RP Analysis: Assessing the Effect of Success Rates Versus Coverage and Alignment on Statistical Production

Matt Harmon and Josh Scott

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1 Introduction

This analysis is part of a new series of Reception Perception articles that applies statistical methods and inference in order to quantify relationships between RP data and particular outcomes of interest. The series aims to expand on and answer questions regarding "how much" we should weigh what we observe on the field and in RP data.

This particular investigation aims to assess how changes in success rates against defensive coverages affect outcomes such as fantasy points per game, a measurement of consistent fantasy points per game, yards per game and receptions per game. This investigation is further expanded to see whether these relationships change based on whether a player lines up outside or in the slot.

Josh Scott is a Subject Matter Expert in the field of economics. He currently teaches college level courses in microeconomics and macroeconomics, and also helps create and edit assessment tools for textbook publishers. Josh has received masters degrees in Economics from the University of Southern California and Louisiana State University, and is currently completing his dissertation for his doctorate at LSU.

2 Data

The explanatory variables of interest all come from the Reception Perception NFL Database. The RP NFL database features over 360 individual seasons from wide receivers of all ages and types. The database features success rates versus various coverage types, success rates by route, alignment percentages, route percentages, target data and "in-space" data for each featured player for that respective year. A key feature of this data set is the repeated observations of many players over the life of the data set, which allows for cleaner analysis of relationships. Table 1 reports descriptive statistics of the main variables included as explanatory variables in estimation.

2.1 RP Summary Statistics

Summary Statistics (Explanatory Variables)

	Mean	SD	Min	Max	se(Mean)	p25	Median	p75
Success rate vs man	66.984	8.394	31.900	82.6	.439	61.5	68.5	73.2
Success rate vs zone	77.994	6.019	44.100	93.6	.315	75.3	78.7	81.4
Success rate vs press	66.094	11.405	30.400	86.7	.596	59.4	67.6	75
Contested target rate	19.372	7.326	2.400	42.6	.383	14.3	18.3	24
Routes	261.137	40.825	77.000	364	2.134	238	267	285
Age	25.44	2.912	21.000	35	.152	23	25	27
Outside	67.05	21.507	5.000	95.5	1.124	55	74	83.3
Slot	30.982	20.688	3.800	94.9	1.081	15.3	23.6	42.1

Note: All variables other than routes and age are measured as percentages.

Additionally, the outcomes of interest were calculated using the statistical outputs of the wide receivers that are observed in the RP NFL database. These annual statistics come from Pro Football Reference. Using these statistics, I calculated four main outcomes of interest for each featured player in the respective season. These outcomes are fantasy points per game (fptsg), true fantasy points per game (trueptsg), receptions per game, and yards per game. The fantasy point metrics were calculated for a PPR format, and yards per game and receptions per game allow us to further dissect how players are scoring their points. In addition, RP is first and foremost a WR evaluation tool, so it is important to assess these traditional outcomes. True fantasy points per game is calculated to factor in the commentary that touchdowns and fumbles are not necessarily "sticky" on a year-to-year basis. Thus, true points per game is calculated without those two methods of fantasy scoring. It can be viewed as a composite of yards per game and receptions per game. We can also refer to this metric as consistent fantasy points per game. Table 2 reports descriptive statistics for the outcomes of interest we wish to investigate.

2.2 Summary Statistics for WR Outcomes

Summary statistics (Outcomes of Interest)

	Mean	SD	Min	Max	se(Mean)	p25	Median	p75
fptsg	12.942	3.863	1.946	25.671	.202	10.414	12.563	15.294
truefptsg	10.623	3.058	2.177	20.094	.16	8.6	10.661	12.621
rg	4.56	1.388	1.000	9.3	.073	3.7	4.5	5.4
yg	60.641	17.922	10.600	114.5	.937	48.1	60.5	71

Note: Points per calculated using PPR format. "fptsg" denotes fantasy points per game. "truefptsg" denotes fantasy points per game but omits touchdowns and fumbles from the calculation. "rg" and "yg" are receptions per game and yards per game, respectively.

