



QUARTERLY U.S. RURAL ECONOMIC REVIEW

Record U.S. Harvests Disrupt the Grain Market Dynamics

This quarterly update is prepared by the Knowledge Exchange Division and covers the key industries served by the Farm Credit System, including the agricultural markets and the rural infrastructure industries.

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Key Points:

- Growers and grain handlers in the U.S. are bracing for record corn and soybean harvests this fall following a healthy wheat harvest that now occupies a substantial amount of grain storage space.
- U.S. agriculture will likely test the effectiveness of the safety net provided by the 2014 Farm Bill, and U.S. growers will find the next year or two to be even more challenging than the previous two years.
- With growing ethanol demand in both the U.S. and abroad, and with a cheap and abundant grain supply, strong margins will likely support ethanol production at a record or near-record pace into 2017.
- The burden on farmers to cut costs is spreading across the supply chain. Fertilizer, seed and chemical producers and ag retailers are all under growing pressure to find their own cost efficiencies and new sources of revenue as they watch profits shrink or turn negative.
- Proposed high-profile mergers within the farm supply space include Agrium-PotashCorp, Bayer-Monsanto, Dow-DuPont, and ChemChina-Syngenta. Farmers and regulators have voiced concerns about declining competition and the potential loss of innovation in the seed and chemical space.
- Following a decrease in milk production in most of the world's top exporting regions, global dairy markets have turned a corner and prices are on the rise.
- In 2016, the U.S. sugar market has split into two markets, one with the more highly valued non-GMO sugar from cane and the other with largely-GMO sugar from beets.
- Low natural gas prices and expanding renewable energy will continue to pressure energy prices through the winter of 2016/17. Consequently, the economic viability of coal generation will remain strained and the debate around the future of existing nuclear units will continue to rage on.
- Early in August, the FCC released long-awaited details for rural support mechanisms and set ground rules to govern and facilitate the transition of rural local exchange carriers into an all-IP broadband network.

Grain Markets Brace for Record U.S. Harvests

Record high yields for corn, wheat and soybeans have disrupted the market dynamics for the 2016/17 crops. After rallying in mid-2016 in response to the reduced South American harvests, the markets now recognize that they will have to digest record large U.S. harvests. Global demand for agricultural commodities continues to ratchet higher, but the weak macroeconomic environment and strong U.S. dollar will limit U.S. export potential and result in significant increases in carryover stocks. Meanwhile, supplies of animal protein are on track to reach record highs in 2016, adding to the downward pressure on red meat and poultry prices. And at long last, dairy product prices worldwide appear to have bottomed out and begun to improve; yet the strong U.S. dollar will impede the efforts of American dairy processors and manufacturers to expand their exports.

Going forward, U.S. agriculture will likely test the effectiveness of the safety net provided by the 2014 Farm Bill, and U.S. growers will likely find the next year or two to be even more challenging than the previous two years. Farm income will remain at or below the current sharply reduced level, while direct government payments will likely shrink as much as \$4-5 billion over 2016-17. Virtually all corn and soybean acreages are locked into the Agriculture Risk Coverage Program, with support payments tied to a moving average of revenue per acre (which is trending downward). Hence, growers and agribusinesses will be under continuing pressure to lower their costs and shore up their profitability.

Global Economic Environment

Geopolitical risks continue to loom large. Amid the strong nationalist, anti-globalization sentiment, upcoming elections in the U.S. (2016), France (2017), and Germany (2017) could result in potentially disruptive political shifts. At the same time, the advanced economies soon must begin to address the challenges of aging populations within the context of already onerous government debt levels. Europe must also deal with

the U.K.'s exit from the EU, immigrant migration, and its ongoing sovereign debt issues. China will remain a significant wildcard as it seeks to maintain growth through traditional stimulus of infrastructure and state-owned enterprises, while also seeking to expand their economy's dependency on consumer demand.

Going forward, the downside risks will outweigh those on the upside.

- **The divergent paths of the central banks in the U.S., Europe and Japan will continue to inject volatility into the financial and exchange rate markets.** Zero interest rate policies (ZIRP) have prevailed for nearly eight years, with little expectation of any sharp reversal in the next three years. Negative interest rate policies now prevail in 22 countries accounting for 25 percent of world GDP.
- **The value of the U.S. dollar will remain under upward pressure given that the divergent central bank policies continue and the U.S. begins to address economic imbalances.** Having already risen dramatically in recent years, the value of the U.S. dollar has weakened recently due to deferred actions on the part of the U.S. Federal Reserve. Over the next year or two, the U.S. dollar will be under moderate to significant upward pressure as a safe haven or as a result of more favorable growth prospects relative to other economies.
- **China's rapidly rising debt levels pose a threat to its future economic growth.** In the past decade to 2015, China's total debt soared 465 percent to 247 percent of GDP, with nonfinancial corporate debt surging to 170 percent of GDP. Analysts are concerned about nonfinancial corporate borrowers' declining profitability and its implications for whether they will be able to service this burdensome debt in the face of a decelerating economy – and especially China's large state-owned enterprises.
- **Negotiations over the U.K.'s exit from the EU, upcoming elections in France and Germany, the growing immigrant migration pressures, and the continuing sovereign debt issues in other EU**

countries will generate significant political and economic instability in Europe. Overall economic growth in Europe will likely remain subdued around 1 to 2 percent during 2017-19, with the potential for even worse scenarios.

- **Emerging markets will continue to have difficulty in attracting capital as demand growth in commodity markets remains subdued.** Slower growth in China and many advanced economies will limit the potential growth in many emerging economies, particularly those that have relied on raw material and commodity export growth to drive their economies.
- **World energy markets will be a source of stability to the global economy, with oil and gas production adjusting to the new economic realities and prices holding steady at current ranges.** Going forward, the combination of a more self-sufficient North American energy market, sluggish U.S. economic growth, reduced European dependence on Russian energy supplies, China's realignment of its energy supply chains and the response from Saudi Arabia will have significant economic and geopolitical consequences.
- **Geopolitical flare-ups will continue to add volatility to the global landscape.** Turmoil in the Middle East shows no sign of abating, and Ukraine's problems are likely to worsen. Russia, Iran and North Korea continue to engage in behaviors that are likely to have a negative impact on U.S. interests. Subpar economic growth in many other regions will likely exacerbate political turmoil.

U.S. Economic Environment

Real GDP growth faltered during the first half of the year, but the economic fundamentals have not changed. They're all still weak, but no weaker than they were previously. Along with residential housing construction, consumer spending remains the economy's primary engine of growth and continued to grow at a 3 percent rate during the first half of the year. However, the contentious nature of the November elections could turn out to be a temporary disruptive factor.

“*Political uncertainty will continue to play a major role in shaping economic expectations. Awaiting the new Congress and President is a daunting backlog of contentious issues.*”

At the same time, business fixed investment actually declined while consumer-goods companies drew down their inventories to accommodate the growth in consumer spending. It was the weakness in these two spending components that dragged real GDP growth down to 1 percent on average. Year-over-year (YoY) comparisons were made worse by upward revisions to growth in 2015. Consumer spending and inventory rebuilding will likely support stronger growth rates in the second half of 2016.

Consumer spending will remain the driving force going forward. While month-to-month outlays have been erratic, cumulative spending through the first eight months of 2016 has averaged 2.9 percent above last year. Buoyed by continued job growth, low interest rates, low fuel costs, and wage and income gains, consumers should remain in a buying mood through the balance of the year. Residential housing investment will continue to bolster economic growth with housing starts continuing to recover from historically low levels and mortgage interest rates unlikely to move significantly higher.

Other sectors of the economy will be less robust. Net exports will remain a drag on growth as the strong U.S. dollar makes imports cheaper while raising the cost of exports to foreign purchasers. Federal, state, and local government spending will remain subdued with no new stimulus on the horizon. During the first half of 2016, business fixed investment spending was nearly one percent below year earlier levels. Business fixed investment will likely continue to languish amid declining corporate profits and uncertainty and political gridlock over fiscal, regulatory, health care, and immigration policies.

Political uncertainty will continue to play a major role in shaping economic expectations. Awaiting the new Congress and President is a daunting backlog of contentious issues (e.g., infrastructure investment, fiscal stimulus, tax reform, immigration, regulatory reform, health care, trade agreements, and budget deficits). Conceivably, if the post-election political climate were to improve to the point where Congress were able to reach tenable compromises on some of these pressing public policy concerns, businesses would in turn be more willing to boost their fixed investment spending, leading to an acceleration in real GDP growth above our baseline projection of 1.75 to 2.25 percent. But considering the past eight years of political discord, most analysts remain skeptical.

To some extent, the U.S. economic outlook for 2017 and beyond depends on the outcome of the upcoming election. A Clinton victory would likely mean a continuation of most public policies currently in place, except perhaps for the Trans-Pacific Partnership. A Trump victory would be widely construed as a precursor to the dismantling or re-direction of many of the nation's existing public policies, along with uncertainty and confusion about what will replace them.

U.S. Agricultural Markets

Everyone in the grain markets is focused on the size of the 2016/17 crop. The expectation of record yields and crops has changed the market dynamics. The key question now becomes one of demand growth. Export market growth has been encouraging and may get a boost from lower prices, while domestic usage is also growing with the expanding supplies of animal protein. On balance, however, the gains are unlikely to match the emerging growth in supplies. Markets are signaling per bushel 2016/17 cash prices for wheat under \$4, corn around \$3 and soybeans around \$9 – all well below last year's levels.

The need for debt across agriculture and agribusiness is on the rise, and that trend is likely to continue through the next year and beyond. Farmland prices and cash rents are on the decline, bringing some relief to renting farmers but also impairing asset values and balance

sheets for many. The pace of consolidation throughout agriculture is likely to increase assuming that the low price environment persists beyond 2016/17. Many grain elevators, input suppliers, and protein suppliers are rationalizing assets and business lines.

