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PURDUE AGRICULTURAL ECONOMICS REPORT

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SAVE THE DATES

June 23 and 24 - Indiana State Farm Management Tour in Adams and Jay Counties

July 9 and 10 - Purdue Top Farmer Conference in West Lafayette

Information will be posted at Purdue's Center for Commercial Agriculture site:

<http://www.agecon.purdue.edu/commercialag/progevents/index.html>

AN UPDATE ON INDIANA FARMLAND ASSESSMENTS

By: Larry DeBoer

Agriculture's farmland assessment problem has caught the attention of the Indiana General Assembly. Senate Bill 436 passed the Senate and the House by wide margins. At this writing it is in conference committee. The bill postpones use of new soil productivity factors, and more significantly limits increases in the base rate for farmland assessment for taxes in 2016 and 2017. The bill asks that a legislative committee study the methods for assessing farmland.

The Rising Base Rate

The base rate is the starting point for farmland property tax assessment. It's a statewide dollar amount per acre.

It's adjusted by each acre's productivity factor, so that the acre's value reflects how much corn it can grow. Some values are adjusted downward for factors like forest cover or frequent flooding. The resulting assessment is multiplied by the sum of the tax rates for the local governments where the land is located. That's the tax bill.

The base rate is calculated with a capitalization formula that includes commodity prices, yields, rents and costs in the numerator, and an interest rate in the denominator. Until recently prices have increased and the interest rate has decreased. That has pushed the base rate up, a lot.

As recently as pay-2008 (for taxes paid in 2008) the base rate of farmland was \$880 per acre. By 2014 the base rate had exactly doubled to \$1,760. This year it's up another 16.5% to \$2,050, and the Department of Local Government Finance has announced a base rate of \$2,420 for

pay-2016. That's another 18% increase. Since the data enter the base rate formula with a four-year lag, we can project the base rate through 2018 with confidence under the current formula. Given the price, yield, rent, interest rate and cost numbers we already know, the existing base rate formula calculates to \$2,770 for 2017, and \$3,050 for 2018, increases of 14.5% and 10.1%, respectively.

Property taxes on agriculture have increased substantially as a result of these base rate increases. From 2007 through 2014, overall agricultural taxes increased 47%, while total property taxes decreased by 6%, led by a 33% drop in homestead taxes. Farm property tax increases are now coming at a time when expected operating returns have moved down sharply, contributing to even tighter farming margins.

Corn and bean prices peaked in 2013, and have fallen since then. Because of the lags in the formula, the lower 2014 prices cannot start to affect the base rate until 2018. The base rate is unlikely to fall before 2019 at the earliest. Until then farm property taxes will rise, even if farm incomes fall.

Senate Bill 436

This past summer a legislative study committee recommended a base rate freeze and further study of the problem. In his State of the State address the Governor pledged to prevent further rapid increases in the base rate.

Senate Bill 436 is the result. It passed the Senate with 49 votes and the House with 91. The two bills differ, however, so a compromise must be negotiated in conference committee. The bill contains many property tax provisions. The most controversial deals with assessment of special purpose business properties. There also are provisions for exempting small businesses from personal property taxes and to better define "agricultural use" for assessment purposes.

Most important for agriculture, though, is a provision that limits increases of the base rate per acre. The bill uses the "assessed value growth quotient", which is a 6-year average of Indiana personal income growth rates currently used to set increases in the maximum property tax levy. The quotient is 2.7% for 2015. The Indiana Legislative Services Agency estimates that the quotient will be 2.5% for 2016 and 3.8% for 2017. Under SB 436, for property taxes in 2016 and 2017, the base rate is limited to the previous year's base rate increased by the growth quotient. The base rates for 2016 and 2017 would be about \$2,100 and \$2,180, respectively, instead of \$2,420 and \$2,770. The

limit expires after 2017. The bill requests that an appropriate study committee take up the issue of alternative means of agricultural land assessment.

The limit has consequences for taxpayers and local governments. The Legislative Services Agency's fiscal note estimates that the freeze would reduce farmland taxes by \$45 million in 2016 and \$80 million in 2017, while increasing the taxes of other taxpayers by \$36 million and \$65 million. Local governments would lose \$9 million in property tax revenue in 2016 and \$15 million in 2017.

The limit would reduce taxable assessed value below what would exist, if the base rate were allowed to rise. Higher tax rates would then be needed to raise the same revenue for local governments. The higher tax rates would increase tax bills on other taxable property, so taxes would shift from farmland owners to other taxpayers. The higher tax rates would also push more taxpayers above their Constitutional tax caps. That part of the property tax would have been paid by land owners, but would not be paid by taxpayers at their caps. Local governments would lose that revenue.

Policy Choices

SB 436 may be a temporary fix to make time to study farmland assessment procedures. Providing farmland property tax relief won't be easy. Any reduction in property taxes for farmland will necessarily mean higher taxes for other taxpayers, lost revenue for local governments, or both, compared to what would happen with a rising base rate. Other interests can be expected to take a hard look at any proposals.

We could change the farmland base rate capitalization formula. This is tricky, because the Indiana Supreme Court says that assessments must be based on "objective measures of property wealth." Capitalization is a recognized method for valuing property wealth. All the numbers that go into the formula are objective, measured and published by outside agencies. The base rate formula looks like it satisfies the court's definition, and the definition could limit changes. The Court's objective measures requirement may also work against a simple continuation of the growth quotient limits.

We could eliminate the four-year lag. Taxes in 2016 could be based on assessments in 2015 which would be based on data through 2014. That's a two-year lag. But the formula's result using data through 2014 was \$3,050 per acre. The base rate would drop sooner—but before then it would rise faster.

One thing the Indiana Constitution does allow is a tighter tax cap. The Constitution says farmland taxes may not exceed 2% of assessed value. The General Assembly could pass a law to set a lower cap. That could provide a lot of tax relief for farmers. It could also cause a lot of revenue losses for rural local governments, especially those with relatively high tax rates.

