OVER THE past 18 months, many prices have been on the rise. The general economy is facing its first significant bout with inflation in roughly 20 years. Agricultural commodity prices are high, with crop prices doubling over the time frame. While agricultural producers have enjoyed increased revenues with the boosted prices, they are now also facing increasing costs as the prices for agricultural inputs rise—agricultural land values (and cash rents) have soared and herbicide and pesticide costs have increased. However, the agricultural input with the most dramatic price rise has been fertilizer. US agriculture relies on a strong base of row crop production, with corn being the leading crop. To produce the high yields required to match global demand for corn, US corn production is highly dependent on fertilizer, including nitrogen, which is an essential nutrient for growing corn.

Recently, anhydrous ammonia prices increased substantially, from $290 per ton in June 2020 to $1,350–$1,375 per ton in January 2022.

What is happening to the US and global fertilizer markets?

In 2021, several factors disrupted the US supply chain of fertilizer production in the short run, including extremely cold weather in Texas, Hurricane Ida, and the COVID-19 pandemic. The natural disasters in the southern part of the country paused the majority of fertilizer production as 56% of ammonia production capacity is located in Texas, Louisiana, and Oklahoma.\(^1\) The extreme weather not only directly impacted fertilizer production, but it also disrupted natural gas production, the major feedstock for nitrogen fertilizers. The limited natural gas production spiked natural gas prices from $2.71 per 1,000 cubic feet in June 2020 to $9.33 in February 2021 (USEIA 2022). Natural gas prices remained above $4 per 1,000 cubic feet throughout 2021. In addition, because the COVID-19 pandemic delayed plant maintenance, resulting in slower production, the supply problem worsened (AFBF 2021). Table 1 outlines the latest fertilizer supply and demand estimates from the US Geological Survey (USGS), along with recent trade data on fertilizers.

Under normal conditions, imports would easily substitute for the shortage in domestic fertilizer supply. However, fertilizer production in other countries was also disrupted. Towards the end of 2021, world natural gas prices, especially in the EU and China, increased rapidly due to low inventories, high demand, and supply disruptions. EU natural gas futures substantially increased from about €19.82 per megawatt-hour (~$4.75 per 1,000 cubic feet) at the beginning of 2021 to a peak at €180.27 per megawatt-hour (~$46.75 per 1,000 cubic feet) on December 21, 2021. Although the situation has improved due to an increase in supply from Russia and a mild winter, EU natural gas prices remain as high as €81.91 (~$27.25 per 1,000 cubic feet) in February 2022. The fallout from the Ukraine-Russia conflict is likely to support high natural gas prices for some time.

As a result of high natural gas prices, some fertilizer plants in Europe temporarily halted or reduced their production from September to November 2021. Imports from other countries such as Trinidad and Tobago, the United States, and Australia replaced European production. Tight global supplies led to higher world fertilizer prices. In addition, China banned exports of urea and phosphate for domestic use until June 2022, Russia began its six-month quota on various fertilizer exports last December, and Belarus faces economic sanctions. These last three items are important as China, Russia, and Belarus are global leaders in fertilizer exports. While the United States has not traditionally sourced fertilizer from those markets, the lack of Chinese, Russian, and Belarusian supplies on the global market has forced countries that do rely on those supplies (mainly in Europe and South America) to search for alternative sources, including the countries from which the United States purchases.

**Potential long-run factors**

The expectation was that fertilizer prices would decline in the second half of 2022 as producers would be able to gear up production. However, several factors could prevent fertilizer prices from going back to the mid-2020 level, including natural gas pricing/supply, shifts in trade policy, increased acreage demand by farmers, and concerns about market power in the fertilizer industry.

Despite earlier declines in EU gas prices, high natural gas prices in Europe will likely persist due to the conflict between Russia and Ukraine and climate change regulation. The EU household and industrial sectors use natural gas to generate electricity, heat, and power. Additionally, the EU has become highly dependent on Russian gas as 44% of EU gas imports in 2020 were from Russia. Within the past few months, Europe has relied more on US exports of liquefied natural gas, putting pressure on the US market. Meanwhile, natural gas has been seen as a greener source of energy than coal and oil. As climate regulation becomes stricter, higher carbon prices could raise demand for natural gas, causing higher global natural gas prices in the future.

On the trade front, domestic manufacturers can and have requested tariffs on fertilizer imports to reduce what is seen as unfair foreign competition. The previous anti-dumping duties on ammonium nitrate and urea imports from Russia

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**Table 1. US Fertilizer Data**

<table>
<thead>
<tr>
<th></th>
<th>Ammonia</th>
<th>Phosphate Rock</th>
<th>Potash</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2021 Estimates</strong></td>
<td>1,000 metric tons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US Production</td>
<td>14,000</td>
<td>22,000</td>
<td>480</td>
</tr>
<tr>
<td>Imports</td>
<td>2,200</td>
<td>2,400</td>
<td>7,000</td>
</tr>
<tr>
<td>Exports</td>
<td>260</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Apparent Consumption</td>
<td>16,000</td>
<td>25,000</td>
<td>7,400</td>
</tr>
<tr>
<td>Stocks</td>
<td>360</td>
<td>10,000</td>
<td></td>
</tr>
</tbody>
</table>

**US Import Sources (2017–2020)**

<table>
<thead>
<tr>
<th></th>
<th>Trinidad and Tobago</th>
<th>Peru</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>63%</td>
<td>87%</td>
<td>75%</td>
</tr>
<tr>
<td>Canada</td>
<td>34%</td>
<td>Morocco</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Russia</td>
<td>10%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>2%</td>
<td>Belarus</td>
<td>8%</td>
</tr>
<tr>
<td>ROW</td>
<td>1%</td>
<td>ROW</td>
<td>7%</td>
</tr>
</tbody>
</table>


**Table 2. 2021 World Fertilizer Production (1,000 Metric Tons)**

<table>
<thead>
<tr>
<th></th>
<th>Ammonia</th>
<th>Phosphate Rock</th>
<th>Potash</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>39,000</td>
<td>85,000</td>
<td>Canada</td>
</tr>
<tr>
<td>Russia</td>
<td>16,000</td>
<td>38,000</td>
<td>Russia</td>
</tr>
<tr>
<td>US</td>
<td>14,000</td>
<td>22,000</td>
<td>Belarus</td>
</tr>
<tr>
<td>India</td>
<td>12,000</td>
<td>14,000</td>
<td>China</td>
</tr>
<tr>
<td>Indonesia</td>
<td>5,900</td>
<td>9,200</td>
<td>Israel</td>
</tr>
<tr>
<td>ROW</td>
<td>63,100</td>
<td>51,800</td>
<td>ROW</td>
</tr>
</tbody>
</table>

were lifted in 2016; however, the US International Trade Commission imposed tariffs on phosphate imports from Russia and Morocco in March 2021 as petitioned by Mosaic. Meanwhile, CF Industries has filed a complaint on UAN imports from Russia and Trinidad and Tobago. If the anti-dumping and countervailing duty on these imports is implemented, they are set to last for at least five years and add an extra cost of $12.78 per acre (Bergmeier 2022). The UAN tariffs could be imposed following the preliminary results from the US Department of Commerce’s report on the market price of fertilizer imports from Russia and Trinidad and Tobago.

High crop prices could also spur farmers into increasing acreages and/or farming their acreages more intensively. Smith (2022, p. 4) finds this a “plausible factor behind rising fertilizer prices.” If fertilizer companies are responding to perceived increases in demand, the increased prices seen today could be reflecting an expectation of demand tomorrow.