The data was cleaned and merged to create a panel that can be used to assess the effects of success rates and alignment while allowing us to control for unobserved player traits and unobserved yearly anomalies.

3 Method and Model

Armed with panel data on WRs, I implemented Multi-Way and Two-Way Fixed Effects models when running regression analysis. As mentioned, this data and model type allows for cleaner relationships between success rates versus coverages and outcomes of interest. These relationships will be less obscured by factors such as a one year boost in scoring, unobserved changes in officiating, and unobserved player traits. The baseline model, equation 1, is shown and described below.

$$ln(y_{it}) = \beta_1 MAN_{it} + \beta_2 ZONE_{it} + \beta_3 PRESS_{it} + \gamma X_{it} + \alpha_i + \phi_t + \epsilon_{it} \quad (1)$$

$ln(y_{it})$ is the log of one of the four outcomes of interest. Taking the natural log of the outcome variable yields results in percent change format (ie- a change in a parameter of interest generates a percent change in the outcome of interest, on average). β_1, β_2, and β_3 are the parameters of interest. X_{it} are any controls included in the model. The standard controls used are contested catch rate, age squared, routes run, and slot percentage. α_i are player-fixed effects, and ϕ_t are year-fixed effects. Note that age itself is not included in the regression because it will be collinear with year-fixed effects. However, with preliminary regressions using a time indicator, the age variable is positive and significant, and age squared is negative and significant. This pattern is exactly as expected, And results are not affected. Results also do not change significantly if ln(age) is added.

The parameters of interest in equation 1 tell us the general effects of a one percentage point increase in success rate versus the main types of coverages wide receivers see. The results will give us a "rule of thumb" that can help us weight the results from a particular player profile. In other words: *how much* is a one percentage point increase in man coverage worth, and how much is it worth *relative* to a one percentage point increase in success rate versus zone? Are these increases worth the same, or is one relatively more important than the other?

The next step is to expand upon the baseline equation to account for differences in the relationships based on player alignment. While the baseline equation gives a general rule/relationship, it is important to explore whether lining up outside or in the slot affects the importance of each success rate. In particular, is success versus man or zone more important to a particular alignment, and *how* important is it?

$$\begin{aligned} ln(y_{it}) = {} & \beta_1 MAN_{it} + \beta_2 ZONE_{it} + \beta_3 PRESS_{it} + \sigma(\text{Success x Alignment}) \\ & + \gamma X_{it} + \alpha_i + \phi_t + \epsilon_{it} \end{aligned} \tag{2}$$

Equation 2 investigates this idea by interacting success rates (man and zone) with an alignment of choice. This expansion allows us to see how the relationship between success rates and the outcomes of interest change at particular alignment percentages. For example, we can run use this model to assess the relationship between success rate versus man and fantasy points per game when aligned on the outside 50% of the time, and see how the relationship differs as a receiver aligns at higher percentages.

Multiple versions of equation 2 can be used to account for different combinations of success rates and alignments. (We then look at the derivatives while holding alignments at constant levels to assess the changes). We can then see how the baseline results changes for different percentages of alignment outside and alignment in the slot.

4 Results

4.1 Baseline Results

Table 1 shows the baseline results of this analysis. Each column shows the relationship between the explanatory variables and one of the five different outcome variables. The first four columns are of focus. Column 1 shows the relationship between fantasy points per game and the explanatory variables of interest.

Recall that taking the log of the dependent variable allows us to assess the effects in terms of percentage change. The coefficient for success rate versus man coverage indicates that a *one percentage point increase* in success rate versus man coverage is correlated with a *1.4 percent* increase in fantasy points per game, on average. Meanwhile, the coefficient for success rate versus zone coverage indicates that a *one percentage point increase* in success rate versus zone is correlated with a *0.92 percent* increase in fantasy points per game, on average. Both coefficients are highly statistically significant.