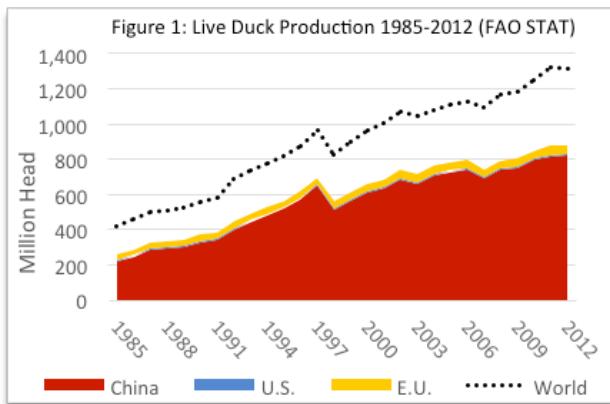
Senate Bill 436 is not yet passed and signed. If it does pass and the limits are put in place, there's no guarantee that a new method for farmland assessment could be found, given the consequences for other taxpayers and local governments, and the restrictions in the Constitution.

One thing is sure, the powers-that-be are paying attention. At the least, this means that there is opportunity to seek changes that could slow down the rate of farm property tax increases.

CHINA: EMERGING OPPORTUNITY FOR THE U.S. AND INDIANA DUCK INDUSTRY

By: Rachel Carnegie and H. Holly Wang

Duck is a small specialty meat in the U.S., however, it has an enormous market in Asia. In the last three decades, the world duck production expanded 3.1 times, from about 400 million head in 1985 to 1.3 billion head in 2012 (Figure 1). China dominates world duck consumption with 3 million tons produced domestically plus a net import of 13.2 thousand tons in 2011. U.S. duck production is barely visible in Figure 1. The quantity and quality demanded in China has risen with disposable incomes, with urban population growth, with internal food safety scandals, and with changing consumer tastes. It is in this rapidly-evolving yet huge market that provides an emerging opportunity for the U.S. duck industry and the corn and soybean producers who would provide their feed.



Traditionally, the duck industry in China produced birds with heterogeneous qualities for purchasers who preferred strong-tasting, domestically-produced, and often older-age ducks. Today, a new market for premium-quality ducks has emerged, particularly amongst affluent, urban, quality-conscious buyers. These buyers increasingly rely on branding, quality guarantees, safety certification, and country of origin labeling to determine product quality and safety.

The motivating factors for this outgrowth of traditional duck demand can be traced to demographic, socio-cultural, economic, and dietary changes taking place in China. Demographic transition includes changes in family structure, urban population growth, and education levels, as well as the opening of Chinese cities to global commerce which brings new cultural influences. Additionally, increases in consumer disposable incomes have increased food consumption volumes and resulted in stronger desires for improved food quality (Gale & Huang, 2007). As a result, major deviations away from traditional Chinese diets are taking place including increases in meat consumption, particularly poultry and beef, and increased dining out. Thus it is in the food service industry that many high-quality meat products may be sold at a premium.

The EU duck industry has already capitalized on this new demand opportunity and begun marketing their breeds and products in the Chinese market. U.S. firms are equally eager to enter the Chinese market and well positioned to do so. Two main strengths of the U.S. duck industry are: (1), its advanced production technology and biotechnology in developing breeds with particularly desirable features such as a high muscle meat ratio, low feed conversions, and disease resistance, and (2), its reputation in food safety and quality control. Three main challenges to the U.S. duck industry are:

- (1) The limited growth opportunities in the domestic specialty meat market
- (2) The Chinese traditional preference for domestic products over imported ones
- (3) The lack of information in the U.S. about the Chinese duck market and a lack of understanding of Chinese consumer segments and their preferences.

To address the last two concerns we surveyed restaurant consumers and managers. The surveys were conducted during the summer of 2013 in Beijing, Shanghai, Chengdu, and Guangzhou, representing four different geographic and cultural regions of China. One manager and

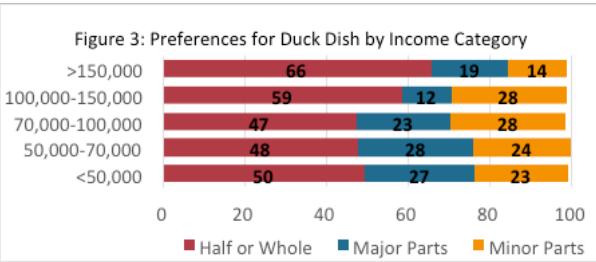
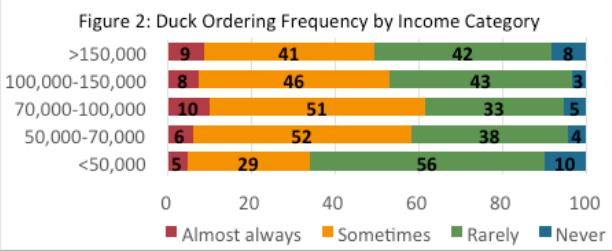
five consumers from randomly selected restaurants were interviewed by trained enumerators. Restaurants ranged from large luxury restaurants with many private dining rooms to small "mom-and-pop" restaurants with scarcely ten tables.

Consumers are Different

Demographic features of consumers such as gender, age, education, household size, annual household income, income changes, and migration are often linked with particular behavioral patterns. In addition, each city (region) has unique local traditions and characteristics that impact behavior patterns.

Based on consumer education, income, and behavior, three market segments emerge—two are traditional demand segments and there is one new demand segment. The traditional segments are mostly composed of low and middle-income consumers and still exhibit traditional preferences, while the new segment, composed of mostly high-income consumers, displays markedly more western preferences (Cui, 1999; Cui & Liu, 2000; Cui & Liu, 2001; Pan & Kinsey, 2002; Poon, 2006). The three consumer segments are detailed in Figure 2 and Figure 3.

Segment 1. The first segment is composed of consumers whose incomes have seriously fallen behind in the recent economic growth including those from economically depressed areas (such as Chengdu) or from less privileged backgrounds (such as migrants, or the less-educated). This segment is often labeled as the "Salary Class" and the "Working Poor." Migrants probably make up a large portion of this segment because big economic gaps exist between large cities and rural areas in China. Under China's residence control policies, residents in these four major cities who recently migrated from the small towns or rural areas often have disadvantaged status. Consumers in this segment have low incomes thus dine out less frequently and spend less when they do dine out. They also have a strong preference for local and traditional cuisine, which often contains strong-tasting, minor cuts and older ducks raised in Southern China. Despite these preferences, however, these consumers often order duck less frequently, but order major parts including breast and leg meat more often. This may be explained by the fact that traditional establishments often price duck at a premium price relative to other traditional meats such as pork, and the major parts are less tasty and less pricy on the same edible meat basis compared to whole or minor parts. So despite these consumers' tastes, they are largely constrained by their low incomes to purchase more discounted entrees.



