Data on the Farm: Data Valuation and Proving Damages

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Abstract
The valuation of farm data has been an emergent topic in agricultural economics. Previous work focused on proving damages in the hypothetical event that farm data were misappropriated, although no estimation could be found when data were destroyed or otherwise unavailable to the farmer. Based on first hand experiences, the estimation of direct, consequential, and speculative damages of lost farm data are described.

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Introduction

The valuation of farm data has been an emergent topic. Previous work has addressed how damages could be proven in the event that farm data were misappropriated (i.e. when farm data were disclosed such that it was used in a manner not consistent with agreements although the farmer still had complete access to the data)[1],[2]. Here, a description of the value of that data were estimated to the specific farmer is offered.

Description of Farm Data Loss Scenario

The facts of the case were that the yield monitor on the combine harvester was destroyed while the combine was being serviced by a service provider. The service provider admitted fault and agreed to replace the yield monitor; however, the service provider was not willing to compensate the farmer for the data. The farmer believed that the data did have substantial value and had intended to use that data in their farm management decision-making process. Therefore, the farmer argued that the service provider should compensate the farmer for the lost data. The farmer has a history of using yield monitor data for farm management decision making including on-farm experiments that tested products and rates of inputs under their management practices under environmental conditions of their fields. The farmer desired to determine the value of the lost farm data in anticipation of building a case against the service provider.

Background on Precision Agriculture and Farm Data

To reiterate the importance that farmers place on their data, farmers' willingness-to-pay for data sensors and collection tools (commonly referred to as precision agriculture) indicate farmers readily invest their financial resources and, more importantly, their human capital in this technology. The substantial amounts of time and money invested to collect and store site-specific data indicate farmers at least perceive value in the data collected for farm management decision making purposes. Substantial proportions of farmers[3] and even higher percentages of farmland are being harvested with combines equipped with yield monitors capable of collecting site-specific data.[4] In addition to direct investments in sensors and data management services,

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[1] A. Ellixson and T.W. Griffin, *Farm Data: Ownership and Protections* (September 16, 2016). Social Science Research Network, *available at* http://ssrn.com/abstract=2839811 (last visited October 1, 2016).

[2] T.W. Griffin, *Value of Farm Data: Proving Damages Based on Trade Secret Protections* (2016). Kansas State University Department of Agricultural Economics Ag Manager blog post, http://www.agmanager.info/crops/prodecon/precision/Damages.pdf (last visited October 1, 2016).

[3] T.W. Griffin, *Adoption of Precision Agricultural Technology in Kansas* (2016). KFMA Research Article KSU-AgEcon-TG--2016, *available at* http://www.agmanager.info/KFMA/Newsletters/Research/PrecisionAgAdoption.pdf (last visited October 1, 2016).

[4] D. Schimmelpfenning and R. Ebel, *On the Doorstep of the Information Age: Recent Adoption of Precision Agriculture*, USDA Economic Information Bulletin No. EIB-80 (August, 2011), *available at* http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib80.aspx (last visited October 1, 2016).

investments in human capital are substantial.[5] Further, it has been documented that yield monitors are used to empower farmers to conduct their own on-farm experiments[6].

Estimating Damages

Direct, consequential, and speculative damages will be discussed with respect to this case. Consequential damages, otherwise known as special damages, are "damages that can be proven to have occurred due to the failure of one party to meet a contractual obligation (goes beyond the contract itself and into the actions garnished from the failure to fulfill)". Speculative damages are "damages claimed by a plaintiff for losses that may occur in the future, but are highly improbable."

Direct damages regarding hardware and equipment are mentioned before discussing loss of data. Consequential and speculative damages resulting from foregone revenue from lost data are considered. Speculative damages will be discussed with respect to 1) foregone opportunity to participate in 'big data' communities, 2) the increased risk of damaging field equipment, 3) inability to negotiate with landowners, and 4) lack of information to base improved drainage structures are described.

