STRUCTURAL CHANGE IN MLB COMPETITIVE BALANCE: THE DEPRESSION, TEAM LOCATION, AND INTEGRATION

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No detectable break points in within-season competitive balance (1901–99) occur after 1937 in the National League or after 1962 in the American League, despite expansion, free agency, and the growth of local TV revenue disparity since then. Instead, a continual improvement in competitive balance has occurred since those years. Associated with break points prior to these years, (1) the AL emerged from the depression much more unbalanced than the NL, (2) team movement and league expansion alter balance in well-known ways, and (3) discriminatory preferences were stronger in larger-revenue markets than in smaller-revenue markets in both leagues. (*JEL* C32, L83)

I. INTRODUCTION

Competitive balance is the object of significant attention in the analysis of pro sports leagues. Recent examples include Depken (1999), Eckard (2001), and Humphreys (2002). Under the uncertainty of outcome hypothesis, imbalance of a sufficient level may actually drive the demand for pro sports down and league revenues with it. We join Scully (1995) in adding to the time-series analysis of sports league outcomes. In our particular case, the object of analysis is within-season competitive balance in Major League Baseball (MLB) 1901–99.

In MLB, a number of structural changes have been hypothesized to dramatically alter competitive balance among teams over time—the draft (1965), the end of the reserve clause (1975), and the fundamental alteration in local revenue brought on by increases in the value of local TV broadcast rights (early 1980s). In addition, it is commonly thought that expansion should water down talent and reduce competitive balance while relocation of smaller-revenue market clubs should enhance balance as teams move to improve revenues. The impact of racial integration on competitive balance remains a relatively less-explored area.

In past works, short-term "cross-section type" approaches have been used to address structural change in competitive balance. Originally, Noll (1988), Scully (1989), Quirk and Fort (1992), and Fort and Quirk (1995) compared average measures of competitive balance for a specific number of years before and after the draft, free agency, and salary caps occurred. Fort and Maxcy (2003) provide a complete literature review of the work that followed. La Croix and Kawaura (1999) add ad hoc structural change dummy variables to competitive balance regressions. Adding to the insights gained by these approaches is one that relies on statistically detecting changes in competitive balance. Our work doesn't replace these others, but we hope it adds to their findings.

To that aim, we apply break point detection techniques developed by Andrews (1993), Bai

ABBREVIATIONS

AABL: African American Baseball League
ADF: Augmented Dickey-Fuller
AL: American League
BP: Bai and Perron
LTL: Log Tail Likelihood
MLB: Major League Baseball
NL: National League
PP: Phillips-Perron
RSD: Ratio of Standard Deviation
TL: Tail Likelihood

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(1997, 1999), and Bai and Perron (1998, 2003) to within-season MLB competitive balance measures, 1901–99. That technique uses regression with a constant and a time trend. If break points are detected, their technique then adds a dummy variable for the year of the break point to the regression to estimate the significance and direction of structural changes.

The method employed detects no break points for the National League (NL) after 1937, and the same goes for the American League (AL) after 1962. Thus the draft, free agency, recent MLB expansion, and the growth in local TV revenue disparity do not coincide with shifts in competitive balance. Instead, we find statistically significant trends in improved competitive balance in each league over these time periods. This leads us to conclude that more gradual occurrences over time (more, and more geographically dispersed, population centers; diffusion of games through TV; and globalization of the talent pool) have played the dominant role in the behavior of competitive balance. But we hasten to point out the following for very recent occurrences. The technique employed cannot tell us whether this improvement trend is because of or in spite of MLB efforts intended to enhance balance, such as the increase in local revenue sharing in the collective bargaining agreements effective in 1996 and 2001.

In the periods where structural changes are detected, break points usually coincide in believable ways with the economics of larger-revenue markets during the Great Depression in both leagues. But the AL emerged from the Depression much more unbalanced than the NL. Team movement and league expansion also have expected impacts on competitive balance. We also find that discriminatory preferences were stronger in larger-revenue markets than in smaller-revenue markets in both leagues.

The article proceeds as follows. First, we specify the time-series approach. Second, the results are shown and discussed within the context of the limits of the break point technique. Conclusions round out the study.

II. EMPIRICAL APPROACH

Andrews (1993) focuses on a single structural change, whereas Bai and Perron (1998, henceforth BP) consider issues related to multiple structural changes with unknown break points. They consider the properties of break point estimators and the construction of tests that allow inferences about the occurrence of structural change and the number of breaks.

BP consider the following multiple linear regression with m breaks ($m+1$ regimes):

$$(1) \quad y_t = x_t'\alpha + z_t'\beta_j + u_t, \quad t = T_{j-1}+1, \ldots, T_j, j = 1, \ldots, m+1.$$

The dependent variable at time t is y_t. $x_t(p \times 1)$ and $z_t(q \times 1)$ are vectors of covariates and α and β_j are the corresponding vectors of coefficients. The disturbance at time t is u_t. The indices $(T_1, \ldots, T_m)$ are treated as the unknown break points. This is a partial structural change model because the parameter vector α is not subject to change. When $p=0$, this model is a pure structural change model where all the coefficients are subject to change. For our baseball investigation, if a break point is 1926, then the first regime is 1901–26 and the second regime is 1927–99.

