When I Saw Him/Her Standing There: Transaction costs in partnerships

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Abstract

Professionals often come together to achieve personal goals, but partnerships burdened with transaction costs may flounder and even perform worse than going alone. When is it worthwhile to form a partnership? We simulate a market of young scientists choosing whether to do research alone or in collaborations. We explore two types of transaction costs that hinder team production: publication costs that arise when the rate of output drops due to characteristics of the partnership (e.g. excessive correspondence, disagreements, etc) and authorship costs that arise from conflicts over who sits first author. We find that partnerships thrive when there are no difference or difference are small in publication costs between those who collaborate and those who work alone. Not having preference for authorship performs better than having a strong preference to be the first author.

1 Introduction

Before they ever met, John Lennon and Paul McCartney dreamt of becoming rock stars. When they started songwriting they made an informal agreement: any song they wrote, however much each individual contributed, credit should be shared equal The umbrella Lennon/McCartney partnership – some early songs were credited McCartney/Lennon – went on to record over 250 songs whose copyrights were bought in 1984 for \$47.5 million dollars [1].[1] Forming a band and sharing songwriting credit are cited as two key reasons why John Lennon and Paul McCartney were best as The Beatles and why The Beatles

[1] It was Michael Jackson who bought Northern Songs, the company that owned The Beatles catalogue. Following Jackson's death in 2009, his copyrights were bought for \$2.2billion in 2012. How much this sum is due to The Beatles copyrights is unclear.

were so successful. At the peak of their partnership the two songwriters often directly or indirectly worked "nose to nose and eyeball to eyeball", until, according to McCartney, the death of their manager Brian Epstein and the entrance of John's lover Yoko Ono pushed them apart. The Beatles broke up in 1970. John Lennon and Paul McCartney never wrote another song together [2].

Professionals with personal goals often come together and form partnerships they believe will improve the odds of personal success. Songwriters form bands, companies merge, academics collaborate, just to name a few examples. In each one transaction costs can burden the productivity of the partnership. Transaction costs in a partnership abound and usually prevent the professionals from working nose to nose and eyeball to eyeball: too many emails, too many creative differences, too much disagreement, all resulting in too much distance. Songs never get written, deals never seal, papers never reach journals. At the same time, there are no doubt costs to working alone. Loneliness is often motivation enough for partnerships, especially in solitary professions like academia. Professionals may seek a partner without knowing exactly what are the gains of a given partnership relative to the costs. Knowing when and when not to seek a partner is therefore crucial. Not every partnership can be The Beatles, but no partnership should ever be Wings.[2]

In this paper we explore the effects of partnership transaction costs using a simulated market of young scientists conducting research. Young scientists must publish a certain amount of papers by a certain time in order to reach tenure. Collaborations may improve the odds if working together improves the quality of a paper. Collaborations may also decrease the odds if working together slows down the writing of a paper. Moreover, strong preferences for first authorship may hurt those scientists who get stuck as second-authors when second-authorship counts for less. In addition, those with strong preference for first-authorship may find the number of collaborations they can enter are few. Taking a population of young scientists, some who prefer to be alone, some who prefer to work together with a strong preference for first authorship, and some who prefer to work together indifferent to authorship, which ones reach tenure and which ones reach tenure fastest?

2 Methods

We follow the ODD method to present our model [3].

2.1 Purpose

We created an agent-based model to study the conditions under which it is better to publish with collaborators rather than publish alone. The model simulates academics who employ three different working strategies:

1. Publish alone.
2. Collaborate and always be first author.

[2]With apologies to Paul McCartney.

3. Collaborate and take any authorship.

Our goal was to compare the performance of these strategies. We implemented the agent-based model in R.

2.2 Entities, state variables and scales

The model has 30 young scientists, each of them pursuing one of the three strategies. Each strategy was assigned to 10 young scientists who cannot change their strategy.

Time is represented discretely in this model and one time step represents a year in young scientist's academic career. During each year the scientists execute the commands described in the schedule (described in Process overview and scheduling). One run of the simulation lasts 20 time steps (i.e. simulates 20 years). The space is not explicitly modeled. Table 1 reports the state variables and entities used in our model.

