Teaching Income Inequality More Effectively:

An Example Using Major League Baseball

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Abstract

Many students struggle with Lorenz curves and Gini coefficients, two convenient and well-known tools for graphing and measuring income inequality. This paper describes how these important economic tools can be illustrated using salary data from Major League Baseball (MLB). Even students who are not especially interested in baseball or professional sports generally profit from this approach, simply because it is both accessible and intuitive. In addition, it facilitates discussions of several topics, including poverty, welfare, and positivism. This paper is the first to link MLB salary data, economic pedagogy, and measures of income inequality.

Introduction

Our paper continues the application of sports in the economics classroom. We intend to describe the ways in which two convenient and well-known tools for graphing and measuring income inequality, Lorenz curves and Gini coefficients, can be illustrated with salary data from Major League Baseball (MLB). After a brief discussion of the distribution of MLB salaries, we will continue by explaining how MLB data and income inequality measures can stimulate classroom discussions of several topics, such as the concept of poverty or positive versus normative economics. Recently, several papers have discussed the use of sports examples and data to illustrate economic concepts. The sports industry provides many analogies that make it easier to catch students' attention. Economists have, for instance, shown how to employ sports strategy to explain game theory (Dixit and Nalebuff, 1991; Merz, 1996), how to use baseball statistics to illustrate comparative and absolute advantage (Scahill, 1990), and how the game of baseball can assist in teaching various economic principles (Bruggink, 1993). In addition, Siegfried and Sanderson (1998) demonstrate that the use of sports analogies in the teaching of economics is limited only by the instructor's creativity.

Our data consist of all MLB salaries from 1985 to 1999. We choose MLB salary data since it is the most abundant and most readily available. Any interested instructor can find this same MLB data on several internet sites. The data can also be found in the archives of many daily newspapers across the country. In addition, a cursory examination of the sports economics literature reveals that the most studied sport is baseball; this may indicate that economists are more interested in baseball relative to other sports, but it is more likely due to the greater availability of MLB data. Although this paper is the first to link MLB salary data, economic pedagogy, and measures of income inequality, this is not the first paper to use Lorenz curves and Gini coefficients to analyze salary distributions in sports. Fort (1992) and Quirk and Fort (1997: 235-239) show that MLB salaries, up to 1990 and 1991 respectively, have become less equally distributed over time, due in large part to increases in player mobility (free agency). In addition, Quirk and Fort analyze salary data from four U.S. professional sports (baseball, football, basketball, and hockey) and find that sports with higher degrees of free agency have less equitable salary distributions.

Measuring Income Inequality in MLB: 1985-1999

The Lorenz Curve

One of the most elegant devices for understanding income inequality is the Lorenz curve. Conrad Lorenz, an American statistician, devised this convenient graphical tool in 1912. Lorenz curves place the cumulative percentage of income received on the vertical axis, and the cumulative percentage of population on the horizontal axis. The Lorenz curve diagram, then, is a square, and the Lorenz curve “sags” below a diagonal line running from the lower left corner to the upper right corner. This diagonal line is often called the “line of equality,” since if the Lorenz curve were coincident with this line, income could be described as being perfectly equitably distributed. It is also convenient to scale the graph in decimal units, so that the sides of the square are exactly one unit.

Textbooks normally introduce the Lorenz curve to describe the distribution of earnings within a country. For example, Lorenz curves are used in public finance textbooks (e.g., Hyman, 1993: 406-408), labor economics textbooks (e.g., McConnell et al., 1999: 508-509), and economic development textbooks (e.g., Todaro, 1996: 139-145). Despite the elegance of the Lorenz curve, we have found that students are often overwhelmed by discussions of cumulative values, income deciles, and the like. They often fail to grasp the main points that the instructor is attempting to make, focussing instead on details. To lessen this difficulty, we have found it helpful to use professional athletes as an example. In our experience, many students are interested in sports in general, and nearly every student finds it fascinating to study the often extremely large salary figures that professional athletes receive.