Moving to column 2 will factor out fantasy points that are deemed "not sticky" from year to year, such as touchdowns and fumbles. Thus, the coefficients on our explanatory variables this column could be deemed as the consistent fantasy points we should expect per game on average. Here, we see that a *one percentage point increase* in success rate versus man coverage is correlated with a *1.31 percent* increase in consistent fantasy points per game, on average. For zone, a *one percentage point increase* in success rate versus zone is correlated with a *0.75 percent* increase in consistent fantasy points per game, on average. Again, both coefficients are highly statistically significant.

Columns 1 and 2 both give us a key insight: In general, *a one percentage point increase in success rate versus man coverage (ex: from 66% to 67%) is worth approximately 1.5 to 1.75 times the value (or 50 to 75% more) of the same increase in success rate versus zone.* This can be a helpful rule of thumb when looking at numbers at a glance. Columns 3 and 4 also yield interesting results. An increase success rate versus man coverage will yield a substantially larger percent increase in yards per game on average, while we can expect an increase in either success rate to yield similar increases in receptions per game.

While many use Reception Perception as a tool for fantasy football, RP is first and foremost a tool for evaluating wide receivers. Column 2 is essentially a composite of columns 3 and 4, which show the impact of our explanatory variables on receiving yards per game and receptions per game. Column 3 shows that a *one percentage point increase* in success rate versus man coverage is correlated with a *1.56 percent* increase in reception yards per game, on average. This is almost one full percentage point higher and at least 2.5 times larger that the effect of a a one percentage point increase in success rate versus zone coverage on yards per game. Meanwhile, a one percentage point increase in success rate versus man or zone coverage leads to roughly a 1% increase in receptions per game[1]. In terms of statistical production, we see that a lot of the general differences between WR outputs are driven by differences in yards per game and its relationship with different success rates.

Additionally, an increase in routes is positive and highly statistically significant across the board. This is intuitive, as more routes should be correlated with positive outcomes. Column 5 is included as a baseline test of what contributed

[1]Statistically speaking, we cannot say these values are different from each other

to increased targets. We can conclude that, in addition to running routes, success rate versus man coverage contributes to a statistically significant increase in targets. Success rate versus zone coverage does contribute to an increase in targets, but is not as precisely estimated and is statistically significant at $p = 0.053$.

Table 1: Impact of Success Rates on Receiving Outcomes

	(1) (log FptsPG)	(2) (log TruePts PG)	(3) (log Yds PG)	(4) (log Recs PG)	(5) (log Tgts PG)
Success Vs Man	0.0140**	0.0131**	0.0156***	0.00975*	0.00850*
	(0.00426)	(0.00396)	(0.00446)	(0.00383)	(0.00336)
Success Vs Zone	0.00923**	0.00752*	0.00586	0.0104**	0.00546
	(0.00355)	(0.00330)	(0.00372)	(0.00319)	(0.00280)
Success Vs Press	0.00304	0.00222	0.00207	0.00223	0.00206
	(0.00290)	(0.00270)	(0.00304)	(0.00261)	(0.00229)
Contested Catch Rate	0.000533	0.00131	0.00101	0.00180	-0.0000310
	(0.00126)	(0.00117)	(0.00132)	(0.00113)	(0.000997)
Routes	0.00248***	0.00268***	0.00255***	0.00291***	0.00292***
	(0.000386)	(0.000359)	(0.000405)	(0.000347)	(0.000305)
Slot Percentage	0.000442	0.000323	-0.000585	0.00156	-0.000671
	(0.00125)	(0.00116)	(0.00131)	(0.00112)	(0.000986)
Age-Squared	-0.00337	-0.00457*	-0.00509*	-0.00375*	-0.00383*
	(0.00201)	(0.00187)	(0.00211)	(0.00181)	(0.00159)
Constant	2.205	2.940*	5.076***	1.416	2.611*
	(1.412)	(1.312)	(1.480)	(1.269)	(1.115)
Adjusted R^2	0.556	0.601	0.524	0.663	0.637
Within R^2	0.408	0.441	0.383	0.473	0.459
Observations	308	308	308	308	308

