

ALFALFA IN THE CONTEXT OF GLOBAL CROP PRICE PROSPECTS

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ABSTRACT

World and U.S. markets for grains, alfalfa and dairy products are linked on both the supply side and the demand side. On the demand side, commodities compete as livestock feeds and are affected by economic growth drivers. Grain and oilseed crops provide much of the crop protein consumed globally, but data on contributions of hay, silage and pasture are missing from standard sources. In the United States, alfalfa ranks third as a source of plant-based protein produced, behind soybeans and corn, but again, data on protein contributions of pasture are not readily available. Crop commodities compete for land, water and other resources and face similar cost drivers from energy and other purchased inputs. For these reasons, commodity prices tend to be linked and move together. Agricultural commodity markets have been unusually unsettled over the past five years. Grain and related prices jumped in 2007 and have remained unusually high by the standards of recent history. At the same time, the very long decline in inflation-adjusted farm prices generally mean that commodity prices remain below where they stood two or three decades ago. Recent forecasts suggest continued relatively high prices for grains and oilseed for the foreseeable future. Alfalfa is linked to grain and oilseed prices in the feed market and to milk on the demand side. Building on historical relationships, we use price projections for corn and milk to project continued relatively high prices for alfalfa over the next decade.

Key Words: alfalfa, global commodity markets, agricultural economics, farm price projections

INTRODUCTION

Alfalfa plays a central role in the United States as a feed crop that complements high energy feed sources and substitutes, to some extent, for other sources of protein and roughage. For these reasons, the market for alfalfa is closely linked with markets for other feeds and grain and oilseed markets more broadly. Alfalfa is used in livestock rations, and especially dairy rations in the west. For this reason, alfalfa markets are closely linked to the market for milk.

This paper explores recent patterns and prospects for agricultural commodity markets with particular emphasis on the linkage between grain, oilseed and dairy markets with alfalfa markets. We focus on the historical data and prospects for the next decade, but also discuss some driving forces and especially the statistical patterns in the recent data.

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ALFALFA IN GLOBAL AND U.S. MARKETS

The market for grains and oilseeds are global, as are the markets for meat, processed dairy products and, to an increasing extent, alfalfa hay. Fluid milk and high moisture content roughages have relatively low prices per unit of weight and are expensive to ship long distances. Of course, the markets for pasture are also relatively local. As a forage crop, alfalfa competes in local markets, while as a protein and energy source, alfalfa competes in global feed markets.

Although we often think of oilseed meals as the major plant-based proteins, wheat, corn and rice account for about half of the plant-based protein supplies globally, where the data do not include forage crops. Major oilseeds account for another 30 percent of the total with soybeans following wheat as the second most important source of plant protein. Alfalfa has a major role to play in this broad global market, especially in places such as Asia, where pasture is scarce, grains and oilseeds are imported, and imported alfalfa can serve as both a forage and a source of protein. The U.S. exported about 2.5 million tons of hay to Japan, Korea and China for about \$650 million in 2010. Exports are on track to exceed that amount in 2011.

Table 1 considers the role of alfalfa in the U.S. market for plant based protein sources, which includes hay and silage but does not include pasture. Soybeans supply about one third of U.S. plant protein, with corn accounting for almost 30 percent. Together these two sources add up to about 60 million tons of protein. The 71 million tons of alfalfa produced in the United States accounts for about 12 million tons or about 13 percent of the U.S. protein production. Corn silage provides about seven percent of protein. These crops are clear potential substitutes for alfalfa in the U.S. market.

Based on the U.S. data and information about the role of alfalfa in Europe and selected other regions, we expect that alfalfa plays a significant role in global protein supplies. Even U.S. production alone would place alfalfa in the top ten crops, slightly behind cottonseed. With production in just a few additional regions, alfalfa would likely be in the range of five percent of world protein supplies, in the range of barley, rapeseed and oil palm.

Pasture is almost surely the most important source of forage for livestock in terms of energy and/or protein. This is even more true outside the United States, where pasture-based dairy and beef systems are dominant.

Table 1: Crude protein tonnage in US harvested crop production, 2009^a

Crop	Production	Effective crude protein content ^b	Crude protein	Share of crude protein available in top 15 harvested crops
	(1) (1000 metric tons)	(2) (percent)	(3) (1000 metric tons)	(4) (percent)
Soybeans	91,417	34.8	31,813	33.8
Corn	333,011	8.3	27,640	29.4
Alfalfa	71,072	18.7	12,057	12.8
Wheat	60,314	12.8	7,720	8.2
Corn (silage)	98,166	7.0	6,872	7.3
Other hay ^c	69,517	4.0	2,781	1.3
Cottonseed	6,330	19.9	1,260	1.3
Sorghum	9,728	12.6	1,226	0.8
Rice, paddy	9,972	7.3	728	0.6
Barley	4,949	11.6	574	0.5

^a not including pasture

^b column (2) is obtained by multiplying dry matter share by protein share, where values for dry matter share are available. Where values for dry matter share are not available, the protein share given in column is assumed to apply to the entire crop.