Rather than trying to motivate a discussion of income distribution and Lorenz curves using data from a country's population, it may be useful to start by presenting a table such as Table One, which contains information on MLB salaries from the 1999 season. Most students are instantly interested that the total amount of money earned by the 823 players is over $1.4 billion, with an average income of $1,726,283 and a median income of $700,000.[1] Furthermore, most students find the income distribution implications both interesting and accessible. For example, students can see directly that the poorest 10 percent of the players receive only 1.16 percent of total salary payments, while the elite athletes (the richest 10 percent) receive nearly 40 percent. Students can also easily calculate related figures, such as the fact that the top 20 percent of players receive almost 63 percent of total salaries. Once students have become interested in this, and have digested the information in Table One, it is a straightforward matter to introduce them to the Lorenz curve. The Lorenz curve for MLB in 1999 is shown in Figure One.

{INSERT TABLE ONE AND FIGURE ONE HERE}

To keep our representative student's interest just a little longer, we find it helpful to introduce a second Lorenz curve: one based on 1985 MLB salaries.[2] The pertinent information is presented in Table Two. Immediately, students will notice the enormous jump in total salaries over this 15-year period, both in real and nominal terms. More importantly, they may also be able to see that salaries were substantially more evenly distributed in 1985. In that year, the wealthiest decile received only 25 percent of total income: as noted above, by 1999 this figure was nearly 40 percent. At this point, it may be useful to draw the 1985 Lorenz curve on the same graph as the 1999 curve, as is done in Figure Two.

{INSERT TABLE TWO AND FIGURE TWO HERE}

Because the distribution of MLB players' salaries changed so dramatically between 1985 and 1999, these numbers provide a convenient way to talk about the difference between the mean and the median, and what such a difference says about a distribution. The average salary more than doubled in real terms over this time period: in 1985, the average salary was $481,521 ($743,757 in 1999 dollars); by 1999 the average salary was $1,726,283. By contrast, the median salary increased only marginally: in 1985, the median player earned $407,500 ($629,424 in 1999 dollars); by 1999, the median player earned $700,000. By drawing a few distributions, students can see that such changes could take place only if the inequality of earnings dramatically increased between 1985 and 1995.

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[1] This total salary only represents a part of the total income generated by professional baseball. In any case, students may find it interesting that in 1997, total MLB salaries exceeded the gross national products of eight of the world's nations.

[2] As an additional pedagogical bonus, this provides an excellent opportunity to reinforce the difference between real and nominal values, a concept normally taught in introductory courses.

It is an easy matter at this juncture to discuss the fact that the farther the Lorenz curve bows from the line of equality, the more unequally income is distributed. Students can quickly see that the 1999 curve is below the 1985 curve, reflecting an increase in income inequality. However, students may also be able to grasp the fact that it is difficult to tell precisely how much less equal the situation had become by 1999 simply by looking at the Lorenz curves. At this point, the Gini coefficient, which is simply a quantification of the Lorenz curve, can be seamlessly introduced.

The Gini Coefficient

Students also often find the concept of Gini coefficients tedious. The typical undergraduate economics student seems to miss the fact that Gini coefficients are simply handy summary measures of Lorenz curves. However, once the student fully appreciates the concept of the Lorenz curve, it is normally not as difficult to teach him or her the importance of the Gini coefficient. The Gini coefficient is the ratio of the area between the line of equality and the Lorenz curve and the area beneath the line of equality. In Figure 3, the Gini coefficient is given by the following:

$$\text{Gini coefficient} = A/(A + B).$$

By considering the above definition and a graph such as Figure Three, most students will quickly notice that a more “bowed out” Lorenz curve results in a larger Gini coefficient since area A becomes relatively larger. That is, large Gini coefficients imply greater degrees of income inequality. It will also be almost as clear that the Gini coefficient ranges from zero to one. A Gini coefficient of zero reflects perfect income equality, since the Lorenz curve and the line of equality would be coincident. A Gini coefficient of one implies a Lorenz curve coincident with the outer boundaries of the box and therefore perfect income inequality.

