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What Affects Firm Location and Firm Employment at State Borders?

by Georgeanne M. Artz, Yulong Chen, Liyuan Ma, and Peter F. Orazem
pfo@iastate.edu

WHAT MAKES some places grow and some places stagnate or decline? There are many politicians, economic development specialists, and regional planning experts who claim they hold the keys to economic growth, and yet there is great persistence in the strength of local economies over very long time periods. The five states with the lowest labor productivity in 1974 were Mississippi, South Carolina, Vermont, Arkansas, and Maine. By 2015, all of these states were still ranked among the bottom six states. As wages follow labor productivity, these states also ranked among the bottom ten in average earnings per job over the 41-year period. Surely if there were some magic elixir that spurred economic growth, at least one of these states would have broken out from the bottom of the pack. Perhaps the only ones benefiting from the development advice are the advisers.

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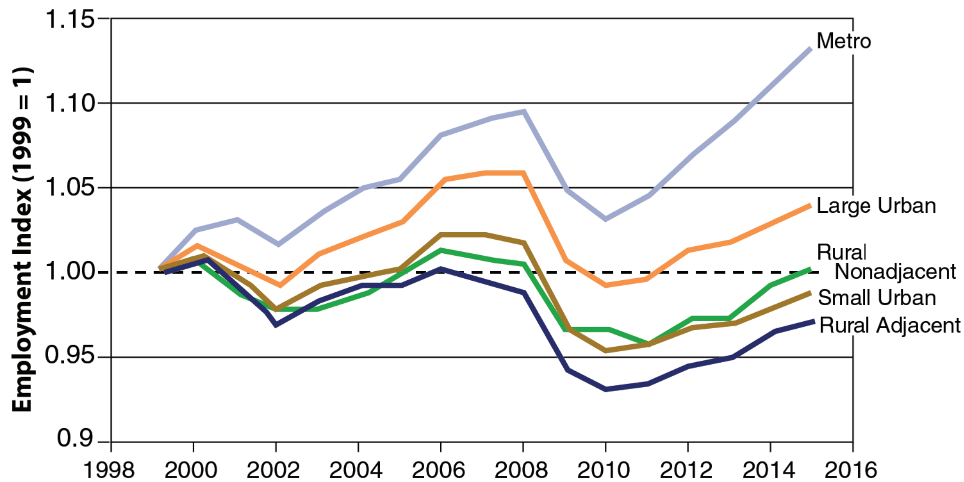


Figure 1. Employment growth by county size, 1999–2015
Note: Authors' computations based on the Wholedata Establishment and Employment Database.

So why is economic activity so persistent over time? We opted to investigate this question by looking at firm entry, firm exit, and relative employment between adjacent counties on either side of a state border. These counties should share the same labor market, the same access to credit, the same customer market, and the same locational and geo-climatic amenities. If, over time, more economic activity occurs on one side of the border than the other, it must be driven by greater anticipated profitability in one state rather than the other. We examine whether these systematic patterns of firm location are related to state tax or expenditure policies, or if they are driven by locational advantages that are not influenced by government policies.

Our choice of measures of the strength of the local economic environment are informed by the long-term pattern of growth by size of local economy. In this century, virtually all of the employment growth has occurred in the metropolitan and large urban markets. As shown in Figure 1, since 1999, employment grew 14% in metropolitan areas and 5% in large urban markets, and shrank or stagnated everywhere else, suggesting that the factors favoring economic growth are concentrated in more populated markets.

Since Marshall's (1890) pioneering book, economists have known that firms are more productive when they are in close proximity to suppliers or customers, when they are clustered among similar firms that share a pool of skilled workers and technologies, when they have a ready supply of educated workers, and when their customers have disposable income. All of these agglomeration factors give firms a productive advantage from locating in cities. However, Artz et al. (2016) showed that these same factors matter for firm entry and survival in less-densely populated markets as well. Therefore, we focus on these factors as descriptive of the local economic environment. If agglomeration matters for employment, firm entry, and firm exit, then we would expect the border county with the better economic environment would dominate its neighbor.

Governments may try to make up for these disadvantages by adjusting their tax rates and subsidies to try to counteract these naturally occurring disadvantages attributable to weaker economic environments. We include controls for the highest state marginal tax rate on property, sales, income, capital gains, corporate income, and unemployment insurance. High marginal tax rates should reduce economic activity. On the other hand, tax revenue is used to produce public goods, which should improve the economic climate, and so we include per capita state government expenditures as a factor.

Agglomeration Effects at State Borders

In Table 1, we present regression coefficients that show how industry employment, firm entry, and firm exit are affected by these factors at state borders. All measures react strongly to our market agglomeration measures. One finding may seem surprising—many of the agglomeration factors that encourage firm entry also generate more firm exits, due to the strongest local

Table 1. Regressions of differences across paired border counties in industry log employment, firm birth rates and firm death rates, 1998–2015

Variables	Log(Employment)	Birth rate	Death rate
Agglomeration Measures			
Upstream	0.16***	0.33***	0.22***
	(0.02)	(0.08)	(0.07)
Downstream	0.01	0.15*	0.12
	(0.01)	(0.08)	(0.07)
Firm Cluster	0.05***	0.000	-0.000
	(0.01)	(0.002)	(0.002)
Industrial Diversity[b]	7.52***	21.08***	20.05***
	(0.20)	(0.80)	(0.67)
Population with high school degree or above	0.07***	0.31***	0.26***
	(0.002)	(0.01)	(0.01)
ln(Per Capita Income)	0.05	1.89***	-0.22
	(0.08)	(0.72)	(0.50)
Taxes and Expenditures			
Combined Tax Effect	-0.02*	0.24	0.53***
	(0.01)	(2.44)	(0.20)
Government expenditure per capita	0.26***	0.07	0.76**
	(0.06)	(0.47)	(0.37)
Subsidies	[a]	[a]	[a]
Observations	749,762	293,794	293,794
Clusters	5,647	1,700	1,700
R-squared	0.25	0.14	0.16

Notes: State fixed effects are controlled in the regressions. Standard errors reported in parentheses are clustered at state border and industry level. ***significant at 1%, **significant at 5%, *significant at 10%.
[a] Subsidies either had no effect or a negative effect on employment, firm entry.
[b] This is measured by 1-Herfindahl-Hirschman Index.

markets attracting entrants who may need to displace incumbent firms. Even marginally profitable firms may opt to sell to new entrants willing to pay a price high enough to justify exit.