Entity	**State variable**	**Description**
Agents	Young scientists	Each scientist is classified according to his working strategy: alone, collaborates with preference for first authorship, collaborates without preference for first authorship
	Probability to publish	A probability that a scientist (or a group of two) will publish a paper any given year. Scientists who work alone have a different probability of publishing than both types of scientists who work in collaborations.
	Probability of high impact publication	Given that a scientists (or a pair of them) are publishing in a given year, a probability that the paper will appear in a high impact journal.
	Tenure threshold	Each scientist earns points from publishing. The threshold represents the minimum value of points a scientist must earn in order reach tenure.
	α	For collaborators, the payoffs are adjusted by α, the benefit of first-authorship or the cost of second-authorship. For first authors $\alpha > 0$, for second authors $\alpha < 0$.

Table 1: State variables and entities.

2.3 Payoffs

To keep our model simple we used the following payoff functions and assumptions:

- Tenure: $\sum_{t=1}^{T} \pi_i \geq \pi_{tenure}$
- $\pi_i^{loner} = a_1\theta_1 + a_2\theta_2$
- $\pi_i^{collaborator} = a_1\theta_1 + a_2\theta_2 + \alpha$
  - each year, $max(a_1) = max(a_2) = 1$
  - $\theta_1 = 1, \theta_2 = 2$
  - First author: $\alpha > 0$
  - Second author: $\alpha < 0$

Therefore for scientists who work alone:

1. If a scientist does not publish in a given year she earns 0 points.
2. If she publishes in a high impact journal she earns 2 points.
3. If she publishes in a low impact journal she gets 1 point.

And for scientists who form collaborations:

1. If a collaboration is not publishing that year they both earn 0 points.
2. If a collaboration publishes in a high impact journal: the first author earns $2 + \alpha$, second author gets $2 - \alpha$.
3. If a collaboration publishes in a low impact journal: the first author earns $1 + \alpha$, second author earns $1 - \alpha$.

2.4 Process overview and scheduling

The model proceeds in discrete time steps, and the entities execute procedures according to the following order. For each time step:

1. **Pair cooperators with other cooperators:** The scientists who pursue the strategy of collaborating (both those with preference for first authorship and without preference) are randomly paired with each other.
2. **Compare partner preferences:** Each partner in the pair compares their authorship preference to that of their partner's. The possible scenarios are:
   - if both partners have no preference for authorship order, then they flip a coin to decide who will be the first author
   - if one of the partners have a preference to be the first author, he gets to be the first author and his partner gets second authorship.
   - if both partners have a preference to be the first author, the collaboration collapses and both of them get 0 points added to their total accumulated points.
3. **Writing and publishing**
   - The scientists who like to work alone go through the following writing and publishing process:
     - They draw a random number and if it is smaller than the assigned probability to publish for loners, they get to publish that year. Otherwise they get 0 points added to their total accumulated points.

  – If they get to publish, they draw another random number and if it smaller than the assigned probability of high impact publication for loners, then they get a payoff of publishing in a high impact journal. Otherwise they get a payoff of low impact journal.

- The scientists who work in collaborations go through the following writing and publishing process:
  – The pair draws a random number and if it is smaller than the assigned probability to publish for collaborators, they get to publish that year. Otherwise they get 0 points added to their total accumulated points.
  – If they get to publish, they draw another random number and if it smaller than the assigned probability of high impact publication for collaborators, then they get a payoff of publishing in a high impact journal. The first author get a payoff plus the premium for being the first author (α), while the second author gets the payoff minus the penalty of being the second author (α). Otherwise they get a payoffs of low impact journal (with α added to the payoff of the first author and subtracted for the second author's payoff).

4. **Do you get tenure?** Each scientist who does not have tenure, compares all accumulated points to the tenure threshold and if they have at least as many points as the threshold they get assigned tenure. After the tenure is assigned the academics keep earning points in the next time steps.

