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Ethanol Policy Changes to Ease Pressures in Corn Markets: Could They Work?

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JEL Classifications: *Q42, Q48, Q18. F13, Q28*

The abrupt surge in corn and food prices in 2008 put the U.S. biofuel support policies under increased scrutiny. In the context of an active policy debate, some suggested that allowing more biofuel imports into the United States could soften the impact of ethanol on corn prices. Recent declines in commodity and food prices in the face of an expanding global recession have softened the policy debate. Whether this is a temporary reprieve remains to be seen. Links between biofuel policies and corn markets have been considered elsewhere (Tyner and Taheripour; Collins).

At least two policies are relevant in this context: a) the existing ethanol tariffs, which limit the potential for imported ethanol to displace domestically produced ethanol from corn; and b) the Renewable Fuel Standard (RFS), which leads to certain volumes of corn use as feedstock.

This article considers the potential impacts of policy changes that would allow the ethanol tariff to expire and the RFS mandate to favor feedstocks other than corn. Back-of-the-envelope analysis leads to an expectation of increased imported ethanol, less domestically produced corn ethanol, and thus a lower impact on corn prices—the presumed goal. However, the interaction between commodity markets and policies produce some unintuitive results that suggest the complexity of moderating such price impacts.

U.S. Ethanol Tariffs and Mandates

The current US ethanol specific tariff is a $0.54 per gallon tax on imported ethanol. Domestic ethanol production is also supported through a $0.45 ethanol blenders' tax credit. The tariff is set, in part, to ensure that the blenders' tax credits are not transferred to foreign ethanol producers. However, the ethanol tariff has been controversial and some policymakers have suggested that it should not be renewed when it is set to expire at the end of 2010.

The RFS affects the market differently by mandating greater and more diverse biofuel use. The broadest mandate of the RFS requires blenders to use a minimum of 11.1 billion gallons of renewable fuels in 2009, increasing to 36 billion gallons by 2022 (Figure 1A). This increased mandate is not expected to come exclusively from corn ethanol. Other renewable fuels, such as biodiesel, are also required to play a role. Indeed, much of the mandated biofuel use must come, not from corn, but from "advanced" systems. Cellulosic ethanol is considered "advanced" as it can be derived from renewable sources of cellulose, hemicellulose which comprises 20–40% of various agricultural residues, or lignin such as contained in crop residue, grasses, municipal waste, and woody biomass. Focusing on the near future allows us to sidestep the role that cellulosic biofuels might play in the RFS, the feasibility of which has been raised by Khanna. Other "advanced" ethanol systems could also include feedstocks like sugar cane, sugar beets and perhaps even sorghum. The advanced biofuel mandate is part of the overall ethanol mandate. Accordingly, use of advanced biofuels beyond certain levels could displace corn-based ethanol.

Since the type of feedstock used has no bearing on fuel quality or, by extension, on the retail fuel prices paid by consumers, differential production costs would imply different adoption paths for these biofuels in the absence of policy intervention. Forecasts suggest that conventional (i.e. corn) ethanol (CE) will be less costly to produce than "advanced" noncellulosic ethanol (OAE) in the United States which, in turn, would be less costly than cellulosic ethanol. As the RFS is currently understood, it seems likely that ethanol derived from sugar cane (presumably from Brazil) would count towards the advanced biofuel mandate, and in the absence of a tariff might be imported cheaply—perhaps even competitively with CE. Production costs for Brazilian ethanol have tended to be lower than US CE (Shapouri and Salassi). However, it would likely first be used to satisfy the advanced mandate, which is comparatively more costly for the United States to fulfill.

If in any given year the quantities of ethanol used in the U.S. market fell short of their mandated levels, fuel blenders would be compelled to handle more ethanol to meet the mandated limits. To sell more ethanol they would need to lower the retail price in order to make the ethanol blend more attractive to the retailer and the consumer. Lowering the price of ethanol can generate demand by giving consumers incentives to: 1) shift from straight gasoline to an ethanol blend (where the option exists), 2) increase the amount of fuel they are willing to buy, and 3) to buy vehicles that can use higher blends of ethanol (e.g. E85).

The last effect also depends on the pace of infrastructure development, such as retailers installing pumps to distribute higher ethanol blends. We expect consumer willingness to switch among fuels will over time lead to correlation between gasoline and ethanol prices. However, consumption may not shift quickly in response to large differences in prices (if any increase must come by expanding E85 use) or may respond very quickly (if there is substantial room for greater E10 use) (FAPRI-MU 2008b; Meyer and Thompson).

