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# **A Distance-based Algorithm for Defining Antitrust Markets**

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# A Distance-based Algorithm for Defining Antitrust Markets\*

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2025-07-07

## Abstract

We propose a simple algorithm for defining merger-specific geographic antitrust markets based on merging firm proximity. Applying it to over a thousand hypothetical bank mergers, we compare concentration measures in our markets to those defined by the Federal Reserve, which are not merger-specific, finding broad agreement but also offering potential improvements upon current definitions.

**Keywords:** market definition; bank mergers; computational methods

**JEL classification:** G34, L40, C63

## 1 Introduction

We propose a simple algorithm for defining geographic antitrust markets and apply it to over a thousand hypothetical bank mergers. Our algorithm utilizes the distances between merging parties' branches to delineate markets. This approach is motivated by existing banking literature, which emphasizes customers' willingness to travel as a key factor in bank choice.

To demonstrate the utility of our approach, we simulate mergers between the two banks with the largest total deposits in each Fed market within the lower 48 states. We exclude any merger that would result in a combined institution holding more than 10% of total U.S. deposits, consistent with the national liabilities cap established by Federal Reserve Regulation XX (2025). For each eligible merger pair, we include every Fed market where both banks have branches and then algorithmically generate all overlapping distance-based

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\*The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the Board research staff or by the Federal Reserve Board of Governors. We thank Robert Adams and Serafin Grundl for helpful comments.

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markets. Finally, we identify all branches that are contained in each market and compute concentration measures.

Our analysis reveals broad agreement between Fed and distance-based markets. However, among the Fed markets that do not exceed the concentration thresholds, 25% contain at least one distance-based market that exceeds the thresholds, indicating potential consumer harm in more localized areas. Additionally, among Fed markets that exceed the concentration thresholds, 8% do not contain any distance-based markets that exceed the thresholds, suggesting that the broader market definitions may overstate competitive harm.

The relevance of branch proximity to both depositors and small business borrowers is well documented. As far back as *Philadelphia* (1963), there was witness testimony suggesting that bank branches typically draw customers from 1.5 to 2 miles. Recent research continues to underscore the importance of proximity in banking behavior. For instance, the median consumer in a Metropolitan Statistical Area resides within four miles of their nearest bank branch (Benson et al. (2024)), and there is an 81% probability that a bank customer’s home is within five miles of their branch (Honka, Hortaçsu, and Vitorino (2017)). In the context of small business lending, half of all bank loans are made to firms located within four miles of the lending branch (Adams, Brevoort, and Driscoll (2023)). These patterns suggest that localized, community-based relationships remain central to banking, especially for small businesses.

## 2 Current Practice

Multiple federal agencies, including the Federal Reserve, the U.S. Department of Justice, the Office of the Comptroller of Currency, and the Federal Deposit Insurance Corporation are tasked with evaluating the competitive effects of bank mergers. We focus on the Federal Reserve because its banking market definitions are publicly available.

As illustrated in the BB&T-Suntrust merger Board Order (Board of Governors of the Federal Reserve System (2019)), the Federal Reserve’s current procedures for identifying potentially harmful mergers involves two steps:

First, the Federal Reserve defines relevant product and geographic markets. For the product market, the Federal Reserve follows the definition adopted in *Philadelphia* (1963), which treats banking as a “cluster” of related products that includes commercial deposits, loans and other core banking services. To establish geographic markets, the Federal Reserve relies on Fed markets, which are predefined geographical areas created by the regional Federal Reserve banks that are intended to “... reflect commercial and banking realities and should consist of the local area where customers can practicably turn for alternatives.” (Board of Governors of the Federal Reserve System (2019))

Second, the Federal Reserve assesses market concentration using the Herfindahl-Hirschman Index (HHI), calculated from the deposit shares of branches within each Fed market. A market is flagged as “highly concentrated” if the post-merger HHI exceeds 1,800 and the

merger increases HHI by more than 200 points, or if the merged bank’s market share exceeds 35% (Board of Governors of the Federal Reserve System (2019)).