2.5 Scenarios

First, we wanted to investigate the differences between the situations when the effect of authorship order is large ($\alpha = 0.5$) and small ($\alpha = 0.05$). Then, for each of these scenarios, we made additional assumptions about the differences in the publication rate between those who work alone and those who work in collaborative settings. We chose three types of differences in publication rate: no difference, mild difference and large difference. We ended up with six simulation scenarios:

	Sim 1: No difference	Sim 2: Mild difference	Sim 3: Large difference	Sim 4: No difference	Sim 5: Mild difference	Sim 6: Large difference
Probability of publication alone	0.5	0.7	0.7	0.5	0.7	0.7
Probability of publication in collaboration	0.5	0.4	0.2	0.5	0.4	0.2
Probability of high impact alone	0.5	0.5	0.5	0.5	0.5	0.5
Probability of high impact in collaboration	0.9	0.9	0.9	0.9	0.9	0.9
α	0.5	0.5	0.5	0.05	0.05	0.05

Table 2: Simulation scenarios

3 Results

3.1 When is it better to work in collaboration with others then work alone?

We compared how many points on average each strategy has at every time step. Figures 1-2 show that, on average, both collaborator strategies do better than working alone only when there are no differences in publications rate both in the scenarios when authorship order effects are large and small.

When authorship order effects are high ($\alpha = 0.5$) and the differences in the publication rates are mild, the collaborator strategy that prefers first authorship does worse than publishing alone. However, collaborator strategy that doesn't have any preference for authorship does as well as working alone. When authorship order effects are small ($\alpha = 0.05$), the collaborator strategy that prefers first authorship does as well as working alone and the collaborator strategy that does not have a preference for authorship does better than the other two strategies.

When publication rate of those who work alone is much larger than for the collaborators, both collaborator strategies do worse than lone strategy if the effects of authorship are high ($\alpha = 0.5$). However, the collaborator strategy that does not have a preference for authorship does at least as well as working alone when the effects of authorship order are small ($\alpha = 0.05$).

3.2 Does the collaborative strategy with strong preference for first authorship win the tenure race?

As shown by Figure 3, the only situation where the average time to tenure was shortest for the strategy with strong preference for first authorship was when there were no differences in publication rates and only small effects of authorship order ($\alpha = 0.05$). In all other cases where collaboration is worthwhile, collaborations of young scientists with no authorship preference win out.

4 Discussion & Future Directions

Our simulation reveals an intuitive result: collaborations between willing agents are successful when transaction costs are low. When young scientists work together without impediment they are able to produce better research that have better odds at publishing in better journals. These collaborations rack up more academic points than loners and reach tenure faster.

Less intuitive is the result that young scientists with strong authorship preferences don't outperform their indifferent counterparts, many times performing worse. Evidence points to this strong preference as the reason behind such poor performance. Demanding to be first-author reduces the number of collaborations a young scientist can enter. When the few collaborations demanding scientists enter face high publication costs, these scientists become dramatically less productive through time. There is one exception to this result. Under certain conditions – no difference in publication costs and low first-authorship benefit – demanding scientists on average reach tenure faster. However, this advantage is realized only over the short term. Across time, scientists indifferent to authorship accumulate nearly the same amount of academic points.

With these results in hand we can think of many interesting directions to take our model:

- **Learning.** Drop random matching and let scientists keep or dissolve partnerships. Allow agents to form endogenous preferences about authorship and reflect on past performance: "Should I be less/more demanding for first authorship next time?"
- **Endogenous publication odds.** Allow the probability of publishing and probability of getting into a prestigious journal to be a function of past performance. This could then feed into learning.
- **Interdisciplinary research: segregation or comparative advantage?** Like Schelling, let scientists carry expertise in one field or another and a preference of working with "kin" or "strangers".
- **Navigate a rugged landscape of ideas.** Like all professions, science is ripe with good ideas and wrought with bad ones. Letting good ideas represent peaks and bad ideas represent valleys, scientists navigate the rugged idea landscape either alone or in collaborations. The landscape could be made endogenous by assuming ideas are emergent properties of scientist interactions. This approach was inspired by Keith Richards (whose career with The Rolling Stones was launched by a Lennon/McCartney song): "I feel like all the songs in the world are just floating around, it's just a matter of like an antenna, of whatever you pick up."

References

[1] Wikipedia contributors. "Northern Songs." Wikipedia, The Free Encyclopedia. Wikipedia, The Free Encyclopedia, 14 Jun. 2015. Web. 25 Jun. 2015.

[2] Roylance, B. (Ed.). (2000). The beatles anthology. Chronicle Books.

[3] Grimm, Volker, et al. "A standard protocol for describing individual-based and agent-based models." Ecological modelling 198.1 (2006): 115-126.