^c Other hay includes oat (4.4% CP), barley (4.4% CP) and wheat hay (3.5% CP). The utilized crude protein share is the midpoint of their crude protein shares.

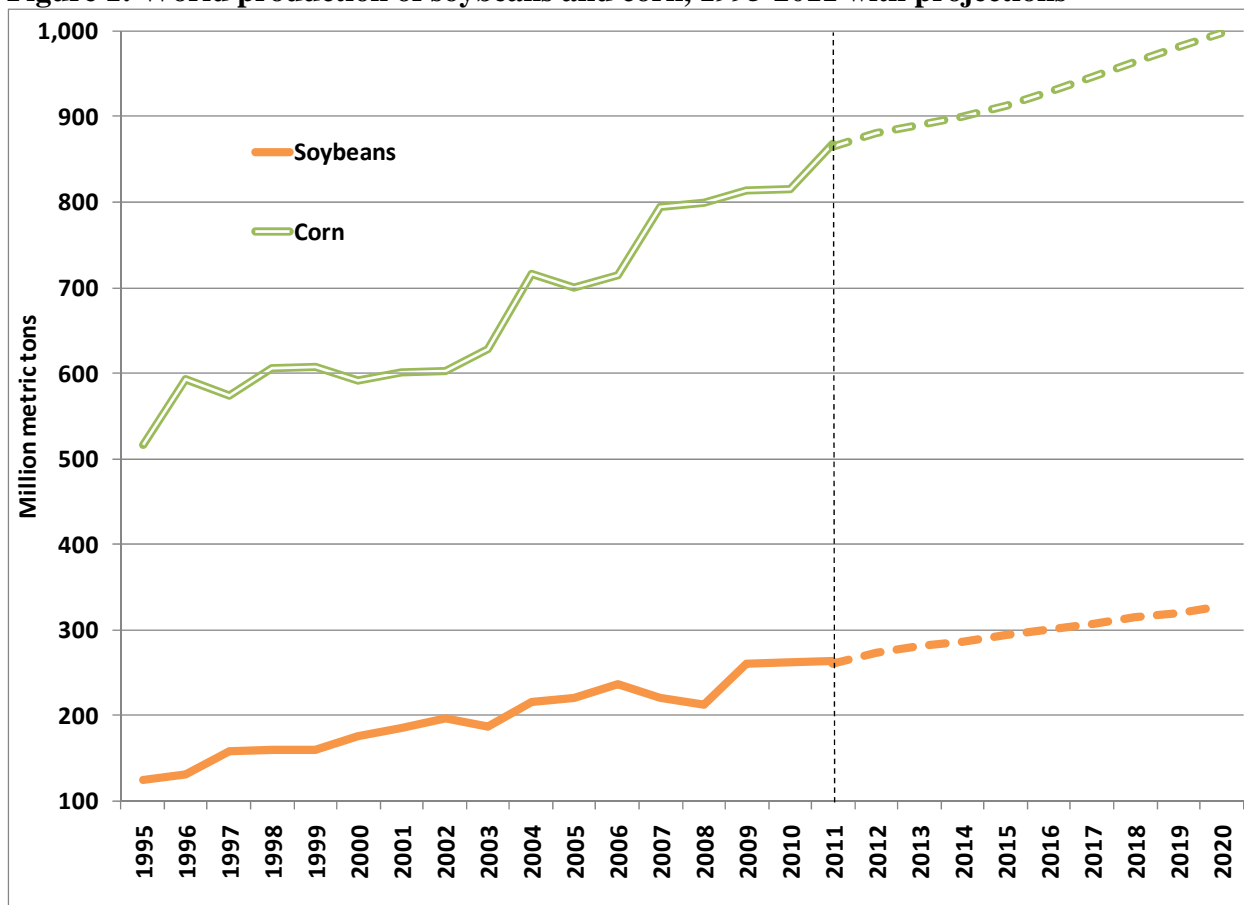
Sources: FAOSTAT. 2010. "Crop Production." <http://faostat.fao.org/site/567/default.aspx#ancor>
See list of references for sources on the crude protein content of crops. In particular, see Conte (2009), Swanepoel, Robinson, and Erasmus (2010), and National Research Council (2000).

RECENT HISTORY AND PROJECTIONS OF COMMODITY PRODUCTION

Several organizations use recent history and current policy and market conditions to project global production of major farm commodities and the distribution across nations and regions. The major sources of historical data and projections are the United States Department of Agriculture (USDA). In addition, the Food and Agricultural Organization (FAO) in Rome and the Food and Agricultural Policy Research Institute (FAPRI) at Iowa State and the University of Missouri project production as a part of their baseline process.

