



A Symposium Sponsored by
The Federal Reserve Bank of Kansas City

Kansas City, Missouri
June 8-9, 2010



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Session 1:

Agricultural Profitability in the 21st Century

Agricultural Profitability in the 21st Century

*J.B. Penn
Deere and Company*

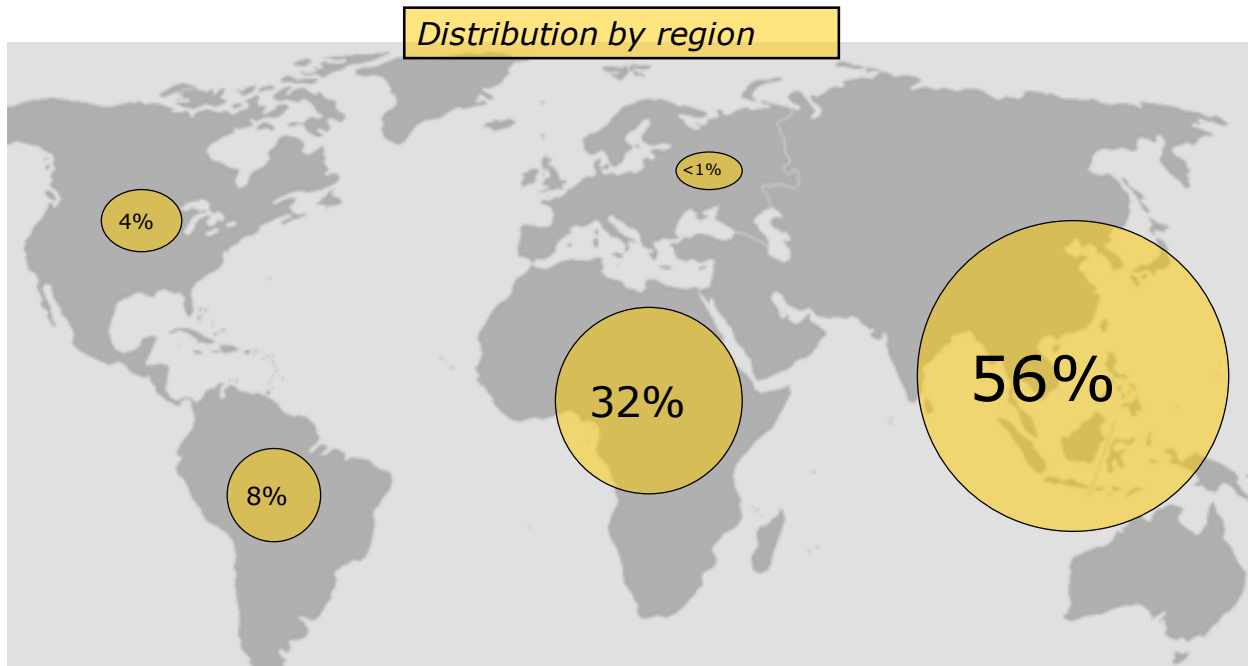
The first decade in this new century has been a very tumultuous one and a very prosperous one for North American agriculture. So it is an ideal time to step back and say, “What next? What is likely to follow? Will it be more of the same? Will North American agriculture revert to the old patterns or will it be something entirely new?”

Today, I will look at the fundamentals that are affecting the marketplace as we go into the second decade of the 21st century. First, I want to review the principal demand drivers for the food and agricultural industry and say a little bit about the characteristics of the markets. Second, I want to look at the global supply system as we see it today – what is its current condition, what are some expected changes, and what are its constraints. Third, I want to talk about some of the policy drivers that shape the business environment. Finally, I will provide some summary observations.

Let’s start with the demand drivers. When you strip down to the essentials, there are really three forces that are the fundamental drivers of demand for the food and agricultural industry. First is the number of consumers in the world and where they are located– so population growth, the number of people we have today and the number we expect in the longer term. Second is the purchasing power those consumers have and where they are on the individual income ladder. Are they at the bottom, in the middle, or at the top? Their position is very important in terms of the demand for agricultural products. Third, there is a set of public policies in the aggregate that come together to very much influence the environment in which we have to do business. I want to say a few words now about each of these.

First of all is population growth. Everybody in this room is familiar with these numbers now. We’ve all seen these over and over, as we’ve talked about this subject since 2008. We have a little over 6 billion people in the world today. We are going to have 1½ billion more by 2025 and then the world population is going to plateau around the middle of the century at something just over 9 billion people. So we are going to add 1½ billion people – more consumers – in the next 15 years and we are going to add 3 billion people, or 50 percent more people than we have today, in just 40 years’ time. That’s not very long. When I look back over my career, which spans 40 years, that is not a very long period indeed. So one of the major forces is the number of people and where they are going to be located in the world.