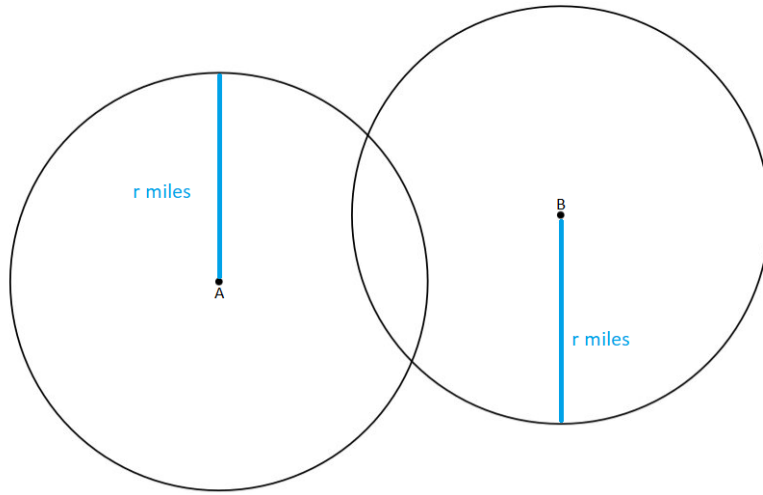
### 3 A Distance-based Algorithm

Building on these findings, we propose a simple model of branch choice. We assume customers are willing to bank up to a (euclidean) distance of  $r$  miles from either their homes or workplaces. Extending this assumption across all customers, a radius of  $r$  miles around a bank branch defines a branch’s *catchment area* (Ellickson, Grieco, and Khvastunov (2020)), or the set of potential customers who would be willing to bank at that branch. Our model implies that if two branches are within  $2r$ , their catchment areas overlap, and a merger may reduce competition for customers in this area, especially if few substitutes exist. Conversely, branches greater than  $2r$  apart are not regarded as substitutes by any customers.

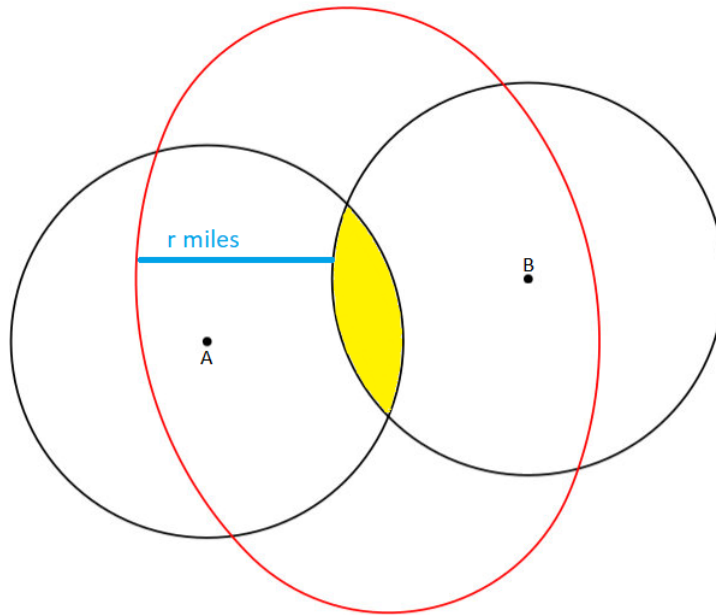
Our algorithm:

1. For a given radius  $r$ , identify all pairs of merging parties’ branches within  $2r$  of each other. For each branch in the pair, construct a circle with radius  $r$  representing those branch’s catchment areas. See Figure 1.
2. For each branch pair identified in Step 1, identify the set of potential customers who would consider either branch by taking the intersection of their catchment areas (see the highlighted area in Figure 2).
3. For each intersecting area identified in Step 2, draw a buffer of radius  $r$  to identify the region that includes third-party branches of interest to these customers. The resulting area, colored red in Figure 2, defines the geographic market we use for competitive analysis.
4. Identify all branches that are contained in the geographic market identified in Step 3, aggregate the relevant metric (deposits) to the owner (holding company), and compute relevant concentration measures (HHIs etc.)