Segment 2. The second segment is composed of middle and rising-income consumers with some college education who have gained financially from the expanding economy, who often lived in cities with growing economies but retained strong national customs (such as Beijing), and may have been part of the newly affluent. This consumer segment is labeled as "White Collar" or "Emerging." They often come from small households with only a few members, such as double career families, a few are migrants or families with one child. They often have less time to prepare food at home, and dine out more frequently than Segment 1. Although they also exhibit a strong preference for traditional or local cuisine, they have the income to dine out more frequently, they order duck more frequently, and they purchase whole duck entrees and minor cuts. They may have some form of college training and are from the middle income and purchase duck most frequently and order minor cuts and whole and half duck entrées more frequently than other segments.

Segment 3. The third segment is composed of highly-educated, high-income consumers, including those who have captured a share of the growing prosperity in globalized cities (such as Shanghai and Guangzhou). They have generally been exposed to western cuisine and culture. They are called the "Nouveau Riche," "Emerged," or "Affluent." They come from mostly small, power-couple households or large (> 5) wealthy households, such as business executives and celebrities, who are likely to eat out frequently, but not necessarily with the entire family. They also pay considerably more when dining out and they have acquired modern tastes and have reduced de-

sires for the traditional local tastes compared to the other two segments. Instead, they prefer other meats such as beef to duck, and when they do order duck, they prefer mostly major cuts and whole or half duck entrees. When they face falling incomes, they decrease the frequency with which they order duck and switch back to minor cuts which may be sold at a relative discount in globalized food establishments.

Other Factors. Age and gender are also related to consumer behavior and preferences. Older consumers order duck more frequently and prefer whole or half duck entrees, which likely reflects older consumers' preference for traditional dishes, such as Peking Roast duck, over modern cuisine. Male consumers order duck dishes more frequently and prefer major cuts more than female consumers who prefer minor duck cuts. This is consistent with the tradition that Chinese females enjoy the taste of food more even at the cost of a lot more work at the table.

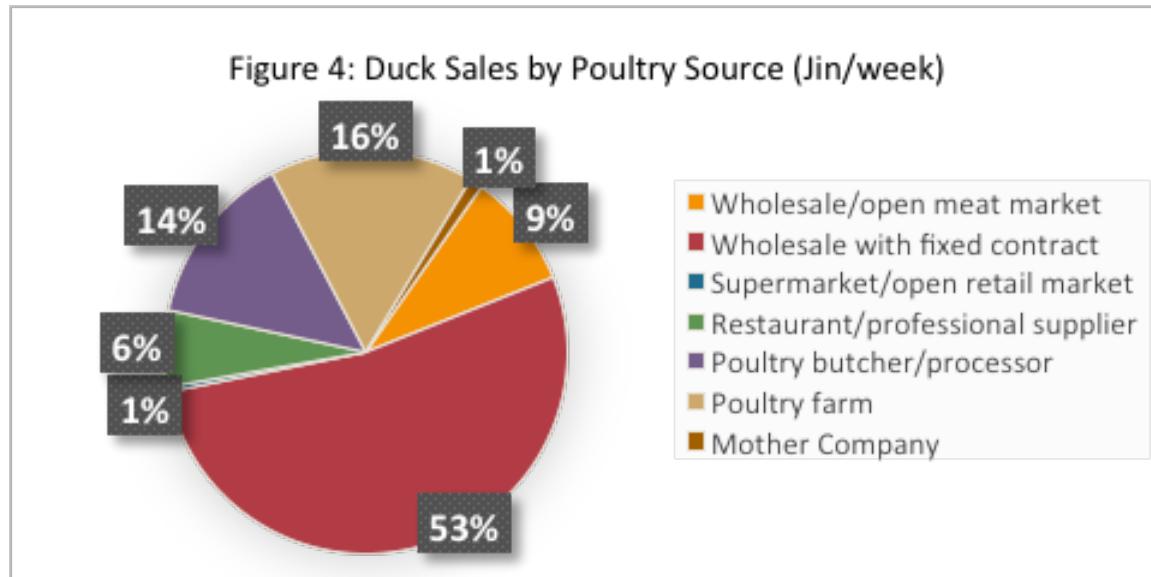
Restaurant Manager Affect Duck Preferences

From the manager survey we found restaurants use seven sources for their ducks as shown in Figure 4. In descending order of use these are: contracted wholesalers, farms, butchers/processors, open wholesale markets, restaurant special suppliers, poultry butcher/processor, and retailers.

category is composed of smaller, premium restaurants with low weekly sales volumes, low annual gross sales, but premium prices who mainly purchase from open retail/supermarkets, poultry farms, or poultry butchers/processors. The third category is composed of larger, premium restaurants with low weekly sales volumes, but high annual gross sales and high prices who mainly purchase from restaurant and professional suppliers. The final category is composed of large, inexpensive restaurants with large weekly sales volumes and high annual gross sales, but low prices. They mainly purchase from fixed-contract wholesalers. Categories two and three, with premium pricing, have stronger breed preferences evidenced by their higher use of EU/Cherry Valley or Chinese Natural breeds.

Market segmentation of restaurant managers who purchase duck can be compared on three dimensions: (1) Gender, (2) Age/experience, and (3) Education level.

