of β can fully reflect the occurrence of organizational synergies.

[14] Unfortunately this fundamental property of the CES production function was neglected due to the overemphasis on the elasticity of substitution.

[15] In this specification α represents synergies for given x_j. The usual interpretation of economies of scale aplies only when all x_j change proportionately. Arrow et al (1961,p.247) acknowledged such amibiguity in the returns to scale interpretation. Another important aspect of this specfication may be noted. In general, it will be expected that $\alpha < 1$ even when $\alpha > \beta$. That is, organizational production functions exhibit decreasing returns to scale even if that interpretation is pursued.

induced to comply then the synergies expected from β cannot materialize. In particular, note that if all x_j operate independently they produce an output

$y^* = \sum x_j^\beta > 1$. If they form a team the resulting output is greater than y^* if and only if $\alpha > \beta$. Hence, $\alpha = \beta$ corresponds to the case where team members voluntarily offer only that much cooperation as is warranted by the elasticity of substitution. In general, organizational dissonance is signalled whenever $\alpha < \beta$.

This specification of the organizational production function suggests that $\beta \neq 0$, reflecting the elasticity of substitution, and $\alpha > \beta$, indicating the predisposition of team members to comply with team goals, are the basic sources of organizational synergy. However $\beta \neq 0$ cannot, by itself, guarantee the emergence of synergies. This is the foundation on which spinoffs from teams can be conceptualized.

Note that the existence of synergies is a property of the entire team. On the otherhand, any spinoff decision of an individual of talent j will depend on his returns alone. He can be expected to leave the team if he expects to receive more compared to what he can if he remains within the team. Fundamentally, the disagreements pertain to sharing of gains. Three possible sharing concepts are discerinble. First, $\alpha < \beta$ enables the team to pay each individual his marginal product and leave some positive profit to the owner of capital. The team may, in fact, implement this mechanism. Second, each individual's contribution to output can be viewed as consisting of output from his personal effort to deliver output and his contribution to team effort leading to synergies. The payments to an individual may then depend on both these factors.[16] Third, suppose an individual comes up with a new idea. The team will implement it if synergies are expected. Further, the level at which it is implemented will depend on the perception of the owner of capital regarding its market potential. There can be information asmmetry and disagreement if the market potential of the idea is private information of the individual who created it and the owner of capital experiences information asymmetrty. Under these conditions disagreements may arise with respect to the market potential and the contractual payments for the indvidual who created the new idea. These aspects must be kept in perspective while examining the prpensity of an individual to spinoff from a team. The rest of the analysis will assume that individuals

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[16] Some aspects pertaining to contractual sharng have been examined in Adams (2005), Autrey (2005), deVaro and Kurtulus (2006), and Dessein et al (2007).

are paid their marginal products. Contractual payment mechanisms necessitate a somewhat different analysis though the fundamental insights regarding spinoffs remain the same.

3 Team Formation and Stability

To begin with, observe that there must be reasons why an individual agrees to be a part of a team in the first place. The purpose of this section is to analyze the conditions under which there will be a possible rearrangement of teams. However, it must be noted that the new team must require the talents of both the teams. They should be willing to cooperate post merger. This is precondition to achieve the desired synergy in the combined team.

Proposition 1: The emergence of diminishing returns to individual effort and the possibility of creating synergies from team formation are central to its emergence.

Proof: Let individuals of only talent j produce the output to begin with. It is obvious that such an organization will experience diminishing returns. Let the output be

$y = x_j^{\beta}$; $\beta < 1$. Each of the individuals receives a wage, $w_j = \beta x_j^{\beta-1}$

They may expect to use their talents more efficiently if they form a team with individuals of another talent k. The emergence of synergies can be represented by the production function, $y = (x_j^{\beta} + x_k^{\beta})^{\alpha/\beta}$; $\alpha > \beta$

The wages paid to an individual of talent j will then be, $w_{jt} = \alpha x_j^{\beta-1} (x_j^{\beta} + x_k^{\beta})^{\alpha/\beta - 1}$
Observe that $w_{jt} > w_j$ whenever $\alpha > \beta$ and $x_j, x_k > 1$. The possibility of deriving benefits from synergies is at the apex of team formation and its stability in general. Note that $\alpha < 1$ is a distinct possibility. Hence, there is an acknowledgement that bigger teams may also experience diminishing returns. As a result, the search for synergies through team expansion continues.