Estimating Expectation Damages

Expectation damages ("compensation awarded for the loss of what a person reasonably anticipated from a transaction that was not completed"[7] – in this context most likely arising from the covenants created by the warranty clauses of the equipment sales contract) were easier to estimate than consequential damages. In most cases of clear negligence little effort may be needed for the other party to agree to pay for damaged equipment and hardware, and software if on the computer. Given that the direct damages of the physical components were not contested, the service provider replaced the yield monitor with a similar device. The remaining two types of damages, consequential and speculative, are examined next.

Estimating Incidental Damages

The analysis of incidental damages ("losses reasonably associated with or related to actual damages"[8]) were conducted in into two stages. The first stage calculates the foregone investment of implementing the on-farm experiment including the 1) differences in cost of the products being tested relative to the status quo product, 2) yield penalties from delayed planting[9], and 3) miscellaneous supplies such as consultants, flags, and measuring tapes of conducting the

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[5] T.W. Griffin, T.B. Mark, C.L. Dobbins, and J. Lowenberg-DeBoer, *Estimating Whole Farm Costs of Conducting On-farm Research: A Linear Programming Approach*. 4(1) INTERNATIONAL JOURNAL OF AGRICULTURAL MANAGEMENT 21-27 (2014).

[6] T.W. Griffin, *Farmers' Use of Yield Monitors* (2009). University of Arkansas Division of Agriculture publication FSA36, *available at* http://www.uaex.edu/publications/pdf/FSA-36.pdf (last visited October 1, 2016).

[7] BLACK'S LEGAL DICTIONARY, 7th ed. (1999).

[8] BLACK'S LEGAL DICTIONARY, *supra* note 7.

[9] Griffin, *supra* note 5.

experiment. The second alternative builds upon the first alternative by estimating the foregone revenue stream. This foregone stream was based on making a better decision such as choosing a superior product relative to the status quo. This second alternative is further described below.

Stage 1 Methodology
Partial enterprise budgets were created for each treatment from the on-farm experiment in addition to the status quo farmer practices for producing the crop. These budgets listed the products and/or rates of products applied to the field. Comparisons to the status quo farmer practice were made to determine the amount of investment in products above what the farmer would normally have applied.

Stage 2 Net Present Value Methodology
The current value of the discounted stream of income that would have been realized if the data had not been destroyed was estimated by standard net present value (NPV) procedures.[10] Two scenarios were evaluated. The first scenario evaluated the revenue stream if the data were available. The second scenario evaluated the revenue stream for when farm data were unavailable to the decision making process. The difference in the two NPV scenarios is the forgone revenue and can be thought of as the cost of making the wrong decision.

To set the precedent of historical use of data in farm management decision-making, the value of completed on-farm experiments from the last several years were estimated. A series of NPV analyses were conducted on several recent experiments to demonstrate a history and value of utilizing yield monitor data from on-farm experiments. This indicated that the farmer 1) had a history of using yield monitor data for farm management purposes and 2) that the data had a substantial value to the farmer's overall net farm income. For the on farm experiments that yield data were not available, the cost of conducting the research[11] were calculated then a reasonable expected yearly revenue stream were estimated for the net present value analysis.

One of the first decisions to be made is how many years that the results will be usable for the farm. Discussions with the farmer revealed how many years that the results from previous on-farm experiments typically were used. As a guideline, corn hybrid results are usable for only 1 or maybe 2 years given the relatively short market life of corn genetics. Other input products such as herbicides, fungicides, and insecticides have a longer market life than corn hybrids. Results may be usable for 1 to potentially 10 or more years. For fertilizer rates, the results may be useful for several additional years since the products typically do not have a defined market life. Regardless, on-farm research results have a finite lifespan such that the value of data diminishes over time. The results from on-farm research may also be limited in time due to results becoming common knowledge to farmers once public research results are released and/or neighboring farmers providing anecdotal insights. Therefore, the revenue stream may be reduced to fewer years than even the market life of the product.

[10] P.J. Barry and P.N. Ellinger, Financial Management in Agriculture (7th ed. 2015).
[11] Griffin, *supra* note 5.

