Corporate Acquisitions and Ownership of Veterinary Clinics: Local Market Power and Differing Targets

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Abstract

Mergers and acquisitions (M&A) are a common occurrence in many human healthcare industries and have been a topic of concern for market efficiency, patient outcomes, and cost of care. However, M&A is relatively new feature in the animal healthcare industry where cash-for-services is the predominate mode of payment rather than insurance and market concentration is low on an aggregate scale. We examine the effects of M&A of the largest corporate veterinary services provider on local market dynamics between 2017-2020. Specifically, we analyze over 200 acquisitions to determine the effects on concentration, revenue, and firm entry. We find that market concentration increases by 10.6% of a standard deviation and the effect gets stronger over time as the market adjusts. This is due to an increasing number of firms in the local market after the acquisition which offsets the revenue being concentrated within fewer firms. The results of analyzing this more competitive healthcare industry allows us to draw interesting parallels to what is happening in human healthcare and broadens the scope of literature on healthcare markets.

Keywords: Acquisitions, Market Concentration, Veterinary Services

JEL Classification: L22, G34, R12

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1 Introduction

Mergers and acquisitions have long been of interest, especially among healthcare industries. As larger entities acquire smaller competitors factors such as market power, patient outcomes, prices, labor conditions, value creation, and costs are concerns that plaque the industry (Arnold, 2020; Eliason, Heebsh, McDevitt, & Roberts, 2020; Kishimoto, Goto, & Inoue, 2017). Much of the literature on mergers and acquisitions (M&A) within healthcare markets focus on such sectors as hospitals and dialysis companies (Dai & Tang, 2015; Eliason et al., 2020; Gaynor, Moreno-Serra, & Propper, 2013; Louri, 2001). However, these healthcare sectors are heavily dependent on insurance programs that assist in covering the cost of many procedures and services. In addition, there is a large degree of market concentration on a national and local level. In contrast, the veterinary services market has similar structures to human healthcare in terms of cost, albeit for animals, with low levels of market concentration, with the exception of food animal veterinary services (Corley & Godley, 2011). In addition, veterinary medicine is predominately driven by cash transactions rather than insurance. Nonetheless, both the human healthcare and the veterinary services industries have a number of large corporations and venture capital groups acquiring businesses across the country.

Given that the veterinary services industry is a relatively competitive market, there is concern that acquisitions are leading to substantive increases in local market power (Bimbatti Mattos, 2019). Corporate firms have access to more financial resources that decrease the reliance on traditional business financing. Thus, the acquiring firms can pay higher wages, afford larger marketing efforts, and purchase new and better technology. The concern from independently owned veterinary businesses is that acquisitions from these groups are leading to a "roll-up" situation (Bimbatti Mattos, 2019). "Roll-up" strategies are where large firms gradually increase market share by acquiring many of their smaller competitors across a large geographic area (Eliason et al., 2020). In the human healthcare industry, "roll-up" strategies as a part of horizontal integration have been observed in dialysis companies, physician practices, and medical device companies (Capps, Dranove, & Ody, 2017; Dunn, 2016). While there are benefits to M&A such as lower costs through economies of scale, recent work has highlighted the fact that more concentrated markets can lead to lower quality service, worse mortality outcomes, and declines in value for payers (Cuellar & Gertler, 2006; Dafny, Duggan, & Ramanarayanan, 2012). Moreover, health insurance plan generosity in human health care only affects hospital prices in competitive markets (L. C. Baker, Bundorf, & Kessler, 2015). All of these outcomes are of concern for the current M&A activity occurring in veterinary medicine as the market continues to evolve with increases in pet insurance adoption and changes in the labor force.

Due to the expected expansion of the veterinary services industry over the next decade in terms of revenue, it is not a foregone conclusion that acquisitions will be detrimental to a competitive market. This expansion is predominately due to an increasing number of households owning pets, quality healthcare extending the lives of animals, and an increase willingness of pet owners to seek preventative care (Einav, Finkelstein, & Gupta, 2017). While M&A increases market power, market expansion of the industry nationally and locally may offset concerns of increased concentration.

Our study focuses on the effects of acquisitions by one of the largest, corporate-owned veterinary services companies - Banfield - on local market power, firm entry/exit dynamics, and market revenue across the United States between 1997 and 2020. By focusing on veterinary services, we diverge from the recent literature on industries that have experienced high consolidation in market power. Analyzing a more competitive healthcare industry can serve as a more realistic view of how less competitive healthcare markets might operate under less concentration. Moreover, since there are competing effects in veterinary healthcare - market expansion and increasing concentration - the effect of M&A is not clear. Due to market expansion, acquired firms' market power could increase but would be limited due to a significant number of new firms entering the market. This phenomenon does not negate the potential of "roll-up" strategies being employed by larger firms, but rather delay the causal impacts. Other highly competitive industries have shown susceptibility to this practice (Dunn, 2016) and is something to monitor as the veterinary industry continues to grow.

Thus, there are three components to this study. First, we are interested in analyzing a more competitive healthcare industry with low insurance adoption. As previously mentioned, this can provide valuable insights and comparisons to more concentrated healthcare markets (Eliason et al., 2020; Gaynor, Ho, & Town, 2015; Gaynor et al., 2013). Second, we examine the market expansion effects on "roll-up" M&A strategies. While it is clear that large corporations such as Banfield are hoping to gain small local market share in a number of geographic areas to control a larger share nationally, it is not well understood how market expansion - increasing number of firms - changes the effectiveness of such a strategy. Finally, an interesting phenomenon occurred within our data: Banfield was acquired by a larger corporate firm (Mars, Inc.). This higher level acquisition allows us to examine the changes in M&A activity under the two different ownership schemes and if there was a difference in the local market effects. Additionally, this work allows for a different look at the veterinary medicine industry as much of the previous work has focused on healthcare inefficiencies (Einav et al., 2017) and veterinarian labor issues (Neill, Holcomb, & Brorsen, 2017, 2018; Neill, Holcomb, Raper, & Whitacre, 2019; Neill, Kakpo, & Mack, 2021; Smith, 2002).

The empirical strategy takes advantage of time-varying acquisitions in various urban markets by comparing markets with acquisitions to markets without one. We focus on urban markets to focus solely on companion animal (pet) veterinary markets and avoid the large/food animal markets in rural areas. The main results find that acquisitions increase market concentration by 10.6% of a standard deviation. There is no evidence of pre-trends in market concentration and the results are robust to using methods developed to address staggered timing of acquisitions. The effects are dynamic with the increase in market concentration becoming larger over time which is consistent with an adjustment period in the market.

Next, market concentration is disaggregated into its component parts, namely market revenue and number of firms. This enables the investigation of the mechanisms that are driving the change in market concentration and examines the effects of market expansion before and after M&A. Unsurprisingly, we find evidence that acquisitions are correlated with increases in market sales revenue. Market revenue increases by 18 million dollars which is half a standard deviation of sales revenue in an urban county. Of primary interest, we also find evidence that acquisitions are increasing the number of firms in a local market, as the number of firms increases by 7.26 after an acquisition. This suggests that M&A still increases market concentration even under market expansion in a highly competitive market. In other words, the acquired firms are capturing a large enough share of the new market revenue to more than offset the effect of new entry caused by the acquisition. This finding also supports prior literature showing how horizontal integration can also benefit competing firms (Shahrur, 2005).

Finally, near the middle of the sample in 2007, Banfield is acquired by Mars Incorporation. Subsetting before and after Mars buys Banfield, there are no effects on markets after this higher level acquisition. This is consistent with the prior literature that finds that smaller firms get larger gains from acquisitions (Moeller, Schlingemann, & Stulz, 2004). A possible reason is that when Banfield is acquired by Mars, internal financing may be more accessible which has been shown to lead to worse acquisitions (Malmendier & Tate, 2008). However, we do find that where acquisitions occur shifts geographically. Specifically, they acquire firms in the higher income areas, which is also where the largest market expansion is occurring for the industry. These findings add to the literature by showing that acquisitions by smaller firms may have larger effects on market power than larger firms.

2 Background on the Veterinary Services Industry

Veterinary medicine is a unique industry that is served by highly educated labor with a focus on animal rather than human welfare. Veterinarians, and more broadly veterinary businesses, manage the health of food producing animals, prevent and contain animals disease outbreaks, and combat against zoonosis – the transmission of disease from animals to humans (Bureau of Labor Statistics, U.S. Department of Labor, 2021). While veterinarians' role in ensuring a safe food supply is both a private and public good, most veterinary businesses are focused on companion animals such as dogs and cats.

Companion animals have grown in popularity over the past several decades due to the mental health benefits of companionship, the accommodation of urban living spaces to allow for pets, and generational trends in ownership (Dotson & Hyatt, 2008). As such, the veterinary industry has seen a general increase in number businesses since the late 1990s. Since then, the growth in revenue for the industry has attracted several large corporations to enter the market. This entrance trend is also true for private equity and venture capital groups.

While the amount of four-firm concentration is low, approximately 10%, there is concern among independent veterinary business owners that these corporate entities are creating a less competitive market environment because they can offer lower prices to consumers, higher wages to veterinarians and technicians, and have better marketing capabilities (Gyles, 2018). Another perceived concern is that business creation among younger generations of veterinarians is slowing due to high debt-to-income ratios (Greenhill, Elmore, Stewart, Carmichael, & Blackwell, 2015).

While all of this is anecdotal, it is not unreasonable to assume that the increased corporate interest in veterinary medicine could result in increased market concentration similar to that of human healthcare. Determining how corporate acquisitions play a role in local market power is a first step to examining whether the veterinary industry is also following the patterns of human medicine in this aspect.

3 Data

The overarching research question is how corporate acquisitions affect local market concentration, revenue, and firm dynamics. The minimum data requirements are time-varying firm level sales to calculate market concentration changes along with the time and location of corporate acquisitions. The firm-year level data on veterinarian businesses comes from Data Axle Marketing. The data contains company name, exact address, and sales revenue each year from 1997 to 2020. Using this data enables pinpointing corporate acquisitions over time and comparing market concentration in markets with no acquisition to markets with an acquisition.[1]

3.1 Veterinary Businesses

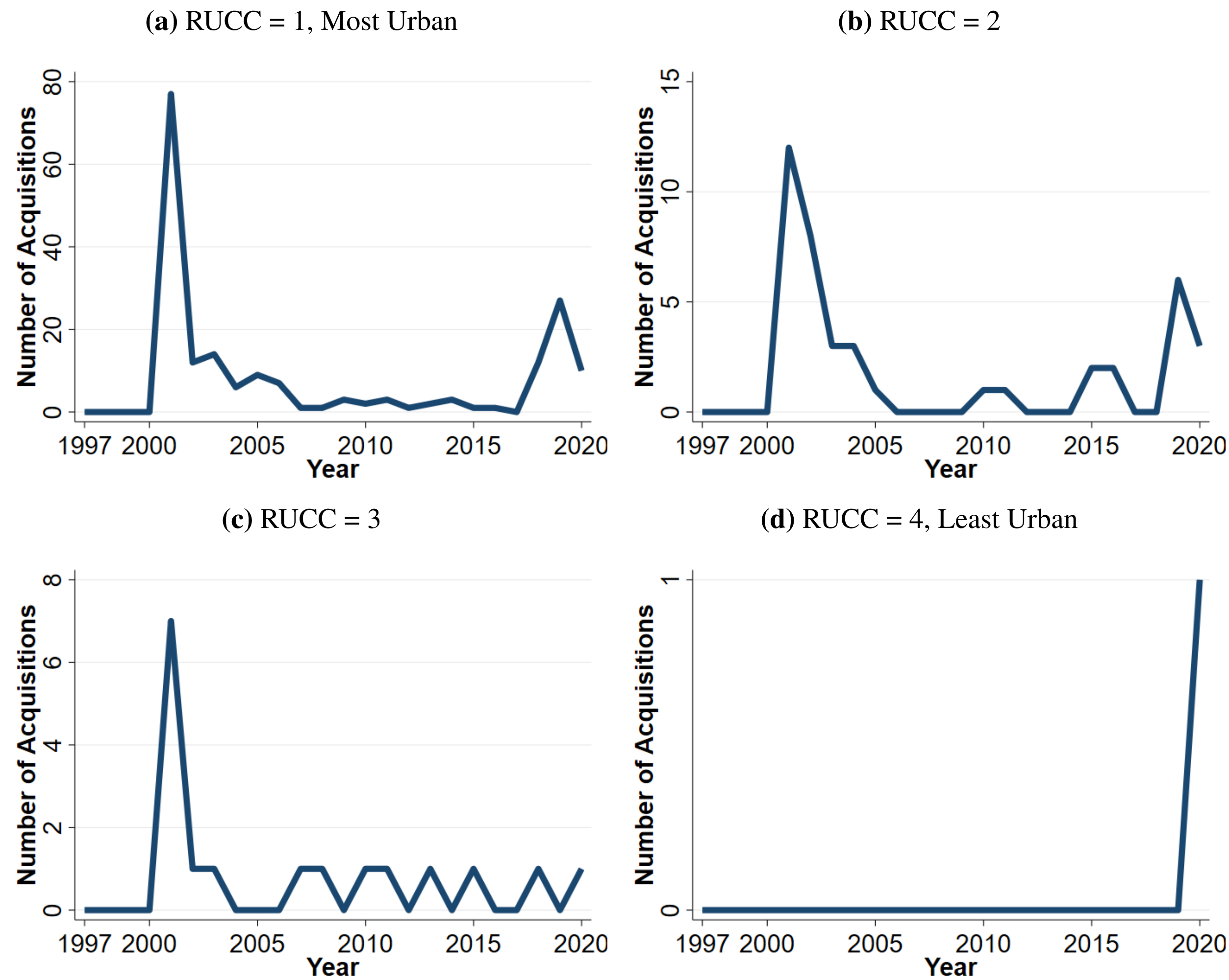
The data from Data Axle contain 1.189 million observations of veterinary businesses in the United States over time. All businesses whose primary NAICS code is 541940, which is the code for "Veterinary Services" are kept. This leaves a panel totalling 1.16 million observations.