At the same time that blenders lower retail prices to meet a binding mandate, they would effectively bid up the wholesale price of ethanol through increased wholesale demand. The resulting gap in wholesale-to-retail prices represents a cost to blenders of a binding mandate. Further, because of the different RFS mandates for alternative feedstocks, their differential delivery costs including tariffs imply that this price gap may be larger for one fuel than the other at any given point in time.

The Effect of U.S. Ethanol Policy Change on Imports

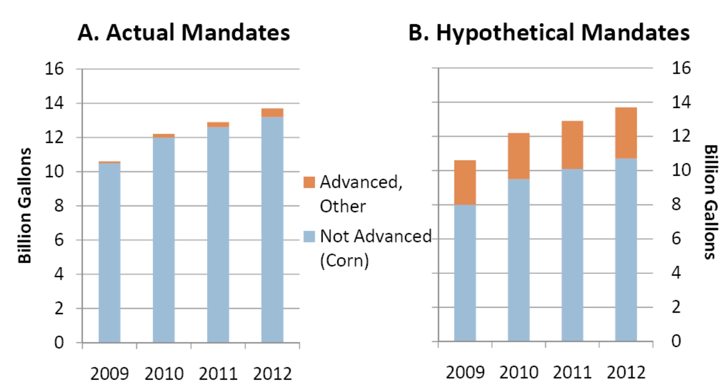
To consider the impacts of potential changes in the ethanol tariff and the RFS, we use the U.S. model of crops and biofuel markets maintained by the Food and Agricultural Policy Research Institute at the University of Missouri (FAPRI-MU 2008b). This partial equilibrium model covers supply and demand quantities, including area planted, production, other domestic uses, trade, stocks, prices, and policies. It has long been used for policy analysis, and focuses on the mechanisms of federal policy (FAPRI-MU 2008a). Here, the U.S. markets are linked to a model of international markets that includes selected countries active in the production of biofuels or relevant feedstocks and details key cross-commodity and cross-market effects in food, feed and land. The Brazilian ethanol market is explicitly modeled and its structure implies significant substitution between fuels and a delayed but strong Brazilian ethanol supply response.

The analysis starts with the construction of a baseline reflecting current market trends and policies (Figure 1A). The ethanol tariff and tax credit are assumed to remain at their 2010 levels—$0.54 per gallon for the tariff and $0.45 for the tax credit—for the period of the analysis. Maintaining the tax credit will tend to encourage consumption, although it may not affect the quantity used if the mandates are binding. Mandates for cellulosic biofuel use and biodiesel are not shown here, although the biodiesel mandate is imposed on the market. Given the near future focus of the analysis and to isolate the impacts of the policy changes of interest, cellulosic biofuel use is assumed to remain small (less than 200 million gallons in 2012) and the corresponding mandate is assumed to be waived.

From this baseline we change the prevailing policy by increasing the OAE portion of the RFS mandate, effectively lowering the role CE can play without reducing the overall ethanol mandate (Figure 1B).We separately eliminate the import tariff, thereby removing the main barrier to imported OAE. Both policy scenarios start in 2009 and all other policies are held constant or at announced levels.

In addition to changing these policies, we also set crude oil prices at different levels and evaluate their conditioning impact. Rising oil prices should lead to higher gasoline prices,

Figure 1. Elements of the Biofuel Mandates that Relate to Conventional Ethanol and Other Advanced Ethanol, 2009–2012



Notes. Other elements of the mandate are not shown here. The biodiesel mandate and cellulosic mandates are subtracted from the advanced mandate.

