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The Compatibility of Farmland Sales and Opinion Survey Data

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Abstract

Given the central role of farmland in the agricultural economy, a large volume of research has examined the factors that determine farm real estate values. Previous empirical studies principally examine either market transactions or opinion surveys. This study provides a detailed comparison of market transaction records and farmer-reported market values from the USDA's primary instrument for measuring state- and national-level farmland values in New York State. Our analysis suggests that when transactions and opinion surveys are appropriately weighted, the two sources provide markedly similar results in aggregate. While opinion surveys and market transactions exhibit differing implicit marginal values of various parcel characteristics, our results demonstrate that many of these differences are due to differences in perceived development potential and market activity (market thinness). The findings have implications for future research concerning the composition of farmland markets and comparability of self-assessed land values and observed transaction prices. This is the first study to examine differences between granular farmland sales and USDA survey data.

1 Introduction

Previous studies of the determinants of farmland values principally draw insights from one of two possible sources of information: market transactions or opinion surveys. As a general rule, economists tend to favor market transaction data over opinion surveys because (market transaction) prices "reflect a free market's expression of different individuals' evaluations of property relative to other purchase options (Darling, 1973, pp. 25)." Both market transaction and opinion surveys, however, are proxy measures for the fundamental value of farm real estate. The fundamental value is subjective, not always clearly defined, and unobservable. As a result, we cannot truly distinguish which of these two proxies, market transactions or opinion surveys, is closest to the true fundamental value of farm real estate. In perfectly efficient markets, transaction prices should be roughly equal to fundamental values. However, market values can deviate from fundamental values because of market imperfections, such as asymmetric information, transaction costs, or thin trading. Thus, while market prices provide an indication of the underlying fundamental value of an asset, they are an imperfect source of information.

In recent years, empirical research has benefited from availability of increasingly rich and detailed market data. While many commonly used data sets represent perfectly efficiently markets (e.g., stock market data, grocery store scanner data), others, such as specialty product markets and farmland markets, do not. As a result of market imperfections and data confidentiality, a number of institutions, such as the USDA, Federal Reserve Banks, and various land-grant universities, conduct opinion surveys to monitor farmland market conditions (Kuethe and Ifft, 2013). Farmland opinion surveys elicit the beliefs of market participants and experts, such as lenders, farm operators, extension educators, real estate appraisers, and brokers. Many of the surveys collect opinions on the current value of farmland of a given quality, such as "good" or "high quality" farmland. Other surveys, such as those administered by the USDA, elicit respondents' expectation of the current market value of a specific parcel of land, such as the land they currently own or operate. Similar to transaction prices, survey responses contain random variation due to differences in respondent beliefs, knowledge, or other factors. As a result, opinion surveys also provide an indication of the underlying fundamental value of farmland, yet they too are an imperfect source of information.

This study examines the degree to which market transaction and opinion surveys provide complimentary information on farmland price determination. Specifically, we compare arm's length farmland transaction prices with opinion survey responses to assess differences in these two commonly-used sources of information. Our study is unique, given its use of opinion survey data from a confidential micro dataset of farm-level land values, which are used to produce USDA's official farmland value estimates (e.g., USDA NASS, 2016), along with a comprehensive set of arm's length sales transactions for the same study area.

Our study area is New York State, which has a diverse agricultural sector as well as large metropolitan and recreational areas that exert pressure on farmland values. According to the 2012 Census of Agriculture, New York State is home to over 35,000 farms and nearly 7.2 million acres of agricultural land (USDA NASS, 2014). Approximately 30% of New York farms are beef cattle operations and 14% are dairy operations. New York is the number three state for milk receipts and in the top five for for many fruits and vegetables (including apples, cabbage, grapes and snap beans). While corn and soybeans are the most common field crops grown, many operations also produce tree crops, oats, and potatoes. The range of outputs produced by New York farms makes it broadly representative of the U.S. farm sector.

The use of opinion surveys to track conditions is not unique to farm real estate but is common among other property classes (Kuethe, 2016; Geltner et al., 2003). The broader real estate literature suggests that homeowners' beliefs of the market value of their homes, in aggregate, were equal to those of professional appraisers (Kish and Lansing, 1954; Kain and Quigley, 1972) but higher than market transaction prices (Goodman and Ittner, 1992; DiPasquale and Somerville, 1995; Kiel and Zabel, 1999). In addition, a number of previous studies compare aggregate farmland values derived from a variety of sources. Scott and Chicoine (1983) and Barnard and Wunderlich (1984) examine state-level farmland indexes based on transactions and USDA surveys. While the two studies vary in terms of index construction, both find that survey-based indexes are highly correlated with market transactions, but survey-based indexes underestimate appreciation rates. Zakrzewicz et al. (2012) finds similar relationship between transaction prices and aggregate farmland values from surveys conducted by the USDA and the Federal Reserve Bank of Kansas City. Shultz (2006) similarly compares aggregate farmland transaction prices to two opinion surveys administered by the USDA, the national June Area Survey (JAS) and the state-level North Dakota Land Value Survey (NDLVS). The study suggests that both surveys tracked transaction prices at the state level, yet the aggregate values diverged in a number of counties. This finding is consistent with Gertel (1995), who shows that the deviation between farmland sales prices and opinion surveys was greater near urban centers in Illinois and Maryland.