Within this framework, the team and its organizational structure will remain stable if each individual with different talents receives the maximum wages they can (say, in comparison to what they can earn in other organizational forms) and the owners of capital consider the profit generated to be adequate to cover the cost of capital per unit of time.

Any one individual will leave the team if he has the entrepreneurial ability to organize a different, but perhaps a smaller, team which enables him to earn higher wages.

Proposition 2 *Teams that experience organizational synergies are not likely to spawn spinoffs.*

Proof: Recall that $\alpha > \beta$ for $\beta \neq 0$ is the only way to assert the existence of organizational synergies. Consider the production function, $y = (\sum x_j^{\beta})^{\alpha/\beta}$; $\alpha > \beta$. The wages paid to a worker of talent j will be $w_j = \alpha (\sum x_j^{\beta})^{\alpha/\beta - 1} x_j^{\beta - 1}$, i = 1,2,…,*jn*. The owner of capital assets receives $p = (1-\alpha)y$. If an individual of talent j contemplates a spinoff, he has to form a team of individuals of talent k = 1,2,…, j. Suppose he can assemble such a team without sacrificing any synergy[17]. After the spinoff, he expects to receive $w_{js} = \alpha (\sum x_k^{\beta})^{\alpha/\beta - 1} x_j^{\beta - 1}$

Note that, $w_{js} \leq w_j$ with the equality holding only for the individuals of the highest talent.

From this it can be inferred that none of the team members will have any motivation to spinoff as long as the team maintains its synergy.

Proposition 3 *Suppose α = β and such teams are formed. They are not likely to spawn spinoffs.*

Proof: When $\alpha = \beta$ the production function reduces to

$$y = (\sum x_j^{\alpha})$$

Buenstorf and Fornahl (2006) designate this as modularity. In such situations team members will be indifferent between working independently or forming a team.However, they may work as a team in the following cases. First, x_j may need to share capital equipment. It may be efficient for a coordinator to allocate capital and allow each team member to function independently. This is the classic M-Form organization. Second, if they operate independently there may be costs of coordinating their outputs to produce a marketable product. The costs of coordinaion by market forces may far exceed the benefits. They prefer to form a team. The payments to individual members of the team are the marginal products they contribute. When a team is formed wage paid to a worker of

talent j $= w_j = \alpha x_j^{\alpha-1}$ which is independent of the contributions of others. Suppose an

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[17] Shrivastava (2010) argued that this is a necessary condition. A spinoff is not possible without it even if there is lack of synergy in the original team and an individual of talent j experiences a disagreement with team management.

individual of talent j can operate his own team. He will still receive $w_j = \alpha x_j^{\alpha-1}$. , He has nothing to gain if modularity persists. In such a case, spinoff will not be advantageous at all.

The following observation is pertinent. Proposition 1 suggests that individuals tend to form bigger teams if it is possible to achieve organizational synergies. Propostions 2 and 3 indicate that such teams remain stable so long as organizational synergies persist.

Suppose, instead, that the team of n talents exhibits lack of synergy. This can be represented by $\alpha < \beta$. In such a case, it can be expected that one or more individuals of talent j will spinoff and form a different team.

In sum, if a team exhibits organizational dissonance apriori, every individual in the team is better off if he spins off. Even individuals of low talent may prefer self-employment rather than working in a team exhibiting dissonance. At best, individuals with the highest talent may be indifferent between staying in or spinning off unless they can form a team with higher synergy.

The above analysis considered the possibility of an individual team member identifying improvements in synergies and then destabilizing the team. It is possible that the owner of the team initiates the ouster of team member(s) whose contribution is less than what they are paid or without whom the rest of the team may gain synergies.[18] This will be elucidated in the following propositions.