Source: Energy Independence and Security Act of 2007.`

Figure 2. Oil Prices and Assumptions

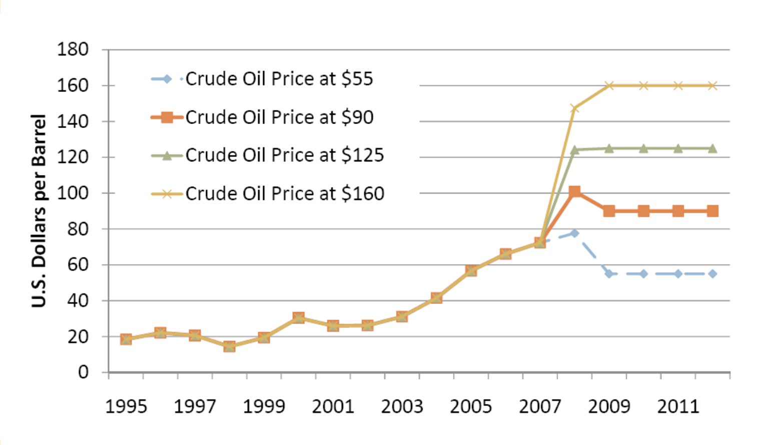
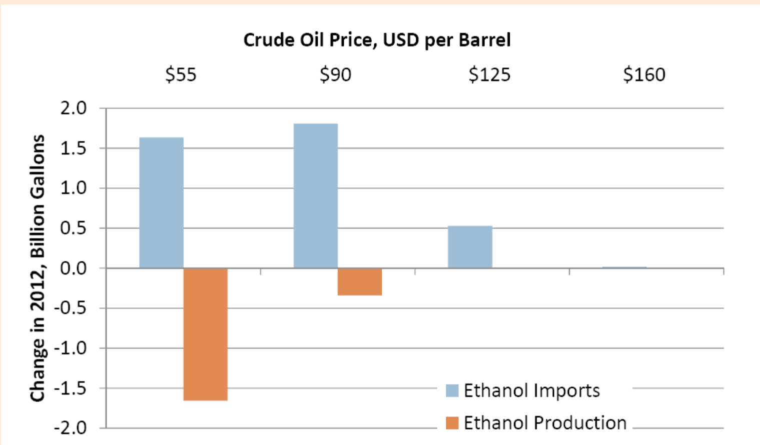


Figure 3. Effect of Changing RFS Mandate on U.S. Ethanol Production and Imports, 2009–2012 Average



lower relative ethanol prices, and greater consumer demand for ethanol blended fuel. Ultimately this could have a large impact on whether the ethanol mandates are binding or not. We explore four different crude oil price scenarios with the West Texas Intermediate price at $55, $90, $125, and $160 (Figure 2).

Results

We begin by considering the impacts of changes in the RFS. In the base case, before introducing any policy change, consumer demand for ethanol tends to exceed the overall mandated level at least until 2012, if the crude oil price is higher than $90 per barrel. OAE similarly exceeds the required amount, at least through 2012, at all oil prices investigated here.

Against this baseline, we first examine the impacts of an increase in the mandate applied to OAE according to the schedule previously illustrated in Figure 1B. This leads to more OAE imports when ethanol consumption is less than the mandated level, as in the case of $55 oil (Figure 3). At this oil price, all the mandates are binding. An increase in imports to meet the higher OAE requirement then results in an equal reduction in the domestic production as less CE is needed to meet the mandate.

At $90 oil, the higher OAE mandate becomes binding and imports are driven higher. However, the overall mandate becomes nonbinding as more of the mandate is shifted to OAE, so domestic production falls by 0.2 gallon for every gallon of additional OAE imported. At $160 oil, consumer demand is significantly higher than the mandated level as ethanol becomes less expensive than gasoline. Since consumers and not mandates drive demand and imports, the assumed change in policy has a diminished effect.

Next we test the effects of an elimination of the $0.54 tariff in 2009 (Figure 4). The $125 and $160 oil price scenarios generate consumer demand for ethanol in excess of the overall mandate. When this demand is met with less costly ethanol imports there can be a large increase in imports and domestic consumption along with a potential decrease in domestic production. At $160 oil, for example, every additional gallon of OAE imported is associated with 0.2 gallon reduction in domestically produced CE. But here, again, the mandate can play a part in determining the market outcome even though the mandate itself is not changed. If a mandate is binding, as is likely when the oil price is $55, then making imports cheaper affects the decision of whether to import or to produce ethanol domestically, but the total use stays at the mandated level. At this oil price, an additional gallon of imported OAE displaces one gallon of domestically produced CE.

Once again, consumer response to prices matters. At $160 oil, for example, high ethanol demand leads to maximum E10 use but further expansion of ethanol use is tempered by an inherently slower E85 adoption. So a tariff reduction in the context of high oil prices has a smaller effect on the ethanol quantity consumed than if the oil price were $125 and there was still room for expansion in the E10 market.