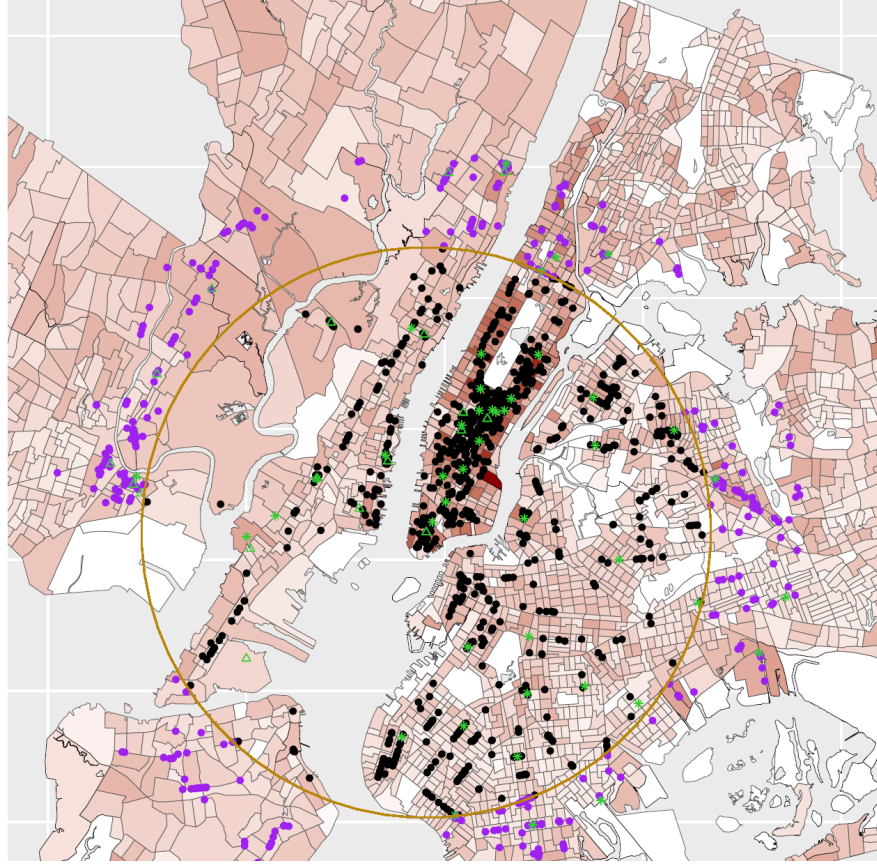
An example of one such resulting market area is depicted in Figure 3. Our algorithm only uses the branches located inside the geographic market, as depicted by the circle, to calculate concentration measures for this market.



**Figure 1** illustrates Step 1 for a given radius  $r$  where each branch is owned by one of the merging parties.



**Figure 2** illustrates Step 2. The shaded intersection denotes the set of customers willing to choose either merging party branch A or B. The red ellipse indicates the geographical area those customers are willing to travel within.



**Figure 3** depicts an example distance-based market in New York City. Shading illustrates census-tract level population density from the American Community Survey. Bank A branches are represented by asterisks, Bank B branches are represented by triangles. Non-merging bank branches inside the market are black. Branches excluded from the market area are purple.

## 4 Data and Implementation

We use data from the American Community Survey (ACS) and the Competitive Analysis and Structure Source Instrument for Depository Institutions (Federal Reserve Bank of St. Louis (2024)), including Fed market shapefiles, geocoded branch locations and branch-level deposits.

We implement our algorithm in PostGIS, using a radius  $r = 8$  kilometers ( $\sim 5$  miles), consistent with the economic evidence cited in Section 1. From the 1,415 Fed markets, we generate 1,057 distinct mergers. Across these mergers, we identify 6,422 Fed markets where the merging parties both have branches and 191,757 distance-based markets. Of these 6,422 Fed markets, 511 do not contain distance-based markets.

Our algorithm produces market definitions that are significantly smaller than those of the Federal Reserve. Table 1 compares the distributions of concentration measures as well as areas for distance-based and Fed markets.

Although our algorithm yields market areas that are only a fraction of the size of Fed markets, concentration measures in these markets are typically lower. This is because our approach is less likely to lump together multiple population centers into a single market, instead tailoring boundaries to the local areas where competition between merging parties is most relevant. In contrast, Fed markets can encompass entire metropolitan regions, which may obscure localized effects of bank consolidation.

**Table 1:** Distributions of market characteristics.

	Mean	Sd	10 pct	50 pct	90 pct
<b><math>\Delta</math> HHI</b>					
Distance	244	483	2	56	734
Fed	463	821	1	85	1,531
<b>Post-merger HHI</b>					
Distance	2,188	1,349	1,040	1,766	4,058
Fed	2,429	1,769	987	1,780	4,749
<b>Combined party share</b>					
Distance	21	18	3	15	47
Fed	26	23	2	19	61
<b>Market area (<math>km^2</math>)</b>					
Distance	509	154	305	501	731
Fed	7,281	14,710	1,398	3,538	15,132