Proposition 4 *A team member will be asked to leave if his contribution to profit is less than the cost of capital necessary to continue his membership in the team.*

Proof: Note that the team is stable if it exhibits organizational synergies. If $y = (\sum x_j^{\beta})^{\alpha/\beta}$, the contribution of a worker of skill j to the profit is given by $p_j = (1-\alpha)(\sum x_j^{\beta})^{\alpha/\beta-1} x_j^{\beta-1}$ and $p = \sum p_j x_j$. If the owner of capital has invested q_j per unit of time in one individual of

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talent j, it is obvious that he will ask this individual to leave the team if $q_j > (1-\alpha)(\sum x_j^\beta)^{\alpha/\beta-1} x_j^{\beta-1}$.

Proposition 5 *Suppose α = β. Assume that $q_j > (1-\alpha)x_j^{\alpha-1}$, i.e; an individual of talent j is costly to the current team. The owner can share a part of the capital cost and maintain control in the spinoff firm if that team member has the entrepreneurial talent to start the spinoff firm.*

Proof: Let $y_2 = \sum x_j^\alpha$. Then, $w_j = \alpha x_j^{\alpha-1}$, and $p_j = (1-\alpha).x_j^{\alpha-1}$.

Suppose the spinoff firm reduces the capital cost to the owner in such a way that $q_j^* \leq p_j$ and $q_{jr} \leq (1-s)p_j$ where q_{jr} is the capital cost burden borne by the spinoff and s represents the share of profits of the spinoff firm claimed by the owner of the original firm.. Surely the possibility that $q_j^* + q_{jr} < q_j$ due to scale effects makes spinoff a superior organizational arrangement. The Tremcar case presented in section 6 is along these lines.

Several other contexts which motivate a spinoff are discernible. First, the owner may ask a member of the team to leave if it improves the synergies of the team and thereby enables him to offer higher wages to all the other members that remain with the team. Second, a particular individual may be asked to leave if the cost of maintaining him within the team is higher than his contribution to profit. The distressed individual may have enough entrepreneurial talent to create a spinoff. Third, the owners may encourage spinoffs by team members who have entrepreneurial talent if it is possible to improve organizational synergy. The owner may maintain adequate control by providing capital and markets for the products of the spinoff firm.

4 Pre- and Post- Spinoff Organization

Baccara and Razin (2007) noted that the structure of the old team and the nature of the innovation determine the motivation to spinoff. However, they acknowledge that the organization of the new team will also have a decisive influence on the spinoff generation and on the spinoff firm's stability and efficiency. This section examines the nature of the

spinoff by considering organizational dissonance and synergy exhibited by team production functions prior to and after the spinoff.

As noted earlier, the efficient structure of an organization depends on its activities and size. A common observation is that small local stores, with possibly one talent organizing it, are quite efficient. However, as Danzon et al (2005) noted, there may be a tendency to employ more than necessary talents as a market premptive measure. Such choices lead to organizational dissonance. Some spinoffs and smaller team formation may lead to synergies.

Organizational synergies or dissonance is an indicator of overall peformance. Spinoffs depend on how they translate into gains to specific individuals in the team.

These two aspects must be kept in perspective while examining spinoff possibilities if there is organizational dissonance apriori.

If a person of talent j leaves the team and starts another one on his own, he has to assemble a new team to organize the production activity efficiently and to capture synergies. The increase in wages post spinoff is the payment for these organizational capabilities. This is reflected in the changes in the production function brought about by the spinoff team. To achieve a general result it is sufficient to consider a team of three different talents where two of them create a synergy and the third creates some dissonance. The following proposition holds.

Proposition 5 *Organizational dissonance apriori and synergies after spinoff are necessary to justify a spinoff.*

Proof: Assume that x_1, x_2, and x_3 constitute a team initially and organizational dissonance is discernible. That is, the production function is

$$y = (\textstyle\sum x_j^\beta)^{\alpha/\beta} \; ; \alpha < \beta$$

Will an individual from x_3 spinoff? It can be surmised that x_3 requires the same team to carry on production if he decides to spinoff. Hence, wages paid to an individual of talent 3 after spinoff, $w_{3s} = w_3$. Consequently individuals of the highest level of talent are not likely to spinoff. For, identifying the source of dissonance and correcting it may be expensive.