Figure 4. Effect of Eliminating Tariff on U.S. Ethanol Production and Imports, 2009–2012 Average

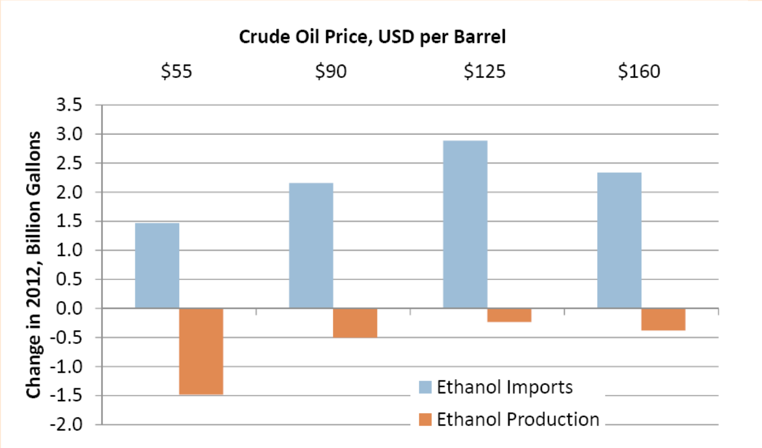
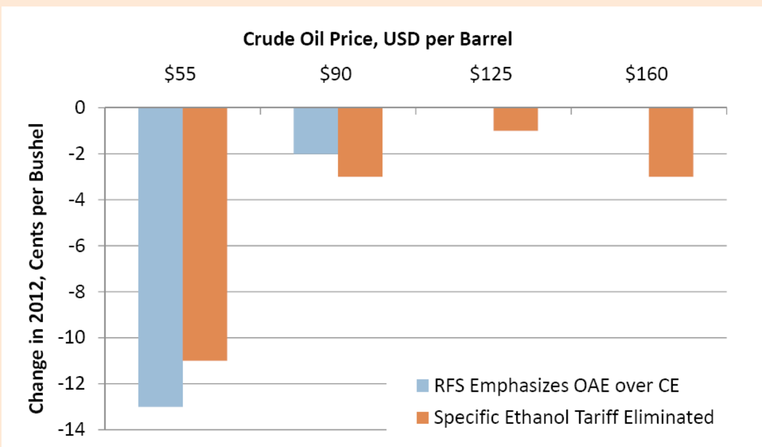


Figure 5. Effect of Policy Options on the Average U.S. Corn Price, 2009–2012 Average



Overall, the analysis suggests that changes in the mandate and tariff generally result in mild effects on the prevailing U.S. corn prices that tend to be largest when the mandate is binding (Figure 5). The corn price falls by more than $0.10 per bushel for either policy change if the oil price is $55 per barrel. The effect of reorienting the mandate towards, presumably, imported advanced biofuels has no effect on corn prices at a higher oil price because there is no effect on ethanol markets. The import tariff elimination can have an effect at higher oil price scenarios, but the effect tends to be larger when oil price is lower. Whereas imports replace domestic production at a one-for-one rate at low oil prices in either scenario because of the mandate, this is not true at higher oil prices and thus the effect on corn prices fades.

Suggestions Based on Analysis

The analysis presented in this paper suggests that the RFS may not impact corn prices with the magnitude that is often assumed. Further, implementation of policies that would presumably mitigate impacts on corn prices requires careful consideration. For example, increasing a mandate has little effect if it is not binding. Conversely, increasing a binding mandate can have large effects. In general, ethanol mandates are more likely to be binding when oil prices are low than when oil prices are high.

Ethanol tariff changes are similarly context-dependent. Tariff effects on corn markets are modest when mandates are not binding, but larger when mandates exceed prevailing demand. However, changes in the ethanol tariff tend to have a larger effect on U.S. ethanol imports and consumption compared to the changes to the RFS mandate explored here.

Our comparison of these two potential policy changes highlights the sensitivity of the impacts to external conditions, such as the oil price. At a low oil price, both policy changes would tend to increase imports and decrease domestic production, with little net effect on overall use. At a high oil price, the impacts could be quite different, as changes in non-binding mandates may have no effect, whereas the lower tariff can increase imports and overall use without any large impact on domestic ethanol production.