BP also address the important problem of testing for multiple structural changes. They cover four tests. The first is a "sup Wald" type test of no structural break ($m=0$) versus a fixed number of breaks. We denote this "Sup $F_T(k)$" for no break versus k breaks. Their second and third tests are double maximum tests, referred to as UD_{max} and WD_{max}. These tests are for the null hypothesis of no structural break against an unknown number of breaks given some upper bound M. The last test compares the null hypothesis of, say, l breaks, versus the alternative hypothesis of $l+1$ breaks. We denote this "Sup $F_T(l+1/l)$" for l breaks versus $l+1$ breaks. The first three tests are designed to detect structural change. The last test is particularly useful in that it allows a specific to general modeling strategy to consistently determine the appropriate number of changes in the data.

Although BP consider the asymptotic theory of break point tests only for the case without a trend regressor, the consistency and rate of convergence for estimated break points applies to the case where a trend regressor is included. Furthermore, Bai (1999) considers the performance of the Sup $F_T(l+1/l)$ tests by conducting Monte Carlo experiments and finds this test procedure satisfactory. Hence, one can safely use the same critical values when a trend regressor is included in the break point analysis.

Most recently, Bai and Perron (2003) address a comprehensive treatment of practical issues arising in the analysis of models with multiple structural changes. Overall, they favor the sequential technique over both the Bayesian information criterion suggested by Yao (1988) and a modified Schwarz criterion suggested by Liu et al. (1997). The sequential technique is based on the sequential application of the Sup $F_T(l + 1/l)$ test using the sequential estimates of the breaks. Bai and Perron also present an efficient algorithm to obtain global minima of the sum of squared residuals and provide a GAUSS program for nonprofit academic purposes. We use that program and follow Bai and Perron (1998, 2003) to detect break points in the MLB competitive balance data. The program identifies break points using a constant and a trend variable, and then adds a dummy variable for significant break point years to facilitate tests of the significance and direction of the break point.

We use two measures of within-season competitive balance. The first is the ratio of actual to idealized standard deviation (RSD) popularized by Noll (1988) and Scully (1989). The denominator of RSD is the standard deviation of a theoretically equally balanced league (derived by imposing that the probability any team beats any other team equals 0.5). A completely balanced league would have RSD = 1 and the greater the ratio, the greater competitive imbalance. We note that our early winning percent data were calculated taking into account that ties were once allowed in MLB (half a win in the numerator of winning percent). Our second measure is related to the excess tail percentages of the distribution of winning percents. Fort and Quirk (1995) used a version of this approach, but the actual measurement used here first appeared in Lee (2004). It represents the likelihood that winning percents of the top and bottom 20% of teams occur in the idealized normal distribution. We refer to this as the tail likelihood (TL), and take its logarithm (LTL). We use LTL instead of just TL because a small change in the tail area under the normal distribution can cause a large change in probability density especially in the range of critical values typically used for tests of significance. Competitive balance is inversely related to RSD and positively related to LTL. Although we use some evidence from championship outcomes in our discussion, we limit our analysis to within-season balance only because this article is long enough as it is. We are certain that a break point analysis of championship balance would be just as interesting.

III. EMPIRICAL RESULTS AND DISCUSSION

If either the RSD or LTL series were nonstationary, the results of break point analysis assuming stationary series would be misleading. We report the results of both augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests in Table 1. The number of lags is determined by minimization of the Schwartz-Bayesian criterion for the ADF test and by the truncation suggested by Newey and West (1994) for the PP test. The unit root hypothesis is rejected for both RSD and LTL at the 1% significance level by the PP test. The ADF test also suggests that the two competitive balance measures are stationary. We proceed taking the series to be stationary.

Detrending is a common time-series approach, and our first assessment concerns the use of a trend regressor. There is ample

TABLE 1
Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Unit Root Tests

		NL		AL	
		RSD	LTL	RSD	LTL
ADF (p)	Constant	−4.537 (2)*	−2.538 (2)	−3.256 (2)**	−2.654 (2)***
	Trend	−3.094 (2)**	−3.910 (2)**	−5.235 (2)*	−4.467 (2)*
P-P (l)	Constant	−4.910 (3)*	−4.281 (3)*	−5.182 (3)*	−5.298 (3)*
	Trend	−6.757 (3)*	−6.389 (3)*	−6.997 (3)*	−7.445 (3)*

p: the number of lags; l: lag truncation.
*Significant at the 99% critical level.
**Significant at the 95% critical level.
***Significant at the 90% critical level.