3.1.1 Acquisitions

Acquisitions by Banfield is the explanatory variable of interest. The company name and full address is used to identify acquisitions. If Banfield is not in the company name at a given address in one year, but it is at that address in the next year, that is counted an acquisition. There are no variables indicating company owners, so this is the only way to identify acquisitions with this data.

[1] No publicly available dataset satisfies these requirements. County Business Patterns (CBP) is a close substitute, though it is too aggregated since it comes at the county level. We do confirm that our key variables follow similar trends and levels to the CBP.

Figure 1: Acquisitions by Year and County Urbanicity



Note: Figures show number of Banfield acquisitions by Year and county-level Rural-Urban Continuum Code (RUCC). Scales differ. Banfield acquisitions are identified by full addresses where there was no Banfield company name in one year, then a Banfield company name at that address in the next year in the Axle Marketing data. County RUCC code comes from the United States Department of Agriculture (USDA). It is updated nearly every 10 years and the codes in the paper are from 2013. The 2013 RUCC codes span 1-9, with 1 being most urban and 9 being most rural. Counties with RUCC codes of 3 or below are considered urban. No acquisitions occur in counties with RUCC codes greater than 4.

Sometimes there are multiple companies at the exact same address. This is not an issue for identifying acquisitions, since all company names at the same address are considered from year to year. One potential issue this could raise is whether this procedure for finding acquisitions actually identifies an increase in the number of businesses at an address, as opposed to Banfield acquiring a firm which would correspond to no net change in the number of businesses at a given address. Of 252 acquisitions, 177 resulted in no net change at a given address. These are summed up in Figure A.1 which shows that the average change in net number of businesses at an exact address after an acquisition is 0.198 with a standard deviation of 0.714.

After trying different private equity company names that acquire veterinarian businesses, by far the largest number of acquisitions are from Banfield Corporation.[2] The likely reason for the prominence of Banfield acquisitions in the data is the company insisted on having the Banfield name on the businesses that were acquired. The analysis focuses only on Banfield, because the other companies may be different which could introduce heterogeneity bias. There are an adequate number of Banfield acquisitions and relatively few acquisitions from other companies, so adding other firms will not increase precision in any appreciable way. Furthermore, Banfield Animal Hospital has the most establishments of any firm with 1,001 locations out of 2,088 total branded locations in November 2021 (SafeGraph, 2021).

An important aspect of Banfield acquisitions is that they overwhelmingly occur in urban areas. Figure 1 shows acquisitions by rural-urban code, from the USDA's Rural and Urban Continuum Code in 2013, and year. A code of 3 or below indicates an urban area. Only 1 acquisition occurs in a (marginally) rural area and it occurs at the end of the sample. For this reason, primary analyses focus only on urban counties, but results remain the same when rural counties are also included.[3] Figure 2a shows there is substantial geographic variation in where Banfield acquisitions occur.[4]

[2]The other equity companies that were searched for include: Pathway Vet Alliance, Blue Pearl, Pet Partners, MedVet, National Veterinary Associates, BlueRiver Pet Care, Vital Pet, Obrien Veterinary Management, VetCor, PetVet, Wellhaven, Community Vet Clinics, VIP Pet Care, Veterinary Practice Partners, Petwell Partners, and Southern Veterinary Partners.

[3]It is important to note that market concentration is much higher in rural areas simply because there is not enough demand within those local markets to support a large number of businesses. Companion animal populations are less dense simply because there are less humans in these areas. In addition, food animal populations tend to be heavily concentrated requiring a small number of veterinarians to actually service them. In other words, food animal populations are based on the number of food animal producing businesses, while companion animal populations are based on number of households within a local area. So, focusing our work on urban market areas predominately restricts our analysis to companion animal practices, but also where the majority of acquisitions occur.

[4]Figure A.2 shows total acquisitions per county.

Furthermore, many of the treated counties are bordered by untreated counties which suggests that spatial autocorrelation is unlikely to be problematic for the estimates.

3.1.2 Market Concentration

The measure of market concentration used is the Hirschman-Herfindahl Index (HHI). HHI is calculated as the sum of all firms' squared market shares in a given market,

$$\text{HHI}_m = \sum_{f=1}^{F} s^2, \tag{1}$$

in which the m stands for market. Firms in the market are indexed $\{1, \ldots, \text{F}\}$ and $s \in (0, 100]$ is each individual firm's market share.

Higher values of HHI indicate a more concentrated market, meaning higher proportions of the total sales revenue is captured by fewer firms. Figure A.3 shows that veterinary services market concentration has remained relatively stable over time, decreasing from 1997-2015, in both urban and rural areas. Very recently, veterinary service has recently begun to become slightly more concentrated. Furthermore, market revenue, $\sum r$, and the number of firms, F, are analyzed independently as outcomes to understand which factors underlying market concentration change.

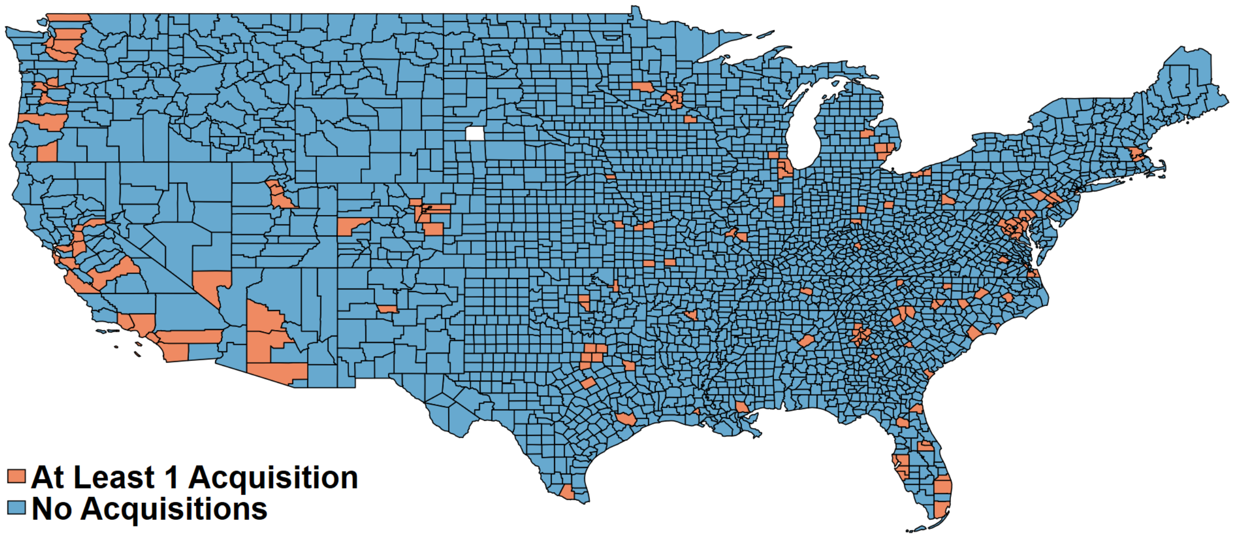
Defining the geographic scope of the market is an important aspect. The baseline dataset uses county boundaries as the geographic scope of markets, like Neill et al. (2019). There are many counties and by using only urban counties, there is not as much heterogeneity across markets. Figure 2b shows that there is also a large range of market concentration and showcases the urban-rural divide in concentration. This is ample variation for use in a regression analysis.

3.2 Descriptive Statistics

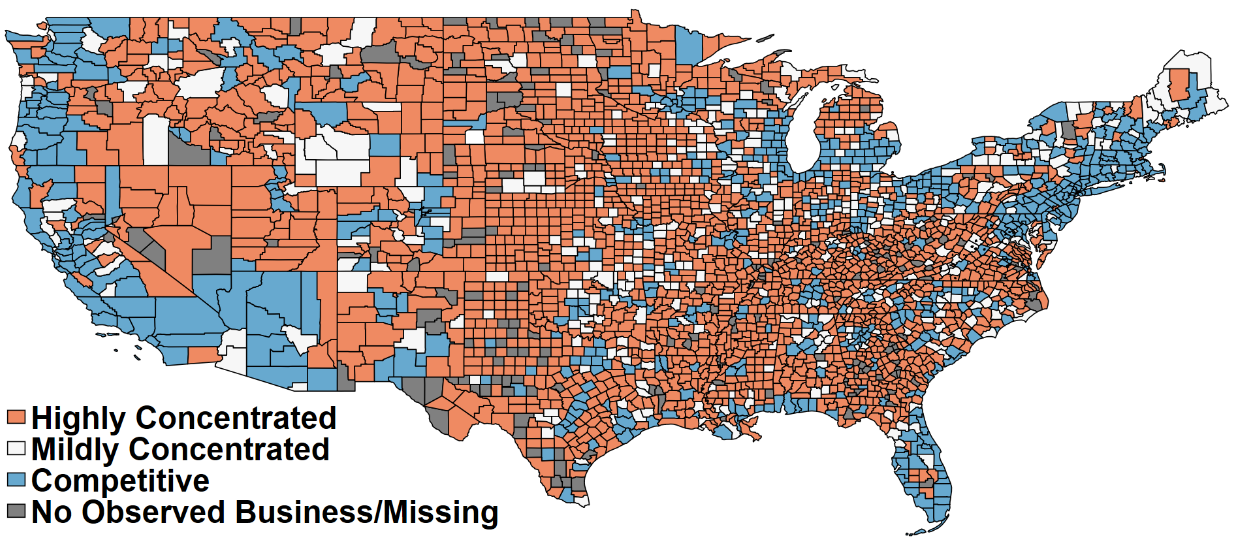
The dataset is a balanced panel of 1,157 urban, as defined by the USDA 2013 RUCC codes, U.S. counties from 1997-2020. Table 1 presents the summary statistics of the aggregate, urban, and rural samples. There is a rural-urban divide in the total number of veterinary businesses, with an average of 17.89 or 21.44, depending on source, for urban areas compared to an average of 2.5-3.2 for rural areas. The market concentration measure, HHI, shows that this urban-rural difference in

Figure 2: Spatial Distribution of Acquisitions and Market Concentration

(a) Acquisitions



(b) Market Concentration



Note: Data source is Axle Marketing businesses for which the primary NAICS codes of Veterinary Services, 541. is used. (a) shows the counties where Banfield acquired at least 1 veterinarian firm from 1997-2020. (b) shows average market concentration measured by the Hirschman-Herfindahl Index (HHI) using firm-level sales revenue. Orange counties are highly concentrated, meaning an HHI $\geq$ 2,500. White counties are mildly concentrated, meaning $1500 \leq$ HHI < 2500. Blue counties are competitive, meaning HHI < 1500.

number of firms is also reflected in how concentrated markets are with rural markets being, on average, twice as concentrated.[5]

Furthermore, the Data Axle data seems to be of adequate quality along two dimensions. First, the number of vet businesses from County Business Patterns (CBP) is nearly identical to businesses in the Data Axle data. In all panels, the average and median count of veterinary businesses in Data Axle compared to CBP are very close.[6] Second, to ensure data consistency, the county sales revenue from Data Axle is greater than the annual payroll from CBP in all panels for both means and medians.

4 Methods

Areas where a Banfield acquisition occurs and areas where they do not are observed in pre and post acquisition periods. This county-level variation over time is used to estimate effects of Banfield acquisitions. The initial estimation strategy uses two-way fixed effects (TWFE) to estimate the static effect of acquisitions. The model is specified,

$$y_{ct} = \beta_1 Acquisition_{ct} + \beta_2 Population_{ct} + \mu_c + \rho_t + e_{ct}, \tag{2}$$

in which c stands for county and t stands for time which is year. The outcomes, y_{ct}, are market concentration, revenue, and net firms. The standard errors are clustered by county to correct for errors that are potentially correlated by county and because treatment is assigned at this level.

The coefficient of interest is β_1 and $Acquisition$ is a binary variable which equals 1 if it is in the post-acquisition period in a county where Banfield bought a veterinarian business. There are 219 acquisitions in the data with 148 unique counties, so there are enough acquisitions where standard errors from county clustered standard errors are asymptotically justified (Cameron & Miller, 2015). Converting acquisitions to a discrete variable does not cause much loss of information, because most areas are treated once with a single acquisition. Separate results, which exclude counties in which multiple acquisitions occurred, either at different times or more than 1 in the same county

[5] Table A.1 shows the descriptive statistics across the 3 urban RUCC codes.

[6] Data Axle may deviate from the population due to sampling. CBP may deviate due to censoring/privacy concerns in some low veterinarian areas.