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Identifying Growth and Diversification Relationships in Washington Agriculture

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JEL Classification: Q12

Agricultural production is one of the few remaining examples of a "nearly" perfectly competitive industry, where products are largely homogeneous and firms are price-takers. However, due to the rapid consolidation of farms, even the agricultural production industry is at risk of market-power imbalances which have impacted other industries. Two market forces, economies of scope and economies of scale, could be behind the increase in consolidation.

Farms increase production levels and diversify product mix to exploit scale and scope economies. As a result, they increase in size, creating the potential for the largest farms to exercise market power and adversely affect consumers. Industry consolidation also has potential for negative side effects relating to the environment, especially in confined animal operations.

To anticipate the likely extent of further consolidation, we examine recent growth and diversification trends to analyze whether Washington farms of different sizes have experienced scale and/or scope economies. Scale or scope economies occur, respectively, if average cost decreases with output level or number of outputs produced. We identify and compare scale and scope characteristics for four major agricultural production industries, both for firms existing in 1992 and for firms that entered the industry by 2002. We also compare scale and scope characteristics and trends for Washington State to national trends.

Industry Selection and Empirical Measurement

We examined data from the U.S. Census of Agriculture for Washington wheat, apple, beef, and dairy producers. Value of production from each of these industries consistently ranks them among the top five agricultural commodities in the state (USDA 2006). Our data came from the three most recent agricultural censuses—1992, 1997, and 2002. We included all firms in the 1992 census that produced at least one of these commodities and for which the operator selected "farming" as the main occupation. This data sample was comprehensive and only omitted hobby, recreational, and retired farmers. However, this one exclusion removed slightly more than half of all dairy and wheat farms, 2/3 of apple farms, and 4/5 of beef farms.

Firms were ordered by size based on their 1992 agricultural sales, excluding government payments and subsidies. They were divided into nonoverlapping deciles, or cohorts, with cohort one containing the smallest 10% of farms and cohort 10 contained the largest 10%. See Table 1 for mean sales by cohort. Farms retained their original cohort assignment across censuses, regardless of whether they grew, shrank, or otherwise changed over time. This preservation of cohort assignment permitted measurement of cohort-specific growth, a key factor for determining which farm size grew the fastest, and facilitated comparison and

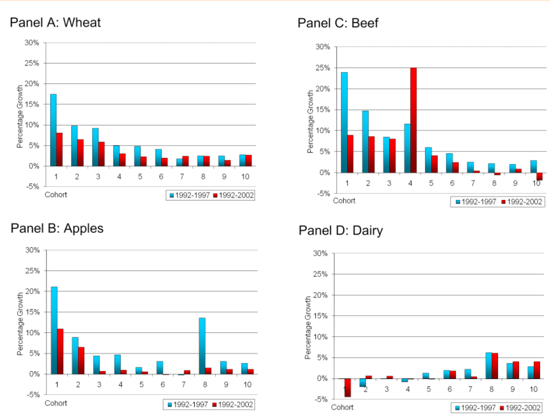
Table 1. Mean Washington Sales by Cohort and Industry in 1992

Cohort	Wheat	Apples	Beef	Dairy
1	$ 36,103	$ 18,266	$ 4,625	$ 51,792
2	$ 71,660	$ 49,064	$ 10,023	$ 125,373
3	$ 100,467	$ 79,769	$ 16,111	$ 186,526
4	$ 129,508	$ 118,030	$ 25,816	$ 243,091
5	$ 161,862	$ 157,320	$ 41,236	$ 300,511
6	$ 200,43	$ 205,417	$ 63,855	$ 370,424
7	$ 247,485	$ 275,739	$ 96,656	$ 447,275
8	$ 315,726	$ 374,317	$ 149,266	$ 591,559
9	$ 442,826	$ 558,835	$ 237,295	$ 867,413
10	$ 1,562,813	$ 2,085,375	$ 934,075	$ 1,968,144
Data source: Census of Agriculture (USDA, 1992)				

analysis across census periods. Each cohort initially had the same number of farms, but those that stopped being farmed caused these numbers to shrink unevenly across censuses.