A key component of the benefit-cost analysis for the expert witness is to compare the 'best' decision from an on-farm experiment relative to the status quo practice, not the worst case practice scenario. As an extreme example, a corn hybrid that had an expected yield of 175 bushels per acre (bu per ac) should be compared against the most likely hybrid choice (say 170 bu per ac) and not the option of no seeds (i.e. 0 bu per acre). So the net benefit for a given year would be the price of corn times yield difference (175 bu minus 170 bu = 5 bu) minus difference in seed costs. A more relevant example may be testing two fungicides against no fungicide at all, *i.e.* the untreated control treatment, where Fungicide A resulted in 15 bu per acre more than the control of no fungicide and Fungicide B resulted in 12 bu per acre more than the control. The expert witness would not use a difference of 15 bu per ac but rather a difference of 3 bu per ac (15 bu – 12 bu = 3 bu per ac). Economists refer to these calculations as partial budget analysis. One of the leading debates in forensic economics literature is the choice of discount rate used in the net present value analysis. Given that the pertinent farm data examples are shorter time periods relative to the class human lifespan examples, the chosen discount rate has relatively less importance to the outcome of the analyses. That being said, some farm data plaintiffs may prefer higher discount rates and others prefer smaller discount rates depending upon the length of the discounted revenues and relative size of annual returns.

Although there is substantial variability in commodity crop prices over time, a constant price may be used for all years of the analysis. To simplify analysis and output, a long-run planning price for each crop[12] was chosen for all analyses. An alternative was to assign two or three planning prices (low, expected, high) and perform the analysis at three different levels of commodity crop prices. This provides the decision maker with a set of analysis to choose from and is common practice in benefit-cost analyses. Consequential damages were estimated using the process described. In the next section, speculative damages are described with respect to this scenario.

Estimating Consequential Damages

Beyond expectation and incidental damages, the potential consequential damages ("losses that do not flow directly and immediately from an injurious act, but that result directly from the act"[13]) of a loss of agricultural data poses a number of challenges, but the connection of those damages to the loss of data are nevertheless real. Here, damages are presented with respect to 1) foregone opportunity to participate in 'big data' communities, 2) the increased risk of damaging field equipment, 3) inability to negotiate with landowners, and 4) lack of information to base improved drainage structures.

[12] Griffin, *supra* note 5.

[13] BLACK'S LEGAL DICTIONARY, *supra* note7.

Consequential damages #1: big data systems

Farm data has an inherent value in "big data" systems; and the loss of data reduced the value of the farm's database for participation these systems.[14] Even moderate sized farms have substantial value of data; or several thousand dollars in damages from inability to participate in community analytics.

Consequential damages #2: risk to field equipment

The yield monitor was used to flag large stones and foundation pieces that need to be removed from the field to prevent equipment damage. Given that the stones and foundation pieces are not going to move on their own, there is opportunity to locate these in upcoming seasons; however there is increased risk that combine heads, planters, and tillage equipment may be damaged prior to removal. Farmers paid $14.30 per acre on average for rocks to be picked out of their fields;[15] therefore we can assume that farmers value this service at least $14.30 or higher per acre in perpetuity. By applying this per acre value to all acres of the farm gives a conservative estimate of any repair costs from equipment damages and an adequate risk adjusted value. Even on small areas of 100 acres, damages of $1,430 are reasonable ($14.30 per ac x 100 acres = $1,430). However the $14.30 per acre expense has expectation that the rocks were removed in perpetuity and therefore the value accumulates over time such that the entire $14.30 per acre was not enjoyed in the first year. Therefore the value must be discounted.

Consequential damages #3: leasing arrangements with landowners

Some landowners expect scale tickets to prove yield in crop share agreements while other landowners rely upon yield monitor data or maps for proving yield and negotiating future rental rates or improvements. For flex-cash and flexing based on yield, the yield monitor has become a standard source of yield data for calculating current rents and negotiating future rental arrangements.[16] Irreparable harm may result in the relationship between the farmer and landowners that could impact the farm acreage structure. A 3,000 acre farm typically leases half of the total farmland; and even a loss of 500 acres forces the farm to a 2,500 acre farm in a market fiercely competing for farmland. The 2,500 acre may now be over-equipped and not able to support the fixed costs of current equipment complement; therefore now at financial risk.

