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Rock and Roll Bands, (In)complete Contracts, and Creativity

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In his analysis of the "battle" between the Beatles and the Beach Boys, Greg Clydesdale (2006) suggests that the Beatles "should not be seen as creative geniuses but as a creative process, [behind which] were two dominant forces. First was the importance of rivalry with the Beach Boys and [second] the nature of the working team that possessed high levels of exchange and complementary blends of expertise and thinking styles." Clydesdale (2006) also suggests "that the structure of incentives is important in determining the nature of the creative output."

Indeed, when production is joint, the characteristics of partners and the nature of contracts are crucial in explaining the success or failure of the partnership. More talented partners increase the probability of success but may also claim a larger share of the pie. If contracts are complete—as they are when partners choose an output-contingent sharing rule ex ante, then they will match efficiently in partnerships. It will not be possible to rematch agents in such a way as to increase the total surplus in the industry. However, if contracts are incomplete—that is, if the partners cannot agree on sharing rules that reflect the varying levels of creativity—the way agents match will not necessarily be surplus maximizing and may be quite different from the matching observed under complete contracting.[1]

This suggests that the pattern of matching can be an indicator of the degree of contract completeness. Creativity is not observable directly but can be indirectly measured by the credit that members of the band receive for composing and writing songs (as well as for other skills).

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[1] See Patrick Legros and Andrew F. Newman (2007) for a general analysis of matching models with nontransferability.

We develop a model where agents with different levels of creativity match and produce a joint output. When creativity within the group fails, the partnership can purchase songs created by others (outsourcing). But songs created within the group are more likely to succeed (think of them as specific to the group members' characteristics) than those created by outsiders.

We consider two specifications, one in which the members of the group sign complete contracts, where, in case of success, each partner's share is freely specified, using an output-contingent rule, and another in which members are limited to incomplete contracts and use a "gentlemen's agreement" to share equally the returns from their activity.

The composition of the group affects the probability of creating songs within the group and the probability of outsourcing them. We show that when contracts are complete, musicians match in a negative assortative way: the most creative match with the least creative. Under incomplete contracting, musicians match in a positive assortative way: more creative musicians match with similarly creative musicians. This difference in the matching pattern also has consequences for the relationship between an index that measures the "dispersion of creativity" within the group (and is directly related to the matching pattern) and the probability that the group will have a hit.

In the complete contract specification, there is a positive covariation between dispersion and success; when contracts are incomplete, this relation is negative. The data show that the covariation between dispersion and success is significantly negative, and that rock bands therefore appear to have a tendency to enter into incomplete contracts. This gives theoretical and empirical support to what was merely a hypothesis based on very good intuition in Clydesdale's (2006) paper.

I. Specifying Matchings

We consider two-member bands whose members are jointly involved in the creation and production of songs. Musicians have a creative

type that is distributed with distribution $F(a)$ on $[0,1]$; to simplify, we restrict attention to symmetric distributions.[2]

Each band tries to create one song and produce it. A song that is "normal" brings a profit π_L, while a "hit" brings a profit $\pi_H > \pi_L$.

For a given group $\langle a, b\rangle$, the process of creation is such that

- With probability $(1-a)(1-b)$ no member succeeds in creating a song. The group can then buy a song at market price q. This song will become a hit with a low probability p_L;
- With probability $a(1-b)$ member a creates the song and gets the credit while with probability $(1-a)b$ member b creates it and gets the credit. Because the song is created within the band, it becomes a hit with probability p_H, where $p_H > p_L$;
- With probability ab both members succeed in creating the song, which then becomes a hit with probability p_H. Because the creation is joint in this case, each musician receives credit.

A. *Matchings and Success*

Let

$$W = p_L\pi_H + (1 - p_L)\pi_L$$

$$V = p_H\pi_H + (1 - p_H)\pi_L$$

represent the expected profits when the band buys a song from an outsider (W) and when it produces a song created by one of its members (V). Clearly $V > W$ since $p_H > p_L$ and $\pi_H > \pi_L$.

At the time of creation of the band, the expected total profit is

$$\Pi(a,b) = (1 - a)(1 - b)(W - q) + [a(1 - b) + b(1 - a) + ab]V.$$

In the complete contracting case, profits are fully transferable between members. In the incomplete contracting case, profits are imperfectly transferable; we consider the extreme situation where profits are shared equally.[3] This case corresponds to what the industry refers to as a "gentlemen's agreement."