{INSERT FIGURE THREE HERE}

Many students object even to simple mathematical equations. Fortunately, if the Lorenz curve diagram is scaled in decimal terms, area A + B is always equal to 0.5. Thus, it remains only to estimate area A. We find it easier to take advantage of the fact that A = 0.5 – B: that is, we estimate area B first, and then calculate area A from that result. An adequate approximation is to calculate the area of a series of triangles and rectangles and sum these. Some examples of these areas are shown in Figure 4. Each triangle has as its base 0.1, since we are using deciles in this particular example. The height of each triangle is equal to the proportion of total income received by that decile. Since the sum of all deciles' proportion of total income must equal one, and since the area of a triangle is one-half the base times the height, the area of all triangles together must be 0.05. The base of each rectangle is also, of course, 0.1. The height of each rectangle is the cumulative probability of all previous deciles. This means that for the first decile there is no rectangle, but only a triangle.[3] From the deciles in Table One, area B can be approximated in the following way.

$$\text{Area B} = 0.1[0.00 + 0.0116 + 0.0238 + 0.0381 + 0.0572 + 0.0879 + 0.1365 + 0.2285 + 0.3704 + 0.6066] + 0.05 = 0.2061$$

Using the fact that Area A is 0.5 minus Area B, we have

$$\text{Area A} = 0.5 - 0.2061 = 0.2939.$$

We can then easily calculate the Gini coefficient for Table One and Figure One thusly:

$$\text{Gini} = 0.2939/0.5 = 0.5878.$$

Students may be initially troubled by this calculation, so it may be of considerable use to have them calculate the Gini coefficient for 1985. Once our students have gone through this once, they generally find the calculation straightforward.

[3] Ehrenberg and Smith (1997: 558-561) use a similar formula but use quintiles in their example. Although calculating Gini coefficients is a bit simpler with quintiles, the calculations are somewhat less accurate.

Having constructed Lorenz curves and having calculated the associated Gini coefficients for two years, it is probably unnecessary to grind through more examples. However, students may find it interesting to consider how MLB's income distribution has changed. Gini coefficients for MLB over the 1985 –1999 period are presented in Table Three and in Figure Five. The instructor can also ask students to puzzle over some possible reasons for the changes. Students will most likely explain the changes as resulting from a redistribution of market power from owners to players via free agency. In addition, we note that the Gini coefficient increases fairly dramatically in 1995, the year after the 1994 work stoppage. The Gini coefficient decreased to the 1993 level by 1999.[4]

{INSERT TABLE THREE AND FIGURE FIVE HERE}

Table Three also provides an opportunity to discuss what can happen to an income distribution when important factors change. The MLB income distribution results from several factors. These factors include, among other things, the degree of baseball labor market competitiveness, the existence of discrimination or position segregation, the distribution of player talent, the institutional setting, and the demand for baseball entertainment. Hence, using Lorenz curves and Gini coefficients with MLB data facilitates an easy transition into a discussion of the labor market effects of market power, racial and occupational segregation, education and training, industrial relations (work rules, collective bargaining, unionization, etc.), and changes in demand for an output. As a follow up, it might be interesting to discuss the effect on market price (the price of tickets) that might occur when MLB salaries change. Quirk and Fort (1992: 219-225) discuss the effect sports salaries can, or cannot, have on ticket prices.

[4] Fort (1992) presents an excellent discussion of the reasons for increases in income inequality in MLB. Instructors interested in finding out more about the work stoppage should read Staudohar (1997).

U.S. Income Distribution

Discussing the changes in Gini coefficients for MLB and the reasons for changes in the MLB income distribution provides a natural opening to talk about Gini coefficients and changes in the U.S. income distribution over a similar period. U.S. Gini coefficients for 1979 to 1997 are presented in Table Four.[5] Notice that the U.S. income distribution has moved in the same direction as that of MLB, although the magnitude of the change is much smaller. At this point, a useful exercise may be for the instructor to ask his or her students to think of reasons why the U.S. income distribution has changed. The reasons students suggest will vary depending upon the class in which the example is being used; however, the reasons could include the growth in payoff to a college degree, the lost jobs in the manufacturing sector, etc. It is interesting to note that the U.S. Gini coefficient from 1985 to 1997 only increased by 7 percent, while the Gini coefficient for MLB was generally much larger over the period and increased by 68 percent. Thus, baseball players have seen their incomes increase dramatically and have seen their distribution of income become much less equitably distributed that of the U.S. as a whole.