Chart 1: World Population Growth

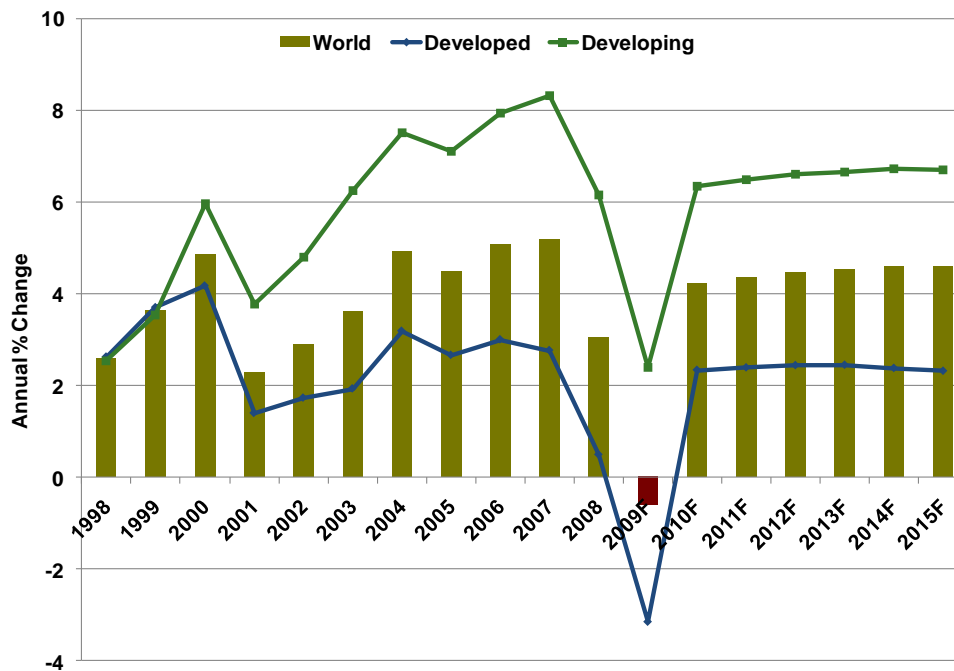


Source: United Nations, World Population Prospects 2008 Revision

This chart breaks down the number of new people to 2025 (Chart 1). The trends are slow to change and relatively stable, so this distribution roughly holds if you extend it on to 2050. Most of the new people in the world, over 80 percent, are going to be in the Greater Asian region and in the African region. In the upper latitudes of the world, there will be very little population growth and you can see a decline in the number of new people in parts of Europe and the former Soviet Union. So the distribution is going to be largely in the Greater Asian region and in Africa, and those happen to be parts of the world where the diets are the least adequate at this point in time.

We have this expectation for all of these new consumers. The big question is what is the purchasing power going to be as we look forward? Chart 2 shows GDP growth for the world, a proxy for income growth. These data are from the International Monetary Fund. The IMF is widely acknowledged as one of the most credible forecasters. They are also seen as reasonably conservative.

Chart 2: World GDP Growth



Source: International Monetary Fund (IMF), World Economic Report, April 2010

So there are a couple of points in terms of the income driver we can take from Chart 2. First of all, we have to recognize what happened in the first part of this decade. We were seeing global growth as we had never seen it before. Global GDP was growing in the 4 to 5 percent range, which is absolutely phenomenal. There were more countries exhibiting positive GDP growth at the same time than ever before in history. Jobs were being created. Incomes were rising. People at the bottom of the income ladder were seeing their incomes increase, and much of that increase was being spent for food.

Then we come to 2008. We see precipitous slowing in the global economy. We first started experiencing the cyclical downturn. Then came the credit crisis. The upshot of that was the global economy in the aggregate actually contracted about a half percentage point in 2009.

Now, here we are almost halfway through 2010 and, as the bar indicates, the forecast is for global GDP growth to exceed 4 percent. The IMF is reasonably bold and has forecasted for the next five or six years. You can see the forecast is for a return to what's called the trend growth potential for the global economy to grow in the 4 to 5 percent range.

Taking GDP growth and breaking it down a little bit more, where that growth is going to occur is exceedingly important to our industry. You can see the world is broken into the developing countries and the developed countries, with the developing countries being the green line at the top. In the first part of the past decade, you can see the developing countries were

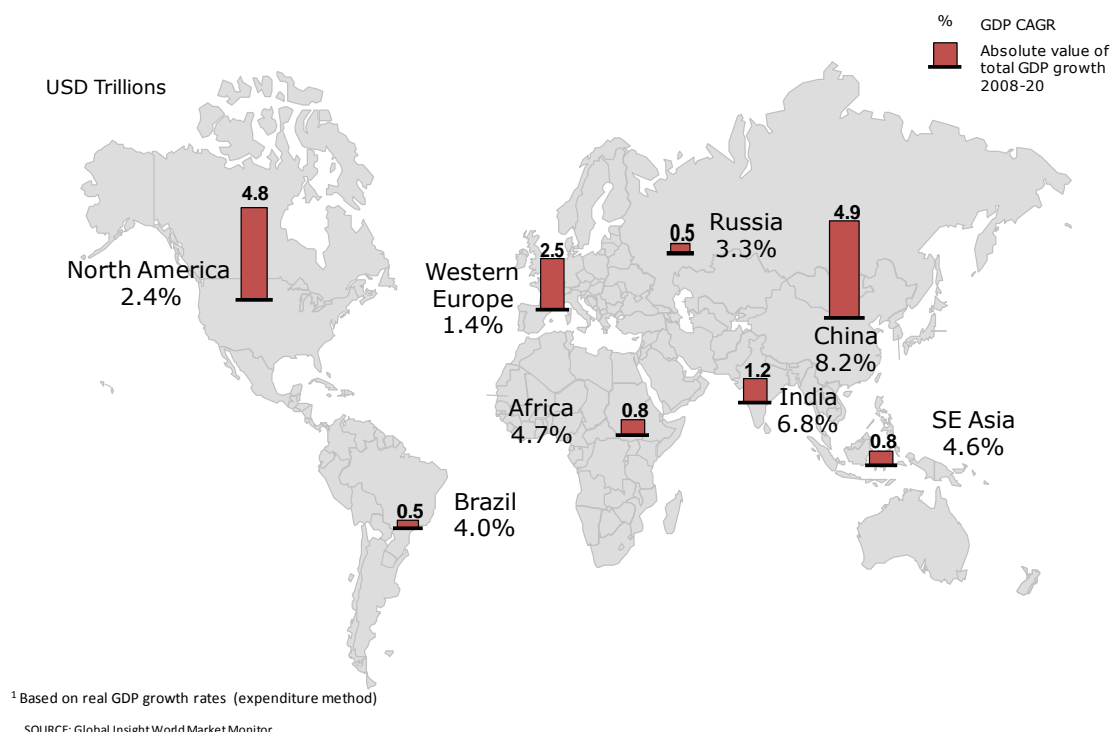
growing at about twice the pace of the developed world. When the recession came, it was certainly a slowdown in growth for the developing countries but not a contraction for them as a group. Led by India and China, growth slowed but it didn't contract, which is exactly what happened for the developed countries, shown by the blue line at the bottom.