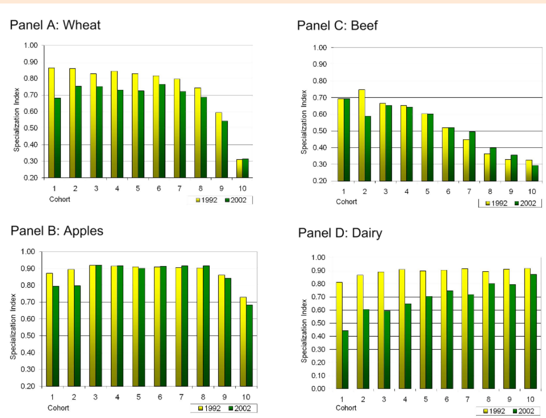
To assess scale economies and calculate commodity-specific growth tendencies, compound growth rates were calculated for the mean of each cohort in each industry. These growth rates measured the rate at which real sales, a proxy for output, increased. To measure scope economies and calculate diversification tendencies, farms in each cohort were divided into five sales categories based on the percent of total agricultural sales obtained from the sale of the main commodity group: (1) 90% or greater, (2) 75–89.9%, (3) 50–74.9%, (4) 25–49.9%, and (5) less than 25%. For example, if a wheat farm in our sample derived 65% of its sales from grain and oilseeds and 35% of its sales from other products/services, this farm fell into diversification category three. A specialization index was created as a weighted sum of the share of farms in each diversification category, with the mean sales percent for the category used as the weight. This index ranges from zero to one, with a score of one indicating complete specialization and a score of zero indicating complete diversification to other agricultural products/services.

Figure 1. Percent Growth in Real Washington Sales (1992–2002)



Data source: *Census of Agriculture* (USDA, 1992, 1997, 2002)

Figure 2. Specialization Index Scores by Washington Industry (1992–2002)



Data source: *Census of Agriculture* (USDA, 1992, 2002)

Growth by Industry

A graphical depiction of cohort growth rates for each of the four Washington industries is presented in Figure 1. Growth rates are included for two periods: 1992–1997 and 1992–2002. From the graphs, it is apparent that there was a negative correlation between initial farm size and growth rate in both periods for three of the industries—wheat, apples, and beef. The statistical correlation coefficients documented this observation; for the 10-year period, they were -0.83, -0.64, and -0.63 respectively. The dairy industry was the exception to this pattern; its 10-year correlation coefficient was positive and strong, 0.82.

Wheat farms had the strongest negative correlation between farm size and growth rate. They were also the only industry to have positive growth rates in all cohorts. For this industry, smallest farms grew the fastest, and largest farms were among the slowest-growing.

In both the wheat and apple industries, the smallest cohort of farms set the bar for growth. In the apple industry, only the growth rates of the smallest two cohorts were substantially different from the others for the 10-year period (see Panel B of Figure 1). In fact, growth rate in this industry was not strongly related to initial farm size for mid-to-large cohorts. While the correlation between growth rates and farm size was also negative for beef farms, the cohort pattern was quite different—cohort four had nearly three times the growth rate of any other cohort.

The growth pattern for dairy farms differed in even more important ways from the other industries. Besides a strong positive correlation between farm size and growth rate, surviving farms in the smallest cohort shrank by 4%. Nearly all growth of farms in this industry occurred in the largest three cohorts.

Specialization

As was the case with growth patterns, Washington wheat, apple, and beef farms followed a specialization pattern that contrasted sharply with the pattern exhibited by dairy farms. For wheat farms, the level of specialization was negatively related to farm size in all censuses, and the correlation decreased in strength over time (see Panel A of Figure 2). While the largest cohorts were the most diversified, the smallest cohorts tended to diversify more rapidly over time. The specialization scores in 1992 ranged from 0.86 for cohort one to 0.31 for cohort 10, with an average specialization score of 0.75. In successive censuses, all but the largest cohort became more diversified. The average score dropped to 0.67 by 2002.

Apple farms also exhibited a negative relationship between farm size and specialization level in each census, but the correlation was not as strong as for wheat farms (Panel B of Figure 2). The specialization scores in 1992 ranged from 0.92 for the third cohort to 0.73 for the tenth, with an average of 0.88, so apple farms were more specialized than wheat farms. They also remained more specialized. Only the smallest two cohorts and the largest cohort became much more diversified by 2002, and the average specialization score dropped only by 0.02 to 0.86.

Beef farms showed the strongest negative correlation between size and level of specialization. Panel C of Figure 2 shows a near-linear relationship between cohorts three–ten and the specialization score. In addition to having the strongest correlation between farm size and index score, beef farms had the lowest levels of specialization with average index scores close to 0.50 in both years. On average, beef farms showed a trivial reduction in average specialization score between 1992 and 2002.

