Cross-League Equivalencies: Using Former MLB Player Data to Evaluate NPB Transfers

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QSS 82 Capstone Project • Quantitative Social Science • Dartmouth College

Research Question

How can NPB performance of former MLB/MiLB players serve as a benchmark to assess fair market value of Japanese pitchers transferring to MLB?

- MLB interest in elite NPB talent is at an all-time high, driven by the recent influx of premier pitchers like Yoshinobu Yamamoto, Rōki Sasaki, and Tatsuya Imai.
- Traditional attempts to value these transfers rely on historical NPB-to-MLB transitions. However, with only ~30 postings in history (½ are pitchers), the sample size is limited.
- This study flips the analytical direction. By evaluating the reverse transition (how former MLB/MiLB players perform when moving to the NPB), we look to utilize a more robust dataset to project fair market value of NPB players.

Data

Dataset:

- Chadwick Bureau Player Register: detect players who played in both MLB/MiLB & NPB
- Baseball Reference: 7,097 MLB pitcher-seasons (2011–2024), 4,921 NPB pitcher-seasons (1997–2026), 41 MLB league aggregates, and 60 NPB league aggregates
- Spotrac: player contracts; 1,443 signings → 279 starting pitchers used for after filters
- Bureau of Labor Statistics: CPI to adjust salary amount to 2024

Dependent variable	log(AAV in 2024 dollars)
Primary IV	xFIP− (league-normalized)
Cross-league translator	Conversion factor = 1.096 [1.067, 1.126]
Controls	Age at signing, log(contract years), qualifying offer indicator, reliever dummy
Adjustments	CPI-U deflator, per-league-year FIP constants

Methodology

Step 1 (Identify Crossover Players): Cross-reference to find 730 pitchers with experience in both NPB and the US baseball system. Apply MiLB-to-MLB translation factors to scale minor-league seasons to MLB-equivalent counting stats.

Step 2 (Estimate MLB-NPB conversion factor): For each crossover pitcher (193 players), compute IP-weighted xFIP- separately over their NPB window and USA window (3 seasons per side, ≥ 50 IP each). Compute the ratio between their IP-weighted xFIP-.

Step 3 (Salary regression on MLB free agents): Fit OLS on log(Average Annual Value) for 279 SP free-agent signings (2014–2024):

$$\log(AAV_{2024}) = \beta_0 + \beta_1 \times xFIP- + \beta_2 \times age + \beta_3 \times \log(years) + \beta_4 \times QO + \varepsilon$$

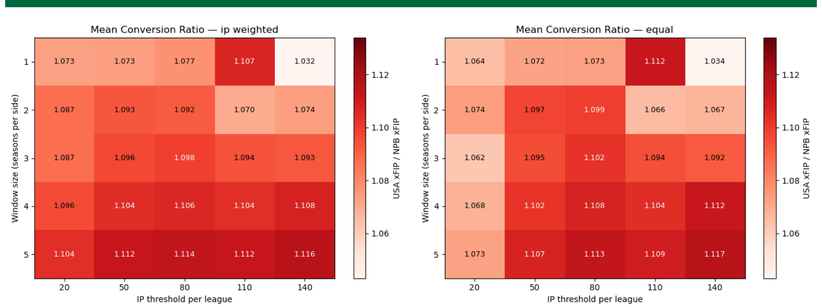
Variables:

- $xFIP-$: defense-independent pitching metric, normalized to league-year average
- age : pitcher's age
- $\log(years)$: natural log of contract length in years
- QO : qualifying offer indicator (binary)