{INSERT TABLE FOUR HERE}

The Population of New Economists

A final population that your students may find interesting is that of economists who have just completed their doctorates. Siegfried and Stock (1999) gathered salary data on a sample of 316 new Ph.D. economists over the 1996-97 period. This sample represents approximately one-third of all doctorates awarded in economics by U.S. universities over that time span. We calculate from these data that the Gini coefficient over the sample period is 0.181, reflecting a considerably lower degree of income inequality among newly-minted Economics Ph.D.s. than for the U.S. population as a whole and especially MLB players. This may imply that economists are a relatively homogeneous population when they are "rookies;" most likely income inequality among economists rises over time as differences in talent are revealed. Although we do not calculate Gini coefficients for rookie MLB players each year, it is very likely that income is more equitably distributed within this sub-population as well.

The Concept of Poverty

The salaries of MLB also provide an interesting way to introduce several important concepts about poverty. For instance, these figures provide an easy way to talk about absolute versus relative standards of poverty and about the problems inherent in poverty measures.[6] The absolute approach to defining poverty begins with the determination of a minimum subsistence income; anyone earning an income below this minimum is considered "poor." Clearly, by absolute standards, no professional baseball player is poor. Even players receiving the minimum salary in 1997 earned $150,000; the absolute standard of poverty in the U.S. for a family of four in 1997 was $16,050. Thus, no professional baseball player falls into this absolute category of poverty. However, measuring poverty in absolute standards is problematic because our perceptions of what goods and services constitute "basic necessities" change over time.

Another way of defining poverty is to use one of a number of relative measures. The simplest measure is to define those in the lowest fifth of the income distribution as poor. By these standards, a family with an income less than $15,400 in 1997 was poor and MLB players making $150,000 in 1997 were poor. Students may find the thought of a "poor" MLB player

[5] These numbers, and the poverty numbers presented below, are the from the U.S. Census Bureau's web page (www.census.gov). Although 1999 MLB figures are discussed elsewhere in this paper, we use 1997 numbers in order to compare them with the U.S. figures, which are not yet available past 1997.
[6] For a more complete discussion of this topic, please see Schiller (1998: 14-38).

humorous, but this highlights the basic problem with relative measures of poverty: some part of the population (20 percent) will always be in poverty. That is, this relative measure of poverty cannot measure progress in reducing poverty. An alternative, but still relative, measure of poverty is the "Fuchs point," defined as half of the median income. By the Fuchs point, progress in reducing poverty is possible; progress is made by raising the bottom end of the income distribution toward the median. As measured by the Fuchs point, all MLB players earning less than $175,000 in 1997 were poor, which amounts to 26.5% of all players. Among the U.S. population, those earning less than $18,503 in 1997 were poor: by this standard just under one-quarter of U.S. households would count as poor.

Positive vs. Normative Economics

Another issue that may arise when teaching students these concepts is the difference between positive and normative statements. There is often a tendency among students to assume that relative income inequality is not desirable. Lorenz curves and Gini coefficients tell us something about the population we happen to be studying; however, these are not appropriate tools for discussing what is fair or what should be. One could ask one's students whether the large degree of income inequality observed in MLB relative to other populations is fair. Students are undoubtedly aware that many professional athletes believe they are underpaid. However, since the data suggest that no baseball players are poor by any absolute standard, how can these players complain about their salaries being too low? One answer, of course, has to do with equity. Players may (legitimately) complain if they are not paid their worth (especially in comparison to other players) and/or if the income distribution is unfair. While some may answer that such inequality is unfair, others may point out that perhaps the inequality is simply reflecting the rewards that extraordinary players deserve.