The potential for market power in the US and global fertilizer industry has been mentioned in previous research articles (Hernandez and Torero 2013; Li 2016; Bushnell and Humber 2017; Bekkerman, Brester, and Ripplinger 2020). After shale gas development in the United States, low natural gas prices led to an expansion in domestic fertilizer production. Even though new firms could enter the market, existing firms also expanded their production capacity, resulting in increased market concentration (Bekkerman, Brester, and Ripplinger 2020). There have also been a couple of high-profile mergers within the industry; and, by 2019, the four largest firms in the United States accounted for 72% of ammonia production capacity (USGS 2021). The challenge in testing for market power currently is that, as described above, there are several confounding factors presently influencing fertilizer pricing, including supply chain disruptions and trade policy, which would impact the results from and the conclusions made from market power models.

An estimating issue with many of the commonly used techniques, referred to as New Empirical Industrial Organization (NEIO) models, is that a firm’s marginal cost must be statistically estimated, based on the underlying data, in order for the models to determine market power. Such parameterizations are akin to averages over the data sample and, hence, measured with error. During the last few years, because of many of the issues discussed here, it is not clear what an “average” marginal cost would be. Hence, NEIO models are quite likely to impose some sort of normality on the last few years as if they were the same as previous years. This does not mean researchers cannot perform such an analysis, but they must be very careful in the estimations and conclusions drawn from such models. Economists are always skittish to ascribe too much by simply looking at firm profitability because reported accounting profits are not identical to the profits economists seek when measuring market power and because profitability can arise in concentrated industries for a variety of reasons. Nonetheless, because stock prices and returns are commonly discussed in the popular press, table 3 presents some returns for comparison.

Table 3 shows that returns as measured by comparing 2018 and 2019 to the pandemic years of 2020

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Table 3. Comparison of Average Returns, 2018/19 and 2020/21

<table>
<thead>
<tr>
<th>Fertilizer Industry</th>
<th>Net Income Chg</th>
<th>Stock Price Chg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF Industries (CF)</td>
<td>45%</td>
<td>25%</td>
</tr>
<tr>
<td>Nutrien (NTR)</td>
<td>-23%</td>
<td>35%</td>
</tr>
<tr>
<td>Mosaic (MOS)</td>
<td>89%</td>
<td>22%</td>
</tr>
<tr>
<td>Yara Intl (YAR.OL)</td>
<td>60%</td>
<td>29%</td>
</tr>
<tr>
<td>Bunge (BG)</td>
<td>184%</td>
<td>43%</td>
</tr>
<tr>
<td>Other Ag Industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archer Daniels Midland (ADM)</td>
<td>34%</td>
<td>36%</td>
</tr>
<tr>
<td>Hormel (HRL)</td>
<td>-9%</td>
<td>13%</td>
</tr>
<tr>
<td>Tyson (TSN)</td>
<td>3%</td>
<td>10%</td>
</tr>
<tr>
<td>Other Large Cap Firms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WalMart (WMT)</td>
<td>23%</td>
<td>34%</td>
</tr>
<tr>
<td>Amazon (AMZN)</td>
<td>93%</td>
<td>68%</td>
</tr>
<tr>
<td>Market Index S&amp;P 500 Index</td>
<td>na</td>
<td>40%</td>
</tr>
<tr>
<td>Average Iowa Farm</td>
<td>Net Income Chg</td>
<td>Stock Price Chg</td>
</tr>
<tr>
<td></td>
<td>66%</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>Chg</td>
<td>Chg</td>
</tr>
<tr>
<td></td>
<td>Land Price per Acre Chg</td>
<td></td>
</tr>
</tbody>
</table>

Notes: “na”=not applicable. Net income for publicly traded firms is from continuing operations on last statement reported each year. Yara Intl. has not yet reported 2021 income. Mosaic and Bunge net income for 2018/19 is based on 2018 due to negative net income for both firms in 2019. Net income, stock prices, and the S&P 500 Index come from Yahoo! Finance and are the end-of-December reported values adjusted for splits and dividends. Iowa Farm Net Income is from ISU Extension with an estimate of 10% increase in 2021 over 2020 based on discussion with extension economists (https://www.extension.iastate.edu/agdm/wholefarm/pdf/c2-10.pdf). Land price changes are estimated from the ISU Land Value Survey (https://www.extension.iastate.edu/agdm/wholefarm/pdf/c2-70.pdf).
Utility-scale Wind and Solar Development in Iowa: Trends, Prospects, and the Land Factor

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In 2020, Iowa ranked first in the United States for percentage of state electricity produced by wind energy, which supplied 57% of the state’s net electricity generation (IUB 2022). Conversely, in 2020, solar energy had a limited role in Iowa’s electricity generation, supplying less than 0.04% of the state’s net electricity generation (IUB 2022), which ranked 43rd in the United States.

In this article, we investigate the stark development and generation disparities between wind and solar energy in Iowa. We focus on utility-scale power plants only, meaning that compiled data applies to power plants that have a relatively large nameplate capacity (one megawatt (MW) is often used as a cut-off value).

Historical wind and solar photovoltaic development
Understanding the development of utility-scale wind and solar energy is pivotal since utility-scale wind and solar power plants accounted for 95.5% of Iowa’s wind and solar power plants under operation as of November 2021, and the continued growth in wind and solar energy in Iowa will rely on more utility-scale wind and solar deployment.

Wind electricity generating capacity in Iowa has flourished since its first operable utility-scale wind power plant emerged in 1998 (figure 1). As of November 2021, Iowa operates 141 utility-scale wind power plants that possess a nameplate capacity of 11,656 MW. The first operable utility-scale solar photovoltaic power plant in Iowa was established in 2016 (USEIA 2021). Between 2016 and November 2021, nine utility-scale solar photovoltaic power plants came into operation and aggregated a total nameplate capacity of 118 MW.

Wind and solar projects on the pipeline
According to the US Energy Information Administration’s “Inventory of Planned Generators 2021,” there are seven utility-scale wind power plants and six solar photovoltaic power plants on the pipeline at various stages of preparation from 2021 to 2030. These projects aggregate a total nameplate capacity of 995.8 MW, with 853.9 MW from utility-scale wind projects and 141.9 MW from utility-scale solar photovoltaic projects. Specifically, one wind project (55.4 MW) has completed construction but is not yet in commercial operation, two wind projects (200 MW and 80 MW) and one solar project (100 MW) are under construction that are less than or equal to 50% complete, three wind projects (7.9 MW, 202.7 MW, and 7.9 MW) and five solar projects (25 MW, 3 MW, 3 MW, 7.9 MW, and 3.9 MW) have completed more than 50% of construction, and one wind project is still pending for regulatory approval. Figure 2 shows the location and capacity of the planned utility-scale wind and solar projects, which shows a similar pattern between geographical locations and resource potentials (figures 4 and 5) compared with the current spatial distribution of utility-scale wind and solar projects.
Financial incentives and regulatory policies

Different factors contribute to the development and disparities between wind and solar energy. Government intervention related to financial incentives and regulatory policies is a critical factor that guides investment into certain renewable energy technologies. Financial incentives and regulatory policies vary between wind and solar energy in Iowa. Based on the Database of State Incentives for Renewables Efficiency (DSIRE), as of 2019, there were 25 federal and state wind programs and 30 solar programs. According to DSIRE’s categorization, financial incentives constitute 72% and 76% of total wind and solar programs, respectively, and regulatory policies constitute 28% and 24% of total wind and solar programs, respectively. Note that the number of policies does not represent the degree of support.