Will an individual from x_2 spinoff? Within the existing team he receives a wage, $w_2 = \alpha x_2^{\beta-1}(\sum x_j^{\beta})^{\alpha/\beta \, -1}$. Post spinoff, he can form a team consisting of x_2 and x_1 only. One possibility is that the smaller team enjoys synergies. In such a case, the production function will be $y = (x_1^{\beta} + x_2^{\beta})^{\gamma/\beta}$; $\gamma > \beta$. The corresponding w_{2s} will be $\gamma(x_1^{\beta} + x_2^{\beta})^{\gamma/\beta}$. It is then possible to have $w_{2s} > w_2$ if $\gamma(x_1^{\beta} + x_2^{\beta})^{\gamma/\beta - 1} > \alpha (\sum x_j^{\beta})^{\alpha/\beta - 1}$. It can be readily verified that it will be satisfied whenever $\gamma > \beta > \alpha$. It follows that x_2 gains by spinoff.

Will an individual from x_1 spinoff ? Let the production function post spinoff be $y = x_1^{\alpha}$. Note that wages of this group of workers prior to spinoff $= w_1 = \alpha x_1^{\beta-1} (\sum x_j^{\beta})^{\alpha/\beta \, - \, 1}$ and wages post spinoff $= w_{1s} = \alpha x_1^{\alpha-1}$. Observe that $w_{1s} > w_1$ whenever $x_1^{\beta} < (\sum x_j^{\beta})$ since $\alpha < \beta$. This inequality holds by assumption[19]. Hence, so long as such individuals have the organizational talent to achieve synergies, they will spinoff. It must be noted that after the spinoff even the other members of the team will be paid higher wages. This is perfectly consistent with the experiences of startups in the Silicon Valley.

When we specifically term talent to achieve synergy as entrepreneurial talent then individuals of talent j have entrepreneurial talent a_j such that $a_1 < a_2 < a_3 = 1$. The production function is then modified as $y = a_1 x_1^{\alpha}$. With this setting, $w_{1s} < w_1$ is possible. That is, these individuals will not spinoff purely because they do not have the organizational capabilities to achieve synergy. The following observations are therefore pertinent. (a) The worker with the highest level of talent cannot work without getting the rest of the team together. Hence, he is not likely to spinoff. (b) Workers with lower talents will spinoff only if they can create smaller teams and achieve synergies. (c) Workers with the least talent have neither the talent to put the requisite team together nor can they obtain complementary resources like capital and finances. They do not spinoff. (d) In this model, spinoff is driven by wage payments. Hence, wage reductions that result from organizational dissonance is the basic disagreement that explains spinoffs. (e) Dissonance alone will not be sufficient for spinoff. Instead entrepreneurial talent is necessary to ensure synergies after the spinoff.

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[19] Suppose the production function post spinoff is $y = x_1^{\gamma}$; $\gamma > \alpha$. It can be readily verified that this result is valid.

Another possible reason for the lack of synergies in large teams could be as follows. On the one hand, if a team has the correct mix of talents, the elasticity of substitution between them will be low. On the other hand, there will be greater substitution possibilities in teams which exhibit organizational dissonance. That is, after the spinoff the new team may exhibit a lower value of β whatever the α may be. Clearly, the possibility of spinoff from team members belonging to x_2 or x_1 persists.