Even when looking at national populations, increasing income inequality is not inevitably bad. In Lewis' (1954) model of economic development, successful transition to an industrialized state involves capital accumulation. Lewis assumed that owners of capital would save a greater proportion of their income than the poor masses. Therefore, rising inequality is to be expected, and even encouraged, in the early stages of development. If it were otherwise, not as much capital would be accumulated and economic growth and industrialization would be postponed or preempted altogether. Of course, Lewis may be right or wrong. The point is that Lorenz curves and Gini coefficients are helpful in describing what is (positive economics), and not what should be (normative economics).

Conclusion

For most of the twentieth century, teachers of economics have used the Lorenz curve and the Gini coefficient to demonstrate to their students such important concepts as income distribution, income inequality, and poverty. Despite their elegance, students often struggle with these tools. In this paper we have attempted to show how Lorenz curves and Gini coefficients can be introduced using a somewhat peculiar example of a population: that of Major League Baseball players. In our experience, this pedagogical device enables students to grasp these concepts almost without realizing that they have. Even students who are not especially interested in baseball or professional sports generally profit from this approach, simply because it is both accessible and intuitive. In addition, it facilitates discussions of several topics, including poverty, welfare, and positivism.

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Table One
Distribution of Total Salaries
Major League Baseball, 1999

Income Decile	Total income owned	% of total income owned	Cumulative income share
First (Poorest 10%)	$16,411,000	1.16%	1.16%
Second	$17,382,050	1.22%	2.38%
Third	$20,269,000	1.43%	3.81%
Fourth	$27,102,000	1.91%	5.72%
Fifth	$43,637,498	3.07%	8.79%
Sixth	$68,990,498	4.86%	13.65%
Seventh	$130,768,332	9.20%	22.85%
Eighth	$201,691,179	14.19%	37.04%
Ninth	$335,532,347	23.62%	60.66%
Tenth (Richest 10%)	$558,947,270	39.34%	100.00%
TOTAL	$1,420,731,174	100.00%	
Number of Players	823		

Table Two
Distribution of Total Salaries
Major League Baseball, 1985
(Salaries in 1999 Dollars in Parenthesis)

Income Decile	Total income owned	% of total income owned	Cumulative income share
First (Poorest 10%)	$5,071,333 ($7,833,181)	1.83%	1.83%
Second	$8,403,250 ($12,979,660)	3.04%	4.87%
Third	$12,011,250 ($18,552,577)	4.33%	9.20%
Fourth	$16,504,525 ($25,492,889)	5.96%	15.16%
Fifth	$20,422,242 ($31,544,195)	7.38%	22.54%
Sixth	$26,898,999 ($41,548,194)	9.72%	32.26%
Seventh	$32,144,702 ($49,650,707)	11.61%	43.87%
Eighth	$39,018,035 ($60,267,257)	14.09%	57.96%
Ninth	$46,713,542 ($72,153,737)	16.87%	74.83%
Tenth (Richest 10%)	$69,686,525 ($107,637,806)	25.17%	100.00%
TOTAL	$276,874,403 ($427,660,203)	100.00%	
Number of Players	575		

Table Three
Gini Coefficients, Major League Baseball
1985 – 1999

Year	Gini Coefficient
1985	0.375
1986	0.486
1987	0.498
1988	0.501
1989	0.527
1990	0.530
1991	0.525
1992	0.569
1993	0.589
1994	0.563
1995	0.667
1996	0.652
1997	0.630
1998	0.601
1999	0.588

Table Four
Gini Coefficients, US
1979 – 1997

Year	Gini Coefficient
1979	0.403
1980	0.401
1981	0.404
1982	0.409
1983	0.412
1984	0.413
1985	0.418
1986	0.423
1987	0.424
1988	0.425
1989	0.429
1990	0.426
1991	0.425
1992	0.430
1993	0.448
1994	0.450
1995	0.444
1996	0.447
1997	0.448