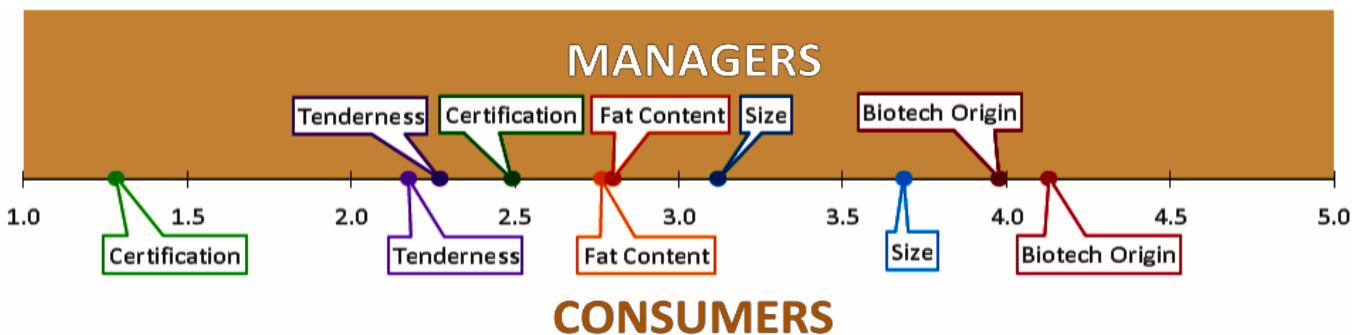
Gender: There were more male managers than female managers and male managers typically had higher education levels. Restaurants with male managers sell higher volumes, achieve higher gross sales, use open wholesale or retail sources more often, have less breed preference, and often have a stronger preference for major cuts. Female managers more often use fixed-contract wholesalers or supply from a mother company, use Chinese Natural breeds, and prefer minor cuts.



We also found there are four restaurant styles. The first category is composed of "mom and pop" style restaurants with low weekly sales volumes, low gross annual sales, and discounted prices. They mainly source poultry from a parent company or open wholesalers. The second

Age/Experience: Young, inexperienced managers more often use fixed-contract wholesale or get their duck supply from a mother company. They have less breed preference, and often order more already processed and cut duck parts in lieu of whole ducks. Older, more expe-

Figure 5: Ranked Preferences of Managers and Consumers



rienced managers often opt for open wholesale or retail, or farm supplied poultry, have some breed preference (mostly Chinese Natural breeds, followed by EU/Cherry Valley breeds), and buy whole ducks and then split them to obtain separate cuts.

Education Level: Less-educated managers sell more volume per week and have higher annual gross sales. They charge less per entrée, use fixed-contract wholesalers more often than poultry farms, butchers, and processors, and purchase EU/Cherry Valley breeds more often. Managers with higher education sell less but charge higher prices, use poultry farms, processors, and butchers more often than fixed contract wholesalers, and either use no particular breed or Chinese Natural breeds. Behavioral differences between the education levels of managers follow two common marketing strategies. Managers with less education buy a more generic wholesale bird and sell large quantities at discounted prices in a high volume-low margin strategy. Managers with more education tend to source selectively from farms, butchers, and processors, sell at high prices and use a lower volume-high margin strategy. One explanation for the divergence in breed preferences is than higher-education managers rely less on breed origin to determine quality whereas managers with less education perhaps rely more heavily on origin as an indication of quality (Bredahl, 2003; Knight et al., 2008).

Comparing Managers and Consumers

Although consumers and managers rank product attributes similarly, consumers rank product attributes more consistently than managers, and managers understand attribute meanings better than consumers.

Consumers and managers were asked to rank five product attributes (1) safety certification, (2) bird size, (3) biotechnology country of origin, (4) tenderness, and (5) fat content. The rankings were from one to five with one being most preferred. Result for both managers (top) and consumers (bottom) are shown in Figure 5.

These attributes represent different preferences managers and consumers may use when determining the value of each product and influence which product to purchase. Bird size can be determined prior to purchase, tenderness and fat content may be experienced after purchase and during consumption, and safety certification and biotech country of origin may or may not be linked with any post-consumption experiences.

Managers often disagree on the relative importance of each attribute making the average rankings converge toward the mean. Managers ranked tenderness as the most important attribute, followed by certification, fat content, size, and biotech country of origin. Consumers largely agreed on the relative importance of each attribute, thus the average rankings are more dispersed. Consumers ranked certification as the most important attribute, followed by tenderness, fat content, size, and biotech country of origin. Although consumers value safety certified products, it is uncommon to find certification labels for duck dishes, so they often rely on their eating experience based on tenderness, fat content, and size to determine restaurant quality and repeat patronage (Bredahl, 2003). As a result, managers often focus on improving the eating experience instead of using safety certification.

We asked consumers and managers about their understanding of the meaning of each attribute and found managers understand better than consumers. The highest percentage of consumers and managers understood tenderness, followed by size, and fat content. There was less understanding of certification, and biotech country of origin. Managers who understand the meaning of biotech country of origin is highest in Chengdu and Shanghai, which is probably a reflection of the entrance of foreign breeds in Shanghai and the strong preference for domestic breeds in Chengdu. Interestingly, nearly all managers in Beijing and Guangzhou understood safety certification, while only about twenty percent of consumers knew the meaning.

Summary: Linking the Indiana Duck Industry to Chinese Consumers

As an emerging economy, China is experiencing fundamental changes in the structure of its food marketing system. In particular, consumer demand has increased beyond what domestic supply is currently providing (Poon, 2006). As a result, China has become a food importing giant, including the largest duck meat importer in the world. The U.S. duck industry has efficient production technology and high safety and quality, but has limited domestic demand. Linking the Chinese consumer with high-quality efficiently produced U.S. duck products appears to be a mutually beneficial solution. Indiana is the largest duck producer in the country and could be well positioned to provide Chinese consumers with safe, high quality poultry.

To better link Indiana to China will require a better understanding of duck consumption in China, and that was the purpose of this study. Several unique features of the duck market in the restaurant industry in China were found and include: (1) that behaviors of both restaurant consumers and managers differ by restaurant characteristics and by city and, (2) although restaurant consumers and managers rank product attributes similarly, consumers rank product attributes more consistently, but managers better understand attribute meanings.

We did interviews in four major cities—populations listed here are approximate. Beijing (22 million) and Shanghai (24 million) are the most developed cities with higher incomes and education levels, Guangzhou (14 million) is next in line in incomes, and Chengdu (14 million) is clearly behind. Shanghai is influenced more by western culture, while Chengdu maintains a strong local culture. Duck is traditionally consumed in traditional ways in Southern China, which includes Chengdu and Guangzhou, while Beijing only consumes Peking Roast Duck, and Shanghai seems to consume duck just as another poultry meat, like chicken.

