# Competition and Market Concentration in the Municipal Bond Market

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**Abstract**

Lack of competition among the underwriters of municipal bonds increases the borrowing costs of local municipalities. I find that the proportion of municipal bonds sold in competitive sales in the state has an economically significant effect on several measures of competitiveness. Competitive sales increase the number of active underwriters in the state and decrease substantially the concentration in the market for underwriting services for municipal bonds. I also find that state restrictions on the negotiated sale of municipal bonds can materially decrease market concentration. Market concentration has increased considerably over time, but only negotiated sales have contributed to greater concentration.

**Keywords:** Market power, concentration, Herfindahl Index, book building, auctions, municipal bonds.

**Classification:** H3, H7, G1.

# 1. Introduction

In February 2019, the City of Philadelphia filed an antitrust lawsuit against seven major banks where it accused them of secretly colluding and manipulating interest rates of variable-rate demand obligations. The city claimed that the seven banks had raised hundreds of millions from the city in fees they did not earn. The city also alleged that the collusion had cost billions of dollars to local government throughout the country. Similar lawsuits have also been filed on behalf of the states of California, Illinois, Massachusetts and New York.

The same banks accused by the City of Philadelphia are also the largest underwriters of municipal bonds. With more than 450 billions issues per year, the costs of collusion would be gigantic. Despite the high costs that collusion could have, there are no real measures of the risk of collusion in the market for underwriting services for municipal bonds. Neither is it known how competitive the industry is. Even so, policymakers are aware of these risks. With the objective of avoiding collusion and above-market interest rates, the laws of many states establish that municipal bonds must be sold in public auctions.

Otherwise, municipal issuers can choose from four available methods to place the bonds: *public competitive sale*, *quasi-competitive sale*, *negotiated sale*, or *private placement*. Competitive sales and negotiated sales are the muni market counterparts of auctions and book building. At the same time, competitive sales can be public or private. In private-competitive sales, also known as quasi-competitive sales, bidders must be "invited" to bid. The presumption behind the above-mentioned laws is that auctions increase competition, and greater competition leads to selling the bonds on better terms.

However, there is a tendency to lift restrictions on negotiated sales. In 2018, the legislature of Louisiana amended the provisions relating to the sale of bonds to allow municipal issuers to choose any of the above methods. In 2019, during the last legislative session, bill 1067 in North Dakota amended the current law to increase the permitted limit for negotiated sales from one hundred thousand to one million dollars. This trend

towards negotiated sales is also observed throughout the world. Jagannathan, Jirnyi, and Sherman [2015] showed that while the fixed price method used to be the most popular method for equity IPOs in 44 out of 47 developed and emerging economies, more recently, book building has become the most popular method in 34 of those economies.

The research that has compared auctions with book building has not been entirely favorable to competitive sales either. On the theory side, Benveniste and Spindt [1989], Benveniste and Wilhelm [1990], and Spatt and Srivastava [1991] found that book building, and not auctions, implements the optimal direct mechanism when investors hold private information about the issue and there is pre-pricing communication. Biais, Bossaerts, and Rochet [2002] and Biais and Faugeron-Crouzet [2002] also found that book building implements the optimal direct mechanism and not auctions, except for dirty dutch auctions under certain conditions. On the applied side, Corwin and Schultz [2005], Ljungqvist and Wilhelm Jr [2002], and Hanley [1993] validated the above models based on their testable implications. However, Degeorge, Derrien, and Womack [2010] came to the conclusion that auctions are as good as book building to extract private information from investors, and Derrien and Womack [2003] found that underpricing was less sensitive to hot market conditions in auctions than in book building.

Cestau, Hollifield, Green, and Schürhoff [2018a] compared auctions and negotiated sales of municipal bonds and found that bonds sold in competitive sales have lower offering yields and are less underpriced on average. They also observed that, although competitive sales are still common in the municipal bond market, the majority of issuers that are not subject to the legal restrictions on negotiated sales do not use auctions. Moreover, there is a trend towards more negotiated sales. They noted that the arguments that explain such a trend in corporate IPOs can not possibly explain the trend observed in the municipal bond market. Given that auctions are also the cost-saving mechanism, it remains largely unexplained why negotiated sales prevail in the muni market.

All of the above literature compares auctions to negotiated sales, but it does not take externalities into account. It is possible that a method of sale is economically optimal but sub-optimal once the externalities are internalized. In particular, I study the effect of

competitive sales and negotiated sales on the concentration in the market for underwriter services. Market concentration is usually correlated with market power, and Green, Hollifield, and Schürhoff [2007a], Green, Hollifield, and Schürhoff [2007b], Green [2007], Hollifield, Neklyudov, and Spatt [2017], and Li and Schürhoff [2019] have shown that broker-dealers use their market power to charge above-competitive prices. Therefore, if a particular method causes a greater market concentration, it may create a negative externality.

I find that market concentration has increased substantially over time, but only negotiated sales have contributed to greater concentration. Competitive sales have a positive effect on the number of active underwriters in the state, as do the restrictions on negotiated sales. The proportion of competitive sales in the state has a huge effect on concentration. Going from fully negotiated to fully competitive decreases the Herfindahl Index by 0.29. The change is equivalent to moving from highly concentrated to unconcentrated. The market for bonds that are not subject to restrictions on negotiated sales is 0.15 more concentrated than the market for restricted competitive sales. The former is highly concentrated while the later is unconcentrated.

## 2. The US Municipal Bond Market

With $466 billion issues per year between 2004 and 2016, the primary market for municipal bonds is one of the largest financial markets in the US. Table 1 classifies the ten largest primary markets in the US by size. The muni bond market is the fifth largest market in the country. The largest markets are those of mortgage-related securities and US treasuries, which are around four times the size of the muni bond market, respectively. At the bottom of the table we have venture capital and IPOs, which are less than one-tenth the size of the muni market, respectively.

The muni bond market is opaque and fragmented. Cestau, Hollifield, Li, and Schürhoff [2018b] state that both characteristics are the result of the asymmetric tax treatment of out-of-state and in-state bonds and the fact that transactions take place in

a dealer intermediated over-the-counter (OTC) market. The asymmetric tax treatment curbs dealers competition [Li and Schürhoff, 2019], and limits arbitrage and risk sharing across state borders (Schultz 2013 and Babina et al. 2019). In addition to its effects on pre-trade transparency, the nature of the muni OTC market leads to substantial dealer market power, which reinforces segmentation [Green et al., 2007b].

There are many consequences of the numerous market frictions that characterize the muni market. Defaults by general purpose governments are extremely rare, yet credit risk premiums are disproportionately high. Despite the large trading volume, liquidity is low and trading costs and premiums are high (Harris and Piwowar 2006 and Hollifield et al. 2017). Bond yields deviate from the law of one price, and price dispersion is high (Green et al. 2007a, Schultz 2012, and Cestau et al. 2013). And not to forget the muni-bond puzzle — yields are too high compared to treasury ones.

Between 1990 and 2014, 57.4% (26.1%) of all new-money (refunding) issues by general purpose governments, universities, school districts, and special purpose districts, were sold in competitive sales, 39.9% (72.0%) in negotiated sales, and 2.67% (1.95%) in private placements. Figure 1 shows the proportion of competitive sales by state and refunding status between 1990 and 2014. The figure only contains contiguous states. The intensity of the color indicates the proportion of competitive sales in the state. States with a proportion of competitive sales below 25% are painted white. Above this number and below 50%, they are painted in a very light color. A darker color indicates a proportion between 50% and 75%. The darkest color is used when the proportion of competitive sales is above 75%. Black and large numbers in the center of each state show the exact proportion of competitive sales. Smaller and gray numbers show the size of the sample. Of the the contiguous states, the proportion of competitive sales of new-money (refunding) bonds is below 25% in 11 (28) states, between 25% and 50% in 8 (9) states, between 50% and 75% in 21 (10) states, and above 75% in 8 (1) states. Competitive sales are significantly more frequent for new-money bonds than for refunding bonds.

# 3. Sample

I obtained the data from Thomson Financial's SDC Platinum database. The data is at the deal level, the unit of observation. Deals are groupings of bonds within a new issue. Municipal issuers may divide new issues into different groups for a variety of reasons. These groups are clearly marked in the name of the bonds. Each deal in the SDC database corresponds to one such division. Most times new issues are not divided, and there exists a one-to-one correspondence between deals and issues.

The initial sample has 423,409 deals between 1966 and 2014. For each deal, I obtained data on issuer characteristics, such as the name of the issuer, the county of the issuer, the state of the issuer, the CUSIP of the issuer, and the government type of the issuer. I also obtained data on various deal characteristics, such as the sale date, deal amount, issue amount, the abbreviated name of the issue, name of the lead underwriter, bid type, taxable status, refunding status, and coupon type.

## 3.1. School districts

The primary market for municipal bonds is dominated by a large number of highly diverse participants, ranging from the state of California to villages in Vermont. Most independent government units are authorized to issue bonds. According to the Census Bureau's 2012 Census of Governments, the list of local independent governments includes 3,031 counties, 15,519 municipalities (cities, towns and villages), 16,360 townships, 12,880 independent school districts, and 38,266 special districts of 24 different types.

From the initial sample, I keep the sample of deals issued by independent school districts. The objective is to take the most homogenous and largest sample of deals possible to eliminate potential confounding factors related to systematic and unobserved differences among the municipalities in different states. School districts are the most homogenous type of issuer in the country. In general, school districts have very simi-

lar missions and goals, perform similar functions, are measured by similar metrics, and are financed in relatively similar ways. Moreover, the purposes for which they are authorized to issue bonds are remarkably alike across states. Additionally, education is generally considered a state matter, not a municipal affair. So they are primarily regulated by the general laws of the state, and not by local laws under the home-rule doctrine. Which brings additional homogeneity to the schools within state borders.

School districts conform very well to the goal of homogeneity. They also fit the sample size objective. There are 97,591 school district deals in the sample. They also have an additional benefit. Because education is a state matter and is regulated by state laws, it is feasible to collect these laws and the amendments thereof and use them to overcome the selection biases that frequently arise in applied econometrics. [1]

I use the government identifier of the SDC database to eliminate 294,261 observations from the sample. However, the identifier does not separately identify school districts and the 24 types of special purpose districts. I use a set of 45 *regular expressions* to drop special purpose districts—26,836 observations—, and secondary types of school districts, such as community college districts, library districts, charter schools, special services districts, vocational schools, and other education-related districts—4,721 observations. As anticipated above, the sample of school districts contains 97,591 observations.

## 3.2. Bond types

The authorization laws under which school districts issue bonds are codified into different sections of the codified laws of the states. Broadly speaking, these sections correspond to bonds and notes, temporary borrowings, lease revenue bonds and certificates of participation, revenue bonds, and some special bond and note authorization laws. Cestau, Hollifield, Green, and Schürhoff [2018a] describe each division in more detail.

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[1]It is not feasible to collect such data for many other government units. Many special districts and government agencies are created by countless private laws, sometimes not even codified. The municipalities in 37 states are allowed to become home-rule municipalities, which means that they can individually pass ordinances that override the state laws in "municipal affairs". I also collected the state laws that regulate the state bond issues, but they are arguably not exogenous, and so they can not be used to overcome the selection biases.

I drop the temporary borrowings from the sample. Temporary borrowings include *bond anticipation notes* (BANs), *tax and revenue anticipation notes* (TRANs, TANs, and RANs), and a few other anticipation notes. TRANs have maximum statutory maturities of less than 15 months, and BANs have maximum legal maturities of less than three years. Both types of obligations behave differently from the different types of long-term obligations. They are not rated in general, they have a different clientele —institutional investors—, and they do not modify the long-term tax levels, but rather they are issued to anticipate budgeted revenues and proceeds.

I classify the types of long-term obligations into two groups: *COPs* correspond to the lease revenue bonds, installment agreements and certificates of participation, and *bonds* include all other types of bonds and notes.

I use the variable *abbreviated name of the issue*[2] in the SDC database to identify temporary borrowings, COPs, and bonds. It is not simple, however. Because the state laws suggest different bond names and customary practices are different in each state, the names of the deals vary significantly between states. In addition, the SDC database is not consistent in the way it abbreviates names and uses different texts to abbreviate the same names. In total there are 5,856 different deal names.

I followed the next steps to assign a bond type to each deal in the sample. By state and for each deal name or group of "sufficiently" similar deal names, I hand-collected from the official statements available at the MSRB data repository, the exact authorization law or laws under which the deals with such name or names were issued. There are several complexities added to this step. First, there is no one-to-one correspondence between bonds and enabling laws. State laws may offer alternative ways, in different enabling laws, to issue exactly the same bond, so the same bonds may be issued under different laws. State laws may also offer supplementary ways to issue exactly the same bond, so sometimes bonds are issued under two or more laws at the same time. Bond issues are regulated in different sections of the codes, complementing and superimposing each other. As a result, official statements usually point to several sections of the

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[2]The actual name of the variable is *IssueDescription*

code. Second, the exact authorization law or laws are not always clearly identified in the official statements. Sometimes, the official statement indicates the exact sections of the code of all the enabling laws. Other times, it states the exact location of a subset of the enabling laws. Sometimes, it points to the chapters or broader divisions in which they are located. Occasionally, they are not indicated at all. To increase complexity, the way in which the enabling laws are reported in the official statements does not vary much within states. So it is possible that none of the bonds in a state have information about the enabling laws in the official statements. In such cases, the solution is to either search the code or ask a bond lawyer in the state. Third, official statements are rarely available for older issues and for some types of bonds. Fourth, official statements from prior to 2007 are not usually digitalized, so it is not possible to use *regular expressions* to "search" the document. In the process, I also obtained data on all the different authorization laws and types of bonds available in each state.

Once I obtained the enabling laws, I matched the texts of the laws to one of the three bond types defined above. In total, I identified 20,013 (632) new-money (refunding) temporary borrowings, 43,660 (25,351) bonds, and 4,923 (2,318) COPs. I was not able to identify the type for 591 (103) deals. In the process, I also corrected the refunding identifier of the SDC database for 448 deals.

## 3.3. Security types

Detroit's default made one thing clear, not all GO bonds are created equal. The recovery rates of the three types of outstanding general obligations were 73%, 42%, and 12%, respectively. Of course, not all revenue bonds and COPs are created equal, either. I use the security classification developed in Cestau, Hollifield, Green, and Schürhoff [2019] to classify the security of the bonds in the sample. By default, a bond or COP creates a long-term financial obligation backed by all available funds of the issuer. The issuer can limit the security to specific sources of funds, include termination clauses, or, on the contrary, augment the security by pledging all available resources and taxing power of the issuer. This is commonly known as pledging the *full faith and credit* of the issuer

(FFC), and it is legally a *general* pledge. In addition to or in lieu of the general pledge, the issuer may pledge *specific* sources of funds. For school districts, the most common sources are ad-valorem taxes, county or state sales taxes, state aid, federal aid, and special assessments. In addition, there are different types of ad valorem taxes. They can be classified as dedicated, special, capital, and general. Each has a different usage restriction. The dedicated one can be only used to service debt. The type of ad-valorem tax was the key feature that distinguished the bonds with the highest recovery rates in Detroit's default. Finally, the pledge of ad valorem taxes may be limited or unlimited.

The security of muni bonds comes mostly determined in the authorization laws. The issuer has as much space as permitted by the enabling law to modify the security of the bond, and it is always very limited. I classify the security of all deals in the sample based on the texts of the enabling laws and the information on the security of the bonds available in the official statements. The official statements, when available, are not always clear about the security of the bond, or they may provide incomplete information. The legal language is not simple to interpret and classify either. The classification process required the assistance of many bond lawyers throughout the country.

Figure 2 shows the securities of new-money bonds by state. In the figure, the securities of the bonds are simplified with respect to the above classification. The first chart plots the bond security of the most common security in each state. The second chart plots the second most common security in each state. The third chart, the third most common security in each state. The white color indicates deals with termination clauses. Termination clauses only appear in COPs, so there are no white states in the figure. Light pink indicates deals backed by all available funds of the issuer without a FFC pledge or specific pledge (GF). Plain pink indicates deals backed only by the FFC of the issuer (GO). Plain red indicates deals backed only by a specific and limited source of funds (RV). The specific source of funds could be any of the above listed. Dark red indicates deals backed by a specific pledge of limited ad-valorem taxes and by the general pledge of the FFC of the issuer (Ltd GO). Finally, purple indicates deals backed by a specific pledge of unlimited ad-valorem taxes and by the general pledge of the FFC of

the issuer (Ultd GO). This category includes double-barreled bonds and does not differentiate between types of ad-valorem taxes. The black numbers in the center of each state indicate the number of deals with the corresponding bond security in the state.

School districts in most states are authorized to issue bonds backed by a specific pledge of unlimited ad-valorem taxes and by a general pledge of the FFC of the school. In most cases, this is the most commonly observed security. In some cases, they are allowed to issue bonds of different securities. In other cases, the law has changed during the observation period, and that is why we observe more than one bond security in the state. In recent years, many states have passed laws that have limited the power to pledge unlimited ad-valorem taxes. Some states do not appear in the figure. School districts in these states, including Alaska and Hawaii, are not authorized to issue bonds whatsoever, except in Kentucky, where school districts issue COPs backed by unlimited ad-valorem taxes and the FFC of the issuer instead.

## 3.4. Statutory restrictions on negotiated sales

One reason why competitive sales are so prevalent in the municipal market compared to other financial markets worldwide is that many municipal issuers are not legally authorized to sell bonds in negotiated sales. In many instances, it is not that the issuer chooses to use an auction, it simply does not have the option.

I used the hand-collected authorization laws to collect, by hand, the laws that regulate the sale of school bonds. The bridge between the enabling laws and sales laws is not obvious. In the best of cases, the enabling law also regulates the sale of bonds. In the second best scenario, the enabling law cross-references the sections of the code that regulate the sale of bonds. In the third best-case scenario, the enabling law makes a general cross-reference to another law where bond sales are regulated. But too often, these are not the case. Either, there is no cross reference, or if there is, it does not regulate the sale of bonds. In that case, the relevant provisions are likely located somewhere in the chapters that regulate public education and municipalities. However, these chapters

might not be grouped within a single division of the code. They might be scattered throughout the code. The codified laws are organized in very different ways in each state. In the worst case, the sales provisions do not even exist.

Once the sales laws are located, there are some additional complexities. First, the sections of the code relating to the sale of bonds may be located in more than one chapter of the code. Best-case scenario, they complement and do not contradict each other. In other cases, they contradict each other. Either one has overridden the others, or they offer alternative ways to issue bonds. Sometimes it is neither. The legislator was not careful enough and made a typographical error or did not use the appropriate language. Second, the sales laws generally provide exceptions to the restrictions on negotiated sales based on coupon type, amount, taxable status, maturity, and other reasons. Third, legal language is not always easy to interpret, and the correct interpretation depends on the customary practices and legal doctrines of the state. The same text that enables negotiated sales in one state may disallow them in another state.

For the above reasons, in the construction of this database, I was assisted by 117 experienced bond lawyers throughout the country[3]

Collecting and interpreting the laws in force today is not the most challenging part. The laws are not static. They are repealed and amended from time to time. The hardest part is getting the texts of all the laws amended and repealed. Sometimes, the current law provides a complete list of all the bills that have ever amended each section. In some cases, they provide data on the last amendment, and it is possible to recursively obtain the complete history of amendments. In other cases, there is no information available. There are some repositories, such as *Justia Law*, that contain previous versions of the codes from which the older texts of the laws can be obtained. However, in general, these repositories do not provide versions of the codes prior to 2005. When there is no history of amendments or previous versions available, the only option is to search year by year, in the repositories of bills of the state legislatures.

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[3]I have contacted around 1000. When I had questions related to the laws of South Dakota I was assisted by the son and mentee of the bond lawyers that wrote the law.

Sometimes, the law that contains the provisions relating to the sale of bonds has not been promulgated long ago. This means that the current law has repealed a previous law altogether, instead of amending it. When the laws are repealed, their texts are completely erased from the codes, and in most cases, there is no information on what used to be the location of the repealed laws in the previous codes. Thus, almost no traces of the texts of the repealed laws remain. If available, it is possible to obtain the location of a repealed law in old official statements. Otherwise, a patient search of the repositories of the state legislature is required. Finally, the hardest is to find the texts of the full history of amendments to the laws that have been repealed.