TABLE 2
Bai and Perron Empirical Results: NL with Only a Constant as Regressor

Specifications							
	$z_t = \{1\}$	$q = 1$	$p = 0$	$h = 10$	$M = 5$		
Tests							
	Sup $F_T(1)$	**Sup $F_T(2)$**	**Sup $F_T(3)$**	**Sup $F_T(4)$**	**Sup $F_T(5)$**	**UD_{max}**	**WD_{max}**
RSD	48.53*	54.23*	32.42*	30.73*	26.67*	54.23*	69.52*
LTL	44.31*	56.00*	33.34*	30.77*	25.23*	56.00*	71.79*
	Sup $F(2/1)$	**Sup $F(3/2)$**	**Sup $F(4/3)$**	**Sup $F(5/4)$**			
RSD	27.97*	2.81	3.99				
LTL	51.66*	4.43	9.60	3.31			
Number of breaks selected, sequential method[a]							
RSD	2						
LTL	2						
Estimates[b]							
	β_1	**β_2**	**β_3**		**T_1**	**T_2**	**$\bar{R}^2(R^2)$**
RSD	3.132*	2.297*	1.746*		12	65	0.466
	(24.00)	(36.98)	(22.19)		[8, 14]	[61, 72]	(0.477)
LTL	−6.061*	−3.185*	−1.367*		12	63	0.543
	(−15.84)	(−17.16)	(−6.10)		[9, 16]	[60, 69]	(0.553)

h: a minimum size of each regime; M: upper bound.
[a]We use a 5% size for the sequential test Sup $F_T(l+1/l)$.
[b]t-values are in parentheses; 90% confidence intervals for T_i are in brackets.
*Significant at the 99% critical level.
**Significant at the 95% critical level.
***Significant at the 90% critical level.

reason to suspect a trend that enhances balance over nearly 100 years. One reason would be the appearance of more, and more geographically dispersed, population centers. As population and willingness to pay became more equally distributed among the major cities hosting teams, competitive balance would increase. Another explanation would be the diffusion of games on TV. Most of the country does not have a home MLB team. But TV would allow many to support teams (financially through ad revenues) that aren't really even that close to them. Finally, over time, the game has become more racially and ethnically diverse. Our analysis here will cover the more tumultuous absorption of the best Negro League talent in the late 1940s through early 1950s. But there also is the internationalization to the Caribbean and, since the mid-1970s, the Pacific Rim. Schmidt and Berri (2003) suggest that the globalization of the talent search would have general impacts on competitive balance.

We approach the trend issue as follows. First, we apply the BP procedure with only a constant as regressor ($z_t = \{1\}$ and $p = 0$) to both RSD and LTL. We allow up to five breaks and use a trimming $\varepsilon = 0.10$, hence each segment has at least 10 observations ($h = 10$). The results are presented in Tables 2 (NL) and 3 (AL). Second, we use a partial structural change model with $z_t = \{1\}$ and $x_t =$ time trend. The results are in Tables 4 (NL) and 5 (AL). Both point estimates and confidence intervals are presented in the tables.

Comparing Table 2 to Table 4 (for the NL) and Table 3 to Table 5 (for the AL), the trend variables are statistically significant at either 99% or 95% critical levels in three of four cases (the exception is RSD in the AL). Even

TABLE 3
Bai and Perron Empirical Results: AL with Only a Constant as Regressor

Specifications							
	$z_t = \{1\}$	$q = 1$	$p = 0$	$h = 10$	$m = 5$		
Tests							
	Sup $F_T(1)$	**Sup $F_T(2)$**	**Sup $F_T(3)$**	**Sup $F_T(4)$**	**Sup $F_T(5)$**	**UD_{max}**	**WD_{max}**
RSD	76.23*	60.79*	47.39*	37.86*	21.33*	76.23*	77.93*
LTL	88.85*	93.32*	70.65*	53.74*	47.95*	93.32*	119.65*
	Sup $F(2/1)$	**Sup $F(3/2)$**	**Sup $F(4/3)$**	**Sup $F(5/4)$**			
RSD	8.68***	4.15	2.70				
LTL	19.52*	5.01	2.47	4.29			
Number of breaks selected, sequential method							
RSD	1						
LTL	2						
Estimates							
	β_1	**β_2**	**β_3**		**T_1**	**T_2**	**$\bar{R}^2(R^2)$**
RSD	2.569*	1.821*			57		0.410
	(43.93)	(26.40)			[54, 61]		(0.416)
LTL	−4.019*	−2.033*	−0.929*		57	80	0.475
	(−22.87)	(−7.35)	(−2.97)		[54, 63]	[78, 89]	(0.486)

Notes: See Table 2.

though the contribution is slight, it is significant—in the NL, adding the trend increases R^2 by 2% for both RSD and LTL. In the AL, adding the trend variable increases R^2 by 2% for LTL. But the difference in interpretation of the results is important. For example, ignoring the statistical significance of trend variables, one would be led to the belief that a break point occurred around 1965 in the NL (from Table 2, both RSD and LTL include the interval 1961–69). This coincides with the adoption of the MLB draft in 1965. But the significant trend variable eliminates that story. In the AL, ignoring trend variables would indicate an additional break point in 1980, with the confidence interval spanning 1978–89. This would coincide with growing local revenue inequality that started in the late 1970s through the mid-1980s, documented by Quirk and Fort (1992). But the statistically significant trend variable eliminates that story as well.