Table 1: Summary Statistics

Panel A: Aggregate	Mean	Median	SD	Min	Max	Count
Count of Veterinarian Businesses (Axle)	9.98	3.00	23.73	0	651.0	75432
Count of Veterinarian Businesses (CBP)	8.21	3.00	21.75	0	634.0	75432
Axle Sales Revenue, Millions	7.50	1.38	36.71	0	7956.5	75432
CBP Annual Payroll, Millions	3.35	0.47	10.96	0	385.3	57429
Hirschman-Herfindahl Index	4102.06	3148.56	3225.29	0	10000.0	66254
Population	96187.29	25298.00	310664.86	40	10105708.0	72241
Real GDP, Billions	4.85	0.93	17.81	0	678.8	74036
Real GDP Per Capita	40435.31	38278.71	11412.81	12224	238524.0	70938

Panel B: Urban (RUCC $\leq$ 3)	Mean	Median	SD	Min	Max	Count
Count of Veterinarian Businesses (Axle)	21.44	10.00	35.87	0	651.0	28008
Count of Veterinarian Businesses (CBP)	17.89	8.00	33.32	0	634.0	28008
Axle Sales Revenue, Millions	17.25	5.67	34.78	0	681.1	28008
CBP Annual Payroll, Millions	7.38	2.48	16.12	0	385.3	23876
Hirschman-Herfindahl Index	2418.69	1469.55	2552.70	0	10000.0	26482
Population	220112.25	90497.00	484438.12	58	10105708.0	26828
Real GDP, Billions	11.70	3.92	28.11	0	678.8	27115
Real GDP Per Capita	43857.18	41626.68	11866.85	17993	191516.7	25985

Panel C: Rural (RUCC $\geq$ 4)	Mean	Median	SD	Min	Max	Count
Count of Veterinarian Businesses (Axle)	3.21	2.00	3.53	0	46.0	47424
Count of Veterinarian Businesses (CBP)	2.50	2.00	2.95	0	31.0	47424
Axle Sales Revenue, Millions	1.75	0.76	36.61	0	7956.5	47424
CBP Annual Payroll, Millions	0.48	0.00	0.90	0	34.1	33553
Hirschman-Herfindahl Index	5222.92	4586.78	3138.02	0	10000.0	39772
Population	22977.89	16345.00	21453.76	40	201513.0	45413
Real GDP, Billions	0.89	0.59	0.91	0	12.1	46921
Real GDP Per Capita	38457.31	36485.01	10651.96	12224	238524.0	44953

Panel D: County Level	Mean	Median	SD	Min	Max	Count
Urban (RUCC $\leq$ 3)	0.37	0.00	0.48	0	1.0	3144
Rural-Urban Code, 2013	5.01	6.00	2.71	1	9.0	3143
RUCC 2013 - RUCC 2003	-0.12	0.00	0.97	-7	7.0	3138
Total Banfield Acquisitions	0.08	0.00	0.47	0	9.0	3144

Note: Observations are 3,143 counties from 1997-2020. Rural-Urban Code is from the USDA Rural Urban Continuum Codes (RUCC) from 2013 version with the next latest version release in 2003. Panel A includes counties with any RUCC code. Panel B includes urban counties which have a RUCC code $\leq$ 3. Panel C includes rural counties which have a RUCC code $\geq$ 4. Count of Veterinarian Businesses is count of businesses with NAICS code 541940, Veterinary Services, from Axle and the Census Bureau's County Business Patterns (CBP) data respectively. Annual payroll comes from CBP with NAICS code 541940. Total Banfield Acquisitions, Sales Revenue, and Hirschman-Herfindahl Index come from Axle. Population comes from the Census Bureau. GDP comes from Bureau of Economic Analysis, specifically the annual personal income, CAINC1, series. GDP is in 2020 US Dollars.

at the same time, are similar which indicates dichotimizing acquisitions is likely an innocuous simplification.

The county fixed effects are shown by μ_c. Some characteristics of counties may also correlate with concentration or acquisitions, including μ_c ensures time-invariant county-level characteristics do not bias the effect of acquisitions. The year fixed effects are shown by ρ_t. These ensure that time trends in concentration and acquisition do not bias the effects of acquisitions. Under certain assumptions, the inclusion of time and county fixed effects enable β_1 to have a causal interpretation as the average treatment effect on the treated (ATT).

Population is an important control, because the businesses being bought are made to provide veterinary services to companion animals and companion animals follow human population. This is a common concern in the literature on economics of veterinary services (e.g. Neill et al. (2019)) and the AVMA uses human population to predict pet population (AVMA, 2018). Another advantage of population is it is relatively well measured.

While population is important to address, awareness of the role of covariates in identifying causal effects using differences-in-differences is still growing (Caetano, Callaway, Payne, & Rodrigues, 2022). One problem with time-varying covariates is that they could be affected by treatment itself, making them endogenous and therefore a bad control. It is unlikely that a veterinary services firm acquisition has effects on population of counties. We believe that population is an appropriate and necessary control for these reasons; however, we also report estimates without population at the suggestion of A. C. Baker, Larcker, and Wang (2022) and the results are nearly identical across several estimators. In addition, the results examine heterogeneity by RUCC codes, which are themselves a function of population and commuting flows.

4.1 Identification

In a canonical 2X2 differences-in-differences setup without heterogeneous treatment or anticipatory effects, β_1 identifies the ATT under parallel trends of potential outcomes (De Chaisemartin & d'Haultfoeuille, 2020; Roth, Sant'Anna, Bilinski, & Poe, 2022). This requires assuming that, in the absence of an acquisition, market concentration (and the other outcomes) would continue trending along parallel paths in both treated and untreated markets. In this context, this is a reasonable assumption, because it is unlikely that market concentration is a primary motivation for acquiring businesses.

While parallel trends are sufficient to identify the ATT in a 2X2 case with no heterogeneity (De Chaisemartin & d'Haultfoeuille, 2020; Roth et al., 2022), this dataset has more than 2 periods and groups that are treated at different points in the panel, which is called staggered treatment. Staggering causes TWFE models to use some differences between late treated and early treated units in the computation of the estimated effect. These comparisons are inappropriate in the presence of either group or time treatment effect heterogeneity. We diagnose the extent of this issue with TWFE estimates using the decomposition from Goodman-Bacon (2021).

Another issue that has been identified in the econometric literature is potential bias from dynamic treatment effects. The usual methods for estimating dynamic effects in an event study with staggered adoption (i.e. binning the coefficients with unit composition changing into one coefficient) have been shown to bias estimated treatment effects (Sun & Abraham, 2020). In this context, it is likely that the market adjusts over time meaning dynamic treatment effects are likely. Since this is the case and assuming treatment effect homogeneity across time and groups would be an overly strong assumption. Other robust estimators, including those from Callaway and Sant'Anna (2021), imputation from Borusyak, Jaravel, and Spiess (2021), and stacking (Cengiz, Dube, Lindner, & Zipperer, 2019; Deshpande & Li, 2019), are used which address these issues.

5 Results

As shown in Panel A of Table 2, acquisitions are estimated to make markets more concentrated. When including all urban counties and counties with multiple acquisitions, an acquisition increases HHI by 271.69 (p-value = 0). Table A.2 shows that including rural counties increases the estimated effect of an acquisition on HHI to 294.08. As shown by column 1 of Panel A in Table A.3, removing the population control increases the effect size to 333.36. The standard deviation of HHI in urban counties is 2,552.7 which means an acquisition increases market concentrated by 10.6% of a standard deviation, an economically significant effect.

As shown in Panel A of Table A.4, these results are robust to including county-specific linear time trends. With linear time trends, identification is more dependent on the immediate jump in

Table 2: Static Twoway Fixed Effects Estimates of the Effect of Acquisitions on Local Market Concentration

Panel A: All Urban Counties	(1)
Banfield Acquisition	271.69***
	(53.80)
Observations	25369
# Urban Counties	1167
# Urban Treated Counties	145
Panel B: Drop Non-Single Acquisition Counties	(1)
Banfield Acquisition	197.19***
	(64.30)
Observations	24242
# Counties Treated	97
Panel C: Drop Counties With Single Treatment	(1)
Banfield Acquisition	388.67***
	(77.88)
Observations	23162
Average # Acquisitions Per County	3.163

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Cluster-robust standard errors, by county, in parentheses. All regressions estimated by two-way fixed effects OLS. All regressions include county and year fixed effects. Banfield Acquisition is a binary variable equaling 1 if it is in post-acquisition period in a county in which Banfield acquires a veterinarian business. For more details, see Equation 2. The dependent variable in all panels is market concentration, calculated by the Herman-Herfindahl Index (HHI). Panel A includes all urban counties. Urban counties are defined by the rural-urban continum codes (RUCC) from 2013 USDA data, those with 3 or below are considered urban. Panel B includes urban counties and drops counties in which multiple acquisitions occur, either multiple at one time or multiple treated periods. Panel C includes urban counties and drops counties that are treated by a single acquisition. Population is the only control variable used. For regressions without covariates, see Table A.3.

outcomes at the time of treatment (Pischke, 2019; Wing, Simon, & Bello-Gomez, 2018). Dynamic estimates will reveal whether the smaller coefficient that results from including county-specific linear time trends should be interpreted as an issue with parallel trends or is due to dynamic effects.

These estimates could be biased by counties that are treated by multiple acquisitions or treated in multiple time periods, so Panel B of Table 2 re-estimates the effect of acquisitions with a sample of counties that were never treated or were only treated with one Banfield in one period and never again. This reduces the number of treated counties to 97. There is still a statistically significant effect of acquisitions on market concentration, although it shrinks from 271.69 to 197.19. One possible reason the effect of acquisitions shrinks for single treatment counties is if multiple acquisitions have a larger effect on market concentration. To investigate whether multiple acquisitions have larger effects on acquisitions, Panel C drops all single business, single period acquisitions. Panel C of Table 2 shows that there are an average of 3.163 acquisitions among counties experiencing multiple acquisitions and this produces a larger estimated effect, 388.67, of acquisitions than single acquisition counties. A single acquisition increases concentration by 197.19 and 3.163 acquisitions increases concentration by 388.67 which implies there are diminishing effects of acquisitions on concentration.

Twoway Fixed Effects Weights Diagnosis The treatment is staggered and there could be heterogeneous or dynamic effects which would bias the TWFE estimate due to inappropriate comparisons being made between and early and late treated units (Goodman-Bacon, 2021). To assess whether the TWFE estimate is biased by comparisons between late treated and early treated, the estimates are decomposed into how much weight is placed on each respective comparison (Goodman-Bacon, 2021). As shown by Figure A.4b, the weights suggest minimal bias due to the TWFE estimate placing large weights on late treated to early treated, because almost zero weight is applied to those inappropriate comparisons (they are close to the y-axis) and good comparisons receive 86.08% weight.[7] Furthermore, almost all of the good comparisons, treatment compared to never treated, are near the point estimates from Table 2 and only two are opposite signed from the aggregate effect.

[7] As shown by Figure A.4a, when the population control is removed the weight on good comparisons increases to 94.2%.

5.1 Alternative Static Estimators

While there is little cause for concern that TWFE is placing undue weight on inappropriate comparisons (De Chaisemartin & d'Haultfoeuille, 2020; Goodman-Bacon, 2021), several contemporary estimators that address the bias from staggering and heterogeneous effects are used to see how robust the results are. Stacking, which manually removes the bad comparisons and stacks datasets by treatment timing, is used first.[8] The advantages of the stacked estimator are that it removes problematic comparisons and relies on familiar OLS. A disadvantage of stacking is that policy changes without an equal number of post or pre-periods cannot be included.[9] As shown in column 1 of Table 3, the effect of acquisitions on market concentration is smaller when estimated with TWFE on a stacked dataset, but remains statistically significant.

The stacked estimator is not explicit about the weighting and summing of event-specific treatment effects.[10] To address these issues, two other estimators are used - imputation (Borusyak et al., 2021; Gardner, n.d.) and the group-time treatment effect aggregation approach (Callaway & Sant'Anna, 2021). Imputation estimates a model for non-treated potential outcomes using the fixed effects and covariate - population, then extrapolates to treated observations by imputing non-treated potential outcomes and estimating treatment effects for each treated observation, and then takes averages of the effects. As shown in column two of Table 3, the imputation method estimates the effect of acquisitions on HHI to be statistically significant and, depending on which treated counties are included, between 242.98 and 231.76. These estimates are close to the TWFE estimate of 271.69.

A possible issue with the imputation estimator is that it places more weight on earlier periods where treatment and comparison groups could be less similar and the data in this paper spans a fairly long 23 year period. This assumption can increase precision, but makes the estimator more

[8]Two of the original applications of stacking are Deshpande and Li (2019) and Cengiz et al. (2019). Stacking reformats the data in event time, does this for each event time, and stacks all the datasets together. In this context, we have a 9 year window with 4 leads and 5 lags. We do not use acquisitions that occur after 2016, because then there is not the same amount of post-acquisition data. In 2017, Figure 1 shows a large increase in acquisitions, so we consider that the second wave of acquisitions and stacking produces estimates of the first wave of acquisitions.

[9]This is not a problem for pre-periods, since the data begins in 1997 and the first acquisition is in 2001. Unfortunately, this means that acquisitions after 2016, known as second wave acquisitions, see Figure 1 , are not included. It is appropriate to lose these since there are plenty of acquisitions that occur before and it is helpful to observe post periods due to the possibility it takes several years for markets to adjust fully.

[10]The weights are determined by the number of treated units and variance of treatment within each stacked event (Roth et al., 2022).

Table 3: Estimates of the Effect of Acquisitions on Local Market Concentration from Staggered-Adoption Robust Methods

Panel A: Urban Counties	(1)	(2)	(3)
Banfield Acquisition	151.43***	242.98***	219.25***
	(44.64)	(58.19)	(54.71)
Observations	132860	25369	28008
Stacked Method[a]	X	-	-
Imputation Method[b]	-	X	-
CS Method[c]	-	-	X
Panel B: Urban Counties, No Retreated	(1)	(2)	(3)
Banfield Acquisition	118.12**	231.76***	204.17***
	(55.02)	(61.34)	(54.81)
Observations	132226	24242	26832
Stacked Method[a]	X	-	-
Imputation Method[b]	-	X	-
CS Method[c]	-	-	X

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Cluster-robust standard errors, by county, in parentheses. All regressions include county and year fixed effects. Banfield Acquisition is a binary variable equaling 1 if it is in post-acquisition period in a county in which Banfield acquires a veterinarian business. The dependent variable in all panels is market concentration, calculated by the Herman-Herfindahl Index (HHI). Panel A includes all urban counties. Urban counties are defined by the rural-urban continum codes (RUCC) from 2013 USDA data, those with 3 or below are considered urban. Panel B includes urban counties and drops counties in which multiple acquisitions occur, either multiple at one time or multiple treated periods. Population is the only control variable used. For regressions without covariates, see Table A.3. [a]Column 1 uses TWFE on the stacked dataset which is balanced in event time in 4 periods before an acquisition and 5 periods after. It includes dataset by county and dataset by year fixed effects. [b]Column 2 uses the imputation estimator of Borusyak et al. (2021) and Gardner (n.d.). [c]Column 3 uses group-time effect aggregation from Callaway and Sant'Anna (2021). It uses never treated as comparison units, the doubly robust differences-in-differences estimator based on inverse probability of tilting and weighted least squares (Sant'Anna & Zhao, 2020), and shows the simple aggregation. See Section 5.1 for more details.

susceptible to bias if there is a monotonic violation of parallel trends (Roth et al., 2022). At the cost of using less data leading to less precision, estimators from Callaway and Sant'Anna (2021) require a less strict parallel trends assumption. Column 3 shows the simple average of all post-treatment $ATT(g, t)$'s from Callaway and Sant'Anna (2021) is also very similar in magnitude and statistically significant.