I drop the observations from the state of Tennessee—64 observations— because most school districts in Tennessee are incorporated under private laws, and thus, their sales laws are not available. Figure 3 shows the proportion of competitive sales by state and type of law restriction. A deal is classified as *restricted* if it has a restriction on negotiated sales, or *free* if such restriction does not exist. The intensity of the color indicates the proportion of competitive sales in the state of the deals with the corresponding restriction type. States with a proportion of competitive sales below 25% are painted white. Above this number and below 50%, they are painted in light green. A darker green indicates a proportion between 50% and 75%. The darkest green is used when the proportion of competitive sales is above 75%. Black numbers in the center of each state indicate the number of observations by state and restriction type.

Of the 41 states remaining in the sample, there are restricted deals in 22 states, and free deals in 37 states. Arkansas, Oklahoma, Vermont, and West Virginia are the only fully restricted states. North Dakota, Indiana and New Mexico are almost fully restricted. States with both types of restrictions may arise for three reasons: They authorize secondary bond types that do not have restrictions on negotiated sales. The laws have changed during the observation period. The laws provide exceptions to the restrictions. As expected, most restricted deals are sold in competitive sales. However, most free bonds are predominantly sold in negotiated sales. The proportion of competitive sales is under 25% in 19 of the 37 states that authorize negotiated sales. Utah and New

England states are marked exceptions. They are fully free and most deals are sold in competitive sales. In South Carolina, most free deals are also sold in competitive sales. However, free deals are a small fraction of restricted deals in the state. We also observe a high proportion of competitive sales, between 50% and 75%, in Minnesota, Iowa, and Michigan. Louisiana and Maine also present similar values. Overall, the figure highlights the importance of taking into consideration the restrictions on negotiated sales when analyzing the behaviors of municipal issuers. Failure to do so may lead to the wrong conclusions. It seems that a high proportion of muni issuers prefer competitive sales. But the truth is that when they are allowed to choose, they predominantly prefer negotiated sales.

## 3.5. Periods

The banking sector is very dynamic. Constantly, new banks are created, they disappear, they merge and acquire each other, sometimes the buyer adopts the name of the acquired (e.g. Travellers Group and City Corp.), sometimes the opposite, or the merged bank selects a new name, bank names change over time, brand names change, banks create new divisions and subsidiaries, brand and branch names disappear but not the parent bank (e.g. Wachovia, Salomon, Paine-Webber), or sometimes they just exchange divisions with each other. In the sample, a bank that changed names during the observation period resembles two banks with half the market concentration each. Two banks that merge look like three banks in the data. A branch that disappears, but not the parent bank, looks like a bank absorbing all the market share of another bank.

If we are not careful, measurement error accumulates. To reduce measurement error, I divide the observation period into five periods of five years each and calculate market concentration for each period. The periods are: 1990-94 (period 1), 1995-99 (period 2), 2000-04 (period 3), 2005-09 (period 4), 2010-14 (period 5).

I also replace the name of every *lead manager* in the sample with the name of the parent company. When banks merge, and the name of the new bank differs from the

names of both merged banks, I replace the name of the bank with the name most similar to the merged bank with the name of the merged bank. I reconstruct the complete history of mergers and acquisitions for each bank and assign names following this criterion. The names of 14,983 lead managers change with respect to the SDC database.

## 3.6. Final Sample

The SDC data is rather incomplete before 1990. Thus, I drop observations prior to 1990 (6,486 observations). I drop observations from the states of Connecticut, Massachusetts, and Maine (355 observations) because school districts in these states are intrinsically different from school districts in other states. They do not have taxing powers, and bond issues are ultimately a joint and prorated obligations of two or more member towns.

The final sample contains 75,791 deals (21,606 restricted deals). It includes 43,320 (16,968 restricted) new-money bonds, 25,230 (2,179) refunding bonds, 4,923 (1,508) new-money COPs, and 2,318 (951) refunding COPs in states in 39 states.

# 4. Market Concentration

## 4.1. Indicators of national concentration

I use three types of indicators to measure concentration in the underwriting industry: the ratio of the number of annual issues to the number of annual active underwriters, several concentration ratios, and the Herfindahl index (HI).

Nationwide, the number of annual active underwriters has declined by a third in the last two decades. Chart (a) of Figure 4 shows the evolution in the number of annual issues in my sample and the number of active underwriters per year. While the former increases, the latter decreases sharply. These trends have led to an increase in the number of annual issues per underwriter, as shown in chart (b). Chart (c) shows the breakdown of this ratio by bond type, and (d) presents an indexed version of (c) to

facilitate comparability, where the four indices cross at 100 in the year 2000, the base year. Although lower for COPS than bonds, concentration, as measured by the afore-mentioned ratio, has followed similar paths for the four types. Trends are similar and detrended correlations are positive, reaching values as high as .61 and .74 between both types of new-money issues, and both types of refunding issues, respectively.

Figure 5 exhibits the paths of several additional concentration indicators. The Herfindahl index of the industry, either measured from the market shares of observed deals in the sample or the total notional amount thereof, has almost tripled between 1990 and 2014. The concentration ratios, measured in terms of deals or notional amounts, of the top underwriting firm, the top two, and the top three have more than doubled dur-ing the same period, and those of the top five, ten, twenty, and thirty firms have risen dramatically. Nevertheless, they have all remained extremely low compared to other in-dustries and the upper threshold of unconcentrated industries of the Horizontal Merger Guidelines of August 19, 2010, by the Department of Justice. Table 2 shows the Herfind-ahl index and several concentration ratios of the industry between 1990 and 2014 for the ful sample and the samples of each bond type, in terms of deals and notional amounts. Although the HI of refunding COPs — 0.05 — is significantly higher than those of new-money COPs, refunding bonds, and new-money bonds, in that order, they are all an order of magnitude lower than 0.15, the upper threshold of *unconcentrated markets* sug-gested in the aforementioned guidelines. The combined market share of the six largest underwriters is less than 25% of all deals in the sample and only 28.65% of the total notional amount. The combined share of the top 48 underwriters is just 71.1% (80.8%) of all deals (notional amount).

All of the above indicators suggest that concentration in the underwriting business is exceptionally low. However, Figure 6 shows that the muni market is far more concen-trated than it seems. In this figure, I use heat maps to plot the geographical distribution of the underwriting activity of the 48 largest firms between 2010 and 2014. The heat maps for the remaining periods can be found in Appendix A. To construct these plots, first, I formed groups of six, based on size, to ease visualization. The first group con-

tains the six largest underwriters in this period, the second group the following six largest firms, and so on, till the last group which contains the 43 to the 48 largest firms in this period. Each row in this figure plots the geographical distributions of a different group of firms. Within groups, firms are also ordered by size and assigned a different color. Red always represents the largest firm of the group, yellow the second largest, followed by green, cyan, blue, and purple, in that order. For each group, I measure the underwriting activity of each firm in the group in each county and assign the color of the most active firm to the county. This way I avoid hyper-complex color combinations; It also helps to identify the dominant firm in each county. The left column plots measure underwriting activity by the number of deals underwritten in the county; The right column plots measure underwriting activity by notional amount. In case of a tie, I assign the color of the underwriter with the lowest rank. Ties seldom happen and the way they are solved is visually irrelevant. If a school district serves in more than one county, I allot the entire issue to each county in which it operates. I also use two color intensities to reflect the intensity of the underwriting activity of the most active firm in the county. In the left column plots, lighter colors indicate that just one deal was underwritten by the firm with the most deals in the county, and in the right column plots, they indicate that less than 10.22 mil were underwritten by the most active firm in the county. Both values correspond to the median county activity of the most active firm in each county.

Figure 6 reveals several interesting facts that are worth mentioning. First, underwriters act locally, not nationally. Therefore, it is not very informative to compute national indicators of concentration when underwriters do not cross state borders, or at least not many borders. Even the top six underwriting firms do not have a strong presence in every corner of the country. On the contrary, they tend to be more active in specific regions of the country, although not always contiguous. As we descend in the rankings of the largest firms, these regions of activity become increasingly smaller and more and more contiguous. Second fact, and more striking than the first, we do not see many mixtures of pixelated colors as in the stands of old sports video games. That is, in regions where one firm has an active presence, no other firm of the same group appears. It does not necessarily mean they are absolutely absent from such regions, but at least it means that

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underwriters tend to clearly prevail over similar size underwriters in the regions where they are active. Local concentration seems extremely prevalent. It is common to see an underwriter painting an entire region of one solid color. Sometimes state boundaries are clearly distinguishable. Third fact, some underwriters, with an absolute presence in every county of one state, have no activity whatsoever in border counties from other states. All in all, Figure 6 provides evidence of a high degree of geographic segmentation and concentration in the muni underwriting business. Therefore, it seems more appropriate and relevant to measure market concentration by state rather than nationally.

## 4.2. Indicators of state concentration

I calculated the Herfindahl index and several concentration ratios for each state and period in terms of deals and notional amount. Median values — across states — are reported in Table 3. Mean values are similar to median values, and they are reported in Table B.1 of Appendix B. We can make two important remarks based on these indicators of state concentration.

First, as it was anticipated in the analysis of Figure 6, the median state concentration is much higher than the national concentration. In every period and for every bond type, the median state HI is one order of magnitude higher than the corresponding value reported in Table 2. Before, based on the national value of the index, we concluded that the industry was highly unconcentrated. However, the median state HI is around 0.20 in the last period, which points to a moderately concentrated industry according to the guidelines of the Department of Justice. Moreover, when we perform the same analysis by bond type, we find that, in the last period, the underwriting industry of new-money bonds was moderately concentrated — between 0.15 and 0.25 —, that of refunding bonds was highly concentrated — above 0.25 —, and those of new-money and refunding COPs were almost super concentrated — above 0.50 —. It is not straightforward to interpret the Herfindahl index, however. To facilitate its interpretation, I make some simplifying assumptions to express the index in terms of market shares of the top underwriting firm. Let us assume that there are ten underwriters, where the second underwriter is half the

size of the first, and the remaining eight are the same size. These assumptions resemble fairly well the distribution of market shares in the median state. A HI=0.15 implies a market share of the top underwriter of 30%. A HI=0.25 implies a market share of 43%. A HI=0.50 implies a market share of 63%.

We will reach the same conclusion if we look at the concentration ratios in Table 3. The median state concentration is much higher than the national one. While the six largest firms had a combined market share of 22.2% (28.6%) of all deals (notional amount) in the country, in the last period, just the median largest firm had a market share of 32% of all state deals and notional amount. While the 48 largest firms had a combined market share of 71.1% (80.8%) of all deals (notional amount) in the country, in the last period, just the median five largest firms had a combined market share of 81% (80%) of all state deals (notional amount). When we analyze the breakdown by bond type, we find that concentration ratios increase for refunding bonds, new-money COPs, and refunding COPs, in that order. In each of periods two, three, and four, the median of the combined market share of the two largest underwriters is 100% of all state deals and notional amount.

Nevertheless, not all states resemble the median state and not every state is moderately concentrated. There is variation across states in the HI. Figure 7 shows the Herfindahl index in terms of deals for each state and period. Unconcentrated states are painted white — below 0.15—, moderately concentrated states light-blue, a darker color indicates highly concentrated states, and the darkest blue indicates super concentrated — above 0.50 —. Black and large numbers in the center of each state show the value of the index. Smaller and gray numbers show the size of the sample in each state and period. In the last period, between 2010 and 2014, there were 12 unconcentrated states, 14 moderately concentrated states, nine highly concentrated states, and two super concentrated states. Figure B.1 in Appendix B breakdowns Figure 7 by bond type. As we move from new-money bonds to refunding COPs, the graphs become more uniformly dark.

Second, concentration has increased over time. Based on the Herfindahl index, the underwriting industry has gone from being unconcentrated to being moderately concen-

trated in terms of deals, and from being borderline between unconcentrated and moderately concentrated in terms of notional amount, to being moderately concentrated. When we analyze the breakdown by bond type, we observe the same pattern for new-money bonds, and a shifted pattern for refunding bonds. Refunding bonds went from being moderately concentrated to being highly concentrated in terms of deals, and slightly below borderline between moderately and highly concentrated, to slightly above borderline in terms of notional amount. Although more concentrated than bonds, COPS do not show any clear pattern. An analysis of the concentration ratios yields analogous results. The increase in concentration is also clearly visible in Figure 7. As we move from period 1 to period 5, the number of blue colored states increases to the detriment of the number of white colored states. The same pattern is also visible in the breakdowns by bond type in Figure B.1.

One question that naturally arises is what caused the increase in concentration. Many potential factors can play a role, such as mergers and acquisitions in the banking industry, or the convergence to a higher long-term concentration level. However, in the next section, I show that the increase in negotiated sales has played a fundamental role in the observed increase in concentration.

# 5. Effect of competitive sales on concentration

## 5.1. Effect on the number of active underwriters

In this section, I study the relationship between competitive auctions and the number of active underwriters. Likely, the number of deals is one of the main determinants of the number of active underwriters. Figure 8 seems to confirm this hypothesis. The figure presents a scatter plot where each dot indicates the number of deals observed in a given state and period and the number of active underwriters observed in that same state and period. Each combination of state and period is a different observation. Clearly, the two variables are positively related. The number of active underwriters increases with the

number of deals. A linear relationship has an $R^2$ of 0.44, which indicates a good fit. However, it is evident in chart (b) that a linear relationship has a poor fit at the lower end of the graph. A non-linear relationship of the form $y = b_0 + b_1 x^{b_2}$ has just a slightly better fit overall — $R^2 = 0.51$—, but performs especially better at the lower end of the plot.

The question is whether we observe a stronger relationship between the number of deals and active underwriters for competitive deals. For each state and period pair, the unit of observation, I calculate the proportion of competitive deals. I divide the sample into two: the sample of observations with a proportion of competitive deals above the median —competitive state-period—, and the sample of observations below the median —negotiated state-period—. The median is 44%. I estimate the above non-linear relationship for each sample. Chart (a) of Figure 9 plots the fitted values of the "competitive state-period" sample and the "negotiated state-period" sample. The fitted curve of the former lies significantly above the latter, especially in the segment of the graph where we observe the most observations in Figure 8. Irrespective of causality, the relationship between the number of deals and active underwriters is stronger when we observe a high proportion of competitive deals in the state.[4]

I also estimate the above non-linear relationship for the sample of competitive deals and the sample of negotiated deals. In every state-period observation we observe a mix of competitive deals and negotiated deals. Thus, for each observation, I count the number of competitive deals and the number of active underwriters of competitive deals, and I do the same with negotiated deals. For each state-period pair, I count the number of negotiated deals and the number of underwriters doing negotiated deals. I estimate the non-linear relationship for each sample. Chart (b) of Figure 9 plots the fitted values of the "competitive deals" sample and the "negotiated deals" sample. Consistent with (a), the fitted curve of the former is significantly higher than the latter. Moreover, the difference is notoriously larger. [5]

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[4]I also estimated the following non-linear relation: $y = b_0 + b_1 x^{b_2 + b_3 * I_c}$, where $I_c$ is an indicator variable for the competitive sample. The coefficient $b_3$ is positive and statistically significant at the 1% significance level. That is, the slope of the competitive sample is significantly higher.

[5]I also estimated the following non-linear relation: $y = b_0 + b_1 x^{b_2 + b_3 * I_c}$, where $I_c$ is an indicator variable for the competitive deals sample. The coefficient $b_3$ is positive, larger than before, and statistically

It is clear that the relationship between the number of deals and the number of active underwriters is stronger for competitive deals. The question is whether there is a causal relationship between competitive deals and the number of active underwriters. We can rule out reverse causality. The purposes for which a school can be authorized to issue bonds are clearly specified in the authorization laws. Moreover, most new-money bonds need to be approved in a referendum, and refunding bonds must have a clear economic benefit. Some underwriters might encourage some issuers to issue refunding bonds in negotiated sales, but it is unlikely that the number of active underwriters in negotiated deals has a significant effect on the number of issues.

The relationship between competitive deals and active underwriters might be caused by a confounding factor. However, the difference between the estimated relationships lies not in the intercepts of the fitted curves, but in the slope of the curves. Therefore, it is not just causing more competitive bids and more active underwriters in a state. It means that the confounding factor must affect the propensity of the school for using competitive sales and the speed at which the number of active underwriters increases with the number of deals. It is an intricate and unlikely chain of causal relations. In any case, I use the sales laws to study whether competitive sales increase the number of active underwriters. Chart (c) of Figure 9 shows the fitted values of a sample of "restricted" bonds and a sample of unrestricted — "free" — bonds. On the one hand, the fitted values are not subject to confounding factors, but on the other hand, the results are nuanced by the fact that free bonds in many states are predominantly sold in competitive deals anyway. Nevertheless, consistent with (a) and (b), the fitted curve of the restricted sample lies above the fitted curve of the free sample. As expected, the difference between curves is smaller than before. [6]

All in all, there is evidence that competitive auctions increase the number of active underwriters in the state.

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significant at the 1% significance level.

[6]I also estimated the following non-linear relation: $y = b_0 + b_1 x^{b_2 + b_3 * I_c}$, where $I_R$ is an indicator variable for the restricted sample. The coefficient $b_3$ is positive but not statistically significant at the 10% significance level.

## 5.2. Effect of the proportion of auctions on the State Herfindahl Index

In this section, I study whether competitive auctions decrease concentration. Figure 10 presents six scatter plots where each dot indicates the proportion of competitive deals and the HI of a different observation. The unit of observation is the pair of state and period. The left column plots calculate the HI in terms of deals, and the right column plots in terms of notional amount. The first row plots use the full sample, the second row plots use the sample of new-money bonds, and the last row the sample of refunding bonds.

The two variables seem to be negatively related in every sample, regardless of how we measure HI. A higher proportion of competitive sales is associated with a lower concentration. The relationship looks stronger in the sample of new-money bonds when the proportion of competitive bids is below 80%. Above 80% the dispersion of HI increases. Dispersion is also high when the proportion of competitive sales is low. We also observe a shift to the right when HI is measured in terms of notional amount. A possible explanation is that large size deals in states with low issue activity and small size underwriters are more than 20% more likely to be competitive. Given their high relative weight, they disproportionately inflate the percentage of competitive deals in terms of notional amount. They also increase the market share of the firm underwriting them. The two might also explain why we observe a weaker relationship in the sample of new-money bonds when HI in measured in terms of notional amount.

I quantify the relationship by regressing the HI against the proportion of competitive sales for each sample. Table 4 shows the estimated coefficients. I estimate three specifications in each case. One without control variables, one that includes state fixed effect, and one that also includes period fixed effects. Other controls are irrelevant and omitted. The coefficients that measure the effect of competitive sales on HI are all largely negative and significant at the 1% significance level. They all show that competitive sales have a huge impact on concentration. According to the guidelines of the Department of Justice, a market that reduces its HI by -0.10 points, from 0.25 to 0.15, goes from highly con-

centrated to unconcentrated. The median coefficient in Table 4 is -0.22, more than twice that reduction. The HI is between 0.15 and 0.25 in the full sample. A -0.22 reduction, centered around these values, means going from being deep in the highly concentrated range to being deep in the unconcentrated range. This is the effect of going from fully negotiated to fully competitive.

To facilitate the interpretation of the effects on HI, I will express them in terms of market shares of the largest underwriter. I take the same simplifying assumptions as before, and I assume that we start from a HI=0.45. The coefficient on the proportion of competitive sales in the full sample is -0.29 (-0.29) when we include state and time fixed effects and we measure HI in terms of deals (notional amount). This means that going from fully negotiated to fully competitive decreases the market share of the largest underwriters from 60% to 32% (32%). The coefficient in the sample of new-money bonds is -0.26 (-0.25) in the third specification. Going from fully negotiated to fully competitive decreases the market share of the top underwriter from 60% to 36% (38%). The coefficient in the sample of refunding bonds is -0.11 (-0.15) in the third specification. Going from fully negotiated to fully competitive decreases the market share of the top underwriter from 60% to 52% (48%).

It is important to highlight that the situations fully negotiated and fully competitive are feasible. There are many almost fully negotiated and almost fully competitive observations in the sample, and a few are 100% either competitive or negotiated. Regarding identification, it is important to notice that there is also a lot of within-state variation in the proportion of competitive sales. For example, Montana went from fully competitive to fully negotiated.

Table 5 presents the results of a robustness test. I estimate the first and third specification of Table 4 in the sample of new money bonds backed by unlimited and dedicated ad-valorem taxes. I do not include double-barreled bonds. Nor do I include bonds backed by unlimited ad-valorem taxes that are not levied exclusively for the service of debt. The objective is to take the most homogenous and largest sample possible to eliminate possible confounding factors related to the statutory security of the bond. Although

not authorized in every state, this type of bond security is the most commonly used for new-money bonds. All the coefficients are significantly larger than their counterparts in Table 4. The coefficient on the proportion of competitive sales is -0.35 (-0.36) when we include state and time fixed effects and we measure HI in terms of deals (notional amount). Going from fully negotiated to fully competitive decreases the market share of the top underwriter from 60% to 10% (10%).