More granular studies examine the differences between individual farmland transactions and assessments conducted for tax purposes. These studies are able to more directly compare parcel-level characteristics through hedonic price analysis, and they suggest that assessed values and sale prices tend to diverge in the key determinants of farmland values. Ma and Swinton (2012) find that estimates of farmland values prepared for tax purposes consistently underestimated the value of surrounding natural amenities. In a study of water valuation in drought prone regions, Grimes et al. (2008) find that while assessed land values were highly correlated with transactions prices, they underestimated the added value of irrigation. Thus, both Ma and Swinton (2012) and Grimes et al. (2008) suggest differences in attribute valuations between market participants (i.e., transaction prices) and the opinions of professional appraisers. This finding is consistent with similar studies of other real estate classes, such as residential real estate (Berry et al., 1975; Nicholls and Crompton, 2007; Bowman et al., 2009; Cotteleer and van Kooten, 2012) and industrial land (Kowalski and Colwell, 1986).

While the existing literature documents the deviations between transaction prices and opinion surveys in aggregate (see, for example, Scott and Chicoine, 1983; Barnard and Wunderlich, 1984; Zakrzewicz et al., 2012, and related studies), data access has limited the ability to examine more granular differences between these sources of information. This study compares disaggregate farmland values derived from two sources of information, a farmer opinion survey administered by the USDA and market transaction records, for the same study area. In one sense, this work builds on the previous studies of Ma and Swinton (2012) and Grimes et al. (2008). However, instead of comparing transaction prices to assessed values, we are able to examine, in more detail, the differences between market transactions and opinion surveys. While the differences between transaction prices and tax assessment values may have important implications for taxation purposes, our study is directly related to the USDA's measurement of aggregate farm real estate values. The USDA's operator-assessed farm real estate value estimates are designed to be representative of all farmland in the US and, therefore, disagreements between transaction prices and survey responses convey information about the representativeness of land that is exchanged in farmland markets.

This study makes (at least) three important contributions. First, we examine differences between weighted and unweighted observations to determine the potential for sample selection bias. Market values may be subject to sample selection bias because parcel sales are generated non-randomly (Clapp and Giaccotto, 1992). This analysis also provides a test of USDA methodology for official land value estimates. Our analysis demonstrates minimal differences between the datasets when opinion surveys are weighted according to the USDA's survey weighting procedure and transaction records are weighted according to parcel acreage. Second, we use regression analysis to identify differences in the marginal implicit values of various farmland property characteristics. For example, the regression results suggest that opinion survey respondents do not differentiate between medium and low-quality soils, yet market transactions suggest a positive price premium for medium quality soils relative to low quality soils. Third, we exploit additional questions of the opinion survey instrument to examine differences between market opinions for land with and without development potential, as well as land located in counties with a relatively high volume of farmland transactions. The results suggest that in areas *without* development potential, opinion surveys are more influenced by a parcel's agricultural productivity, but in areas *with* development potential, opinion surveys are associated with higher premiums for connectivity to neighboring towns and urban areas. In addition, we demonstrate that the regression results for opinion surveys in areas with more active real estate markets (i.e., those in counties with above-median sales volumes) more closely resemble those of transaction values.

These findings have important implications for farmland value research, and farm real estate values are important to farmers, farmland owners, agricultural lenders, and agricultural policymakers. Approximately 46% of the United States' land area is devoted to agricultural production, with 29% (665 million acres) in grassland pasture and rangeland and 17% (392 million acres) in cropland (Bigelow and Borchers, 2017). Further, the USDA estimates the total value of U.S. farm real estate at $2.6 trillion (USDA ERS, 2017). Farm real estate accounts for more than 83% of the value of the farm sector's total asset base (USDA ERS, 2017). It is the primary store of farmers' wealth and an important source of collateral (Nickerson et al., 2012). Thus, the accurate measurement of farm real estate values is a critical need of the agricultural sector.

These findings also have implications for applied economics research when price data is limited due to availability or imperfect due to market deficiencies. In some cases, reconsideration of survey data may be merited. When feasible, comparison of price data with survey data can elucidate when such datasets are comparable. Such analyses could be instructive in situations where high-quality market data is not available. For example, Wineman and Jayne (2017) use survey data to analyze farmland value trends in Tanzania, where transactions data is not available. If research is limited to situations where detailed market data is available, economic knowledge may be limited or even biased towards such markets. For example, much of the agricultural economics literature uses field crop or corn production data from the Midwest, while fewer studies have been conducted on specialty crops. Further, survey data could provide important insights to market data, if additional information can be analyzed.

The remainder of the paper is organized as follows. Section 2 describes our data sources. Section 3 outlines our estimation strategy. Section 4 summarizes our key findings, and Section 5 provides concluding remarks, including policy implications and suggestions for future research.