The IMF is showing here a V-shaped recovery (there was a lot of talk about what size this would be). You can see pretty clearly they are expecting a bounce-back to the trend growth path and for that to be true for the developing countries, as well as for the developed countries that produce that overall growth in the 4 to 5 percent range. It's extremely important the growth in the developing countries continues apace.

Chart 3 projects in both absolute value of GDP and in the rate of growth. You can see the map of the world faintly in the background. There are a couple of things that are evident from this chart. First of all, the growth rates in the lower latitude of the world are much higher than they are for the developed countries in the upper latitudes.

The second thing is, if you add the absolute value of GDP growth for the Asian region – for China, India, Southeast Asia, you see it amounts to about \$7 trillion. If you add the absolute value of GDP growth for North America and Western Europe – the developed part of the world – you can see it amounts to about \$7 trillion. What we are seeing emerge in this century is a multipolar economy. No longer do you have the First World and the Third World, but you now have several poles of economic activity and that, again, is extremely important for the food market and extremely important for the food and agricultural business. This is something we have not had before.

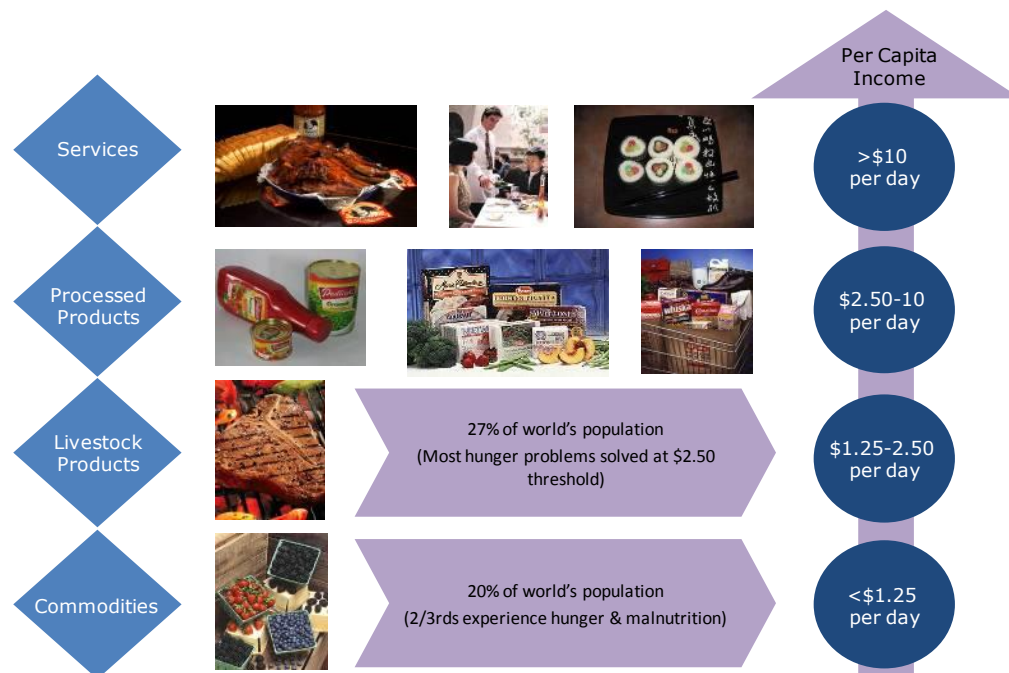
Chart 3: World GDP Growth by Region – 2008 to 2020



When you look at the number of consumers and where they are located, you look at the incomes and how fast they are going to be growing and where that's occurring in the world, that brings you to the dynamics of food demand and a little bit more of what that means for our business.

On the right-hand side of the following chart is the income ladder (Chart 4). You can see we have about half – 47 percent – of the world's population today of 6 billion people live on less than \$2.50 a day. These were the people who were the most affected by this dynamic and widespread GDP growth we had in the first half of the decade. These are the people who were quickly moving up the income ladder, spending most of that additional income for food.

Chart 4: Dynamics of Food Demand



Source: World Bank, 2008

On the left-hand side of the chart, you can see what happens as incomes rise. People move away from staple foods, from basic commodities, and the first thing they want to add is more animal protein to their diets. As incomes continue to increase, they add more animal products and they add more services to the food products.

Again, when you look at population growth and income growth and where all of that is expected to occur, you are seeing this dynamic work itself out for our business as we look just 10 or 15 or 20 years ahead.

What are the implications of all this? As I indicated, we are in a multipolar economy now. We have engines of growth outside of the developed world. We've certainly seen that in this past

recession in the case of India and China. We no longer have the Third World. This “emerging market economy” label is now more appropriate than probably “developing countries.”