Every result presented in this section suggests that the proportion of competitive sales in the state has a huge positive impact on concentration.

## 5.3. Effect of competitive sales on the State Herfindahl Index

In this section, I study the difference in concentration between competitive sales and negotiated sales. Every period, we observe both negotiated deals and competitive deals in most states. For each pair of state and period, I calculate the Herfindahl Index in the sample of competitive deals in the state and the Herfindahl index in the sample of negotiated deals in the state. Thus, in this case, the unit of observation is the state-period-method triplet. Table 6 reports median values across states by period and sales method in the full sample, and the samples of new-money bonds, refunding bonds, new-money COPs, and refunding COPs. The table reveals several interesting facts.

First, negotiated deals are far more concentrated than competitive deals. In the refunding COPs sample, the average reported value for negotiated sales is around 50% larger than that of competitive sales. Excluding the sample of refunding COPs, the average of all reported values for negotiated sales — 0.31 — is twice as large as the average of all reported values for competitive sales — 0.15 —. The foregoing is also true if we calculate the average by sample or by the way in which we measure HI. The difference is economically huge. The HIs of competitive deals in the full sample, in the new-money bonds sample, and in the refunding bonds sample, are on average below the threshold between unconcentrated and moderately concentrated. The HIs of negotiated deals are on average above the highly concentrated threshold in the same samples.

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Second, concentration, in terms of deals and notional amount, has increased significantly over time in the sample of negotiated deals. The increase has been quite uniform in terms of deals. In terms of notional amount, there are some ups and downs, but with a clear upward trend.

Third, concentration has remained stable in the sample of competitive deals regardless of how we measure HI. In particular, it has remained very stable in the sample of new-money bonds, while it has decreased significantly, both in terms of deals — from 0.14 to 0.12 — and in terms of amount — from 0.26 to 0.12 — in the sample of refunding bonds. This fact contrasts with the overall increase in concentration reported in Section 4.2. Cestau, Hollifield, Green, and Schürhoff [2018a] show that the proportion of negotiated sales has increased significantly throughout the country. Thus, the overall increase in concentration has been caused by the increase of negotiated sales, which are more concentrated than competitive deals, and by the increase in the concentration in negotiated sales. Competitive sales have not contributed to the increase in concentration.

Note that, on average, the coefficients on the proportion of competitive deals in Section 5.2 are larger than the average difference in HI between competitive sales and negotiated sales. Also, note that all period fixed effects in Section 5.2 are economically small and most of them are not statistically significant at the 10% significance level. However, in this section, we observe an upward trend in concentration in the sample of negotiated sales. These inconsistencies are reconciled by the fact that the proportion of negotiated sales and the concentration in the negotiated sales have followed the same trend, and that there was no time trend in the competitive deals. Therefore, the time trend in negotiated sales was absorbed by the proportion of competitive deals variable and not by the period fixed effects.

Table 7 presents the results of a series of robustness test. First, I calculate the Herfindahl index in the sample of new money bonds backed by unlimited and dedicated ad-valorem taxes. The difference in concentration between the samples of negotiated and competitive deals increases substantially with respect to that found in the sample of new-money bonds. The average periodic difference in the HI in terms of deals (notional

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amount) increases from 0.15 (0.17) to 0.19 (0.22). Concentration in the competitive deals decreases and concentration in the negotiated deals increases. Other than that, all results remain qualitatively the same. I use this sample and the sample of new-money bonds in the following two robustness tests.

I also calculate the HI of each state-period-method triplet after excluding potential quasi-competitive sales from the two samples. I classify a competitive sale as potentially quasi-competitive if it is not mandatory to publish a public notice of the competitive sale or if the issuer can request bids by invitation. Either case, the issuer can limit participation of potential bidders. Which does not mean it will. Also, the provisions of Treasury Regulation Section l.148-l(f)(3)(i) limits the ability to exclude potential bidders. Period medians are reported in panels "NB-Quasi" and "NB-Ultd Adval-Quasi". They are almost identical to their counterparts. Either issuers from excluded competitive sales are giving reasonable notice of sale, or they are actually limiting the participation of potential bidders and consequently increasing concentration, but state concentration is naturally low in those states—the state fixed-effect— and both effects cancel out.

Finally, I also calculate the HI after excluding potential quasi-competitive sales when I have insider confirmation that is a common practice in the state, such as in Minnesota, Pennsylvania, and for low issue amounts in New York. Period medians are reported in panels "NB-Insider" and "NB-Ultd Adval-Insider". They are also almost identical to their counterparts. Either the effect of the participation restriction and the state fixed effect cancel out, or issuers are inviting bidders that would have won anyway had it been public. In fact, that is the implicit selection criterion in most cases. Table C.1 in presents the results of additional robustness tests: when I exclude issues under 1.5 million, when I drop issues that are excluded from a public sale requirement due to amount, coupon type, or taxable status, and when I exclude issues without an official statement. In all cases, the results remain qualitatively and quantitatively the same.

Overall, the difference in concentration between the samples of negotiated deals and competitive deals proves exceptionally robust and economically important.

## 5.4. Robustness tests using exogenous state laws

In this section, I use the legal restrictions on the sales method to rule out possible confounding factors. In the previous section, we compared the concentration in competitive deals and negotiated deals in the same state. Thus, unobserved state variables are not a source of bias because they cancel out when we calculate the difference between the two. Possible sources of bias are unobserved variables at the state-type level. Variables shared only by the sample of competitive sales in the state that also decrease concentration. Most likely, a selection bias.

For example, there might be unobserved characteristics at the issue level that makes it attractive to a greater number of potential bidders. Since more potential bidders show interest, it is worth making a competitive sale. If more potential bidders also decrease concentration, concentration and competitive sales would correlate. However, this would also mean that states with a higher proportion of competitive sales have a higher proportion of "attractive" bonds. There is a high number of states that are almost 100% negotiated. It is unlikely that bonds in these states are absolutely less attractive than the bonds in highly competitive states. Moreover, physical presence and relationships are important in the muni market underwriting business, so potential bidders must pre-establish in the state if they want to bid. That means that bonds should be more attractive ex ante. In addition, we compare very similar issuers across states — school districts —. And the difference is even greater in the sample of new-money bonds backed by unlimited and dedicated ad-valorem taxes, which is the most common security and a very homogenous sample. Therefore, it is unlikely, although not impossible, that the selection bias explains the difference in concentration.

In any case, I use the sales laws to study whether competitive sales decrease concentration. I also compare the concentration in the samples of restricted bonds and free bonds, regardless of the method of sale. For each pair of state and period, I calculate the Herfindahl Index in the sample of restricted deals in the state and the Herfindahl index in the sample of free deals in the state. On the one hand, the legal restrictions on

negotiated sales are at the state level, so they are not subject to the confounding factors described above, which are below the state level, at the state-bid type level. On the other hand, the difference is diminished by the fact that free bonds in many states are sold predominantly in competitive deals anyway.

Table 8 reports median values across states by period and type of legal restriction in the full sample, and the samples of new-money bonds, refunding bonds, new-money COPs, and refunding COPs. First, free deals are much more concentrated than restricted deals. The average of all the values reported for free deals in the full sample and the sample of new-money bonds is 0.22, more than 50% larger than that of restricted deals — 0.14 —. As expected, the difference is lower than that found between competitive and negotiated deals. However, it is still very large economically. The restricted bonds are unconcentrated on average. Free deals vary between moderately concentrated and highly concentrated. The average of all the values reported for free deals in the other samples is 0.27, around 70% higher than that of restricted deals — 0.16 —. Second, concentration, in terms of deals and notional amount, has increased significantly over time in the sample of free deals. Third, concentration has remained fairly stable in the sample of restricted deals, regardless of how we measure HI. Basically, all results are economically important and qualitatively equal to those of the competitive and negotiated analysis.

When we compare restricted deals to free deals we are not subject to confounding variables below the state level, but we might be subject to confounding variables at the state level. States with legal restrictions on negotiated sales might be different from states without such restrictions. Cestau, Hollifield, Green, and Schürhoff [2018a] show that there are no systematic differences between states with legal restrictions and states without legal restrictions. Even so, Table 9 shows the results of a series of robustness test that rule out this potential source of bias.

Panel-A "ALL-Comp" shows the median state HI per period, in terms of deals and amount, in the sample of restricted competitive deals and in the sample of free competitive deals. It compares competitive sales only. The values reported for both samples are

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very similar to each other. Thus, either in terms of deals or notional amount, there is no evidence of unobserved systematic differences between restricted deals and free deals, at least in relation to competitive sales. Panel-B "ALL-2lawsOnly" shows the median state HI per period in the sample of restricted deals and in the sample of free deals, regardless of the method of sale, in states with both types of sales restrictions. It compares deals in restricted states only. Therefore, the results are not subject to the state-level confounding factors mentioned above. The difference in concentration between free deals and restricted deals is just a bit higher than in the full sample, especially in terms of notional amount. On the one hand, the increase is not statistically significant. On the other hand, in this panel, I eliminate all possible systemic differences across states, but I do not eliminate the possible systemic differences between restricted deals and free deals within states. These differences might explain why we obtain a slightly greater difference in concentration. Nonetheless, there is no statistical evidence in Panel-B that the difference in concentration between free and restricted deals in the full sample is caused by unobserved differences between states with restrictions and states without restrictions.

Panel-E "ALL-restOnly" shows the median state HI per period in the sample of restricted competitive deals and the sample of restricted negotiated deals. It compares negotiated sales and competitive sales in the sample of restricted deals only. We observe negotiated sales in the sample of restricted deals for several reasons. For example, in all states, the law provides that the issuer may either reject all bids or any-or-all bids. In most cases, in such circumstances, the issuer is authorized to sell the deal by negotiation. In most states, issuers are allowed to sell restricted deals by negotiation to any agency or instrumentality of the state or the federal government. There are other legal reasons why we observe negotiated deals in the sample of restricted deals, as well as some coding errors in the SDC database. Panel-D attempts to eliminate the possible systemic differences across states and within states. The difference in concentration between negotiated deals and competitive deals in the restricted deals sample is, on average, a bit higher than the difference between both sales methods in the full sample —Table 6 of Section 5.3 —. The increase is not statistically significant in terms of deals. However, it

is statistically significant at the 5% level in terms of notional amount. This means that, either the results in Table 6 have a slight downward bias, or we were unable to eliminate every possible systemic difference within the states. After all, we observe negotiated sales of restricted deals only in special circumstances. The deals might well be special, too.

Panel-C "ALL-noRestNeg" drops the negotiated sales of restricted deals from the sample because they might be "special". The panel shows the median state HI per period in the sample of restricted competitive deals and in the sample of free deals, regardless of the sales method. Notice that, since the panel compares restricted deals to free deals, the results are not subject to selection biases. Also keep in mind that, since it drops restricted negotiated sales — not truly restricted — it alleviates the "diminishing" problem mentioned above. This time the results are almost identical to those in Table 6. However, we were expecting to obtain values halfway between those in Table 8 and those in Table 6 because we have just partially solved the diminishing problem. Based on the results of Panel-D, it is possible that the results in Table 6 have a slight downward bias.

Finally, Panel-D "ALL-Rcomp-Fneg" also drops free competitive deals from the sample. The panel shows the median state HI per period in the sample of restricted competitive deals and in the sample of free negotiated deals. Since it compares competitive deals against negotiated deals, it is not subject to the diminishing problem mentioned above. However, it is partially subject to selection bias. On the one side, there is no selection involved in the sample of restricted deals; Competitive sales are mandatory. On the other side, there is a selection involved in the sample of free negotiated deals; The issuer chose negotiated. The values in Panel-D, where results are partially subject to selection bias, are almost identical to those in Table 6, where the results are fully subject to selection bias. As there is no statistical difference between tables, there is also no evidence of selection bias.

I also calculate the median state HI by period and type of legal restriction in the sample of new money bonds backed by unlimited and dedicated ad-valorem taxes. Results are reported in Table 8. Concentration in the free deals increases and concentration

in the restricted deals decreases with respect to the sample of new-money bonds. The difference in concentration increases substantially. Incredibly, the increase is proportionally the same[7] as the increase between both samples in the difference in concentration between negotiated and competitive deals in Section 5.3.

To conclude this section, I replicate the above robustness tests, from Panel-A to Panel-E, in the samples of new-money bonds — first sample — and the sample of new-money bonds backed by unlimited and dedicated ad-valorem taxes — second sample —. The results of the robustness tests are shown in the central columns and in the columns on the right of Table 9, respectively. The results of the Panel-A test in these samples are very similar to the results obtained in the full sample. There is only a slight difference in period 1, when HI is measured in terms of notional amount, in the second sample. Overall, there is no evidence of unobserved systematic differences between restricted deals and free deals, at least in relation to competitive sales. The result of the Panel-B test is the same as before in the first sample, and "better" in the second sample, in the sense that the difference in concentration does not change. In conclusion, there is no evidence of unobserved systematic differences between restricted states and free states. In both samples, the result of the Panel-E test is the same as in the full sample. Thus, it is possible that the results of Table 6 have a slight downward bias for these samples as well. The results of the Panel-C test are "much better" than in the full sample, in the sense that the difference between restricted and free is exactly what we expect it to be; Halfway between the values of Table 8 and Table 6 for each sample. Therefore, this time, there is no evidence that the results of Table 6 have a downward bias for these samples. Finally, the results of the Panel-D test are as good as in the full sample. That is, there is also no evidence of selection bias in these samples.

The robustness tests based on the legal restrictions on negotiated sales show very consistent results across all samples. Most of the tests show no evidence of bias in the estimated difference in concentration between competitive deals and negotiated deals.

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[7]I calculated the difference per period, both in terms of deals and notional amount, in both samples for both sections. I calculated the sum of the differences per sample for both sections. Then, I calculated the proportional increase in the sum for both sections.

A few tests suggest that the estimated difference might have a slight downward bias. In no case there is evidence of an upward bias.

# 6.  Conclusion

The paper presents overwhelming evidence that competitive sales reduce concentration tremendously. The paper also warns of a substantial increase in concentration in recent years. The risks of higher concentration are twofold. It can increase market power and the likelihood of collusion. However, the paper also shows that policymakers have the tools to control market concentration. The results are compelling. The market for underwriting services for restricted bonds is far less concentrated than that of unrestricted bonds. The author recommends policymakers to consider the results presented in this paper when discussing amendments to the provisions that restrict negotiated sales.

Whether the increase in concentration leads to greater market power, and whether greater market power leads to higher offering yields and underwriting fees, are questions yet to be answered. Future research should quantify the cost of the externality produced by negotiated sales. It is also unknown whether auctions can deter collusion more effectively than negotiated sales. The question should be the subject of future research.
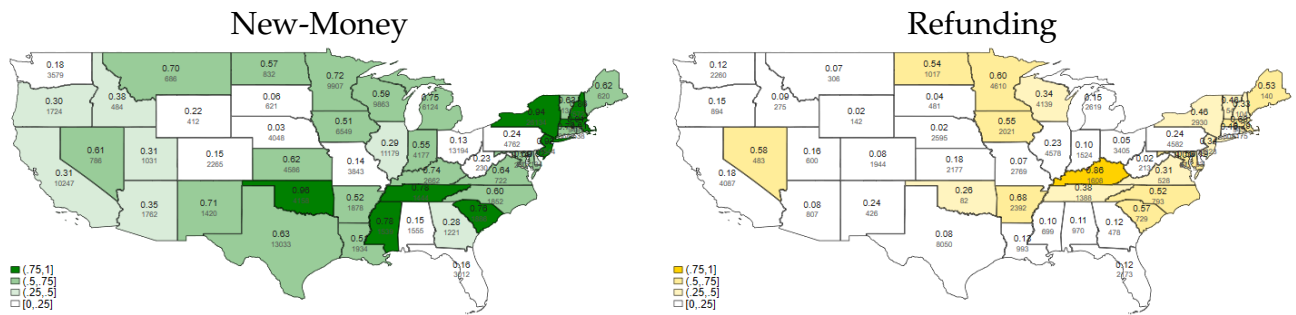
**Figure 1: Proportion of competitive sales.** The figure shows the proportion of competitive sales by state and refunding status between 1990 and 2014. The intensity of the color indicates the proportion of competitive sales in the state; 0-25%, 25%-50%, 50%-75%, 75%-100%.
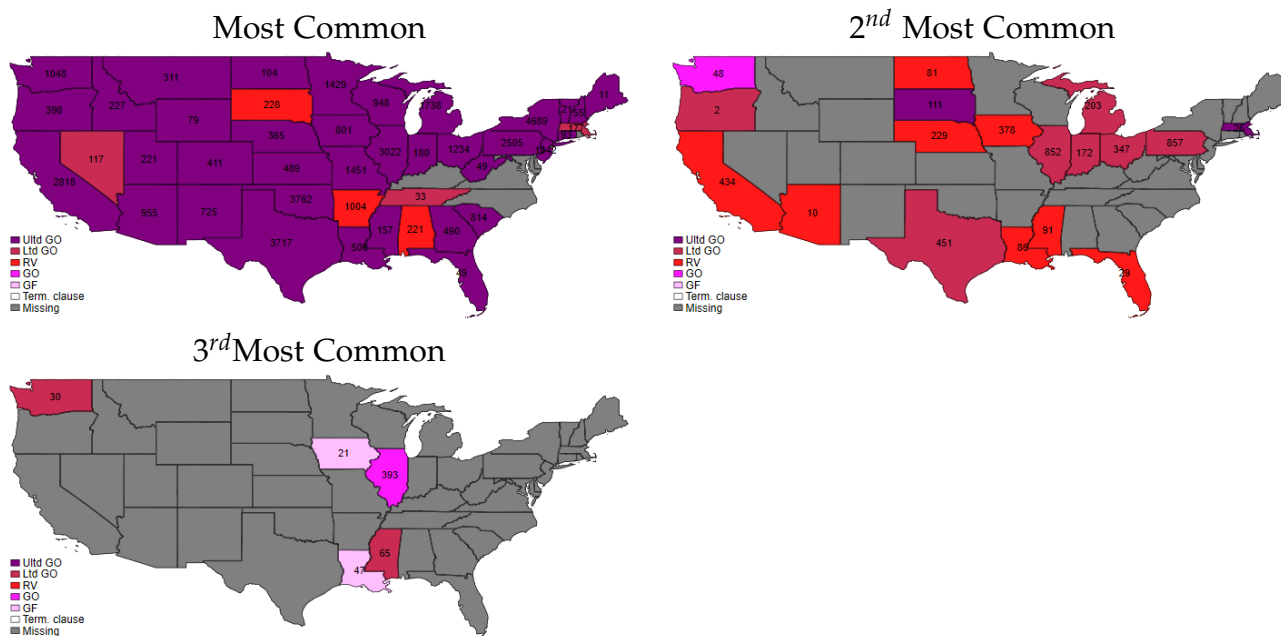
**Figure 2: Bond Security by state.** The figure shows the securities of new-money bonds by state. White color indicates deals with termination clauses. Light pink indicates deals backed by all available funds of the issuer, without a general or specific pledge (GF). Plain pink indicates deals backed only by the FFC of the issuer (GO). Plain red indicates deals backed only by a specific and limited source of funds (RV). Dark red indicates deals backed by a specific pledge of limited ad-valorem taxes and by the FFC of the issuer (Ltd GO). Purple indicates deals backed by a specific pledge of unlimited ad-valorem taxes and by the FFC of the issuer (Ultd GO). The black numbers in the center of each state indicate the number of deals with the corresponding bond security in the state.
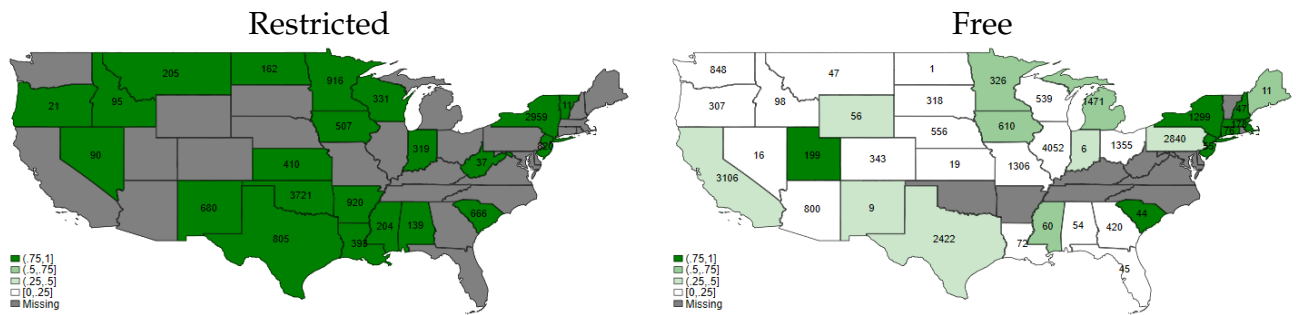
**Figure 3: Proportion of competitive sales by restriction.** The figure shows the proportion of competitive sales by state and restriction type status between 1990 and 2014. The intensity of the color indicates the proportion of competitive sales in the state; 0-25%, 25%-50%, 50%-75%, 75%-100%.