Figure One
Lorenz Curve: Major League Baseball, 1999

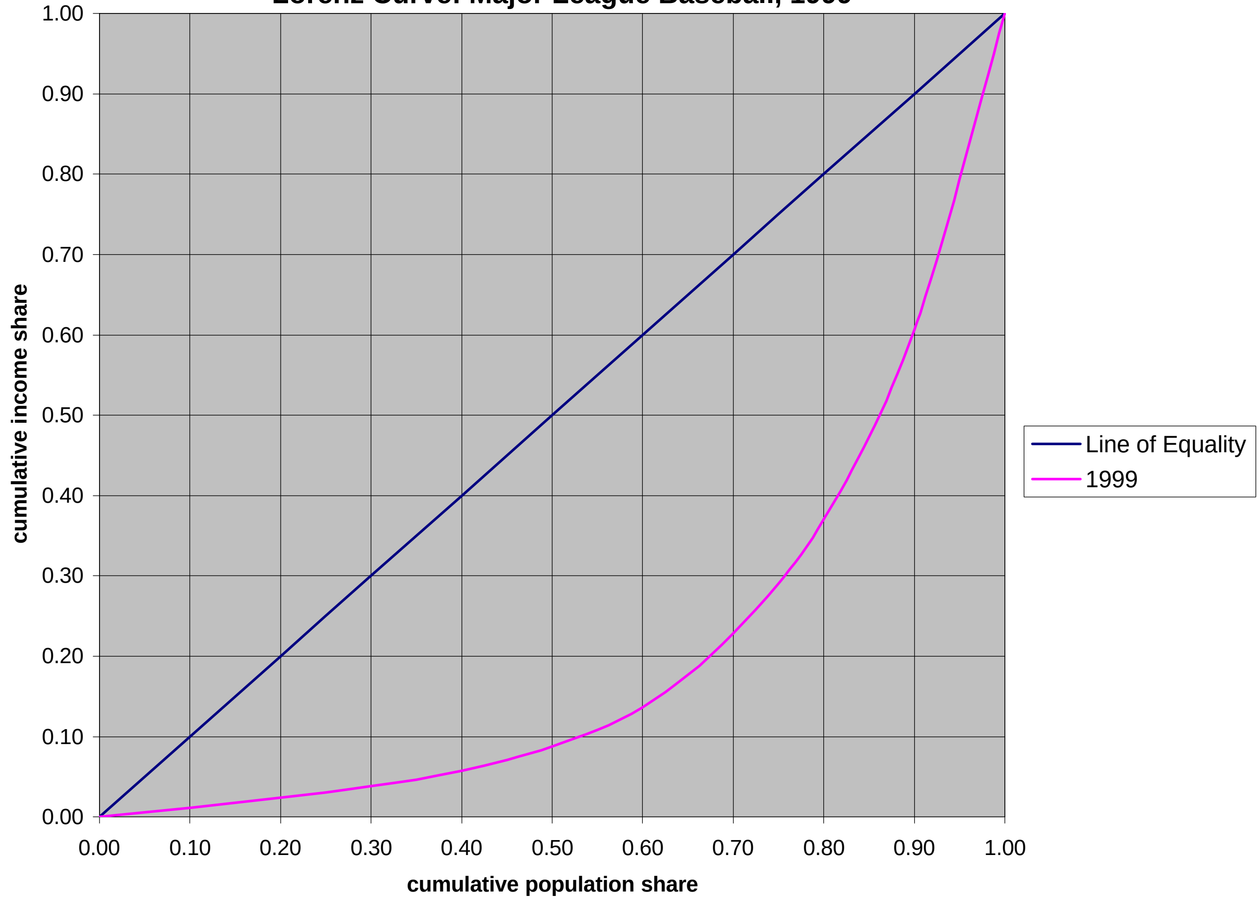

Figure Two
Lorenz Curves: Major League Baseball, 1985 and 1999