5 Quality Ideas and Spinoffs

Over time, with accumulated knowledge and experience, some individuals may get new ideas which may be in the form of new techniques for improvements in existing products or developing new products. If the team member with a new idea can convince the existing team that the new idea is profitable and organizationally feasible, the team may agree to compensate the innovator adequately by offering a share of monopoly rents so that the innovator stays with the team. There may be disagreements between the innovator team member and rest of the team if the team is not convinced about the economic value of the innovation and/or their ability to implement it within the team. Furthermore, there may be disagreements about adequate compensation even if the team agrees to implement the new idea. Such possibilities may trigger a spinoff. Spinoff by a team member with a new idea is inevitable if there is organizational dissonance and the rest of the team feels that dissonance cannot be reined in even after the introduction of the new innovation. The analysis of these cases follows from the results of the two earlier sections.

However, some new possibilities necessitate further analysis. For example, if the team member with a new idea does not have the requisite entrepreneurial abilities a spinoff may not materialize unless the idea is very promising. Another possibility is that although, there is organizational synergy ex ante, expected organizational dissonance post spinoff will inhibit spinoff. However, the outcome will depend on the quality of the new idea. The team member with a new idea may find it difficult to achieve the necessary coordination required for implementation of the idea within the new team. The expected probability of success of the new idea along with the quality of the idea determines the possibility of spinoff. Note that the new idea does not necessarily improve the intrinsic talents of the team members. Instead, it will either improve the productivity of each of them or provide

better returns due to improvement in the product. Assume that the team consists of n talents and organizational synergies exist initially. Then, the team production function is $y=(\sum_j x_j^{\beta})^{\alpha/\beta}$. If the current team incorporates the innovation, without sacrificing its synergies, the production function can be written as

$$y=\tau.(\sum_j x_j^{\beta})^{\alpha/\beta}$$

where τ is the extent of productivity gain from the innovative idea. The synergies expected from implementing such new ideas are least conducive to spinoff. This would be especially so if the team agrees to absorb the new idea. Thus the following proposition follows.

Proposition 6 *Suppose there is organizational dissonance after the spinoff. The spinoff will not be worthwhile if the productivity gains from the quality of new ideas are not adequately large.*

Proof: Assume that the original team did not agree to incorporate the innovative idea. This motivates the individual to spinoff and to form a new team. There is nothing new to prove if organizational synergies can be established after the spinoff, as the spinoff is always worthwhile to the innovator if $\tau>1$. Hence, let us assume that dissonance is expected after the spinoff. The new production function will be $y = \tau (\sum x_j^{\beta})^{\gamma/\beta} = \tau y_s$; $\gamma < \beta$. If the individual representing $x_n=1$ is the source of the innovative idea and creates the spinoff, then the wages to x_n before and after the spinoff will be $w_n = \alpha y x_n^{\beta-1}/\sum x_j^{\beta}$ and $w_{ns} = \tau \gamma x_n^{\beta-1} y_s/\sum x_j^{\beta}$; $\gamma < \alpha$, and $y_s < y$ respectively. When will be $w_{ns}<w_n$? Invoking the result that $y\tau>y_s$, we must have $\alpha/\gamma = \tau^*$.

Hence, the individual of talent n will not find it advantageous to spinoff if $\tau<\tau^*$. In other words, a spinoff will occur if τ is large enough even when there is organizational dissonance after the spinoff.

However, note that an increase in the marginal product, and the consequent possibility of spinoff do not depend on an increase in output. This necessitates reexamination of two issues: (a) Is the wage earned by the innovator the best criterion to determine the motivation to spinoff? and (b) will it be socially efficient to allow spinoffs triggered by higher wages if they do not result in increased output? We considered the worst case

scenario ex post. Perhaps the organizational dissonance post spinoff will not be as severe as this.

Observe that the introduction of the new idea within the existing team may be the source of dissonance and spinoff. A spinoff firm may be in a position to restore synergies as well as gain from the higher productivity. This case does not warrant further analysis.

6 Three Examples

The three examples in this section support the theoretical arguments presented in the earlier sections. The basic point in presenting these examples is to demonstrate the role of organizational dissonance and synergies in the formation of spinoffs. However, they do not satisfy all the underlying assumptions of the models. Conversely, it is also true that economic theory cannot incorporate all the features present in any realistic experience.