Next, we move on to inferences about the number of break points using the sequential technique favored by BP. Turning first to the NL in Table 4, the sup $F_T(k)$ tests are all significant for k between 1 and 5. Therefore, there is at least one break. The sequential procedure selects two breaks because the sup $F_T(2/1)$ tests are significant for both RSD and LTL, but the sup $F_T(3/2)$ tests are not. The trend variables are consistent with a general improvement in balance over time for both measurements ($\alpha_1 < 0$ for RSD and $\alpha_1 > 0$ for LTL). In addition, using all of the information from our two balance measurements, break points occur at 1912, 1926, and 1933 for the NL. Comparing the β_2 and β_3 coefficients as shift parameters relative to the constant term, β_1, the technique finds an improvement in 1912 ($\beta_2 < \beta_1$ for RSD and $\beta_2 > \beta_1$ for LTL) and declines in balance in both 1926 ($\beta_3 > \beta_2$ for RSD) and 1933 ($\beta_3 < \beta_2$ for LTL).

Turning to the AL in Table 5, the sup $F_T(k)$ tests indicate that at least one break is present, and the sequential procedure selects only one break because of the insignificance of the sup $F_T(2/1)$ tests for both of RSD and LTL. The

TABLE 4
Bai and Perron Empirical Results: NL with a Constant and Time Trend as Regressors (Partial Structural Change Model)

Specifications							
	$z_t = \{1\}$	$X_t = \{\text{time}\}$	$q = 1$	$p = 1$	$h = 10$	$m = 5$	
Tests							
	Sup $F_T(1)$	**Sup $F_T(2)$**	**Sup $F_T(3)$**	**Sup $F_T(4)$**	**Sup $F_T(5)$**	**UD_{max}**	**WD_{max}**
RSD	11.42**	10.65*	8.82*	6.34**	5.53**	11.42**	12.23**
LTL	11.73*	14.50*	11.13*	7.72*	6.77*	14.50*	18.59*
	Sup $F(2/1)$	**Sup$F(3/2)$**	**Sup $F(4/3)$**	**Sup $F(5/4)$**			
RSD	9.58**	3.20	2.31	5.09			
LTL	17.75*	5.09	4.96	1.97			
Number of breaks selected, sequential method							
RSD	2						
LTL	2						
Estimates							
	β_1	β_2	β_3	α_1	T_1	T_2	$\bar{R}^2(R^2)$
RSD	3.196*	2.394*	2.994*	−0.015*	12	26	0.480
	25.58	17.93	18.07	−5.85	[9, 16]	[21, 31]	(0.496)
LTL	−6.414*	−4.061*	−5.919*	0.054*	12	33	0.554
	−16.78	−11.73	−10.14	6.41	[9, 18]	[28, 37]	(0.568)

Notes: See Table 2.

trend variable is significant for LTL but not for RSD. As with the NL, the trend is a general improvement in balance. Using the information from both RSD and LTL, break points occur at 1926 and 1957 for the AL. The 1926 break point is associated with a decline in balance ($\beta_2 < \beta_1$ for LTL) and the 1957 break point an improvement in balance ($\beta_2 < \beta_1$ for RSD).

In what follows, we take advantage of the information in the confidence intervals to frame our discussion about break points in competitive balance and historical occurrences in MLB. We will refer to the Giants period (the New York team won four NL pennants and finished second twice), 1909–18, where competitive balance improved in the NL but no change is detected for the AL. The Early Depression period covers the intersection of three confidence intervals, 1926 and 1933 for the NL and 1926 for the AL. The intersection defining the Early Depression period, 1928–31, is associated with a decline in balance in both leagues. Finally, the Yankee period (they won seven AL pennants and finished second and third the other two years), 1954–62, is associated with improved competitive balance in the AL, but no change is detected for the NL.

While thinking through the history of MLB, what can be made of these break points? First, these break points cannot be reasonably associated with the draft (1965), free agency (1975), league expansion after 1962, or growing local revenue dispersion (early 1980s). That the draft and free agency have no associated break point is consistent with Rottenberg's (1956) invariance principle. Furthermore, following the detailed list in Scully (1989, p. 64), we can think of no rule changes that seem consistent with either the timing or direction of the break points in either league. We move on to consider the identified break points, seriatim.