5.2 Dynamic Effects

The effects of acquisitions could be dynamic due to the market adjusting to a new acquisition over time. Dynamic treatment effects are estimated using a typical event study specification,

$$y_{ct} = a + \sum_{j=2}^{J} \beta_j + \sum_{k=0}^{K} \beta_k + Population_{ct} + \mu_c + \rho_t + e_{ct}. \tag{3}$$

The coefficients of interest are the lags (β_j's) and leads (β_k's) which are the time-varying effects of acquisitions. These estimates are compared to the prevailing difference between treated and comparison markets in the omitted base period of j=1 (Clarke & Tapia-Schythe, 2021).

One issue that arises due to staggered adoption is that there are not an equal number of lags and leads for counties treated in different years. This means that if the estimates of all lags and leads are estimated and shown, composition effects confound the time-varying effects of the policy as not all counties are represented in each lag and lead. One proposed solution is binning coefficients in which composition effects are present, but this can bias the event-time coefficients that have no changing composition (Sun & Abraham, 2020). A different solution is to balance the panel in event-time, but this can reduce precision. An alternative solution is to use the stacked dataset that was constructed earlier which is balanced in the event-time dimension, makes no bad comparisons, and can leverage changes with a balanced event window.

Using the stacked dataset requires a slight modification to the specification. When estimating the dynamic effects with the stacked dataset, the equation follows,

$$y_{ctg} = a + \sum_{j=2}^{J} \beta_j + \sum_{k=0}^{K} \beta_k + Population_{ct} + \mu_{cg} + \rho_{tg} + e_{ctg}. \tag{4}$$

in which g stands for group. There is a dataset for each treatment year, so g=2001 for observations in the stacked dataset which is formed for treated counties in 2001 with only clean comparison counties (i.e. those not treated in the next 5 years). The small change is due to the county and year fixed effects being separately interacted with these dataset indicators as outlined in A. C. Baker et al. (2022).[11]

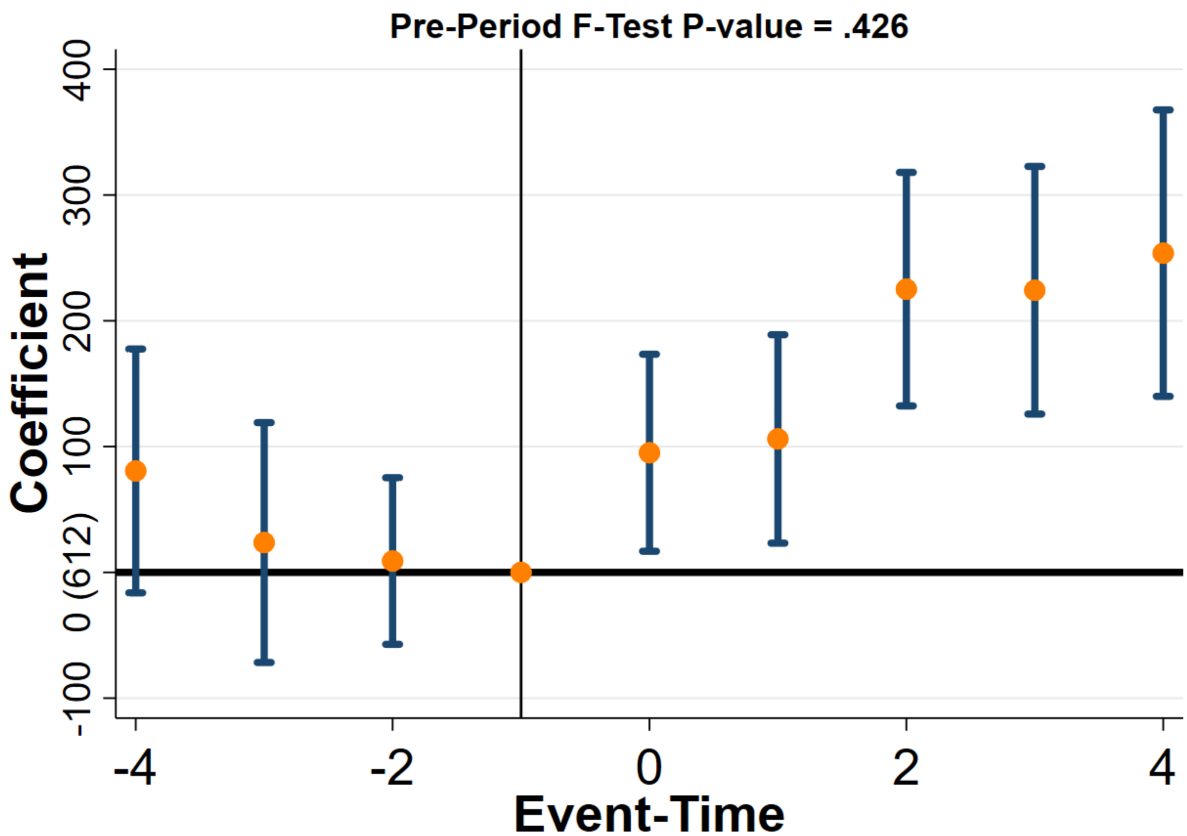
The dynamic treatment effects from a stacked data event-study specification are shown in Figure 3. The post-period coefficients (β_k's) are positive and statistically significant at or above 95% confidence which is consistent with the static estimates. The first two post-period coefficients are smaller (95.1-106.08) than static estimates, but the third post coefficient and those after it (224.7-253.7) are close to the static coefficient estimates of 271. This implies that market concentration adjusts some immediately and then fully within 3 years after an acquisition occurs.

The average HHI in Event-Time = -1 is 612 (as shown in parentheses at y=0), which makes these large increases.

It is impossible to test that market concentration would remain parallel across treated and untreated counties in the post-period in the absence of an acquisition, but the pre-period coefficients provide a convenient diagnostic for investigating the parallel trends assumption. If there are no significant differences in market concentration across treated and untreated counties in the pre-acquisition period, then the pre-period coefficients will be 0 and this implies that post-acquisition trends would be parallel in the absence of an acquisition. The pre period coefficients (β_j's) are typically close to 0. In the 5 years immediately before an acquisition, these coefficients are all very close 0 and precisely estimated. The joint F-test that all pre-period coefficients equal 0 is not rejected with p-value = .4260. This shows there is no difference in the trends of market concentration between treated and untreated areas in the 5 years prior to acquisitions occurring. This is consistent with the identifying assumption of parallel trends. As shown by Figure A.5, the same conclusions can be drawn from unstacked event studies.

[11]It is unclear whether the standard errors should be clustered at the county or county by group level, so we follow the suggestion of Wing (2021) and keep the standard errors clustered at the county level.

Figure 3: Dynamic Effects of Acquisitions on Market Concentration



Note: The sample is only urban markets. The data is stacked by treated year. These figures report coefficients from Equation 4 for the estimation of dynamic effects of acquisitions on market concentration. Coefficients represent the change in concentration for acquisition markets relative to non-acquisition markets in the years before and after an acquisition, as compared with the year immediately prior to the acquisition. Market concentration is measured by the Hirschman-Herfindahl Index (HHI). The standard errors are clustered at the county level. The F-test p-value reported above the graph is for the null hypothesis of the coefficients in the pre-period being jointly equal to 0. See Section 5.2 for additional analysis details. See Figure A.5 for event studies from unstacked data.

5.3 Number of Establishments

Market concentration depends on the number of firms in the market and total sales revenue. One explanation for the increase in market concentration following acquisitions is that sales revenue remains constant and less firms enter or more firms exit the market. To assess how acquisitions affect firm dynamics, Panel A of Table 4 uses the count of veterinarian businesses in a market as the outcome. In column 1, the TWFE estimate is statistically significant with 99% confidence and can be interpreted as acquisitions increase the number of businesses in a market by 7.26. The standard deviation in the number of veterinarian businesses in urban areas is 35.87 which makes this estimate economically significant since the coefficient is 20.2% of a standard deviation. As shown by Figure A.6a, the appropriate comparisons receive 86.1% of weights and an inappropriate comparison has a significantly negative estimate of -96, with a weight of 8.9%, which biases the positive estimate towards 0.

As shown by columns 2-4 in Panel A of Table 4, using estimators that are robust to issues with TWFE does not alter the statistical significance of the impact of acquisitions on firm dynamics. The range of the estimates is somewhat large, ranging from 5.18 using stacking to 10.19 using group-time aggregation (Callaway & Sant'Anna, 2021). The number of net businesses grows after an acquisition, likely do to the aggregate market expansion effects of the overall industry. This could mean that businesses are still exiting, but more new businesses are entering to outpace the exits or that there is little to no exiting.

5.3.1 Dynamic Effects

Whether the estimates of the effect of acquisitions on firm entry can be given a causal interpretation depends on whether acquisition markets would have continued following parallel trends in entry as non-acquisition markets in the absence of the acquisition. While untestable, it is possible to verify parallel trends in the pre-acquisition period. One way that trends would not be parallel is if acquisitions occur in markets where there is higher firm entry before the acquisition occurs. The dynamic effects of acquisitions on firm entry are shown in Figure 4.

As shown in Figure 4a, there are dynamic effects of acquisitions in the full sample of urban counties. In the first period after an acquisition (Event-Time = 0), there is an immediate increase

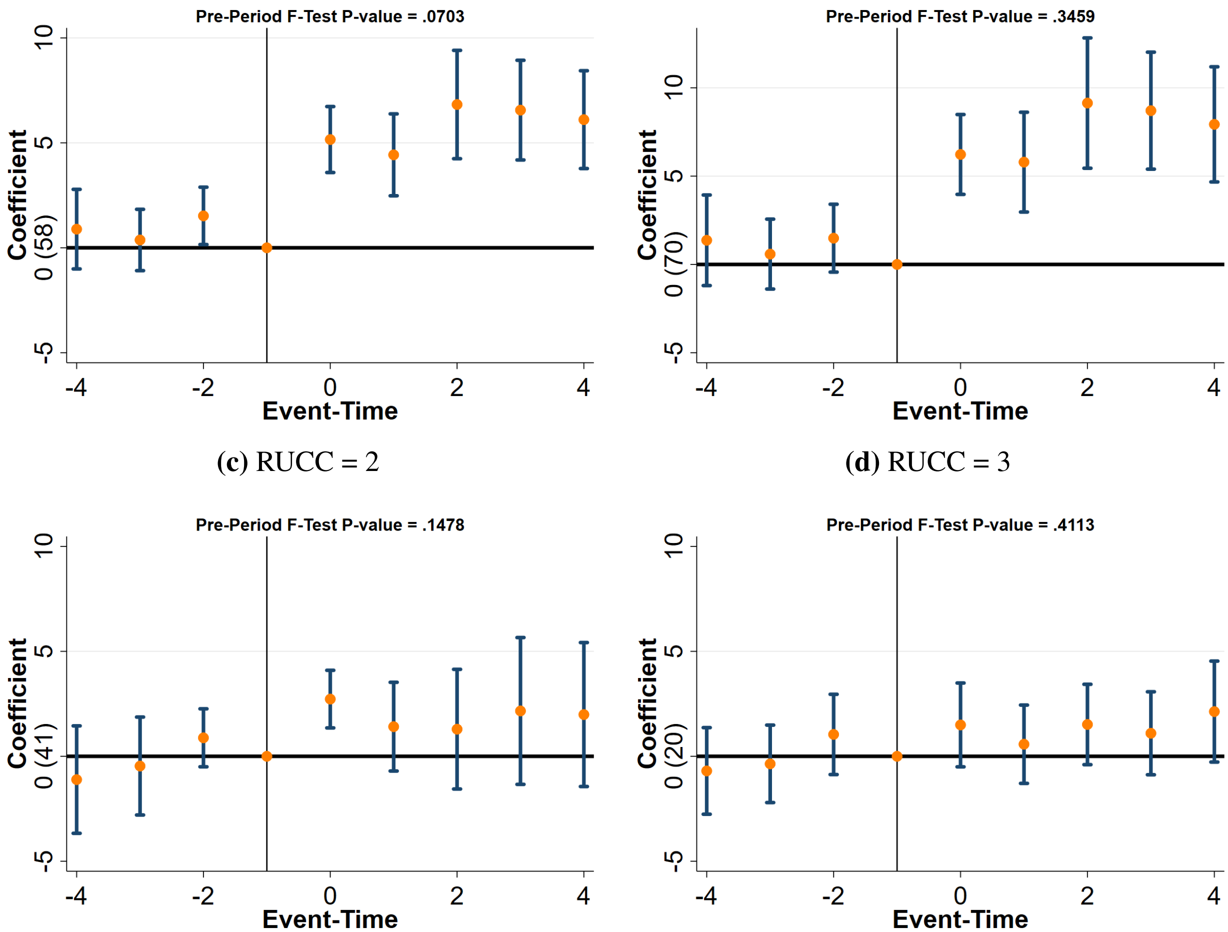
Table 4: Estimates of the Effect of Acquisitions on Market Sales Revenue and Number of Veterinary Establishments

Panel A: Number of Firms	(1)	(2)	(3)	(4)
Banfield Acquisition	7.26***	5.11***	6.31***	10.19***
	(1.32)	(0.94)	(1.93)	(2.13)
Observations	26828	141151	26828	28008
TWFE	X	-	-	-
Stacked Method[a]	-	X	-	-
Imputation Method[b]	-	-	X	-
CS Method[c]	-	-	-	X
Panel B: Sales Revenue (Millions)	(1)	(2)	(3)	(4)
Banfield Acquisition	18.72***	11.46***	19.23***	18.71***
	(2.99)	(1.86)	(3.80)	(3.72)
Observations	26828	141151	26828	28008
TWFE	X	-	-	-
Stacked Method[a]	-	X	-	-
Imputation Method[b]	-	-	X	-
CS Method[c]	-	-	-	X

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Cluster-robust standard errors, by county, in parentheses. All regressions include county and year fixed effects. Banfield Acquisition is a binary variable equaling 1 if it is in post-acquisition period in a county in which Banfield acquires a veterinarian business. Population is the only control variable used. The sample includes all urban counties. Urban counties are defined by the rural-urban continum codes (RUCC) from 2013 USDA data, those with 3 or below are considered urban. In Panel A, the dependent variable is number of veterinary services firms. In Panel B, the dependent variable is sales revenue in millions. Column 1 estimates the effect using two-way fixed effects OLS. [a]Column 2 uses TWFE on the stacked dataset which is balanced in event time in 4 periods before an acquisition and 5 periods after. It includes dataset by county and dataset by year fixed effects. [b]Column 3 uses the imputation estimator of Borusyak et al. (2021) and Gardner (n.d.). [c]Column 4 uses group-time effect aggregation from Callaway and Sant'Anna (2021). It uses never treated as comparison units, the doubly robust differences-in-differences estimator based on inverse probability of tilting and weighted least squares (Sant'Anna & Zhao, 2020), and shows the simple aggregation. See Section 5.1 for more details.