Government policies that aim to reduce barriers to entry heavily influence the development of energy, which is especially true for wind and solar. These policies include the Renewables Portfolio Standard (RPS), loan programs, grid-connection-like programs, net metering and interconnected standards, and tax-related credits and exemptions. On the one hand, as a technology-neutral renewable energy policy, RPS tends to favor wind energy because of its cost-advantage over solar power (Wiser, Barbose, and Holt 2011). On the other hand, Iowa does not have a specific solar carve-out embedded in the RPS design that could provide additional support for solar energy deployment. Iowa chose wind energy to satisfy its renewable mandate in 1983, and wind energy development has dominated solar energy development since then.

National renewable energy policies play critical roles in influencing the development rates of both wind and solar energy. Research shows that the federal Production Tax Credit (PTC) and Investment Tax Credit (ITC) have significantly increased the development of renewable energy (Lu et al. 2011; Dwivedi 2018), as spikes in development for both sources around the introduction and expiration of each credit promoted credit renewals. However, wind received more support than solar because solar energy is

continued on page 16
Consumers and investors are putting increased pressure on corporations, governments, and other entities to reduce their environmental footprint. A recent article in *Applied Economics Perspectives and Policy* by Wongpiyabovorn, Plastina, and Crespi (2022) examines this issue. An increasing number of companies and governments are pledging to become carbon neutral or carbon negative over the next few decades. Until the technologies to achieve those goals become available at reasonable costs, a pathway to reducing overall greenhouse gas (GHG) emissions in the production, transportation, consumption, and disposal of goods and services is to purchase carbon credits in the voluntary market and use them to offset emissions.

For the buyer, carbon credits are tradeable certificates that represent the right to emit one metric ton of carbon dioxide-equivalent (CO2e). All GHG emissions can be converted into CO2e units, according to their global warming potential over a certain period. For example, nitrous oxide has a global warming potential equivalent to 265–298 times the global warming potential of carbon dioxide over 100 years (USEPA 2021).

For the producer, it represents a claim that they have “permanently” removed one metric ton of CO2e from the atmosphere, or they have avoided the same amount of CO2e emissions. The concept of permanence varies across credit suppliers (Plastina and Wongpiyabovorn 2021). Forestry has been the leading industry in generating carbon credits worldwide, followed by renewable energy (World Bank 2020). Agriculture supplies less than one percent of all carbon credits issued around the world (FTEM 2021). However, agricultural carbon credits have received plenty of attention recently, as they are considered a supplemental tool to increase the adoption of conservation practices.

A voluntary market for agricultural carbon credits is in its formative stage in the United States, characterized by a growing number of carbon initiatives testing multiple pilot programs pushing their own standards, and living off venture capital and angel investors. A report by the National Academy of Sciences, Engineering, and Medicine (2019) concludes that agriculture has a larger potential than forestry in the United States to generate carbon credits, but only if carbon prices in the voluntary market reach $100 per credit (figure 1).

Price discovery in voluntary carbon markets is not transparent, mostly because a clear definition of the standard characteristics attached to a carbon credit is not available. However, some futures contracts (currently traded with very low open interest) exist to hedge prices of very narrow definitions of carbon credits (Wongpiyabovorn, Plastina, and Lence 2021).

Two important variables that are likely to shape the development of the nascent agricultural carbon market are transaction costs and demand source for carbon credits. Transaction costs, such as transaction fees charged by carbon programs to issue and market carbon credits, or the extra time and effort that farmers will need to devote to reporting activities under the carbon program, will reduce the net value received by the farmer from a given market price. The fewer and more streamlined reporting requirements are, and the more efficient the issuance and marketing of carbon credits are, the larger is the expected share of the market price received by farmers.

The source of demand for agricultural carbon credits is not usually discussed among the challenges faced by this incipient market. However, as highlighted by Wongpiyabovorn, Plastina, and...
Crespi (2022), if a large portion of the demand for agricultural carbon credits originates in the public sector (as a means for administrations to achieve carbon neutrality or simply as a support policy for the agricultural sector), the viability of the system will depend on the political environment.

Based on the level of corporate demand for agricultural carbon credits and the value received by farmers, we envision four possible scenarios for voluntary agricultural carbon markets in the United States (Wongpiyabovorn, Plastina, and Crespi 2022).

**Scenario 1: The next cash crop**

If corporate demand for agricultural carbon credits is high and sustained, and farmers receive high net prices for their credits, then the carbon market will generate a valuable and stable source of revenue for participating farmers (figure 2).

A standardized definition of a carbon credit along with a credible measuring, reporting, and verification (MRV) system for agricultural carbon are necessary to achieve this scenario, as well as limited competition from other sources of carbon credits (via limited quantities issued at similar prices, or via a segmented market for carbon credits with different prices).

This scenario assumes large-scale adoption of multi-year conservation practices according to production protocols that generate high-quality credits.

A sustained demand for agricultural carbon credits and widespread farmer participation would result in liquid markets with moderate price volatility, supported by robust financing and adequate risk-management services for farmers and purchasers of credits.

The development of complementary value chains for low-carbon commodities that trade at a premium over conventional commodities, as well as articulated protocols that would allow producers to migrate across carbon programs, would reinforce this scenario.

**Scenario 2: Low hanging fruits only**

If corporate demand for carbon credits is high but buyers perceive the quality of agricultural carbon credits as low, then agricultural carbon markets will likely be small and underdeveloped.

A necessary condition for this scenario is that competition from other sources of low-value carbon credits is limited. Scenario 2 is likely to occur in the absence of a credible MRV system for agricultural carbon credits, resulting in participants implementing only the least-cost practices to generate carbon credits or practices that would be implemented even in the absence of carbon payments.

Market liquidity would be low, with high volatility around low average prices, and limited financing and risk-management services for farmers and purchasers of credits.

**Scenario 3: Taxpayers pay the bills**

If corporate demand for carbon credits is low but participation in voluntary carbon programs is highly subsidized (directly through cost-share programs to implement certain practices, or indirectly through crop insurance premium deductions or tax credits), to the extent that market prices for carbon credits become of secondary importance to farmers, then an inefficient market for agricultural carbon would develop, funded by present and future taxpayers. The focus of participating farmers would turn to complying with regulations to receive government payments or subsidies (rent-seeking behavior), and the sponsoring government agencies would largely absorb the cost of administering carbon programs.

A low corporate demand for carbon credits could stem from a weak MRV system or high competition from other sources of carbon credits. Market liquidity would be low, with high volatility around low average prices, and limited private financing and risk-management services for farmers and purchasers of credits. Scenario 3 would be unsustainable in the long run.

**Scenario 4: Missed opportunity**

If corporate demand for carbon

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Figure 2. Four possible scenarios for ag carbon markets.
Overcoming the farming community’s stalwart persistent adherence to traditional succession and retirement practices, which effectively obstructs farmland transfer to the next generation, is a pressing matter for contemporary generational renewal in agriculture policy (Dwyer et al. 2019). Extensive research from the Republic of Ireland by Conway et al. (2016; 2017; 2018; 2019; 2020; 2021) highlights an excessive preoccupation with financial incentives encouraging the process, however, with limited value placed on how painful it is for older farmers ‘let go’ of their farms and their ingrained productivist self-image in later life. US research finds that in many cases, older farmers’ sense of place and purpose attached to family farms supersedes economic imperatives stimulating farm transfer to the next generation, which indicates the overwhelming significance of lifestyle over profit (Kirkpatrick 2012; 2013). However, such sentiments have gone unnoticed over the past four decades as there has been little focus on the needs and requirements of older farmers within policy/academic discussion, even though this cohort ultimately have the power and resources to decide whether intergenerational farm transition takes place (Commins 1973; Conway et al. 2017; Leonard et al. 2017).