Grains, Oilseeds, and Ethanol

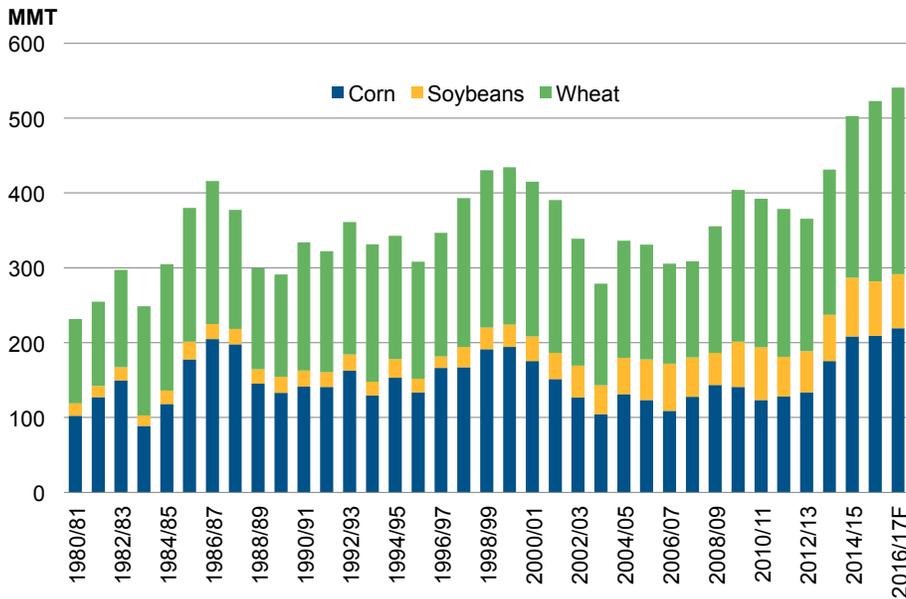
After a summer fraught with volatility and fears of La Niña crimping crop yields, farmers and grain handlers in the U.S. are bracing for record corn and soybean harvests this fall following a healthy wheat harvest that now occupies a substantial amount of grain storage space. Benign weather persisted throughout the growing season for most of the crop belt with corn and soybean yields expected to post records in the U.S. Cash values of corn and wheat have now sunk to the lowest levels in decades in some local areas as the grains compete for space in the feed mix. Corn, wheat and soybean exports, meanwhile, were rejuvenated in the third quarter thanks to shorter corn and soybean crops in South America and wheat quality concerns in Europe. Nonetheless, a persistently strong dollar and burdensome global supplies continue to drag on crop prices. *(See Exhibit 1.)*

The demand outlook for grains and oilseeds is improving with low commodity prices having answered the prayers of end users. Ethanol producers have ramped up production to record or near-record levels with cheap grain bolstering their bottom lines and as drivers increase fuel consumption. Livestock feeders, meanwhile, are also responding to affordably priced grain and soybean meal by expanding their herds and poultry flocks. While dismal grain prices are stressing farm incomes, end users are eagerly taking advantage of the supply abundance and expanding the demand base – a trend that will likely continue well into the next crop year.

Corn

U.S. corn exporters shifted into high gear during the third quarter. The late-season surge stemmed from production losses in Brazil where farmers struggled with a shorter “safrinha” corn crop caused by drier than normal growing conditions. The heavy movement of old-crop corn offered farmers and elevators the opportunity

Exhibit 1: World Ending Stocks

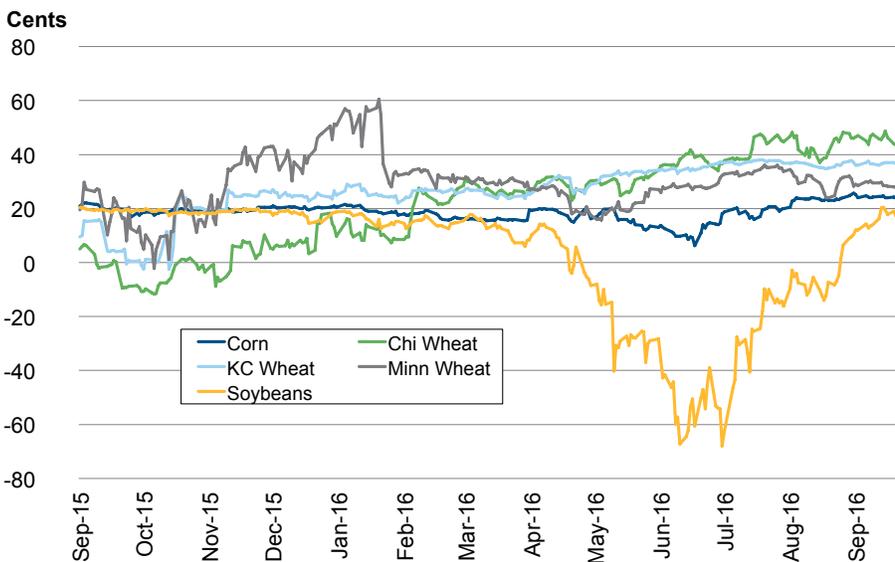


Source: USDA.

Exhibit 2: Futures Carry

Corn & Wheat: Dec '16' - July '17

Soybeans: Nov '16 - July '17



Sources: CME Group, Minneapolis Grain Exchange, CoBank.

to clear bin space and make room for the forthcoming record corn crop. Railroads likened the summer demand to levels that are more typical at harvest time.

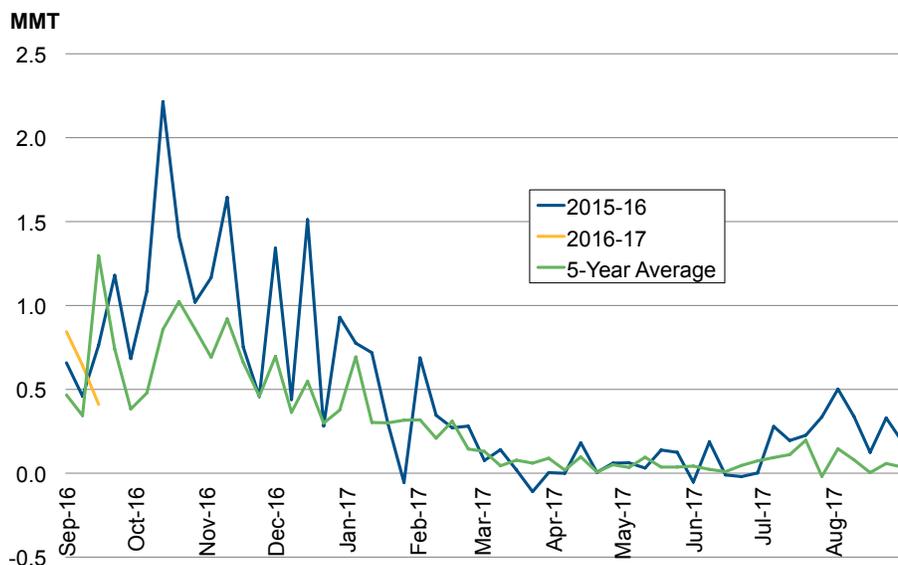
result, farmers, too, have expanded their storage space to benefit from the carry in the futures market and capture higher corn prices later.

The market will be closely watching early harvest reports in the southern Corn Belt in the weeks ahead to verify USDA's prediction of record yields. On the heels of a growing season with minimal weather stress to the crop, farmers will harvest a massive corn crop of 15.1 billion bushels and achieve a 174.4 bushels/acre yield. The record supply this year has raised concerns over a potential shortage of storage space, particularly in regions sitting on abundant new-crop wheat supplies.

Farm coops and grain handlers will soon be filling up whatever empty storage space they do have with this year's record-sized corn crop. (Soybeans do not store as well as corn and have a more seasonal demand pull.) Plus, with corn futures currently paying a hefty carry, grain merchandisers are incentivized to store the crop well into 2017. (See Exhibit 2.) Elevators have responded by expanding storage to capture the profitable carry in futures. Grain handlers also stand to benefit from buying very cheap basis this fall, offering elevators the opportunity to profit on the basis appreciation that typically occurs later in the post-harvest season.

The wide basis that grain handlers stand to buy with this fall's harvest will be a welcome change from last year's strong basis that saw little to no post-harvest appreciation. Wide corn basis, though, lowers cash prices received by farmers. As a

Exhibit 3: U.S. Soybean Export Sales to China



Source: USDA.

Amidst the record supply abundance, end users have responded to low prices by expanding usage. USDA currently forecasts livestock feeders will expand their total corn usage to 5.65 billion bushels – the highest in nine years. USDA also predicts a record-large export program of 2.175 billion bushels and record ethanol usage of 5.28 billion bushels. The steep rise in consumption, though, will not likely cause a material change in the low prices plaguing farm country. This year’s record-sized crop is still expected to leave the U.S. with the largest year-end corn inventories since 1987.

Oilseeds

China’s seemingly insatiable appetite for soybeans has continued to surprise market forecasters with an aggressive import pace that has held strong through the third quarter despite concerns of a slowing economy. (See Exhibit 3.) Production issues in South America – particularly in Argentina where floods damaged soybean crops – helped bolster demand for U.S. origin soybeans. A shortfall in palm oil production resulting from drier-than-normal growing conditions in Malaysia and Indonesia this summer also supported the surge in U.S. soybean export sales. Domestic soybean crush,

meanwhile, is running at a record or near-record pace as crushers keep up with rising demand from hog and poultry feeders that continue to expand. U.S. exports and crush are likely to continue at record or near-record levels in the months ahead.

Farmers have heeded the call and are expected to produce another record soybean crop this fall. Aided by favorable growing conditions through the growing season and into the key month of August, farmers are expected to achieve a record soybean yield of 50.6 bushels/acre with production topping 4.0 billion bushels for the first time in history.

The stout demand profile is expected to support soybean values into

next spring and likely entice farmers to expand soybean acreage further in 2017 at the expense of corn and wheat.