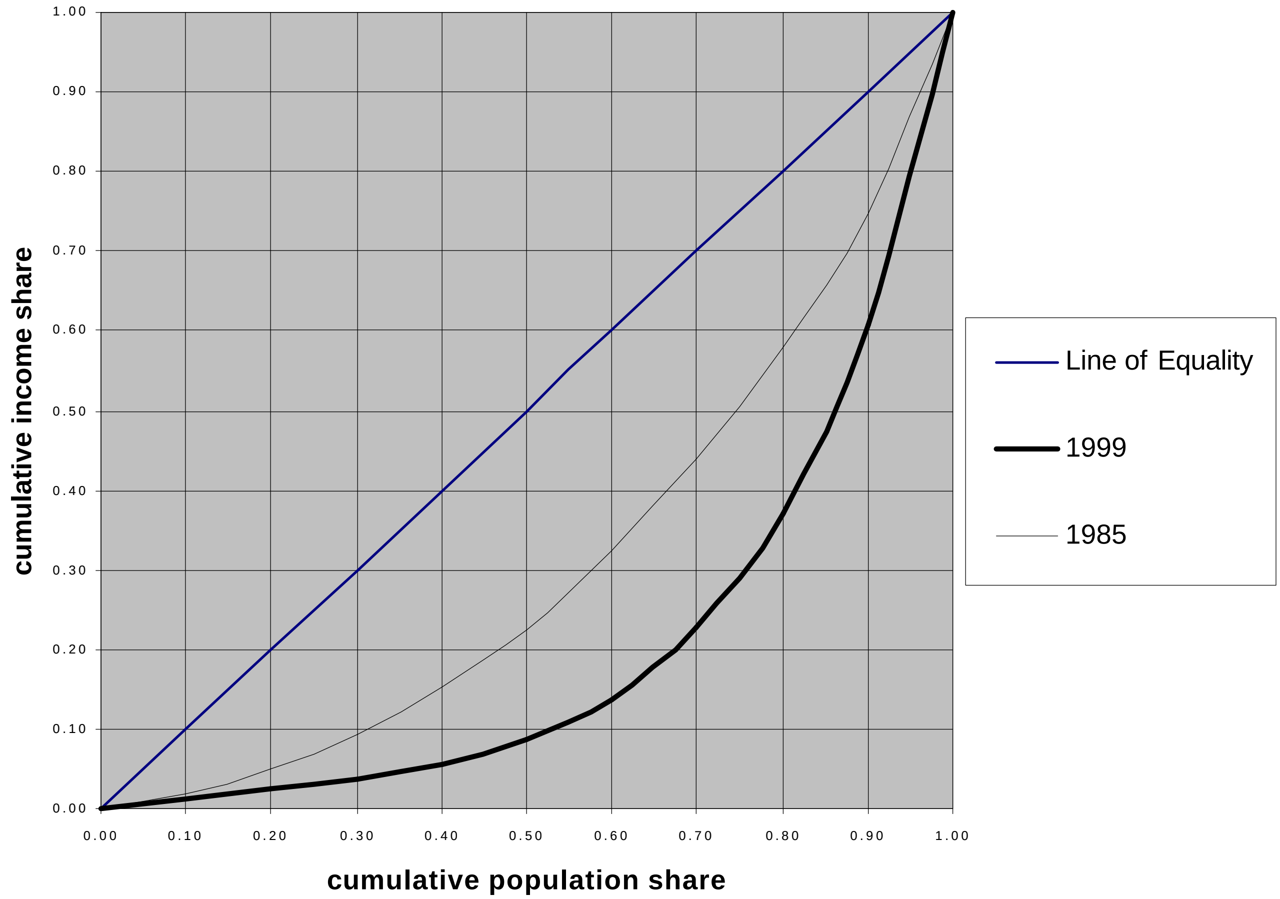

Figure Three

Lorenz Curves and Gini Coefficients

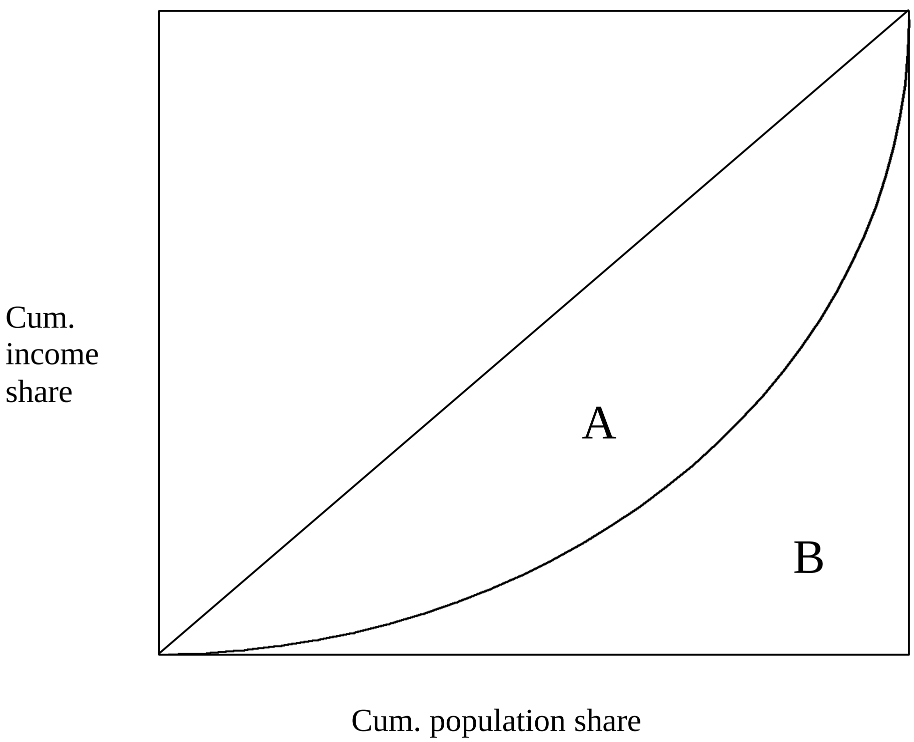

