
**An econophysics approach to
quantifying teamwork in scoring in
NBA basketball**

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The limited nature of possessions in the game of basketball of basketball leads to a simple question of how teamwork is manifested in scoring. It is often said among sports journalists that a player can elevate the performance of his teammates. Notable examples of streaks attributed to this effect by journalists include the “Linsanity” streak of the New York Knicks or the rising performance of the 2013-2014 Washington Wizards.

In this paper an approach from econophysics is applied to the context of team sports to begin to answer this question of how teamwork affects scoring. The partial correlation matrices resulting from the analysis of game points per minutes are visualized to illuminate relationships between players whose scoring rises and falls together or players who diminish their performance for the benefit of a teammate.

1 A small introduction to partial correlation matrices

The use of partial correlation matrices in financial data analysis has been shown to be useful in illuminating the relationships between players in financial markets while adjusting for the performance of the whole. One example would be the relationship between the performance of stocks of corporations in the S&P 500 relative to the index. Kenett, Tumminello, Madi, Gur-Gershoren, and Mantegna (2010)

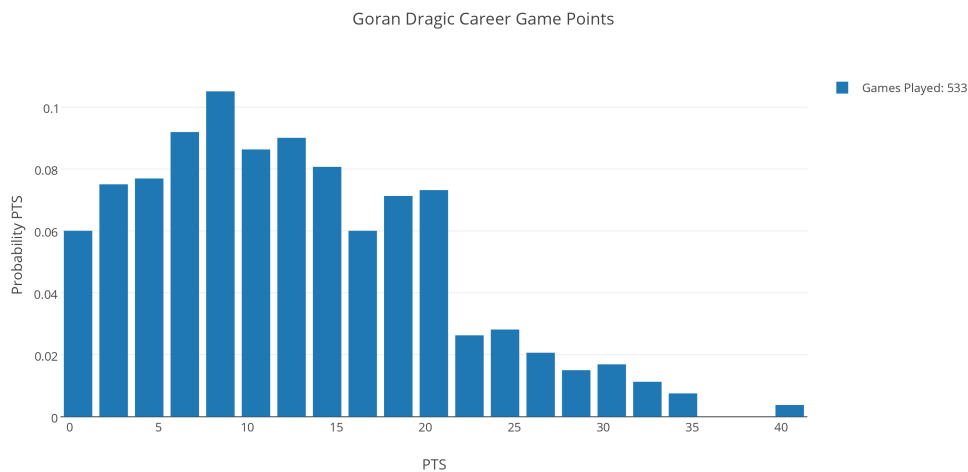


Figure 1: Goran Dragic career game PTS distribution

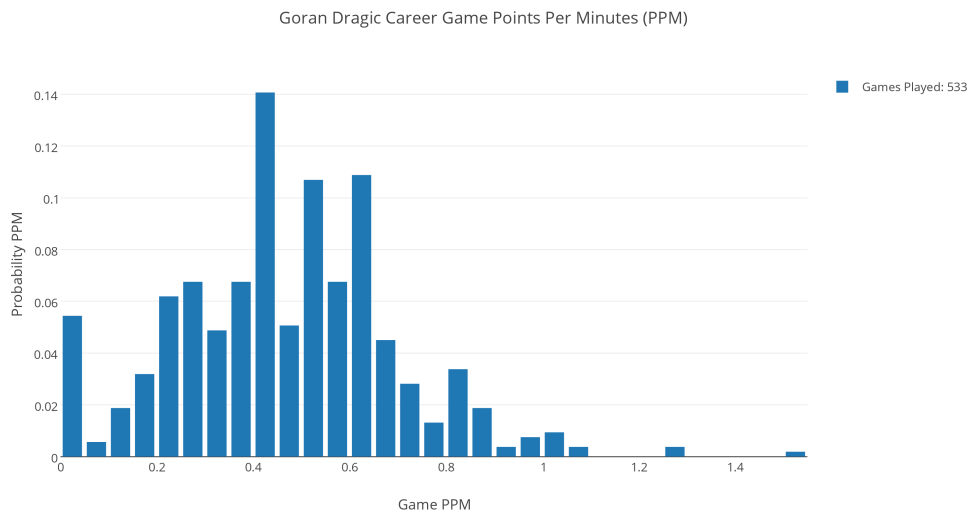


Figure 2: Goran Dragic career game PPM distribution

2 Partial correlation networks in basketball scoring

In this paper partial correlations the application in financial systems is used in an analogous version where the performance of a stock is replaced with the scoring performance of the player and the role of the market index is replaced with the team's game score. Game points per minutes are the variable chosen for this paper but the following analysis could be used for other variables