Figure 4: Dynamic Effects of Acquisitions on Number of Establishments by Urbanicity

(a) All Urban RUCCs **(b)** RUCC = 1 **(c)** RUCC = 2 **(d)** RUCC = 3



Note: The sample is only urban markets. The data is stacked by treated year. These figures report coefficients from Equation 4 for the estimation of dynamic effects of acquisitions on number of veterinary businesses in a market. Coefficients represent the change in number of veterinary businesses for acquisition markets relative to non-acquisition markets in the years before and after an acquisition, as compared with the year immediately prior to the acquisition. The standard errors are clustered at the county level. The F-test p-value reported above the graph is for the null hypothesis of the coefficients in the pre-period being jointly equal to 0. See Section 5.2 for additional analysis details.

in the number of firms by 5.15 and this grows to 6.82 by the third period (Event-Time = 2). The coefficients are all highly statistically significant in the post-period and represent a gain of 5.15-6.82 firms, compared to an average of 58 firms. As shown in Figure 4, in the full sample of urban counties the null hypothesis of pre-period coefficients equaling 0 is rejected at 10% and there is a statistically significant coefficient at Event-Time = -2. The coefficient suggests an increase of 1.52 firms (p-value = .029). This coefficient is much smaller than the coefficients in the post period.

It is possible that the significant pre-period coefficient at Event-Time = -2 is due to heterogeneity across different RUCC codes and an increase of 5-7 firms in a RUCC code of 3 which has an average of 20 firms is a very large increase. To address potential heterogeneity bias, dynamic effects are reported by different RUCC codes. As shown by Figure 4b, the largest increase in number of firms is in the most urban RUCC codes and the joint-F test of the pre-period coefficients equaling 0 is no longer rejected (p-value = .3459). This is due in large part to the coefficient at Event-Time = -2 no longer being statistically significant with p-value going from .029 to .129. Nonetheless the magnitude has not changed by much, going from 1.52 to 1.48. Regardless of using all urban areas or just the most urban areas, the point estimate changes more drastically immediately after the acquisition, changing by 5.15 compared to just 1.52 in the year before the acquisition.

As shown by Figure 4c and Figure 4d, the effects in more rural RUCC codes are smaller in magnitude and most of the single coefficients are not statistically significant; however, the coefficients are all above 0. The coefficients are also jointly significant in the post period (p-value = 0.0031 , p-value = 0.0014.) The largest effects are driven by the most urban RUCC codes, although there is still evidence of positive effects in less urban RUCC codes. As shown by columns 3 and 4 of Table A.5, there are statistically significant static estimates for the most urban and RUCC = 2 areas. When subset by RUCC codes, a zero pre-trend cannot be rejected, suggesting the effects of acquisitions on firm dynamics can be interpreted causally.

5.4 Sales Revenue

Finding that market concentration increases and firm numbers increase due to acquisitions is puzzling since an increase in market concentration could imply fewer firms; however, market share and sales revenue also affect market concentration. To investigate how sales revenue responds to acquisitions, Panel B of Table 4 uses market level sales revenue as the outcome. In column 1, the TWFE estimate is statistically significant at 99% confidence and can be interpreted as acquisitions increasing local market sales revenue by 18.72 million dollars. The standard deviation in the sales revenue in urban areas is 34.78 which makes this estimate economically significant since the coefficient is 53.8% of a standard deviation. As shown by Figure A.6b, the appropriate comparisons receive 86.1% of weights and an inappropriate comparison has a significantly negative estimate of -153, with a weight of 8.9%, which biases the positive estimate towards 0.

As shown by columns 2-4 in Panel B of Table 4, using estimators that are robust to issues with TWFE does not alter the statistical significance of the estimated effects of acquisitions on sales revenue. The range of the estimates goes from 11.45 using stacking to 19.23 using the imputation estimator.[12] A majority of the acquisitions in this paper represent no net change in the number of businesses at an address, so this is not merely a result of more businesses at an address.

The urban sample average market sales revenue is 17.25 million and the average number of firms in a market is 21.44, suggesting firms typically make about 0.8 million dollars in sales revenue yearly. Comparing Panel A to Panel B, acquisitions increase revenue by about twice the amount it increases firms. If the increase in the number of firms is the sole explanation for the increase in sales revenue, then the entering firms make twice the amount of revenue than the implied average sales revenue per firm (0.8 million) and this is unlikely.

5.4.1 Dynamic Effects

To examine the dynamic effects of acquisitions on sales revenue, Figure 5 plots dynamic effects of acquisitions on sales revenue. As shown in Figure 5a, the effects are dynamic but there are pretrends in sales revenue which can be rejected to be zero at the 1% level. Sales revenue is 4.91-5.34 million lower in markets with an acquisition, which is 13% of the 38 million in sales revenue average in Event-Time = -1, than markets without an acquisition in the periods before an acquisition occurs. This is consistent with acquisitions occurring in markets that are depressed in sales revenue relative to other markets. As shown by Figure 5b, this pretrend is most evident in the

[12] The stacked estimator uses variance weighting to combine treatments across cohorts efficiently. This trades off bias for efficiency and may be inconsistent for the sample-average ATT (A. C. Baker et al., 2022).

most urban markets. The pre-acquisition coefficients are between 7.11 and 7.47 and the hypothesis that they equal zero is rejected.

A pretrend of 4.91-7.47 million would be substantial in the least urban market in which the sample average sales revenue is 6.79 or in the RUCC = 2 market in which the sample average sales revenue is 13.97. As shown by Figure 5c and Figure 5d, the pre-period coefficients equaling zero cannot be rejected and the coefficients are all close to zero. Despite there being no pre-trends, the coefficients move up after the acquisition for both of the less urban markets. In Figure 5c some of the post-period coefficients are statistically significant at the 10% and 1% levels and the coefficient magnitudes are 0.62-6.87. In Figure 5d, none of the individual coefficients are statistically significant which is likely due to observing few acquisitions in the least urban areas. Still, the coefficient estimates in the post period are between 1.64 and 2.65 which is close the estimates in RUCC = 2 areas. As shown by columns 5 and 6 of Table A.5, there are statistically significant static estimates for the most urban and RUCC = 2 areas, although the relatively fewer acquisitions leads to greater uncertainty in estimates that are robust to concerns with TWFE (column 6).

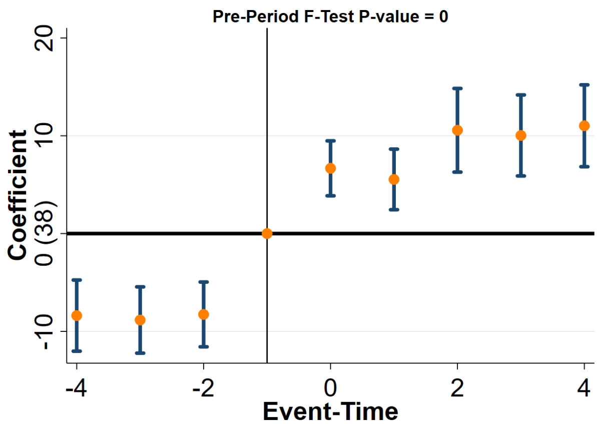
For the less urban markets, the magnitudes of the post-coefficients are similar suggesting between a 0.62 and 6.87 effect. This is relatively larger for the least urban markets which have an average of 12 million in revenue in Event-Time = -1 compared to 24 million in the middle urban markets. The pre-trends in sales revenue, especially in the most urban markets, gives reason to interpret the association between sales revenue and acquisitions cautiously. It is most reasonable to claim a causal association between acquisitions and sales revenue in the less urban markets. Market concentration increases while firm numbers also increase, because the acquired firm is capturing a large enough share of the revenue to offset the reduction in market concentration from growth in number of firms.

5.5 Heterogeneity by Corporate Ownership

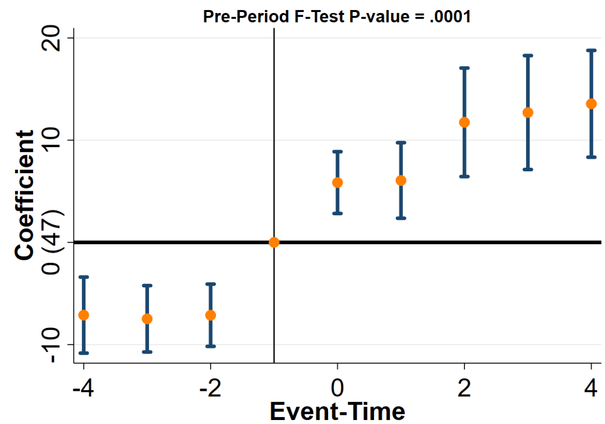
In 2007, Mars Corporation bought Banfield Veterinary Services. This could lead to additional financing options or different returns to acquisitions (Malmendier & Tate, 2008; Moeller et al., 2004). The next set of results investigates whether acquisitions had different effect on markets based on whether the acquirer was Banfield or Banfield-Mars.

Figure 5: Dynamic Effects of Acquisitions on Market Sales Revenue by Urbanicity

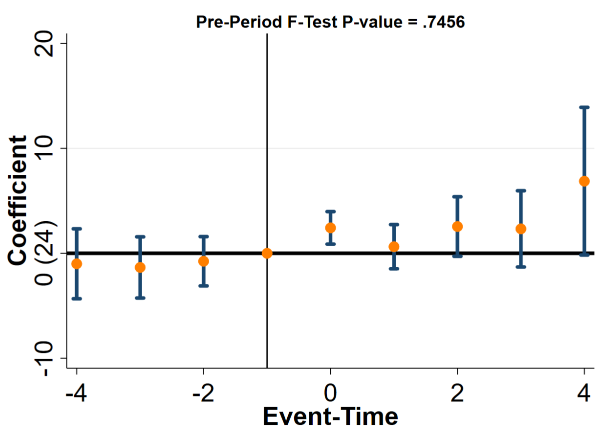
(a) All Urban RUCCs



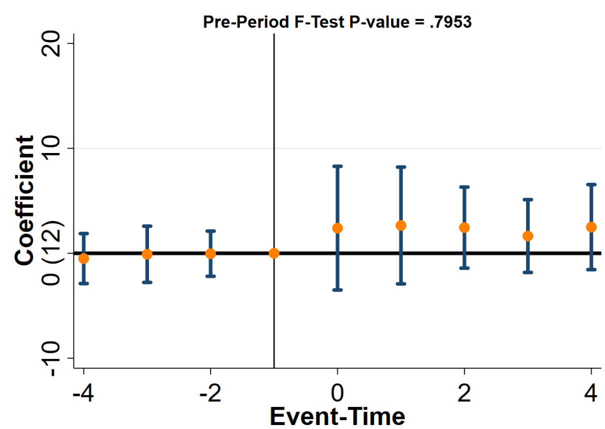
(b) RUCC = 1



(c) RUCC = 2



(d) RUCC = 3



Note: The sample is only urban markets. The data is stacked by treated year. These figures report coefficients from Equation 4 for the estimation of dynamic effects of acquisitions on sales revenue in millions of US dollars in a market. Coefficients represent the change in number of veterinary businesses for acquisition markets relative to non-acquisition markets in the years before and after an acquisition, as compared with the year immediately prior to the acquisition. The standard errors are clustered at the county level. The F-test p-value reported above the graph is for the null hypothesis of the coefficients in the pre-period being jointly equal to 0. See Section 5.2 for additional analysis details.

As shown by Table 5, after Mars acquires Banfield, there are no statistically significant effects of Banfield acquiring a business on markets. The only statistically significant effect that is estimated for after Mars buys Banfield is for the acquisition increasing market share, yet this is a TWFE estimate which could be biased by staggered rollout and heterogeneous effects. Using the group-time effect aggregation from Callaway and Sant'Anna (2021), the coefficient is nearly cut in half, losing it's statistical significance. The results suggest that acquisitions by a larger veterinary services company has smaller, perhaps undetectable, effects on local markets.