**Figure 4: Annual issues and active underwriters.** (a) shows the evolution in the number of issues and active underwriters per year. (b) plots the number of annual issues per underwriter. (c) plots a breakdown of (b) by bond type. (d) presents an indexed version of (c), with the year 2000 as the base year.
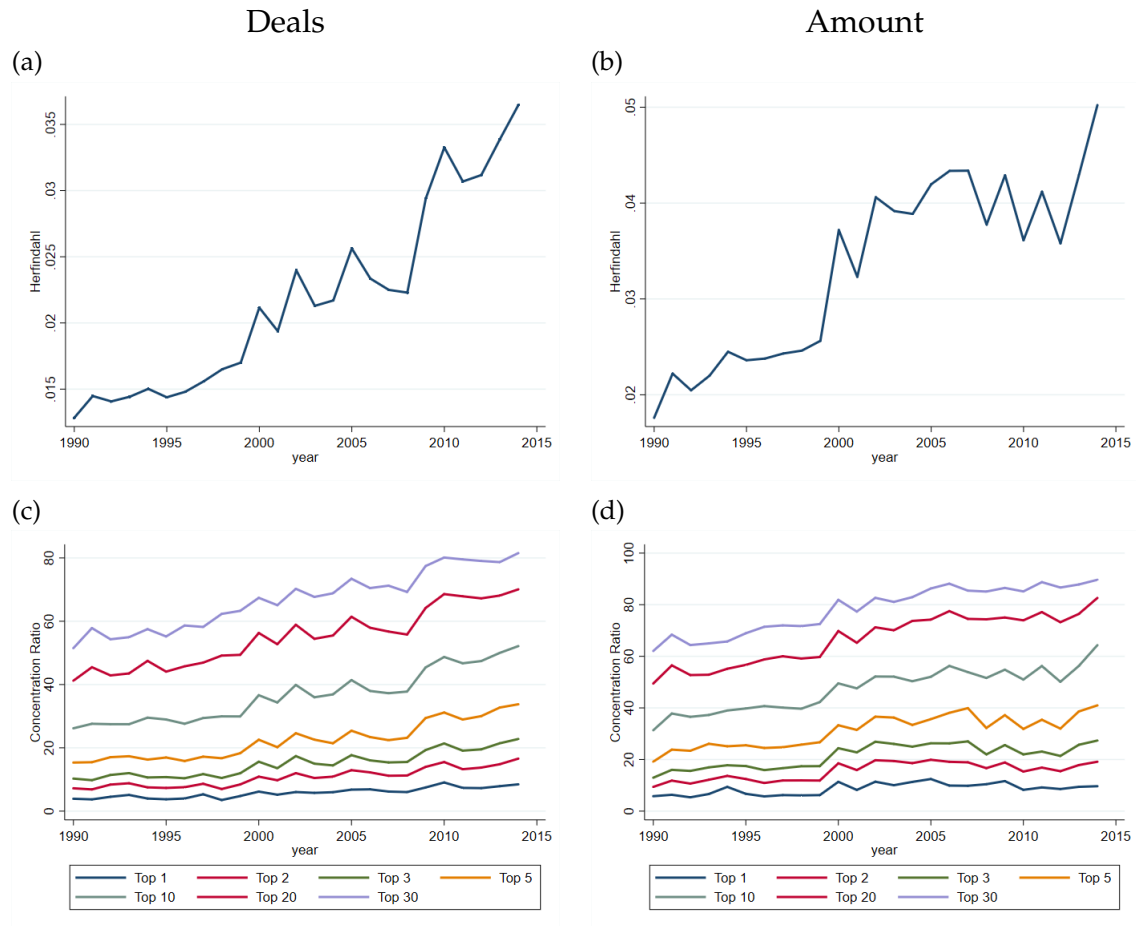
**Figure 5: Herfindahl index and concentration ratios, by year.** The top row plots the Herfindahl index of the sample. The bottom row plots the combined market shares of the largest firm, and the two, three, five, ten, 20 and 30 largest firms. Left column plots use market shares of observed deals. Right column plots use market shares of total notional amount.
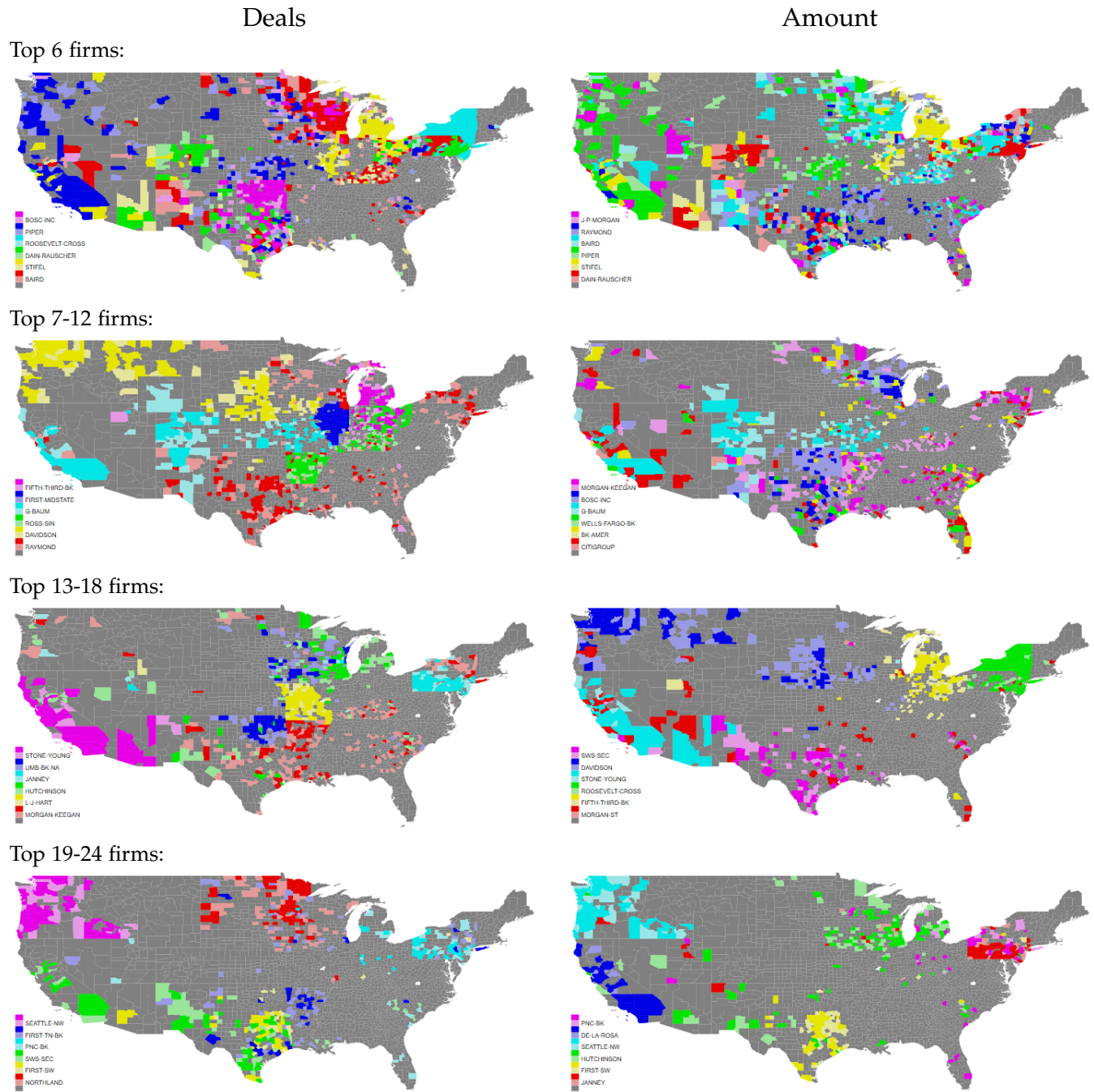
**Figure 6: Geographical distribution of underwriting activity between 2010 and 2014.**
Firms are divided in groups based on underwriting activity between 2010 and 2014.
Groups are indicated at the top of each row. Within groups, red represents the largest
firm of the group, yellow the second largest, followed by green, cyan, blue, and purple.
For each group, I measure the underwriting activity of each firm in each county and
assign the color of the most active firm to the county. Left column plots measure under-
writing activity by the number of deals underwritten in the county, and right column
plots by notional amount. Light colors either indicate that just one deal or less than
10.22 mil in notional amount was underwritten by the most active firm in the county.
The figure continues on the next page.

**Figure 6: Geographical distribution of underwriting activity between 2010 and 2014.**
Firms are divided in groups based on underwriting activity between 2010 and 2014.
Groups are indicated at the top of each row. Within groups, red represents the largest
firm of the group, yellow the second largest, followed by green, cyan, blue, and purple.
For each group, I measure the underwriting activity of each firm in each county and
assign the color of the most active firm to the county. Left column plots measure under-
writing activity by the number of deals underwritten in the county, and right column
plots by notional amount. Light colors either indicate that just one deal or less than 10.22
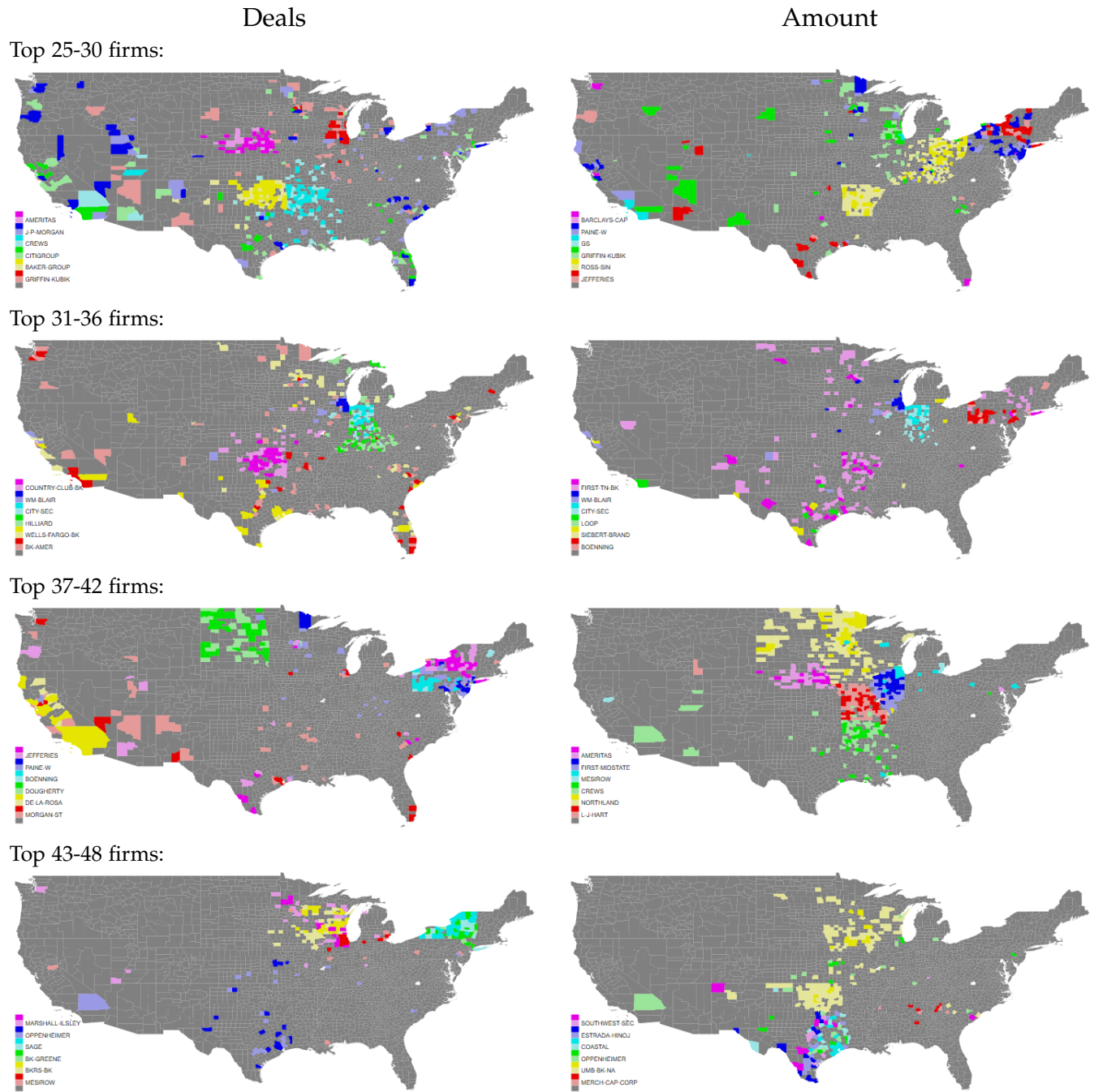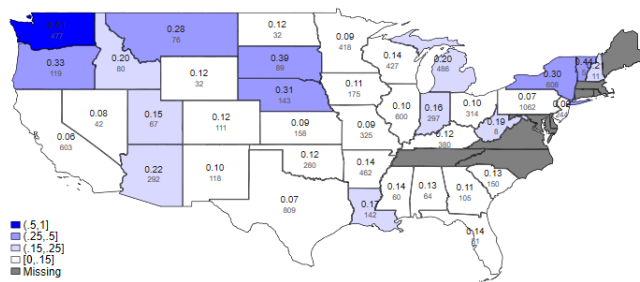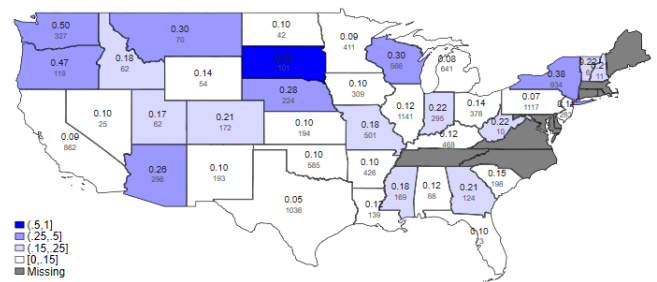mil in notional amount was underwritten by the most active firm in the county.

1990-1994:

1995-1999:



2000-2004:
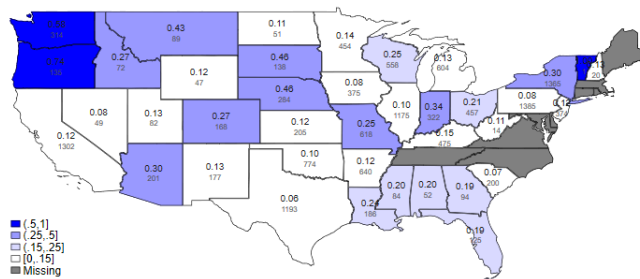
2005-2009:
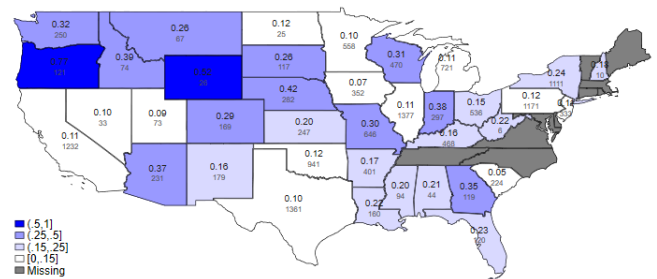