Looking at the first two columns of Table 1, the county with the stronger agglomeration measure had more employment and more firm entry, although not every coefficient is statistically significant. Having a better local source of upstream suppliers attracts more entry and employment on that side of the border. The larger number of downstream customers attracts more entrants on that side of the border. A larger number of firms in the same industry cluster increases industry employment. More firm entry and employment occurs on the side of the border with the more educated local labor supply and the more diverse mix of industries. Firms entered more readily on the side of the border with the higher per capita incomes.

It is perhaps surprising that agglomeration in the own county matters so much compared to agglomeration one county removed. Because these effects are so strong, they drive the location of economic activity on one side of the border and the effects are too large to allow government policy to reverse the advantage. As we will see, taxes and government spending matter, but not enough to counteract the impact of the economic environment.

State Government Taxes and Expenditures

We present the accumulated effect of a unit increase in each of the six taxes. Taxes do not have a significant effect on firm entry, but they do have a small but significant effect on employment, which is greater on the side of the border with lower marginal tax rates. The bigger, but still modest, effect is accelerating firm exits on the side of the border with higher taxes. Having a one-unit higher marginal tax rate in each of the six taxes only increases the firm exit rate by 0.5%. A 10% higher level of per capita state government expenditures raises employment by 2.6% on that side of the border, but it hastens the firm death rate as well.

Which States Have the Worst Tax Structure?

While the effect of the relative tax rates is modest on average, there are some states with substantial effects on employment and firm death rates. The adverse effects of tax rates differ by the type of economic outcome. In Table 2, we list the states with the worst economic outcomes as measured by the summed effect of their 2015 marginal tax rates on their own employment and on their firm survival rates. Only three states, Maine, Rhode Island, and New Jersey, are on both lists. In Oregon, the combined effect of the six tax rates lowers employment by over 25%. Effects on firm death rates are more modest. The most damaging tax policy inducing firm deaths is in Iowa, where the six tax rates raise the firm exit rate by just over 1%.

Table 2. States with the largest adverse effects of tax policy on employment and firm exits

	Lost Employment		More firm death
Oregon	-25.4%	Iowa	1.13%
California	-23.9%	Minnesota	1.09%
Maine	-20.1%	Idaho	0.95%
Delaware	-19.5%	Rhode Island	0.90%
Vermont	-19.1%	Utah	0.90%
Montana	-18.9%	North Dakota	0.88%
New Jersey	-18.0%	New Jersey	0.88%
New York	-17.5%	Pennsylvania	0.79%
North Carolina	-17.4%	Connecticut	0.75%
Rhode Island	-16.3%	Maine	0.74%

Borders with the Greatest Differences Due to Marginal Tax Rates

It is interesting that having a bad tax structure does not necessarily disadvantage firms at the border if their neighbors have even higher marginal tax rates. Hence, New York's relatively high marginal tax rates do not cost it as much because its neighbors, Vermont and New Jersey, have even higher marginal tax rates.

In Table 3, we list the ten borders with the greatest differences in employment and in firm death rates attributable to differences in marginal tax rates. While the average effect of taxes may be modest, some of the differences at state borders are quite large. However, the effects differ depending on the measure of economic performance used, as the correlation between the two measures is only 0.06. Using induced employment differences as the gauge, the greatest cross-border employment difference due to marginal tax rates is the 32% employment advantage Nevada and Washington have over Oregon at their respective borders. Nevada, Washington, and Wyoming are on the favorable side of 8 of the 10 biggest border employment gaps. However only two of these borders, Wyoming-

Table 3. Economic advantage from favorable marginal tax rate policies at state borders

A. Tax-induced percent difference in employment levels at state borders

Advantage	Disadvantage	Employment Advantage	Death Rate Advantage Rank
Washington	Oregon	0.321	100
Nevada	Oregon	0.317	79
Nevada	California	0.300	40
Wyoming	Montana	0.239	76
Washington	Idaho	0.225	15
Nevada	Idaho	0.221	10
South Dakota	Montana	0.218	34
Tennessee	North Carolina	0.207	89
Wyoming	Idaho	0.205	8
Wyoming	Nebraska	0.198	43

B. Tax-induced percentage point difference in firm death rates at state borders

Advantage	Disadvantage	Death Rate Advantage	Employment Advantage Rank
South Dakota	Iowa	0.734	16
South Dakota	Minnesota	0.703	11
Missouri	Iowa	0.515	95
South Dakota	North Dakota	0.489	33
Colorado	Utah	0.484	Opposite advantage
Illinois	Iowa	0.448	40
Nebraska	Iowa	0.437	93
Wyoming	Idaho	0.431	9
Wisconsin	Iowa	0.428	Opposite advantage
Nevada	Idaho	0.403	6

Note: The first state has the economic advantage from its tax policy compared to its neighboring state. Border rankings are based on the relative size of the estimated tax effects at state borders using the coefficients in Table 1. The rank correlation between the tax-induced differences in employment advantage and the firm death rate advantage is 0.06

