Is there a passing premium in the National Football League?

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Introduction

This paper tests the so-called "passing premium" noted by Alamar (2006). NFL teams do not appear to pass as much as they should, despite an increase in the net yardage per pass allowed by rule changes since the late 1970's. The innovation in our approach is to borrow from portfolio finance theory to determine the optimal share of passing and running plays.

Team coaches are assumed to choose an optimal portfolio of running and passing plays over the course of a season. The optimal portfolio of plays maximizes a risk-averse utility function where utility is obtained from net yardage. This gives a specific optimal value for the share of total plays that are running plays (*R* = running, *P* = passing, α = Arrow-Pratt coefficient of absolute risk aversion).

$$\gamma^* = \frac{\frac{\mu_R - \mu_P}{\alpha} - \mu_R\mu_P + \mu_P^2 + \sigma_P^2}{(\mu_R - \mu_P)^2 + \sigma_R^2 + \sigma_P^2}$$

By comparing the actual share of running plays to the optimal γ for each NFL club, evidence can be found to support or refute Alamar's (2006) claim.

Data

The data were compiled from all 2006 NFL regular season games (16 for each of 32 teams) and were acquired from the website www.nfl.com. Net yardage from approximately 1000 total plays for each team was recorded. As in Alamar (2006), 45 yards was subtracted from each play involving an interception or fumble. Typical running and passing yardage distributions are shown below.

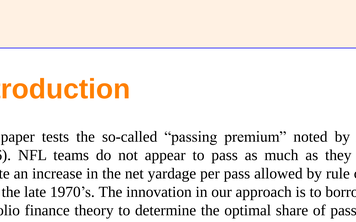


Figure 1. Rushing distribution for the San Diego Chargers.

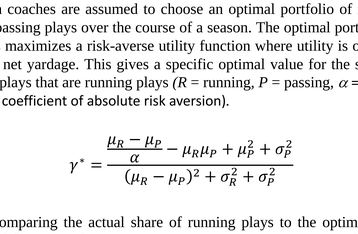


Figure 2. Passing distribution for the New Orleans Saints.

Results

The value for the Arrow-Pratt coefficient of absolute risk aversion was set to α = 0.0285. This value set the actual running share of plays for the San Diego Chargers equal to the team optimal γ. This was thought reasonable since the Chargers had a 14-2 record and thus came the closest to achieving an optimal offensive portfolio.

- Highest running average: Atlanta Falcons – 5.72 yards
- Lowest running average: Cleveland Browns – 2.70 yards
- Highest running std deviation: San Francisco 49ers – 10.9 yards
- Lowest running std deviation: Chicago Bears – 5.31 yards

- Highest passing average: New Orleans Saints – 7.3 yards
- Lowest passing average: Cleveland Browns – 3.39 yards
- Highest passing std deviation: New Orleans Saints – 15.65 yards
- Lowest passing std deviation: Houston Texans – 10.9 yards

Team	μ_R (1)	μ_P (2)	σ_R (3)	σ_P (4)	γ (5)	Running share (6)	Inefficiency (5)-(6)
Patriots	3.988	5.974	8.214	11.610	0.373	0.463	-0.089
Saints	3.125	7.305	9.026	15.651	0.375	0.391	-0.016
Chargers	5.720	6.549	9.408	11.452	0.488	0.488	0.000
Colts	4.454	6.604	5.938	12.423	0.479	0.445	0.034
Ravens	3.775	5.186	6.229	12.229	0.564	0.449	0.115
Cowboys	4.547	6.275	5.839	13.676	0.612	0.487	0.125
Chiefs	4.472	5.574	7.001	13.487	0.644	0.517	0.127
49ers	4.415	4.503	10.894	14.213	0.622	0.477	0.144
Rams	4.135	5.509	7.063	12.010	0.528	0.379	0.149
Bengals	4.070	6.492	6.013	15.047	0.585	0.426	0.159
Jets	3.574	4.918	5.922	13.770	0.658	0.496	0.162
Dolphins	3.591	4.306	8.901	11.961	0.543	0.373	0.170
Jaguars	4.768	5.177	6.947	11.860	0.679	0.507	0.172
Vikings	3.863	4.381	8.881	12.686	0.604	0.423	0.181
Texans	3.584	4.136	7.676	10.903	0.572	0.401	0.171
Redskins	4.770	5.518	6.195	12.804	0.699	0.493	0.206
Falcons	5.721	4.174	10.491	12.399	0.757	0.540	0.217
Eagles	4.875	6.149	9.485	15.576	0.616	0.389	0.227
Giants	4.870	5.008	7.967	12.264	0.684	0.447	0.237
Lions	3.936	4.798	9.123	12.982	0.564	0.318	0.246
Browns	2.699	3.394	8.046	13.801	0.659	0.402	0.257
Panthers	4.168	4.679	7.641	13.129	0.679	0.419	0.260
Cardinals	2.691	4.122	6.463	14.210	0.641	0.380	0.261
Titans	4.276	3.675	8.637	12.742	0.764	0.484	0.279
Packers	4.154	4.763	8.085	13.861	0.674	0.383	0.290
Broncos	4.807	4.702	8.372	13.451	0.734	0.437	0.297
Bears	3.912	4.800	5.314	15.098	0.782	0.483	0.299
Buccaneers	3.633	3.648	7.651	11.942	0.707	0.392	0.314
Seahawks	3.825	4.017	6.743	13.883	0.784	0.433	0.351
Bills	3.848	4.183	5.994	15.056	0.823	0.462	0.361
Raiders	3.601	2.469	8.392	13.685	0.866	0.437	0.429
Steelers	4.715	3.624	9.487	14.720	0.815	0.358	0.458