Figure 1 shows the production history and most recent projections for the next decade made by the USDA for corn and soybean production. World soybean production increased from about 110 million metric tons in 1995 to about 270 million in 2010, rising by more than 150 percent in about 15 years. The notable drop in production between 2006 and 2008 reflected yield flux and the sizable shift of acreage to corn. Corn production increased from just over 500 million metric tons in 1995 to about 850 million in 2010, an increase of about 70 percent over the period. Corn production showed remarkable increases in 2003 and 2004 and then again in 2006, reaching new highs that were then exceeded in the next periods. Over this period, growth in world wheat production was much more modest growing by about 20 percent from about 540 million metric tons in 1995 to about 660 million metric tons in 2010.

Figure 1: World production of soybeans and corn, 1995-2011 with projections



Sources: USDA, FAS. 2011. “Production, Supply and Distribution Online.” Available at:

<http://www.fas.usda.gov/psdonline/psdQuery.aspx>

USDA. 2011. “International Agricultural Projections.” Updated June 10, 2011. Available at:

<http://www.ers.usda.gov/data/internationalbaseline/>.

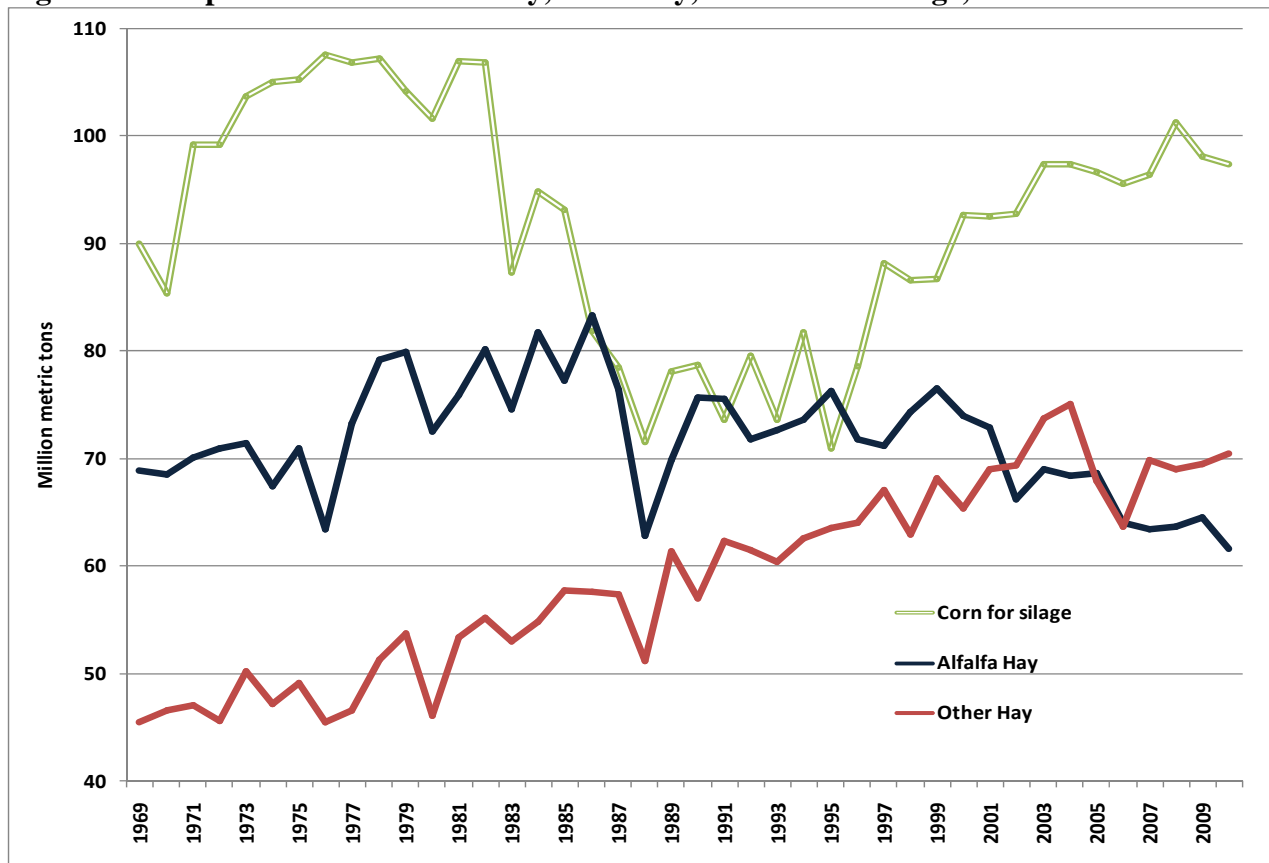
Note: Annual production data is based on marketing years

Projections of production by the major organizations are similar and indicate a gradual increase roughly in line with trends over the past two decades. That means corn production would reach about one billion tons while soybean production would approach 320 million tons by 2020. These projections are in line with global demand increases driven by continued population growth in the developing countries and continued income growth, especially in developing countries. The continuing shift of resources into feed grains and oilseeds reflects a shift to more livestock-based diets as incomes rise.