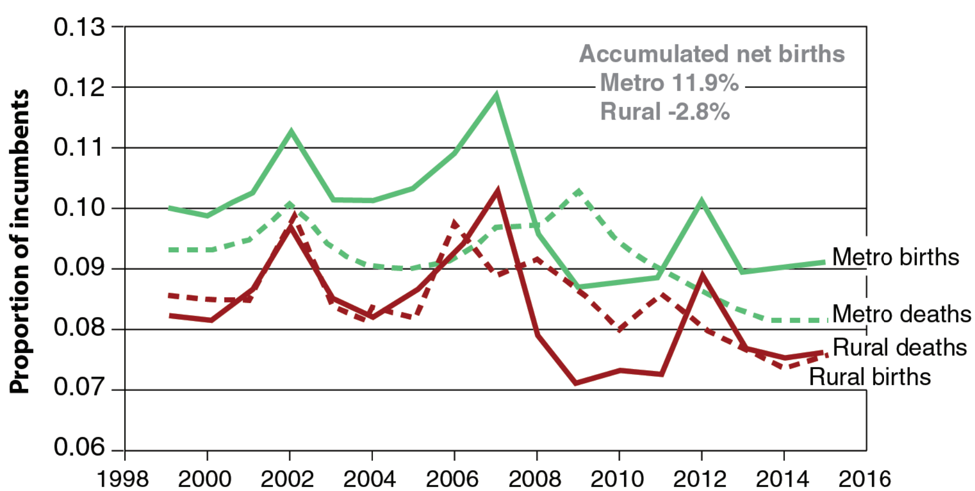


Figure 2. Firm birth and death rates in metropolitan and rural markets, 1999–2015

Note: Authors' computations based on the U.S. Bureau of the Census *Statistics of U.S. Businesses*

Idaho and Nevada-Idaho were also among the 10 largest gaps in terms of firm death rates. The largest percentage point advantage in firm survival attributable to tax policy is South Dakota's 0.7 percentage point advantage over Iowa and Minnesota. Two of the 10 largest border differences in firm death rates, Colorado-Utah and Wisconsin-Iowa, actually have reversed advantages in employment levels.[1] When examining differences in firm exit rates, Iowa is on the disadvantaged side of five borders, a consequence of an atypically high marginal tax on corporate income.

The Implication for Firms in Rural Markets

In Figure 2, we show what has happened to firm birth and death rates in urban and rural markets. Both firm birth rates and firm death rates have fallen over time in both the most and least agglomerated markets. However, in metropolitan markets, the firm birth rates exceed the firm death rates, thus the net number of firms increased 11.9% since 1999. In rural markets, firm death rates are higher than firm birth rates, and so there has been a net 2.8% decrease in the number of firms. Lacking the advantages of agglomeration, rural markets cannot attract enough entry to replace their exiting establishments. And that is why metro and large urban markets are the only ones to have experienced average employment growth in Figure 1.

References

Artz, G.M., Y. Kim, and P.F. Orazem. 2016. "Does Agglomeration Matter Everywhere? New Firm Location Decisions in Rural and Urban Markets." *Journal of Regional Science* 56(1): 72–95.

Bartik, T.J. 2017. "A New Panel Database on Business Incentives for Economic Development Offered by State and Local Governments in the United States." Upjohn Working Paper.

Marshall, Alfred. 1890. *Principles of Economics*. London: Macmillan. ■

[1]Complete lists of the border rankings are in the Appendix.

The Adaptation of Soy-corn Double-cropping to the Brazilian Savanna

by Guilherme DePaula and Ary Fortes
gdepaula@iastate.edu; ary.fortes@embrapa.br

TWO REMARKABLE innovations have enabled Brazilian farmers to compete with the soy and corn exports of their US counterparts—breeding soybean varieties for low latitudes using biological nitrogen fixation (BNF) (Hungria, Campos, and Mendes 2001; Alves, Boddey, and Urquiaga 2002; Dobereiner 1997) and the adaptation of a double-cropping soy-corn system for production in the savanna.

The introduction of BNF soy alongside improved soil management practices in large-scale mechanized plantations led to rapid agricultural expansion in the Brazilian savanna. Figure 1A shows the rapid growth in Brazil's soy exports. In the mid-1990s, Brazil was exporting only 3–5 million tons of soy per year, about 25% of annual US exports. Twenty years later, Brazil and the United States are competing to become the largest soy exporter with annual exports close to 50 million tons each (FAO 2019).

It is only natural to question whether such a unique large-scale technological transformation, also known as the "The Miracle of the Cerrado" (The Economist 2010), can be replicated. Can we systematically adapt crops for large-scale production in different soils and climates? Although we cannot yet answer this question, it is encouraging to find two innovations that broke through the biophysical barriers in a savanna region previously considered to be unsuitable for farming.

The second innovation, the focus of our research project, was the adaptation of a double-cropping soy-corn system for production in the savanna. In such a double-cropping system, farmers plant two crops in one season. Farmers first plant soybeans in October for harvest around February; and, immediately after the soybean harvest, farmers plant corn for harvest in May, June, and July. In 2018, 50% of soy plantations in the warm savanna were soy-corn double-cropping systems (CONAB 2019). Figure 1B shows the resulting increase in Brazilian corn exports. From 2000 to 2015, Brazilian corn exports increased fivefold to about 28 million tons per year.

Asian Soybean Rust and the Adaptation of Double-cropping to the Savanna

In contrast to the development of BNF soy, which started in the 1960s with a decades-long government-sponsored plant breeding program, the adaptation of the soy-corn double-cropping system was a response to a change in the soy growing season in the savanna. Starting in 2007, the soy growing season in the savanna was delayed and shortened to control the development of the fungi *Phakopsora pachyrhizi* that causes Asian Soybean Rust, a severe soybean disease that can spread by wind over large distances. Asian Soybean Rust was first observed in Brazil in 2001 and spread rapidly, affecting 60% and 90% of soybean plantations in the 2001/2002 and 2002/2003 seasons, respectively. As a result, Brazilian farmers lost approximately 8.5 million tons of soybeans from 2001 to 2003 (Godoy et al. 2016; Yorinori, Junior, and Lazzarotto 2004).