2 Data

Our analysis of farmland values and transactions prices draw from two sources of information. Farm operator estimates of land values (i.e., opinion surveys) are obtained from the USDA's June Area Survey (JAS), a multipurpose annual survey used to inform a variety of USDA publications, including the official annual land value estimates (e.g., USDA NASS, 2016). Farmland transactions data were obtained from the New York Office of Real Property Tax Services.

2.1 June Area Survey

The JAS is administered annually by the USDA's National Agricultural Statistics Service (NASS). JAS uses a comprehensive probability- and area-based sampling frame. The sampling frame divides the U.S. into 1 square mile segments. In intensively cultivated areas, segments are sampled at the rate of about 1 out of 125, and in areas that are less intensively cultivated, segments are sampled at a rate of about 1 out of 250–500. When a segment is sampled, enumerators contact all producers operating "tracts" within its boundaries. Tracts denote land inside a segment in a common farm operation.[1] The JAS is constructed as a rolling-panel. Once a segment is sampled, it generally remains in the sample for five years, with approximately 20% of sampled segments rotating through in a given year. NASS supplies probability-based survey weights such that tract-level responses are representative of the surveyed segment, as well as weights that are calibrated to produce representative National and state-wide estimates when taken over the population of segments.

The JAS collects per-acre estimates of the market value of farmland from each farmer-respondent. In addition, the survey contains a number of questions that yield additional insights. For example, the respondents are asked the likely use of tract if it were sold. The likely land uses include (1) agricultural use only, (2) immediate development (residential or commercial), (3) expected future development (residential or commercial), or (4) other. Because the JAS uses a land-area based sampling frame, the segment-level information can be geo-referenced, and the opinion survey information can therefore be linked with other spatially-explicit data sources. Previous empirical studies that use the JAS land value information include Schlenker et al. (2007), Towe and Tra (2013), Borchers et al. (2014), and Ifft et al. (2015).

2.2 Farmland Transactions

Farmland transaction records were obtained from the New York Office of Real Property Tax Services. Most of the sales can be geo-referenced either by linking tax identification numbers with parcel maps or by the parcel address in the transaction record (if it is provided). Thus, the transactions can similarly be linked with other spatially-explicit data sources. The transaction record includes the total acres sold and the sales price for each parcel. In addition, the transaction record includes an indication of whether the transaction was between related parties. Thus, the we can screen the sample to include only arm's length transactions that may more accurately represent the fair market value for the parcel(s). Only

[1] Although the tract is the most disaggregated unit available with the JAS, we are not able to geo-reference individual tracts, which precludes us from linking them with external data sources. However, we do observe the centroid of each JAS segment. The segments, therefore, form the unit of analysis for this study.

parcels that are classified as agricultural (property class 100-190) are used in this analysis.

2.3 Additional Data Sources

As previously mentioned, both the opinion survey and transaction record data can be geo-referenced, and the data can therefore be linked to additional variables through geographic information systems (GIS). The additional variables are outlined in Table 1.

[**TABLE 1 ABOUT HERE**]

We use a variety of measures to control for differences in potential agricultural productivity. First, we construct a measure of soil quality derived from the the 10-class soil quality index developed exclusively for appraisal in New York State (New York State Department of Agriculture and Markets, 2017). The index is calculated using historic yield potential for hay and corn, for all soil types. The index is used by appraisers to value specific soil types and can be matched with the Soil Survey Geographic database (SSURGO) to approximate soil quality for any parcel of land. For our purposes, the soil quality index is grouped into three quality bands: high-quality soil (classes 1-3), medium-quality soil (classes 4-6), and low-quality soil (7-10).[2] Second, to account for cross-sectional differences in climate, we use PRISM data to measure county-level average precipitation and minimum temperature over the 30 years preceding our study period (i.e., 1979 – 2008). The climate variables are measured at the start of the growing season, covering the months of April through June, as this is period is critical to most New York agricultural producers.

Finally, we include a number of additional characteristics beyond potential agricultural productivity that are associated with farmland market prices (see Borchers et al., 2014). The variables include distance to towns with a population greater than 2,500 residents, distance to large urban areas with a population greater than 1 million residents, distance to highway exit ramps, distance to railroads, and nearby population, all of which should, in theory, be positively related to capitalized development potential but could also signify access to

[2] It should be noted that the terms "high-quality," "medium-quality," and "low-quality" are relative to the soils throughout New York State, but the soil quality may differ substantially from soils in other regions of the U.S.

agricultural markets. We also account for recreational potential by the distance to parks and recreational water bodies, a popular source of outdoor recreation in many parts of New York, such as the Finger Lakes region. Finally, we include a number of other distance-based measures for the nearest college/university, golf course, and hospital.

2.4 Comparing data sources

We assemble a complete record of arm's length farmland transactions and JAS segments for the period 2009 to 2014. Between 2009 and 2014, 244 unique JAS segments were surveyed in New York. The rolling panel construction of JAS, yields a set of 394 total JAS observations over the study period. Over the same period, the transaction record includes 3,294 arm's length transactions. Table 2 provides the mean values of the dependent and explanatory variables used in the analysis.