The consumers dining in restaurants are mostly young and middle-aged adults, younger than the general population. Managers are also young, having a similar average age as their customers, which helps them understand their clients. This is also an advantage in terms of introducing a new product, new quality level, and new style of cooking, as younger managers and customers tend to be more receptive to change.

Most duck dishes use the whole duck. Even when cuts are cooked and sold separately, restaurants seem to prefer to buy whole ducks and split them in the kitchen them-

selves. The primary source of duck supply is from wholesalers with fixed contracts. There are a huge number of independent restaurants in all Chinese cities and very few chain restaurants. Because there are many independent restaurants, this supports a highly developed wholesale market. This added layer in the supply chain makes consumers and food preparers less connected to the original duck producers and less likely to understand the quality of the birds (Knight et al., 2008). Also, the ducks produced domestically are generic in that there is no recognized domestic brand.

What duck attributes are valued in China? Both consumers and managers care about the safety of the meat and rank that as one of the most important attributes. We described this as “certification” in the article. They also rank tenderness of the meat as an important attribute to them. Fat content is the third ranked attribute, followed by the size of the bird. They care least about the breed’s (or biotech) country of origin. These preferences are as expected.

Let us review each of these attributes more closely. Highly-publicized food safety scandals in China have heightened consumer sensitivity and encouraged consumers to rely on brand and government certification more heavily as signals of product quality and safety (Liu et al., 2013; Ortega et al., 2012; Veeck et al., 2010). This means that product branding can be a strong marketing tool for producers to differentiate their products as high quality (Zhou & Hui, 2003).

The next most important attributes seem to be the ones that consumers or managers can observe (before purchase/consumption) or experience (after consumption) such as taste, texture, and fat content (Knight et al., 2008). Finally, the least important attribute is biotech country of origin. From the survey we observe that Chinese prefer domestic breeds, thinking they taste better than imported breeds. Although, there has only been limited penetration of imported breeds in the Chinese domestic market, a few managers know EU’s Cherry Valley breed. Certainly, there are opportunities for further market penetration and for the introduction of premium imported ducks. Market strategy recommendations for US agribusinesses include: focus on big cities, adopt differentiated marketing campaigns, heavily promote new products, and stress product value (Cui, 1999; Poon, 2006).

From our own results, we specifically recommend the U.S. industry: 1) target luxurious restaurants and wholesalers servicing such restaurants in marketing promotions, 2) work with the Chinese food service industry to develop new duck dishes that fit Chinese tastes while also em-

phasizing the tenderness and juiciness of younger duck produced with US biotechnology, and 3) train restaurant managers to label safety information of US products, either produced in the US or produced in China by our partners using our biotechnology, on the menus.

The time may be right for the U.S. industry to be more aggressive in China. Recent Chinese government development goals have focused on reforming the domestic animal husbandry industries. This restructuring has created many opportunities for U.S. agribusinesses to export their technologies. This is particularly true in the poultry meat and feed sector and includes: poultry feed exports, poultry housing, poultry production and operations management, value added techniques and advising, processing equipment, offal and minor cut exports, and "green" and "organic" products (Poon, 2006).

Through a better understanding of Chinese consumers and restaurant managers this study hopes to better link the U.S. and Indiana duck industry to the world's largest duck meat importer.

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CLUES TO FUTURE CROP ECONOMICS FROM THE PAST!

By: Chris Hurt

U.S. and global crop agriculture seems to be in a downward transition from record high economic activity during 2010 to 2013. Not surprisingly, the current downward adjustments may be just a portion of a longer run cycle observed in commodity markets. The concept of cycles is rooted in economic theory. A simply summary of that process develops over time as:

1. Markets start out in equilibrium
2. There is some new shock, like a large-unexpected increase in demand
3. Prices respond upward
4. Over time, producers increase production in response to higher prices and consumers constrain purchase quantities with the higher prices
5. Eventually higher supply and weakened consumption return markets to a new equilibrium

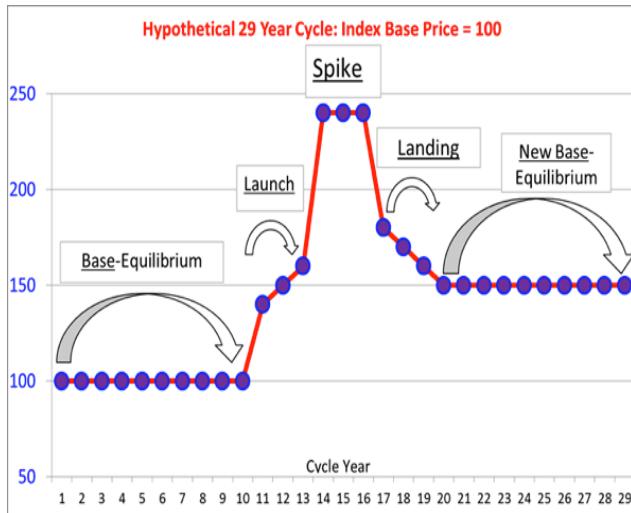
This longer term cycle is most closely correlated with the prices of commodities. Prices of course are determined by both supply and demand forces. Prices are also strongly

related to the amount of economic activity in an industry with the initial upward price movement in commodity prices resulting in high returns to producers which in turn encourage them to increase demand for crop resources like machinery, fertilizer and land. Over time, markets work through the adjustments outlined in steps 4 and 5 above.

Figure 1 is an illustration of a hypothetical 29 year commodity cycle. The observed historic cycles we will show in Figure 2 have had lengths of 29 years, 27 years and 39 years (measuring peak-to-peak). So, the 29 year length is used as an illustration and should not be used as a precise year count. Index numbers are used to provide a rough illustration of the magnitudes of economic activity. Starting from the left hand side in Figure 1, the index of economic activity is 100.

I divide the 29 year cycle into five periods. The first is about 10 years of relative stability in a base equilibrium. The launch represents a few years where some new demand forces begin to drive prices and economic activity higher. The third period is the spike where the peak of the cycle occurs and economic activity may reach double or even triple the levels of the base. A common phrase heard in the industry is "we are now in a new era." The landing is a period when supply is catching up to the demand surges, and prices are moderating. Finally the new base equilibrium may be a fairly long period as represented by roughly 10 years in the illustration. The new base equilibrium may be at a higher level than the original equilibrium and is illustrated as about 1.5 time the base period.