The only thing that occurs to us for the Giants period (1909–18) is World War I, starting in 1914. There could have been an

TABLE 5
Bai and Perron Empirical Results: AL with a Constant and Time Trend as Regressors (Partial Structural Change Model)

Specifications							
	$z_t = \{1\}$	$X_t = \{\text{time}\}$	$q = 1$	$p = 1$	$h = 10$	$m = 5$	
Tests							
	Sup $F_T(1)$	**Sup $F_T(2)$**	**Sup $F_T(3)$**	**Sup $F_T(4)$**	**Sup $F_T(5)$**	**$\text{UD}_{\max}$**	**$\text{WD}_{\max}$**
RSD	14.18*	8.56**	10.57*	9.15*	7.62*	14.18*	16.32*
LTL	15.21*	15.39*	11.43*	9.61*	9.05*	15.38*	19.73*
	Sup F(2/1)	**Sup F(3/2)**	**Sup F(4/3)**	**Sup F(5/4)**			
RSD	4.92	4.92	4.03	6.25			
LTL	4.03	4.14	4.14	6.00			
Number of breaks selected, sequential method							
RSD	1						
LTL	1						
Estimates							
	β_1	β_2		α_1	T_1		$\bar{R}^2(R^2)$
RSD	2.615*	1.943*		−0.002	57		0.406
	24.65	7.85		−0.52	[54, 62]		(0.418)
LTL	−4.603*	−6.594*		0.062*	26		0.442
	−16.04	−13.18		8.22	[21, 31]		(0.505)

Notes: See Table 2.

asymmetric talent diminution across the teams in the NL as players went to serve, but we can only offer this as a possibility because data on player service is spotty. The Society of American Baseball Researchers offers a file (available online at www.sabr.org/sabr.cfm?a=cms,c,523,5,176) listing military service by ballplayers. According to the file, 152 players served in World War I, including 24 eventual Hall of Fame inductees. But without knowing the duration of military service, asymmetric talent distribution remains our speculation, especially because we detect no break point for World War II, when a much larger number (and percentage) of players served.

Moving on, the economics of larger-revenue market teams offers an explanation of the negative impact on competitive balance coincident with the Early Depression period (1928–31). Quirk and Fort (1992, pp. 8–9) show that attendance barely rose during this historic period, consistent with the general reduction in wages and disposable income in the U.S. economy. An analysis of revenue imbalance over this period adds more to the story. For the AL, Table 6 shows (1) revenues fell, on average, from the crash through the 1930s, rebounding into the late 1930s; and (2) revenue Gini coefficients *rose continually* over the same time period. So disposable incomes declined, attendance was at best flat, revenues fell, and revenue disparity increased.

Championship results, summarized in Table 7, emphasize this result. Few teams won championships, and the concentration of championships on the two teams winning the most increased dramatically. That competitive balance also declined suggests that Depression-era effects struck the smaller-revenue AL teams hardest. During the Early Depression period, it appears the Yankees were relatively more depression-proof, and the minimal gate revenue sharing at the time left smaller-revenue AL teams behind.

A similar story, although not quite as stark, holds for the NL. First, in Table 6, revenues

TABLE 6
Revenue Gini Coefficients, MLB, Various Years (All Figures in $Millions, Adjusted to 1982–84 Dollars)

	AL		NL	
Year	**Revenue Ave.**	**Gini**	**Revenue Ave.**	**Gini**
1929	$4.3	0.216	$4.6	0.273
1933	$2.5	0.223	$3.0	0.213
1939	$5.0	0.256	$5.9	0.235
1943	$3.6	0.150	$4.1	0.152
1946	$9.1	0.242	$8.8	0.156
1950s average	—	0.215	—	0.159

Source: Authors' calculations from revenue data reported in Celler Committee Hearings (1951).

TABLE 7
Championships before, during, and after Depression Period and Yankee Period

AL			NL		
Period	**#Teams**	**%Top 2**	**Period**	**#Teams**	**%Top 2**
Depression					
1910–20	4	73	1904–20	7	69
1921–31	3	82	1921–37	4	71
1932–42	3	91	1938–54	7	53
Yankee					
1945–54	4	78			
1954–62	3	89			
1963–71	5	67			

TABLE 8
Team Movement and Expansion in MLB to 1969

Team	Moves
Athletics	Philadelphia–Kansas City (1954)–Oakland (1967)
Braves	Boston–Milwaukee (1952)–Atlanta (1965)
Brewers	*Seattle (Pilots)–Milwaukee (1970)
Dodgers	Brooklyn–Los Angeles (1957)
Giants	New York–San Francisco (1957)
Orioles	Milwaukee–St. Louis (1901)–Baltimore (1953)
Rangers	*Washington Senators II–Texas (1971)
Twins	Washington–Minnesota (1960)
Yankees	Baltimore–New York (1902)

*LA Angels and Washington Senators II, AL expansion teams in 1961. NY Mets and Houston Colt .45s, NL expansion teams in 1962. SD Padres and Montreal Expos, NL, and Seattle Pilots and KC Royals, AL, expansion teams in 1969.

fell on average from the crash through the 1930s, rebounding into the late 1930s just as with the AL. But revenue Gini coefficients *fell* in the early 1930s, rising again at the end of that fabled decade, rather than rising throughout as in the AL. Despite starting with a higher level of revenue imbalance than the AL, the Depression proved more of an equalizer among NL owners, who emerged from the depression with less revenue imbalance than in the AL. Turning to Table 7, championship outcomes in the NL, though quite concentrated, were less so than in the AL. Essentially, during the breakpoint interval two larger-market teams dominated. Before and after, although there still was larger-market dominance, more teams were involved.