[TABLE 2 ABOUT HERE]

The first two columns of Table 2 provide the unweighted means for the per acre farmland values derived from both data sources, as well as the control variables in our full model. Comparing the land value means in the first two columns, there appears to be a sizable difference between the average values contained in the JAS and sales transactions datasets, with the average sales transaction price ($3,361) being roughly 33% higher than the corresponding JAS estimate ($2,734). Differences across the other variables are relatively small, although it does appear that, compared to the JAS segment locations, sales transactions take place closer to small towns, further from highway ramps, and on land with more productive soils. The third column reports the normalized mean difference between the JAS and transaction record data. The normalized mean difference suggests that the two datasets exhibit similar central tendency, with only travel time to small towns exceeding the threshold value of $|0.25|$ (Imbens and Wooldridge, 2009).[3]

[3] The normalized mean difference for variable j is measured as $\frac{\overline{x}_{j1}-\overline{x}_{j2}}{\sqrt{\overline{v}_{j1}+\overline{v}_{j2}}}$, where $\overline{x}_{j1}$ and $\overline{x}_{j2}$ denote the sample means for samples 1 and 2, respectively, and $\overline{v}_{j1}$ and $\overline{v}_{j2}$ represent the corresponding sample variances.

Columns 4 and 5 of Table 2 report weighted means of the same variables. The JAS segments are weighted following the survey-weighting procedure used by NASS to produce official USDA statistics, which are designed to be representative of state-level farmland acreage and production. The transaction record data are weighted according to the parcel acreage. Barnard and Wunderlich (1984) note that aggregate land values are more comparable to official USDA farmland value estimates when the sales values are weighted by parcel acreage. After weighting, the difference in per-acre land values observed with the unweighted means is reduced substantially, with the average weighted sale price ($2,438) just 3% or $68 higher than the average farmer-reported JAS value ($2,370). Differences in the means for the other variables are not meaningfully impacted by weighting. For each variable, the normalized mean difference is less than |0.25| (Imbens and Wooldridge, 2009).

The similarity between weighted farmer-reported land values and weighted transaction prices is important for at least two reasons. First, the weighting reveals that between 2009 and 2014, New York farmland transactions were dominated by small, high-valued land parcels. A "small parcel price premium" is well established in the existing literature, with recent work suggesting that the premium is largely due to the ease of developing relatively smaller parcels (Brorsen et al., 2015). Second, the close correspondence between the weighted JAS values and weighted transaction prices reduces concerns that the two data sets provide an "apples to oranges" comparison. A potential critique of the use of sales data in a hedonic regression model is that sold parcels are not representative of the broader stock of real estate, inducing a form of selection bias (Clapp and Giaccotto, 1992). This concern is potentially relevant for the study of farm real estate, as farmland markets are notoriously thin, with approximately 0.5% of U.S. farmland changing hands in a given year (Sherrick and Barry, 2003). Thus, market thinness increases the potential that transacted parcels are systematically different from those that were not transacted. Further, given that the primary goal of farmland value portion of the JAS is to produce representative estimates of farmland values nationally and at the state-level, the similarity to weighted transaction prices is encouraging. The weighting procedure is a potential remedy for sales-induced selection bias and offers a simple, replicable method that can be readily applied to future empirical farmland value applications. Given that weighting has such a substantial effect on the measures of farmland value and limited effects on our control variables, we apply the survey and acreage weights in our hedonic price model estimation.

3 Estimation strategy

Given the similarity between weighted mean land values from the USDA opinion survey and weighted mean transaction prices, we examine the degree to which the values assigned to various farmland characteristics differ across the two sources of information. To this end, we estimate separate hedonic price models for the two data sets. A generic version of the hedonic price model can be expressed:

$$V_i = \beta_1 A_i + \beta_2 D_i + \varepsilon_i \tag{1}$$

where V_i is the per-acre land value of parcel i, A_i a vector of variables related to the agricultural productivity of parcel i, D_i a vector of non-agricultural variables (such as urban proximity or recreational potential) that potentially impact farm real estate values, β_1 and β_2 vectors of unknown parameters to be estimated, and ε_i a standard i.i.d. residual term.

To ensure that the two model are comparable, the two models include the same control variables (parcel characteristics). In addition, we use the survey and acreage weights described in Section 2.4. Both specifications are estimated in log-linear form and include region and year dummy variables. For our baseline results, we use the full sample of 2009-2014 JAS segments and sales observations to compare the extent to which the explanatory factors listed in Table 2 are capitalized into each land value measure.

To examine a number of real estate pricing anomalies identified by the existing literature, we also estimate a set of supplemental regressions based on different subsets of the JAS data. First, we restrict the sample to only include observations that are located in counties with sales volume greater than the median observed during our estimation period (2009 –

2014). This supplemental regression examines the degree to which market thinness impacts the differences between opinion surveys and market transactions. We posit *a priori* that responses in "thicker" markets will align more closely with transaction values, as respondents receive more information on potential market value of their land. Second, we estimate separate models based on the intended land use ascribed to the market value given in the JAS response. Specifically, we estimate one model with all segments listed as having some development potential (either immediate or expected future development), and another using only the segments that have no development potential. Estimation of (1) using these two subsamples will allow us to gauge the extent to which farmers differ in their capitalization of certain observable factors (e.g., soil quality) based on the intended hypothetical use of their land. We posit *a priori* that responses with development potential will place greater relative weight on urban connectivity, and responses without development potential will place greater relative weight on agricultural productivity (Delbecq et al., 2014).