The other thing these projections for population and income suggest is that by 2030 – just 20 years hence – we are going to have to produce 50 percent more agricultural products than we produce today. By 2050, we will perhaps have to double the amount of agricultural products we produce today. I say again, to 2030 is not a very long. To 2050 is not a very long time to essentially double the agricultural output.

In 2005, if you add up the volume by weight of all of the agricultural output, it was slightly more than 7 billion tons. By 2030, we are going to have to produce an additional 3 to 4 billion tons. Just imagine the investment required. It is not only the production of that amount, but it is the storage, the transportation, the processing, and the distribution of that amount. Think of the huge investment in transportation infrastructure, storage infrastructure, and all the other things required to do that.

Another implication of these population and income numbers is the increased role of trade. The world is becoming increasingly urban. In 2007, we passed the halfway point. More than 50 percent of the world’s population now lives in urban areas. That is projected to be as much as 70 percent by 2050. We are increasingly in a situation where the population centers are in one part of the world, the surplus food production is another part of the world, and to meet the demands we have to increase trade, which highlights the importance of having more liberalized rules, cheaper transactions, and certainly a more robust rules-based trading system.

Very quickly, I want to say a couple words about the market characteristics. In the developing countries, the food markets are still concerned about price: the price of food first and foremost, then getting a sufficient number of calories, and improving and upgrading those diets. Once they pass that, it’s a concern about basic food safety and then it’s about reducing spoilage. Waste and spoilage are a big portion, because of the lack of infrastructure, so the focus is on trying to improve the infrastructure and reduce the wastage.

But in the developed countries, and certainly in the North American market, the concerns and pressures are much different. Production agriculture today in North America is being criticized from many vantage points. We are seeing already a big emphasis on trying to collectively change the national diet.

The U.S. Department of Agriculture issues new dietary guidelines every five years. A new set of guidelines is to be issued shortly. It is expected there will be a big shift away from animal products and into more fruits and vegetables and away from fats. There are new school feeding regulations for breakfast-lunch school programs.

The FDA is reexamining the role of salt in the diet. There are lots of state bans on trans fats, for instance. Sin taxes are coming into vogue again, where you tax sugar products or you tax sweetened sodas.

There is a lot of concern about obesity. It's no longer just a health concern. It's now a part of the food and agricultural policy issue. A lot of discussion is held about local foods, eating smart, home gardens. There are a lot of pressures. There are a lot of shifts characterizing the markets in the developed countries today.

The point is there is a lot of change likely coming. It's going to require adaptation all across the food system from changing production patterns for farmers to also changing patterns for processors, sellers, and for everyone in the system. That concludes the discussion of the principal demand drivers for our industry.

Now I want to say a little bit about the supply system, the condition we find it in today, and then the expectations for it. First, in the surplus food producing regions, we have seen a big investment in research and development over time. We have seen a lot of technological innovation. Producers have been quick to adopt these new techniques. As a result, we have seen tremendous productivity growth in the crop sector and in the livestock sector.

In the food-deficit regions, we see the opposite. There has been a long-term neglect for the agricultural and rural sectors in developing countries. There has been virtually no investment in research and development for three decades or more: no development of extension services, marketing services, very little investment in basic infrastructure such as farm-to-market roads or water containment, flood control, irrigation, or storage facilities. We also see very poor policies – both macro policies for countries and sectoral policies as they affect the agricultural sector. And, certainly in a lot of these countries, very little emphasis is placed on trade.

The result of this is that in the fall of 2006 we saw commodity prices worldwide start to move up and these prices peaked in the middle of 2008. We all remember \$8 a bushel corn and \$15 a bushel soybeans. Those prices prompted a reexamination of the global agricultural production system. The result is what I just described for you there.

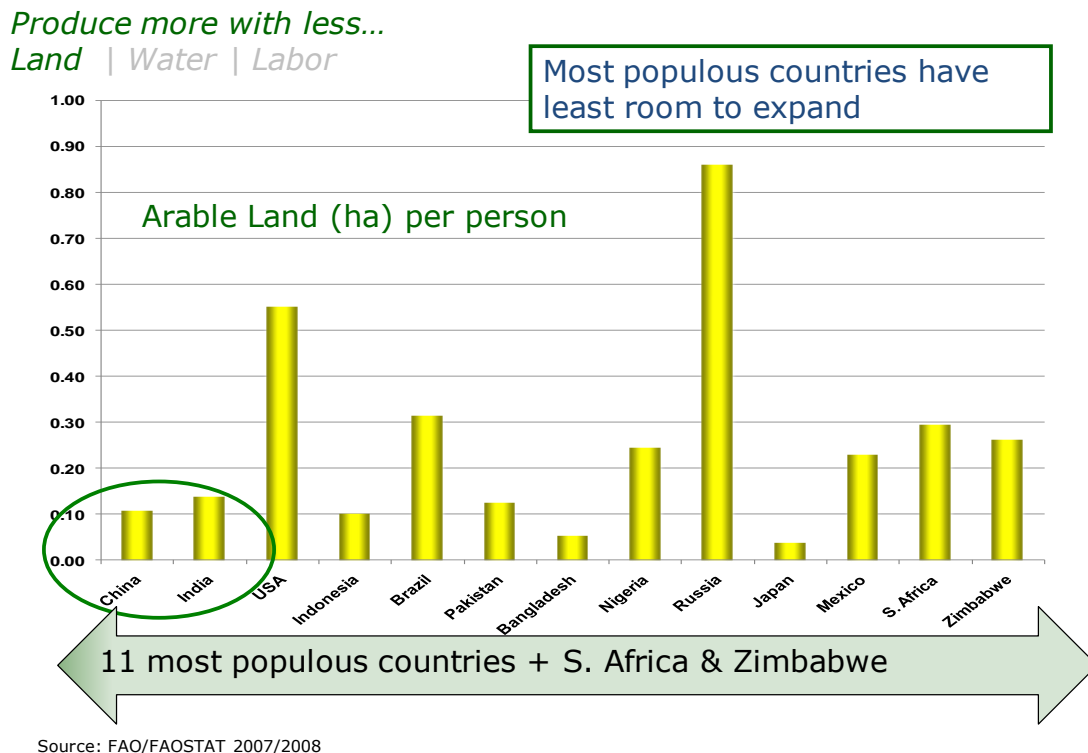
After the price increases beginning in 2006, farmers responded. They haven't repealed the laws of economics. Farmers responded by expanding area and increasing input intensity. By 2008, we saw a big increase in crops, just as the recession came along, which dampened demand. The result today is we have a much better balance in terms of supply and demand, commodity prices have moved down, and the carryover stocks are at more comfortable levels. This came about in large part because the recession gave us a breather.