Milk market conditions in the United States (and globally) also contribute to demand for alfalfa. Figure 2 shows milk production data and projections from USDA and FAPRI. Between 2000 and 2010, U.S. production of fluid milk increased from about 75 million metric tons to about 87 million, almost 15 percent in 10 years. Both the USDA and FAPRI project a gradual increase in milk production of more than one percent per year over the next decade. FAPRI extends their projections to almost 110 million tons by 2025. Data on production of milk in China, Japan and South Korea is available through the year 2009 from FAOSTAT. Between 2000 and 2007,

production in China increased sharply from 8.6 million metric tons to about 35.5 million, but was then flat. Production of milk in Japan fell by about 10 percent between 2000 and 2009, falling from about 8.5 million tons to about 7.9 million tons. Production of milk in South Korea, about 2.2 million tons, hardly changed, despite rapid income growth. For China, there is a potential for U.S. dairy exports to capture a share of the growing market, replacing domestic production for the use of milk in processed products as has been occurring in Japan and Korea.

Figure 2: U.S. production of alfalfa hay, other hay, and corn for silage, 1969-2010



Sources: USDA, ERS. 2011. "Feed Grains Database: Yearbook Tables."

<http://www.ers.usda.gov/data/feedgrains/FeedYearbook.aspx>

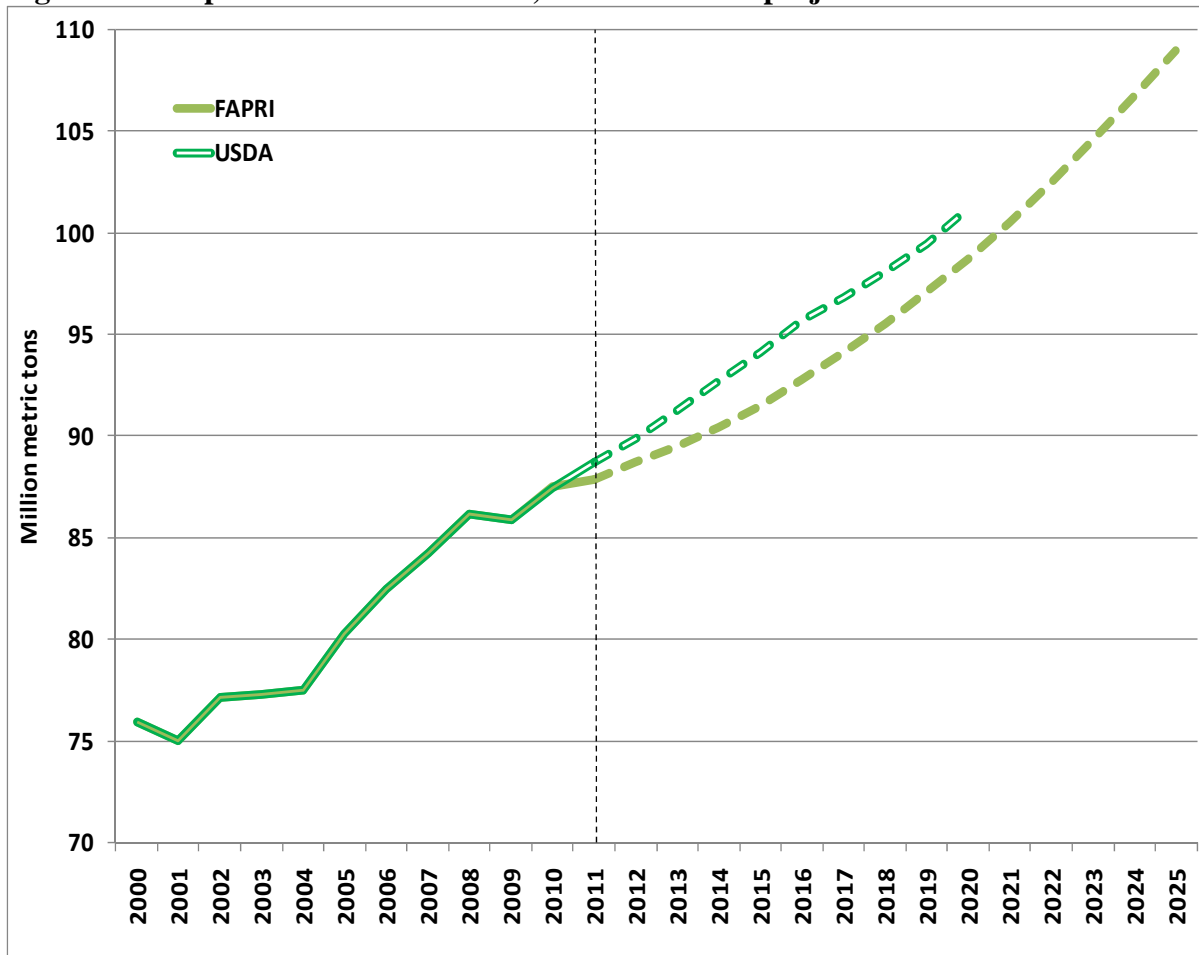
USDA, NASS. 2011. "QuickStats." http://www.nass.usda.gov/Data_and_Statistics/index.asp