A team is formed to achieve synergies. However it is possible that the right individuals are not chosen. External forces such as the availability of new ideas, new avenues for growth or wrong execution of ideas may trigger spinoff from a team. The context of Procter & Gamble Godrej (PGG), as outlined in Karmali (1996), vividly illustrates this.

Before teaming up with P&G, Godrej Soaps was India's second largest seller of soaps after Hindustan Lever. Marketing is one of the essential functions in selling soaps and maintaining market shares. The marketing team of Godrej had a sales team of 550 people and 3000 wholesale distributors. In all, their distribution network had a coverage extending to nearly 2 million retail outlets. However, Godrej had a significant unused capacity in manufacturing. They were forced to utilize it in manufacturing soaps for Johnson & Johnson and Reckitt & Colman. It made sense for them to induct P&G into their team to fully utilize manufacturing capacity on a long term basis since P&G had international brand names like Camay.

P&G expected some synergies as well. P&G, like most other soap manufacturers in the world, was using beef tallow as a primary ingredient. Since the Indian government banned the use of beef tallow P&G could expect to enter the market only through an alternative manufacturing method. Godrej was already using vegetable oils like palm oil and rice bran oil. One synergy for P&G was the benefit of Godrej Soaps' expertise in vegetable oil technology. Further, it could avoid a long gestation time necessary to put up a soap factory

by teaming up with Godrej. It would have taken P&G a considerable amount of time and resources to set up their own distribution team as well. The collaboration of P&G and Godrej meant that Godrej got access to multinational marketing prowess, while Procter got plugged into a strong mainline manufacturing and distribution team. Within the team, Godrej had the sole responsibility of soap manufacturing. P&G had absolutely no control over the costs. This generated disagreement that Godrej was extracting monopoly rents and inflating costs. Second, Godrej sold off some of its brands to P&G because P&G did not want some Godrej brands like their detergent Trilo to compete with their brands like Ariel. In exchange, P&G agreed to market Godrej's Cinthol in global markets. P&G never really fulfilled this promise. Godrej management deeply resented what they saw as Procter's willful neglect of their brands that they built up over the years. Among all these reasons, the most important was the clash of organizational cultures. Godrej executives were accustomed to introducing new products on the basis of gut feelings and selling them through emotive and esoteric appeals. They believed that in India soaps sell more on imagery than on the platform of product benefits. P&G, on the other hand, was more concerned about functional propositions and a calculative long term approach. Senior Godrej executives resented P&G's change in emphasis. As Karmali (1996) put it, "Having run a successful soap business for years, they felt that they know more about it anyway and did not welcome Procter's tutoring." Further, Godrej managers depended mostly on their practical experience in proposing and approving changes. More often than not, final decisions had to be made by top level management. P&G management was more calculated and based on scientific management principles. This resulted in delays in getting any decisions approved. Organizational dissonance was evident.

Karmali (1996, p.60) summed up the lack of synergies succinctly. "Procter on its part had gained distribution strengths but found itself locked into an unsustainable manufacturing agreement and a joint venture that was losing money. Godrej felt let down on two counts: The capacity was not being utilized as guaranteed and more crucially, Procter's marketing prowess was not delivering any benefit to Godrej's painstakingly built portfolio of brands."

In essence, the team formation was based on some expected synergies in manufacturing and distribution. However, the new team organization could not avoid some unforeseen organizational dissonance. A spinoff from the team was inevitable.

The second example pertains to the context of a voluntary spinoff. Tremcar, a Canadian firm in the milk transportation business produces steel tanker trucks. The essential aspects to ensure the success of their business are components manufacturing, an assembly shop, attending to warranties, after-sales service and repairs. All the major activities were initially under the supervision of Tremblay.