4 Results

4.1 Baseline results

The results from the estimation of equation (1) using the full JAS segments and complete transaction record are reported in Table 3. The results include the coefficient estimate, along with 95% confidence intervals generated using county-clustered standard errors.

[TABLE 3 ABOUT HERE]

We first consider the effects of the variables most relevant to agricultural use values. For both the survey and sales regressions, a greater percentage of land with high-quality soils has a positive effect on land value. However, the JAS estimates suggest that opinion survey respondents do not differentiate between medium- and low-quality soils (the omitted category). The market transaction records suggest a positive premium for both high-quality soils (classes 1-3) and medium-quality soils (classes 4-6). In addition, as one would expect, the marginal effect of high-quality soils is greater than that of medium-quality soils. Both precipitation and temperature have significant, yet relatively small, effects in the survey model, but neither are significant in the sales model. Temperature and precipitation may be more salient to farm operators, who would be more likely to have experience with local weather. Given that flooding and excess moisture, more generally, have historically been a much larger problem for New York farms than drought, the negative sign on precipitation may indicate that experience with excess precipitation leads to lower estimates of farmland value. The temperature variable has a negative coefficient, which suggests that higher minimum Spring temperatures are associated with lower farmland values. This finding is somewhat unexpected given that cold weather has historically been a larger problem for New York farms than high temperatures.

The impacts of urban areas on farmland values also differ across the two models. For both JAS responses and market transactions, land values decline as the proximity to large cities declines. The 95% confidence interval suggests that the price gradient for travel time to urban areas is similar between sales transactions and JAS responses. However, the JAS survey responses appear to be be more sensitive to the effects of nearby populations of varying sizes. The coefficient on the population interaction index is positive and significant in the JAS model, but it is indistinguishable from zero in the transaction model. The coefficient on county median household income has the opposite pattern, showing a significant positive effect on sales price and no effect in the opinion survey. Neither the sales prices nor survey responses indicate a significant gradient with respect to the proximity of a small town/city.

As a result, it appears that capitalized future development rents, as perceived by farm operators, are a function of both commuting time and nearby population, whereas development-oriented values in transaction prices are transmitted through commuting time and local income levels. This pattern is potentially explained by the salience of the different factors farmers may perceive to affect the value of their land. Specifically, since farmers are generally non-commuters, it is plausible that they would attribute a lower share of their land's value to how easy it will be to commute from their land to a major urban area. It also seems reasonable that farmers, many of whom may live in close proximity to the land they farm, may perceive at least some of the stream of future development rents through the level of nearby population, as this may convey information on local amenities, such as having multiple school choices and shopping areas, or access to local food markets.

4.2 JAS observations in high-volume sales counties

The richness of our dataset allows us to make a number of additional comparisons between farmland transactions and JAS responses. We first compare the farmland transactions with JAS segments located in counties with a sales count that is at or above the median observed sales frequency over the study period. More than half of the JAS sample is retained after imposing the sales volume restriction, suggesting that the JAS survey is concentrated in counties that have a relatively active farmland markets. The results are reported in Table 4.

[**TABLE 4 ABOUT HERE**]

For the variables representing agricultural use value, one notable change emerges with respect to the soil quality. When we limit our analysis to relatively “thick” markets, both the percentage of high- and medium-quality soils have positive, significant effects, similar to the transaction data. The estimated price premiums for the JAS results are greater than those implied by the transaction record, yet the 95% confidence intervals overlap between the two estimates.

The non-agricultural price determinants also suggest a higher degree of similarity between survey and sales estimates when using the restricted JAS sample. First, the value gradient for urban area proximity is far more similar between the two, with the restricted JAS estimate (–0.36) being slightly steeper than that of the sales model (–0.35). Second, as is the case in the sales model, household income now has a positive and significant effect in the JAS model, which was not the case in the baseline. Moreover, it appears that some of the urban influence effect captured by nearby population in the baseline model appears to have shifted to local income, as the effect of the population interaction index is only weakly significant and smaller in magnitude when using the restricted JAS sample. Recreational water proximity also has a significant negative effect in the restricted JAS sample, which, again, is also the case in the sales model, and contrasts with the results in the baseline JAS model. One final difference between the high-sales and baseline JAS estimates is the precision of the effect related to highway ramp proximity, which has the same sign in both models, but was not significant in the baseline estimation. This contrasts with the sales model, which suggests that land prices increase with distance to the nearest highway ramp, which seems to suggest that highway ramp proximity conveys information related to market accessibility in the survey estimates, and congestion/noise externalities in the sales transaction data. The effects of the remaining variables exhibit little difference between the baseline and high-sales JAS sample.