The incidence of Asian Soybean Rust in Brazil changed the growing season in two ways. First, the Brazilian

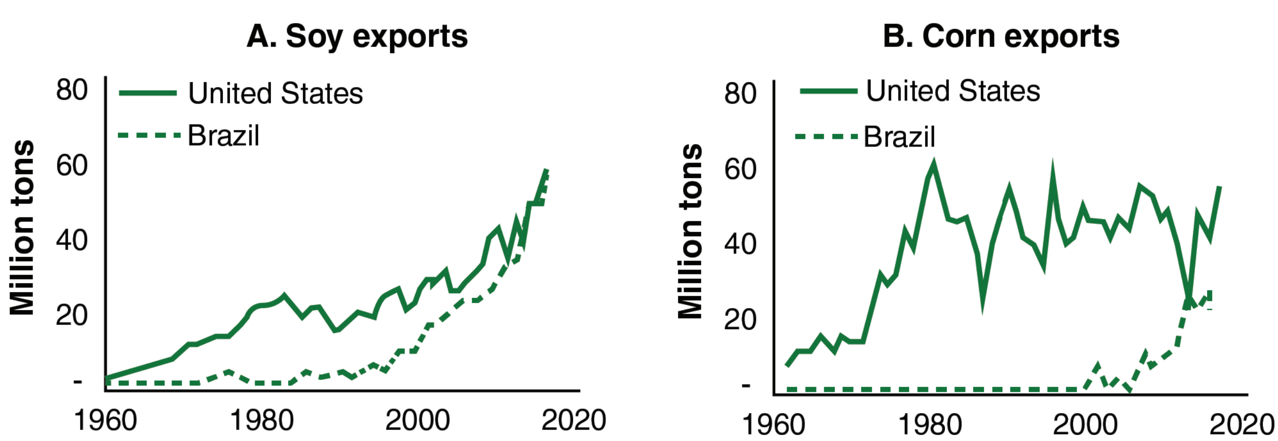
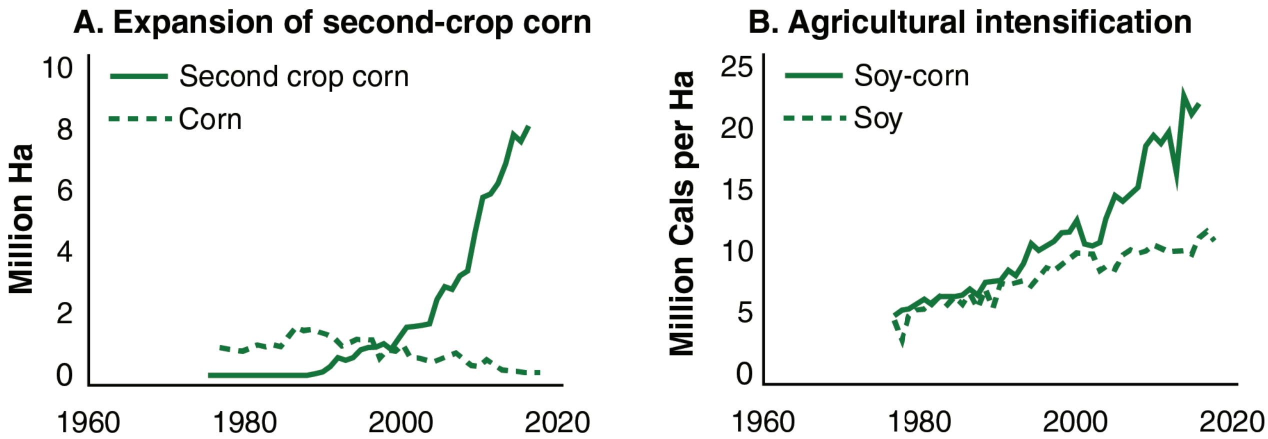


Figure 1. Historical trends in soy and corn exports, US and Brazil, 1960–2019
Data source: Food and Agriculture Organization Statistics (FAO 2019)



.**Figure 2. Soy-corn double-cropping expansion in the Brazilian Savanna**
Data source: Brazilian National Supply Company (CONAB, 2019).
Note: Data is for three savanna states in Brazil: Mato Grosso, Mato Grosso do Sul, and Goias. The 2019 data represent projections from CONAB. The calorie content for corn and soybean are 1,690 and 1,590 calories per pound respectively (Williamson and Williamson 1942).

government introduced new regulations to create a soybean-free period to stop the development of the fungi during the off-season, effectively changing the start of the soy growing season. This soybean-free period was first implemented in the savanna states of Mato Grosso, Goias, and Tocantins in 2006 and was later adopted in other producing states. Second, farmers had to anticipate the soybean harvest to reduce the risk of large losses as the Asian Soybean Rust fungi develops, strengthens, and spreads throughout the season. In particular, climate conditions suitable for soy development, such as high precipitation, favor the growth of the fungi.

The change in the soy growing season in the savanna induced a race for the experimentation, development, and diffusion of early-maturing soy varieties. The successful adoption of these new soy varieties then allowed farmers to introduce a second crop in the same season. In particular, Brazilian farmers found that the double-cropping system was productive in soils with better water retention capability, such as clay soils. Farmers started using hybrid corn varieties with an early maturation cycle for short-season production and intensified the management of the second crop with applications of nitrogen and phosphate fertilizers to improve soil fertility and the introduction of a third crop after corn, a grass (Braquiara) to conserve soil. As a result, the average yield for first- and second-crop corn has converged in the savanna in the past three decades, reaching an average yield of 3.8 tons per hectare. Specifically, second-crop corn yields have increased by 2.3% per year, while first-crop corn yields have improved by 1.9% per year (IBGE PAM 2019). Figure 2A shows the rapid expansion of the area harvested with second-crop corn in the savanna. From 2006 to 2019, the annual compounded growth rate for the second-crop corn harvested area was 12%. By contrast, the area harvested with corn planted as a first crop (summer crop in Brazil) decreased by 50% to 350,000 hectares.

Policy Implications

The expansion of large-scale multiple-cropping systems changes the calculation of important agricultural policy parameters, particularly the responsiveness of acreage and yield to price changes. The calculation of these price elasticities, which are central to the analysis of land-use change, biofuel expansion, and deforestation, has ignored large-scale multiple-cropping systems. The definition of agricultural productivity changes when considering a double-cropping system. Figure 2B shows the change in the agricultural productivity of single-cropping soy and double-cropping soy-corn systems in Brazil measured in terms of calories per hectare. In 2018, the average productivity of the double-cropping soy-corn system in the savanna, about 22 million calories per hectare, was twice that of single-cropping soy plantations. If global corn prices increase, Brazilian soybean farmers may thus choose to plant corn following their soy harvest without expanding into new land, benefiting from economies of scale from double-cropping systems (e.g., lower fertilizer costs due to soy nitrogen fixation). If soy prices increase, Brazilian farmers operating single-cropping systems may venture into new land that can be profitably farmed only with multiple-cropping systems, resulting in an increase in the supply of both corn and soy. The supply functions of these commodities will then tend to become more elastic.