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2 Success Rates and Alignment

While the baseline results give us a general rules of thumb for weighting success rates and understanding their effects on average, alignment is incredibly important for understanding how different wide receivers find success. Our next question of interest is: do these results and relative weights change depending on the percent of time you spend in a particular alignment. To investigate this, We utilize various forms of equation 2, and then we look at how the relationships change when holding alignments at particular percentages. For example, how does the relationship between success rate versus man coverage and true fantasy points per game change if a player lines up outside 55% of the time? What about 60, 65, or 70%, etc? This same relationship also conveys the relationship when the receiver lines up in the slot at lower percentages. We can also substitute in success rate versus zone and investigate a similar question. The tables that follow investigate the relationship between true/consistent points per game and man/zone success rates when receivers are lined up on the outside.

4.2.1 Effects of Increases in Success Rates when Aligned Outside

Table: Relationship Between True Fppg and Success Vs Man At Various Alignment Percentages

Success Rate Vs Man at:	dy/dx	std. err.	z	P>z	[95% co	interval]
Outside= 60%	0.0142	0.0040	3.52	0	0.0063	0.02208
Outside= 65%	0.0141	0.0040	3.57	0	0.0064	0.02187
Outside= 70%	0.0141	0.0039	3.56	0	0.0063	0.0218
Outside= 75%	0.0140	0.0040	3.5	0	0.0062	0.02185
Outside= 80%	0.0139	0.0041	3.38	0.001	0.0059	0.02203
Outside= 85%	0.0139	0.0043	3.23	0.001	0.0055	0.02232
Outside= 90%	0.0138	0.0045	3.05	0.002	0.0049	0.02272

Note: dy/dx indicates the average change in true (consistent) fantasy points per game stemming from a one percentage point increase in success rate versus man coverage, while holding alignment constant at selected intervals.

Table: Relationship Between True Fppg and Success Vs Zone At Various Alignment Percentages

Success Rate Vs Zone at:	dy/dx	std. err.	z	P>z	[95% con	interval]
Outside= 60%	0.00912	0.00415	2.2	0.028	0.00099	0.0173
Outside= 65%	0.00873	0.00375	2.33	0.02	0.00138	0.0161
Outside= 70%	0.00833	0.00347	2.4	0.016	0.00152	0.0151
Outside= 75%	0.00793	0.00335	2.37	0.018	0.00138	0.0145
Outside= 80%	0.00754	0.00339	2.23	0.026	0.0009	0.0142
Outside= 85%	0.00714	0.00359	1.99	0.046	0.00011	0.0142
Outside= 90%	0.00674	0.00392	1.72	0.086	-0.0009	0.0144

Note: dy/dx indicates the average change in true (consistent) fantasy points per game stemming from a one percentage point increase in success rate versus zone coverage, while holding alignment constant at selected intervals.

The first table shows the relationship between true points per game and success rate versus man coverage while holding alignment constant (at percentages aligned outside). What is evident from this first table is the consistent nature of the relationship regardless of how often a player lines up outside. A *one percentage point increase* in success rate versus man coverage generates approximately a *1.4 percent* increase in consistent fantasy points per game, on average. Meanwhile, the second table shows the relationship between true points per game and success rate versus zone coverage while holding alignment constant. Here, zone is less important if lining up outside. The importance of zone success seems to decline the more a player lines up outside[2].

[2] A t-test indicates that the values at Man=60% and Man=90% are statistically different

Overall, these two tables indicate that success versus man coverage is consistently more important for a receiver that is lining up outside. It also yields further context for the quantitative relationship for the relationship between points per game and success rate versus man coverage. While success versus zone is relatively less important for outside receivers, the magnitudes of the coefficients still indicate it is not to be disregarded. In fact, if the shift to zone coverage by defenses proves to be commonplace in the future, a fantasy manager would be smart to pay attention to success versus zone. The two tables that follow apply these same techniques, but to slot alignment.

