

## The Herfindahl–Hirschman Index

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The Herfindahl–Hirschman index, better known as the Herfindahl index, is a statistical measure of concentration. It has achieved an unusual degree of visibility for a statistical index because of its use by the Department of Justice and the Federal Reserve in the analysis of the competitive effects of mergers. The Herfindahl index can be used to measure concentration in a variety of contexts. For example, it can be used to measure the concentration of income (or wealth) in U.S. households and also market concentration, that is, the degree of concentration of the output of firms in banking or industrial markets. It is useful in analyzing horizontal mergers because such mergers affect market concentration, and economic theory and considerable empirical evidence suggest that, other things equal, the concentration of firms in a market is an important element of market structure and a determinant of competition. However, despite its visibility, the Herfindahl index is sometimes not understood in terms of its use, measurement, or interpretation in merger analysis.

To facilitate and simplify the application of the antitrust laws regarding mergers, in 1982 the Department of Justice published formal numerical guidelines for horizontal mergers (those between firms operating in the same product and geographic markets) based on the Herfindahl index (HHI).<sup>1</sup> In 1985, the Justice Department proposed somewhat modified numerical guidelines for mergers in the banking industry and published revised guidelines

in 1992. These numerical guidelines are used by the Federal Reserve as the first step in analyzing the effect on competition of bank mergers. The guidelines, as applied to banking, specify that if a bank merger would result (1) in a post-merger HHI in a market of less than 1,800 or (2) in a change in the HHI of less than 200 (less than 50 in other industries), it is likely that the market structure would not reach a concentration level, or concentration would not increase enough, such that firms in the market would have the market power to maintain prices above the competitive level for a significant period.

The HHI is only one element in the analysis of the competitive effects of bank mergers. However, because of the importance attached to market concentration as an indicator of competition and the relative ease of calculating the HHI, this index serves as an efficient screening device for regulators and as a planning tool for bankers. At the Federal Reserve, the HHI is calculated by including 100 percent of the deposits of commercial banks in a market and at least 50 percent of the deposits of thrift institutions. If the post-merger HHI does not exceed the numerical guidelines, it is *generally* presumed that the merger would not be seriously anticompetitive, and no further analysis is conducted. If, on the other hand, the post-merger HHI exceeds the numerical guidelines, a detailed economic analysis of competition is undertaken to determine whether other factors, such as potential competition, indicate that the market would be more (or less) competitive than the HHI alone suggests.

The HHI accounts for the number of firms in a market, as well as concentration, by incorporating the relative size (that is, market share) of all firms in a market. It is calculated by squaring the market shares of all firms in a market and then summing the squares, as follows:

$$HHI = \sum_{i=1}^n (MS_i)^2,$$

1. The index was developed independently by the economists A.O. Hirschman (in 1945) and O.C. Herfindahl (in 1950). Hirschman presented the index in his book, *National Power and the Structure of Foreign Trade* (Berkeley: University of California Press, 1945). Herfindahl's index was presented in his unpublished doctoral dissertation, "Concentration in the U.S. Steel Industry" (Columbia University, 1950). For more detail on the background of the index, see Albert O. Hirschman, "The Paternity of an Index," *American Economic Review* (September 1964), pp. 761–62.

where  $MS_i$  represents the market share of firm  $i$  and there are  $n$  firms in the market. The following example of calculating the HHI before and after a merger illustrates the use of the formula. Assume that there are four banks in a market. Bank A holds 40 percent of bank deposits in the market, Bank B holds 30 percent, Bank C holds 20 percent, and Bank D holds 10 percent. Substituting these values in the formula gives the HHI for bank deposits in this market:

$$(40)^2 + (30)^2 + (20)^2 + (10)^2.$$

Completing this calculation gives the before-merger HHI:

$$1,600 + 900 + 400 + 100 = 3,000.$$

Next assume that Bank C, with 20 percent of the market, acquires Bank D, which has 10 percent of the market. The HHI after the merger would be

$$(40)^2 + (30)^2 + (20 + 10)^2.$$

Completing this calculation gives the post-merger HHI:

$$1,600 + 900 + 900 = 3,400.$$

The merger therefore increased the HHI by 400, from 3,000 to 3,400.

Further examination of this example reveals that the HHI gives much heavier weight to firms with large market shares than to firms with small shares as a result of *squaring* the market shares. This feature of the HHI corresponds to the theoretical

notion in economics that the greater the concentration of output in a small number of firms (a high HHI), the greater the likelihood that, other things equal, competition in a market will be weak. In contrast, if concentration is low, reflecting a large number of firms with small market shares (a low HHI), competition will tend to be vigorous. The HHI reaches a maximum value of 10,000 when a monopoly exists in which one firm has 100 percent of the market, that is, the  $HHI = (100)^2 = 10,000$ . In contrast, the HHI takes on a very small value, theoretically approaching zero, in a purely competitive market in which there are many firms with small market shares. For example, in a market with 100 firms that each have a 1 percent share of the market, the  $HHI = (1_1)^2 + (1_2)^2 \dots (1_{100})^2 = 100$ .

The following table provides a sense of what different values of the HHI imply for the concentration of a market, assuming that all firms in the market have the same market share. For example, row 2 of the table indicates that a market with five firms of equal size (that is, each with 20 percent of the market) would have an HHI of 2,000.

HHI	Number of firms of equal size in the market	Market share of each firm (percent)
1,000 .....	10	10.0
2,000 .....	5	20.0
3,300 .....	3	33.3
5,000 .....	2	50.0

In conclusion, note that, although the HHI is a useful tool in merger analysis, particularly as an initial screening device, other factors are considered in an economic analysis of competition. □