This study draws on a baseline analysis of International FARMTRANSFERS Survey data obtained from the Republic of Ireland and the US state of Iowa to identify and compare rates and patterns of succession and older farmers’ similarities and/or differences in attitudes and intentions towards retirement. The FARMTRANSFERS project is an international collaborative effort around a common research instrument that “yields a range of (largely quantitative) data relating to the pattern, process and speed of succession and retirement which provides a firm base for future inquiries utilizing different methodologies” (Lobley and Baker 2013).

Figure 1. FARMTRANSFERS Project participant countries (Austria, Australia, Canada, France, Germany, Ireland, Japan, Poland, Romania, Switzerland, United Kingdom, United States).

Figure 2. FARMTRANSFERS Project participant states (California, Iowa, New Jersey, Pennsylvania, Tennessee, Wisconsin, Virginia).
The survey, based on an original design by Errington and Tranter (1991), has now been replicated in 12 countries (see figure 1) and eight US states (see figure 2) and completed by almost 17,000 farmers worldwide.

**Research methodology**

The Rural Studies Centre at the National University of Ireland Galway (NUI Galway) first distributed questions derived from the International FARMTRANSFERS Survey to a stratified random sample of 496 farmers included in Teagasc’s Land Use/Mobility Farm Survey and Choice Experiment 2014, representing over 80,000 nationally. Such an expansive sample is important due to Ireland’s different farming regions. For the Iowa data, from July to October 2019, Iowa State University Extension and Outreach’s Beginning Farmer Center surveyed 739 farmers from a stratified random sample of 3,000 farmers.

Combining International FARMTRANSFERS datasets from Ireland and Iowa provides a unique international perspective on farm succession and retirement across a broad spectrum of cultures, farming operations, typologies, geographical locations, and scale—the average farm size in Ireland is 32.4 hectares (CSO 2016), compared to 145.3 hectares in Iowa (USDA 2020). This would not be possible using other existing datasets. Using the FARMTRANSFERS project also ensures the internationalization of research findings, particularly to key stakeholders outside of academia. In terms of quantitative data analysis for this study, we coded and analyzed questionnaire data using frequency distribution tables and a series of cross-tabulations performed in Statistical Packages for Social Sciences (SPSS) version 23.

**Results and discussion**

FARMTRANSFERS survey findings comparing Irish farmer’s attitudes and intentions towards succession and retirement combined with Iowa data reveal the international scope and complexity of this ‘twin’ process in the farming community. Findings from Ireland highlight a significant cohort of farmers that do not plan to retire from farming in the future—only 25% indicated that they fully intend on doing so, 29% declared that they will never retire, and 46% plan to semi-retire. Conway et al. (2016) identify, of those who are open to the idea of retirement, a “divergence of opinion and uncertainty between retirement expectations and retirement realizations, resulting in the decision to retire being difficult to execute and follow through” (p. 170). The farming community’s powerful, somewhat territorial drive to hold on to their farm at all costs while working hard, taking risks, and enduring hardship and pain, can be conceptualized by Rosmonn’s (2010) notion of the “agrarian imperative.” This construct also provides an explanation for the widely reported “greying” of the farming workforce. In Ireland for example, almost one-third of farmers are older than 65 (CSO 2018), while 34% of US farmers are aged 65 and older (USDA-NASS 2019). In Iowa, 56.45% of respondents indicated that they will semi-retire, 20.25% declared they will never retire from farming, and 23% indicated that they will retire in the future (see figure 3).

The older generation’s reluctance to retire results in intractable challenges for younger farmers who want to establish a career in farming; and, under such conditions, it could take 20 to 30 years for them to integrate and evolve into a more formidable role in the family farm business (Conway et al. 2017). Keating (1996) notes that such a long period of family apprenticeship is “analogous to that of Prince Charles, heir to the British throne” (p. 414). His mother, Queen Elizabeth II, is still in control. By the time Prince Charles succeeds to the throne, his own son will be ready to assume the role; and, somewhat ironically, his son, Prince William, may also find himself spending most of his adult life as an apprentice in the family business (ibid). Ironically, 26 years after Keating (1996) first used this novel way to describe the succession situation on many family farms, Prince
The Iowa and Midwest farmland markets have seen tremendous momentum over the past 18 months. Both the Iowa Land Value Survey and the Chicago Federal Reserve Bank’s AgLetter show that average farmland values in Iowa rose 30% last year to the highest nominal values since the 1940s (Zhang 2021; Oppedahl 2022). At the same time, concerns about the sustainability of high land prices and possible changes in interest rates were the second- and third-most frequently mentioned negative factors in the 2021 Iowa Land Value Survey. In late March, the Federal Reserve Bank is expected to impose the first interest rate hike in three years, which will likely be the start of six-to-seven interest rate hikes over the next two years. This article examines the potential impacts of the future interest rate hikes on the farmland market.

Put simply, land value is the net present value of all discounted future income flows. With certain assumptions imposed, one could think of land value being net income divided by interest (discount) rate. In other words, interest rates inversely correlate with farmland values. At lower interest rates, demand for farm loans increases due to lower interest payments, signaling lower returns on competing assets such as bonds, thereby leading to a higher demand for land. The steep cuts in the federal funds rates in March 2020 resulted in historically low interest rates since the pandemic, which boosted not only farmland values but also residential housing prices across the nation. The Chicago and Kansas City Feds report that Illinois, Indiana, Nebraska, and Kansas land values rose 18%, 22%, 31%, and 25%, respectively, over the past year (Scott and Kreitman 2022). The CoreLogic US Home Price Index also shows a 19.1% increase for US national home prices (Boesel 2022), which was the highest 12-month growth in the US home index since 1976. The consistency across these real estate classes reveal the significance and power of interest rates.

The Federal Reserve is slated to raise its benchmark interest rate—the federal funds rate—by 0.25% in late March to curb inflation, which is running at a 40-year high rate of...
The Federal Reserve’s so-called dot plot, in which US central bankers reveal their projections of the future interest rate path, shows that officials expect to raise the federal funds rate three-to-four times in 2022 and three times in 2023, based on median projections (Foster 2022). This means that the farmland and operating loan rates could increase by 1.5%–2% by the end of 2023, which would be a 30%–40% increase compared to current farm mortgage rates. Figure 1 shows the evolution of federal funds effective rate and the inflation rate proxied by consumer price index since 1977.

In a 2021 Agricultural Finance Review article (see Basha, Zhang, and Hart 2021), we develop an autoregressive distributed lag model and provide the first quantification of the impacts changes in interest rates since 2015 had on farmland values. Our model confirms the inverse relation between interest rate changes and farmland values. In particular, it shows that one hike in federal funds rate could leave a cumulative effect of near-20% loss in I-states farmland values. More importantly, it shows that changes in federal funds rates have long-lasting impacts on farmland values, as it takes multiple years, at least a decade, for the farmland market to capitalize the effects fully.

Our model focuses on the federal funds rate, which is unique in that it is the only interest rate officially set by the Federal Reserve. Thus, it is the major policy lever used by the Federal Reserve to steer the economy. During the 2015–2018 calendar years, the Federal Reserve undertook a series of small interest rate hikes. However, it recently changed course and started lowering interest rates with a drastic 1.5% cut in March 2020 to combat uncertainty due to the COVID-19 pandemic. The same-color bars spanning across multiple years in figure 2 show that the effect of one monetary policy move takes multiple years to be fully capitalized in the land market. The long time horizon is because many of the farmland or farm operating loans are negotiated at most semi-annually, and the lagged effect of prior interest rate movements might offset the effect of new policy proposals. That said, the collective sustained interest rate increases from 2015 to 2018 contributed an over-1.5% decline in farmland values for 2018, a 3.3% decline for 2019, and a projected 4% decline in 2020. The modest interest rate reversal in 2019 is not sufficient to offset these effects, but the larger cut in the interest rate in March 2020 has fully offset the 2015–2018 hikes.