That leaves the nine-year Yankees period (1954–62). Three factors potentially loom large during this period—racial integration (begun in 1947 but not complete until the early 1950s), team relocation, and expansion. Whether integration should enhance or harm competitive balance depends on the ultimate distribution of former African American Baseball League (AABL) talent in MLB. If former AABL talent went to its highest valued use in the league, competitive balance should remain unchanged. Competing with white players, the best incoming black players would move to larger-revenue markets and black players of lesser talent would go to lower-revenue market teams. But a mitigating factor would be the distribution of fan, team, and/or owner race preferences among MLB cities at the time. If discrimination were stronger in larger-revenue markets than in smaller-revenue markets, competitive balance could be enhanced, especially because former AABL talent more often than not was obtained on the cheap by breaking AABL contracts as documented by Fort and Maxcy (2001). If discrimination were stronger in smaller-revenue markets than in larger-revenue markets, competitive balance could be harmed by integration.

Team relocation and expansion is detailed in Table 8. Expansion is generally thought to reduce competitive balance with the entry of weak franchises. But the impact of team relocation on competitive balance depends on the pre- and postmove economic welfare of individual teams. Clearly an owner would never move a team to become economically worse off. So weak teams should move to become economically stronger and more competitive on the field. But if truly weak teams are turned into above-average teams on the field, it isn't clear that competitive balance improved. If strong teams move to become even stronger, it is difficult to see how this could improve competitive balance.

Now the technique employed shows that the net effect of integration, relocation, and expansion was different in the two leagues, namely, a balance-improving break point for the AL but no break point at all for the NL. Piecing together the relative effects of the specific relocation and expansion activity in Table 8 leads to inferences about the distribution of discriminatory preferences in AL and NL cities.

In the NL, team moves were Boston to Milwaukee (1952), Brooklyn to Los Angeles (1957), and New York to San Francisco (1957). Table 9 compares average attendance in the five years prior to and the five years after team relocation as well as to the league average. Average win percentages over the same periods are also shown. Although the Dodgers had been above average in attendance prior to the move, both the Braves and Dodgers were attendance powerhouses after their moves. The Giants' move transformed them from a below- to above-average draw. Although the Braves and Giants also were transformed on the field, the Dodgers actually fell off, although they remained well above average on the field. Taken separately from integration and relocation, these NL team moves should have worsened balance because the Braves, already an above-average team in Boston, became much stronger in Milwaukee, and the Giants, a barely below-average team in New York, became a well-above-average team in San Francisco. Of course, the Dodgers were a top team before the move and remained well above average on the field in Los Angeles.

NL expansions teams began play in New York (the Mets) and Houston (the Colt .45s) in 1962. Both teams were above the league average in attendance during their first five years (Table 9), but their performances were well below average. This tends to support the usual decrease in competitive balance typically expected with expansion.

Taking into account only relocation and expansion, the foregoing suggests that competitive balance would have weakened in the NL. The expansion teams were weak, but the moves produced two truly fabulous improvements and kept the Dodgers strong. Because there was no break point detected by our method for the NL, the distribution of discriminatory preferences in the NL must have offset enough to leave only the detected trend in improvement in competitive balance. This could only be true if discriminatory preferences were relatively more concentrated in larger-revenue markets than in smaller-revenue NL markets.

Turning to the AL, teams moves were St. Louis to Baltimore (1953), Philadelphia to Kansas City (1954), and Washington to

TABLE 9
Relocation and Expansion, Team Attendance, and Win Percentages

	Attendance (Win %)		
Team	**5 Yrs. Before**	**5 Yrs. After**	**%Change**
NL moves			
Braves	850,076	2,045,071	141
	(0.507)	(0.588)	(16)
NL Ave.	1,028,981	1,014,421	−1
Dodgers	1,091,872	2,145,984	97
	(0.614)	(0.551)	(−10)
Giants	814,760	1,494,677	83
	(0.497)	(0.547)	(10)
NL Ave.	1,014,421	1,223,838	21
NL expansion			
Mets		1,487,263	
		(0.322)	
Colt .45s		1,278,649	
		(0.412)	
NL Ave.		1,271,98	
AL moves			
Orioles	325,578	934,744	187
	(0.365)	(0.431)	(18)
AL Ave.	1,100,341	1,006,282	−9
Athletics	413,831	1,039,610	151
	(0.404)	(0.405)	(0)
AL Ave.	1,030,134	1,036,959	1
Twins	544,558	1,353,453	149
	(0.404)	(0.537)	(33)
AL Ave.	1,044,048	949,277	−9
AL expansion			
Angels		779,151	
		(0.474)	
Senators		623,586	
		(0.383)	
AL Ave.		949,277	

Minnesota (1960). Both of the earlier moves were into previous AABL strongholds, broadening fan bases with integration. Though only the move of the Twins generated attendance above the league average, all three teams drew quite well in their new locations relative to the old (Table 9). Very weak teams became average or better at the gate. However, only the Twins truly became above-average competitors on the field. With the Athletics pretty much the same after their move, and the Twins growing to be just about as much above average as they were below averageè prior to their move, the Twins' improvement toward the mean should have generated a slight improvement in competitive balance.