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Patent Expiration, Product Concentration, and Glyphosate Use: A Tale of Unexpected Consequences

by GianCarlo Moschini, Edward Perry, and David Hennessy
moschini@iastate.edu; edperry@ksu.edu; hennes64@msu.edu

PATENTS ARE a powerful tool for asserting intellectual property rights—they offer innovators profitable exclusive rights, thereby providing incentive for critical (and costly) investments in research and development. However, this exclusivity is limited in time. After 20 years (from application), patents expire and generic producers can practice the invention. The enhanced competitiveness of the market typically brings additional benefits to final users. Not much is expected to go wrong when a critical patent on a major product expires—but, as articulated in a recent CARD study (http://bit.ly/CARD19wp588), glyphosate provides an unusual tale.

Glyphosate is the world's most used herbicide. Much of its popularity can be traced to the widespread adoption of genetically engineered glyphosate-tolerant crops. Despite its huge commercial success among US farmers, glyphosate has also stirred some controversy related to the emergence of weed resistance, as well as ongoing litigation for its alleged link to cancer. However, our investigation concerns a narrower point—namely, how changes in the formulation of glyphosate products (increased concentration of its key ingredient) impacted US corn and soybean farmers' glyphosate usage behavior. To perform this investigation, we relied on a large, proprietary farm-

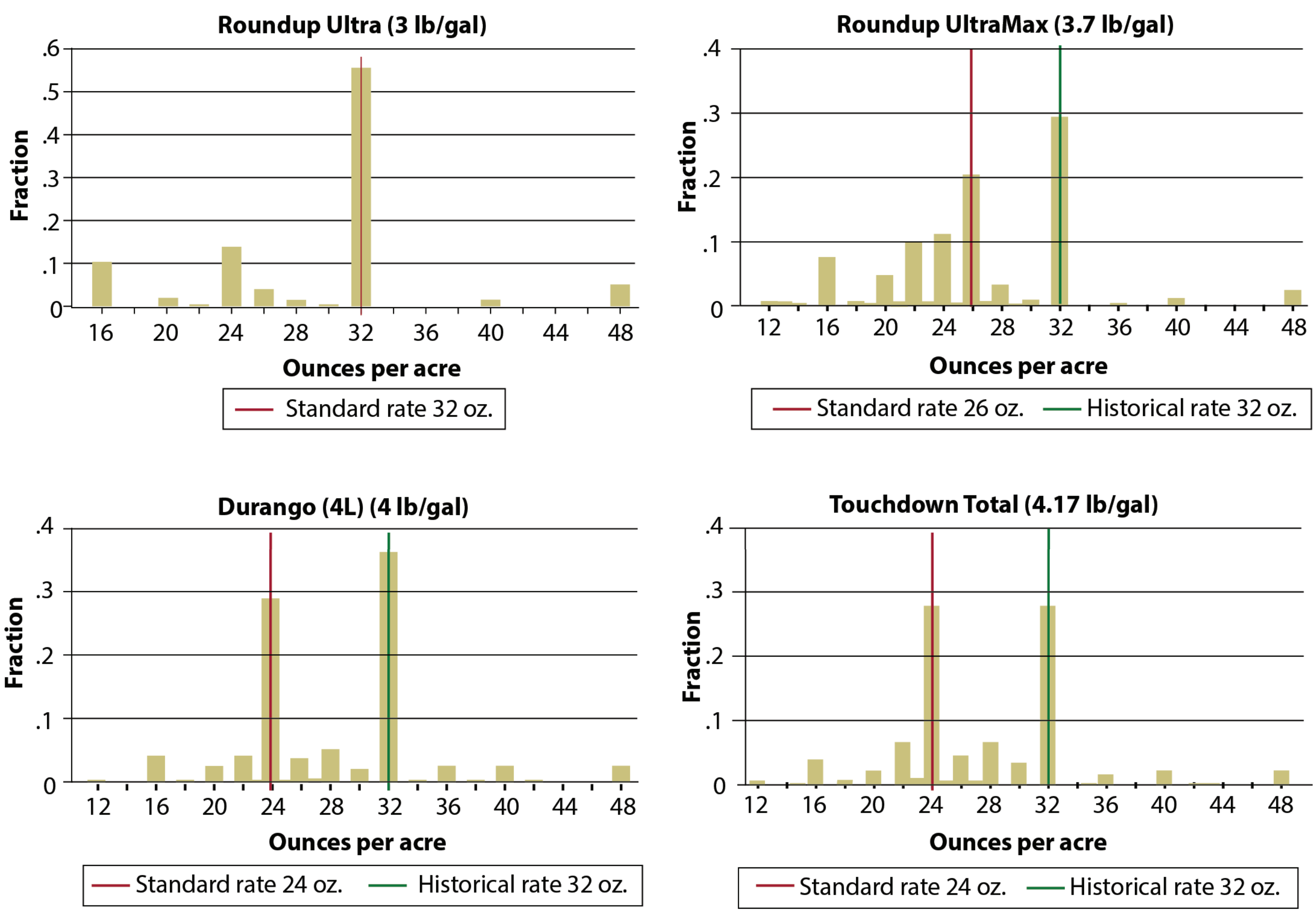

Figure 1. Selected commercial glyphosate product histograms, 1998–2011 [y-axis: fraction of applications; x-axis: application rate (oz/acre)]

Note: Product concentration level in parentheses. The "Standard Rate" is the product-specific rate for the standard field rate of 0.75 lb/acre and the "Historical Rate" is the pre-patent expiration standard rate of 32 oz/acre for 3 lb/gal products.

level dataset of 191,789 glyphosate application decisions made by US corn and soybean farmers from 1998 to 2011.