2010-2014:
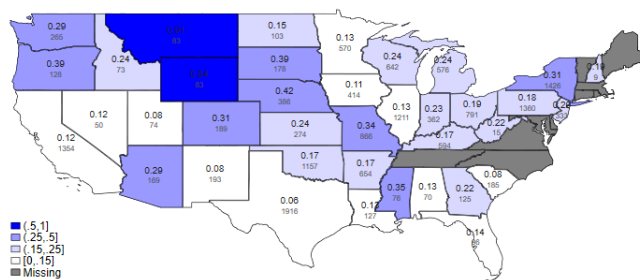


**Figure 7: Herfindahl Index distribution.** The figure plots the Herfindahl Index in terms of deals for each state and period. Unconcentrated states are painted white — below 0.15—, moderately concentrated states light-blue, a darker color indicates highly concentrated states, and the darkest blue indicates super concentrated — above 0.50 —. Black and large numbers in the center of each state show the value of the index. Smaller and gray numbers show the size of the sample.
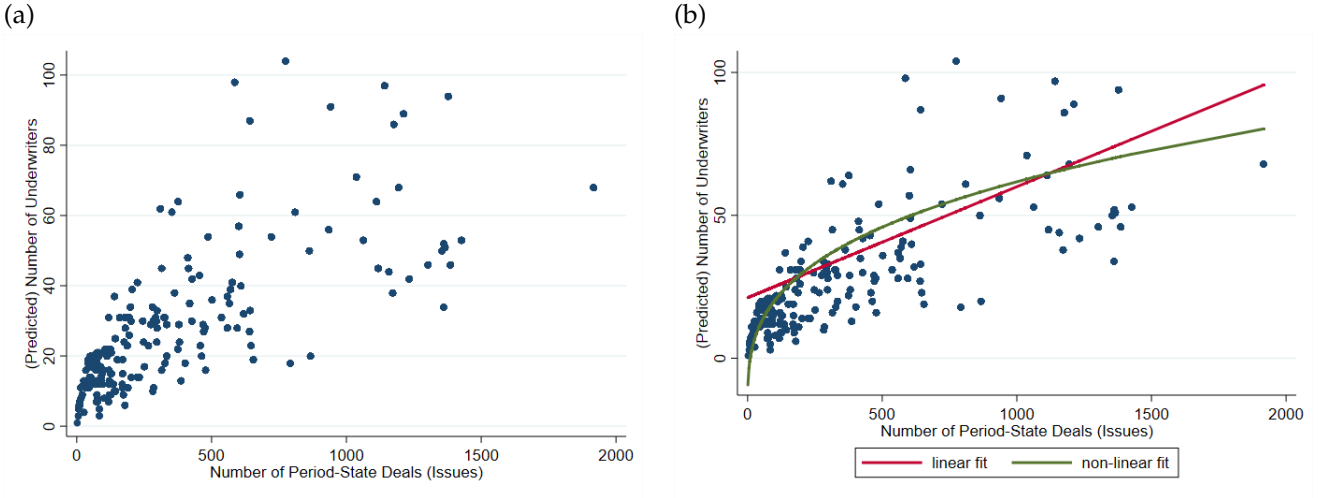
**Figure 8: Active underwriters and the number of deals.** The figure presents a scatter plot where each dot indicates the number of deals observed in a given state and period and the number of active underwriters observed in that same state and period. Panel (b) also shows a linear trend and the fitted values of a non-linear relation of the form $y = b_0 + b_1 x^{b2}$.
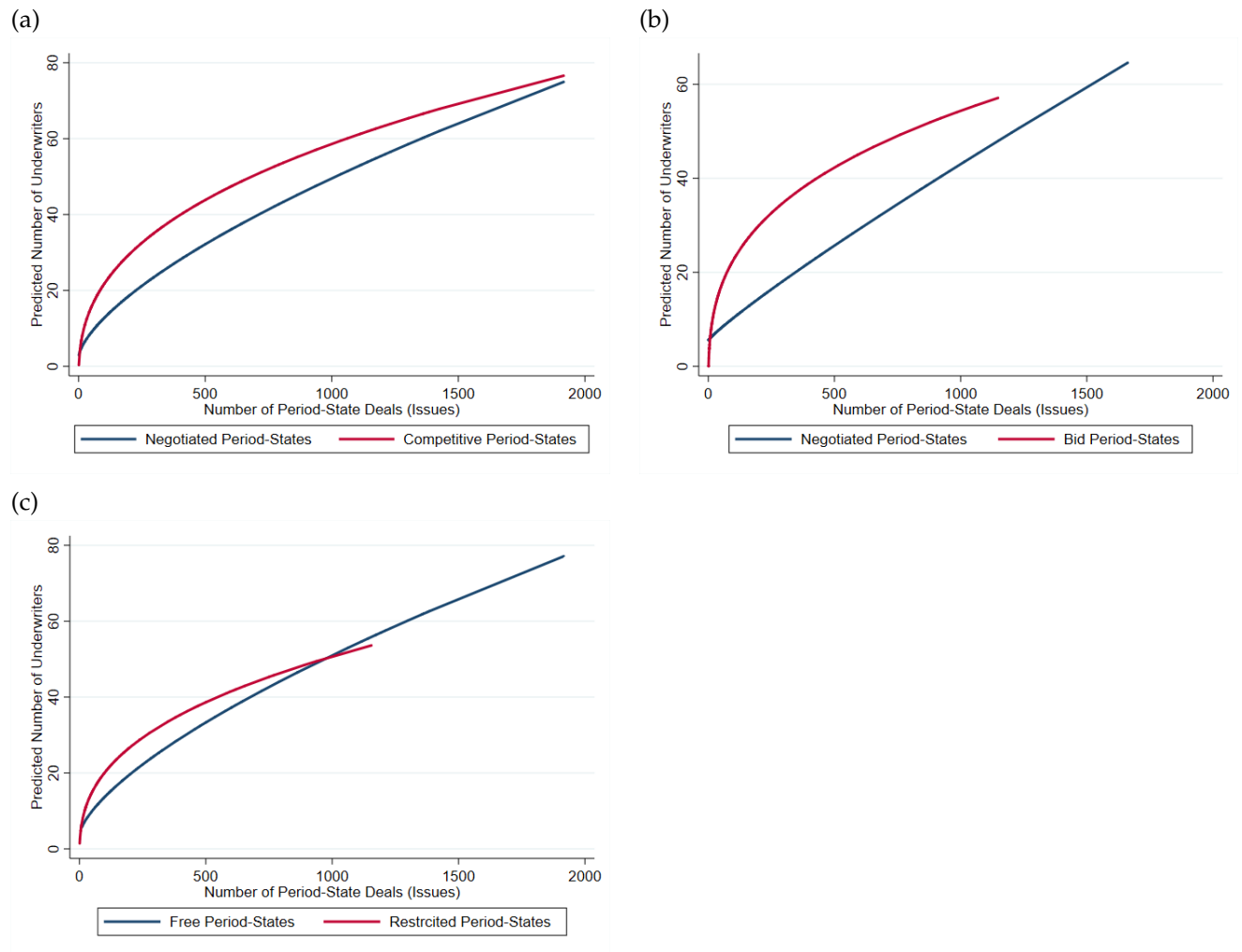
**Figure 9: Active underwriters and competitive deals.** The figure presents the fitted values of a non-linear relationship of the form $y = b_0 + b_1 x^{b2}$ for the relationship between the number of deals and the number of active underwriters. The unit of observation is the state and period pair. Three pairs of samples: (a) the sample of observations with a proportion of competitive deals above the median, and the sample below the median. (b) the sample of competitive deals and the sample of negotiated deals. (c) the sample of restricted bonds and the sample of free bonds in states without contemporaneous restricted bonds.
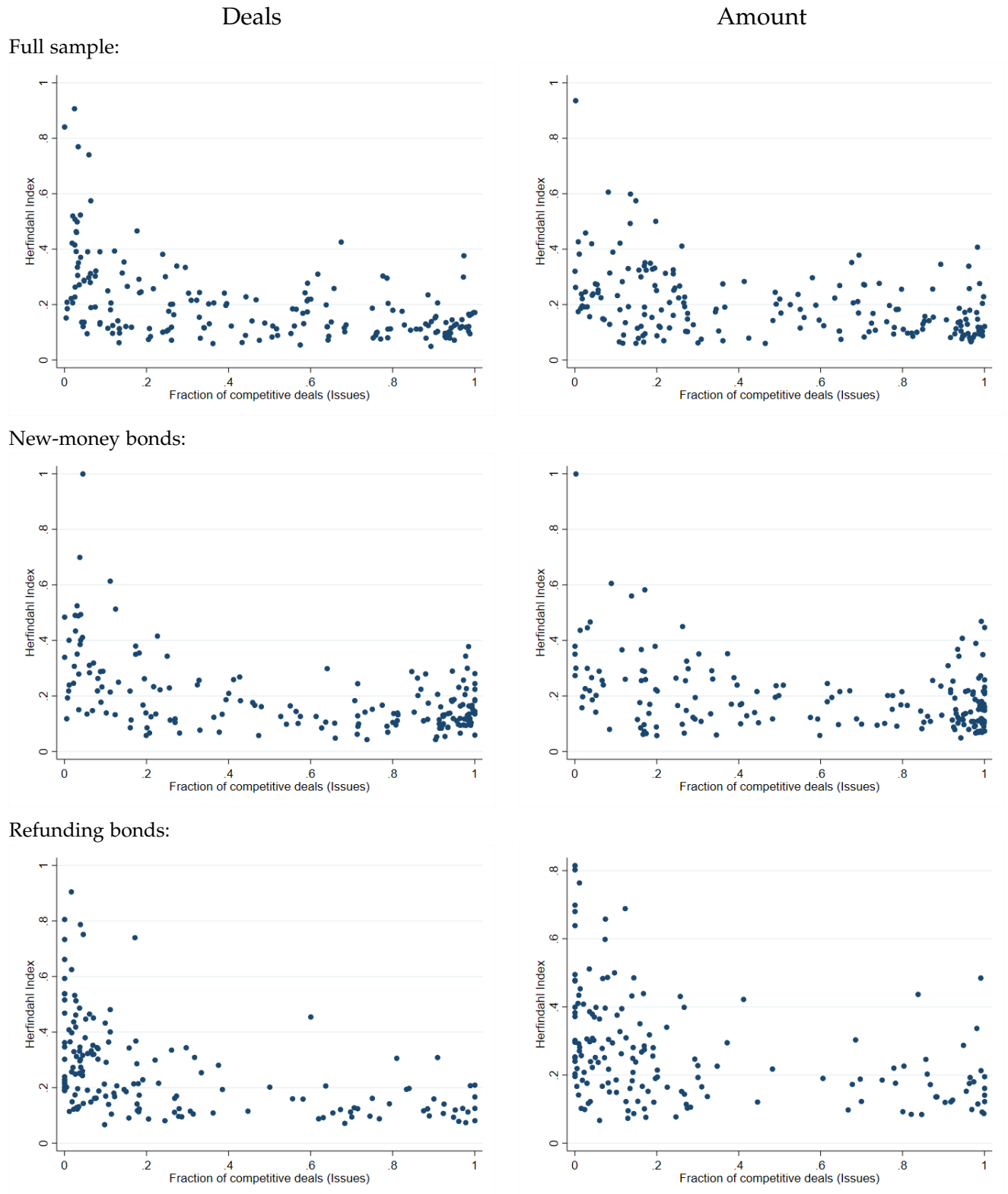
**Figure 10: Concentration and competitive deals.** Each dot indicates the proportion of competitive deals and the HI of a different observation. The unit of observation is the pair of state and period. Left column plots calculate the HI in terms of deals, and right column plots in terms of notional amount.

| US Market | Size |
|---|---|
| Mortgage-Related | 4.5x |
| Treasuries | 3.6x |
| M&A | 2.8x |
| Corporate IG | 2.0x |
| **Municipal** | **1.0x** |
| Asset-backed | 0.8x |
| Private Equity | 0.6x |
| Corporate HY | 0.4x |
| Venture Capital | 0.1x |
| IPOs | 0.1x |

**Table 1: Ranking by primary market size:** the table classifies the ten largest financial markets in the US by the average annual size of the primary market between 2004 and 2016. The unit of measure "x" is the average annual size of the muni primary market.

|  | ALL | | NB | | RB | | NC | | RC | |
|---|---|---|---|---|---|---|---|---|---|---|
| H | 0.015 | 0.024 | 0.016 | 0.025 | 0.022 | 0.026 | 0.027 | 0.051 | 0.050 | 0.050 |
| Top 6 | 22.2 | 28.6 | 21.7 | 30.1 | 27.2 | 28.4 | 32.4 | 45.8 | 44.8 | 43.6 |
| 12 | 34.8 | 45.3 | 34.6 | 46.9 | 42.2 | 46.5 | 48.0 | 62.4 | 61.3 | 61.5 |
| 18 | 43.9 | 57.9 | 44.6 | 59.0 | 51.7 | 58.5 | 59.3 | 73.1 | 71.8 | 73.6 |
| 24 | 51.4 | 64.8 | 52.4 | 65.7 | 58.7 | 65.9 | 67.2 | 80.2 | 79.0 | 81.8 |
| 30 | 57.9 | 70.0 | 58.9 | 71.1 | 64.4 | 71.6 | 72.5 | 84.2 | 83.6 | 87.3 |
| 36 | 62.9 | 74.4 | 63.9 | 76.6 | 69.1 | 75.7 | 76.5 | 87.3 | 87.0 | 90.6 |
| 42 | 67.3 | 78.0 | 67.7 | 79.2 | 73.3 | 79.2 | 79.7 | 89.5 | 89.6 | 92.7 |
| 48 | 71.1 | 80.8 | 71.2 | 81.9 | 76.9 | 82.2 | 82.2 | 91.4 | 91.5 | 94.3 |

**Table 2: Herfindahl index and concentration ratios.** The first row shows the Herfindahl index of the corresponding sample between 1990 and 2014. The bottom rows show the combined market shares of the 6, 12, 18, 24, 30, 36, 42, and 48 largest firms of the corresponding sample. The 5 samples are: ALL — the full sample —, NB — new-money bonds —, RB — refunding bonds —, NC — new-money COPs —, and RC — refunding COPS —. For each sample, the left column use market shares of observed deals, the right column use market shares of total notional amount.

| | Full Sample | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Deals | | | | | Notional Amount | | | | |
| Period | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| HI | 0.13 | 0.14 | 0.15 | 0.2 | 0.19 | 0.16 | 0.15 | 0.18 | 0.19 | 0.2 |
| Top 1 | 23 | 27 | 30 | 33 | 32 | 27 | 28 | 31 | 34 | 32 |
| 2 | 41 | 46 | 48 | 51 | 53 | 49 | 47 | 50 | 54 | 52 |
| 3 | 53 | 54 | 60 | 61 | 67 | 60 | 56 | 65 | 64 | 64 |
| 5 | 70 | 69 | 74 | 78 | 81 | 75 | 73 | 80 | 79 | 80 |
| 10 | 88 | 88 | 91 | 93 | 93 | 93 | 90 | 96 | 96 | 95 |
| | New-Money Bonds | | | | | | | | | |
| HI | 0.14 | 0.15 | 0.15 | 0.16 | 0.19 | 0.19 | 0.15 | 0.17 | 0.18 | 0.2 |
| Top 1 | 26 | 27 | 28 | 32 | 33 | 30 | 27 | 28 | 35 | 29 |
| 2 | 43 | 45 | 47 | 45 | 55 | 52 | 47 | 50 | 52 | 53 |
| 3 | 56 | 57 | 58 | 57 | 68 | 65 | 57 | 65 | 63 | 67 |
| 5 | 70 | 73 | 72 | 75 | 85 | 82 | 75 | 82 | 79 | 81 |
| 10 | 91 | 90 | 92 | 93 | 96 | 92 | 91 | 92 | 91 | 93 |
| | Refunding Bonds | | | | | | | | | |
| HI | 0.18 | 0.21 | 0.26 | 0.25 | 0.27 | 0.24 | 0.25 | 0.27 | 0.28 | 0.25 |
| Top 1 | 32 | 36 | 40 | 38 | 42 | 36 | 37 | 36 | 44 | 37 |
| 2 | 52 | 59 | 64 | 61 | 69 | 61 | 63 | 64 | 65 | 60 |
| 3 | 65 | 72 | 79 | 76 | 78 | 72 | 80 | 80 | 76 | 75 |
| 5 | 81 | 88 | 91 | 90 | 92 | 86 | 92 | 93 | 92 | 92 |
| 10 | 97 | 100 | 100 | 100 | 97 | 99 | 100 | 100 | 100 | 99 |
| | New-Money COPs | | | | | | | | | |
| HI | 0.41 | 0.31 | 0.35 | 0.53 | 0.33 | 0.53 | 0.51 | 0.47 | 0.61 | 0.49 |
| Top 1 | 50 | 43 | 41 | 67 | 50 | 67 | 68 | 60 | 73 | 62 |
| 2 | 75 | 67 | 70 | 96 | 70 | 91 | 90 | 84 | 100 | 90 |
| 3 | 100 | 79 | 92 | 100 | 92 | 100 | 95 | 98 | 100 | 97 |
| 5 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 10 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Refunding COPs | | | | | | | | | |
| HI | 0.26 | 0.5 | 0.5 | 0.68 | 0.52 | 0.42 | 0.66 | 0.66 | 0.8 | 0.44 |
| Top 1 | 36 | 60 | 66 | 80 | 60 | 59 | 78 | 79 | 89 | 57 |
| 2 | 67 | 100 | 100 | 100 | 88 | 84 | 100 | 100 | 100 | 89 |
| 3 | 83 | 100 | 100 | 100 | 100 | 91 | 100 | 100 | 100 | 100 |
| 5 | 93 | 100 | 100 | 100 | 100 | 96 | 100 | 100 | 100 | 100 |
| 10 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

**Table 3: State Herfindahl Index and concentration ratios.** The first row of each panel shows the median state HI of the corresponding period. The bottom rows of each panel show the median of the combined state market shares of the one, two, three, five, and ten largest firms. In each sample, the left columns use market shares of observed deals, the right columns use market shares of total notional amount.

| | Deals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Full Sample | | | New-money Bonds | | | Refunding Bonds | | |
| | (1) | (2) | (3) | (1) | (2) | (3) | (1) | (2) | (3) |
| Prop Comp | -0.19 | -0.32 | -0.29 | -0.17 | -0.27 | -0.26 | -0.24 | -0.12 | -0.11 |
| | (0.03) | (0.05) | (0.05) | (0.29) | (0.04) | (0.04) | (0.04) | (0.06) | (0.06) |
| Period 2 | | | 0.02 | | | 0.01 | | | 0.06 |
| | | | (0.02) | | | (0.02) | | | (0.02) |
| Period 3 | | | 0.04 | | | 0.02 | | | 0.07 |
| | | | (0.02) | | | (0.02) | | | (0.02) |
| Period 4 | | | 0.03 | | | 0.02 | | | 0.04 |
| | | | (0.02) | | | (0.02) | | | (0.02) |
| Period 5 | | | 0.04 | | | 0.02 | | | 0.05 |
| | | | (0.02) | | | (0.02) | | | (0.02) |
| State f.e. | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes |
| Constant | 0.29 | 0.35 | 0.31 | 0.29 | 0.35 | 0.33 | 0.32 | 0.29 | 0.24 |
| | (0.02) | (0.02) | (0.03) | (0.02) | (0.02) | (0.03) | (0.02) | (0.02) | (0.02) |
| N | 189 | 189 | 189 | 178 | 178 | 178 | 161 | 161 | 161 |
| R-squared | 0.22 | 0.22 | 0.24 | 0.23 | 0.23 | 0.24 | 0.21 | 0.21 | 0.21 |
| | Notional Amount | | | | | | | | |
| Prop Comp | -0.13 | -0.28 | -0.29 | -0.11 | -0.24 | -0.25 | -0.17 | -0.15 | -0.15 |
| | (0.02) | (0.04) | (0.05) | (0.02) | (0.04) | (0.04) | (0.03) | (0.06) | (0.06) |
| Period 2 | | | 0.02 | | | 0.00 | | | 0.04 |
| | | | (0.02) | | | (0.02) | | | (0.02) |
| Period 3 | | | 0.03 | | | 0.00 | | | 0.04 |
| | | | (0.02) | | | (0.02) | | | (0.02) |
| Period 4 | | | 0.02 | | | 0.00 | | | 0.03 |
| | | | (0.02) | | | (0.02) | | | (0.02) |
| Period 5 | | | 0.01 | | | -0.01 | | | 0.02 |
| | | | (0.02) | | | (0.02) | | | (0.02) |
| State f.e. | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes |
| Constant | 0.26 | 0.33 | 0.32 | 0.27 | 0.34 | 0.35 | 0.32 | 0.31 | 0.28 |
| | (0.01) | (0.02) | (0.03) | (0.02) | (0.02) | (0.03) | (0.02) | (0.02) | (0.03) |
| N | 189 | 189 | 189 | 178 | 178 | 178 | 161 | 161 | 161 |
| $R^2$ | 0.15 | 0.15 | 0.15 | 0.11 | 0.11 | 0.11 | 0.14 | 0.14 | 0.15 |

**Table 4: Herfindahl Index and the proportion of competitive deals.** The dependent variable is the Herfindahl Index (HI). The independent variable is the proportion of competitive sales. The observation unit is the pair of state and period. (2) includes state fixed effects. (3) adds period fixed effects. The HI is measured in terms of deals (upper panel) and notional amount (lower panel). Robust standard errors in parentheses.

| | New money Ultd Dadval Bonds | | | | New money, Prop. comp $\leq.80$ | | | |
|---|---|---|---|---|---|---|---|---|
| | Deals | | Amount | | Deals | | Amount | |
| | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Prop Comp | -0.20 | -0.35 | -0.16 | -0.36 | -0.34 | -0.27 | -0.27 | -0.32 |
| | (0.03) | (0.06) | (0.03) | (0.05) | (0.06) | (0.08) | (0.07) | (0.06) |
| Period f.e. | No | Yes | No | Yes | No | Yes | No | Yes |
| State f.e. | No | Yes | No | Yes | No | Yes | No | Yes |
| Constant | 0.33 | 0.41 | 0.31 | 0.44 | 0.33 | 0.27 | 0.30 | 0.32 |
| | (0.02) | (0.04) | (0.02) | (0.04) | (0.02) | (0.04) | (0.02) | (0.03) |
| N | 131 | 131 | 131 | 131 | 98 | 98 | 92 | 92 |
| $R^2$ | 0.28 | 0.28 | 0.18 | 0.18 | 0.27 | 0.26 | 0.15 | 0.15 |

**Table 5: Ultd Dadval bonds and non-highly competitive observations.** The dependent variable is the Herfindahl Index (HI). The independent variable is the proportion of competitive sales. The observation unit is the pair of state and period. (2) includes state fixed effects and period fixed effects. The HI is measured in terms of deals — Deals — and notional amount — Amount —. The left columns use the sample of new-money bonds backed by an unlimited dedicated ad-valorem tax. Does not include double-barreled bonds. The right columns use the sample of new-money bond when the observation is not highly competitive — proportion of competitive<.75. Robust standard errors in parentheses.

|        | Full Sample | | | | New-money bonds | | | | Refunding bonds | | | |
|        | Deals | | Amount | | Deals | | Amount | | Deals | | Amount | |
| Period | Neg | Bid | Neg | Bid | Neg | Bid | Neg | Bid | Neg | Bid | Neg | Bid |
| 1 | 0.22 | 0.12 | 0.27 | 0.15 | 0.22 | 0.14 | 0.32 | 0.17 | 0.21 | 0.14 | 0.27 | 0.26 |
| 2 | 0.22 | 0.11 | 0.27 | 0.12 | 0.24 | 0.12 | 0.26 | 0.13 | 0.26 | 0.15 | 0.34 | 0.21 |
| 3 | 0.26 | 0.13 | 0.33 | 0.17 | 0.28 | 0.13 | 0.35 | 0.14 | 0.30 | 0.13 | 0.32 | 0.19 |
| 4 | 0.28 | 0.12 | 0.28 | 0.15 | 0.32 | 0.12 | 0.30 | 0.15 | 0.27 | 0.12 | 0.30 | 0.18 |
| 5 | 0.32 | 0.12 | 0.34 | 0.14 | 0.35 | 0.15 | 0.38 | 0.15 | 0.35 | 0.12 | 0.35 | 0.12 |
|        | New-money COPs | | | | Refunding COPs | | | | | | | |
| 1 | 0.28 | 0.13 | 0.36 | 0.14 | 0.17 | 0.13 | 0.22 | 0.21 | | | | |
| 2 | 0.23 | 0.13 | 0.44 | 0.15 | 0.18 | 0.13 | 0.32 | 0.21 | | | | |
| 3 | 0.27 | 0.16 | 0.47 | 0.13 | 0.20 | 0.18 | 0.35 | 0.19 | | | | |
| 4 | 0.50 | 0.16 | 0.51 | 0.17 | 0.25 | 0.25 | 0.22 | 0.25 | | | | |
| 5 | 0.25 | 0.23 | 0.34 | 0.27 | 0.36 | 0.14 | 0.39 | 0.16 | | | | |