However, the owner of the original team felt that he could not manage a large team as the volume of business increased. He knew that some of his employees had entrepreneurial talents and first hand knowledge of business acquired from the experience of working with them. He spunoff activities into new firms with his employees as major owners. Their production complemented his activity. From the viewpoint of the present study, independence in the modules of production was at the apex of efficient spinoffs.[20]

As the business grew manifold in a few years, Tremblay felt the need to form a separate unit to deal with after-sales service. However, he knew that it would be virtually impossible to sell tankers unless a high level of after-sales service is provided. In Tremblay's mind he was clear that the spinoff must have the expertise and knowledge of the business, should exhibit entrepreneurial talents, and possess leadership qualities and energetic dynamism. Herbert, who worked with Tremblay for nearly 25 years, always dreamed of having his own business. He was an ideal choice for a spinoff. His new firm, Herbert & Son, has taken over the business of the sales agent for the tankers, servicing, warranties and repairs.

The next issue was about the manufacturing of components. This involved the additional problem of setting up a separate production unit. Ostiguy was an employee of Tremcar who was constantly on the look out for new projects and challenges. Tremblay allowed Ostiguy to create a spinoff, Raynox, to manufacture all the requisite components. Tremcar retained some control through equity participation and providing the necessary technical support.

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[20] The following presentation is based on Mireault (2003).

The growth in the market also meant geographic spread of the use of tankers supplied by Tremcar. It was no longer possible for Herbert & Son to do the job. Tremblay found another of his employees, Robillard, who willingly created a spinoff, JC Tanks & Repairs, in western Canada.

In sum, Tremcar was instrumental in spotting the modularity and the entrepreneurial talents of its employees and encouraged the creation of spinoffs. Tremblay preferred spinoffs to subcontracting primarily to ensure the availability of technical experience, entrepreneurial talent and trust above everything else.[21]

The third example relates to the role of outsourcing which has been quite prominent for a long time. Usually a production or marketing team would prefer to outsource some of its activities for a variety of reasons. First, they cannot fully utilize the talents of an entrepreneur who can cater to their requirements due to their small scale. It is also possible that the requirements are of a short- term nature and long term commitments may not be efficient. Second, the organizational rearrangement necessary to accommodate that activity within the existing team may be extensive. An entrepreneur may not be willing to forego his freedom unless the expected returns warrant it. The other thing is that it may be possible to utilize his talent to cater to the needs of other teams as well because the original team will grow over time and may integrate with other teams. Regaining synergies is an essential aspect of integration among teams. The classic example of the Fisher Body vs. General Motors relationship is illustrative of some of the aspects described above.[22]

Fisher Body(FB), owned and operated by Fisher brothers was producing car bodies for several assemblers including General Motors(GM) and Ford.[23] FB created all the capital assets that were necessary for their manufacturing operations. The major reason was that the capital assets were not exclusive to the requirements of GM. FB and GM entered into two agreements in 1919. (a) GM bought a 60 percent equity stake in FB. However, GM was not allowed to exercise any decision making controls that may be detrimental to the minority shareholders. (b) The ten year manufacturing agreement had the following

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[21] The workers could not have contemplated and succeeded in the spinoff on their own despite their entrepreneurial drive in the present case. The original owner pushing them off was necessary.

[22] The most significant studies along these lines are (Coase, 2000, 2006; Goldberg, 2008; Klein, 2007; Klein et al., 1978).

[23] Goldberg (2008) contains a description of the various clauses in the agreement.

clauses. (1) GM will buy substantially all its car bodies from FB. (2) GM will furnish FB its quantity requirements, time schedules, and places of delivery. (3) FB will, immediately upon receipt of these requirements, notify acceptance or otherwise. (4) If FB is unable to comply GM may buy elsewhere or construct facilities to make sure that its production schedules are not disrupted. (5) FB may also sell car bodies to other assemblers like Ford. (6) The prices that GM paid for car bodies of FB were calculated by using a 17.6 percent markup over the operating and transportation costs incurred by FB. Since FB creates and operates the necessary capital equipment, this markup was expected to offer them an adequate return.[24]

As Coase(2000, p.24) pointed out, this agreement brought about an unsatisfactory long-term relationship with FB. The Fisher brothers tended to concentrate on their body-building business with other assemblers and paid less attention to the needs of GM than GM would have liked. A partial solution was implemented in 1922. GM tried to establish higher synergies with FB by appointing Fred Fisher as a member of the executive committee of GM. By 1924, when their employment contract with FB expired, all the Fisher brothers joined GM. They were, as a result, members of the GM team.[25]