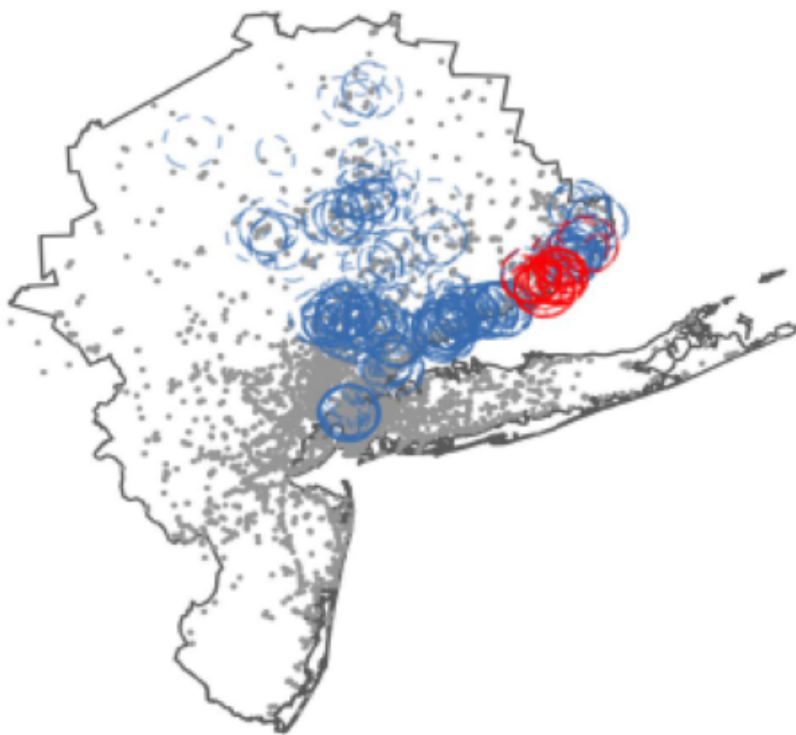
## 5 Example: Metropolitan New York City

To illustrate some of the advantages of our algorithm, Figure 4 displays one of the Fed markets implicated in a hypothetical merger between two large regional banks. The map depicts the New York City Fed market area, with overlaid circles representing distance-based markets identified within it. Markets shaded in blue do not exceed concentration thresholds, while those in red do. Of the 542 distance-based markets identified in the Metro NYC Fed market, 81 (14.9%) exceed the concentration thresholds.

In this hypothetical merger, the metro New York City Fed market did not exceed concentration thresholds. This outcome is unsurprising given the geographic scope of the market, which spans four states, making it difficult for mergers to trigger concentration thresholds at the Fed market level. However, closer inspection reveals a notable cluster of concentrated distance-based markets centered around New Haven, Connecticut. Evaluating this merger solely at the Fed market level could overlook this important segment of consumers who may be adversely affected. This example underscores the benefits of using more localized market definitions to better detect and address competitive concerns.

## Metro New York City, NY-NJ-CT-PA

542 market areas, 14.9% flagged



**Figure 4** depicts the New York City Fed market along with all the distance-based markets and all bank branches in the market. Blue markets are below the concentration thresholds and red are above. The Fed market does not exceed concentration thresholds.

## 6 Concentration Thresholds

Table 2 reports the percentage of Fed markets that contain at least one concentrated distance-based market, conditional on whether the Fed market exceeds the concentration thresholds, capturing something akin to Type 1 and 2 errors:

**Table 2:** Distance-based vs. Fed market threshold comparison across hypothetical mergers.

Fed Market	Distance-based markets	
	None concentrated	At least one concentrated
Not concentrated	75%	25%
Concentrated	8%	92%

Overall, we find substantial agreement between the two market definitions. However, Table



2 reveals two important asymmetries. First, 25% of Fed markets that are not flagged as concentrated still contain at least one distance-based market that exceeds the concentration thresholds. This suggests that broader Fed market definitions may obscure localized pockets of competitive concern. Second, 8% of Fed markets classified as concentrated contain no distance-based market that exceeds the thresholds, indicating that a more granular, distance-based approach may better align with actual consumer and firm behavior and avoid overstating potential competitive harm.

## 7 Discussion

Although we apply this framework to banking, our distance-based algorithm generalizes to industries where reliable information is available on customer willingness to travel. Additionally, by identifying localized areas where competition is most affected, the algorithm can help pinpoint more effective divestiture candidates in merger review.

Three issues merit discussion. First, using a uniform radius across areas with different population densities may not fully capture variation in customer willingness to travel. Future work exploring alternative radii would also help assess the robustness and flexibility of the algorithm. Second, some overlaps may contain few or no customers. Incorporating data on population or business density, as in Figure 3, can help determine the relevance of these overlaps. Third, closely clustered branches can create multiple overlapping markets with similar branch sets, leading to some double-counting. While we eliminate exact duplicates, near-duplicates may remain, though they still represent distinct groups of affected consumers.

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*United States v. Philadelphia National Bank*, 374, 321 (1963).