Figure 1: Hypothetical Price Cycle



During this long term 29 year cycle about 1/3 of the time is in the base equilibrium, about 1/3 of the time is in the

sharp rise and then moderation, and about 1/3 of the time is in the new equilibrium.

It is important to recognize that the exact pattern of any cycle is dependent upon the specific conditions that affect supply and demand during that cycle. This means that the lengths may be different across cycles and the magnitude of increase and decrease can vary in different cycles. This also means that using past cycle behavior to forecast the current and future patterns should be used with great caution. This is because the economic conditions that will prevail in upcoming years cannot be known with certainty, but will evolve as time progresses.

Finally, we will look at past cycle behavior to try to gain some clues about the future of crop economics. Most in agriculture are aware that past cycles have exhibited "boom and bust" tendencies. However, we will soon find that is not always the case, and another possible pattern observed in history is a "boom and moderation" cycle. How will the current cycle end? The answer will be determined over coming years and will likely depend on a group of factors we will discuss.

Historical U.S. Corn Cycle

To gain some insight into the historical economic crop cycles, we will use corn revenue per acre adjusted for inflation (real revenues). Adjusting for inflation is necessary when looking at revenues over more than 100 years because of substantial changes in the buying power of the currency. Corn revenue per acre is used as a proxy for the economic activity generated from an average acre of national corn production. USDA maintains yield per acre and U.S. corn prices received by farmers back many years. This analysis begins in 1900 and projects revenues per acre through 2018 based on average trend yields for the 2015 to 2018 crops and uses current corn futures prices to estimate average cash prices received for the 2015 to 2018 crops. All revenues per acre are then deflated using the Consumer Price Index and 2015 prices (current prices). Government program payments are not included in these revenues, but crop insurance proceeds are included.

Figure 1 shows these real U.S. corn revenues per acre for 1900 to 2018. The first observation is the enormous range from \$113 per acre in the Great Depression year of 1931 to \$1,248 per acre in 1973 during the 1970s boom. Keep in mind that the \$113 per acre is in current 2015 dollars. You will also note the upward moving trend line through the real revenues. Agriculture production technology has changed drastically over this period and one interpretation of the trend line is that this technology has enabled

each acre of corn to produce more economic output in real (inflation adjusted) terms. So comparing 1931 to 1973 needs to be done in relationship to the trend.

A second interpretation of the trend line is that it represents some aspects of an average costs of production over this very long period. Data on costs of production is simply not available over this long period. If one uses the trend line as a rough proxy for costs over time, it may shed some light in evaluating returns during various periods of time. Again this is a rough proxy, but when revenues are well above the trend line, odds are high that this was a very favorable return period for U.S. corn farmers. And when revenues are well below the trend line, this likely indicates a period when returns were low and perhaps negative.

There are four long term cycles? The first cycle is the period represented by World War I and the agricultural depression years of the 1920 and 1930s. The peak year was 1917 when real revenues reached \$678 per acre in current dollars, and busted to just \$172 by 1921. We see clear characteristics of the hypothetical 29 year cycle. Real revenues in the early 1900s were about \$300 to \$400 per acre. Then the new food export demands to feed war-torn Europe pushed real revenues per acre up to \$600 to \$700. U.S. farmers responded by "plowing up the plains," bringing millions of new acres into production. When the war was over, exports to Europe fell, greatly reducing demand for U.S. crops. European farmers went back to production, but the new acreage in the U.S. did not drop out of production. This created an imbalance of excess supply in relationship to demand with farm level prices below costs of production. Other characteristics of the period were plummeting farm incomes, falling land values, and economic recession/depression in U.S. agriculture.

The second cycle boom was around World War II and included the new equilibrium of the 1950s and 1960s. The figure clearly shows how World War II finally helped raise economic activity out of the great depression lows. Real corn revenues in the 1930s of \$200 to \$300 per acre lurched higher to \$500 to \$700 in the early and mid-1940s. Notably, the downward adjustment in the 1950s and 1960s was not nearly as severe as after WW I.

While the WW I cycle was an extreme boom and bust cycle, the 1940s to 1960s cycle was more of a boom and moderation pattern; Why? Two potential explanations are that wage and price controls during WW II were fairly effective at preventing farm prices from rising as sharply as they might have in their absence. It stands to reason that if prices did not go so high in the boom, they did have to fall so much in the downward phase of the cycle. A sec-

ond supporting argument is that world economic growth was strong after WW II as the world was rebuilding and recovering from the pent up demand that could not be satisfied in the great depression of the 1930s. Strong world income growth in the 1950s and 1960s provided a stronger export base for U.S. crops and helped reduce the downside adjustments compared to the disaster after WW I. The important message from this cycle is that U.S. agriculture can have boom and moderation cycles. They do not have to end in busts, especially if the demand base continues to be strong.

The third cycle is the 1970s and 1980s boom and bust. Real corn revenues in the 1960s were in the \$500 to \$700 range and boomed to about \$1,100 an acre on average for the years 1973, 1974, and 1975. Corn and other commodity prices were caught up with massive macroeconomic factors that caused them to move sharply higher. The U.S. abandoned gold as the foundation of the dollar, sharply devaluating the buying power of the dollar. OPEC organized as a cartel to push up world oil prices and the former Soviet Union began to buy massive quantities of wheat and other basic food commodities in the world market. Inflationary monetary and fiscal policies of the U.S. also set off further inflationary pressures. Inflation of the 1970s sent crop prices higher, but policies to gain control of inflation in the 1980s resulted in massive declines of crop prices and economic activity.

The real corn revenues that had been above \$1,000 per acre retreated to generally \$400 to \$500 from the mid-1980s until 2005. Thus in the new equilibrium, real revenues retreated to somewhat below where they were in the base equilibrium before the early 1970s boom.

Both the WW I cycle and the 1970s/1980s cycle were boom and bust cycles. But the WW II cycle was much more of a boom and then moderation cycle. Thus our 100+ year history lesson shows two boom and bust cycles and one cycle of boom and moderation.