Note: Annual production data is based on marketing years

Alfalfa competes with other forage crops in the U.S. market. Figure 3 shows the past forty years of alfalfa and other forage crop production in the United States. Production of other types of hay in the United States fluctuated with weather and market conditions but nonetheless increased substantially from about 45 million tons in 1969 to nearly 70 million in 2010. U.S. production of corn for silage grew from about 90 and 110 million metric tons until the early 1980s, before falling and fluctuating around 70 to 80 million tons from the middle of the 1980s through the mid-1990s. Since then, production of corn for silage has gradually increased back to about 100 million tons. Against this background of other forage crops, alfalfa hay production fluctuated around 70 million tons before jumping to about 80 million tons in the late 1970s. Then, after fluctuating near 80 million tons from the late 1970s through the late 1980s, alfalfa production

dropped and recovered slightly to fluctuate on a slight downward trend from about 75 million tons to below 70 million tons more recently.

Figure 3: U.S. production of fluid milk, 2000-2011 with projections



Source: Food and Agricultural Policy Research Institute (FAPRI). 2011. *U.S. and World Agricultural Outlook*. FAPRI Staff Report. May 11. Available at:

<http://www.fapri.iastate.edu/outlook/2011/>

USDA. 2011. "International Agricultural Projections." Updated June 10, 2011. Available at:

<http://www.ers.usda.gov/data/internationalbaseline/>.

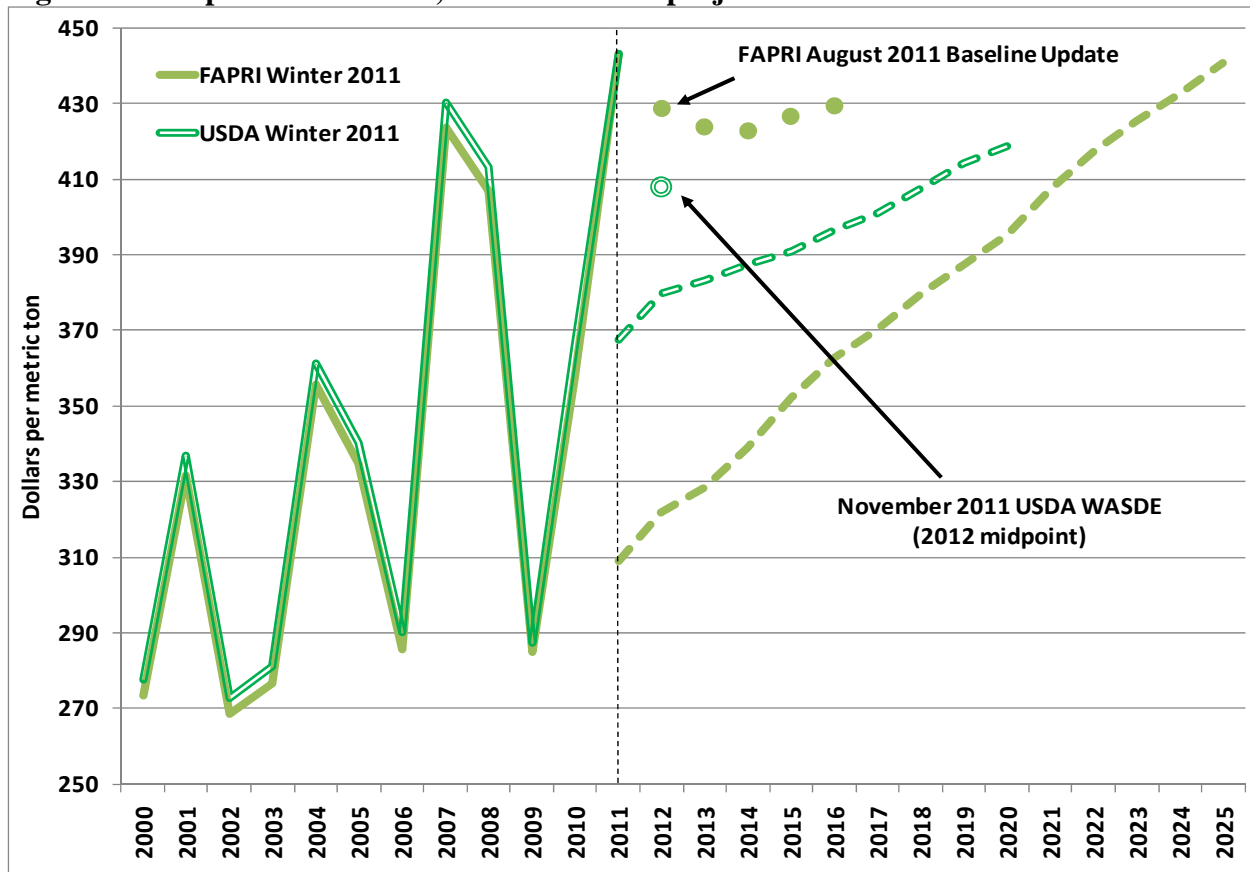
Note: Annual production data is based on calendar year