**Table 6: Herfindahl index and the sales method.** The table reports median Herfindahl Index (HI) values across states by period and sales method. HI is measured in terms of deals and in terms of notional amount. Each panel use the sample indicated at the top.

| | NB | | | | NB-Ultd Dadval | | | |
| | Deals | | Amount | | Deals | | Amount | |
| Period | Neg | Bid | Neg | Bid | Neg | Bid | Neg | Bid |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.22 | 0.14 | 0.32 | 0.17 | 0.31 | 0.14 | 0.35 | 0.20 |
| 2 | 0.24 | 0.12 | 0.26 | 0.13 | 0.28 | 0.12 | 0.31 | 0.14 |
| 3 | 0.28 | 0.13 | 0.35 | 0.14 | 0.30 | 0.13 | 0.42 | 0.13 |
| 4 | 0.32 | 0.12 | 0.30 | 0.15 | 0.31 | 0.11 | 0.34 | 0.11 |
| 5 | 0.35 | 0.15 | 0.38 | 0.15 | 0.39 | 0.13 | 0.39 | 0.14 |
| | NB-Quasi | | | | NB-Ultd Dadval-Quasi | | | |
| 1 | 0.22 | 0.15 | 0.32 | 0.17 | 0.31 | 0.16 | 0.35 | 0.20 |
| 2 | 0.24 | 0.14 | 0.26 | 0.15 | 0.28 | 0.14 | 0.31 | 0.17 |
| 3 | 0.28 | 0.12 | 0.35 | 0.14 | 0.30 | 0.12 | 0.42 | 0.13 |
| 4 | 0.32 | 0.13 | 0.30 | 0.17 | 0.31 | 0.12 | 0.34 | 0.11 |
| 5 | 0.35 | 0.16 | 0.38 | 0.14 | 0.39 | 0.12 | 0.39 | 0.11 |
| | NB-Insider | | | | NB-Ultd D-Insider | | | |
| 1 | 0.22 | 0.14 | 0.32 | 0.18 | 0.31 | 0.14 | 0.35 | 0.20 |
| 2 | 0.24 | 0.12 | 0.26 | 0.14 | 0.28 | 0.12 | 0.31 | 0.15 |
| 3 | 0.28 | 0.12 | 0.35 | 0.14 | 0.30 | 0.12 | 0.42 | 0.13 |
| 4 | 0.32 | 0.12 | 0.30 | 0.17 | 0.31 | 0.11 | 0.34 | 0.12 |
| 5 | 0.35 | 0.16 | 0.38 | 0.15 | 0.39 | 0.13 | 0.39 | 0.15 |

**Table 7: Herfindahl index and the sales method - Robustness tests.** The table reports median Herfindahl Index (HI) values across states by period and sales method. HI is measured in terms of deals and in terms of notional amount. In panel "NB" I use the sample of new-money bonds. In panel "NB-Ultd Dadval" I use the sample of new-money bonds backed by an unlimited and dedicated ad-valorem tax. Both samples serve as base samples in the remaining panels. In panels "NB-Quasi" and "NB-Ultd Dadval-Quasi" potential quasi-competitive sales from the base samples. In panels "NB-Insider" and "NB-Ultd D-Insider" I exclude potential quasi-competitive sales where I have insider confirmation that is a common practice in the state.

| | Full Sample | | | | New-money bonds | | | | Refunding bonds | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Deals | | Amount | | Deals | | Amount | | Deals | | Amount | |
| Period | Free | Rest | Free | Rest | Bid | Rest | Free | Rest | Free | Rest | Free | Rest |
| 1 | 0.15 | 0.13 | 0.19 | 0.15 | 0.15 | 0.14 | 0.20 | 0.16 | 0.18 | 0.13 | 0.22 | 0.25 |
| 2 | 0.17 | 0.12 | 0.21 | 0.12 | 0.21 | 0.14 | 0.20 | 0.12 | 0.21 | 0.16 | 0.24 | 0.18 |
| 3 | 0.21 | 0.13 | 0.26 | 0.16 | 0.22 | 0.12 | 0.22 | 0.16 | 0.25 | 0.13 | 0.24 | 0.15 |
| 4 | 0.23 | 0.13 | 0.23 | 0.14 | 0.28 | 0.13 | 0.24 | 0.17 | 0.25 | 0.19 | 0.26 | 0.28 |
| 5 | 0.24 | 0.17 | 0.25 | 0.16 | 0.23 | 0.16 | 0.24 | 0.15 | 0.29 | 0.13 | 0.25 | 0.21 |
| | New-money COPs | | | | Refunding COPs | | | | New Money-Ultd Dadval | | | |
| 1 | 0.28 | 0.13 | 0.35 | 0.11 | 0.17 | 0.11 | 0.22 | 0.10 | 0.15 | 0.12 | 0.21 | 0.16 |
| 2 | 0.22 | 0.13 | 0.27 | 0.09 | 0.18 | 0.12 | 0.32 | 0.10 | 0.22 | 0.13 | 0.18 | 0.13 |
| 3 | 0.23 | 0.15 | 0.38 | 0.14 | 0.18 | 0.16 | 0.29 | 0.14 | 0.26 | 0.13 | 0.26 | 0.15 |
| 4 | 0.42 | 0.14 | 0.41 | 0.14 | 0.30 | 0.22 | 0.23 | 0.14 | 0.22 | 0.13 | 0.22 | 0.11 |
| 5 | 0.26 | 0.19 | 0.28 | 0.29 | 0.34 | 0.16 | 0.35 | 0.19 | 0.26 | 0.13 | 0.26 | 0.11 |

**Table 8: Herfindahl index and the restriction laws.** The table reports median Herfindahl Index (HI) values across states by period and restriction type. HI is measured in terms of deals and in terms of notional amount. Each panel use the sample indicated at the top. The sample "New Money-Ultd Dadval" is the sample of new-money bonds that are backed by unlimited and dedicated taxes.

| Period | Full Sample (ALL) | | | | New-money bonds (NB) | | | | NB-Ultd Dadval (UltD) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Deals | | Amount | | Deals | | Amount | | Deals | | Amount | |
| | Free | Rest | Free | Rest | Bid | Rest | Free | Rest | Free | Rest | Free | Rest |
| Panel-A | ALL-Comp | | | | NB-Comp | | | | NB-UltD-Comp | | | |
| 1 | 0.12 | 0.14 | 0.21 | 0.15 | 0.14 | 0.15 | 0.23 | 0.16 | 0.14 | 0.14 | 0.26 | 0.16 |
| 2 | 0.12 | 0.12 | 0.17 | 0.12 | 0.13 | 0.14 | 0.15 | 0.12 | 0.12 | 0.13 | 0.13 | 0.13 |
| 3 | 0.14 | 0.13 | 0.18 | 0.15 | 0.14 | 0.12 | 0.17 | 0.16 | 0.13 | 0.13 | 0.11 | 0.14 |
| 4 | 0.12 | 0.13 | 0.16 | 0.15 | 0.12 | 0.13 | 0.17 | 0.17 | 0.11 | 0.12 | 0.12 | 0.10 |
| 5 | 0.12 | 0.17 | 0.15 | 0.17 | 0.16 | 0.16 | 0.16 | 0.16 | 0.15 | 0.13 | 0.16 | 0.12 |
| Panel-B | ALL-2lawsOnly | | | | NB-2lawsOnly | | | | NB-UltD-2lawsOnly | | | |
| 1 | 0.18 | 0.14 | 0.22 | 0.16 | 0.17 | 0.15 | 0.25 | 0.16 | 0.27 | 0.16 | 0.29 | 0.16 |
| 2 | 0.17 | 0.13 | 0.26 | 0.13 | 0.21 | 0.15 | 0.22 | 0.13 | 0.11 | 0.11 | 0.12 | 0.10 |
| 3 | 0.22 | 0.13 | 0.28 | 0.17 | 0.19 | 0.20 | 0.24 | 0.21 | 0.23 | 0.22 | 0.30 | 0.29 |
| 4 | 0.23 | 0.13 | 0.29 | 0.15 | 0.22 | 0.12 | 0.32 | 0.18 | 0.25 | 0.07 | 0.26 | 0.08 |
| 5 | 0.27 | 0.14 | 0.30 | 0.16 | 0.24 | 0.12 | 0.32 | 0.14 | 0.27 | 0.12 | 0.28 | 0.11 |
| Panel-C | ALL-noRestNeg | | | | NB-noRestNeg | | | | NB-UltD-noRestNeg | | | |
| 1 | 0.23 | 0.14 | 0.27 | 0.15 | 0.19 | 0.15 | 0.24 | 0.16 | 0.24 | 0.14 | 0.30 | 0.16 |
| 2 | 0.28 | 0.12 | 0.34 | 0.12 | 0.25 | 0.14 | 0.27 | 0.12 | 0.24 | 0.13 | 0.26 | 0.13 |
| 3 | 0.28 | 0.13 | 0.31 | 0.15 | 0.29 | 0.12 | 0.25 | 0.16 | 0.29 | 0.13 | 0.25 | 0.14 |
| 4 | 0.29 | 0.13 | 0.27 | 0.15 | 0.28 | 0.13 | 0.28 | 0.17 | 0.34 | 0.12 | 0.22 | 0.10 |
| 5 | 0.35 | 0.17 | 0.27 | 0.17 | 0.27 | 0.16 | 0.28 | 0.16 | 0.28 | 0.13 | 0.19 | 0.12 |
| Panel-D | ALL-Rcomp-Fneg | | | | NB-Rcomp-Fneg | | | | NB-UltD-Rcomp-Fneg | | | |
| 1 | 0.22 | 0.14 | 0.26 | 0.15 | 0.19 | 0.15 | 0.28 | 0.16 | 0.31 | 0.14 | 0.33 | 0.16 |
| 2 | 0.25 | 0.12 | 0.30 | 0.12 | 0.25 | 0.14 | 0.28 | 0.12 | 0.29 | 0.13 | 0.30 | 0.13 |
| 3 | 0.29 | 0.13 | 0.31 | 0.15 | 0.28 | 0.12 | 0.30 | 0.16 | 0.31 | 0.13 | 0.31 | 0.14 |
| 4 | 0.28 | 0.13 | 0.28 | 0.15 | 0.34 | 0.13 | 0.28 | 0.17 | 0.36 | 0.12 | 0.33 | 0.10 |
| 5 | 0.33 | 0.17 | 0.34 | 0.17 | 0.36 | 0.16 | 0.35 | 0.16 | 0.36 | 0.13 | 0.35 | 0.12 |
| Panel-E | ALL-restOnly | | | | NB-restOnly | | | | NB-UltD-restOnly | | | |
| | Neg | Bid | Neg | Bid | Neg | Bid | Neg | Bid | Neg | Bid | Neg | Bid |
| 1 | 0.27 | 0.12 | 0.32 | 0.10 | 0.27 | 0.12 | 0.35 | 0.09 | 0.29 | 0.10 | 0.42 | 0.09 |
| 2 | 0.19 | 0.11 | 0.23 | 0.09 | 0.20 | 0.09 | 0.22 | 0.09 | 0.21 | 0.10 | 0.24 | 0.08 |
| 3 | 0.20 | 0.12 | 0.39 | 0.13 | 0.20 | 0.11 | 0.49 | 0.14 | 0.22 | 0.10 | 0.58 | 0.10 |
| 4 | 0.31 | 0.09 | 0.40 | 0.09 | 0.31 | 0.09 | 0.40 | 0.09 | 0.29 | 0.08 | 0.44 | 0.08 |
| 5 | 0.45 | 0.13 | 0.50 | 0.13 | 0.54 | 0.13 | 0.53 | 0.11 | 0.54 | 0.13 | 0.55 | 0.11 |

**Table 9: Herfindahl index and the restriction laws - Robustness tests.** The table reports median Herfindahl Index (HI) values across states by period and restriction type (bid type in Panel-E). HI is measured in terms of deals and in terms of notional amount. Each panel use the sample indicated at the first row. Panel-A excludes negotiated sales from the samples. Panel-B excludes states with only one restriction type. Panel-C excludes restricted negotiated deals from the samples. Panel-D also excludes free competitive deals from the sample. Panel-E excludes free deals from the samples.

A.  Geographical distribution of underwriting activity be-
    tween 1990 and 2010.

B.  Mean state Herfindahl Index and concentration ratios.

## C. Herfindahl index and the sales method.

| | Full Sample | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Deals | | | | | Notional Amount | | | | |
| Period | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| HI | 0.17 | 0.18 | 0.23 | 0.23 | 0.24 | 0.18 | 0.19 | 0.23 | 0.22 | 0.22 |
| Top 1 | 29 | 32 | 35 | 37 | 37 | 31 | 32 | 35 | 35 | 34 |
| 2 | 47 | 48 | 52 | 53 | 56 | 50 | 49 | 53 | 52 | 54 |
| 3 | 58 | 58 | 63 | 64 | 68 | 60 | 60 | 64 | 63 | 65 |
| 5 | 71 | 72 | 75 | 77 | 80 | 75 | 74 | 78 | 77 | 79 |
| 10 | 87 | 86 | 89 | 90 | 91 | 90 | 89 | 92 | 91 | 92 |
| | New-Money Bonds | | | | | | | | | |
| HI | 0.17 | 0.19 | 0.23 | 0.22 | 0.24 | 0.2 | 0.2 | 0.23 | 0.22 | 0.23 |
| Top 1 | 29 | 31 | 34 | 36 | 36 | 32 | 32 | 34 | 35 | 34 |
| 2 | 46 | 48 | 51 | 52 | 57 | 52 | 50 | 53 | 53 | 54 |
| 3 | 58 | 59 | 62 | 63 | 69 | 63 | 62 | 65 | 65 | 66 |
| 5 | 72 | 73 | 75 | 76 | 82 | 78 | 76 | 78 | 78 | 81 |
| 10 | 89 | 88 | 90 | 89 | 92 | 92 | 91 | 92 | 91 | 93 |
| | Refunding Bonds | | | | | | | | | |
| HI | 0.28 | 0.32 | 0.34 | 0.33 | 0.29 | 0.3 | 0.32 | 0.34 | 0.35 | 0.32 |
| Top 1 | 39 | 44 | 46 | 44 | 40 | 43 | 44 | 45 | 47 | 43 |
| 2 | 58 | 63 | 64 | 63 | 64 | 63 | 65 | 64 | 65 | 64 |
| 3 | 69 | 72 | 75 | 74 | 74 | 74 | 76 | 76 | 75 | 75 |
| 5 | 81 | 84 | 85 | 85 | 85 | 86 | 88 | 88 | 86 | 86 |
| 10 | 95 | 95 | 95 | 95 | 94 | 97 | 97 | 96 | 95 | 95 |
| | New-Money COPs | | | | | | | | | |
| HI | 0.47 | 0.39 | 0.43 | 0.61 | 0.47 | 0.55 | 0.51 | 0.51 | 0.65 | 0.53 |
| Top 1 | 54 | 49 | 52 | 68 | 56 | 65 | 61 | 61 | 73 | 62 |
| 2 | 73 | 68 | 70 | 85 | 76 | 80 | 77 | 80 | 86 | 82 |
| 3 | 84 | 78 | 83 | 90 | 86 | 88 | 85 | 89 | 92 | 89 |
| 5 | 91 | 89 | 91 | 95 | 93 | 94 | 93 | 95 | 96 | 95 |
| 10 | 97 | 96 | 98 | 99 | 99 | 98 | 98 | 99 | 99 | 99 |
| | Refunding COPs | | | | | | | | | |
| HI | 0.5 | 0.59 | 0.57 | 0.65 | 0.53 | 0.55 | 0.64 | 0.63 | 0.67 | 0.53 |
| Top 1 | 55 | 63 | 63 | 72 | 62 | 63 | 71 | 71 | 74 | 62 |
| 2 | 70 | 78 | 79 | 83 | 79 | 75 | 84 | 85 | 84 | 82 |
| 3 | 78 | 86 | 88 | 89 | 87 | 82 | 89 | 91 | 89 | 89 |
| 5 | 87 | 93 | 95 | 95 | 94 | 90 | 94 | 95 | 95 | 95 |
| 10 | 97 | 98 | 99 | 99 | 98 | 97 | 98 | 99 | 99 | 99 |

**Table B.1: Mean State Herfindahl Index and concentration ratios.** The first row of each panel shows the mean state HI of the corresponding period. The bottom rows of each panel show the mean of the combined state market shares of the one, two, three, five, and ten largest firms. In each sample, the left columns use market shares of observed deals, the right columns use market shares of total notional amount.

|  | NB-OS | | | | NB-Ultd Dadval-OS | | | |
|---|---|---|---|---|---|---|---|---|
|  | Deals | | Amount | | Deals | | Amount | |
| Period | Neg | Bid | Neg | Bid | Neg | Bid | Neg | Bid |
| 1 | 0.22 | 0.14 | 0.32 | 0.17 | 0.31 | 0.15 | 0.35 | 0.21 |
| 2 | 0.24 | 0.12 | 0.26 | 0.13 | 0.28 | 0.12 | 0.31 | 0.15 |
| 3 | 0.28 | 0.13 | 0.35 | 0.14 | 0.30 | 0.13 | 0.42 | 0.13 |
| 4 | 0.32 | 0.12 | 0.30 | 0.15 | 0.31 | 0.11 | 0.34 | 0.11 |
| 5 | 0.35 | 0.15 | 0.38 | 0.15 | 0.39 | 0.13 | 0.39 | 0.14 |
|  | NB-1.5M | | | | NB-Ultd Dadval-1.5M | | | |
| 1 | 0.23 | 0.15 | 0.24 | 0.18 | 0.38 | 0.15 | 0.33 | 0.19 |
| 2 | 0.25 | 0.12 | 0.27 | 0.14 | 0.28 | 0.12 | 0.31 | 0.14 |
| 3 | 0.30 | 0.12 | 0.32 | 0.15 | 0.31 | 0.12 | 0.37 | 0.13 |
| 4 | 0.35 | 0.12 | 0.32 | 0.13 | 0.35 | 0.10 | 0.33 | 0.11 |
| 5 | 0.36 | 0.14 | 0.37 | 0.15 | 0.41 | 0.13 | 0.38 | 0.14 |
|  | NB-Except | | | | NB-Ultd D-Except | | | |
| 1 | 0.24 | 0.14 | 0.32 | 0.17 | 0.31 | 0.14 | 0.35 | 0.20 |
| 2 | 0.24 | 0.12 | 0.26 | 0.13 | 0.29 | 0.12 | 0.32 | 0.14 |
| 3 | 0.28 | 0.13 | 0.32 | 0.14 | 0.31 | 0.13 | 0.42 | 0.13 |
| 4 | 0.34 | 0.12 | 0.29 | 0.15 | 0.31 | 0.11 | 0.34 | 0.11 |
| 5 | 0.36 | 0.15 | 0.34 | 0.15 | 0.41 | 0.13 | 0.40 | 0.15 |