such as players game points, John Hollinger's player efficiency rating (PER), or a plus/minus rating for a players performance. Game points per minutes were defined as players total points for a game divided by the players total minutes played per game. Figure 2 displays an example career distribution for this variable. The same players PTS distribution is shown in figure 1. Players who joined a team through a trade midyear were removed from the analysis as well as players who played less than 50 games a season to impose a minimum amount of data per player in the following analysis. Further analysis is planned to include these players.

Celtics 2012 Game PPM Team Score Partial Correlation Matrix

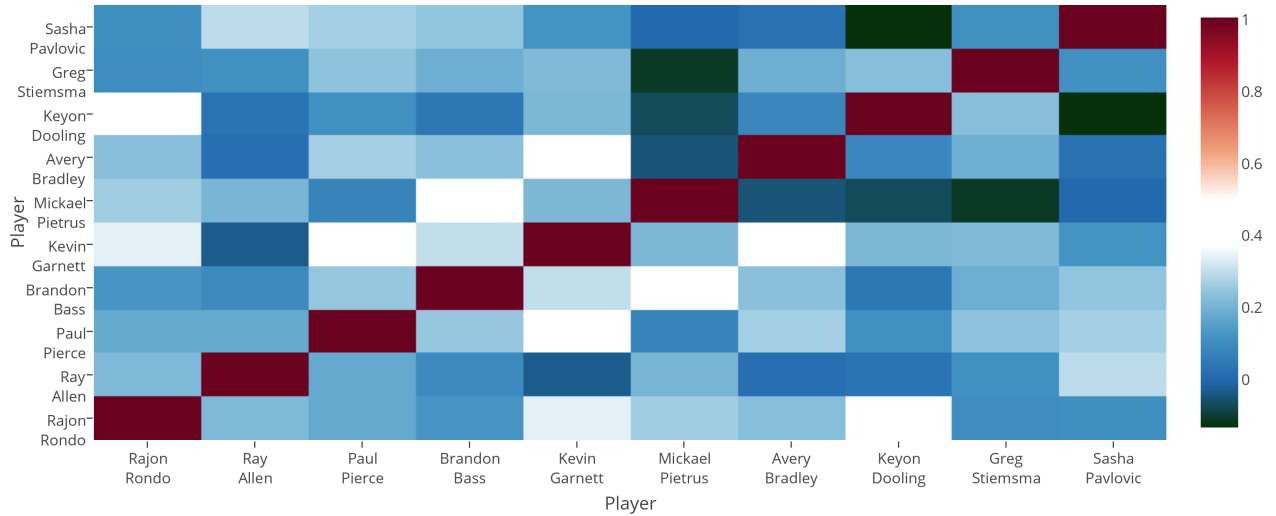


Figure 3: Celtics 2012 game PPM correlation matrix

3 Discussion

3.1 Interpreting the correlation matrix

Due to the “zero-sum” nature of possessions one expects anti-correlations to be common which is observed in the analysis. However exceptions are available like the 2011-2012 Boston Celtics shown in figure 3. Teams can occasionally become correlated enough to have an abundance of positive links. A positively correlated team is interpreted to be a team susceptible to “hot” or “cold” scoring streaks . A negatively correlated team is interpreted to be a team susceptible to tradeoffs in scoring production. However this trade is not necessarily detrimental given a beneficial example can be conjured where a high scoring player is anticorrelated with a group of low scoring players such that the loss in production by the low scoring players is offset with the gain in scoring by the high scoring player. Negatively correlated teams require a greater amount of analysis in determining cost benefit considerations. A team with low correlation is interpreted as a low risk team which can score with less uncertainty in their contributions. This consideration of the trade off of risk and scoring hints at considering team rosters much like a stock portfolio where risk traded off according to the investors risk tolerance.