Market participants will soon turn their attention to South America where farmers in Argentina and Brazil are also expected to respond to enticing soybean prices and plant record-large soybean acreage. Planting will be in full swing in October with South American weather being the major market focus this winter. The National Weather Service’s Climate Prediction Center now calls for a 55 to 60 percent chance of El Niño-Southern Oscillation (ENSO) neutral conditions, meaning La Niña is not likely to develop. La Niña typically entails hot and dry weather for Argentina and southern Brazil.

However, concerns are rising about credit issues affecting planted soybean acreage in the world’s top soybean-exporting country. As Brazil continues to battle political and economic issues, soybean acreage expansion could potentially be constrained by farmers’ lack of access to capital. For the upcoming crop season, USDA currently forecasts record soybean production in Brazil of 101.0 million metric tons (3.71 billion bushels), with Argentine production improving to 57.0 million metric tons (2.1 billion bushels).

Wheat

Winter wheat planting is underway. Farmers are expected to shrink wheat seedings as prices continue to labor at 10-year lows under the weight of record global abundance. With the world expected to harvest another record wheat harvest for the fourth year in a row, wheat farmers are struggling with prices that are far below the cost of production and are even below the USDA Marketing Assistance Loan and Loan Deficiency Payments (LDP) rates. Record wheat crops in Russia and Europe have added to the supply burden with the strong dollar hobbling U.S. export competitiveness. Farmers in the Central and Southern Plains have already indicated that hard red winter wheat acreage could be down substantially for the second year in a row.

Despite the onslaught of discouraging news, wheat shipments posted an encouraging rebound in the third quarter as importers took advantage of sharply lower export prices. Quality issues with the European crop stemming from relentless rains during harvest also stimulated export sales for U.S. wheat. U.S. exports for the 2016-17 crop year are expected to be the biggest in three years.

Exhibit 4: HRS – HRW Wheat Spread

MW Dec 16 – KW Dec 16



Source: CME.

The export picture for wheat is a mixed story. USDA expects the overall world wheat export trade to reach new heights for the 2016-17 crop year. But with a cheaper currency and record exportable supplies, Russia is now slated to be the top wheat exporter for the first time in history – a title formerly held by the U.S. only a few years ago. While the world wheat trade is growing, the U.S. faces an uphill battle in capturing growing demand and regaining its former title as the world's top wheat exporter.

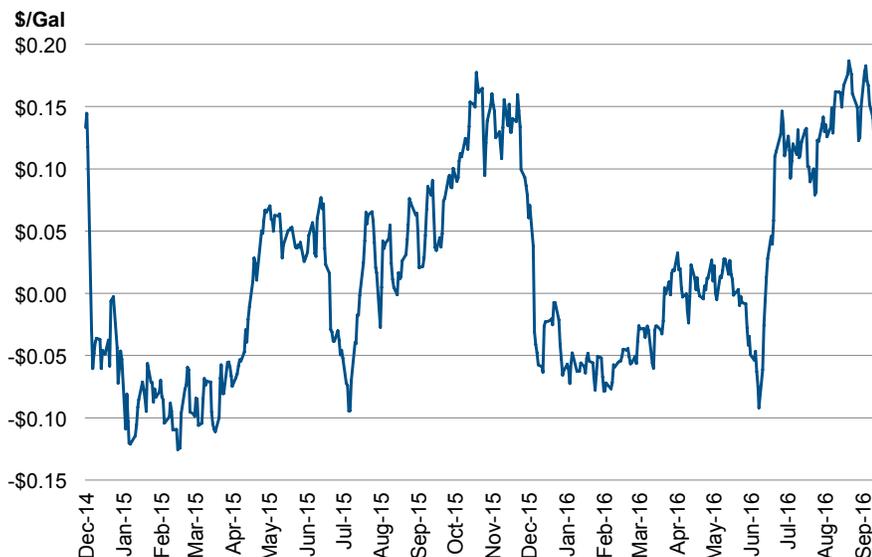
Worldwide and in the U.S., protein will be a growing concern amidst shortages of high-protein wheat supplies. Big yields typically result in low-protein crops. Because of record yields this year around the globe, protein content has suffered with quality milling wheat now priced at a premium. Low-protein wheat, meanwhile, has continued to slide in value to remain competitive with corn for inclusion into the feed mix. Hard red spring wheat, which is typically 14 percent protein, is now priced at a steep premium to hard red winter wheat, which is normally around 12 percent protein. (See Exhibit 4.)

Attention in the months ahead will turn to the southern hemisphere wheat crop where Australia and Argentina will be bringing in their harvests in late November. Australia is expected to haul in a healthy harvest of 27.5 million metric tons (1.0 billion bushels), according to USDA, with Argentina bringing in 14 million metric tons (529 million bushels), both of which are marked improvements over last year.

Ethanol

Ethanol producers have responded to cheap corn prices and strong consumer demand for fuel with record ethanol production this summer. With crude oil and gasoline prices drifting lower and encouraging drivers to spend more time on the road, and with ethanol exports holding strong, the Energy Information Administration (EIA) projects U.S. ethanol production at 990,000 barrels per day in 2016, up 2 percent YoY.

Exhibit 5: Ethanol Crush Margin
Dec 2016 Corn & Ethanol Contracts



Source: Bloomberg.

Ethanol consumption, meanwhile, is also expected to improve by 2.1 percent to 930,000 barrels per day for 2016 and 2017. The global surplus of crude is expected to last well into 2017, keeping fuel prices depressed and drivers eager to consume more fuel. The expansion in fuel demand is expected to lift ethanol usage and production to new records in the year ahead.

Ethanol producers enjoyed positive margins throughout the third quarter after suffering losses at the start of 2016 when corn prices rallied on La Niña fears. (See Exhibit 5.) The sharp correction in corn prices this summer shaved more than \$1 off the price of a bushel of corn. The grain surplus that is expected this fall will likely provide ethanol plants with affordable corn supplies and positive margins for months to come.

Corn, though, is finding pressure from competing grains like sorghum for usage by ethanol producers. According to USDA's monthly Grain Crushings and Co-Products report, ethanol plants used 5.980 million hundredweight of sorghum for ethanol in July, which compares to zero a year ago. With sorghum yielding the same number of gallons per bushel as corn and with sorghum prices trading at a steep discount in the cash market,

ethanol producers are finding still more opportunities to expand production with cheap sorghum.

The export picture is also encouraging for U.S. ethanol producers. With U.S. exports holding strong, Brazil's government is now considering whether to eliminate a tax break for Brazilian ethanol producers, which could spur some Brazilian producers to switch from ethanol production to making sugar, potentially opening more export opportunities for the U.S.

With growing ethanol demand in both the U.S. and abroad, and with a cheap and abundant grain supply, strong margins will likely support ethanol production at a record or near record pace into 2017.

The major threat to ethanol profitability lies with China's newly enacted 33.8 percent duties on U.S. dried distillers grains. China, the world's largest buyer of DDGs, sources nearly all of its needs from the U.S. The change in China's trade policy will likely trim U.S. DDG exports, making more supply available domestically.

Farm Supply

Crop input prices have been gradually receding in sync with crop prices, with fertilizer prices falling faster than those for seed and crop protection. In September, USDA lifted their projection of net farm income in 2016, noting that they previously had underestimated in prior projections how deeply farmers would cut their fertilizer, seed and chemical expenses. USDA now estimates that farmers will spend \$15.5 billion on all purchased inputs in 2016, down 5.7 percent from a year ago.

The burden on farmers to cut costs, however, is spreading across the supply chain. Fertilizer, seed and chemical producers and ag retailers are under growing pressure to find cost efficiencies and new sources of revenue as they watch profits shrink or turn negative. Ag suppliers must also contend with a strong U.S. dollar

that encourages imports of competing products, adding further pressure to prices and profits.

Crop Nutrients

Fertilizer producers, wholesalers and ag retailers are preparing for the upcoming fall fertilizer season. But with crop prices continually dragging at multi-year lows, fertilizer prices are widely expected to continue drifting south in the months ahead with only seasonal recoveries expected.

Complicating matters for the fertilizer supply chain is the pressure on farm incomes. With farmers striving to rein in production costs under the strain of low crop prices, farmers will remain reluctant buyers and will continue delaying fertilizer purchases as late as possible, thereby leaving ag retailers and wholesalers gun-shy on building inventories with demand so uncertain.

On a positive note, National Weather Service's Climate Prediction Center calls for a mostly open forecast in the most recent three-month outlook, potentially resulting in an uninterrupted fall-application season that would support strong fertilizer sales.

New nitrogen (N) production capacity will be coming online in the U.S. in the months ahead and will compete with imports on price, to the benefit of farmers. The opposite has been true for potash (P) with mines having been idled as fertilizer producers cut costs, clear excess inventory and support prices. Given the current supply abundance, prices are likely to remain weak.

The combination of flat or falling crop nutrient prices and a mostly flat consumption trend for N, P and potassium (K) has triggered a wave of consolidation through the industry in recent months. Most notably, Agrium and PotashCorp in Canada announced plans to merge. Previously, Agrium had acquired numerous ag retailer locations across Canada and the U.S. from Crop Protection Services (CPS) and Cargill AgHorizons. Agrium is the world's largest ag retailer while PotashCorp is the world's largest fertilizer producer. Combined, the merged companies would control 62 percent of the potash production capacity in North America, which will most certainly attract the scrutiny of regulators.

Most recently, the U.S. Court of Appeals for the D.C. circuit ruled that the Occupational Safety & Health Administration (OSHA) violated the law when it imposed Process Safety Management for Highly Hazardous Chemicals (PSM) requirements on anhydrous ammonia retailers. OSHA's attempt to lift the PSM exemption on ag retailers would have significantly raised costs for handling anhydrous ammonia and ultimately increased fertilizer costs to farmers.