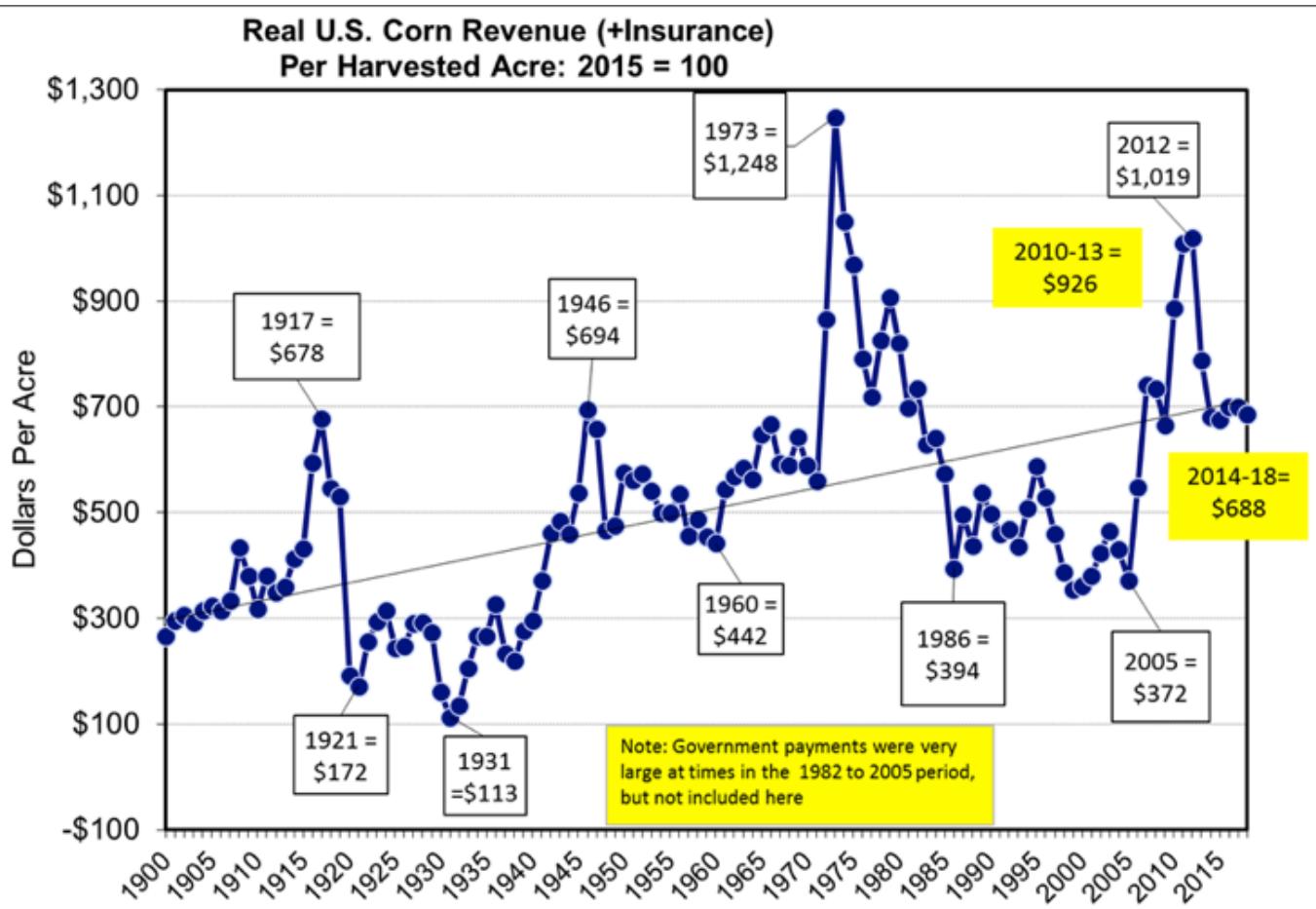
Characteristics of the Current Cycle

We have seen that cycle patterns and lengths are dependent on the forces at play during each individual cycle. What about the current cycle? A glance at Figure 2 shows that 1998 to 2005 was the lowest period of real corn revenues dating back to the 1920s and 1930s. Crop margins were tight and there was little incentive for the world to invest in low-return crop production, yet world total usage was growing. This was thus a period when world ending inventories were slowly declining, but still considered adequate and therefore crop prices remained depressed.

At least three drivers began to change the global picture in the mid-2000s. Global biofuels policies were to dramatically increase demand for feed stocks like corn and vegetable oils. In fact, one of the objectives of U.S. biofuels policy was to enhance economic activity in rural communities. The second factor was the enormous increase in soybean demand from China. Ag economists often broadly characterize this driver as "higher incomes in developing countries." The third driver was macroeconomic policies that caused the U.S. dollar to be at 20 year lows at times during the 2008 to 2011 period. And finally, low yields in parts of the world during this period and low U.S. yields in 2010, 2011 and 2012 contributed to shortages in world supplies. Demand growth had exceed supply and as a result prices rose to ration a short supply situation.

As a result of inventory shortages and higher prices, real corn revenues per acre rose from \$372 per acre in 2005 to a peak of \$1,019 per acre in 2012 (with crop insurance indemnities included in revenues). The boom was in place. A return to better yields in the 2013/14 and 2014/15 crop years and a leveling-off of demand growth for biofuels has enabled the world to begin to restore inventories to more adequate levels with prices in moderation.

Figure 2: U.S. Real Revenue Per Acre



How Does the Current Cycle End?

We have seen that booms in economic activity in crop agriculture have occurred four times in the past 115 years. Real corn revenues per acre in 2015 dollars were used to illustrate these cycles that may be around 30 years or longer. They are composed of a base equilibrium period, a period of surge, and then a period of downward adjustment as prices return to a more stable new equilibrium. While history provides some general patterns and time lengths, each cycle's parameters are determined by the unique events occurring at that time. The current cycle has clearly exhibited a boom phase when real corn revenues in the U.S. more than doubled from the 1998 to 2005 lows. Real corn revenues averaged \$926 per acre during the four year period covering the 2010 to 2013 U.S. crops. The crops in 2013, 2014, and 2015 appear to be making a transition toward a much lower revenue average. The years of 2015 to 2018 are simply projected from current futures prices and therefore the actual outcomes for these years are still to be determined and thus could be much different from what appears to be exhibiting signs of movement toward the new equilibrium. In contrast to the \$926 average real revenue for the 2010 to 2013 crops, those revenues fall by \$238 an acre for the

estimates of the five crops representing the 2014 to 2018 U.S. crops. If so, this represents sharply lower economic activity and implies that producers, landowners, and agribusinesses are forced to adjust.