Table 5: Estimates of the Effects of Acquisitions by Whether Mars Corporation Owned Banfield

Panel A: TWFE	Market Concentration		Number of Firms		Sales Volume	
	(1) Before MARS	(2) After MARS	(3) Before MARS	(4) After MARS	(5) Before MARS	(6) After MARS
Banfield Acquisition	202.06***	63.25**	5.24***	-0.13	11.40***	-0.72
	(50.32)	(31.03)	(0.95)	(1.45)	(1.98)	(2.31)
Observations	10958	13295	11667	13994	11667	13994
Panel B: CS[a]	Market Concentration		Number of Firms		Sales Volume	
	(1) Before 2007	(2) After 2007	(3) Before 2007	(4) After 2007	(5) Before 2007	(6) After 2007
Banfield Acquisition	161.78***	37.52	5.69***	0.23	9.66***	1.91
	(46.01)	(31.26)	(1.49)	(1.51)	(1.93)	(2.28)

Note: $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Cluster-robust standard errors, by county, in parentheses. All regressions include county and year fixed effects. Banfield Acquisition is a binary variable equaling 1 if it is in post-acquisition period in a county in which Banfield acquires a veterinarian business. Population is the only control variable. The sample includes all urban counties. Urban counties are defined by the rural-urban continum codes (RUCC) from 2013 USDA data, those with 3 or below are considered urban. In columns 1 and 2, the dependent variable is market concentration, measured by HHI. In columns 3 and 4, the dependent variable is number of veterinary services businesses. In columns 5 and 6, the dependent variable is sales revenue in millions of US dollars. Panel A estimates the effect using two-way fixed effects OLS. Panel B estimates the using group-time effect aggregation from Callaway and Sant'Anna (2021). [a]It uses never treated as comparison units, the doubly robust differences-in-differences estimator based on inverse probability of tilting and weighted least squares (Sant'Anna & Zhao, 2020), and shows the simple aggregation. See Section 5.1 for more details. MARS buys Banfield in year 2007.

5.5.1 How Acquisition Targets Changed Under Mars' Corporate Ownership

Understanding why acquisitions are less consequential for markets after Mars acquires Banfield is important for the industry. There may be a difference in the firms acquired or the surrounding market that are acquired by Mars-owned Banfield. To investigate, whether pre-acquisition characteristics of markets and firms change after Mars buys Banfield is analyzed. Figure 6 plots the yearly average pre-acquisition characteristics and the pre and post averages which are averages of the plotted yearly averages, weighted by number of acquisitions.

The average market concentration is slightly lower after Mars buys Banfield, going from an average of 563.5 to 446.7 after Mars buys Banfield. There are nearly no differences in urbanicity of the market or the population after Mars buys Banfield. As shown by Figure 6d, real GDP of acquisition markets does increase after Banfield is bought from 41.9 to 80.01. Figure 6e shows that Mars-owned Banfield buys businesses in markets with an average gdp per capita of \$58.87 thousand, while before the acquisition the gdp per capita was only \$49.37. These results suggest that Mars-owned Banfield acquisitions did not affect markets, because they acquired in less concentrated markets with higher incomes. Furthermore, Mars-owned Banfield acquires firms with different characteristics. As shown in Figure 7, Mars-owned Banfield buys firms with higher sales revenue and more employees.

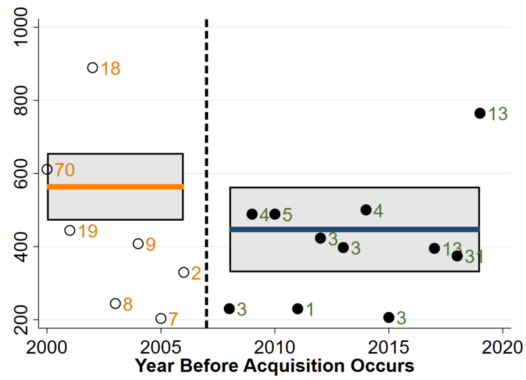
6 Conclusion

The effects of acquisitions on healthcare market concentration is an important concern, having consequences for wages, mortality, quality of service, prices, value creation, among others. Most of the research on this topic has focused on human healthcare, a highly concentrated, insurance driven market with less variation, that makes it difficult to study determinants of market competition. Unlike human healthcare, animal healthcare is a more competitive market and patients are rarely covered by insurance. This makes veterinary markets an interesting context in which to study the effects of corporate acquisitions on markets. Moreover, the veterinary industry has been undergoing significant market expansion over the last 30 years, and is expected to continue into the next decade. Thus, the effects of M&A on local markets is important for understanding the past and current market, and how the animal healthcare market may evolve into the future. Further, parallels between the animal and human healthcare market can be made as both markets continue to evolve.

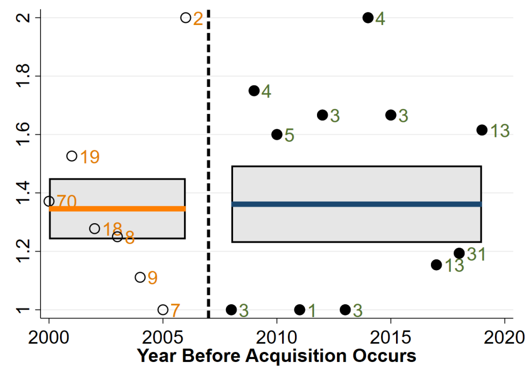
In our study we focus on the general market effects of the largest corporate firm's acquisition of smaller firms to analyze three key facets: (1) the effect of M&A on a relatively competitive healthcare industry; (2) determine how market expansion affects M&A market concentration effects;

Figure 6: Effects of Corporate Ownership on Average Acquisition Market Characteristics

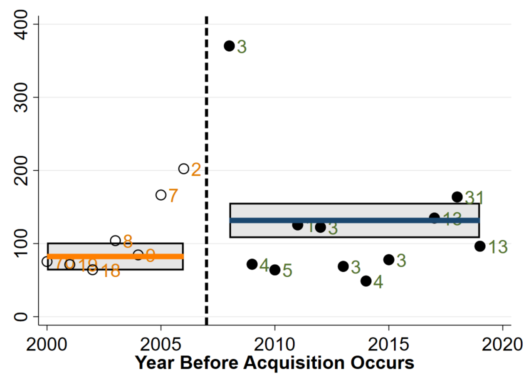
(a) Market Concentration



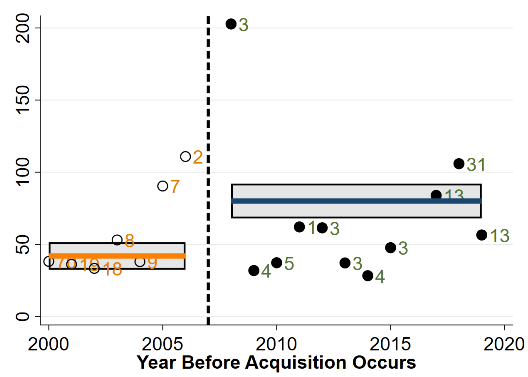
(b) Urbanicity



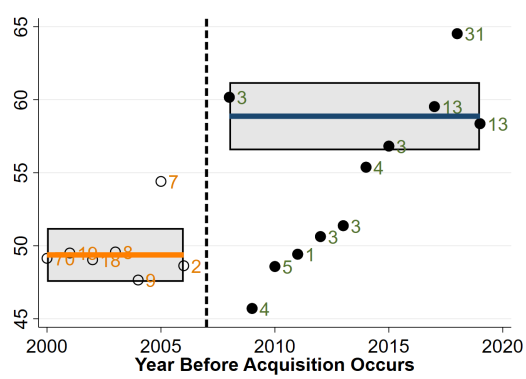
(c) Population



(d) Real GDP, Billions



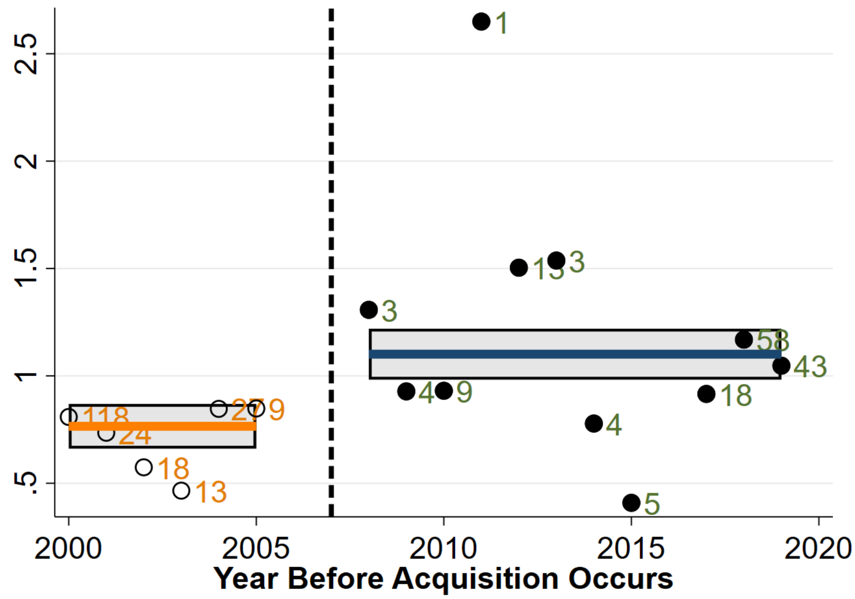
(e) Real GDP Per Capita



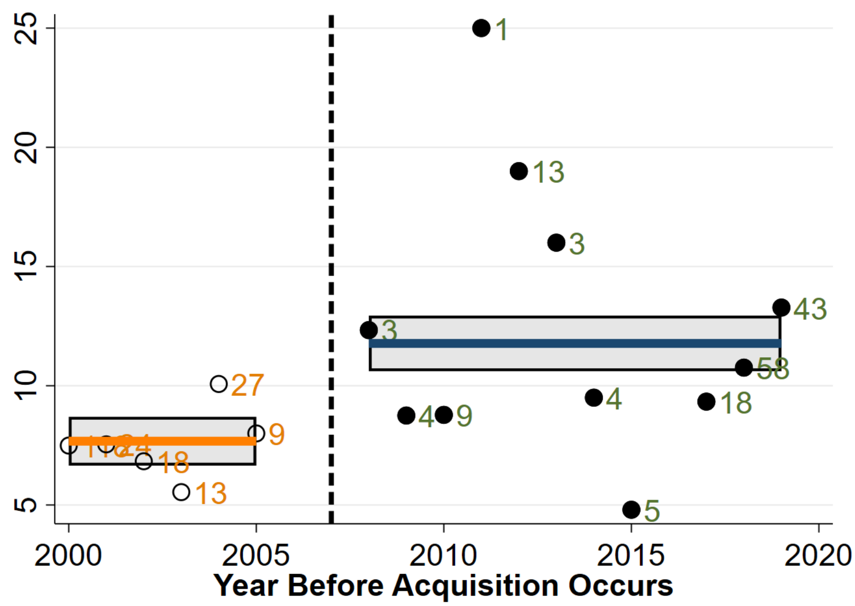
Note: Black dotted line is when MARS Corporation buys Banfield Animal Hospital in 2007. Data is from the market in the year before the acquisition occurs. Dots represent averages for that year. The number labels show the number of counties that make up that average. The horizontal orange line is the weighted (by number of counties) average for before Mars owned Banfield and the blue line is the weighted average for after Mars owned Banfield. The shaded areas show the 95% confidence interval around the averages. GDP and GDP per capita are in 2020 dollars. Real GDP per capita is in thousands of 2020 dollars.

Figure 7: Effects of Corporate Ownership on Average Acquisition Establishment Characteristics

(a) Sales Revenue (Millions)



(b) Number of Employees



Note: Black dotted line is when MARS Corporation buys Banfield Animal Hospital in 2007. Data is from the market in the year before the acquisition occurs. Dots represent averages for that year. The number labels show the number of acquisitions that make up that average. The horizontal orange line is the weighted (by number of counties) average for before Mars owned Banfield and the blue line is the weighted average for after Mars owned Banfield. The shaded areas show the 95% confidence interval around the averages.

and (3) analyze how a higher level corporate merger of the acquiring firm changes M&A activity. The results show that acquisitions have a large effect on market concentration. These effects are dynamic over time, indicating that the market undergoes an adjustment period. Furthermore, this increase in market concentration happens simultaneously despite local market expansion - e.g. as increases in both revenue and number of firms simultaneous occur. Enough of the newly created market revenue is captured by the acquired firms that it more than offsets the effect of entry on market concentration. A possible explanation is that newly entering firms are more specialized (e.g. - emergency/critical care). Specialization of firms is a growing trend that likely complement these general practices structures. Finally, M&A activity of Banfield is altered after a higher level acquisition by Mars. Specifically, they acquire practices in less concentrated and higher income areas - where most of the market expansion tends to occur given the rise in pet populations. This suggests that acquisitions by a larger veterinary services company might have reduced negative effects on local market concentration.

There are some limitations. For instance, these are the effects of Banfield acquisitions, a specific corporate firm. Banfield acquisitions may have different effects on markets than non-Banfield acquisitions. Another limitation is that there are no post-periods in stacked event studies for acquisitions for the "second wave" Banfield acquisitions that begins in 2017. Lastly, the veterinary industry is particularly interested in rural veterinarian shortages, so it would be of interest to understand how acquisitions have differing effects in rural and urban areas. However, this data has only 1 rural acquisition from Banfield. Further, as in much of the merger effects literature, our findings may face multiple threats to identification, because acquisitions do not occur randomly and acquired facilities likely differ from those not acquired in important, potentially unobservable ways. However, we have no way to control for this facet without more detailed information on the firm level like that in Eliason et al. (2020).