Prior to 2000, the US glyphosate market was a monopoly. Virtually all farmers purchased one formulation of Monsanto's Roundup, which contained 3 lb/gal of the acid glyphosate in the form of an isopropalymine salt. The standard recommended field dose for a single application of glyphosate was 0.75 lb/acre, which implied a product-specific rate of 32 fl oz/acre with 3 lb/gal products. This is indeed the rate that the majority of farmers used. Following the patent expiration in 2000, new products with higher concentration levels also entered the market (e.g., products with 3.7, 4, and 4.5 lb/gal). As such, the standard product dose was lowered on the labels of these higher concentration products. As farmers adopted higher concentration products, however, a strong pattern emerged—many farmers were applying them at 32 fl oz/acre, the pre-patent expiration standard rate for 3 lb/gal products.

To illustrate this remarkable tendency, Figure 1 shows histograms of application rates for four of the most popular commercial glyphosate products in our data. The red line indicates the product rate for a standard single dose of glyphosate (0.75 lb/acre) for each product and the green line marks the rate of 32 fl oz/acre, the historical product rate for a standard application of 3 lb/gal products. As expected, there was significant clustering at the standard rate for all products. For example, the standard rate for Roundup UltraMax was 26 fl oz/acre, and about 20% of applications were indeed at this rate. However, what is more remarkable is the other clustering, which occurs at the green line, or 32 fl oz/acre. For certain products, this was the most common application rate, despite the fact that the label instructions for these newer products never explicitly suggest 32 fl oz/acre.

What could explain this seemingly anomalous behavior? In addition to old-fashioned confusion, as may arise in more complex environments, we argue that a good part of the story is inertia—farmers relied on *habit*, or rule of thumb, in choosing the application rate when confronted with newer, more concentrated products.

The use of habit and rule of thumb is not unusual in complex decision contexts. Modern crop farming is a technologically intensive business where producers need to manage production, storage, distribution, and marketing, while also dealing with finance, weather, pests, regulations, and other hazards. Successful farming in the face of such complexity leaves latitude for apparent inefficiencies or unintended consequences. One activity that has become increasingly complex is pesticide application. There are hundreds of pesticide products, differing in attributes such as compound, concentration, salt, and surfactants. With so many differences in both attributes and application situations, pesticide products can come with instruction labels exceeding 50 pages in length. As a result, various extension webpages have been written to help farmers navigate the choice and use of hundreds of different pesticide products. (Indeed, recently, herbicide label complexity has been cited as a source of spray drift by farmers who applied Dicamba herbicide to newly-released Dicamba resistant soybeans.)

It is important to emphasize our study does not suggest that farmers should never use higher herbicide application rates. Some circumstances may indeed warrant higher rates (for example, high weed pressure). Rather, what the data reveals is that some producers used higher doses with higher concentration products at disproportionate rates by focusing on the old 32 fl oz/acre application rate.

As with any statistical analysis, it is important to consider the possibility that other factors may have contributed to the observed behavior. The model of the study does, in fact, establish that falling glyphosate prices (because of increased market competitiveness) also promoted glyphosate use. Still, having accounted for the contribution of other factors, such as prices and farmer demographics, we find that a significant component attributable to the concentration effect remains—other things equal, when farmers used a more concentrated product, their overall use of glyphosate increased.

How much of a difference did the "concentration effect" make on the overall use of glyphosate? To answer this, we develop a carefully structured counterfactual analysis centered on having identified a set of "rationally attentive farmers" who used the correct dosage with more concentrated glyphosate products early on. Our conclusion is that, had all farmers behaved as rationally attentive farmers, US corn and soybean farmers would have used 4.4% less glyphosate from 2003 to 2011, saving an average of $59 million per year.

These findings have some broader implications for producers, extension programs, and regulation. First, they imply an opportunity to reduce the use of glyphosate, and potentially weed-tolerance selection pressure, without losses in efficiency. In addition to increasing profitability, such a reduction in herbicide use would mitigate any adverse effects that the chemical has on ecological and human health. Our work also suggests an

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Volatile Prices and Profit Margins

by Lee Schulz and Chad Hart
lschulz@iastate.edu; chart@iastate.edu

THE CALENDAR year 2019 has been interesting for agricultural markets. We began the year with record supplies for all of Iowa's major commodities. However, trade disputes have cast a cloud over growth in crop and livestock usage and weather events and foreign disease outbreaks have sparked quick reversals in commodity prices. Since the first of the year, corn prices have fluctuated by $1.10 per bushel, soybeans by $1.55 per bushel, hogs by $28 per hundredweight, and cattle by $16 per hundredweight. And we're still only halfway through the year.

The hog industry has seen both gains and losses from trade this year. Initially, the various trade disputes the United States had/is having with other countries had a negative impact on prices and profit margins. For the first couple of months in 2019, lean hog futures generally drifted lower. However, the ramifications of the African Swine Fever (ASF) outbreak in China provided a significant trade boost in late March and April, which pushed hog prices over $100 per hundredweight. Since then, hog prices have settled back down, such that mid-June hog prices are equal to prices at the beginning of the year (about $82 per hundredweight).

The hog price swings directly translate into hog profit margins. Margins drifted lower the first part of the year, spiked with the trade rush from ASF, and have hovered lower as we enter summer. Figure 1 details the current (mid-June) outlook for hog margins. For livestock margins, we calculate the return to producers from selling the animal after subtracting the costs of initially obtaining the animal and the feed needed to bring it up to market weight. In general, margins over $40 per head would be considered profitable, as roughly $40 per head is needed to cover the additional costs in raising hogs. As Figure 1 shows, current projected margins for hogs are profitable for most of 2019 and 2020—the recent price slide has reduced profit margins, but not eliminated them.

For the cattle market, prices started the year on an upward trend that didn't break until mid-April. A combination of higher projected supply and feed costs have since put a damper on cattle prices. Prices quickly declined in late April and have continued to head lower. Currently, compared to the first of the year, cattle futures are down roughly $12 per hundredweight. Cattle margins mostly followed along with prices, improving from January to April, then deteriorating after. Figure 2 displays the current cattle margins—a rough breakeven is $150 per head. Cattle currently moving through the sale barn are profitable, but profitability looks more elusive in the third and fourth quarters of 2019, before returning in the spring of 2020. Seasonal pricing patterns take profitability lower again in the summer of 2020.