4.3 JAS observations with and without development potential

Prior research suggests that farmland prices in areas with development potential differ substantially from those without development potential (e.g., Delbecq et al., 2014). As a result, we also examine the degree to which transactions prices and survey responses differ according to whether the survey respondents noted that, if sold under current market conditions, the most likely use of their land would be either immediate or expected future development. Note that, since the surveys take place at the JAS tract level, and not all of the responses for tracts in a given segment will report the same expected land use, we include all of the segments for which at least one tract is reported as having some form of development as its most probable use. The results are reported in Table 5.

[TABLE 5 ABOUT HERE]

Although the share of JAS segments with development potential is relatively small (<20% of the total baseline sample), several noteworthy findings emerge from this subsample regression. First, the distance gradient for both small towns and large urban areas is much steeper for segments with development potential than for either the sales or baseline JAS results. Furthermore, it is the only JAS regression that exhibits a distinguishable gradient due to small town proximity. Second, distance to colleges also has a marginally significant negative effect for responses with development potential, suggesting that nearby higher-education institutions provide some source of amenity value for farmland with development potential. Finally, when the JAS responses are limited to those with development potential, the regression results exhibit no statistically significant relationship between farmland values and any of the variables associated with agricultural productivity (e.g., soil quality, climate).

Using the intended land use information, we also created a subsample of the JAS that contains only those segments that are listed as having no immediate or expected future development potential. Overall, the regression results for this subsample are quite similar to the baseline JAS results, which is not surprising given that more than 80% of the baseline JAS observations are contained in this subsample. The only discernible difference between this subsample estimation and the baseline JAS results comes from the effect of recreational water proximity, which suggests that this amenity effect is not constrained to parcels that will be developed in the near future. Somewhat surprisingly, we do not find a significant effect related to medium-quality soils when using only the segments with no development potential. This may be related to farmer preferences for higher quality soils. In addition, we find evidence of a negative land value gradient with respect to large urban areas, which has several potential explanations. On one hand, it could be the case that proximity (in travel time) to large urban areas is important from a market access perspective, since these areas could be important distribution and marketing hubs for agricultural producers. Second, it is possible that farm operators who do not plan to sell their land for development still take the sales of nearby properties that will be developed as a signal of their own land's market value. Third, cities may have been historically located in areas more suitable for cultivation or with a nearby food source.

5 Conclusion

Farmland is a critical input to the agricultural sector, accounting for more than 83% of the value of the farm sector's total asset base (USDA ERS, 2017). As a result, a large volume of empirical research has examined the factors that determine and influence farmland values.

The existing literature principally draws from one of two sources of granular farmland price information: market transactions or opinion surveys. As noted previously, each data source offers a number of advantages and disadvantages. This study is the first to compare individual market transactions with farmer-reported farmland value opinions from the USDA's June Area Survey. JAS serves as the foundation for the USDA's farmland price reporting and analysis.

Our study has several important implications for future empirical research and the construction of official statistics. First, we demonstrate that when survey responses and market transactions are appropriately weighted by replication weights or parcel acreage, respectively, the farmer opinions collected by USDA NASS provide a nearly equivalent statewide farmland value estimate. Further, using detailed regression analysis, we demonstrate that the marginal values of most property characteristics are similar between the two data sources. This provides strong evidence that the underlying data that is used to estimate USDA official farmland values reflects, and is representative of, actual farmland sales.

While the similarities and inconsistencies between different sources of farmland values have been acknowledged to some extent, the existing literature provides limited information on why farmers' perceptions of market values may differ from actual market transaction prices. Our analysis demonstrates that the difference can be explained by a few key factors. First, many of the differences can be explained by farmers' perceptions of development potential. Our baseline results suggest that farmers appear to be more heavily influenced by nearby population levels, whereas market values are more sensitive to commuting times and local income levels. Further, the marginal value of various characteristics differs substantially when the analysis is limited to responses with or without stated development potential. Second, the opinions of farmers in areas with more active local farmland markets, as measured by volume of sales, are more similar to transaction prices. Intuitively, experience with a more fluid local property market leads to a greater degree of convergence between operator-assessed and market value estimates.

While applied economists tend to favor transactions data over opinion surveys, our results highlight additional merits of opinion surveys. For example, it is often difficult to determine sale or purchase intent in property transaction records, whereas the JAS instrument solicits this information directly. Our baseline analysis of weighted and unweighted sample statistics also suggests that transaction data may be significantly influenced by the purchase of small parcels, some of which are likely being purchased for nonagricultural purposes. We further find that the intended use of the hypothetical property sale influences, in several expected ways, the results of regressions based on farmer-assessed values. Weighting by parcel acreage may be a potential remedy for sample selection bias and is am important consideration for future studies using transactions data. Further, the weighting here may be less arbitrary than dropping parcels below a certain size, a typical practice in farmland valuation studies.

Our findings also suggest that some caution is warranted when using sales prices in farmland hedonic analyses, particularly in study areas that are subject to a high degree of urban influence or in areas with limited number of transactions (thin markets). We find that a high volume of local sales activity creates a more balanced valuation of farmland between these two sources, suggesting that market activity should be considered when assessing the potential accuracy of opinion surveys.