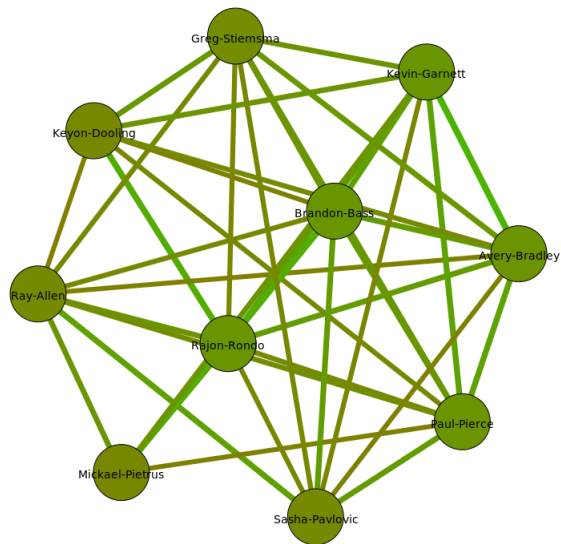


Figure 4: Celtics 2012 game PPM correlation network

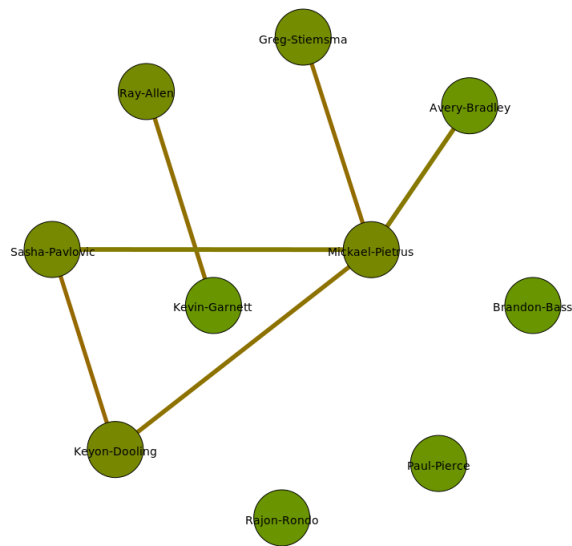


Figure 5: Celtics 2012 game PPM anti-correlation network

3.2 Correlation networks and team rosters

The resulting correlation matrices from the analysis can be used to visualize the scoring relationships between players by constructing a complex network from the matrix. Two such networks are shown in figure 5 and figure 4 for the 2011-2012 Boston Celtics. In these visualizations one observes that many of the bench players for this team were prone to anti-correlations in their scoring which indicates a trade off in scoring while the starters are best characterized as a “streak” unit with positively correlated relationships. An exception in the starters is the relationship between Kevin Garnett and Ray Allen which may be indicative of their respective roles in the offense of the team where Kevin Garnett is more likely to score if the offense occurs near the basket while Ray Allen is more likely to score if the offense is scoring away from the basket. These resulting networks may be useful in deciding which players should accompany each other depending on the current performance of a player.

3.3 Future work

The relationship between correlations and uncertainty in scoring performance has been discussed but there is work to be done in discovering how exactly this relationship is reflected in the wins and losses of a team. It would seek to answer if a high correlation team wins at a less consistent rate than a low correlation team. There is also work to be done in deciding the best way to weight the total correlation for the team in a manner in which a low minutes player contributes the same as a high minutes player. Work in evaluating the predictability of scoring relationships between players in different teams would be useful for consideration in the evaluation of trades between teams.

References

Kenett, D., M. Tumminello, A. Madi, G. Gur-Gershgoren, and R. Mantegna (2010): “Dominating clasp of the financial sector revealed by partial correlation analysis of the stock market,” *PLoS ONE*, 5(12), e15032.