**Table C.1: Herfindahl index and the sales method. Robustness tests.** The table reports median Herfindahl Index (HI) values across states by period and sales method. HI is measured in terms of deals and in terms of notional amount. The samples of new-money bonds — NB — and new-money bonds backed by an unlimited and dedicated ad-valorem tax — NB-Ultd Dadval — serve as base samples in the six panels of the table. In panels "NB-OS" and "NB-Ultd Dadval-OS" I exclude issues under 1M without an official statement. In panels "NB-1.5M" and "NB-Ultd Dadval-1.5M" I exclude issues with notional amount under 1.5M. In panels "NB-Except" and "NB-Ultd D-Except" I exclude issues that are excluded from a public sale requirement due to amount, coupon type, or taxable status.
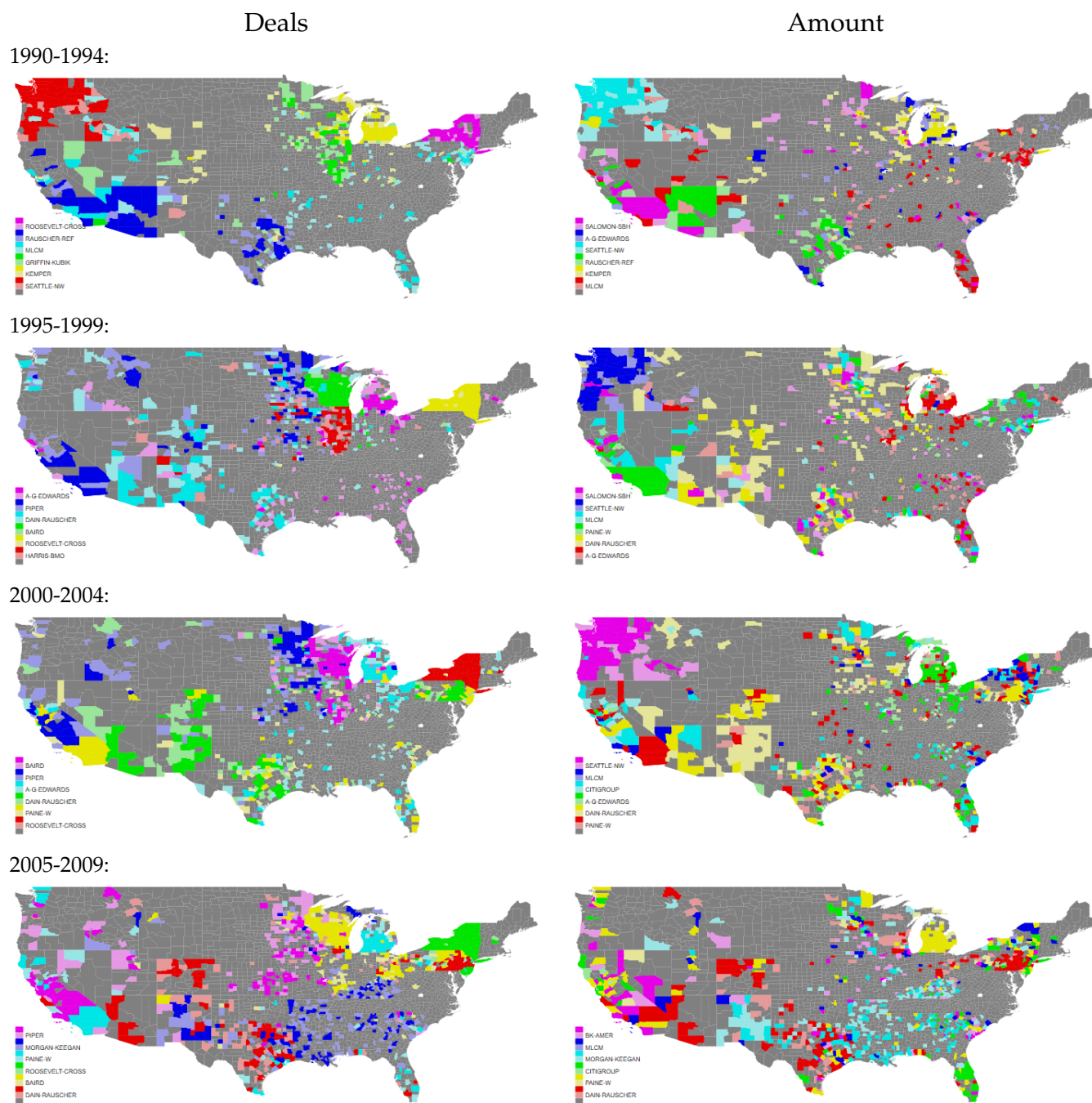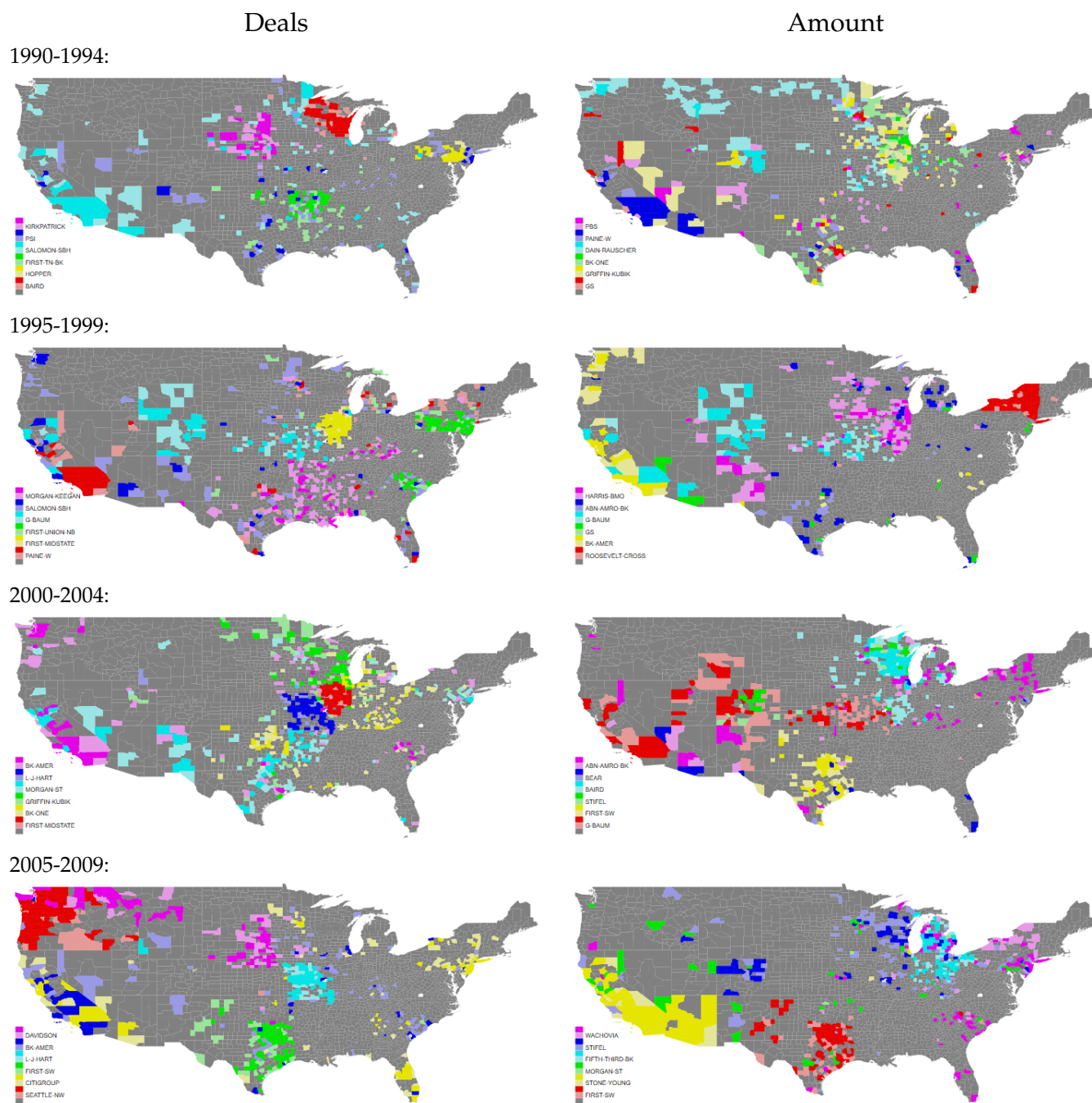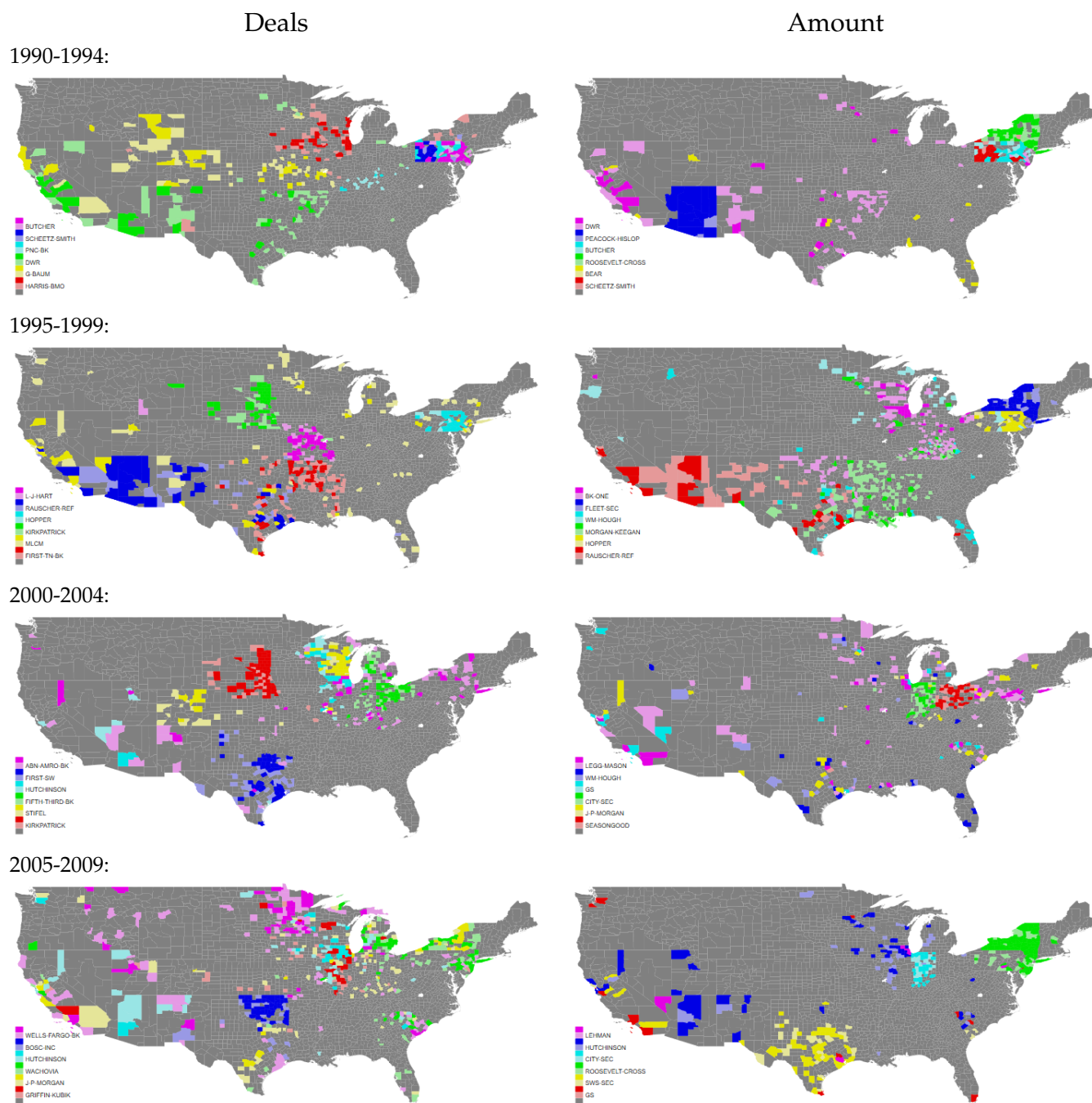
**Figure A.1: Geographical distribution of underwriting activity of the top 6 firms.** Periods are indicated at the top of each row. Red represents the largest firm of the period, yellow the second largest, followed by green, cyan, blue, and purple. Each period, I measure the underwriting activity of each firm in each county and assign the color of the most active firm to the county. Left column plots measure underwriting activity by the number of deals underwritten in the county, and right column plots by notional amount. Light colors either indicate that just one deal or less than 10.22 mil in notional amount was underwritten by the most active firm in the county.
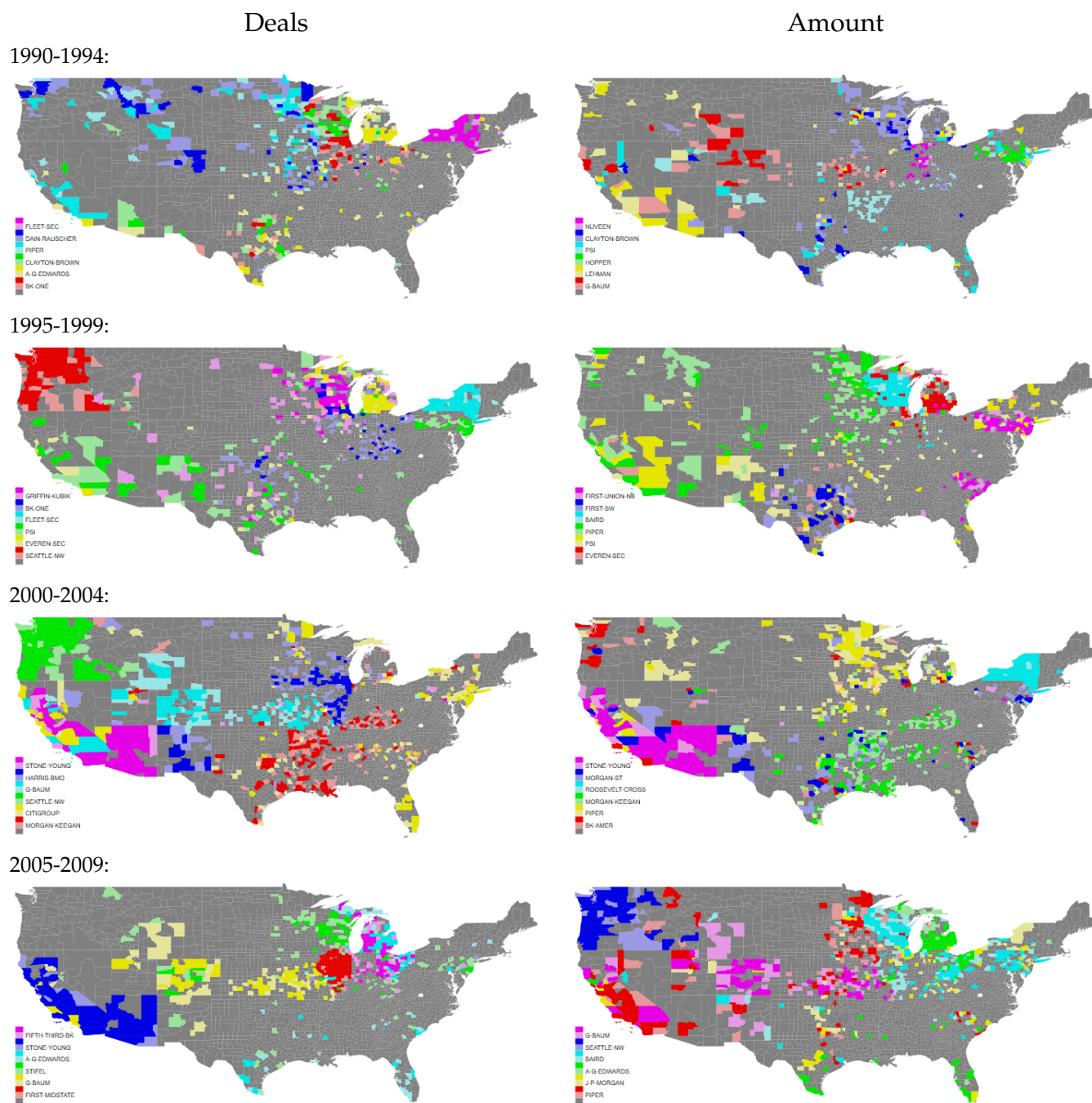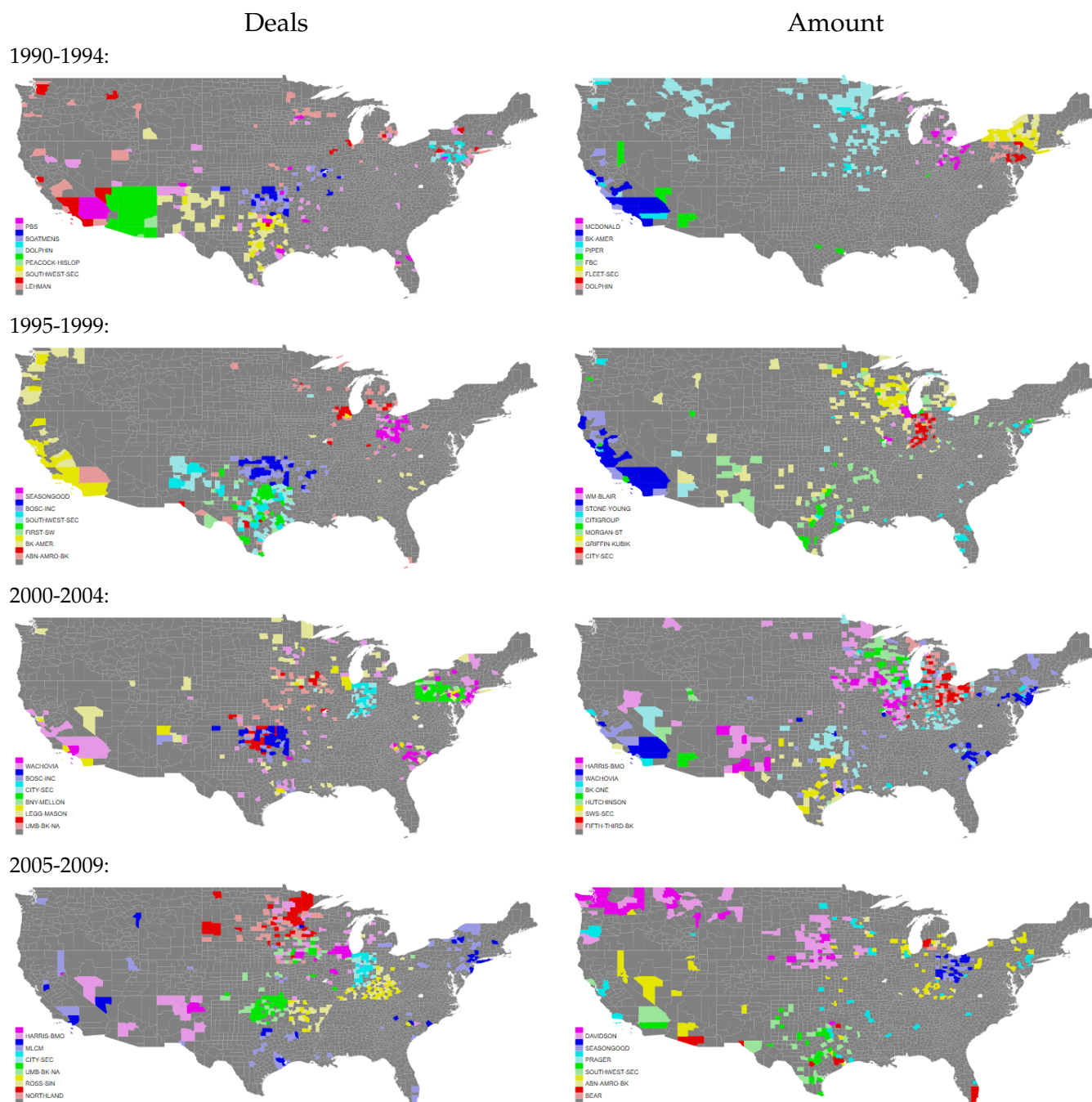
**Figure A.2: Geographical distribution of underwriting activity of the top 7-12 firms.** Periods are indicated at the top of each row. Red represents the largest firm of the period, yellow the second largest, followed by green, cyan, blue, and purple. Each period, I measure the underwriting activity of each firm in each county and assign the color of the most active firm to the county. Left column plots measure underwriting activity by the number of deals underwritten in the county, and right column plots by notional amount. Light colors either indicate that just one deal or less than 10.22 mil in notional amount was underwritten by the most active firm in the county.
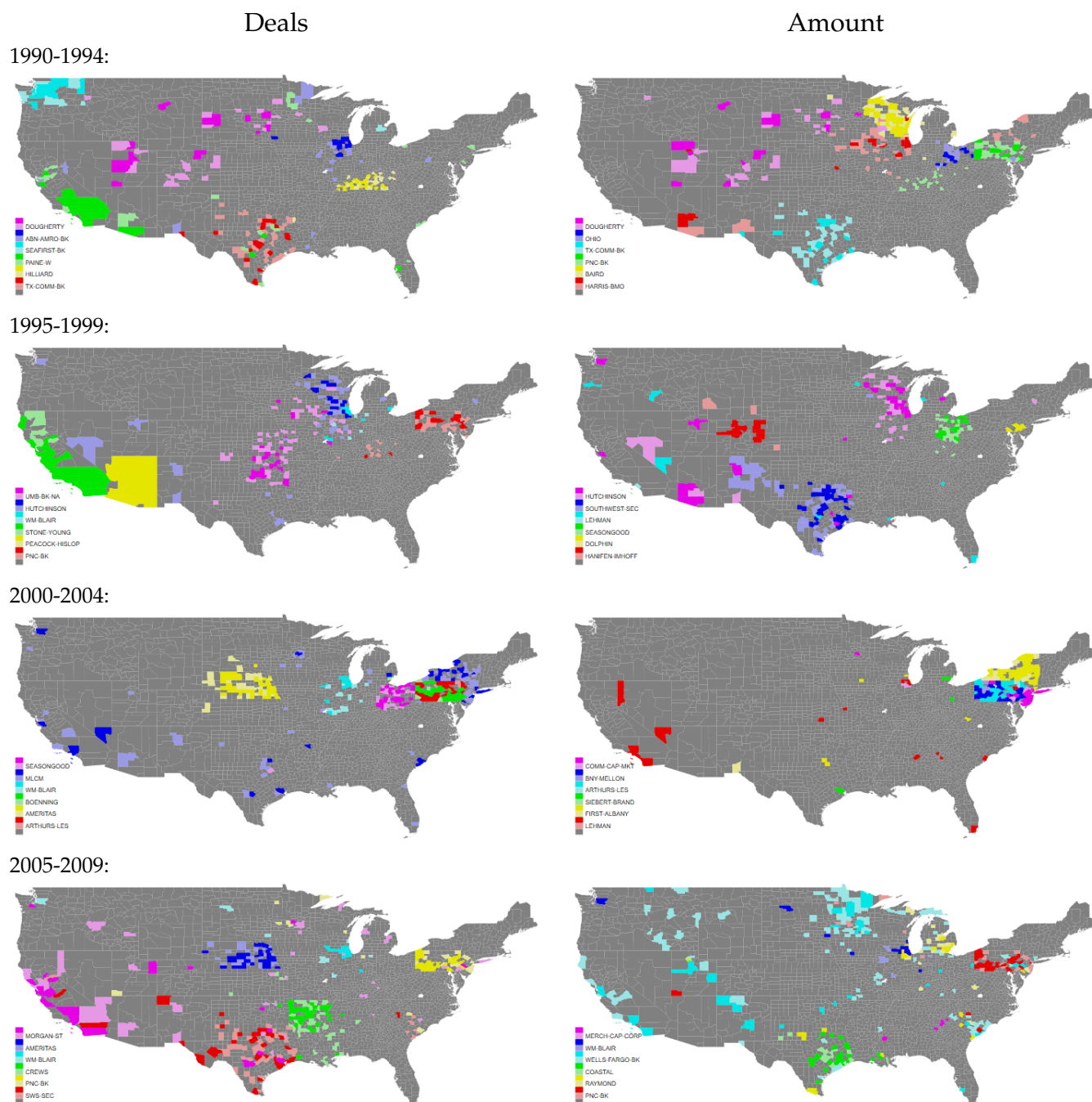
**Figure A.3: Geographical distribution of underwriting activity of the top 13-18 firms.**
Periods are indicated at the top of each row. Red represents the largest firm of the
period, yellow the second largest, followed by green, cyan, blue, and purple. Each
period, I measure the underwriting activity of each firm in each county and assign the
color of the most active firm to the county. Left column plots measure underwriting
activity by the number of deals underwritten in the county, and right column plots by
notional amount. Light colors either indicate that just one deal or less than 10.22 mil in
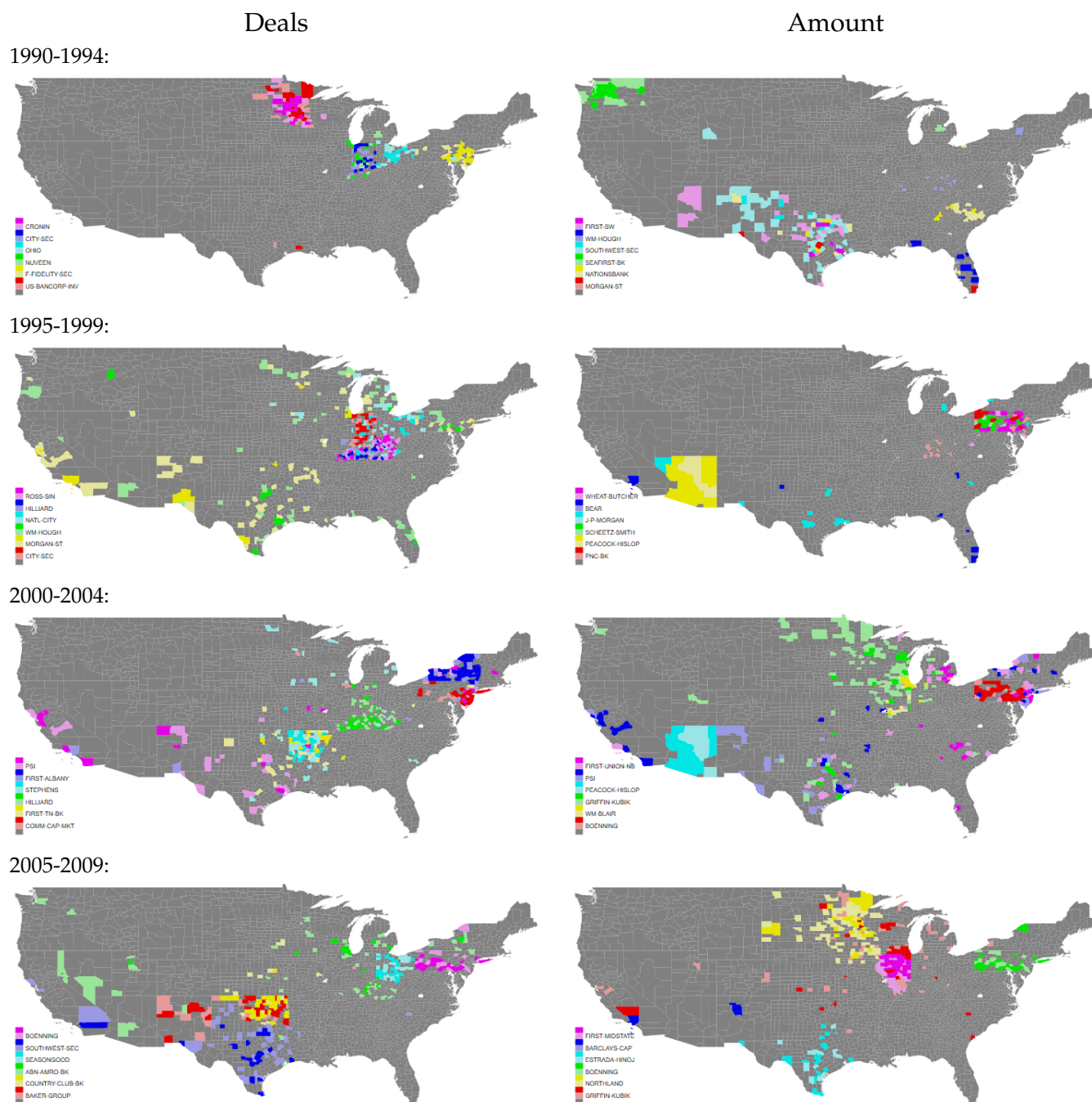notional amount was underwritten by the most active firm in the county.