Figure 2 also reveals the dynamic path when the monetary policy changes will be most noticeable. The peak impact of the 2020 cut will reveal itself in 2022 and the uplift on the land market due to the 2020 cut will overwhelm the remaining impact of the 2015–2018 hikes. In other words, without the proposed interest rate hikes, the 2020 cut will dominate the net effect for the foreseeable future, leading to a net positive interest rate environment beginning in 2022.

Similarly, in figure 2, the downward-pointing brown and gray bars show the effects of the proposed interest rate hikes in the next two years. The peak effects of these projected federal funds rate increases will be felt most in 2024 and 2025. The magnitude of the 2020 rate cut is so substantial that its effect will still be dominant for calendar year 2022 and likely the first half of 2023. In other words, the proposed interest rate hikes will exert downward pressures on the farmland market; however, the hikes are not substantial enough to fully offset the influence of the March 2020 cuts, and the farmland market likely will not feel the downward pressure from higher interest rates until after 2024.

Figure 2. The short- and long-term impacts of recent Federal Reserve interest rate moves on I-states’ farmland values.

Note: The legend shows the policy years during which the Federal Reserve made changes in the benchmark federal funds rates. The 2022 and 2023 projections assume three and four hikes based on the Federal Reserve Dot Plot.

continued on page 22
Is the United States Trying to Undermine the WTO?

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A NATIVE of Eustis, Nebraska, Clayton Yeutter (1930–2017) was a tireless advocate for US agriculture. In his roles as the US Trade Representative and Secretary of Agriculture under the Ronald Reagan and George H.W. Bush administrations, Yeutter oversaw an unprecedented expansion of US agriculture into global markets and negotiated resolutions to bitter trade disputes, which, for example, resulted in the opening of Japanese markets to US beef and citrus. Yeutter envisioned a better way, however, where trade disputes could be resolved fairly under established international law. The World Trade Organization (WTO) emerged as a key component of the Uruguay Round of the renegotiation of the General Agreement on Tariffs and Trade (GATT). Yeutter was instrumental in creating the WTO’s dispute-settlement mission—a preeminent legacy.¹ Starting in the mid-1990s, countries could bring trade disputes before the WTO as an impartial referee.

The WTO dispute-settlement mission is now under significant threat. The United States has chosen to block the appointment of new members to the WTO’s Appellate Body. Without an operating Appellate Body the technical process for resolving disputes hits a dead end. The following quote is pulled from the WTO’s web page:

“The WTO dispute-settlement mission is now under significant threat. The United States has chosen to block the appointment of new members to the WTO’s Appellate Body. Without an operating Appellate Body the technical process for resolving disputes hits a dead end.”

WTO review because it knows that its actions cannot stand up to that review (Bown and Keynes 2020). By operating outside of the agreed rules, the United States is losing sight of Yeutter’s vision of an orderly trading system. The obvious risk for US agriculture is that all of the hard-fought market access, protected under WTO bindings, will be ignored by our trade partners and ultimately lost.

Trade disputes almost always arise when a country implements a so-called trade remedy against another country. Take the case of international dumping with anti-dumping duties (tariffs) as the trade remedy. WTO members agree not to sell goods in other countries’ markets at prices below the fair or normal price in their own market. It is considered unfair, for example, for a Canadian producer to sell lumber to a US distributor for $1.00 per board foot when it sells the same product to Canadian distributors for $1.50 per board foot. This is dumping, a type of WTO-inconsistent price discrimination that harms US producers. In the United States, we have laws that allow recourse in the form of anti-dumping duties, or tariffs, which brings the price of the Canadian export back up to the fair price of $1.50 as it leaves Canada. Commitments made by the United States as a signatory to the GATT do not allow it to place arbitrary tariffs on Canadian lumber, but an anti-dumping duty is okay to the extent that the gross-of-tax price is roughly consistent with the fair price.

A trade dispute arises when the facts are in question. Canada may claim that the price differences, or some portion of the differences, charged by its firms are justified because of product quality or contract-specific differences. More commonly, they may dispute the method used by the United States to measure price differences across many contracts and the method used to calculate the implied duty. In this regard, Canada may allege that the United States is the party violating WTO commitments by justifying a protectionist tariff under the guise of anti-dumping law. To the extent that Canada and the United States cannot resolve the dispute, the countries can bring the case before the WTO as a judge of the facts. If the United States implements the anti-dumping law in a consistent manner, Canada will have to either stop dumping or live with the US tariffs. If, however, Canada can show that the duties are unjustified or incorrectly calculated, the United States will need to modify its policy or

¹. To read more on Clayton Yeutter’s life, see the new biography Rhymes with Fighter: Clayton Yeutter, American Statesman, by Joseph Weber, University of Nebraska Press, December 2021.
face a set of retaliatory tariffs. Canada may then legally place tariffs on any US sourced products such that US exports reduce by a value equivalent to the Canadian export damage caused by the illegal US duties.²

It is not surprising that the United States has adopted a hostile posture toward WTO dispute settlement in recent years. The United States seems to want to operate outside of the GATT rules, which it originally spearheaded, negotiated, and ratified. A couple of stinging losses for the United States at the WTO exemplify this—in 2019 the WTO ruled in case DS471 that the United States had imposed illegal anti-dumping duties damaging Chinese exports by $3.579 billion per year on a set of 25 products (WTO 2019).

In January of this year, on a subset of those products, the WTO ruled in case DS437 that the United States had imposed illegal countervailing duties (another type of trade remedy) damaging Chinese exports by another $645 million per year (WTO 2022). China originally brought these cases to the WTO in 2013, with the final decision going against the United States after years of stalling the inevitable. The decisions illustrate the United States’ consistent violation of trade remedy procedures. The US violations in these cases precede, by many years, the recent trade war between the United States and China. Under WTO rules, the findings in DS437 and DS471 alone legitimize any set of Chinese tariffs on agricultural goods that reduce annual imports from the United States by over $4.2 billion.

A simple example illustrates how the United States uses anti-dumping law to artificially inflate tariffs against its trade partners. A key component of case DS471 was the practice of zeroing by the United States Department of Commerce (USDOC) in its calculation of the anti-dumping duties in question. Consider a set of transactions on a relevant product like Steel Cylinders imported from China. To simplify the example, let us assume that the fair price for Steel Cylinders as they leave the Chinese factory gate is $5.00. Assume that the USDOC sees four transactions each of equal quantity—two transactions where Chinese firms sell to US buyers at a price of $4.00 and two at a price of $6.00. On average, are the Chinese firms dumping Steel Cylinders into the US market? The WTO would say no, the average price that the firms sell to US buyers is $5.00, so there is no dumping and the appropriate anti-dumping duty is zero. The USDOC, along with the import-competing industry, have a different approach. They calculate the average price to be $4.50, arguing that China is dumping by $1.00 on two of the transactions and by zero (hence the label zeroing) on the other two transactions. The average of [1, 1, 0, 0] is $0.50 so the USDOC calculates an anti-dumping tariff that effectively raises the price of all imports by $0.50. WTO’s Appellate Body consistently rejects this type of creative mathematics.

The United States inevitably, and predictably, loses cases before the WTO because it is unwilling to bring its policies and methods in line with its commitments under the GATT. Of course, now with no Appellate Body, there is no venue to hear the cases. Under WTO rules, the United States can appeal any case brought against it, but without an Appellate Body there is no one at the WTO to reject the established errors in the US methods. Could this be the US strategy to avoid losses at the WTO? If so, it is a short-sighted strategy because it fails to acknowledge the enormous benefits the United States gets out of having a rules-based trading system. At some fundamental level, trust in a set of rules and norms for international transactions facilitates trade. Clayton Yeutter saw these benefits in terms of marketing US agricultural goods across the globe. It has been a good run, but if we do not support and respect our institutions of law and order we cannot expect to depend on them when needed.