Seed and Crop Protection

The M&A boom has enveloped the seed and crop protection space as companies seek ways to cut costs through scale efficiencies. The latest addition to the list of potential mergers is Bayer's purchase of Monsanto for \$66 billion, which would give Bayer-Monsanto a 36-percent share of the U.S. corn seed market, 34-percent of the global herbicide space, and 23 percent of the insecticide market. Meanwhile, the Dow-DuPont merger would have a 41 percent share of the U.S. corn market and 19 percent of both the global herbicide and insecticide markets; and ChemChina-Syngenta would have 25 percent of the global herbicide market and 23 percent of the global insecticide market.

Farmers and regulators have voiced concerns about declining competition and the potential loss of innovation in the seed and chemical space. Ag retailers who sell to farmers are concerned over loss of bargaining power with the merged companies and face greater pressures to also consolidate. With regulatory approval currently on the radar screen for potential mergers, companies are already considering divesting certain assets. In the case of Bayer-Monsanto, the LibertyLink seed line could potentially be divested to preserve competition with Monsanto's Roundup Ready technology.

Regardless of regulatory decisions, the forces to consolidate across the industry will remain in place with low commodity prices continuing to pressure farm income. More mergers and acquisitions are sure to unfold in the future as farmers seek to lower production costs by cutting input expense.

Animal Protein

Total red meat and poultry production is on pace to increase 2.7 percent in 2016. Improving exports and a decreased volume of imports are leading to a moderate 1.3 percent increase in domestic supplies. Following the domestic supply surge of nearly 5 percent in 2015, the marketplace is reaching a balance point with major price adjustments in the rear view mirror. Increased overall production levels are fueled by lower input prices, mainly for feed and energy. Growing supplies will likely result in gradual erosion of prices into 2017, but also improve capacity utilization for some links in the supply chain. The consumer will be the biggest beneficiary of lower prices, and U.S. meat consumption is expected to increase as a result. For producers, lower trending prices make risk management a focus moving forward.

With the increase in supplies, demand growth will be the top priority for each of the protein sectors. Overall meat supply growth will pressure individual species pricing, as they compete for share of the meat case. The animal protein complex is growing more dependent on exports,

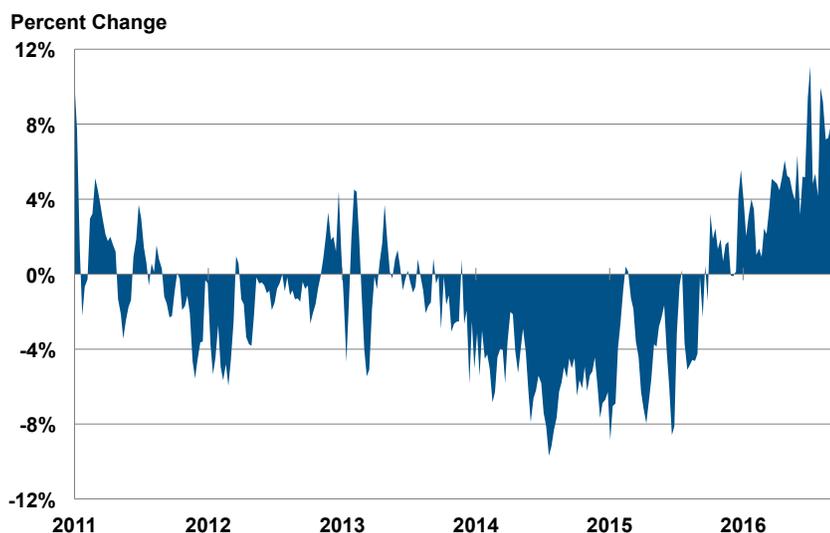
and lower meat prices will improve the competitiveness of U.S. products in foreign markets.

Beef

Aggressive herd rebuilding efforts, which began in 2014, are now appearing in the form of increased commercial beef production. (See Exhibit 6.) Annual beef production is on pace to increase 4 percent in 2016, following five years of negative growth. Given long term cattle cycle trends, beef production will certainly increase in 2017, and is projected to grow 4-5 percent.

Cow-calf operators will determine the pace of herd expansion moving forward. Recent record profitability at the cow-calf level and three years of excellent pasture and range conditions have been the catalysts for expansion. In 2016, the pace of expansion is cooling due to lower levels of profitability for the cow-calf producer. Estimated cow-calf returns have been ratcheting downward throughout 2016 as the value of feeder cattle declines. The latest Livestock Marketing Information Center projection calls for a return of just over \$70 per cow in 2016, well below the \$300 returns posted a year ago.

Exhibit 6: Weekly U.S. Beef Production, 3 Week Moving Average



Sources: USDA, Livestock Marketing Information Center, CoBank.

Average herd cull rates and cow slaughter levels are returning to longer term average levels, while heifer placements are on the rise in 2016. The decisions to retain heifers or place them on feed will be a key factor in overall feedyard placement and inventory levels over the winter and into 2017. Cow-calf profitability will deteriorate to negative levels, triggering liquidation and the next contraction phase of the cattle cycle.

Placements into feedyards are growing in 2016, with YoY increases each month starting in February. The trend of increasing YoY placements is anticipated to continue throughout 2016 and into 2017, reinforcing increased availability of fed cattle moving forward. Front-end fed cattle supplies remain much more current than a year ago due to elevated marketings. For the year to date (YTD), slaughter levels

are up 4.4 percent and weights are up slightly, yielding a 4.8 percent production increase in 2016. Carcass weights are anticipated to follow seasonal patterns, while remaining below 2015 levels.

Coming off cyclical highs in the fall of 2014, beef prices have made a dramatic correction to the tune of 40 percent in two short years. More importantly, price spreads between classes of cattle appear to have normalized in early 2016, which will assist margin operators in taking advantage of hedging profit opportunities. Under the assumption that prices will trend downward in the face of growing supplies, price rallies may be short lived but will present small windows of opportunity for hedging decisions.

Cattle feeders continue to face increased market volatility and challenging conditions in 2016, with equity losses continuing for nearly 18 months. Following last year's difficulties, the feeding sector is in a more hospitable business environment today. Increased availability of feeder cattle will improve capacity utilization, and the industry will realize greater operational efficiencies moving forward. A favorable outlook for abundant and low priced feed through 2017 remains a positive factor for feeder margins. Lower input prices for feeder cattle and grain should continue to drive breakevens lower and reduce the amount of capital required to feed cattle. As always, the development and proper execution of a sound risk management plan will be paramount to the success of cattle feeders in the face of down trending prices.

Resilient U.S. consumer demand has kept retail prices above historical norms. Retail prices have begun to retreat, but at a much slower pace than cattle values. This widening spread is typical for this phase of the cattle cycle and has contributed to excellent profit margins for retailers and packers. Packer margins have reached 20-year highs in 2016, spurred on by the widening spread between beef cutout and live cattle values as well as improved packing capacity utilization. Lengthened work week hours and increased Saturday slaughter are tools being used to better utilize current capacity. As the industry nears full capacity, its recent profitability will likely lead to increased capex spending to expand existing plants or build new

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ones. Capacity expansion will accommodate growing beef supplies and also enable packers to take advantage of high-margin, value-added processing opportunities.

The net trade balance for beef has improved markedly in 2016. Annual exports are on pace to increase 3 percent in 2016, while imports are projected to decline 8 percent. The trends of rising exports and declining imports are expected to continue through 2017, lessening the burden of larger domestic beef supplies. Beef exports accounted for 14 percent of total beef production in July, a full percentage point higher than last year.

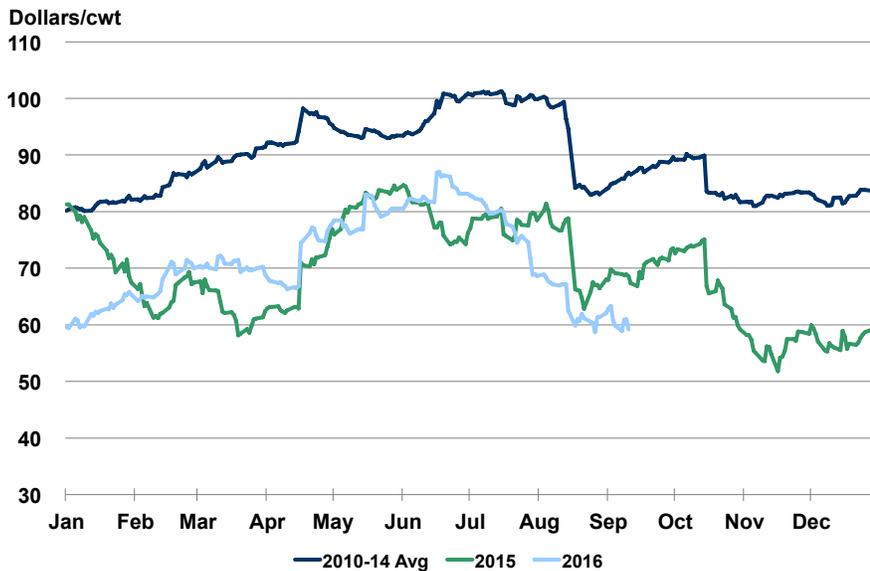
Foreign demand for U.S. beef continues to gain momentum, particularly in Asia. For the top two performers, YTD export volumes through July are up 12 percent to Japan and 23 percent to South Korea. U.S. imports of Australian beef have slowed significantly due to reduced slaughter and higher prices.

China may soon begin importing U.S. beef, too. Late in September, China announced that it has lifted its 13 year ban on imports of U.S. beef. This is a major development and will be closely watched as negotiations take shape with the USDA regarding specific trade conditions. The U.S. beef industry has had its eye on the potentially lucrative Chinese market for a long time, and U.S. producers are biding their time until the Chinese market is officially open and they can begin shipping product. China is the number two beef importing country by volume, behind the U.S., and YTD beef imports into China are up 51 percent in 2016.