Table 1. The last column computes the difference between the optimal running share of plays and the actual running share of plays. The New England Patriots ran the ball a little too much, but most teams passed the ball too much. The Pittsburgh Steelers were the worst offenders.

The best portfolio managers in 2006

The worst portfolio managers in 2006

The results suggest that most teams pass too much, that is, that there is a *running premium*, not a passing premium. We also need to find support for the portfolio model that suggests a tradeoff between risk and return. If there is, in fact, no tradeoff, the utility function cannot be relied upon to find the optimal γ. Figures 3 and 4 lend some support to the portfolio approach.

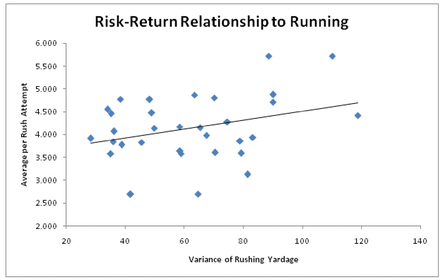


Figure 3. There does appear to be a positive association between average running return and running risk. The correlation coefficient is 0.321 with a p-value of 0.073.

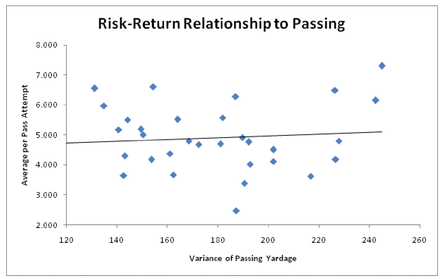


Figure 4. The association between average passing return and risk is weak or non-existent with a correlation coefficient of 0.094 and p-value of 0.606. This suggests that coaches are *risk-neutral* with regard to passing, implying that coaches only consider the necessary yardage and not the risk associated with passes of different expected yardages.

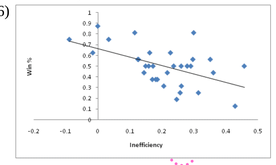
Conclusions

The evidence supports the hypothesis that there is not a "passing premium" in the NFL, rather, for most teams, there is a "running premium". There is also support for the portfolio approach to selecting an optimal portfolio of running and passing plays.

The main shortcoming of the approach here is that only the 2006 season is considered. Rules regarding passing have relaxed since the late 1970's with the intention of making passing plays more effective. It could be that the running premium found for 2006 did not exist before the rule changes. The only way to test this hypothesis is to obtain play by play data for a year prior to 1978. I have not found a source.

A final point. The inefficiency figures found in the last column of Table 1 should be strongly negatively associated with final performance at the end of the 2006 season. This was tested by using a heteroskedasticity consistent regression technique to regress 2006 winning percentages on the efficiency measure. The results are statistically significant at any reasonable level of confidence.

Winning % = 0.66 – 0.795 Inefficiency
t-statistic = (14.82) (3.56)
R-squared = 0.283



Almost all coaches call passing plays too often. Just be happy one of them is not managing your financial portfolio.

Literature cited

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For further information

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Thank you for reading my poster.