References

Suggested citation

2. In the case of the recent tariff war between the United States and China, the WTO process for settling disputes was ignored. The United States moved directly to retaliatory tariffs as recourse for China’s alleged violation of intellectual property commitments. China in turn retaliated with its own tariffs on US goods as recourse for the US action. All of these tariffs are per se legal from the perspective of WTO commitments, because the dispute was never brought before the WTO as arbiter.
and 2021 vary greatly. The returns as measured by either net income or stock prices for the five publicly traded fertilizer companies that sell into the North American market are higher on average than those of the selected other agricultural industry players. Bunge clearly brings the average up but notice Nutrien had negative net income returns over this period. The fertilizer industry average net income return was higher than Walmart but not higher than Amazon and lagged both in terms of average stock price returns (31% for the fertilizer group vs. 51% for Amazon and Walmart). In fact, the fertilizer group’s average stock return (31%) is lower than the return of a portfolio of 500 other large cap companies as measured by the S&P 500 (40%). Net income and stock prices are not the same thing as measures of economic profit that accounts for market power, but they are suggestive. Stock prices, especially, reflect what investors think the potential for earnings are, and stock price returns for these companies before and during the pandemic should reflect investors’ broader market perceptions. The takeaway from examining stock price returns is that the fertilizer industry is similar to the broader market from an investment perspective.

Table 3 also presents average net income returns for Iowa farms. By comparison, Iowa farmers saw a 66% return in net farm income (compared with an average of 71% for the fertilizer industry and 9% for other ag firms); and, although stock prices are not available for Iowa farmers, if we examine land prices, there was a 16% average increase in Iowa farmland price from 2018–19 to 2020–21 (compared with a 31% increase in the stock price of the fertilizer industry). Untangling any relations from underlying market conditions affecting all firms is difficult; however, a recent study by Outlaw et al. (2021) finds that corn farmers’ incomes and fertilizer prices do seem to move together. More analysis of market power issues is needed. However, simply examining profitability returns or stock prices with farm income is difficult because issues such as trade, weather, and COVID-19 are impacting farms as well as their input suppliers. We do not know enough, but we do know that the last two years have greatly impacted all markets.

References

Suggested citation
Voluntary Carbon Markets

continued from page 7

credits is low and the perceived quality of agricultural carbon credits is low, resulting in low credit prices and possibly, but not necessarily, including adverse selection or moral hazard in the marketplace, then agricultural carbon markets will likely collapse.

A low corporate demand for carbon credits could stem from a weak MRV system or high competition from other sources of carbon credits.

A limited adoption of conservation practices will likely generate high volatility around low average agricultural credit prices and steer farmers away from carbon markets. There would be limited private financing and risk-management services for farmers and purchasers of credits. Scenario 4 would be unsustainable in the short run.

Final remarks

The current state of affairs around voluntary carbon markets seems to support a strong corporate demand for agricultural carbon credits based on the number of large corporations making pledges to become or remain carbon neutral (e.g., Microsoft, JP Morgan, Delta Airlines, Google). Most carbon programs are paying farmers who participate in their pilot programs between $10 and $30 per acre per year. However, market-based carbon prices will determine payments per output to farmers after the pilot period, and there are no clear signals that prices in voluntary carbon markets will increase in the near future (despite the increase observed in the price for carbon offsets in the mandatory cap-and-trade system for power plants in California). The prices of CBL Nature-Based Global Emission Offset (N-GEO) futures, which is based on carbon offsets generated by activities in agriculture, forestry, and other land use, were $12.49, $15.35, and $18.64 per ton of CO2e for the contracts expiring in December 2022, in December 2023, and in December 2025, respectively, as of March 2, 2022 (CME Group 2022). As a reference, the Nori Carbon Removal Marketplace (http://nori.com) has been selling carbon credits for $15 per ton plus 15% fees in 2021 and 2022.

The lack of standards and proliferation of intrinsically different carbon programs (in terms of how carbon is measured, how claims are verified, how credits are sold, etc.) seems to indicate that large transaction costs can be expected, potentially resulting in low net values for farmers. Based on these premises, the most likely scenario in the status quo is the second one, “low hanging fruits only.”

This analysis does not account for the increased interest in carbon capture and sequestration (“industrial carbon sequestration”) in the corn-based ethanol industry or the carbon calculation in renewable diesel production to qualify for the incentives offered by California’s low-carbon fuel standards, which could present further opportunities for farmers to monetize the implementation of conservation practices.

References


Suggested citation


Acknowledgments

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The authors are thankful to the editors of AEPP for allowing us to disseminate this APR article.
not eligible for PTC, whereas both wind and solar are qualified for ITC, making wind more preferable to utility companies. Wind and solar also receive state-level supports in Iowa in the form of financial incentives such as sales and property tax exemption and investment tax credits. The most recent legislation in Iowa, the 2020 Solar Bill, codifies net metering, allows electric utilities to bill customers under net metering or inflow-outflow rate, and calls for a potential “Value of Solar” study in the future. Although the bill aims to influence residential power, in contrast to the utility-scale power this research focuses on, the passing of this bill shows that Iowa’s policymakers recognize the social interests related to solar energy use and development across the state.

Land footprint of wind and solar energy

Figure 3 shows the geographical locations of current utility-scale wind and solar projects in Iowa. Unsurprisingly, the geographical distribution for current utility-scale wind projects largely overlaps the area with the highest wind resources in Iowa (figure 4). On the other hand, the majority of current utility-scale solar power plants reside in areas where the solar radiation is the lowest (figure 5). Nonetheless, we cannot tell if solar natural resources play a role in development location as there are only nine utility-scale solar projects and solar potential does not vary significantly across the state.

To further look at the land use characteristics of wind and solar projects in Iowa, figure 6 shows the map of average farmland value by county from 2000 to 2021.

Combined with figure 3, we find that Iowa’s wind projects are primarily located in areas with high farmland values. In contrast, the nine current solar projects are mostly located in brownfield land and old manufacturing sites to reduce development costs. Wind turbines can co-exist with crops and some studies show they can have positive effects on crop yield (Kaffine 2019; Takle 2018) and farmland value (ILC 2019), whereas solar photovoltaic panels compete with crop production for land. Both wind turbines and solar panels also have environmental impacts related to land and soil (Armstrong et al. 2014; Thomas et al. 2018), and the impacts and perceptions of these impacts can influence communities’ attitudes, often significantly.

It is hard to compare the land footprints of wind and solar energy because many solar panels are concentrated in one field for a solar project whereas wind turbines are spread across fields. However, we can
compare their land costs separately based on reports from various sources. According to Halvatzis and Keyser (2013), the average land lease payment per MW of wind turbine in Iowa is $4,000 per year, which is consistent with USDOE’s national average of $3,350 per year (USDOE 2022). Siting one MW of solar panels currently takes approximately 5–10 acres of land in Iowa (Ong et al. 2013) with per acre solar lease rates ranging from $600–$1,100 (ISETI 2020; IFT 2021), implying an annual land cost of $3,000–$11,000 for installing one MW of solar capacity. Therefore, the land cost of solar in Iowa can be comparable to wind but is likely to be greater than wind depending on per-acre lease payment and the number of acres used for each megawatt of power generated. At the rate of 5–10 acres of land for one MW of solar panel electricity, it will take about 60,000 to 120,000 acres of land to reach 11,656 MW of the current total wind capacity in Iowa, and an additional 4,250 to 8,500 acres of land for the 854 MW of wind capacity in the pipeline. To put the numbers in perspective, the 2017 Agricultural Census indicates that Iowa has 26.5 million acres of cropland, of which about 1.6 million acres were enrolled in the Conservation Reserve Program averaged annually over the last 10 years. Both solar panels and wind turbines can have significant impacts on neighboring land and communities, which often results in heated local debates and eventual local regulations.