Animal healthcare is a growing, policy relevant industry. While acquisitions increase market concentration, there is no evidence that acquisitions lead to incumbent firms to exit. The data in this paper is unable to ascertain whether the increase in sales revenue is due to higher prices or higher quantity of services and products sold. Without this data, insights on how pets and pet owners are affected is impossible to make.

There are several directions for future research. First, determining whether there different effects of acquisitions if the acquiring firm is not Banfield. This would inform whether there are heterogeneous effects from the multitude of new corporate, venture capital, and private equity firms entering the veterinary healthcare space. Second, the causal effect of an acquisitions in rural areas could have significant implications for food safety and food animal production. Finally, given the more extensive literature on veterinary labor markets, how acquisitions affect labor outcomes such as those suggested in Kehrig and Vincent (2021) is of interest. Overall, the animal healthcare market/industry is an understudied area. This industry has the potential to provide new insights to the human healthcare industry given the less competitive nature. Simultaneously, the veterinary market has the opportunity to learn from the positives and negatives of the human healthcare market as is evolves over the coming decades.

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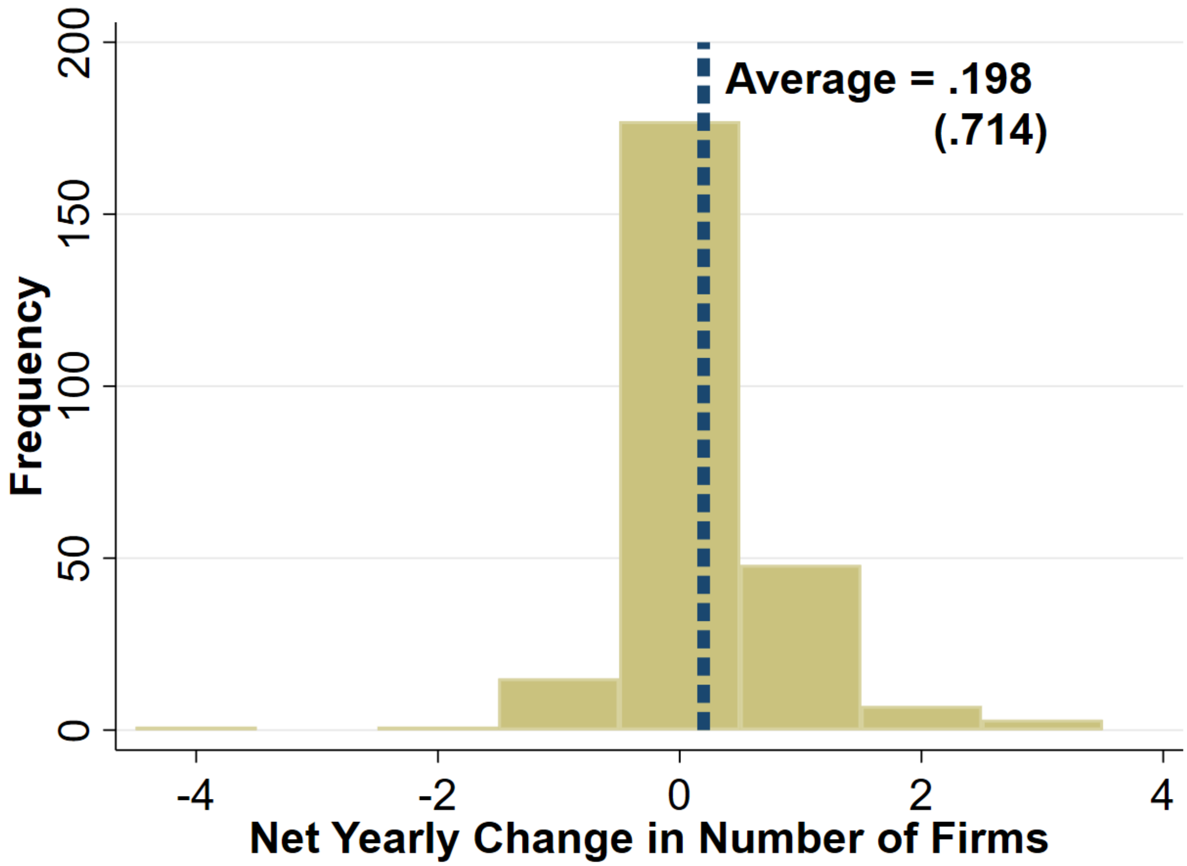
Online Appendix

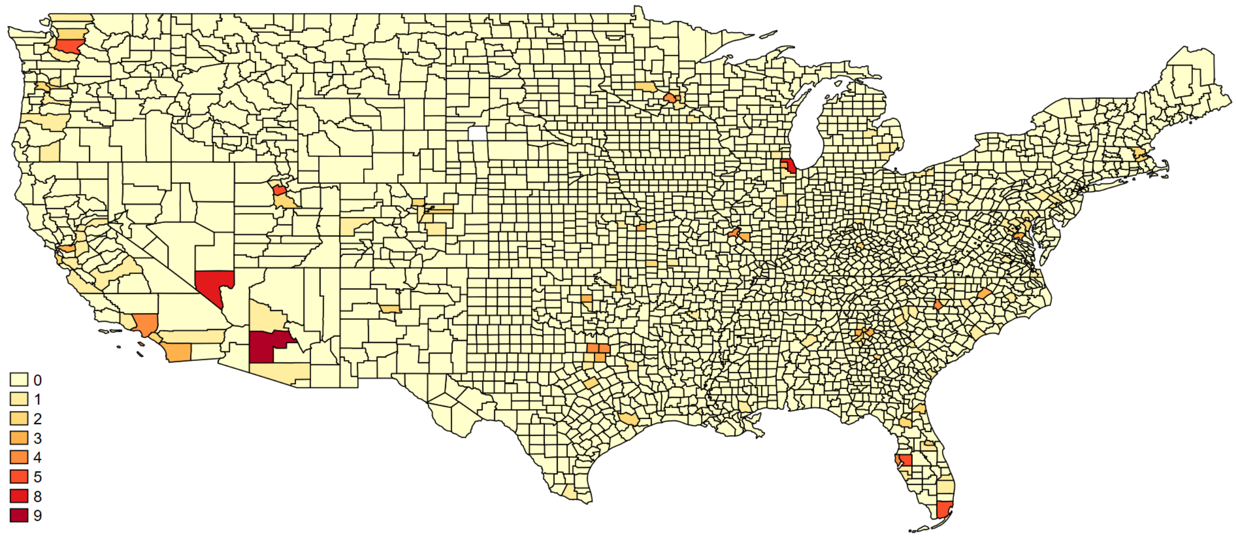
A Additional Tables and Figures

Figure A.1: Net Change in Number of Businesses at an Address When Acquisitions Occur



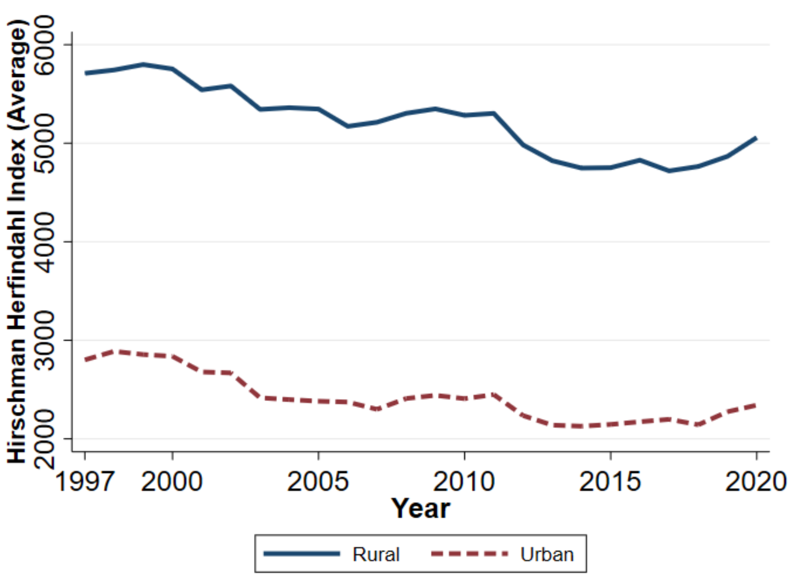
Note: Figure shows the average net change in number of businesses at a given address when a Banfield is identified as a company at a given address in y+1, but not in y. It is very rare that a new business is mis-classified as a business acquisition. Standard deviation in parentheses.

Figure A.2: The Total Number of Acquisitions Per County



Note: Figure shows the total number of Banfield acquisitions by county.

Figure A.3: Yearly Trends in Market Concentration by Urbanicity



Note: Figure shows the yearly trends in market concentration, measured by the Hirschman-Herfindahl Index (HHI). Higher values indicate more concentrated markets. The solid, navy line represents rural areas and the dashed maroon line represents urban areas. The rural-urban delineation is made using the USDA Rural-Urban Continuum Codes (RUCC) from 2013. As defined by the USDA, counties with RUCC ≤ 3 are considered urban.

Table A.1: Descriptive Statistics for Each Urban RUCC Code

Panel A: RUCC = 1, Most Urban

	Mean	Median	SD	Min	Max	Count
Count of Veterinarian Businesses (Axle)	33.51	13.00	51.96	0	651.0	10368
Count of Veterinarian Businesses (CBP)	28.74	11.00	49.34	0	634.0	10368
Axle Sales Revenue, Millions	28.74	8.95	50.39	0	681.1	10368
CBP Annual Payroll, Millions	13.05	4.21	23.95	0	385.3	9065
Hirschman-Herfindahl Index	2046.35	1128.15	2372.46	0	10000.0	9996
Population	383241.60	129336.00	744781.97	3978	10105708.0	9933
Real GDP, Billions	22.03	6.46	43.31	0	678.8	9955

Panel B: RUCC = 2

	Mean	Median	SD	Min	Max	Count
Count of Veterinarian Businesses (Axle)	19.03	10.00	22.40	0	170.0	9096
Count of Veterinarian Businesses (CBP)	15.37	7.00	18.73	0	119.0	9096
Axle Sales Revenue, Millions	13.97	5.41	20.71	0	249.6	9096
CBP Annual Payroll, Millions	5.40	2.39	7.64	0	81.4	7834
Hirschman-Herfindahl Index	2358.14	1431.77	2538.18	121	10000.0	8667
Population	168355.29	87044.00	186585.17	1843	1047279.0	8707
Real GDP, Billions	7.91	3.68	10.13	0	114.3	8928

Panel C: RUCC = 3, Least Urban

	Mean	Median	SD	Min	Max	Count
Count of Veterinarian Businesses (Axle)	9.36	7.00	8.82	0	67.0	8544
Count of Veterinarian Businesses (CBP)	7.40	6.00	7.25	0	52.0	8544
Axle Sales Revenue, Millions	6.79	3.70	12.08	0	375.9	8544
CBP Annual Payroll, Millions	2.25	1.70	2.47	0	21.9	6977
Hirschman-Herfindahl Index	2961.82	1843.79	2694.15	0	10000.0	7819
Population	77254.88	73038.50	59145.21	58	250873.0	8188
Real GDP, Billions	3.31	2.99	2.79	0	24.7	8232

Note: Observations are 3,143 counties from 1997-2020. Rural-Urban Code is from the USDA Rural Urban Continuum Codes (RUCC) from 2013 version with the next latest version release in 2003. Panel A includes the most urban counties with a RUCC code of 1. Panel B includes urban counties with a RUCC code of 2. Panel C includes the least urban counties which have a RUCC code of 3. Count of Veterinarian Businesses is count of businesses with NAICS code 541940, Veterinary Services, from Axle and the Census Bureau's County Business Patterns (CBP) data respectively. Annual payroll comes from CBP with NAICS code 541940. Total Banfield Acquisitions, Sales Revenue, and Hirschman-Herfindahl Index come from Axle. Population comes from the Census Bureau. GDP comes from Bureau of Economic Analysis, specifically the annual personal income, CAINC1, series. GDP is in 2020 US Dollars.

Table A.2: Naive TWFE Estimates For Full Sample

Panel A: No Controls	
	(1)
Banfield Acquisition	381.31***
	(49.02)
Observations	66234

Panel B: Population Control	
	(1)
Banfield Acquisition	294.08***
	(51.92)
Observations	63452

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Cluster-robust standard errors, by county, in parentheses. All regressions estimated by two-way fixed effects OLS. All regressions include county and year fixed effects. Banfield Acquisition is a binary variable equaling 1 if it is in post-acquisition period in a county in which Banfield acquires a veterinarian business. For more details, see Equation 2. The dependent variable in all panels is market concentration, calculated by the Herman-Herfindahl Index (HHI). All panels include rural and urban counties. Panel A uses no controls. Panel B uses population as a control variable.