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Tables

Table 1: Variable names and descriptions

Variable name	**Variable description**
Value per acre	Dependent variable; derived from operator-reported values from the June Agricultural Survey or sales transactions
Population interaction index	Distance-weighted sum of nearby population (2010) within a 50-mile radius
Travel time to small town	Road hours to nearest town/city of >= 2,500 people
Travel time to urban area	Road hours to nearest town/city of >= 1 million people
Distance to recreational water	Miles to nearest recreational water source
Distance to railroad	Miles to nearest railroad
Distance to highway ramp	Miles to nearest interstate highway ramp
Distance to park	Miles to nearest national, state, or local park
Distance to golf course	Miles to nearest golf course
Distance to college	Miles to nearest college
Distance to hospital	Miles to nearest hospital
Percent high-quality soil	Percentage of land in soil classes 1-3
Percent medium-quality soil	Percentage of land in soil classes 4-6
Household income	County-level median household income
Precipitation	Average total precipitation from April-June over 1979-2008
Minimum temperature	Average daily minimum temperature from April-June over 1979-2008
Year(t)	Annual indicator variable (2009 omitted base)
Region(i)	Indicator variable for following New York regions: Central New York, Finger Lakes, Southern Tier, Mohawk, North County, Mid-Hudson, Western New York (Capital Region omitted base, Long Island excluded)

Table 2: Comparison of variable means

	Un-weighted			**Weighted**		
	Survey	**Sales**	**Normalized Mean Difference**	**Survey**	**Sales**	**Normalized Mean Difference**
Value per acre	2734.03	3631.84	–0.15	2370.42	2437.62	–0.02
Population interaction index	31.64	32.06	–0.02	29.70	27.78	0.08
Travel time to small town	0.23	0.17	0.34	0.24	0.20	0.20
Travel time to urban area	2.92	3.05	–0.10	2.87	3.18	–0.23
Distance to recreational water	6.01	6.08	–0.01	6.31	6.06	0.04
Distance to railroad	3.59	3.82	–0.07	3.88	4.03	–0.04
Distance to highway ramp	8.83	10.29	–0.11	9.45	11.62	–0.15
Distance to park	5.89	5.93	–0.01	5.47	5.60	–0.02
Distance to golf course	4.37	4.57	–0.06	4.80	4.88	–0.02
Distance to college	10.39	10.37	0.00	11.17	10.76	0.05
Distance to hospital	9.80	9.45	0.06	9.94	9.77	0.03
Percent high-quality soil	25.29	29.32	–0.10	22.41	26.61	–0.11
Percent medium-quality soil	47.06	48.14	–0.03	46.88	49.65	–0.07
Household income	46.55	46.21	0.04	45.92	45.61	0.04
Precipitation	9123.69	8983.90	0.11	9257.35	8966.97	0.24
Minimum Temperature	659.27	664.07	–0.04	653.83	652.90	0.01

Table 3: Baseline estimation results

	Full JAS Sample			NY Sales		
	Estimate	C.I.		Estimate	C.I.	
Population interaction index	0.018	[0.008,0.029]	***	>–0.001	[–0.005,0.004]	
Travel time to small town	0.070	[–0.576,0.717]		–0.07	[–0.598,0.457]	
Travel time to urban area	–0.200	[–0.373,–0.027]	**	–0.352	[–0.498,–0.207]	***
Distance to recreational water	–0.010	[–0.026,0.005]		–0.015	[–0.027,–0.004]	**
Distance to railroad	–0.016	[–0.054,0.022]		0.007	[–0.012,0.026]	
Distance to highway ramp	–0.005	[–0.016,0.006]		0.011	[0.003,0.019]	***
Distance to park	0.010	[–0.008,0.029]		0.018	[0.003,0.033]	
Distance to golf course	–0.044	[–0.078,–0.01]	**	–0.02	[–0.037,–0.003]	**
Distance to college	–0.001	[–0.02,0.017]		0.001	[–0.008,0.011]	
Distance to hospital	0.007	[–0.01,0.024]		–0.002	[–0.017,0.013]	
Percent high-quality soil	0.007	[0.002,0.012]	***	0.005	[0.004,0.007]	***
Percent medium-quality soil	0.003	[–0.002,0.007]		0.002	[0.001,0.004]	***
Household income	0.001	[–0.02,0.021]		0.019	[0.001,0.037]	**
Precipitation	>–0.001	[>–0.001,>–0.001]	**	>–0.001	[>–0.001,<0.001]	
Minimum Temperature	–0.003	[–0.005,–0.002]	***	<0.001	[–0.001,0.001]	
Observations	394			3,249		
R^2	0.53			0.31		

Notes: The dependent variable in the above model is the natural log of the per-acre land value or sales price. All models also include region and year dummy variables. Standard errors are robust to correlation at the county level. The bracketed values represent the 95% confidence interval of the coefficient estimate. The asterisks denote significance at the 10% (*), 5% (**), and 1% (***) levels. An estimate or confidence interval limit denoted as "<0.001" signifies a positive value in the (0,0.001) interval. An estimate or confidence interval limit denoted as ">-0.001" signifies a negative value in the (-0.001,0) interval.