The set of feasible payoff allocations within a group reflects contract completeness or incompleteness. With full transferability, any allocation $(u, \Pi(a,b) - u)$ between the two partners is on the Pareto frontier; with limited transferability, the Pareto frontier reduces to the pair $(\Pi(a,b)/2, \Pi(a,b)/2)$. An equilibrium specifies a matching function and a payoff allocation in such a way that two matched agents have a feasible allocation for this match and there exist no feasible payoffs for any two agents that are strictly greater than their equilibrium payoffs.

As is well known, in the complete contracting case, the ex ante formation of groups will maximize total profit in the band, and the way musicians match reflects their comparative advantages. Here, because $\partial^2\pi(a,b)/\partial a\partial b = W - q - V < 0$, the marginal productivity of a given type of partner decreases with the creative type of the partner. There is therefore negative assortative matching in equilibrium, and if $m(a)$ is the match of a, then, by measure consistency, $F(a) + F(m(a)) = 1$. Since we assume that F is symmetric, it must be that $m(a) = 1 - a$. In this case, the expected probability of success is

$$S(a) = p_H - a(1 - a)(p_H - p_L),$$

which increases with a if $a \geq 1/2$ and decreases if $a < 1/2$. Because there is negative assortative matching, the variance of types in the group varies with a, and the amount of credit that each member receives also varies with a. Note that the total amount of credit in the band is $a + m(a) = 1$. Because that total is independent of a, the shares of credit received by the partners in equilibrium are $(a, 1-a)$.[4]

[2] The matching patterns are independent of the symmetry of the distribution, and the covariation between the variables is the same as in the paper for the incomplete contracting case. When contracts are complete, the covariation between the different variables is affected by the distribution F but is still different from that obtained under incomplete contracting.

[3] Imperfect transferability arises if it is too difficult to agree on shares of profits as a function of the characteristics of the agents. One explanation for this is the difficulty of preventing renegotiation and "hold-up" (Sanford J. Grossman and Oliver D. Hart 1986): once a song is created, the other musicians may threaten to leave the group or not to produce the song if they do not get a higher share of the surplus. If the song created within the group has no value outside the group, this leads to equal sharing.

[4] The only one to receive credit with probability a^2 is a. However, he shares credit with the other member with

By contrast, in the incomplete contracting case, each musician a wants to match with the musician b for whom $\frac{1}{2}\Pi(a,b)$ is maximum: the process of matching is no longer governed by comparative advantage but by absolute advantage. Since $\Pi(a,b)$ increases strictly with b, all musicians want to match with the highest possible type, and this leads to positive assortative matching: now, $m(a) = a$.[5] The probability of success is then

$$S(a) = p_H - (1 - a)^2(p_H - p_L),$$

which increases with a.

B. *Matchings, Sharing, and Outsourcing*

The "dispersion of creativity" measure that we use is a normalized Herfindahl index, equal to the sum of the squares of the shares of credit divided by the total expected amount of credit (or number of credits) in the group. In the complete contracting case, this index is

$$D(a) = a^2 + (1 - a)^2,$$

which increases with a when $a \geq \frac{1}{2}$ and decreases when $a < \frac{1}{2}$. There is therefore a positive covariation between S and D in the complete contracting case.

If contracts are incomplete, the credit that goes to each member is a, while the total credit is $2a$. Each partner has an equal share of credit, yielding

$$D(a) = \frac{1}{4a},$$

which decreases with a. There is therefore a negative covariation between S and D.

There also exists a covariation between outsourcing (buying a song instead of creating it) and dispersion. In the case of complete contracting, outsourcing is equal to

$$O(a) = a(1 - a),$$

which increases for $a < \frac{1}{2}$, and then decreases. By contrast, if contracts are incomplete,

$$O(a) = (1 - a)^2,$$

which decreases with a. This leads to the following proposition, which will guide our empirical strategy.

PROPOSITION 1: *In the complete contracting case, there is a positive covariation between the expected probability of a hit and the dispersion of credit within the group. This covariation is negative in the incomplete contracting case. The covariation between outsourcing and dispersion is negative in the first case and positive in the second.*

The model developed here deals with "singles" produced by two-member bands. In reality, bands are larger and the number of members who are credited is sometimes greater than two, but the basic insight concerning matchings and (in)completeness of contracts remains valid.