A Figures

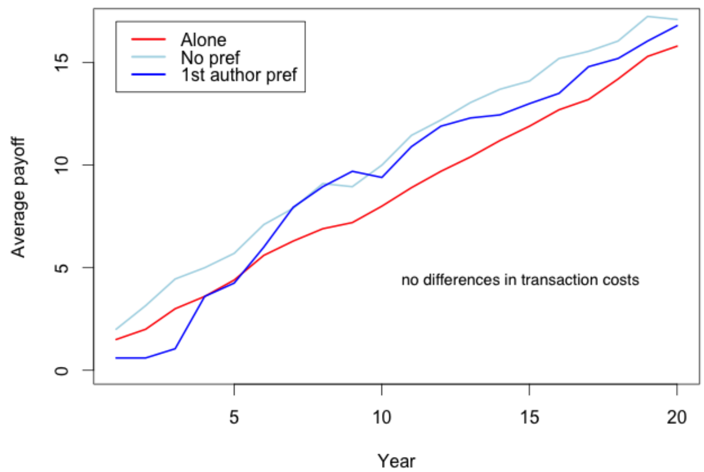

Figure 1: Simulation 1: no difference in publication rate, $\alpha = 0.5$

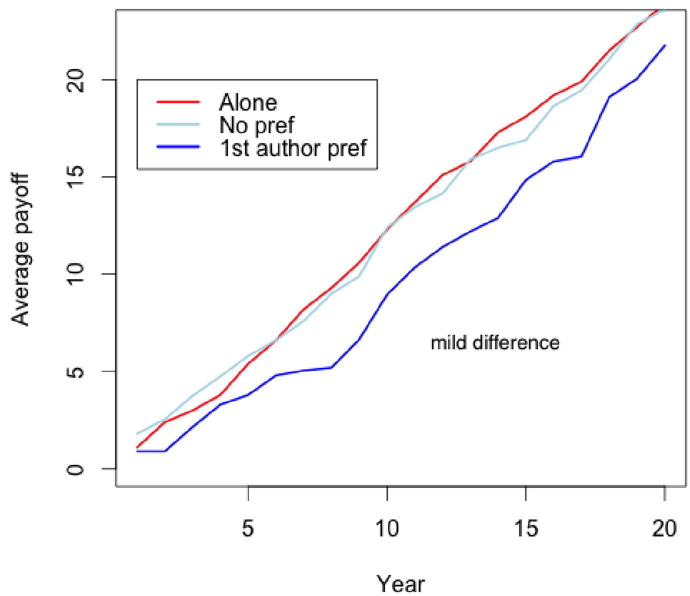

Figure 2: Simulation 2: mild difference in publication rate, $\alpha = 0.5$

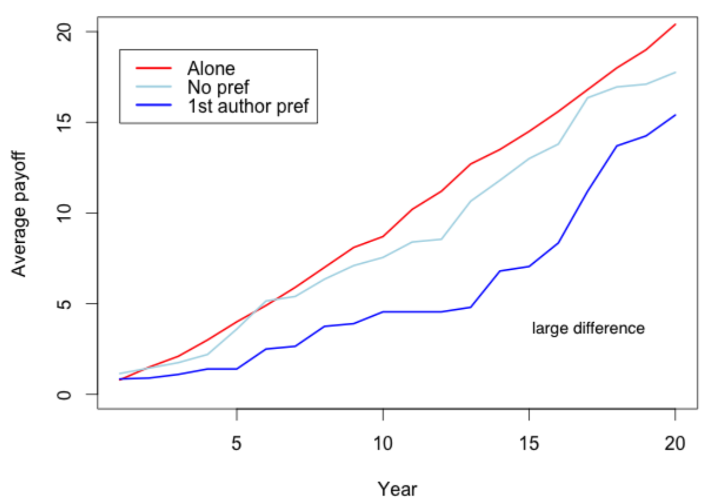

Figure 3: Simulation 3: large difference in publication rate, $\alpha = 0.5$

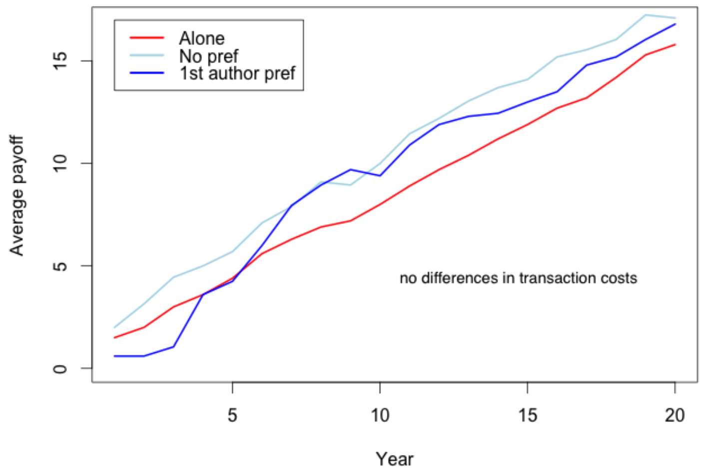