Pork

The U.S. pork industry is expected to grow supply a modest 1 percent in 2016, well below last year's outsized gain of 7 percent. Strong price signals in early 2016

Exhibit 7: Daily Lean Hog Futures, Front Month Contract



Source: CME Group.

spurred producers to increase the pace of marketings and slightly reduce carcass weights (down 0.6 percent YTD). Concerns about looming slaughter capacity constraints are causing some producers to send hogs to market early. However, the elevated slaughter levels during mid-2016 have created excess supply and dragged down prices. Pork slaughter has edged up 0.5 percent YTD. Combined with the slight decrease in weights, the modest gain in slaughter left overall production essentially unchanged YTD. For all of 2016, pork production is projected to rise 1-2 percent, with similar growth currently forecasted for 2017.

Hog producers and packers have been profitable throughout 2016. Proper risk management and opportunistic marketing in the first half of 2016 shielded many producers from the effects of the recent price correction. (See Exhibit 7.) The favorable grain outlook is a positive factor for hog production margins through 2017. With consumer demand supporting sticky retail prices, growing export sales, and a growing spread between lean hogs and the pork cutout, the stage is set for excellent packer profitability. 2016 is on pace to be the second most profitable year for pork processors, only behind 2014.

Pork slaughter capacity constraints remain top of mind for the industry. Concerns remain that slaughter rates will bump up against full capacity in the fall of 2016. As a temporary respite, processors will expand weekly hours and increase Saturday slaughter levels. Longer term, five new or renovated pork packing plants are expected to come online beginning in 2017. These state-of-the-art facilities will ease capacity constraints, raise the industry standard for efficiencies, and likely put pressure on dated facilities throughout the Midwest. A combination of production growth and a shuttering of existing, less efficient plants will contribute to optimal utilization of these new plants.

U.S. pork exports are up 3 percent YTD, on pace for a forecasted increase of 3 percent in 2016. In July, exports accounted for 27.5 percent of U.S. pork production, versus 23.5 percent a year ago. Pork shipments from the U.S. to China are up 80 percent YTD as a result of China's widespread supply shortage and higher domestic prices. The combination of China's lower corn support prices and higher pork prices should spur expansion of the hog herd, but without a corresponding increase in pork production until mid-2017.

To date, the U.S. has struggled to capture additional market share of Chinese pork imports, mostly losing out to the EU. Lower prices are making U.S. pork more competitive, but China's continuing ban on ractopamine complicates the U.S.'s efforts to grow this trade relationship. The U.S. will continue to seek China's export approval for additional plants, but trade progress with China is expected to be slow.

Poultry

Broiler production remains largely unaffected by the 2015 outbreak of Highly Pathogenic Avian Influenza (HPAI). Turkey and egg layer production systems have also avoided a repeat outbreak in 2016, easing industry

fears of a recurrence. Strict biosecurity protocols that were developed and implemented in the second half of 2015 appear to have been successful in disease mitigation. The industry is optimistic that these efforts will prove effective over time; however, the risk for another HPAI incident still exists.

Broiler trade restrictions imposed following the 2015 outbreak have nearly all been lifted, which is expected to boost export volumes in the second half of 2016. In the event of future outbreaks, the industry will be focused on working with countries on more geographically specific trade bans in order to avoid blanket trade bans on all U.S. poultry products.

The broiler industry appears to be holding to its long term trajectory of steady, modest production growth. Chicks placed are currently up 0.4 percent YTD in 2016, indicating that integrators are planning very modest production growth for the remainder of 2016. Efficiency gains consisting of increased weights have begun to slow in late 2016, for two reasons. First, growing numbers of broilers are being raised antibiotic free, which decreases the overall growth rate. Second, the incidence of “woody

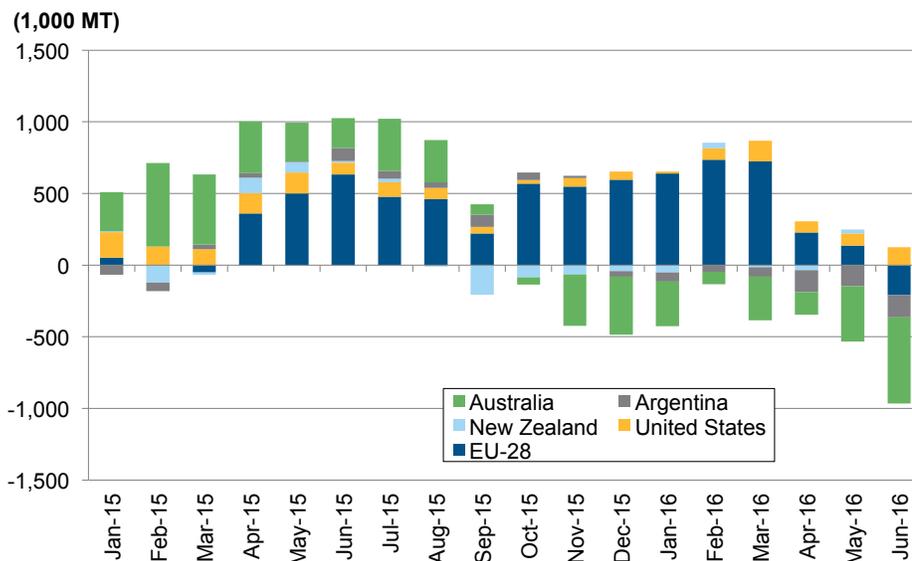
breast” has increased in 2016 and has raised calls for integrators to grow birds more slowly. Broiler production is on track to expand 1 percent in 2016, with a 2-3 percent growth rate projected for 2017.

This projection for 2017, however, comes with a few caveats. The outlook for small bird production remains the brightest, while big bird and tray-pack production systems are facing substantial pressure as they edge closer to breakeven levels. In fact, margins across the industry have narrowed from \$0.08-0.10 a pound during the past year or two to about \$0.00-0.05 a pound today. The current grain glut and expectation of lower grain prices will be supportive of integrators’ margins, but the projected growth of supply could lead to downward pressure on wholesale poultry prices.

U.S. broiler exports are the wild card in the industry’s outlook. These exports are gaining momentum in the second half of 2016, on the heels of a significant slowdown in export volumes in late 2015. After a dismal start early in 2016, annual growth of 2-3 percent is currently forecasted. Double-digit YoY export volume increases are expected for the remainder of 2016. Lower prices, combined with increasing market access due to lifting of HPAI bans, are providing a much needed boost in the U.S. broiler export program. Growing exports in step with steady production increases is critical to keeping the domestic supplies in check.

However, if the anticipated pick-up in export volumes fails to materialize, margins will get squeezed and could end up in the red. Broiler producers’ ability to adjust output levels faster than the cattle and hog sectors will remain a significant advantage. Hence, if margins were to slip into the red in late 2016, the integrators would respond quickly by curtailing their planned production for the first half of 2017.

Exhibit 8: Major Dairy Exporters – Milk Production Change from Prior Year



Source: USDA.

Dairy Situation and Outlook

Following a decrease in milk production in most of the world's top exporting regions, global dairy markets have turned a corner and prices are on the rise. (See Exhibit 8.) If export opportunities reappear and domestic demand maintains its strength, dairy product prices should continue to rise in 2017, but upside potential will be limited by continued strong milk production in the U.S. and the abundance of dairy products in storage.

The global slowdown in production has been driven by a combination of prolonged negative margins at the farm level and government intervention. The European Commission has directed €150 million toward incentivizing farmers in the EU to reduce milk production. More funds are available to be distributed by the individual member states. This is in addition to public intervention and private storage aid for skim milk powder which will last through February 2017.

While most of the major exporting regions reduced production in June, the U.S. has been the exception and has maintained a fairly steady growth trajectory. Strong domestic demand for dairy products has allowed farm milk prices to avoid the extreme lows seen in other regions of the world, and low feed prices have helped support margins. The national herd is currently the largest since 2008 and the most efficient in history on a milk per cow basis which makes any sudden reduction in milk flow unlikely.

During the first half of the year, milk production increased by just over 1 percent against the same period in 2015, while exports declined nearly 7 percent. Together, these factors have led to a buildup of domestic inventories of dairy products which will need to be worked down over the rest of the year. Recent price increases in Europe and Oceania are helping to bring world prices back in line with those of the U.S., which should help to re-open a number of export opportunities. But those opportunities will still be constrained by the headwinds of a strong U.S. dollar.

Domestic demand for dairy products has been strong, but not strong enough to keep up with the building inventories. During the past two years, the price of butter

reached the \$3 per pound mark in September. But this time around, record-high butter inventories have quelled fears of a holiday shortage, and the price has hovered in the low \$2 a pound range. Butter currently in warehouses is mostly set aside for holiday orders and should be drawn down as the season approaches. Prices are expected to hold fairly steady with little change from the current low \$2 per pound range.

In August, the USDA agreed to purchase \$20 million pounds of cheese to provide support to the industry and help reduce the surplus. These purchases will take the form of up to 11.8 million pounds of cheese to be delivered between November 2016 and March 2017. The purchases will certainly be beneficial to the food assistance programs that will receive the cheese, but will make a negligible dent in the current inventory levels which are nearly 72 million pounds above a year ago.

Nonfat dry milk and dry whey prices have been improving very gradually after dragging along at historically low levels for months. As global prices rise, these products will be the first to benefit from any return to the export markets. Orders are reportedly picking up and continued gradual improvement is expected moving into 2017.