Figure Four

Lorenz Curves and Gini Coefficients

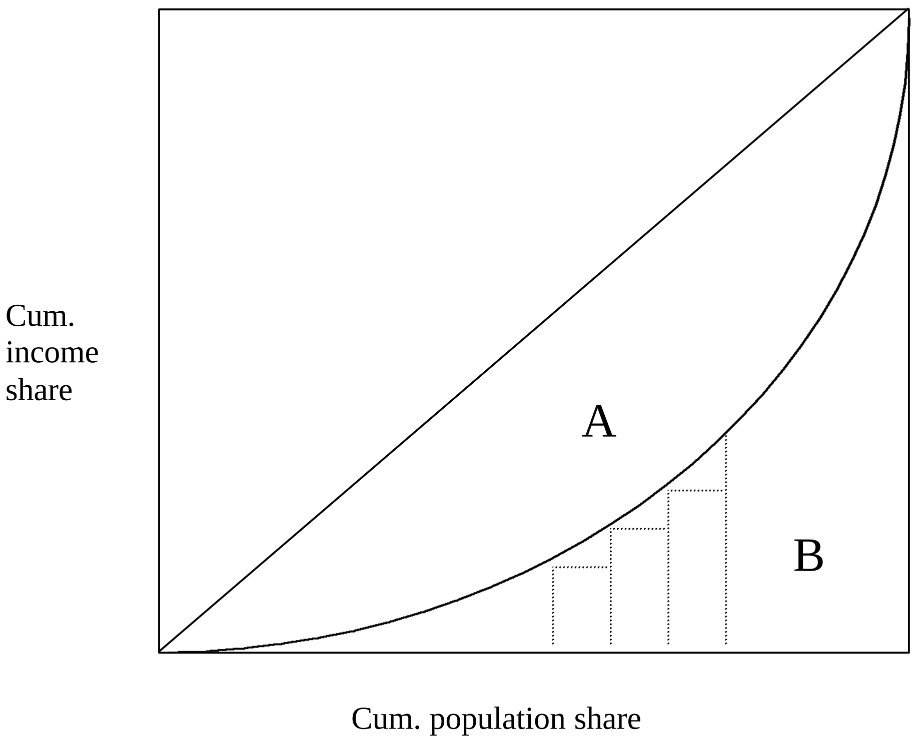

Figure 5:
Gini Coefficient, Major League Baseball, 1985-1999