The question is what do we do now? What happens to the supply side as we look forward 10 years, 15 years, and 20 years? I would suggest, as we try to meet these growing demand requirements, we are going to face some increasing constraints.

We all know about the land constraint. Most of the good farmland in the world today is already under cultivation. Any additional land you bring in is going to require increased capital investment, because it is not of the same quality as land we are already using. There is no consensus as to how much additional land might be available. The estimates vary, but they

generally gravitate toward something in the 10 to 12 to 15 percent range. Again, any expansion in the land base for farming purposes is going to be costly and is going to be controversial.

Chart 5: Growing Resource Constraints - Land



We are all aware of environmental and other concerns. We are aware of the indirect land-use issue. So any additional expansion of area is going to be both costly and controversial. Chart 5 further illustrates that point, because it shows the 11 most populous countries in the world. It shows the arable area per hectare and it certainly reveals the most populous countries have little room for further expansion.

Water may be the more constraining resource – more so than land – as we look to the future. Agriculture is the big user of available fresh water today, using 70 percent or more worldwide (Chart 6). The competition is increasing from urban and industrial uses. We're already experiencing water-scarcity problems in many parts of the world. We certainly see that here in North America.

Chart 6: Growing Resource Constraints - Water

Produce more with less...

Land | Water | Labor

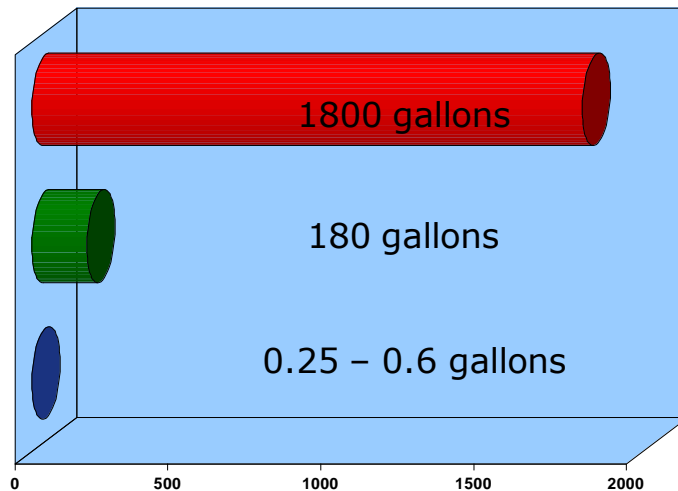
10X more water needed to raise 1 pound of beef than 1 pound of wheat

Amount of water required for:

One pound of beef

One pound of wheat

Daily drinking requirements



Source: UN-Water and FAO

As agriculture is called upon to produce more, the pressure is going to grow for increased irrigation, because that is one way you can boost yields on the land you are already farming. But we are also going to have to use the water more efficiently. That's going to call for more investment in new irrigation technologies and more capital investment in the adoption of those new technologies as they are developed. This chart, again, emphasizes the added pressure on water, as we see the dietary transformation around the world that includes more and more livestock products in the diet. So not only are we going to be required to irrigate more, but as we produce more animal products then more and more water is going to be required.

I want to mention labor. It seems a little strange to be talking about labor as a constraint if we are going from 6 billion people to 9 billion people, but it is already occurring. In fact, I've seen a spate of articles in the last few days about labor shortages in China. The world's most populous country is already having problems in finding available labor and labor with appropriate skills. That is certainly going to be the case in the agricultural industry and in some segments of food processing. So the big consideration is going to be, what does that do to the capital structure? What does that do to the cost structure of food production and processing as we go forward?

Despite all the recent controversy about climate change, there is still a large body of technical experts who believe climate change is going to affect the agricultural industry in the next 40 years and most of that effect is going to be adverse. There is further consensus that most of the adverse effects from climate change are going to be in the lower latitudes of the world in

the emerging market countries, where the production plants are the least able to adapt to climate change, which is also the part of the world where the diets are already the least adequate. We are going to have another emerging controversy, because it is the upper latitudes of the world that will be alleged to have caused the climate change. It's the lower latitudes that will be bearing the brunt of that climate change. We're probably in for another controversial issue there.

The point I'm making is, in addition to the other constraints I've just enumerated, climate change – if it is real and if we see the onset of it – is going to further constrain the ability to produce food and fiber.

The implication of having the production plan in the condition it is in today and having constraints is we have a very big challenge in front of us. We are going to have to feed more people, feed them better, and we're going to have to do it with about the same bundle of resources, or maybe even less, than we have today. And we're going to have to do it less intrusively by reducing the environmental footprint of the global agricultural plan. That is quite a challenge indeed.