Local regulations on siting
Siting regulations, on a local level, guide and permit the development of renewable energy technologies. Not all Iowa counties have adopted zoning regulations—as of 2021, 21 of Iowa’s 99 counties have a utility-scale solar zoning ordinance, and 58 counties have a utility-scale wind zoning ordinance (table 1). The county-specific zoning ordinances are designed to deal with building specifications and restricted areas of construction and differ across counties in zoning stringency such as setbacks, ground cover, and decommissioning agreement. The clarity of utility-scale zoning ordinances reduces soft costs by eliminating the information uncertainty between renewable energy developers and local communities and reducing the risk and time associated with developers seeking siting locations for utility-scale wind and solar power plants. Therefore, a lack of clarity on utility-scale solar photovoltaic energy tends to hinder utility-scale solar energy’s development abilities in

Table 1. Summary: Utility-scale Solar and Wind Zoning Ordinances in Iowa

<table>
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<tr>
<th>Category</th>
<th>Number of counties</th>
<th>Range (feet)</th>
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</thead>
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<td><strong>Utility-scale solar zoning ordinance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setback requirement:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Occupied residence</td>
<td>20</td>
<td>[50, 1000]</td>
</tr>
<tr>
<td>· Any non-participating parcel</td>
<td>20</td>
<td>[50, 250]</td>
</tr>
<tr>
<td>Ground cover requirement</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Decommissioning agreement</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td><strong>Utility-scale wind zoning ordinance</strong></td>
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</tr>
<tr>
<td>Setback requirement:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Occupied residence</td>
<td>56</td>
<td>[1000, 2640]</td>
</tr>
<tr>
<td>· Any non-participating parcel</td>
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<td>[12, 75]</td>
</tr>
<tr>
<td>Decommissioning agreement</td>
<td>49</td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors’ own compilation from county documents. Data compiled by the authors using Iowa’s county-level zoning ordinance file.
Charles is still in the same situation in 2022. This “Prince Charles Syndrome” predicament also appears to be the case for many “younger” farmers worldwide. Such sociocultural barriers for younger farmers are particularly concerning as survey findings illustrate that 52% of Irish farmers and 40% of Iowa farmers (40%) have identified a successor (see figure 4), which signifies a resurgence in demand from the younger generation for a career in farming, leading to an anticipated renaissance in agriculture, and, by extension, a rejuvenation of rural life (Chiswell 2014; Farrell et al. 2022), provided they can take over the farm in a timely manner.

However, findings from Irish farmers surveyed in FARMTRANSFERS identify that farmers are ill prepared for succession, with 77% not having a succession plan in place. Moreover, 52% of respondents were found to not even have a will in place. This finding is analogous with results obtained from Iowa, which reveal that 66% of respondents do not have a formal succession plan (see figure 5).

Such ambivalence towards the succession process is also evident in previous studies from the United States, such as Whitehead, Lobley, and Baker (2020) who highlight that programs encouraging farm transfer reported “approximately 20 beginning farmers for every existing farmer” (p. 216). In contrast to the situation in Ireland, however, there is a significant number of respondents who declare that they have a will—only 13% indicated that they do not have one.

An analysis of aggregate data of the International FARMTRANSFERS survey from Ireland found that this lack of preparedness exists in spite of the fact that the inherent desire to keep the farm in the family is clearly evident in findings from the survey, which found that only 4% of respondent’s “desired succession and inheritance outcome” was to “sell the farm.”

Such findings indicate little headway has been made in bringing about regularized and accepted practices of intergenerational farm transfer within the farming community, despite an array of financial enticements encouraging the process over the past 40 years. Thus, the idea that tax exemptions, penalties, or a new form of early retirement scheme will be a catalyst to stimulate the process is disconcerting and shows a real lack of understanding of the mind set and ethos of older farmers. Such a disconnect between realities on the ground indicates that a cultural shift on the age-old problem of a “greying” farming population requires well-informed and creative policy interventions and strategies that recognize the “language of farming” in order to effect change, emulating Shucksmith and Hermann’s (2002) contention to respect “farmers’ own ways of seeing the world” (p.39).

**Conclusion**

This study’s exploration of Irish farmer’s succession and retirement plans, compared with those obtained from Iowa, reaffirms that farmers are reluctant to “step aside” and retire from farming, and that this is not confined to one country, but rather has a global dimension. Consequently, there is an urgent need for agricultural policymakers and practitioners to re-examine their existing predominant focus on addressing needs and
requirements of the younger farming generation and place a greater or equal emphasis on maintaining the quality of life of those most affected by the process, namely the older farmer. This study recommends that future policy aimed at stimulating generational renewal in agriculture must be accompanied by a comprehensive set of interventions aligned to the World Health Organization’s (WHO) age-friendly environments concept, due to its association with and contribution to active and healthy aging in later life, echoing previous research by Conway et al. (2022). Although there is currently no universally accepted definition of an “age-friendly” environment, the WHO defines an age-friendly community as one in which “policies, services, settings and structures support and enable people to age actively” (WHO 2007, p. 5). Despite the growth of the age-friendly environments movement however, existing literature predominantly focuses on a model of urban aging, thereby failing to reflect the diversity of rural areas, particularly the farming community. Applying this concept in an agricultural setting will not only help ease the fear and anxiety associated with “stepping aside” and retirement from farming by addressing the personal and social loss that the senior generation of the farming community may experience upon transferring the farm, but will also begin a much broader international conversation on the place, views, concerns, and challenges of older farmers in the context of the future prosperity of the agricultural sector, and ultimately the future sustainability of farm families, rural communities, and natural environments on which we all depend.

This research is but a start however, and the insights documented and issues raised will hopefully stimulate further investigations along these lines in order to help protect the mental health and wellbeing of the older generation of the farming community. In future work, it would be particularly valuable to investigate how to transform farming into an age-friendly sector of society, with a particular focus on rolling out an innovative new social organization for older farmers called “Farmer’s Yards,” designed to fit their specific interests, needs, and values in later life.

References

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Iowa. Given the growing interest in solar and concerns over broader impacts, some counties have implemented a moratorium to allow time for regulation development. For example, on December 21, 2021, Johnson County enacted a temporary moratorium (until June 5, 2022) on utility-scale solar energy systems in unincorporated Johnson to review and discuss solar-related regulation (JCBS 2021). And on March 8, 2022, Green County approved a temporary moratorium on utility-scale solar farms for six months (Carison 2022). Moreover, to protect more productive farmland, Iowa lawmakers proposed a bill on February 15, 2022, that could limit solar panels to less productive farmland with a minimum setback distance of 1,250 feet from the nearest neighboring landowner (Peikes 2022).

A study conducted at Columbia Law School's Sabin Center for Climate Change Law cites recent moratoriums enacted in Iowa to halt wind energy development in various counties (Marsh, McKee, and Welch 2021). Adair, Hardin, and Madison Counties enacted caps or moratoriums in 2019 that limit the amount of wind turbines in each county. These cases highlight the importance of local regulations on the development of solar and wind energy. Furthermore, contextualizing these moratorium cases may help reassess the narrative behind local ordinances. In the case of Adair County, 14 utility-scale wind projects created a cumulative 865 MW of nameplate capacity between 2010 and 2021. Over those 11 years, Adair County had the highest concentration of wind turbines in the state, which constituted 9.4% of Iowa's total utility-scale wind nameplate capacity in 2021. With an influx of projects entering an already-developed wind turbine infrastructure, one could argue that Adair County’s cap is not surprising.