II. Data

The database consists of albums created by the 151 bands listed in Philip Dodd's (2001) *Book of Rock*, which started their career between 1970 and 1979. Dodd's definition of rock includes not only the most important artists in the genre but also musicians who had a significant influence on the pop/rock scene. It also includes very well-known bands (U2 from Ireland and Aerosmith from the United States) and less celebrated ones (Big Star and Hüsker Dü, both from the US). Colin Larkin's (2006) *Encyclopedia of Popular Music* is used to establish discographies. To treat each band equally, we imposed a 25-year limit on all of them. That is, if a band released its first album in 1975 we tracked its discography up to 2000. In most cases, the lifetime of a group is shorter than 25 years, and we considered 25 years to be long enough to reveal a musician's creative output. Compilations of songs from different studio albums are excluded, as are live albums. The final database consists of 1,494 albums released by the 151 bands between 1970 and 2004. Because we are interested in bands in which, most of the time, several members are active creators (though it may happen that credit goes to only one member in some albums), we excluded albums in which all credit always goes to a single musician ("soloists," such as Michael Jackson).This reduced the database to 107 bands and 982 albums.

probability $a(1 - a)$, and therefore he has an expected number of credits of a.

[5] This is true for any distribution.

Awards conferred by the Recording Industry Association of America (RIAA) are used as proxies for success. RIAA recognizes albums that reach a certain sales threshold. Gold and platinum awards, introduced in 1970 and 1976, respectively, certify sales of 500,000 and 1,000,000 albums. Multi-platinum (2 million albums sold) and diamond (10 million) awards were introduced in 1984 and 1999, respectively. To avoid "backward spillover effects" from awards given to new releases of old albums, the only awards taken into account are those obtained within one year of the date of the first release. That criterion yields 110 platinum (multi-platinum and diamond) and 123 gold awards; 749 of the 982 albums received no award.

Two reasons led us to consider albums instead of bands. First, bands are often unstable. Though the name of the band may remain the same, members change, and it would have been difficult to deal with such changes. Second, the number of albums is much larger than the number of bands, which is important for empirical analysis. In essence, we assume that each album is produced by a different band.

Following our theoretical model, two variables define the internal organization of a band or, here, of an album: dispersion and outsourcing. Dispersion is defined as the Herfindahl index (based on the sharing of credit) divided by the total number of credits. To compute the index for each album, we collected (using the cover of the album or other sources—the band's webpage or specialized websites such as Discogs.com or Allmusic.com) the number of times each member of the band was cited (credited) in each song. Credits to songs that are outsourced were not taken into account. Outsourcing measures, for each album, the share of songs that a band buys on the market for songs. This is computed using the same sources as those used to compute dispersion, that is, album by album. On average, 6 percent of the production is outsourced. Success is represented by a dummy variable that takes the value of one if the album received at least a gold award, and zero otherwise.[6]

The ratio "awarded number of albums/total number of albums" is roughly the same for soloists (21 percent) as for groups (24 percent).

[6] Separating gold from platinum and multi-platinum does not change the results.

Table 1—Estimation Results

Panel A. Comparison of means, dispersion index	
Albums with no award	0.050
Albums with award	0.026
Difference of means	-0.024 ($t = -3.56$)
H_0 : Difference < 0	Pr = 0.9998
Panel B. Logit regressions, dependent variable is success (*z-values between brackets*)	
Dispersion only	-8.46 (-3.81)
Intercept	-0.88 (-8.99)
Dispersion	-10.77 (-3.88)
US group	0.91 (5.52)
Major label	2.10 (8.25)
Piracy	-0.63 (-1.11)
Intercept	-2.80 (-10.90)
Observations	982

Soloists are more productive (11.6 albums per band versus 9.2 for groups) but have to outsource three times more than groups.

III. Results and Conclusions

Proposition 1 provides an easy way to test which model (complete or incomplete contracting) applies, since the sign of the correlation between success and dispersion and between outsourcing and dispersion tells us which type of contract has been entered into. Results are summarized in Table 1. Since success is a dichotomous variable, we simply test whether the difference in mean dispersion varies between albums with and without awards. The test shows that the difference is significantly negative and has a very low probability (0.0002) of being positive. Similar results are obtained with logit regressions, whether or not we introduce exogenous control variables that may affect sales, and thus awards, but not dispersion: (i) a dummy variable equal to one if the band is American, and zero otherwise (essentially British bands, but also from Canada, Australia, and Europe)—American bands do significantly better than others; (ii) a dummy variable equal to one if the label is from one of the major recording studios, and zero otherwise—it significantly helps to be produced by a major; (iii) a piracy variable equal to zero before 1999, and to one afterward, to take into account that sales may have decreased as a result of piracy, making success more difficult to attain—the estimated parameter is negative as expected, though it is not significantly different

from zero at the 5 percent probability level. The coefficient of success on dispersion is significantly negative in all cases.

The correlation coefficient between outsourcing and dispersion is equal to 0.09, which is significantly different from zero at the 0.5 percent probability level.[7]

Both results point to the conclusion that contracts are incomplete and there is positive assortative matching of partners in a band.

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[7] Qualitatively identical results are obtained if "soloists" are included in the calculations.