All is not gloomy. There are a couple of positive things that have happened on the supply side I want to briefly mention. One is structural change that has occurred slowly, but has occurred nonetheless in U.S., European Union, Australian, and New Zealand farm policies. That is the reduction of artificial incentives to produce specific crops.

As you know in North America, for a long time farmers just continued to produce regardless of what the market signals were indicating. We produced huge surpluses that overhung the market and masked the price signals. Most of that is gone today, so we have a much more robust system. We have a just-in-time inventory system. We produce a crop in the Northern Hemisphere, and we start to consume it, just as we are producing a crop in the Southern Hemisphere. Then we start to consume that one. So we have a much more responsive and robust system today.

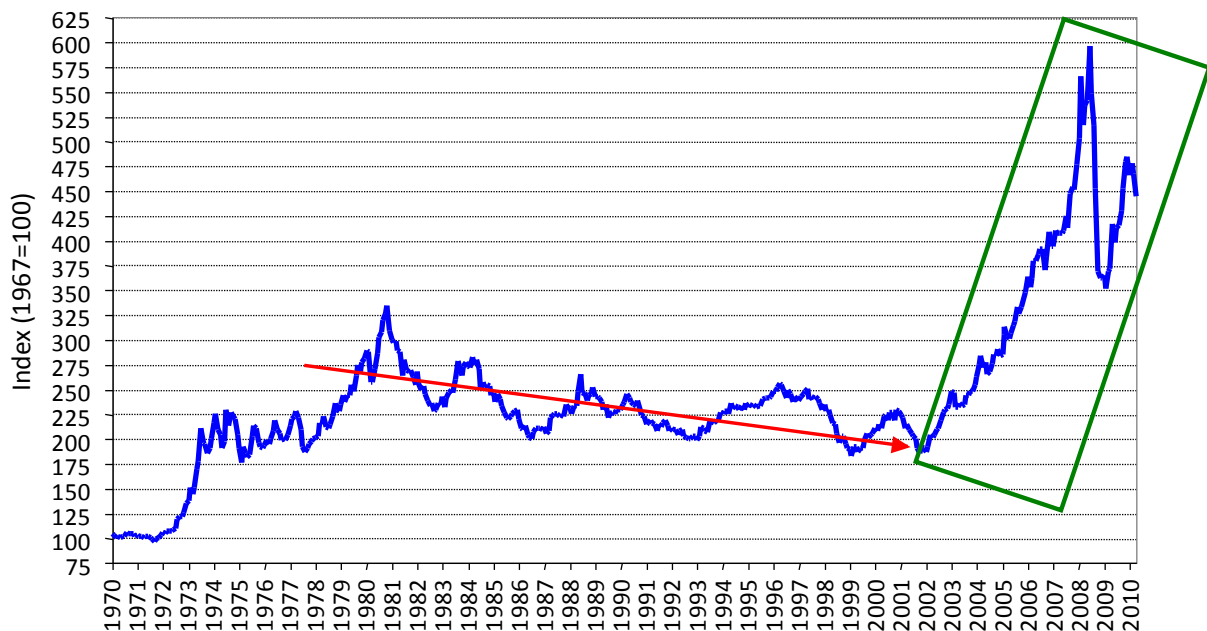
A second positive aspect is, following the price spikes in 2008 and the political turmoil following those spikes, we saw increased attention once again to the condition of the agricultural plan. There were a lot of multilateral initiatives, such as the G-20 pledge of \$20 billion for agricultural development. The United States has a new initiative on food security with an additional \$3 billion.

Many emerging-market governments, especially in Africa, pledged 10 percent of their national budgets to be devoted to agricultural and rural sectors. In addition to all of the governmental activity, we have seen a lot of investor attention. The sovereign wealth funds and individual investors – hedge funds and others – are focused on obtaining access to agricultural resources and producing agricultural products. I was in Africa a couple weeks ago visiting some of the big investor projects involving 25,000 hectares and more. That is occurring and it is occurring much more widely than I had recognized.

The big question about these new sources of supply expansion in my view is, is it different this time? Will it continue? History tells us, as commodity prices go up, everybody focuses on agriculture. As commodity prices go down, attention soon wanes. These governments forget their pledges and these investment projects begin to shift their capital to places where returns are higher. The question of whether this time is really different or not is going to depend on what happens to commodity prices in the future.

This is a rather interesting chart (Chart 7). I'll leave it up to you to interpret as you wish. This is a 40-year sweep of commodity prices – all commodities, not just food and agriculture but all commodities that are traded on the futures exchange. Out of this index, food and agricultural commodities make up 41 percent and petroleum makes up 26 percent, which equal two-thirds. Metals and minerals make up the other third. This is all commodities.

Chart 7: CBS Futures Index



Source: Informa Economics, May 2010

You can see down to the turn of the century we had a decided downward trend. About the time of the turn of century, when we started experiencing this robust, widespread global economic growth, you can see what happened to commodity prices. They shot up.

Next, you can see what happened when the Great Recession came. Commodity prices fell. To me, the interesting thing in this is, despite having endured the greatest recession since the Great Depression, commodity prices have not returned to their pre-crisis levels. What accounts for that? That is where you can interpret it as you wish. I think it suggests there are structural changes that have occurred – the most important one probably being new sources of demand. We

have suddenly seen this vast growth, especially in the Asian region. We've seen the dietary transformation that has occurred in that part of the world. That is probably one.