The AL expansion in the Yankee period produced stronger teams on the field than the earlier NL expansion but much weaker draws at the gate. The Angels shared Dodger stadium for four years with disastrous attendance results before becoming a much stronger draw after moving to Anaheim in 1966. The Senators languished well below the league average at the gate and left to become the Texas Rangers after the 1971 season. The Angels were close to an average team on the field. On net, with a slight improvement due to relocation, even with a nearly average expansion team in Los Angeles, the net result of relocation and expansion in the AL was probably a wash for competitive balance, at best.

But this isn't the end of the story for relocation and expansion in the AL. Moves by the Braves to Milwaukee (1952), Dodgers to Los Angeles (1957), Giants to San Francisco (1957), and Washington to Minnesota (1960) left the Red Sox, Yankees, and Orioles in sole possession of valuable larger-revenue markets. One would suspect that this would harm AL competitive balance. The Yankees were already enjoying stratospheric win percents (0.643 and 0.641 for the five years before and after the Dodgers and Giants left, respectively), but they went on the historical championship tear that led us to name this the Yankees period in the first place. Boston fell off a bit (0.582 to 0.524) with the move of the Braves, but the Orioles became much stronger with the truly hapless 1961 expansion Senators in their backyard (0.498 to 0.554). Taking into account the relocation of both AL and NL teams and AL expansion, one is left with the strong feeling that competitive balance should have worsened in the AL.

But the break point analysis suggests an *improvement* in competitive balance during the Yankee period rather than a decline. Discriminatory preferences must have been enough stronger in larger-revenue markets than in smaller-revenue markets in the AL to offset the decline suggested by relocation and expansion. Thus, as in the NL, discrimination impediments to integration appear to have been stronger in larger-revenue markets than in smaller-revenue markets in the AL. Why this might have been so would be a fascinating additional inquiry.

The balance-improving within-season break point also is consistent with championship outcomes before and after the Yankee period (back to Table 7). All of this was mainly due to the fact that the Yankees were no longer the same dominant team in the period after the break point interval (the Yankees won six pennants before, seven pennants during, and two pennants after the break point interval).

IV. CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

As a statistical matter, we find that two measures of MLB competitive balance are stationary. Employing break point techniques, we find no detectable structural change in within-season competitive balance after 1937 in the NL and after 1962 in the AL. Instead, we find a statistically significant (albeit small in magnitude) trend improvement in competitive balance since then in each league. Such a trend suggests that factors like the equalization of population centers, game diffusion on TV, and internationalization of the talent pool have been important in the determination of competitive balance.

A general trend improvement without a break point for the draft or free agency is consistent with Rottenberg's (1956) invariance principle. In addition, this trend holds despite team relocation, expansion, and growing local revenue disparity beginning in the early 1980s. Possibly, competitive balance would have improved more without growing revenue dispersion. But at least by the technique employed here, the recent growth in revenue disparity never is associated with a decrease in competitive balance. Finally, detrending these stationary processes proved extremely important in relating MLB history to discovered break points (as it usually has been in other time series analysis, e.g., pre– and post–WW II). Without detrending, some tantalizing but incorrect conclusions would be made concerning the draft in the NL and local revenue explosions in the AL.

We also have something to observe about using LTL in addition to the tried-and-true RSD. Just using RSD, we would have missed the 1926 break point for the AL and 1933 for the NL. Although the former didn't add much to our exploration of MLB, the latter revealed the important similar impact of the Depression years on *both* leagues, not just the NL. This suggests that researchers analyzing the behavior of competitive balance (as well as those analyzing the impact of competitive balance on fan demand) really should try a variety of measures because apparently different amounts of variation can be captured by focusing a bit more on the tails with the LTL measure.

The break points that we do find typically coincide in believable ways with the economic logic of larger-revenue market team dominance and economic depression. However, although break points coincide with the Depression in both leagues, revenue dispersion increased through the Depression in the AL while it lessened during the Depression and rebounded after in the NL. And the AL emerged with a greater level of revenue inequality. We also find believable impacts for relocation and expansion. But those results also suggest that discrimination impediments were concentrated in larger-revenue markets in both the NL and AL. Both of these results, differential impacts during the Great Depression and concentrated discriminatory preferences in larger-revenue markets suggest interesting further study.