PROJECTIONS OF MILK AND GRAIN PRICES

USDA and FAPRI also project prices for grains oilseeds, dairy products and other farm commodities. They do not project prices for alfalfa or other forage crops. Figure 4 shows just how variable milk prices have been over the past decade, jumping from less than \$280 per metric ton (all milk) to more than \$420 per metric ton with four big swings in just the past 12 years. With this historical record, projecting milk prices forward is fraught with potential errors, as indicated by the FAPRI and USDA near term projections made just 10 month ago. In early 2011, USDA expected 2012 milk prices to remain at about \$370 per metric ton in 2011 and rise

slightly from there in 2012. FAPRI expected milk prices to collapse again in 2011 down to about \$310 per ton and then rise from there for the next 15 years. In fact, milk prices have averaged more than \$440 per ton over the past year above the moderate prices of 2010 and the opposite of the projections of FAPRI. Indeed, in their adjusted projections released in August 2011, FAPRI now projects milk prices to fall some in 2012, but remain over \$425 per ton for the next several years. The USDA *World Agricultural Supply and Demand Estimates* released in November forecasts milk prices to average about \$409 for 2012. USDA and FAPRI release their new 10-year projections in February. Based on recent experience, we should expect both organizations to project that milk prices will remain above \$400 per ton and rise slightly over the decade.

Figure 4: U.S. price for all milk, 2000-2011 with projections



Source: Food and Agricultural Policy Research Institute (FAPRI). 2011. *U.S. and World Agricultural Outlook*. FAPRI Staff Report. May 11. Available at:

<http://www.fapri.iastate.edu/outlook/2011/>

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http://www.fapri.missouri.edu/outreach/publications/2011/FAPRI_MU_Report_10_11.pdf

USDA. 2011. "International Agricultural Projections." Updated June 10, 2011. Available at:

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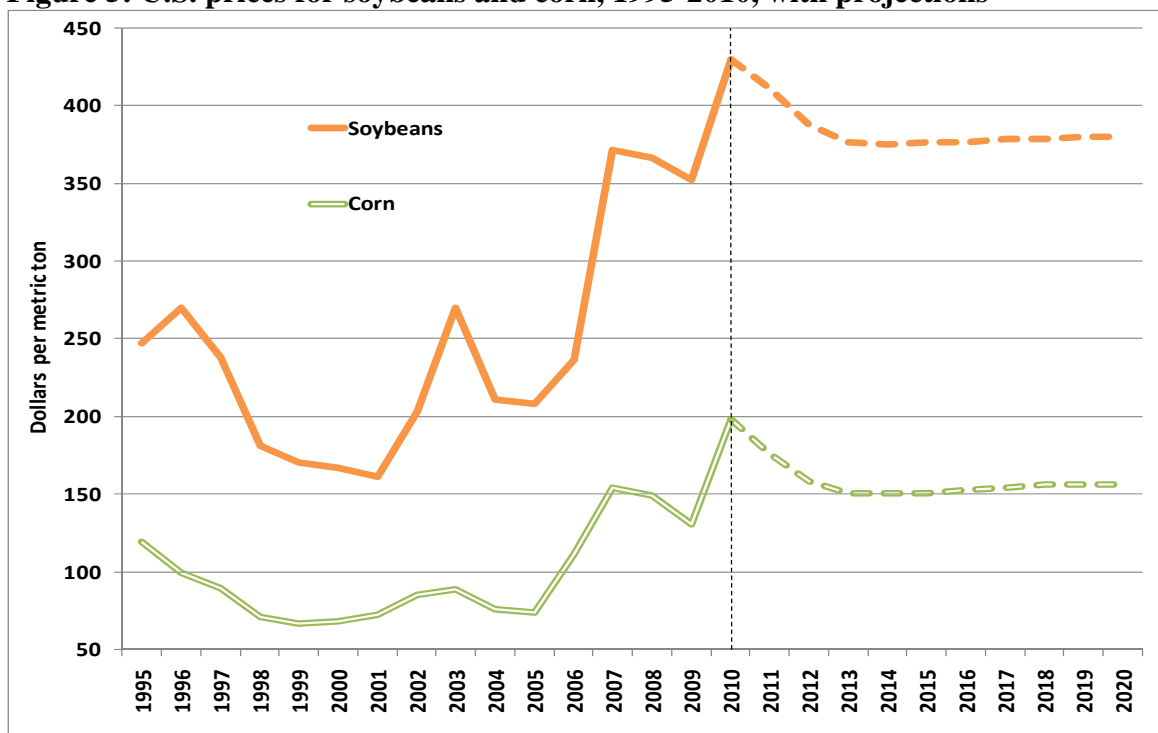
Available at: <http://www.usda.gov/oce/commodity/wasde/latest.pdf>

Note: Prices are calendar year average prices received, unadjusted for inflation

The data and projections displayed in Figure 4 illustrate just how difficult it is to project farm prices and that this is especially true in volatile markets such as milk over the past decade. First, analysts must assess supply conditions, including potential for weather fluctuations in the United States and in other major supply regions. Next, they must forecast rates of income growth in the U.S. market and key foreign markets before turning to consider exchange rate movements for the U.S. dollar, the euro and other key currencies on both the supply side and demand side. Farmers only slowly adjust milk production in response to price signals, by culling fewer cows and heifers and altering feeding practices. Buyers also respond to price changes only gradually, so within a year, prices rise or fall significantly in response to supply or demand shocks. Changes in milk prices and quantities affect alfalfa markets, so concerns in forecasting milk markets are important for expectations about alfalfa markets.