Late in 1925, General Motors, as a part of its expansion plan, wanted to close the FB plant in Detroit and build a new body plant in Flint, near its assembly plant. FB objected to this. They wanted to expand their Detroit plant because FB had customers other than GM and it would have been less costly to supply them from Detroit rather than Flint. The added disincentive was that they would lose on the markup on transportation costs embodied in the original GM agreement if they relocated to Flint. Coase (2000,pg.28) noted the following viewpoint of Sloan who was then the president of GM. " We were establishing throughout the country assembly plants … and where we had a chasis plant, we had to

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[24] It will be noted presently that including transportation costs was perhaps a mistake. Klein (1988) was explicit in stating that they were included in costs for purposes of the agreement.

[25] Coase (2000) is of the opinion that they did so voluntarily. Hence, it cannot be claimed that it was forced on them because they tried to holdup GM. (Klein et al., 1978; Klein, 2007), on the other hand, suggests that a holdup did occur despite this because FB refused to locate a plant at Flint in 1925. This debate is of very little consequence for the purpose at hand.

have a Fisher Body plant but the Fisher Body Corporation was unwilling to put in an investment in these assembly plants. That handicapped us considerably."

In 1926, GM acquired the rest of the 40 percent equity stake held by FB. However, they retained all the Fisher brothers as their employees. In other words, GM merged the teams soon after they discovered discord or disagreement. The new team with all the manufacturing talents in place created a body plant in Flint by the end of 1926.

For all practical purposes, it should be noted that GM and FB started as different teams because they expected disadvantages of a joint team. GM made some mistakes in drawing up the agreement. There was some dissonance in operating the two teams independently. This, along with the expanding business of GM made it more economical to merge the teams.[26] Clearly, they expected synergies in doing so. As Casadesus-Masanell and Spulber (2000) argued, this merger brought about improving coordination of production and inventories, assured GM of an adequate supply of car bodies and provided access to the manufacturing and executive talents of Fisher brothers.

7 Conclusion

This paper proposes organizational production functions as a useful tool for the analysis of a variety of spinoffs. The framework is rich enough to explain several stylized facts recorded in the literature. However, some issues require further attention.

It was noted at the outset that team synergy may depend on two other factors that have not been explicitly incorporated in the organizational production function. First, it was acknowledged that managerial allocation of capital and other resources to different talents in the team affect the output of the team. Second, managerial attitudes, reflected in the independence they offer to team members and equity in the distribution of gains, define the environment which determines compliance to team goals and the associated synergies. An organizational production function approach may incorporate the second aspect to some extent. However, the first aspect necessitates further analysis.

However, the fact that a competitive product can be introduced even though the original team refused to accept it because it cannibalizes the demand for the current product is a crucial aspect. In that case, the spinoff gains at the expense of the original team. Usually

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[26] Klein (2002)[p.64] makes this point explicitly.

the spinoff must finance its activities from sources outside the team. A spinoff may be based entirely on the possibility that stakeholders are convinced about the greater probability of success of spinoff team. The rate of profit, return on investment and stock market reaction to new public offerings may be crucial determinants of spinoff. A more detailed analytical framework is necessary to explore these aspects.

As a practical reality, a spinoff firm may not produce a similar product and it may not have a similar organizational structure. Given such heterogeneity, there is a need to specify common grounds to offer the basis of comparisons. Perhaps the rate of profit and the rate of return on investment provide such measures. The problem would then be to identify the advantages for the individual who initiated the spinoff in the first instance. On occasions, individuals may leave a team and join another existing team because the other team is willing to accept new ideas.

Though the generic forms of the production function developed in this study are adequate, the details in any one specific case may have its own idiosyncrasies. The sheer variety of causes and experiences of spinoffs make it difficult to suggest an all inclusive theoretical framework. Perhaps the best that can be done is to exhibit a rich variety of alternative theoretical structures from which one can be chosen to suit the given context.

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