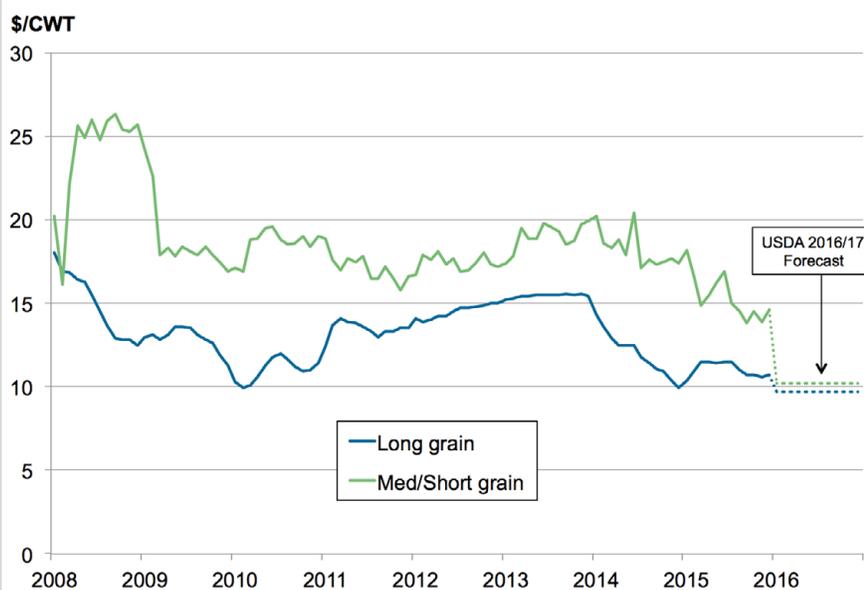
Dairy product prices should continue to improve through the remainder of this year and into next, driven by returning export opportunities and supported by a foundation of continued strong domestic demand. The gradual improvement in product prices will translate into higher farm milk prices over time, and producer margins will benefit from low feed costs. Stronger margins on the farm will keep the heavy milk supply flowing, and will temper any dramatic price increases.

Other Crops

Cotton

Improved weather conditions and expectations of higher returns relative to other crops led to an increase in U.S. cotton plantings this year. The crop is estimated to be 26 percent larger than last year's, and the largest crop since 2012/13. Lower prices and reduced competition from other major exporting countries could spur U.S.

Exhibit 9: U.S. Rice Prices Received by Farmers, by Class



Source: USDA-NASS, WAOB.

exports to the highest level in four years in 2016/17. Nevertheless, U.S. ending stocks are expected to grow 30 percent or more YoY as domestic output will exceed demand. The larger output and ending stocks will be a drag on U.S. prices, causing them to slide from \$0.58 per pound in 2015/16 to about \$0.54 in 2016/17.

The 2016/17 global cotton harvested area will be the smallest in 30 years, largely as a result of acreage declines in India, China, and Pakistan. Despite these reductions, world production is predicted to be 6 percent greater than what it was last year and represents the first YoY production upswing in six years. Global cotton consumption is expected to remain essentially unchanged from the last two seasons as cotton continues to face stiff competition from cheaper, man-made fibers in the clothing market. World ending stocks will continue shrinking, falling to levels not seen since 2011/12, as China continues to reduce its inventories.

Rice

Global rice production will set an all-time high in 2016/17 as key growing regions rebound from last year's El Niño. Although 2016/17 global consumption is also expected to be at record levels, world output should surpass usage,

resulting in higher global ending stocks and adding to an already over-supplied market. China accounts for the bulk of world ending stocks, and its inventories are expected to be the highest in 16 years.

Three strong crop years in a row have allowed most countries to build sufficient supplies. Hence, global trade will fall for the third consecutive year in 2016/17. The ongoing abundance of supply and lack of new demand in the global market will put further pressure on global rice prices.

Despite the recent flooding in Louisiana and Arkansas, U.S. rice supplies will also be ample in 2016/17. Increased acreage and yields are set to give rise to a

substantial increase in output. The increase in supply, both domestically and globally, will lead to the lowest price levels in nearly a decade. (See Exhibit 9.) Lower prices will aid U.S. rice exports in 2016/17, but financial strain on the farm will continue as per acre production costs rise YoY.

Recent news reports indicate that the U.S. is bringing a WTO case against China over its excessive use of subsidies for the production of rice, corn, and wheat. Reportedly, China's support for these crops exceeded the allowable limits by \$100 billion in 2015. China's subsidies elevate domestic prices to stimulate production, and indirectly discourage imports. A decision by the WTO is likely to take months and, thus, will have little near-to-medium term impact on the markets.

Sugar

In 2016, the U.S. sugar market has really become two markets. As food manufacturers pivot to offer non-GMO products, sugar from cane (all non-GMO) has become more highly valued than sugar from beets (almost all GMO). Thus, prices have diverged, with beet sugar prices falling and cane prices rising substantially as supplies dwindle. Typically, when cane supplies drop, Mexico

would step in and supply the U.S. market. But Mexico has been supplying the U.S. with refined cane sugar – not the preferred raw cane sugar. This is causing some strain for cane sugar processors.

Mexico is also still negotiating terms with the U.S. on the Suspension Agreement, which is aimed at preventing Mexico from dumping sugar in to the U.S. market below prevailing prices in Mexico. These talks may take several more months, and they complicate the future of raw cane sugar supply in the U.S.

U.S. production of both beet and cane sugar will rise modestly in 2016, collectively setting an all-time high. However, domestic cane sugar demand will outstrip domestic production in 2016/17, and imports from Mexico will decline as an agreement remains elusive. This will leave the U.S. market imbalance to be solved in 2017. Meanwhile, beet producers could be stuck with an overabundant supply of beet sugar and low prices. The USDA will do what it can to avoid loan forfeitures such as those that occurred in 2013. At this point, forfeitures are not expected.

The Suspension Agreement with Mexico and decisions about which type of sugarbeets to grow will determine how the U.S. sugar market shapes up over the next few years. Beet growers are reluctant to go back to planting non-GMO beets, but some likely will if market signals continue to call for them.

Specialty Crops

Update on California

California's ongoing drought will impair agricultural revenues again this year, but the impact won't be as big as in previous years given that California had a wetter winter and spring in 2016. It is estimated that the direct costs of drought for California will total \$550 million in 2016. Last year, the drought-induced direct losses were estimated at \$1.8 billion. The losses due to the drought have been more pronounced in certain industries, namely grains, cotton, oilseeds and feedstuffs.

California growers have weathered the drought fairly well so far, despite reduced or even zero water deliveries

“*Early indications are not encouraging for significant drought relief in California during the 2016/17 rainy season.*”

in some districts, as they were able to draw heavily on groundwater sources. Water allocations have been much better this year due to the improved precipitation of the past winter. As a result, only about 80,000 acres of land will be fallowed in 2016 due to the drought, with 90 percent of this fallowed acreage located in the Central Valley south of the Delta. In contrast, an estimated 540,000 acres of farmland was fallowed in 2015.

Early indications are not encouraging for significant drought relief in California during the 2016/17 rainy season. A few months ago, weather forecasters had assigned a high probability of a strong La Niña during the 2016/17 winter. However, weather forecasters are now predicting that La Niña probably won't be much of a factor this coming winter. A weak or absent La Niña does not necessarily portend well for California in terms of precipitation, though. In recent years, it has become clear that La Niña is not the only predictor of droughts and dry conditions in California. So despite the likelihood of a weak La Niña, the latest seasonal predictions do not provide much hope for relief from the drought this rainy season. indeed, as the past winter has shown, anything can happen – yet even normal levels of precipitation during the rainy season will not necessarily end California's drought problems.

In addition to the ongoing water woes, the Golden State now faces further labor constraints. In mid-September, Governor Brown signed a bill that requires farmers to pay their workers overtime after eight hours a day or 40 hours a week, making California the first state in the nation to implement legislation that affords agricultural employees the same overtime hours and pay scale that workers in other industries get. The new legislation, which reduces the overtime threshold from 10 hours a day (or 60 hours

a week) and requires farm workers to take one day off every seven days, would gradually increase the overtime pay for California's farm workers starting in 2019.

This bill has been very controversial as it could have huge repercussions for California's agricultural industry and its approximately 800,000 farm workers. There are concerns that the requirements of the new legislation are likely to harm both farmers and farm workers. Farmers will probably cut employee hours in an attempt to reduce costs. Shorter hours mean that agricultural workers earn less money with the earnings of seasonal workers being further impacted by having to take off one day a week or four days a month over a limited period of employment. In an industry already plagued by labor shortages and high labor costs, the added costs resulting from this new law together with the pending increases in the minimum wage, could be detrimental for agricultural output, profitability and employment.

Tree Nuts

The almond harvest is underway, with another four to six weeks to go. As a result of adequate water supplies this crop year, growers are anticipating a bumper crop,

estimated at 2.05 billion (meat) pounds and the third highest on record. It is being produced on 900,000 bearing acres. After the slow start to the 2015/16 marketing year, almond shipments have recovered well following the price corrections that occurred in the first couple of months of 2016. Consequently, shipments for the 2015/16 marketing year totaled just over 1.8 billion pounds at the end of July and were on par with the previous year's shipments.

August heralded the start of the new almond marketing year with August shipments about 35 percent ahead of those of a year ago. If shipments continue at this pace, it is expected that they will reach the 2 billion pound mark in the 2016/17 marketing year. As the harvest progresses, more will become known regarding crop quality, receipts and demand trends. In the meantime, almond prices are expected to remain fairly stable.

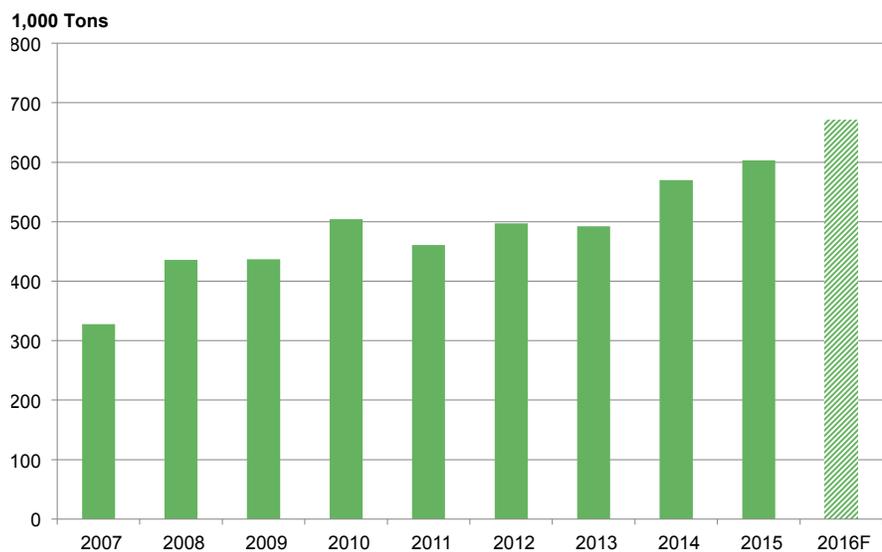
Walnut orchards are being prepared for harvest, which will begin any day now. Hot weather in August has brought forward the start of the harvest. California's 2016 crop is predicted to total 670,000 tons, 11 percent larger than the 2015 crop of 603,000 tons. (See Exhibit 10.)