Table A.3: Estimates with No Covariates

	(1)	(2)	(3)	(4)
Panel A: HHI				
Banfield Acquisition	333.36***	210.08***	402.30***	394.27***
	(52.56)	(44.96)	(55.94)	(54.52)
Observations	26476	133823	26476	28008
TWFE	X	-	-	-
Stacked Method[a]	-	X	-	-
Imputation Method[b]	-	-	X	-
CS Method[c]	-	-	-	X
Panel B: Number of Firms	(1)	(2)	(3)	(4)
Banfield Acquisition	17.25***	10.11***	18.78***	16.39***
	(2.25)	(1.25)	(2.42)	(2.20)
Observations	28008	142237	28008	28008
TWFE	X	-	-	-
Stacked Method[a]	-	X	-	-
Imputation Method[b]	-	-	X	-
CS Method[c]	-	-	-	X
Panel C: Sales Revenue	(1)	(2)	(3)	(4)
Banfield Acquisition	35.06***	19.75***	39.77***	29.70***
	(4.25)	(2.40)	(4.72)	(3.61)
Observations	28008	142237	28008	28008
TWFE	X	-	-	-
Stacked Method[a]	-	X	-	-
Imputation Method[b]	-	-	X	-
CS Method[c]	-	-	-	X

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Cluster-robust standard errors, by county, in parentheses. All regressions include county and year fixed effects. Banfield Acquisition is a binary variable equaling 1 if it is in post-acquisition period in a county in which Banfield acquires a veterinarian business. No control variables are used. The sample includes all urban counties. Urban counties are defined by the rural-urban continum codes (RUCC) from 2013 USDA data, those with 3 or below are considered urban. In Panel A, the dependent variable is HHI. In Panel B, the dependent variable is number of veterinary services firms. In Panel C, the dependent variable is sales revenue in millions. Column 1 estimates the effect using two-way fixed effects OLS. [a]Column 2 uses TWFE on the stacked dataset which is balanced in event time in 4 periods before an acquisition and 5 periods after. It includes dataset by county and dataset by year fixed effects. [b]Column 3 uses the imputation estimator of Borusyak et al. (2021) and Gardner (n.d.). [c]Column 4 uses group-time effect aggregation from Callaway and Sant'Anna (2021). It uses never treated as comparison units, the doubly robust differences-in-differences estimator based on inverse probability of tilting and weighted least squares (Sant'Anna & Zhao, 2020), and shows the simple aggregation. See Section 5.1 for more details.

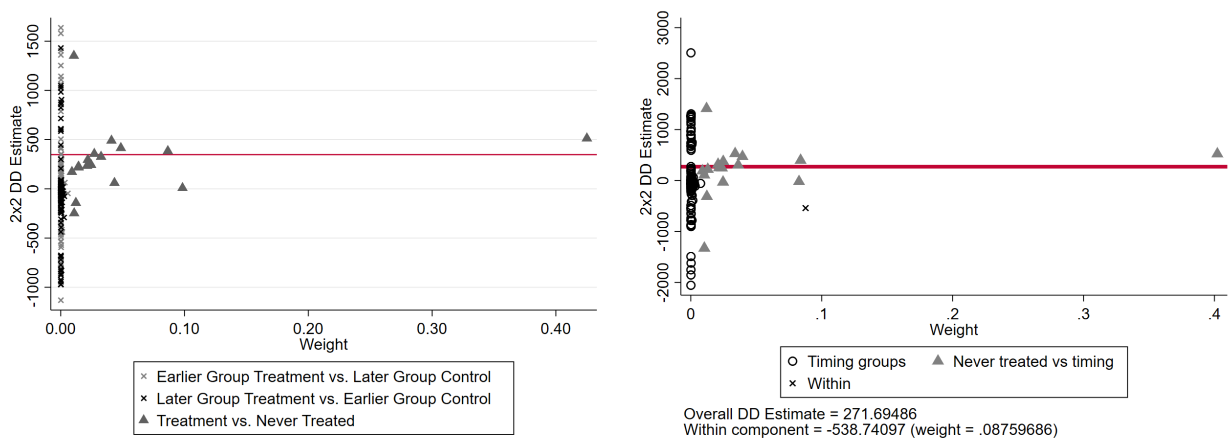
Table A.4: Naive TWFE Estimates With County Specific Linear Time Trends

Panel A: HHI	
	(1)
Banfield Acquisition	107.98**
	(51.00)
Observations	25369
Panel B: Number of Firms	
	(1)
Banfield Acquisition	4.21***
	(0.90)
Observations	26828
Panel C: Sales Revenue (Millions)	
	(1)
Banfield Acquisition	17.51***
	(2.81)
Observations	26828

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Cluster-robust standard errors, by county, in parentheses. All regressions estimated by two-way fixed effects OLS. All regressions include county and year fixed effects and county-specific linear time trends. Banfield Acquisition is a binary variable equaling 1 if it is in post-acquisition period in a county in which Banfield acquires a veterinarian business. For more details, see Equation 2. All panels include only urban counties. Urban counties are defined by the rural-urban continum codes (RUCC) from 2013 USDA data, those with 3 or below are considered urban. In Panel A, the dependent variable is market concentration. In Panel B, the dependent variable is the number of firms in the market. In Panel C, the dependent variable is market sales revenue in millions.

Figure A.4: Goodman-Bacon Decompositions of TWFE Regressions of Acqusition's Effect on Hirschman-Herfindahl Index

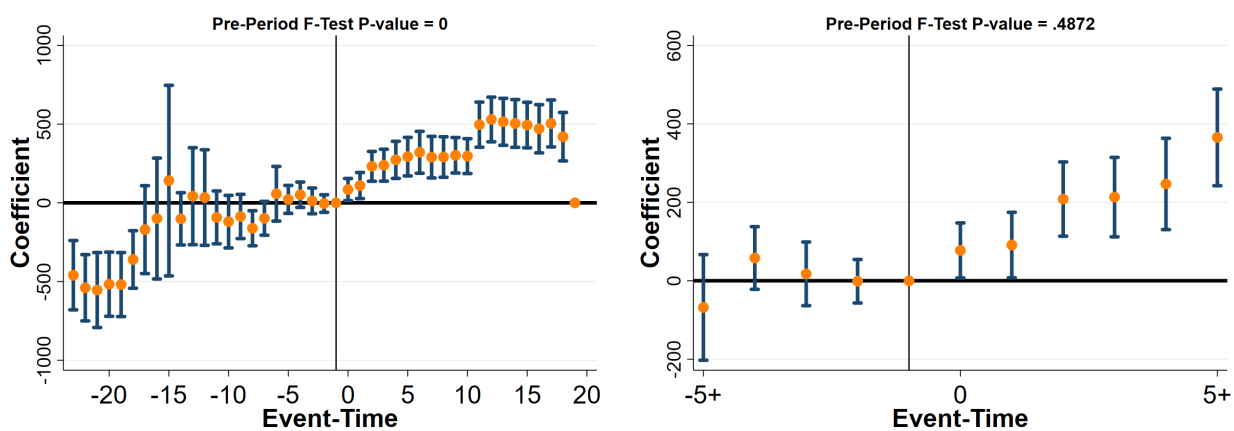
(a) Without Population **(b)** With Population



Note: Scales differ. Figures show the decomposition of the TWFE static estimate into its respective 2X2 comparisons (Goodman-Bacon, 2021). The x-axis is the weight placed on the comparison by TWFE. The y-axis is the effect size used in the aggregate effect. Triangles are the unproblematic comparisons. The red line shows the TWFE estimate. The dependent variable is market concentration, measured by HHI. (a) shows the decomposition without controls. (b) shows the decomposition with population as a control.

Figure A.5: Market Concentration Event Studies With Unstacked Data

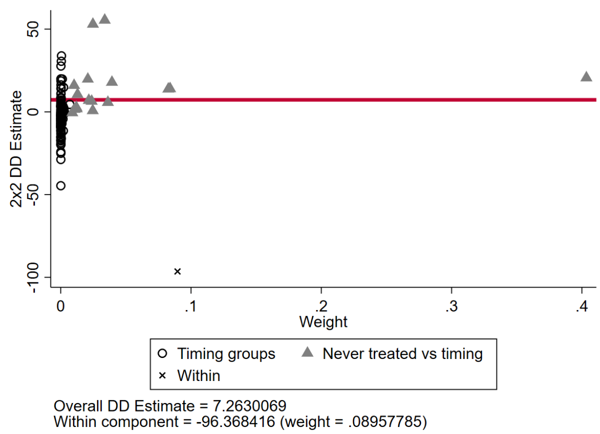
(a) Naïve **(b)** Binned



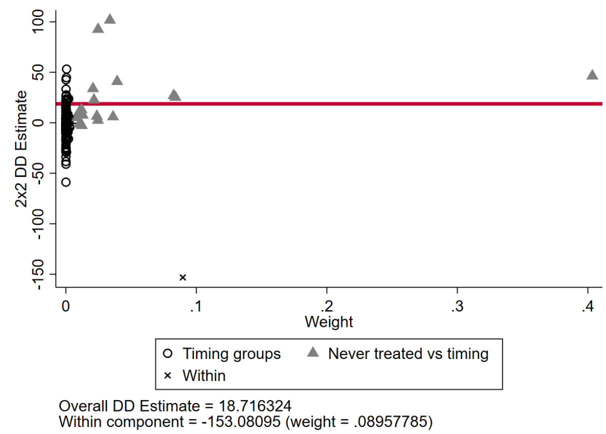
Note: The sample is only urban markets. These figures report coefficients from Equation 3 for the estimation of dynamic effects of acquisitions on market concentration. Coefficients represent the change in concentration for acquisition markets relative to non-acquisition markets in the years before and after an acquisition, as compared with the year immediately prior to the acquisition. Market concentration is measured by the Hirschman-Herfindahl Index (HHI). In (a), the coefficients have changing composition of counties. In (b), the periods beyond the stack data event-study window are binned. The standard errors are clustered at the county level. The F-test p-value reported above the graph is for the null hypothesis of the coefficients in the pre-period being jointly equal to 0. See Section 5.2 for additional analysis details.

Figure A.6: Goodman-Bacon Decompositions of TWFE Regressions of Acqusition's Effect on Firm Numbers and Sales Revenue

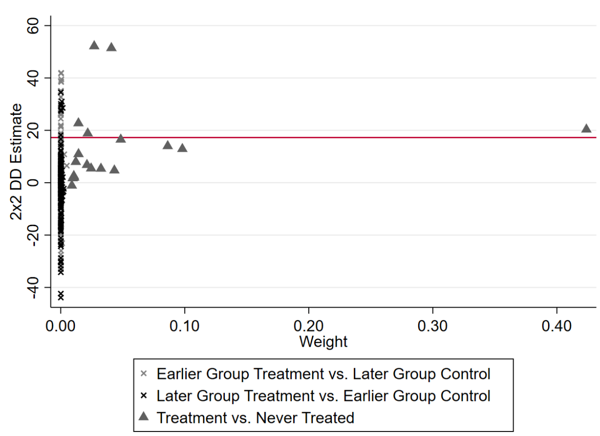
(a) Number of Firms With Population Control



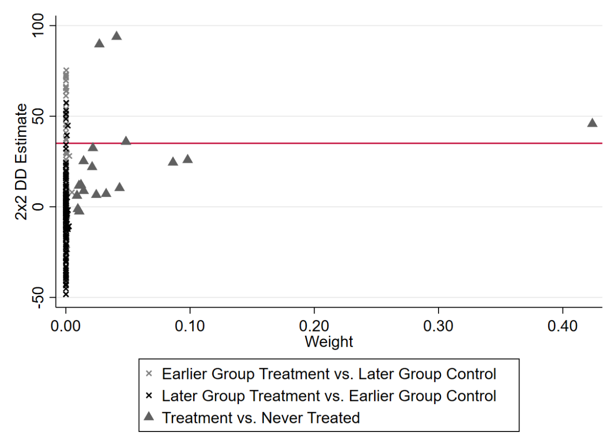
(b) Sales with Population Control



(c) Number of Firms Without Population Control



(d) Sales Without Population Control



Note: Scales differ. Figures show the decomposition of the TWFE static estimate into its respective 2X2 comparisons (Goodman-Bacon, 2021). The x-axis is the weight placed on the comparison by TWFE. The y-axis is the effect size used in the aggregate effect. Triangles are the unproblematic comparisons. The red line shows the TWFE estimate. The dependent variable differs across columns. In (a) and (c) the dependent variable is number of firms. In (b) and (d) the dependent variable is market sales revenue. The specification differs across rows. In (a) and (b) population is used as a control. In (c) and (d), no covariates are used.

Table A.5: Estimates Subsampled by Rural-Urban Code

Panel A: RUCC = 1	Market Concentration		Number of Firms		Sales Volume	
	(1)	(2)	(3)	(4)	(5)	(6)
Banfield Acquisition	308.67***	164.94**	9.15***	11.72***	24.42***	21.80***
	(68.59)	(67.58)	(1.89)	(2.97)	(4.25)	(5.10)
Dep. Var Average	2046.4		33.51		28.74	
Observations	9575		9933		9933	
TWFE	X	-	X	-	X	-
CS^{a}	-	X	-	X	-	X
Panel B: RUCC = 2	Market Concentration		Number of Firms		Sales Volume	
	(1)	(2)	(3)	(4)	(5)	(6)
Banfield Acquisition	207.64**	212.44*	2.09	3.23**	6.66**	4.57
	(96.46)	(118.71)	(1.61)	(1.58)	(3.28)	(3.84)
Dep. Var Average	2358.1		19.03		13.97	
Observations	8304		8707		8707	
TWFE	X	-	X	-	X	-
CS^{a}	-	X	-	X	-	X
Panel C: RUCC = 3	Market Concentration		Number of Firms		Sales Volume	
	(1)	(2)	(3)	(4)	(5)	(6)
Banfield Acquisition	149.87	77.59	3.00***	0.61	3.00*	0.23
	(206.61)	(140.94)	(0.89)	(1.50)	(1.58)	(1.92)
Dep. Var Average	2961.8		9.359		6.789	
Observations	7490		8188		8188	
TWFE	X	-	X	-	X	-
CS^{a}	-	X	-	X	-	X

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Cluster-robust standard errors, by county, in parentheses. All regressions include county and year fixed effects. Banfield Acquisition is a binary variable equaling 1 if it is in post-acquisition period in a county in which Banfield acquires a veterinarian business. Only urban counties included in all panels. Population is the only control variable used. Columns 1, 3, and 5 are estimated by two-way fixed effects OLS. ^{a}Columns 2, 4, and 6 uses group-time effect aggregation from Callaway and Sant'Anna (2021). It uses never treated as comparison units, the doubly robust differences-in-differences estimator based on inverse probability of tilting and weighted least squares (Sant'Anna & Zhao, 2020), and shows the simple aggregation. See Section 5.1 for more details.