Finally, our work begs for one extension. The mechanisms used by MLB to aid competitive balance (the draft, local revenue sharing, and the luxury tax), jointly determined by players and owners through collective bargaining, may have reduced the level of imbalance enough that our technique was unable to detect significant shifts in the recent past. Additional work aimed at discovering whether improved balance occurs in spite of or because of MLB efforts aimed at enhancing competitive balance is clearly suggested.

Turning to competitive balance policy, our analysis leaves us on speculative ground for two reasons. First, ours is an inferential analysis, and structural modeling applications are required to tie any explanations to statistically detected shifts in balance (or reject them in favor of other explanations). Second, our analysis follows only one of the lines of inquiry concerning competitive balance identified by Fort and Maxcy (2003), namely, the line interested strictly in its behavior over time. Another line of investigation estimates the impact of competitive balance, whatever its level, on demand and fan welfare. We inform this other line of inquiry with our findings that competitive balance has improved in the NL since 1937 and in the AL since just prior to 1954 (the break point in 1957, with its confidence interval starting in 1954, is associated with an improvement in balance). But such a finding does not mean current levels of competitive balance pose no problems for fans and, consequently, the leagues that depend on them. If fans find even an improved level of balance to be more detestable over time, then competitive balance will be the focus of leagues and interested policy makers. Our analysis does not address that issue. But it does help dispel arguments for policy intervention based on reductions in within-season competitive balance. Such simply has not been the case in the 50 years since 1954 in the AL or for the nearly 70 years since 1937 in the NL.

REFERENCES

Andrews, D. W. K. "Tests for Parameter Instability and Structural Change with Unknown Change Point." *Econometrica*, 61, 1993, 821–56.

Bai, J. "Estimating Multiple Breaks One at a Time." *Econometric Theory*, 13, 1997, 315–52.

———. "Likelihood Ratio Tests for Multiple Structural Changes." *Journal of Econometrics*, 91, 1999, 299–323.

Bai, J., and P. Perron. "Estimating and Testing Lineal Models with Multiple Structural Changes." *Econometrica*, 66, 1998, 47–78.

———. "Computation and Analysis of Multiple Structural Change Models." *Journal of Applied Econometrics*, 18, 2003, 1–22.

Celler Committee Hearings. *Study of Monopoly Power, Part 6, Organized Baseball*. House Committee on the Judiciary, 82d Congress, 1st Session, July, August, October 1951, H1365-3, Y4.J89/1:82/1/pt. 6.

Depken, C. A. III. "Free Agency and the Competitiveness of Major League Baseball." *Review of Industrial Organization*, 14, 1999, 205–17.

Eckard, E. W. "Free Agency, Competitive Balance, and Diminishing Returns to Pennant Contention." *Economic Inquiry*, 39, 2001, 430–43.

Fort, R., and J. Maxcy. "The Demise of African-American Baseball Leagues: A Rival League Explanation." *Journal of Sports Economics*, 2, 2001, 35–49.

———. "Comment: 'Competitive Balance in Sports Leagues: An Introduction.'" *Journal of Sports Economics*, 4, 2003, 154–60.

Fort, R., and J. Quirk. "Cross-Subsidization, Incentives, and Outcomes in Professional Team Sports Leagues." *Journal of Economic Literature*, 33, 1995, 1265–99.

Humphreys, B. R. "Alternative Measures of Competitive Balance in Sports Leagues." *Journal of Sports Economics*, 3, 2002, 133–48.

LaCroix, S. J., and A. Kawaura. "Rule Changes and Competitive Balance in Japanese Professional Baseball." *Economic Inquiry*, 37, 1999, 353–68.

Lee, Y. H. "Competitive Balance and Attendance in Japanese, Korean and U.S. Professional Baseball Leagues," in *International Sports Economics Comparisons*, edited by R. Fort and J. Fizel. Westport, CT: Praeger, 2004, 281–92.

Liu, J., S. Wu, and J. V. Zidek. "On Segmented Multivariate Regressions." *Statistica Sinica*, 7, 1997, 497–525.

Newey, W., and West, K. "Automatic Lag Selection in Covariance Matrix Estimation." *Review of Economic Studies*, 61, 1994, 631–53.

Noll, R. G. "Professional Basketball." Stanford University Studies in Industrial Economics Paper no. 144, 1988.

Quirk, J., and R. D. Fort. *Pay Dirt: The Business of Professional Team Sports*. Princeton, NJ: Princeton University Press, 1992.

Rottenberg, S. "The Baseball Players' Labor Market." *Journal of Political Economy*, 64, 1956, 242–58.

Schmidt, M. B., and D. J. Berri. "On the Evolution of Competitive Balance: The Impact of an Increasing Global Search." *Economic Inquiry*, 41, 2003, 692–704.

Scully, G. W. *The Business of Major League Baseball*. Chicago: University of Chicago Press, 1989.

———. *The Market Structure of Sports*. Chicago: University of Chicago Press, 1995.

Yao, Y.-C. "Estimating the Number of Change-Points via Schwarz' Criterion." *Statistics and Probability Letters*, 6, 1988, 181–89.