Due to continuous increases in bearing acreage over time, the 2016 crop will be the biggest yet. The larger 2016 crop is a result of a 15,000 acre increase in bearing acreage YoY to 315,000 acres; higher planting densities (number of trees per acre), and improved yields. This year's crop also benefitted from adequate chilling hours and better rains this past winter. Walnut prices have traded lower throughout the 2015/16 marketing year, which helped to grow 2015/16 shipments by 16 percent over the previous year.

Processing Tomatoes

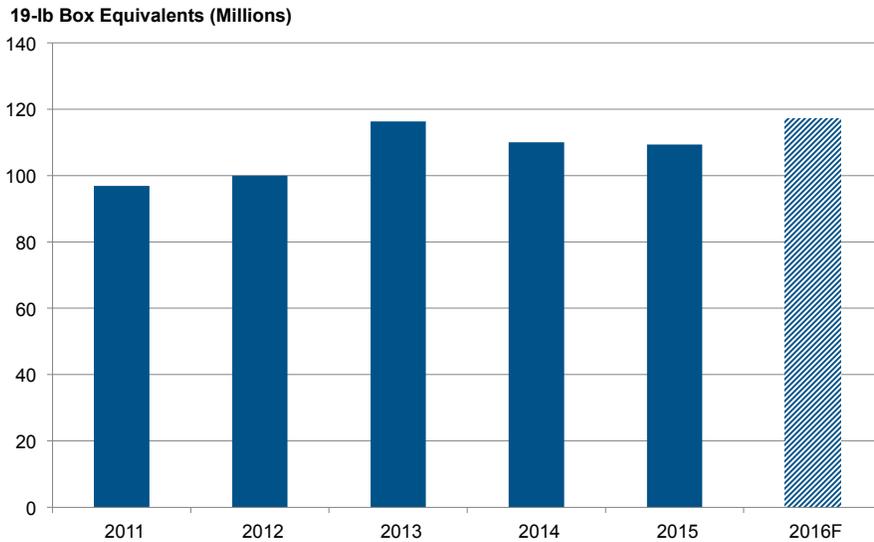
California's processing tomato harvest is now about 83 percent complete but is slowing as it nears completion. Estimates of this year's harvested

Exhibit 10: California Walnut Production 2007-2016



Source: USDA-NASS.

Exhibit 11: California Table Grape Shipments 2011-2016



Source: CTGC.

tonnage have been revised downward again and now stand at 12.8 million tons, which is 1.6 million tons below last year's crop. Yet the current crop will still be the third largest on record.

To date, the quality of the 2016 crop has been reported as good. The base contract price for this season is \$72.50/ton, or about 10 percent below last year's contracted price of \$80/ton, along with a series of late season premiums. These premiums range from \$3/ton to \$15/ton for a series of later delivery dates starting mid-September and running through the end of the harvest in mid-October. The organic processing tomato harvest is also progressing well and will be the largest organic crop ever harvested.

Wine and Table Grapes

Harvests of wine and table grapes are ongoing with the harvest of the early wine grape varieties completed. The last USDA crop estimate puts California's 2016 wine grape crop at 3.9 million tons, up 5 percent from last year's crop of 3.7 million tons. But yields have been coming in under estimates, giving rise to speculations that the 2016 crop will be average-sized. Market chatter of a lighter crop has helped to stabilize the spot prices of some varieties and boosted the prices of others. Overall,

a lighter crop would be welcome in terms of balancing the market that is over-supplied in some categories.

The eating quality of this year's table grape crop is excellent: extreme heat has intensified the sugars and flavors of the grapes. At an estimated 117.1 million 19-pound box equivalents, the 2016 table crop will top the 2013 monumental crop of 116.3 million 19-pound box equivalents. (See Exhibit 11.) So far this season, prices are tracking last year's – a positive upshot given that the total value of the 2015 crop was a record \$1.83 billion. A rejuvenation of the table grape industry through new investments

and improved grape varieties is spurring the growth in volumes and value seen in the last couple of years.

Infrastructure Industries

Power and Energy

Low natural gas prices and expanding renewable energy will continue to pressure energy prices through the winter of 2016/17. Consequently, coal economics will remain strained and the debate around the future of existing nuclear units will continue to rage on.

Monthly natural gas production is hovering around 2.3 trillion cubic feet, just 5 percent below record levels reached last March. Booming supply has outpaced record power demand for gas, which is currently running 23 percent ahead of the five-year average; and inventories remain close to all-time highs. Gas prices, after climbing more than 70 percent during the first eight months of the year, have leveled off in recent weeks at about \$2.90/MMBtu. With the arrival of shoulder season and inventories set to expand, spot prices at the Henry Hub will likely hover around \$2.90 to 3.00/MMBtu through this winter.

Energy prices should benefit from higher seasonal demand through the winter but low natural gas prices will limit the extent of any run-up. Continued expansion of renewable energy will further weigh on energy prices in every region of the country.

The effects of low natural gas prices and growing renewable energy generation on wholesale energy markets are most clearly illustrated in Texas. The ERCOT system set a demand record of 68,300 MW in 2011, driving spot prices at all major trading hubs to \$3,000/MWh. This year ERCOT climbed to a new system-wide peak demand of 71,000 MW on August 11, but spot prices across the state never even exceeded \$100/MWh. This is largely due to significant wind generation and a robust transmission system that can deliver cheap renewable energy to all the major demand centers.

Both wind and solar generation facilities are set to expand across the country with 4,900 MW and 6,000 MW of new capacity currently under construction, respectively. California remains the leader in solar development

accounting for one-third of all capacity under construction. But the remaining new capacity is spread across 20 different states in every corner of the country. Texas accounts for 1,500 MW of new wind capacity under construction with the remaining spread across the Midcontinent, Midwest, and Southeast regions.

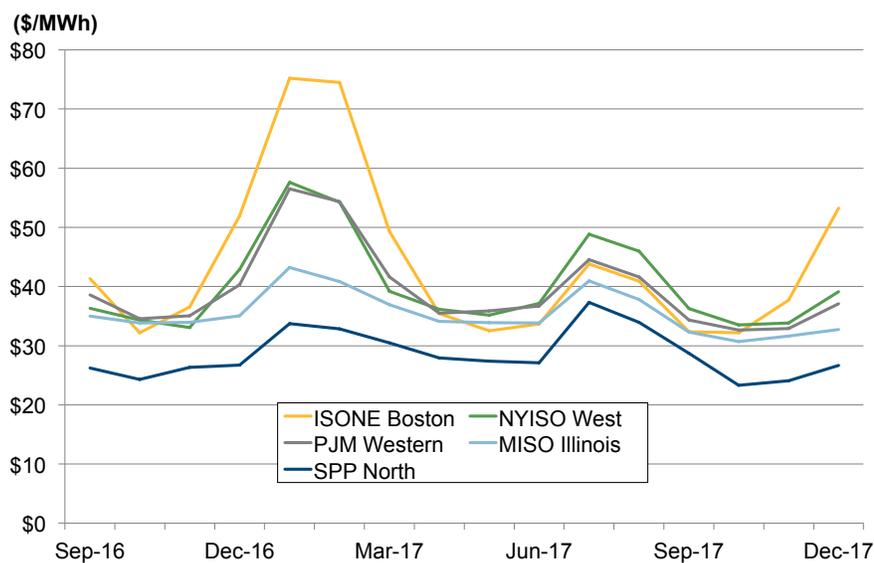
Growing renewables coupled with an expanding gas fleet with 4,300 MW currently under construction will continue to displace higher cost and less efficient coal and nuclear units. Coal-fired retirements have slowed somewhat, but 5,400 MW are currently slated to be taken offline through June 2017.

Nuclear units facing financial distress constitute one of the more surprising fall-outs of prolonged weak energy prices. In the last four years, over 3,000 MW of nuclear capacity have been shut down in California, Vermont, and Wisconsin. There are another 14 nuclear plants that have been identified as either imminently closing or at risk of closing which represent over 15,000 MW of nuclear capacity.

Smaller, aging nuclear plants pose the biggest financial risks. Older, single-reactor plants produce at around \$40/MWh, compared to \$34/MWh for the average nuclear unit. Forward wholesale prices are well below \$40 in all but one of the regions, resulting in a gloomy outlook for high cost plants in competitive power grids with weak demand and low cost gas and renewables. (See Exhibit 12.) Entergy, for example, closed its Vermont Yankee plant and plans to shut down the Pilgrim plant in Massachusetts.

Closure of nuclear plants leads to the loss of hundreds, sometimes thousands, of jobs and potentially higher energy prices for consumers, making it a highly politicized issue. This issue was recently on display in New York where regulators approved \$500 million in annual subsidies to

Exhibit 12: Forward Wholesale Power Prices



Source: SNL Energy.

keep three nuclear plants operational in upstate New York with a total capacity 3,320 MW.

Energy companies and utilities that own struggling nuclear plants will likely end up seeking billions of dollars in subsidies from Pennsylvania, New Jersey, Ohio, and Connecticut. Approval in these states is uncertain, whereas New York's situation was different because it required only regulatory approval.