4.2.2 Effects of Increases in Success Rates when Aligned in the Slot

Table: Relationship Between True Fppg and Success Vs Man At Various Alignment Percentages

Success Rate Vs Man at:	dy/dx	std. err.	z	P>z	[95% co:	interval]
Slot= 60%	0.0143	0.0051	2.8	0.005	0.0043	0.02432
Slot= 65%	0.0144	0.0055	2.62	0.009	0.0036	0.02508
Slot= 70%	0.0144	0.0059	2.46	0.014	0.0029	0.02589
Slot= 75%	0.0145	0.0063	2.31	0.021	0.0022	0.02675
Slot= 80%	0.0145	0.0067	2.17	0.03	0.0014	0.02764
Slot= 85%	0.0146	0.0071	2.04	0.041	0.0006	0.02857
Slot= 90%	0.0146	0.0076	1.93	0.054	-0.0003	0.02951

Note: dy/dx indicates the average change in true (consistent) fantasy points per game stemming from a one percentage point increase in success rate versus man coverage, while holding alignment constant at selected intervals.

Table: Relationship Between True Fppg and Success Vs Zone At Various Alignment Percentages

Success Rate Vs Zone at:	dy/dx	std. err.	z	P>z	[95% conf.	interval]
Slot= 40%	0.00923	0.00433	2.13	0.033	0.0007403	0.0177216
Slot= 45%	0.00961	0.00487	1.97	0.048	0.0000672	0.0191536
Slot= 50%	0.00999	0.00547	1.83	0.068	-0.0007235	0.0207032
Slot= 55%	0.01037	0.00611	1.7	0.089	-0.0015973	0.0223359
Slot= 60%	0.01075	0.00678	1.59	0.113	-0.0025307	0.0240282
Slot= 65%	0.01113	0.00747	1.49	0.136	-0.0035077	0.025764
Slot= 70%	0.01151	0.00818	1.41	0.159	-0.0045172	0.0275324
Slot= 75%	0.01189	0.00890	1.34	0.182	-0.0055514	0.0293255
Slot= 80%	0.01227	0.00963	1.27	0.203	-0.0066048	0.0311

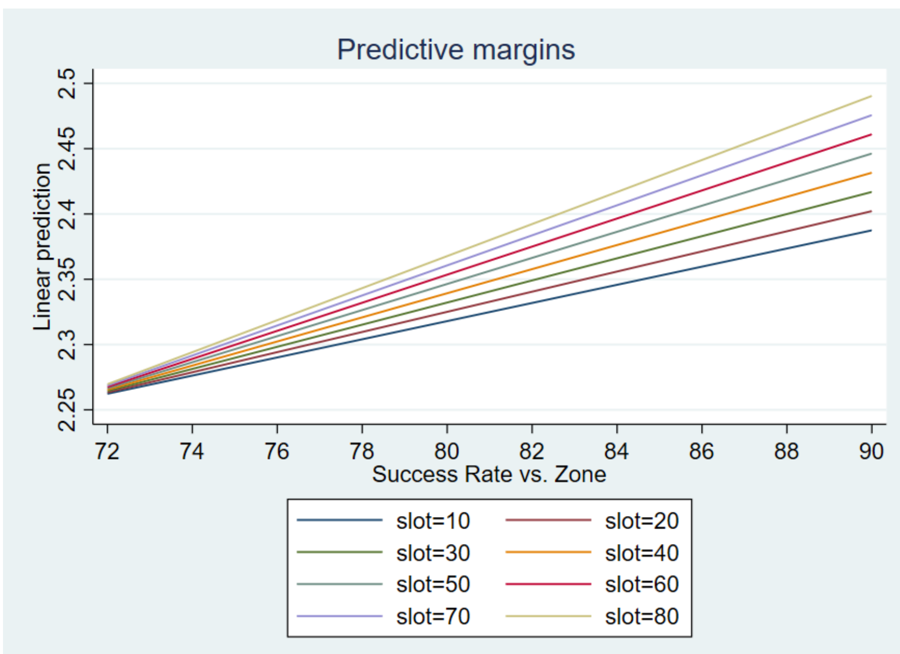
Note: dy/dx indicates the average change in true (consistent) fantasy points per game stemming from a one percentage point increase in success rate versus zone coverage, while holding alignment constant at selected intervals.