Table 4: Results in above-median sales counties

	JAS segments in above-median sales counties			NY Sales		
	Estimate	C.I.		Estimate	C.I.	
Population interaction index	0.013	[>–0.001,0.025]	*	>–0.001	[–0.005,0.004]	
Travel time to small town	–0.025	[–0.799,0.750]		–0.07	[–0.598,0.457]	
Travel time to urban area	–0.364	[–0.629,–0.098]	***	–0.352	[–0.498,–0.207]	***
Distance to recreational water	–0.020	[–0.035,–0.004]	**	–0.015	[–0.027,–0.004]	**
Distance to railroad	0.003	[–0.044,0.050]		0.007	[–0.012,0.026]	
Distance to highway ramp	–0.014	[–0.026,–0.001]	**	0.011	[0.003,0.019]	***
Distance to park	–0.001	[–0.018,0.015]		0.018	[0.003,0.033]	
Distance to golf course	–0.044	[–0.082,–0.007]	**	–0.02	[–0.037,–0.003]	**
Distance to college	0.006	[–0.015,0.026]		0.001	[–0.008,0.011]	
Distance to hospital	0.001	[–0.014,0.017]		–0.002	[–0.017,0.013]	
Percent high-quality soil	0.010	[0.004,0.017]	***	0.005	[0.004,0.007]	***
Percent medium-quality soil	0.008	[<0.001,0.016]	**	0.002	[0.001,0.004]	***
Household income	0.043	[0.008,0.079]	**	0.019	[0.001,0.037]	**
Precipitation	–0.001	[-0.001,>–0.001]	***	>–0.001	[>–0.001,<0.001]	
Minimum Temperature	–0.003	[–0.006,–0.001]	***	<0.001	[–0.001,0.001]	
Observations		251			3,249	
R^2		0.52			0.31	

Notes: The dependent variable in the above model is the natural log of the per-acre land value or sales price. All models also include region and year dummy variables. Standard errors are robust to correlation at the county level. The bracketed values represent the 95% confidence interval of the coefficient estimate. The asterisks denote significance at the 10% (*), 5% (**), and 1% (***) levels. An estimate or confidence interval limit denoted as "<0.001" signifies a positive value in the (0,0.001) interval. An estimate or confidence interval limit denoted as ">-0.001" signifies a negative value in the (-0.001,0) interval.

Table 5: Results with and without development potential

	JAS segments with development potential			JAS segments without development potential			NY Sales		
	Estimate	C.I.		Estimate	C.I.		Estimate	C.I.	
Population interaction index	0.014	[–0.016,0.043]		0.015	[0.004,0.025]	***	>–0.001	[–0.005,0.004]	
Travel time to small town	–2.062	[–3.535,–0.588]	***	0.293	[–0.401,0.986]		–0.070	[–0.598,0.457]	
Travel time to urban area	–0.077	[–1.176,–0.356]	***	-0.259	[–0.437,–0.080]	***	-0.352	[–0.498,–0.207]	***
Distance to recreational water	–0.045	[–0.080,–0.010]	**	-0.017	[–0.033,–0.001]	**	–0.015	[–0.027,–0.004]	**
Distance to railroad	0.050	[–0.076,0.177]		-0.022	[–0.062,0.018]		0.007	[–0.012,0.026]	
Distance to highway ramp	–0.004	[–0.031,0.023]		-0.001	[–0.012,0.010]		0.011	[0.003,0.019]	***
Distance to park	–0.023	[–0.103,0.057]		0.004	[–0.015,0.023]		0.018	[0.003,0.033]	
Distance to golf course	0.059	[–0.004,0.121]	*	-0.049	[–0.085,–0.014]	***	–0.020	[–0.037,–0.003]	**
Distance to college	–0.050	[–0.100,<0.001]	*	0.005	[–0.015,0.024]		0.001	[–0.008,0.011]	
Distance to hospital	0.026	[–0.024,0.076]		0.002	[–0.016,0.020]		–0.002	[–0.017,0.013]	
Percent high-quality soil	>–0.001	[–0.013,0.013]		0.007	[0.002,0.012]	***	0.005	[0.004,0.007]	***
Percent medium-quality soil	0.002	[–0.007,0.011]		0.002	[–0.002,0.006]		0.002	[0.001,0.004]	***
Household income	0.018	[–0.022,0.058]		0.001	[–0.023,0.025]		0.019	[0.001,0.037]	**
Precipitation	>–0.001	[–0.001,<0.001]		>–0.001	[–0.001,>—.001]	***	>–0.001	[>–0.001,<0.001]	
Minimum Temperature	<0.001	[–0.005,0.005]		-0.003	[–0.005,–0.002]	***	<0.001	[–0.001,0.001]	

Notes: The dependent variable in the above model is the natural log of the per-acre land value or sales price. All models also include region and year dummy variables. Standard errors are robust to correlation at the county level. The bracketed values represent the 95% confidence interval of the coefficient estimate. The asterisks denote significance at the 10% (*), 5% (**), and 1% (***) levels. An estimate or confidence interval limit denoted as "<0.001" signifies a positive value in the (0,0.001) interval. An estimate or confidence interval limit denoted as ">-0.001" signifies a negative value in the (-0.001,0) interval.

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