Specialization levels in the dairy industry contrasted sharply to those of the other three industries. Whereas specialization index scores were negatively correlated with cohort size in the wheat, apple, and beef industries, they were positively correlated in the dairy industry (Panel D of Figure 2). Thus, among the four industries examined, dairy is the only one in which specialization *increases* with farm size. Also, on average, the dairy industry was the most specialized industry in the sample in 1992 but diversified more rapidly than any of the others. It experienced an average drop in specialization index score of 23% from 1992 to 2002.

One important insight gleaned from these results is that, in all industries, higher levels of specialization were generally associated with higher growth rates. Consequently, we infer that economies of scale, rather than economies of scope, appear to have driven farm growth.

Farm Entrants

Most farms that entered the wheat, apple, and beef industries were comparable in size to farms in the smallest incumbent cohorts. In the dairy industry, however, entrants were bimodally distributed between smallest and largest incumbent cohorts, with relatively few comparable in size to mid-level cohorts. New farms in all industries entered with specialization levels higher than the average incumbent farm. Thus, while many farm entrants failed to fully capture either economies of scale or economies of scope at the time of entry, they entered at sizes for which evidence for the existence of economies of scale and/or scope was the strongest. In all but the beef industry, new farms tended to diversify at a more rapid rate than incumbent farms, which implies they quickly recognized and captured economies of scope after entering the industry.

Comparison to National Trends

Overall, trends in Washington growth rates were similar to national growth rates in each of these industries (Melhim, O'Donoghue, and Shumway 2009). While similarities were greatest between wheat, apple, and beef farms, the national patterns reflected stronger negative correlations between farm size and growth rate for these industries. Growth rate patterns of Washington dairy farms also generally followed the trends of national dairy farms. One exception is that the smallest cohort, which grew by 5% nationally, shrank by 4% in Washington. Washington diversification trends were also similar to national trends for all but the beef industry. However, in all industries, Washington farms were generally more specialized.

The most striking difference between Washington and national trends dealt with the size of entrants in the wheat, apple, and beef industries. Average sizes of national entrants exceeded the average size of their incumbent counterparts while average sizes of Washington entrants were smaller than incumbents. In addition, farms entering the dairy industry nationwide were much larger than the average incumbent and did not follow the bimodal distribution of new entrants in Washington. In contrast, diversification patterns of new entrants in most national industries did not differ much from the pattern seen in Washington, i.e., farms entered the industry at a more specialized level than incumbents and they diversified more rapidly over time.

Implications

Census-documented changes between 1992 and 2002 imply that the wheat, apple, and beef industries in Washington *may*, in one sense, be converging toward equilibrium farm sizes. While farms in all size cohorts are growing, the largest cohorts are growing at slower rates. This finding, which also applies to the nation, could be the result of the largest farms facing diseconomies of scale, or at least diminishing economies of scale, as output expands. However, in the dairy industry, the largest farms are among the fastest growing—evidence that strong economies of scale persist. This finding suggests that further consolidation of dairy farms is probable, which could, in the long run, ultimately distort the near perfectly-competitive nature of this industry, increase the potential adverse environmental impacts from large confined animal operations, and put the economic welfare of some small agriculturally-based communities at risk. Of the four studied, it is this industry that warrants most attention. Further, to address each of these three concerns, policymakers could focus on policies that facilitate the growth and/or diversification of small and medium-sized dairies.

With the exception of the apple industry, the more highly specialized farms have higher growth rates. This fact suggests that economies of scale rather than economies of scope drive farm growth in the wheat, beef, and dairy industries. Therefore, policies aimed at increasing output of the primary commodity on small and medium-sized farms are expected to have a greater effect on farm growth than policies oriented toward increasing diversification.

Washington trends are generally comparable to national trends, especially where firm growth is concerned, and imply similar conclusions with respect to future consolidation, growth, diversification, and policy. One exception is that the average new entrant at the national level is larger than the average of incumbent farms, whereas, except for the dairy industry, the average new entrant in Washington is smaller. Diversification trends are mostly similar, but Washington farms are more specialized on average. Another notable exception is that at the national level, beef farms become more specialized over time, a trend not followed by Washington beef farms. Despite all the similarities, the few differences between Washington and national trends document an important fact. National trends are not always the trends of individual regions and states, so policies designed to achieve a specific goal in all areas may need local adjustment.

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