For both livestock sectors, projected feed costs have flipped from low and steady to high and volatile. One of the major keys to continued profitability for both cattle and hogs will be how feed costs (crop prices) continue to evolve this summer and fall. Corn and soybean stocks were at very high levels as we entered 2019. The abundance of available crop held crop prices in check for the first four months of the year. However, the extremely moist conditions across the majority of the Great Plains and Midwest for the bulk of spring have delayed planting and raised concerns of much smaller crop production for 2019. Those concerns are now the major driver for crop pricing this summer.

New crop corn prices, as measured by the December futures contract, started the year in the $4 per bushel range. With the approach of spring and planting season, corn prices began to fall, especially with the announcement of an intended hike in corn area for 2019 in the March USDA Prospective Plantings report. The low in corn prices hit in mid-May, but since then, corn prices have increased by $1 per bushel. The increase is being spurred by the record slow planting

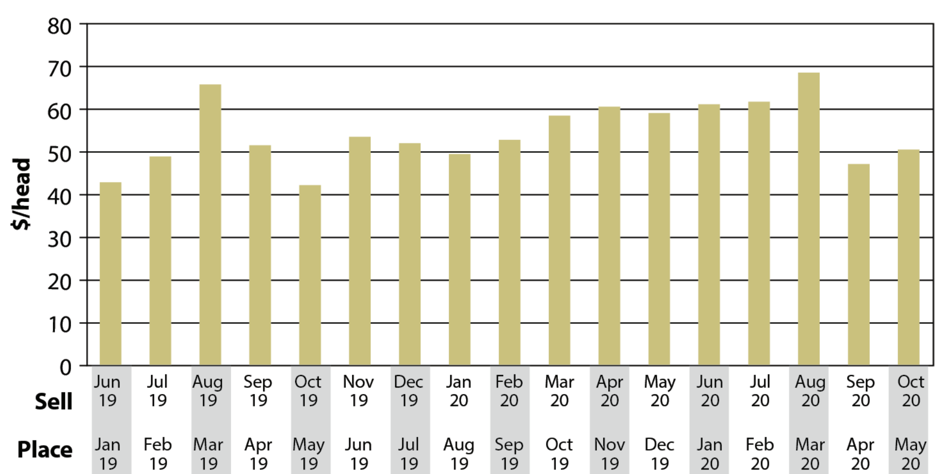

Figure 1. Projected hog margins

progress for corn across the nation. Normally, half of the nation's corn crop is planted by May 7. This year, it was May 20. The two week delay is significant as it pushes pollination into a hotter part of the year and increases the potential of a freeze impacting corn yields more likely. Within the past few days, corn prices have been at multi-year highs.

New crop soybean prices (November futures) started the year in the $9.40 per bushel range. While the general pattern in pricing follows the story from corn, the price movements themselves have been less profitable. The early year price decline was larger for soybeans than corn. By early May, soybean prices had slid below $8.50 per bushel. And while the weather delays have impacted soybeans as well, the price recovery was not nearly as substantial. Current prices are hovering just below $9.40 per bushel, so soybean prices rallied just enough to offset the declines from earlier this year.

Comparing projected crop revenues to production costs, corn has held the advantage throughout 2019. The slow degrade in corn prices earlier in the year had driven projected margins down to zero, but the weather rally has significantly increased profit margins for those who did get their corn planted. The trade issues had already put soybean margins at zero to begin the year. Early concerns about another big soybean crop and the escalation of trade problems drove those margins into negative territory in April and May. The planting delays have allowed a modest rebound in soybean margins, but current estimates are still below breakeven.

So, on the whole, livestock profit margins are positive, but have been slipping back. Corn returns are improving, but only because upcoming supplies are expected to be much smaller. Soybean returns are still being reduced by the lingering uncertainty in trade policy. Government support will offset some of the crop losses, via the trade aid, disaster package, and crop insurance. But the story for 2019 is definitely mixed for the Iowa agricultural economy—improvement in some areas coupled with losses in others. ■