Grain markets have also been variable over recent decades, but not as volatile as milk prices. Figure 5 displays U.S. marketing year prices for corn and soybeans since 1995. Figure 5 shows actual prices for the 2010 marketing year and then the winter 2011 USDA projections for 2011. These data show a rapid rise in prices from lows that were established from the 1990s through 2006. Both corn and soybean prices more than doubled from 2005 through marketing year 2010 (Irwin and Scott 2011). Due to poor harvests, USDA now projects a price of \$263 for the 2011/12 marketing year, up from less than \$200 per metric ton projected last winter. For soybeans, USDA sees a price of \$465 per ton in 2011/12, up from the about \$400 per ton projected last winter.

Figure 5: U.S. prices for soybeans and corn, 1995-2010, with projections



Sources: USDA, NASS. Various years. *Agricultural Prices Annual Summary*.

USDA. 2011. *USDA Agricultural Projections to 2020*. February 14, 2011. Available at:

<http://www.ers.usda.gov/publications/oce111/>.

Note: Prices are marketing year average prices received, unadjusted for inflation

USING CORN AND MILK PRICES TO PROJECT ALFALFA PRICES

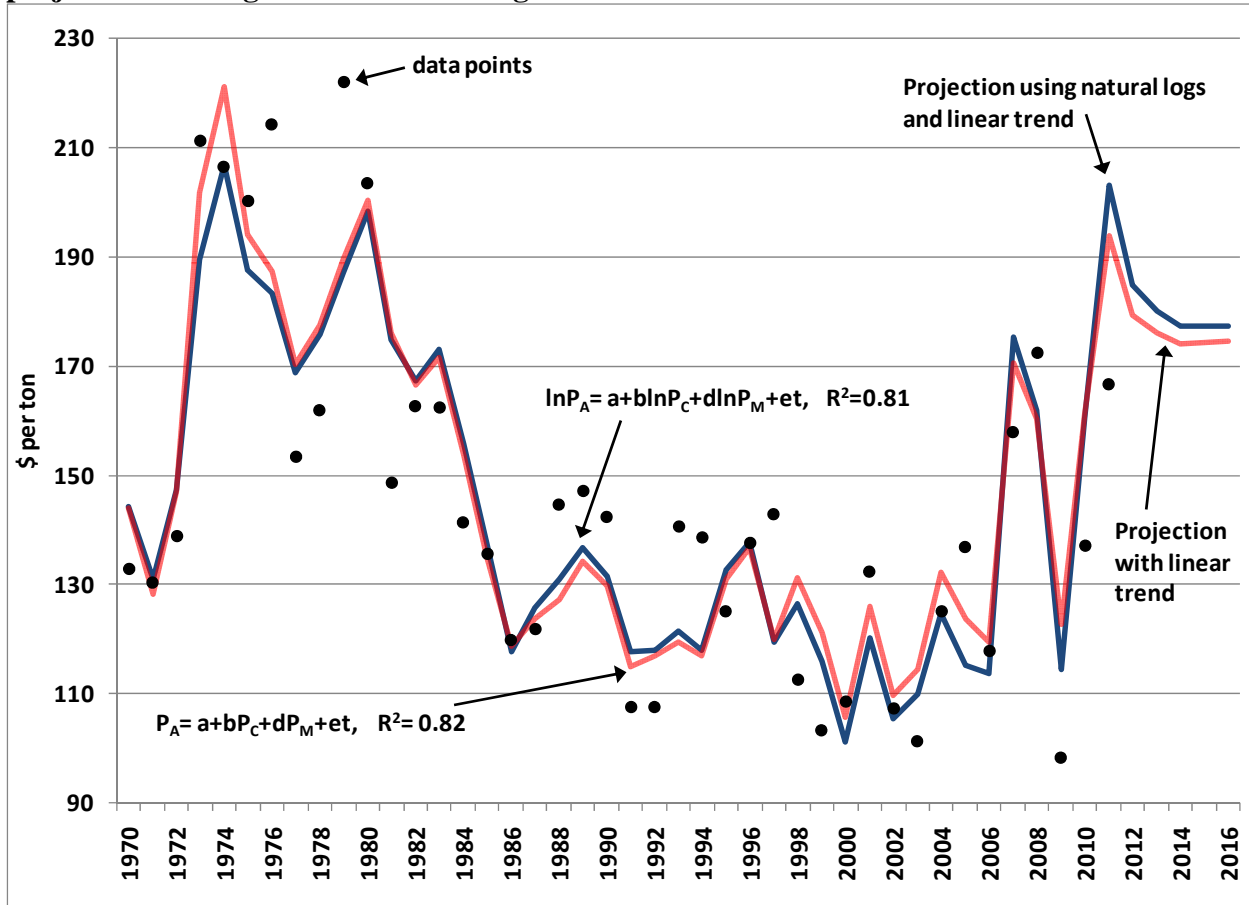
Many underlying drivers for alfalfa markets have been discussed above, but additional issues may be raised here. First, as energy and other commodity prices have risen, alfalfa costs have increased rapidly. Second, regulatory costs seem likely to increase as human populations expand in regions with animal feeding operations. Third, exports of dairy and beef products are increasing with income growth and lowered trade barriers, especially in Asia. Hay exports are also increasing to supply cattle in Asia, but of course, exports of animal products substitute for exports of hay.