According to nuclear operators, troubled plants can survive with subsidies of \$15-20 per MWh, making their generation cheaper than adding new wind and solar capacity. So the nuclear subsidy question often comes down to a state's willingness to pay extra in order to keep carbon dioxide (CO₂) emissions lower. If nuclear plants close under financial stress, CO₂ would rise as natural gas generation replaces nuclear capacity. However, large portions of these potential nuclear plant closures are located in regions where it is difficult to build new natural gas infrastructure largely due to market constraints or notoriously challenging environmental opposition – e.g., New York ISO, New England ISO, and California.

Lacking the ability to expand natural gas infrastructure, many states will wrestle with how to provide reliable and affordable power while maintaining the flexibility to meet the strict CO₂ emission standards mandated under the Clean Power Plan. Therefore, the upcoming decision by the D.C. Court of Appeals on the Clean Power Plan could heavily influence the direction of the nuclear subsidy debate, and therefore the need for new power generating capacity.

Rural Water Industry

Water and wastewater utility executives are trying to figure out how best to meet the increasingly stringent nitrogen and phosphorus limits in a cost-effective manner. Elevated concentrations of these nutrients in bodies of water located across the country are responsible for numerous highly publicized algae blooms. The Environmental Protection Agency (EPA) is on high alert and is accelerating its efforts to reduce excess nutrient runoff into rivers, lakes, and oceans. However, the vast multitude of nutrient sources complicates the

“*Elevated concentrations of these nutrients in bodies of water located across the country are responsible for numerous highly publicized algae blooms.*”

EPS's efforts at regulation. This will likely drive the EPA to lean more heavily on wastewater treatment facilities to reduce nutrient runoff. Rural water and wastewater utilities could end up being responsible for an outsized share of a watershed's nutrient control.

The capital costs associated with building a new wastewater treatment plant, or retrofitting an existing plant to remove nutrients, typically amount to less than \$25 per gallon per day (gpd) of treated wastewater. However costs vary widely depending on the technology and the volume of water treated. Larger operations typically utilize anaerobic digesters versus aerobic. Anaerobic plants that serve a large population deliver a reduced cost per unit of waste treated, despite higher upfront costs.

Anaerobic digestion also benefits from the production of biogas, a byproduct of the bacteria eating the solid waste material during the treatment process. Many utilities with anaerobic facilities capture this biogas and convert it to electricity to run their facilities, or sell the biogas to a separate end user. In either case, the utility drastically reduces the operating costs of treating wastewater, an option that is not available to utilities that employ aerobic technology.

Data covering existing facilities suggest that an average treatment flow rate of approximately 5 million gallons per day (mgd) is the threshold for implementation of anaerobic digestion. Reasonable design specifications assume treatment of 100 gpd per capita. This flow leaves utilities that serve roughly less than 50,000 residents unable to realize the benefits associated with anaerobic digesters – i.e., lower unit and operating costs.

One of the EPA's top priorities today is helping states to implement Total Maximum Daily Loads (TMDL) budgets that limit total TMDL for contaminants from all sources within a watershed, with nutrients being the primary target. Municipal waste is only one of many sources of nutrients. Industrial and electric utility operations, septic tanks, and agricultural production are also at the top of the list. With so many sources of pollution, it is difficult for regulators to establish and enforce regulatory schemes across many small polluters.

Going forward, water and wastewater utilities will likely find themselves under greater scrutiny from regulators since the easiest way to measure and manage nutrients is by testing treated wastewater. This increased scrutiny could force rural water utilities located in agricultural regions to shoulder an outsized portion of nutrient control. With limited resources to build new and bigger treatment facilities, rural water and wastewater utilities will have to work closely with their neighbors to develop mutually beneficial solutions that reduce their watershed's overall nutrient load beyond treated wastewater.

Communications Industry

Early in August, the Federal Communications Commission (FCC) issued long-awaited details for rural support mechanisms and set ground rules that will govern and promote the transition of rural local exchange carriers (RLECs) into IP-based broadband providers over the next 7 to 10 years. The new rules will take effect in 2017. Until then, RLECs will invest substantial time and resources in determining their best path forward.

With the publication of the FCC's final model-based support plan for rate-of-return (ROR) carriers, universal service reform was solidified and a 90-day decision window was established. On or before November 1, ROR carriers must declare whether they will commit to model-based funding or stick with a modified legacy mechanism for the duration of the 10-year funding period. Those carriers that elect the new model will have permanently changed their regulatory paradigm, with no opportunity to revert to cost-based funding at any point in the future.

The FCC also implemented a budget control mechanism, which began to reduce support during the third quarter, to enforce a \$2 billion annual budget for total ROR support. The budget rule confirms that the majority of ROR companies will receive less support in the future regardless of which funding mechanism they choose.

Going forward, the FCC will make at least \$1.038 billion available through model-based funding for nearly 5 million eligible locations in ROR service territories. Nearly half of the eligible areas require a 25/3 megabit per second (Mbps) minimum service benchmark, while another 38 percent of the eligible areas must meet a 10/1 Mbps obligation. Although the FCC attempted to make the model enticing, having included multiple model revamps to incorporate rural carrier feedback and the ability for the Commission to inject an additional \$150 million to the annual model-based fund, many ROR companies remain disillusioned with the mechanism. A total of 273 formal challenges were filed against the model. Challengers sought mainly to highlight inaccuracies in Form 477 data, and to add a provision to split service territories where a neighboring service provider would disqualify an RLEC's otherwise eligible area. Regulatory experts described the challenges as detailed and well-reasoned; however, all but 80 were dismissed.

The FCC also announced that it will hold a reverse auction for \$2 billion in rural broadband funding that price cap carriers declined. Industry insiders anticipate that the auction will occur in 2017 and that the program's \$215 million annual budget and technology-agnostic service parameters will attract a wide range of participants, including RLECs, cable operators, wireless companies, satellite providers, and wireless Internet service providers (WISPs). Despite stringent prequalification requirements, a six-year build out term, and daunting service obligations ranging from 10/1 Mbps to 1 Gbps/500 Mbps, analysts anticipate that the promise of 10 years of predictable support to deploy and sustain service in a known area may draw a great deal of interest.

Users' demand for high-speed Internet capacity – everywhere and on every device – continues to soar. North Americans consumed nearly 25 petabytes of data in 2015,

and their usage is expected to more than double to 59 petabytes by 2020. Video is the number one driver of data traffic. It alone accounted for 68 percent of consumer traffic in 2015, and its share is expected to grow to 82 percent by 2020, owing in part to new video-capable social media apps and bandwidth intensive 4K UHD TV.

As of July 2016, the average U.S. household had ten active connected devices, a number that jumps to 19 in households with four or more people. By the end of 2016, 79 percent of Americans will own a smartphone, including 41 percent of children under 11 years of age. Revenues from mobile data, which accounted for nearly half of global mobile revenue in 2015, are expected to grow 7 percent a year to \$600 billion by 2020.

To handle the increasing demand, fixed and mobile broadband providers will have to invest in networks and technology designed to boost broadband speeds. Users in the U.S. currently get fixed broadband speeds of 55.97 Mbps on average, and 19.27 Mbps on mobile networks, and providers typically experience healthy take rates as they roll out faster speeds. Despite the strong demand, many RLECs are believed to have postponed capital expenditures in recent years owing to regulatory uncertainty – thus exacerbating a digital divide between urban and rural areas. With the FCC's new reforms and support mechanisms in place, rural providers are expected to make significant network investments for the next three to five years. Annual investment totals among all broadband operators during this period should easily eclipse the \$78 billion that U.S. broadband providers invested in 2014.

Although 28 of the 62 participants in the ongoing 600 megahertz spectrum auction qualified as rural operators, small and rural providers have exited the mobile business at a swift pace during the past 18 months. By the end of the year, the FCC is expected to replace the current mobile funding (which amounts to only 60 percent of former support levels) with a new support program that will reduce available funding even further. Mobile carriers that continue operations will be required to implement upgrades to support VoLTE and 4G technologies in the next three to five years – costly endeavors under any conditions, but especially so in an environment where

roaming and end-user revenues are often inadequate to generate a competitive return on investment.

After several years of losing market share, the pay-TV cable market has begun to adapt to the new realities of multiple screens, TV everywhere and competition from IPTV and over-the-top (OTT) providers – by focusing more than ever on broadband. Its broadband-centric shift has been successful. Major U.S. cable companies added half a million broadband subscribers in the second quarter of 2016. Analysts predict that the pay-TV market, with \$170 billion in revenue in 2016, will continue to erode in coming years. However, recent data show that “cord-stackers,” or consumers that subscribe to both a traditional pay-TV package and OTT content, report higher customer satisfaction levels. Despite such challenges as rising content costs, mounting regulatory requirements, greater competition and tighter margins, entertainment remains a key element of long-term success for communications providers. Companies will continue to roll out and fine-tune new offerings including skinny bundles, prepaid TV packages and OTT integration to combat further losses on the content side.

With Internet traffic likely to continue to surge at astronomical rates, data center owners and operators are ideally positioned to benefit greatly from this growth. They also stand to benefit from the rising demand for cloud services, big data analytics, colocation and managed services, and Internet of Things (IoT) technology. Analysts predict that the global data center market will grow by 11 percent over the next four years. Forecasts also call for the cloud service market (software-as-a-service) to increase nearly two-fold from \$38 billion in 2015 to \$75 billion by 2020, and infrastructure-as-a-service revenue to reach \$43.6 billion, more than triple the \$12.6 billion generated in 2015.

Fiber networks are poised to remain the shining star in the communications portfolio. The ever-increasing volumes of data traversing the networks, paired with the need for redundancy and long-distance backhaul, will drive healthy demand in both dense metro and secondary markets. Other industry segments, as well as private equity, are keen to invest in these assets. ■

This quarterly update is prepared by the Knowledge Exchange Division and covers the key industries served by the Farm Credit System, including the agricultural markets and the rural infrastructure industries. Analysts at Plus One Strategic Communications LLC prepared the overview of the communications industry.

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