The first slot alignment table shows the relationship between true points per game and success rate versus man coverage. It is remarkable how consistently important success rate versus man coverage is, regardless of where a player

from each other.

lines up. A *one percentage point increase* in success rate versus man coverage generates approximately a *1.42 percent* increase in consistent fantasy points per game, on average. Regardless of what percentage a player spends inside or outside, these results stay consistent and statistically significant.

An equally important result is found in the second slot alignment table. Here, we see that the importance of success rate versus zone *grows* the more a player lines up in the slot. This is important to see, and increasingly puts what we have seen from 2021 into context. The more a player plays in the slot, the higher the effect of a one-percentage point increase in success versus zone on consistent fantasy points per game[3]. We also see a convergence in effects of success versus man and zone. When looking at the full range of alignment from outside = 90% (which implies $slot \approx 10\%$) to slot = 80% shows the coefficient changing from approximately 0.675% to 1.23%, which is a large fluctuation. While these estimates are less precisely estimated due to a lower number of slot receivers compared to outside receivers, the picture we have seen the last few years is more clearly painted. Combining high success rates versus zone with high slot alignments magnifies the effects, as seen in the chart below. Each line reflects the coefficients of the previous tables of zone success, but for the different slot percentages. The x-axis measures strength of zone success, and the y-axis is predicted log of true fppg. Exponentiation gives us a range of 9.5 to 12.25 points per game (just from these aspects).



[3] A slot alignment range of 40% to 80% was chosen to reflect the range of percentages reflected in the data.

These results explain why we can see players Hunter Renfrow, Christian Kirk, Tyler Boyd, ARSB, and Cooper Kupp thrive in this role and be strong fantasy players despite average to below average success rates versus man coverage. While no one quite saw Kupp's phenomenal year coming (at least not to this extent), we now have more context as to why he had a monstrous year, and why we cannot disregard players who are great against zone and see a ton of it. Kupp's 91% success versus zone while seeing zone on 72% of his sampled routes made sure of it. While he did make tremendous progress in success rates versus man and press, these are still average marks relative to historical RP observations.

5 Summary

This analysis explores the relationship between success rates versus different coverages and important outcomes of interest. In general, we find that a one percentage point increase in success rate versus man coverage (ex: from 66% to 67%) is worth approximately 1.5 to 1.75 times (or 50 to 75% more) the value of the same increase in success rate versus zone. This can be used as a great rule of thumb when reading through profiles. Additionally, the difference in yards per game resulting from an increase in success rates is a large driver of the differences. We also find that the relationship between success rate versus man coverage and both fantasy points per game measures is remarkably consistent regardless of where a player lines up. Success rate versus man coverage is confirmed to be the principal and consistent driver of important WR outcomes (other than being on the field).

What is equally important in this study is what we find with regards to success rate versus zone. In contrast to success rate versus man coverage, the importance of success rate versus zone coverage is highly dependent on alignment inside or outside. When looking at the full range, from being a pure outside receiver to being a majority slot player, the coefficient changes drastically (practically doubles in magnitude). Thus, we should not disregard success versus zone. Instead, we should weight it heavier when the player lines up inside more, or gets lined up all over the field in order to exploit coverages. Players like Deebo and Kupp are evidence of this. Success rates matter, but the key to truly understanding a player is understanding these rates in conjunction with alignment.