With this background, we use projections on milk and grain markets to project alfalfa markets over the next few years. Clearly, this approach, which does not use data on near-term weather, stocks or local considerations, cannot be used for short-term forecasting. We have seen that with volatile markets even organizations with long histories and market specialists at hand are often wrong in projecting short-term commodity prices. Weather alone is enough to cause rapid shifts in farm commodity prices and few are willing to place much confidence in detailed weather forecasts a year in advance.

Figure 6 displays alfalfa prices by year from 1970 through 2011 (the solid dots on the figure are actual prices as reported by USDA and deflated for inflation using the GDP deflator). Figure 6 also shows two linear regressions using prices of milk and corn to explain prices of alfalfa—one in linear terms and one with all variables expressed in natural logs. Both fit the data reasonably well, $R^2 = 0.82$ and $R^2 = 0.81$. Adding such variables as the price of soybeans adds nothing to explanatory power. The data indicate that two variables capture more than 80 percent of the variation in alfalfa prices over the past 40 years: the higher the prices of corn and milk, the higher the prices of alfalfa, even after adjusting for inflation.

Figure 6 also uses the FAPRI projections for milk and corn (adjusted for 2 percent inflation per year) and the coefficients from the regressions to forecast alfalfa prices through 2016. Ignoring the projections for 2012, for which other sources provide more information, this model suggests that inflation-adjusted prices will head towards \$170-175 per ton in 2005 dollars, supported by relatively high milk and corn prices.

Figure 6: U.S. real price for alfalfa hay (2005 dollars), 1970-2010 with fitted values and projections through 2016 based on regression estimates



Sources: USDA, NASS. Various years. *Agricultural Prices Annual Summary*. Food and Agricultural Policy Research Institute (FAPRI). 2011. *FAPRI-MU August 2011 Baseline Update for US Agricultural Markets*. FAPRI-MU Report #10-11. August 25. Available at: http://www.fapri.missouri.edu/outreach/publications/2011/FAPRI_MU_Report_10_11.pdf
 Note: Prices are marketing year average prices received, adjusted for inflation

CONCLUDING REMARKS

This paper has reviewed important market drivers, some historical data and some production and price forecasts that are particularly relevant for alfalfa markets in the United States. In addition, we have used the most credible forecasts available for related markets to project prices for alfalfa up to 2016.

Three policy issues should be highlighted. First, the recently approved Free Trade Agreement with South Korea is good news for alfalfa markets because it may encourage milk and hay exports (Lee and Sumner 2011). Both these demand drivers tend to cause higher prices for alfalfa. Second, regulatory policy surrounding animal agriculture may well change where animal products are produced. For example, issues related to emission, animal wastes, animal housing conditions and others may drive some animal agriculture from California to less regulated states

and regions. This may not affect the overall quantity of milk produced, but could affect regional hay markets significantly.

Third, Congress is now framing the Farm Bill to replace that which became law in 2008. Several features of policy are important for alfalfa markets. The more grain and oilseed market subsidies that remain and take forms that reduce downside revenue risk, the more land will be planted to those crops. Various forms of revenue guarantees, whether through the crop insurance program subsidies or through standard farm program subsidies that payout when farm revenue falls below triggers set by Congress, all stimulate production of the favored crops relative to alfalfa. Second, ethanol policy through subsidies, trade barriers and mandates continues to help assure high market prices for corn by stimulating the use of ethanol beyond what would be caused by market forces. Some assessments suggest that, given a high price of oil and given that ethanol plants are already on-line, much corn would continue to be used for ethanol even without the trade barriers, subsidies and mandates. This issue is not settled, but the rationale for continued ethanol subsidy programs seems undermined in either case.

Alfalfa markets are closely linked to dairy and grain markets and thus prices are likely to be variable for the foreseeable future. Long-term prospects for meat and milk demand are strong. That means demand for alfalfa (or one of its close substitutes) is likely to grow.

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