The second one is this structural change in the farm programs, so that farmers can now respond. That is no longer masking the signals. We can see much more clearly what is happening.

Third, what this reveals is, after the price spike in 2008, we've unmasked the condition of the production sector. A lot of people now realize the condition of the global agricultural production plan in many parts of the developing world and the markets are taking that into account.

The final thing is probably the emergence of value investing. Virtually everybody now – the hedge funds and the others – want to have commodities as a part of their portfolio. That is a relatively new thing. Maybe that plays some role in what we're seeing here today.

After the review of the main demand drivers and the characteristics of the supply plan today and then the prices, I want to move on and say a quick word about policy drivers.

We have a whole host of policies that affect our business: immigration policy, financial regulatory reform policy, energy policy, climate change policy, macroeconomic policies, and monetary policy. A lot of these policies are pending in North America and a lot of these are going to be decided by the Congress before long. They will have an impact on our business.

I want to take a longer look at the things that could affect the outcome of the fundamentals I've just described. The first of these is the failure to liberalize the global trading system. I've already made the case, I hope, trade is going to be increasingly important because production is going to be in one part of the world and consumption in another. We're going to need to have a strong rules-based trading system and we're going to need to have the barriers reduced to a minimum. We're also going to need a strong dispute-resolution system. And sanitary and phytosanitary rules increasingly coming into the trade agenda are going to need to be dealt with.

The other issue is infrastructure investment in the emerging countries. I've talked about that and have said there is a lot of attention being given to that. There is a possibility we are getting a misinterpretation or we're getting a garbled message. A lot of those activities are focused on state-driven development with minimal involvement of the private sector, minimal harnessing of private-sector capital.

The one thing we have learned is central planning doesn't work. If the effort crowds out the private sector, if the private sector doesn't have a very big role in the investment in these agricultural systems, then we will waste a lot of money. We are going to see a lot of scarce capital invested into production systems that are not sustainable. I am concerned about that. As you look at the plans by a number of these governments, you can see it has much more of central-planning focus than it has of a market-driven focus.

Finally, in innovation we need improved policies certainly. We need investment certainly, but we also need research and development. I want to mention briefly the Global Harvest

Initiative. This is an organization created a couple years ago by Deere, DuPont, ADM, and Monsanto. The purpose of the organization is to highlight the situation just described and to focus on what we call the productivity gap. Over the last 50 years, global agriculture has experienced some increase in the rate of productivity of global agriculture.

But, if we are going from 7 billion tons of output to 10 or 11 billion tons to 14 billion tons, then the rate of productivity growth is going to be some multiple of what an extrapolation of the trend rate of productivity growth has been. We have a gap. We have one line going this way and one line going that way. We need to close that gap. The Global Harvest Initiative is focusing on the most meaningful ways to close that gap.

Of course, if we don't close the gap – if demand outruns the ability to supply it – then we will have expanded hunger and malnutrition, beyond what we have today. We will have trade disruptions and environmental degradation. We'll have a drag on global GDP growth and we've already seen global GDP growth is a big, big driver in our business.

Finally, we'll have what we all dread, which is political instability. We saw riots and fragile governments grapple with the food price increase in 2008, so you can imagine if this occurs on a more frequent basis what will happen to fragile governments. In some key parts of the world, that could result in regional hostilities, disruption of shipping, disruption of all kinds of economic activity, and we'd have a much more unstable world than we have today. That is not good for our business. That is not good for the world.

To make a couple of final key points: One is I think the fundamentals underpinning our business, looking ahead 10, 20, or 30 years, are quite strong. The basic fundamentals are really quite good.

There are some real challenges for the global food system. Trying to meet these demands with a smaller bundle of resources and with these additional constraints from society is indeed a daunting challenge, but it is one we can meet. There is no doubt we can certainly meet the challenge. The people who thrive, the people who do well, and who are profitable are the people who are flexible and adapt. The pace of change is only going to accelerate, so we are going to have to be very adept in adjusting to that change.

Overall, it is an absolutely fabulous time to be in agriculture. For much of my career, we have focused on saying we have the production capability, if we only had the demand. And we looked for new uses for agricultural products. Looking ahead, the situation may be just the opposite. We have the demand. Can you produce it? So I think it is an absolutely fantastic time to be in agriculture.