If this pattern does develop we may eventually declare this cycle to have been a boom and moderation cycle more similar to the WW II and 1950s/60's cycle. This type of cycle is much easier for agriculture producers and agribusinesses to adjust to as compared to the boom and bust cycles as seen in WW I and after, and in the 1970's/1980's.

No one can foresee the future events that will determine how this cycle will end, but we can point to the most likely drivers to watch.

1. Biofuels Policy and Direction: It is clear that government biofuels policies were one of the drivers in the surge in demand for crops like corn for ethanol and vegetable oils for biodiesel. While the U.S. had the largest biofuels program, Europe, Canada, and a host of other countries moved in a similar manner. The EPA is the administrator of the U.S. biofuels program and they have shown an unwillingness to "force" the growing mandated volumes of cellulosic ethanol in the legislation, especially since that industry has not been building sufficient plant capacity to produce mandated volumes. Some analyst have suggested that these volumes could be met with biodiesel which would be very bullish to vegetable oil prices. On the other hand, world energy supplies are much more abundant relative to demand, and energy prices much lower than when biofuels policy was passed. This suggest that the U.S. Congress could re-evaluate our biofuels policy in the broader context of a comprehensive U.S. energy policy. Those in the crop production and biofuels industries who are arguing for the continued expansion of biofuels usage under the current mandate would likely have reduced political support in this more abundant energy environment. On the other side, oil companies and some sponsors in Congress are proposing a total elimination of the biofuels mandate.

How this works out has potentially huge implications for economic activity in agriculture. One compromise is to freeze biofuels mandates around their 2014 or 2015 levels. This basically says that the mandate will stay in place for existing investments in biofuels, but the U.S. government will be slow to stimulate added investments in biofuels capacity.

USDA, in their "Agricultural Projections to 2024," largely favors this concept of keeping the bushels of corn use for ethanol fairly stable over the next decade. They have

corn use for ethanol staying around 5.1 to 5.2 billion bushels per year. If this were to be correct, the amount of corn used for ethanol actually goes down over time as a percent of usage. This pattern would mean weakening demand for corn to be used in biofuels, but it is not the sharp loss of demand experienced after WW I and in the 1980s. This would favor the current cycle ending in moderation.

For soy oil to be used in biodiesel, USDA economists have a small increase in the total amount used such that the biodiesel use as a percent of total use remains nearly constant over the next decade. If so, this means stable demand for soy oil use for biodiesel.

2. Chinese demand for soybeans. Chinese economic growth has been the primary driver of huge increases in their purchases of U.S. soybeans. So, a second driver will likely be how Chinese soybean demand evolves in coming years. From the 2005 U.S. crop to the 2014 crop, the rate of growth in U.S. soybean exports grew at a compound rate of over 7% a year. USDA's long look project has that rate of growth slowing to under 1% per year through the year 2024. However, their world export activity grows at close to 3% a year, but it is anticipated that the U.S. will get a small portion of this total growth with South America getting the largest portion. This is primarily because the world soybean usage growth rate exceeds the rate of yield increases so, new lands will have to be dedicated to soybean production and South America has the greatest ability to bring new land into production. USDA currently suggest a continuation of Chinese soybean demand growth, but at a slower rate. If this pattern evolves, it reduces the likelihood of this cycle ending in a bust.

3. Macroeconomic events. In the article, we outlined how macroeconomic events can have large influences on how a cycle ends. Both of the boom and bust cycles described had macroeconomic events that were harmful to crop economic activity. The WW I cycle ended with the agricultural recession of the 1920s and the great depression of the late-1920s and 1930s. The great depression represented a period of loss of demand for ag products from a weak general economy.

The 1970s and 1980s boom and bust cycle was highly tied to macro events that deeply depreciated the buying power of the dollar, to new demands from the Former Soviet Union, to inflationary U.S. monetary and fiscal policy, and ultimately to the monetary policies in the 1980s needed to correct inflationary expectations built up in the 1970s.

In the current cycle there are potential macroeconomic risk. The approximate 23% appreciation of the dollar in the past year is a serious constraint for U.S. agriculture to sell their products in world markets. A global recession is another potential threat that would weaken world demand and is associated with weak economic activity in ag markets. Geopolitical conflicts pose another possible negative driver especially if they result in distortions or reductions in international trade. The potential for another global financial crisis as experienced in 2008 and 2009 is a concern. China has been a primary driver of world economic growth and of U.S. agriculture and raises special concerns should a major economic slowdown, or social or political disruption occur there.

If the world can avoid a major negative macro event, the odds increase for this cycle ending in moderation. Of course, macro events along with world weather and its impact on yields is nearly impossible to accurately predict. This leaves agricultural managers only able to be watchful for these potential drivers and be ready to adjust strategies if they develop.

While we tend to believe this boom cycle will end with moderation, the actual outcome is still to be determined. One consequence is clear from these wide swinging levels of economic activity across the cycle and that is that the management strategies should change at different points on the cycle. A second point is that there are periods of rapid adjustment on the cycle. The first of those is in the boom when adjustments are occurring toward the upside. The second is as adjustments are changing to the downside. These are likely the adjustments crop agriculture is now going through.

Many farm operators, land owners, and agribusiness managers have acquired fixed assets in recent years, in some cases with the expectation of the boom phase continuing. They should be mindful that historic cycles suggest that the downward adjustment may have already started and that the new equilibrium can be much lower than the peaks and can last for extended years. The most difficult period is the early years of the downward adjustment and that may be where we are right now on the cycle. Our history lesson would suggest that getting through the next few years and making the transition to lower levels of economic activity seems to be a prudent strategy. However, only time will tell how the actual path through this cycle will unfold.

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