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[14] T.W. Griffin, T.B. Mark, S. Ferrell, T. Janzen, G. Ibendahl, J.D. Bennett, J.L. Maurer, and A. Shanoyan. *Big Data Considerations for Rural Property Professionals*. JOURNAL OF AMERICAN SOCIETY OF FARM MANAGERS AND RURAL APPRAISERS 2016:167-180, *available at* http://www.asfmra.org/wp-content/uploads/2016/06/441-Griffin.pdf (last visited October 1, 2016).

[15] A. Johanns and W. Edwards, *Iowa farm Custom Rate Survey* (2014), Ag Decision Maker File A3-10 FM 1698, *available at* http://sauk.uwex.edu/files/2014/04/Iowa-Custom-Rate.pdf (last visited October 1, 2016).

[16] T.W. Griffin, *Farmers' Use of Yield Monitors* (2009). University of Arkansas Division of Agriculture publication FSA36, *available at* http://www.uaex.edu/publications/pdf/FSA-36.pdf (last visited October 1, 2016).

Consequential damages #4: drainage improvements

Yield monitor data are used to calculate yield loss due to unimproved drainage.[17] Without adequate data, improved drainage structures were not installed in proper locations for at least another year. Yield losses were estimated for one year by comparing yields from with and without improved drainage structures. This is especially important when negotiating with landowners in their decision to make drainage improvements.

Limitations of these analyses

It can be argued that if the farmer valued the data on the yield monitor, they would have downloaded the data prior to the combine being serviced or at the very least downloaded data periodically such as weekly or after each on-farm experiment were harvested. This argument provides credence to the recommendation of downloading data frequently and to make redundant backup copies. If data from several on-farm experiments only existed on the yield monitor, the interpretation could be the farmer placed relatively low value on that data. Similar arguments can be made for other types of precision agricultural data. Newer technology that wirelessly transmits data to the cloud alleviates some of this concern and could indicate the farmer placing more value on the data if they actively pay for telematics services that securely transfer and archive data.

One area of analysis omitted here is the value foregone from lost data for other entities besides the farmer. Seed company representatives may have been relying upon that data as part of a larger on-farm research program. Local retailers often rely upon farm-level data to populate their data systems for community analysis; and would be at some level of disadvantage especially early on in the lifecycle of their system. Landowners often expect yield monitor data as part of their indication of yields and some use it to reminisce from nostalgic purposes or use as conversation piece with their friends.

Summary

Farm data has a value to farmers (and others), although specific values have not been estimated that can globally be applied across farming operations. Estimating consequential and speculative damages from foregone data is one of the first steps in valuation of farm data. The value of data lies in how that data are converted to information suitable for farm management decision making. Using yield monitor data and other spatial technologies to conduct on-farm research has been a leading example of monetizing data. In this specific case the greatest value estimated was from consequential damages while speculative damages were the most difficult to estimate. In the near future it is expected that the value of farm data will increase if that data are combined across farms into a community, *i.e.* big data.

Moving forward, a few things to keep in mind are:

1) Download data and make redundant backups on a regular basis. This should be done more frequently than once a growing season and may be done on a weekly or even daily

[17] Griffin, *supra* note 16.

basis. With modern telematics, yield and other data may be downloaded (or uploaded to the cloud) as fields are harvested.

2) Make use of farm data on yearly basis so that a continued utilization has occurred.
3) Backup copies of data are encouraged; however, using third parties (landowners, retailers, or other providers) as backup may adversely impact assertions the producer was actively seeking to keep the data confidential and thus undermine potential trade secret claims later.
4) Rather than data being destroyed, the more relevant issue may be of farm data being misappropriated and disclosed to others