**Figure A.4: Geographical distribution of underwriting activity of the top 19-24 firms.**
Periods are indicated at the top of each row. Red represents the largest firm of the period, yellow the second largest, followed by green, cyan, blue, and purple. Each period, I measure the underwriting activity of each firm in each county and assign the color of the most active firm to the county. Left column plots measure underwriting activity by the number of deals underwritten in the county, and right column plots by notional amount. Light colors either indicate that just one deal or less than 10.22 mil in notional amount was underwritten by the most active firm in the county.
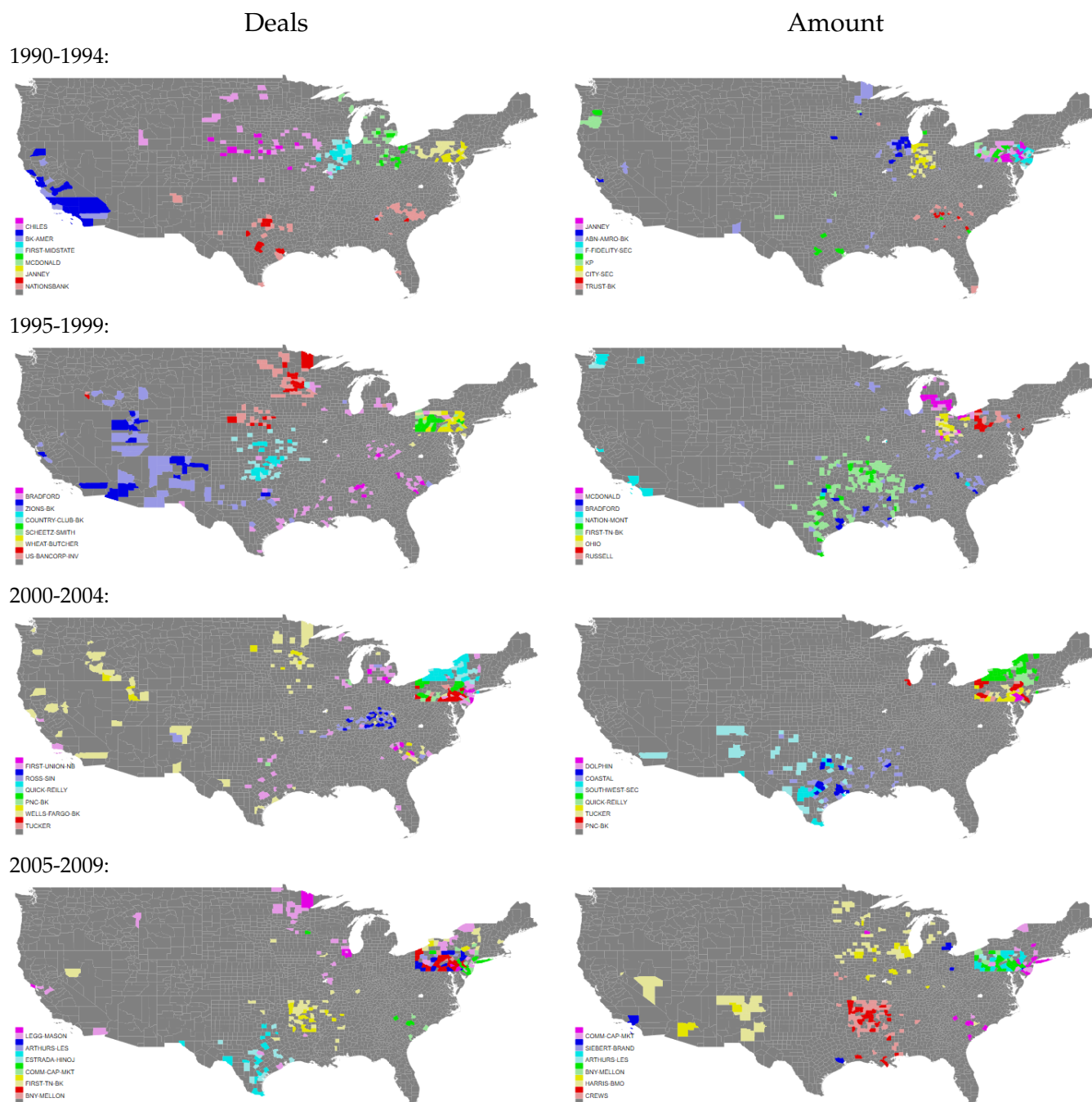
**Figure A.5: Geographical distribution of underwriting activity of the top 25-30 firms.**
Periods are indicated at the top of each row. Red represents the largest firm of the period, yellow the second largest, followed by green, cyan, blue, and purple. Each period, I measure the underwriting activity of each firm in each county and assign the color of the most active firm to the county. Left column plots measure underwriting activity by the number of deals underwritten in the county, and right column plots by notional amount. Light colors either indicate that just one deal or less than 10.22 mil in notional amount was underwritten by the most active firm in the county.
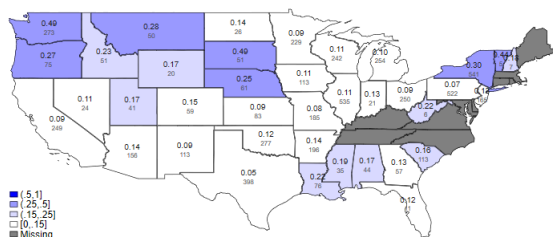
**Figure A.6: Geographical distribution of underwriting activity of the top 31-36 firms.** Periods are indicated at the top of each row. Red represents the largest firm of the period, yellow the second largest, followed by green, cyan, blue, and purple. Each period, I measure the underwriting activity of each firm in each county and assign the color of the most active firm to the county. Left column plots measure underwriting activity by the number of deals underwritten in the county, and right column plots by notional amount. Light colors either indicate that just one deal or less than 10.22 mil in notional amount was underwritten by the most active firm in the county.
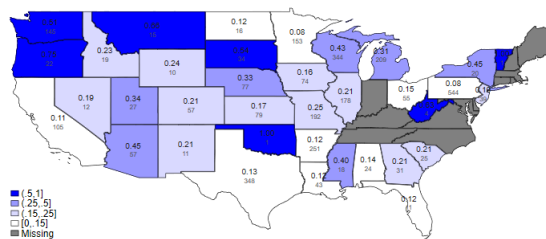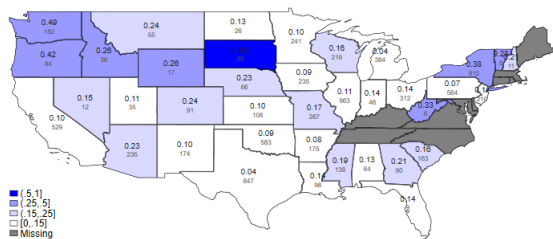
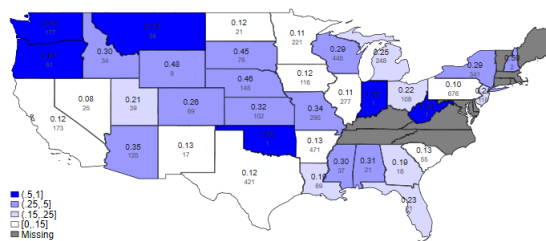**Figure A.7: Geographical distribution of underwriting activity of the top 37-42 firms.**
Periods are indicated at the top of each row. Red represents the largest firm of the
period, yellow the second largest, followed by green, cyan, blue, and purple. Each
period, I measure the underwriting activity of each firm in each county and assign the
color of the most active firm to the county. Left column plots measure underwriting
activity by the number of deals underwritten in the county, and right column plots by
notional amount. Light colors either indicate that just one deal or less than 10.22 mil in
notional amount was underwritten by the most active firm in the county.

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**Figure A.8: Geographical distribution of underwriting activity of the top 43-48 firms.** Periods are indicated at the top of each row. Red represents the largest firm of the period, yellow the second largest, followed by green, cyan, blue, and purple. Each period, I measure the underwriting activity of each firm in each county and assign the color of the most active firm to the county. Left column plots measure underwriting activity by the number of deals underwritten in the county, and right column plots by notional amount. Light colors either indicate that just one deal or less than 10.22 mil in notional amount was underwritten by the most active firm in the county.
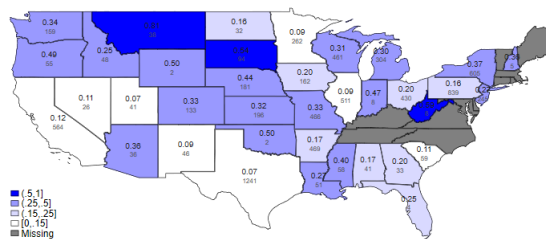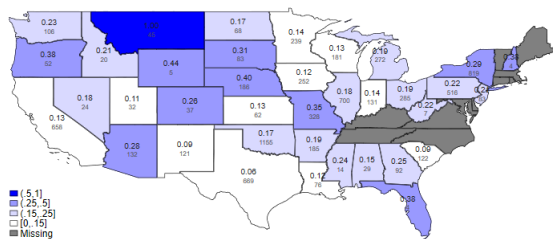
**Figure B.1: Herfindahl Index distribution by bond type.** The figure plots the distribution of Herfindahl Index by bond type. Unconcentrated states are painted white, moderately concentrated states light-blue, a darker color indicates highly concentrated states, and the darkest blue indicates super concentrated. Black and large numbers in the center of each state show the value of the index. Smaller and gray numbers show the size of the sample. The figure continues on the next page.
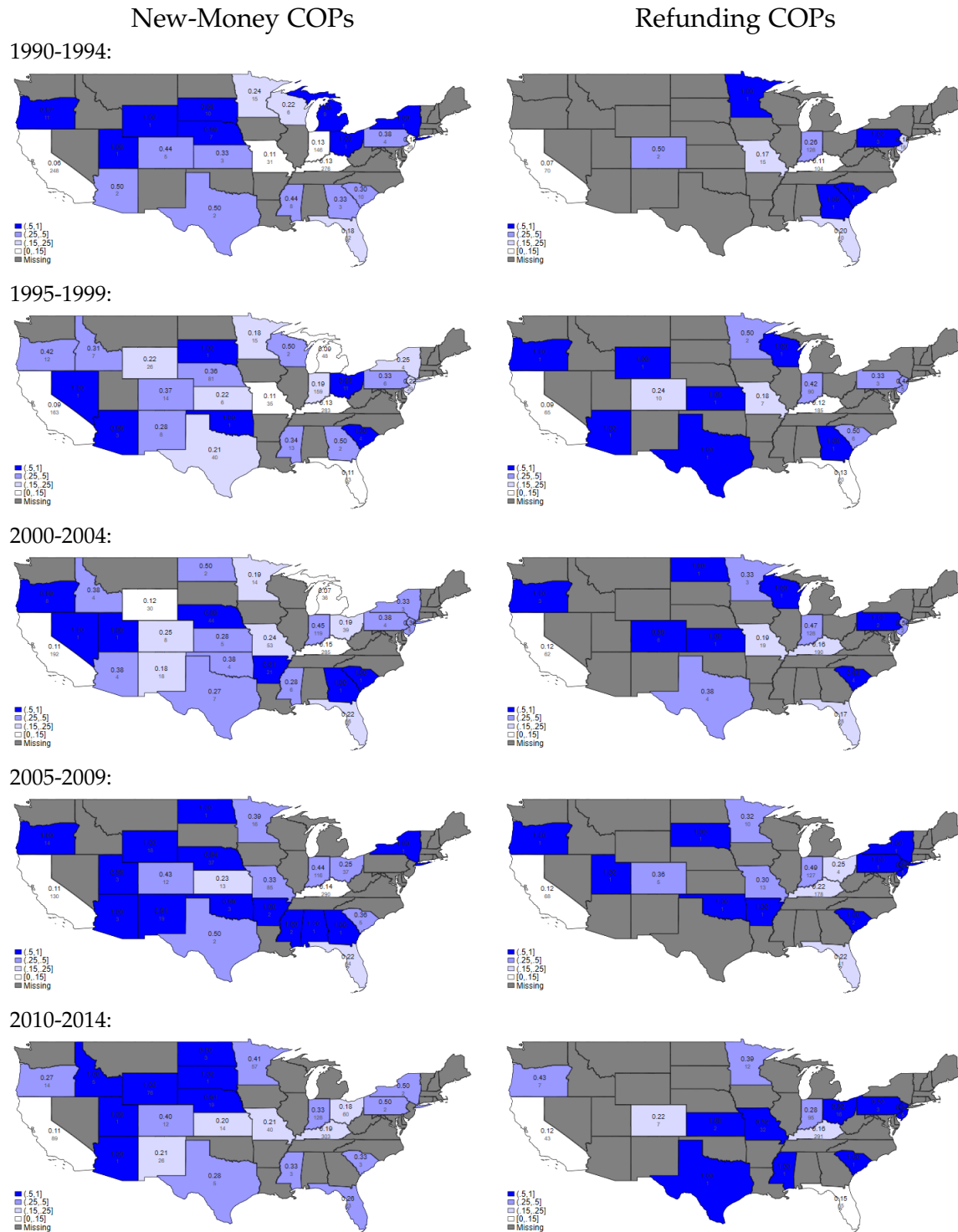
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**Figure B.1: Herfindahl Index distribution by bond type.** The figure plots the distribution of Herfindahl Index by bond type. Unconcentrated states are painted white, moderately concentrated states light-blue, a darker color indicates highly concentrated states, and the darkest blue indicates super concentrated. Black and large numbers in the center of each state show the value of the index. Smaller and gray numbers show the size of the sample. The figure continues on the next page.

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