To sum up, wind energy has dominated utility-scale renewable electricity generation in Iowa in the last couple of decades and will likely continue to do so in the foreseeable future. Utility-scale solar projects have the potential to make Iowa’s electricity grid more diversified with its recent explosion of growth. With sustained support of government policies, and also expansion of counties that incorporate solar into zoning ordinances, Iowa will see continued growth of utility-scale solar. However, concerns over land use and related regulations will play a critical role in the development of both wind and solar energy in Iowa in the immediate future.

**References**


Suggested citation

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interest rates until late 2023.

This is in part consistent with projections of how 2022 farmland values and residential home prices will go. Agricultural professionals and producers generally expect to continue seeing an increase in their local farmland values, probably around 10% in the core Corn Belt area. Cash rents show a 10%–20% increase compared to 18 months ago as well.

In a prior analysis, we compare the downturn from 2013–2018 with the 1980s and 1920s farm crises (see Zhang and Tidgren 2018). While the staggering inflation is a cause for concern, the replay of a farm crisis or a near-term burst of the “farmland bubble” seems unlikely due to the current very low interest rate environment, the slow and modest moves indicated by the Federal Reserve as opposed to substantial and surprise hikes, less reliance on adjustable-rate mortgages, and the substantially higher commodity prices despite rising input costs. Furthermore, the agricultural sector in general is not as leveraged as 82% of Iowa farmland is fully paid for (Zhang, Plastina, and Sawadgo 2018). With higher inflation and dramatic market volatility in stock and energy markets, farmland is a growing interest among investors considering it as part of an investment portfolio.

In sum, our analysis shows that the effects of the interest rate changes vary due to timing and magnitude. The current projected interest rate hikes will exert downward pressures on the land market; however, it probably is not sufficient to offset the supporting role of the 2020 rate cut this year. The net effects of all interest rate changes since 2015 will become negative for farmland values in late 2023 and onward. The federal funds rates have been lower than 3% for almost 15 years, which is a critical factor to watch when examining future farmland and other real estate values.

References

Suggested citation
Recent CARD Publications

Multi-plant Coordination in the US Beef Packing Industry

Christopher C. Pudenz, Lee L. Schulz

Abstract
US beef packers openly began employing multi-plant coordination during the last decade. Using the Salop Circular City framework, we demonstrate that this leads to wider spreads between downstream beef prices and upstream fed cattle prices. Taken together with market concentration, geography and transportation costs, alternative marketing arrangements, and cattle cycles and related beef packer capacity utilization, multi-plant coordination helps explain farm-to-wholesale beef price spreads that have remained wide absent any obvious market shocks. We find that, as cattle inventories decline, a multi-plant coordinator will permanently shut down a plant before a plant run as an individual profit center will shut down, which is consistent with packer behavior in recent years. We further demonstrate that adding a strategically-located packing plant, owned by a different firm, can narrow the price spread. Our results add new underpinnings to ongoing policy discussions. CARD working paper 21-WP 630. Available at https://www.card.iastate.edu/products/publications/synopsis/?p=1343.

How Carbon Credits are Certified Could Change the Market Structure

John M. Crespi, Stéphan Marette

Abstract
While there is much discussion about the need for viable carbon credit markets with well-defined credible certification, there is also a need to consider the impacts of the costs of certification on the structure of those markets. This policy brief provides background to the consideration of how certification costs might influence the industrial structure of the certification industry and how firms compete with each other. CARD policy brief 22-PB 37. Available at https://www.card.iastate.edu/products/publications/synopsis/?p=1344.

Of Women and Land: How Gender Affects Successions and Transfers of Iowa Farms

Beatrice Maule, Wendong Zhang, Qing Liu

Abstract
Using 591 crop and livestock farmers’ responses to the 2019 Iowa Farm Transfer Survey, we examine factors driving the gender imbalance in farm successor choices among Iowa farmers with a focus on female successors and landowners. Our data reveals a large gender gap—58% of farmers chose sons and only 8% chose daughters as main successor. We develop four conceptual hypotheses from a model linking farmer and successor characteristics with the farmer’s probability of choosing a daughter as main successor. Our models reveal the probability of choosing daughters as main successor increases when the farmer is female, when the farmer only has daughters, when the daughters have farming experience or an agriculture-related job, and when the farm operation is a partnership with a wife. We find an 11.1% probability of a female farmer choosing a daughter as a successor, but only 4.6% for a male farmer. A daughter having an agriculture-related job increases the probability from 4.4% to 17.0%; whereas the same related experience increases a son’s chance from 34.7% to 59.4%. With half of Iowa farmland owned by women, our paper reveals striking evidence of gender imbalance in farm succession, transfer, and inheritance decisions of US farms. CARD working paper 22-WP 631. Available at https://www.card.iastate.edu/products/publications/synopsis/?p=1346.
Recent CARD News

Hayes Honored for 35 Years of Service
Dermot Hayes, Charles F. Curtiss Distinguished Professor in Agriculture and Life Sciences, was honored by Iowa State’s 25 Year Club for his 35 years with the university. https://www.card.iastate.edu/news/brief/?n=264.

Stephany CARES Team Receives CYtation Award
CARD Grant Support Specialist Lisa Stephany is a member of The CARES Team (pre-award support) that is the recipient of a 2021 Iowa State University Professional and Scientific Team CYtation Award.

The CYtation Team Award honors a team, which includes ISU P&S employees, that: 1) have performed above and beyond the call of duty, 2) have done something extraordinarily well, and 3) have acted in such a way as to make a very real difference in the institution within the past year.

The other members of the winning CYtation Team are Asrun Kristmundsdottir, Kerri Bilsten, Kendra Lee, Natalia Rogovska, Mandy Voyek, Seth Wilmes, Kelly Yohnke, Wenli Su, and Julia Webb.

The Provost will present the team with certificates of recognition at the Professional and Scientific Council CYtation Awards Ceremony, March 24, 2022, in the ISU Alumni Center. https://www.card.iastate.edu/news/brief/?n=256.

Orazem wins Inspiration Award
University Professor Peter F. Orazem has been selected to receive the 2022 Faculty/Staff Inspiration Award. He is among five individuals to be honored with the award this year.

The Alumni Association established this award in 2011 as a way for former ISU students to recognize current or former ISU faculty or staff members who had a significant influence in their lives as students at ISU. Orazem was nominated by former student Deepak Premkumar.

The Faculty/Staff Inspiration Award is funded by earnings from the Nancy and Richard Degner Alumni Association Endowment. Orazem will be honored and recognized at the ISU Alumni Association Board of Director’s annual meeting and reception held on the evening of Friday, May 20 in the ISU Alumni Center. https://www.card.iastate.edu/news/brief/?n=255.

Hayes receives grant to study cattle, hog processing capacity
Professor Dermot Hayes received a $37,500 grant for the project “Cattle and Hog Processing Facility Capacity and Ownership Structure.” Hayes was awarded the grant from the University of Missouri, Columbia, and will work closely with Associate Professor Keri Jacobs, a former CARD researcher. Hayes will document the background on disruptions in cattle and hog processing and their economic damages, explore capacity perspectives and relevant considerations, assess the opportunity for adding meaningful capacity via medium-sized plants for cattle and hogs, consider models of producer-ownership of cattle and hog processing facilities, and prepare a case study of EU cattle and hog processing.


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