Primary Findings

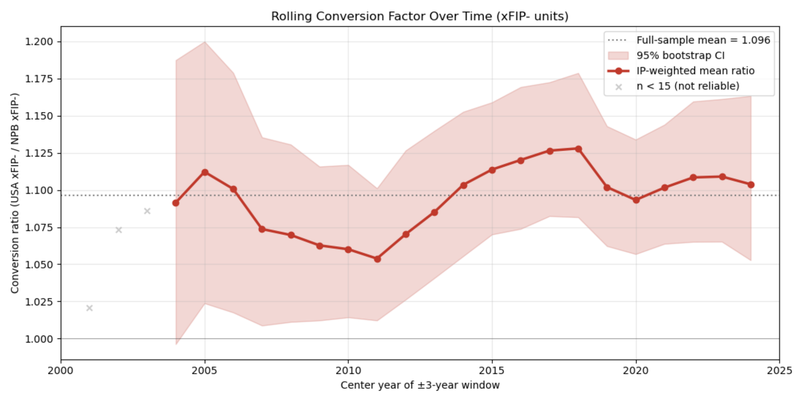
- Most of the apparent NPB-MLB performance gap is run environment, not skill. Raw xFIP suggests NPB pitchers are 31% better; once league context is controlled for, only ~10% (factor: 1.096, 95% CI [1.067, 1.126]).
- MLB free-agent pay is structured and predictable from four covariates (xFIP-, age, log contract length, QO): $R^2 = 0.53$, β(xFIP-) robust across four model specifications.
- Yoshinobu Yamamoto predicted within 1% of actual AAV ($27.4M vs $27.1M) after constraining contract length to the training-data 95th percentile to avoid extrapolation.
- Cross-league translation operates at the population level, not the individual level. NPB xFIP- alone explains only 3% of the variance in same-pitcher USA xFIP-.

Results Part 1: NPB-MLB Translation



Finding: MLB-NPB Conversion factor: 1.096 [1.067, 1.126] at 95% confidence interval

→ Implication: When the same pitcher pitches in both leagues, his xFIP- in the US is on average 9.6% worse than his xFIP- in NPB.

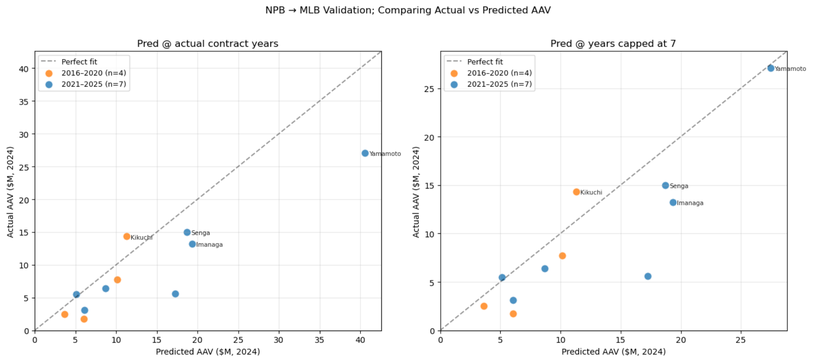


Results Part 2: Salary Prediction

Table 1: OLS Regression of log(AAV) on Pitcher Characteristics

Specification	n	β(xFIP-)	β(age)	β(log years)	β(QO)	R^2
Primary (all SP)	279	-0.025^{***}	$+0.041^{**}$	$+0.725^{***}$	$+0.613^{***}$	0.528
Robustness A (multi-yr SP)	103	-0.010^{*}	$+0.049^{***}$	$+0.651^{***}$	$+0.332^{***}$	0.586
Robustness B (SP + RP)	700	-0.014^{***}	$+0.029^{**}$	$+0.947^{***}$	$+0.573^{***}$	0.516
Robustness C (no QO)	279	-0.029^{***}	$+0.038^{**}$	$+0.852^{***}$	—	0.491

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. *Robustness B also includes* β(reliever) = -0.579^{***}.



Discussion

Interpretation:

- Once league run environment is controlled for, NPB pitchers' xFIP- is only ~10% better than the equivalent MLB level.
- Despite the wide variance in MLB FA contracts, four covariates (xFIP-, age, log contract length, QO) explain ~53% (~59% for multi-year SP contract) of the variance in log(AAV).

Limitations:

- NPB xFIP- alone explains only 3% of the variance in USA xFIP-. The conversion factor accurately translates populations of pitchers, not individuals.
- Only three SP free agents in training signed for ≥9 years (Cole, Ohtani, Yamamoto). The model's β(log_years) is calibrated to the typical 1–7 year range.
- Free agents are systematically older than typical pitchers. The regression captures pricing at MLB free agency, not market value at arbitrary career stages.

References

1. Bradbury, John Charles. 2007. "Does the Baseball Labor Market Properly Value Pitchers?" *Journal of Sports Economics* 8 (6): 616–32. https://doi.org/10.1177/1527002506296366

2. Krautmann, Anthony C., Elizabeth Gustafson, and Lawrence Hadley. 2003. "A Note on the Structural Stability of Salary Equations: Major League Baseball Pitchers." *Journal of Sports Economics* 4 (1): 56–63. https://doi.org/10.1177/1527002502239658