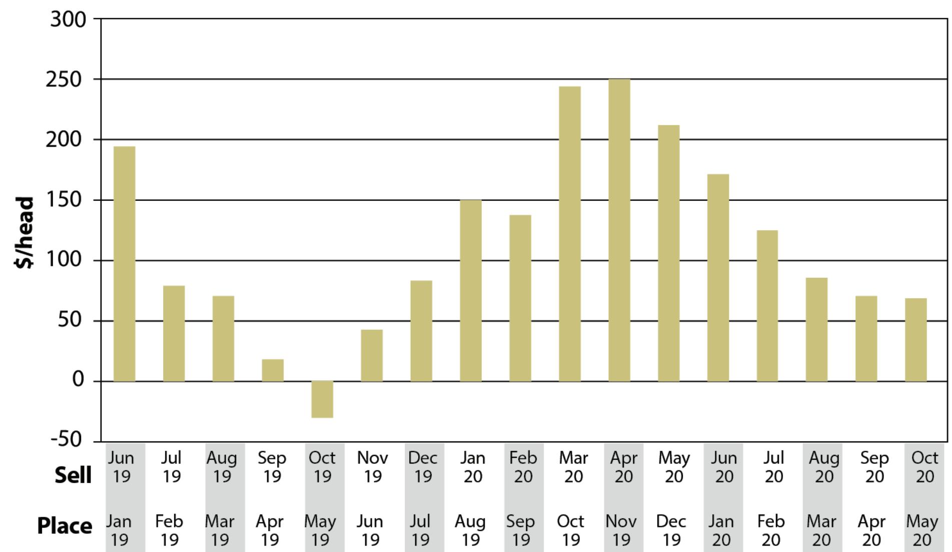

Figure 2. Projected cattle margins

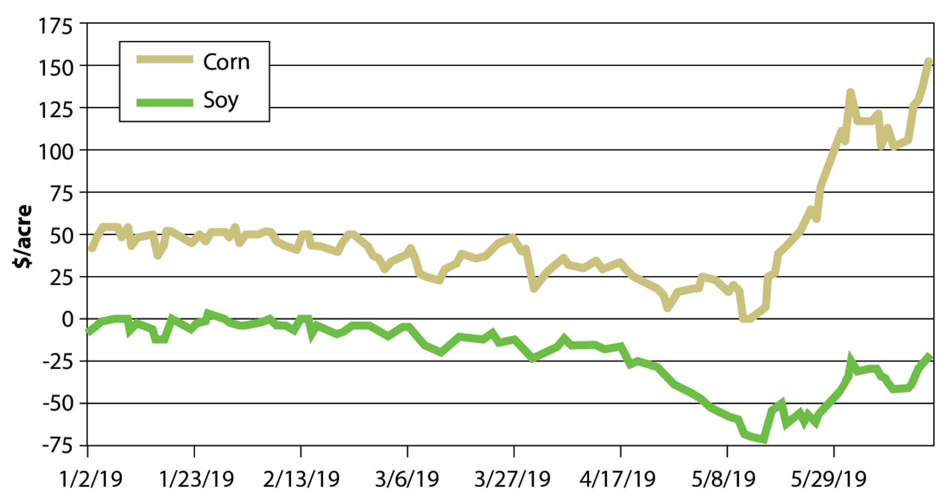

Figure 3. Projected crop margins for the 2019 crops

The Adaptation of Soy-corn Double-cropping to the Brazilian Savanna
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Perhaps the most important policy lesson from the double-cropping boom in Brazil is the interlinkage of developmental technologies, agricultural, and environmental policies. First, the policy objective behind the adaptation of soy and corn to production in the savanna is the economic development of a large low-income part of the country where land was mostly used for extensive grazing. The transition from extensive grazing to intensive commercial farming has increased rural income, migration, commodity exports, local tax revenue, and infrastructure. Second, the innovation and diffusion processes underlying BNF soy and double-cropping systems have resulted from a series of technology policy decisions, such as integrating public and private research organizations early in the process, regulating seed patenting, and opening agricultural and technology markets to private investment.

Agricultural expansion into marginal soils and climates increases yield risk. The Brazilian Agriculture Corporation (EMBRAPA) has developed an agricultural zoning system to assess climate risk for farming and inform the underwriting processes for insurance and credit. This risk management system is used to determine soybean-free periods to reduce the costs and risks associated with Asian Soybean Rust. Finally, agricultural intensification can affect the environment through leaching and the conversion of natural vegetation. The agricultural expansion in Brazil led to the revision of the Brazilian Forestry Code in 2012, designed to protect forests on private properties. Although all these policy components are incomplete and constantly evolving, the large-scale adaptation of agriculture in Brazil can inform similar agricultural expansion processes in other savanna regions to stimulate economic development and respond to environmental changes.

References

Alves, B. J.R., R.M. Boddey, and S. Urquiaga. 2003. "The Success of BNF in Soybean in Brazil." *Plant and Soil*, 252(1): 1–9.

Döbereiner, J. 1997. "Biological Nitrogen Fixation in the Tropics: Social and Economic Contributions." *Soil Biology and Biochemistry* 29(5-6): 771–774.

Brazilian National Supply Company (CONAB). 2019. https://www.conab.gov.br/info-agro/safras/serie-historica-das-safras. Accessed June, 2019.

Food and Agriculture Organization of the United Nations (FAO). 2019. http://www.fao.org/faostat/en/#rankings/commodities_by_country_exports. Accessed June, 2019.

Godoy, C.V., C.D.S. Seixas, R.M. Soares, F.C. Marcelino-Guimarães, M.C. Meyer, and L.M. Costamilan. 2016. "Asian Soybean Rust in Brazil: Past, Present, and Future." *Pesquisa Agropecuária Brasileira*, 51(5): 407–421.

Hungria, M., R.J. Campo, and I. de C. Mendes. 2001. *Fixação Biológica do Nitrogênio na Cultura da Soja*. Embrapa Soja; Brasília, DF: Embrapa Cerrados.

Instituto Brasileiro de Geografia e Estatística (IBGE). 2019. "Producao Agricola Municipal (PAM)." Available at: https://sidra.ibge.gov.br/pesquisa/pam/tabelas. Accessed June, 2019.

The Economist. 2010. "Brazilian Agriculture: The Miracle of the Cerrado." Available at: https://www.economist.com/briefing/2010/08/26/the-miracle-of-the-cerrado.

Yorinori, J.T., J. Nunes Júnior, and J.J. Lazzarotto. 2004. "Ferrugem Asiática da Soja no Brasil: Evolução, Importância Econômica e Controle." *Embrapa Soja-Fôlder/Folheto/Cartilha* (INFOTECA-E).

Williamson, L. and P. Williamson. 1942. "What We Eat." *Journal of Farm Economics* 24(3): 698–703. ■

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continued from page 8

increased focus by university extension programs on applicator understanding of conversion rates between different products, not only for glyphosate but pesticide products in general. From a regulation standpoint, there may be benefits to simplifying instruction labels with emphasis on highlighting the appropriate application rates. More generally, our work points to the need to investigate possible behavioral effects in other, related contexts (for example, antibiotic use in animal agriculture).

For more information, see:

Perry, E.D., D. Hennessy, and G. Moschini. 2019. "Product Concentration and Usage: Behavioral Effects in the Glyphosate Market." *Journal of Economic Behavior & Organization* 158(February 2019): 543–559. ■

It is with great sorrow** we **announce the passing of our colleague and friend, Georgeanne Artz, on April 25, 2019.

"Georgeanne was a leading scholar in CARD, as smart as they come, but humble and always willing to help. She shall be greatly missed not only for her regular contributions to CARD's mission but more importantly as a friend and advisor to so many. Thank you Georgeanne for your dedication. You have made Iowa State University a better place and we are all the better for having had you here." – John Crespi, Interim Director, CARD.

Artz studied at Yale University, the University of Maine, and Iowa State University. She received both the Impacting Iowans Award and the College of Agriculture and Life Sciences' Outstanding Service in Student Recruitment and Retention Award.

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