Figure 4: Simulation 4: no difference in publication rate, $\alpha = 0.05$

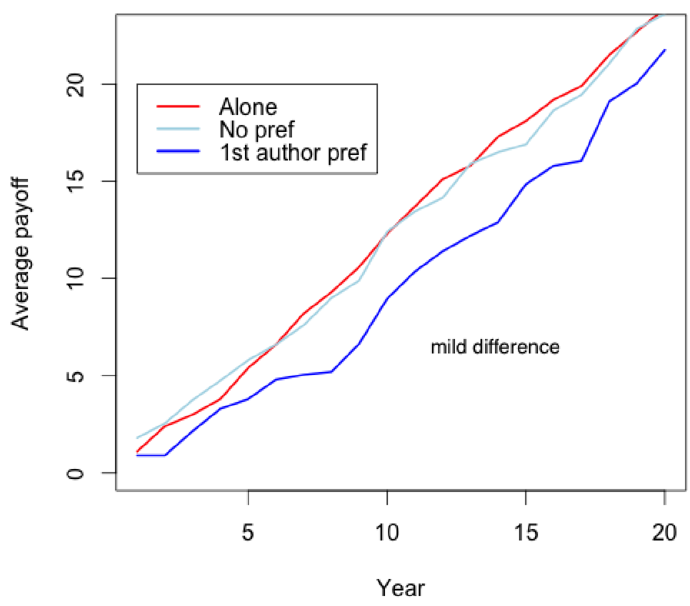

Figure 5: Simulation 5: mild difference in publication rate, $\alpha = 0.05$

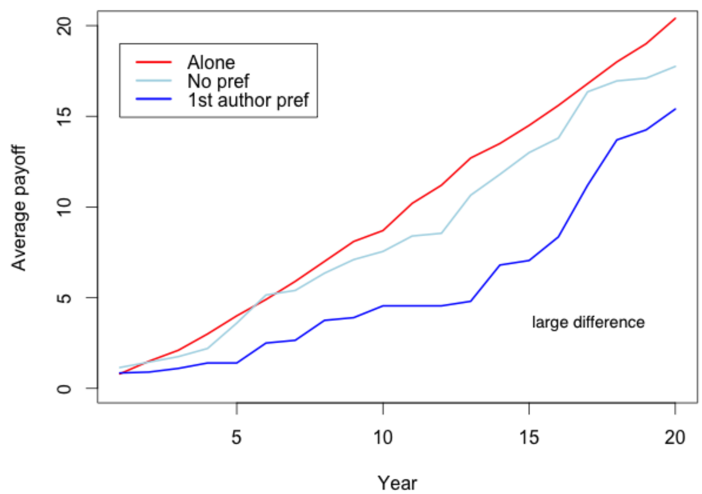

Figure 6: Simulation 6: large difference in publication rate, $\alpha = 0.05$

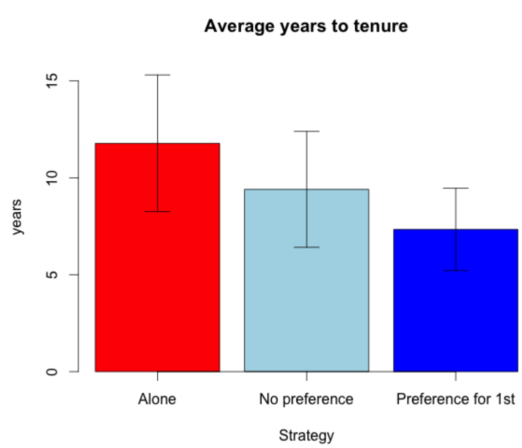

Figure 7: No differences in publication rate and small differences in authorship benefits/costs