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*J.B. Penn
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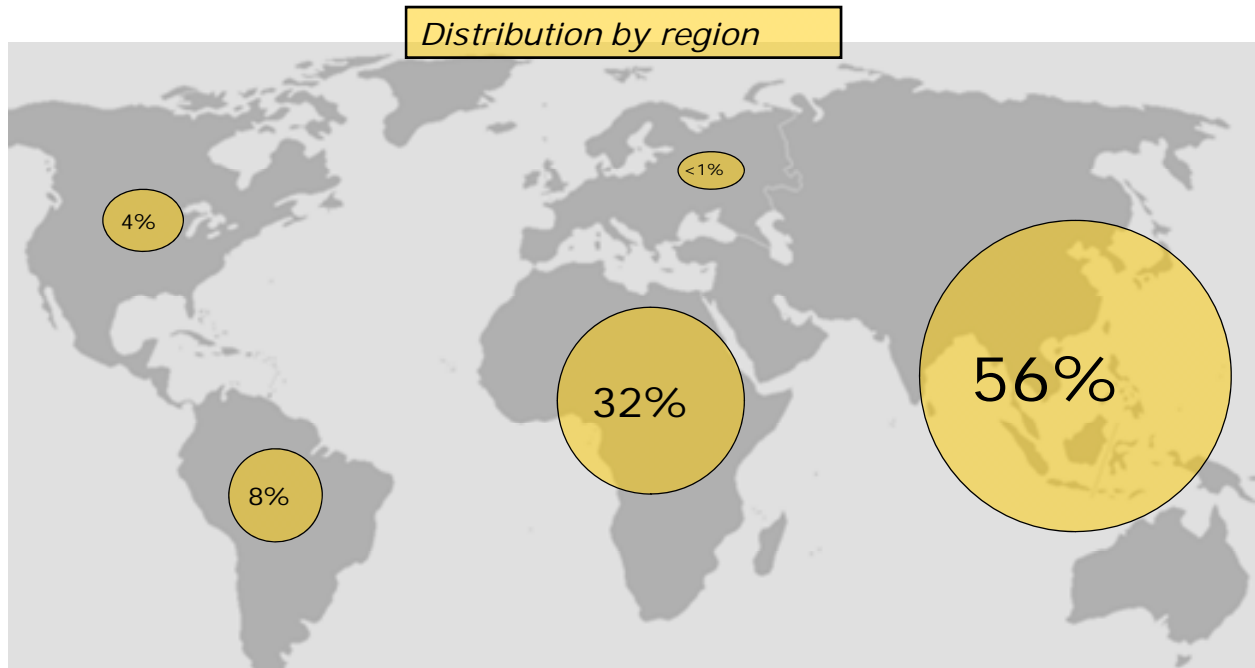
The first decade in this new century has been a very tumultuous one and a very prosperous one for North American agriculture. So it is an ideal time to step back and say, “What next? What is likely to follow? Will it be more of the same? Will North American agriculture revert to the old patterns or will it be something entirely new?”

Today, I will look at the fundamentals that are affecting the marketplace as we go into the second decade of the 21st century. First, I want to review the principal demand drivers for the food and agricultural industry and say a little bit about the characteristics of the markets. Second, I want to look at the global supply system as we see it today – what is its current condition, what are some expected changes, and what are its constraints. Third, I want to talk about some of the policy drivers that shape the business environment. Finally, I will provide some summary observations.

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First of all is population growth. Everybody in this room is familiar with these numbers now. We’ve all seen these over and over, as we’ve talked about this subject since 2008. We have a little over 6 billion people in the world today. We are going to have 1½ billion more by 2025 and then the world population is going to plateau around the middle of the century at something just over 9 billion people. So we are going to add 1½ billion people – more consumers – in the next 15 years and we are going to add 3 billion people, or 50 percent more people than we have today, in just 40 years’ time. That’s not very long. When I look back over my career, which spans 40 years, that is not a very long period indeed. So one of the major forces is the number of people and where they are going to be located in the world.

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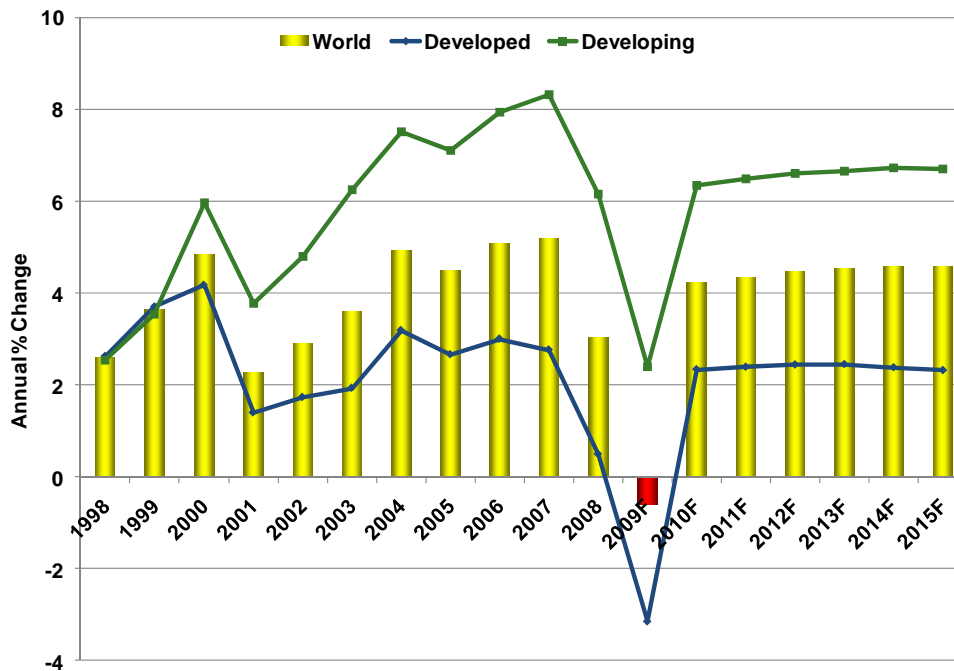


Source: United Nations, World Population Prospects 2008 Revision

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We have this expectation for all of these new consumers. The big question is what is the purchasing power going to be as we look forward? Chart 2 shows GDP growth for the world, a proxy for income growth. These data are from the International Monetary Fund. The IMF is widely acknowledged as one of the most credible forecasters. They are also seen as reasonably conservative.

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Source: International Monetary Fund (IMF), World Economic Report, April 2010

So there are a couple of points in terms of the income driver we can take from Chart 2. First of all, we have to recognize what happened in the first part of this decade. We were seeing global growth as we had never seen it before. Global GDP was growing in the 4 to 5 percent range, which is absolutely phenomenal. There were more countries exhibiting positive GDP growth at the same time than ever before in history. Jobs were being created. Incomes were rising. People at the bottom of the income ladder were seeing their incomes increase, and much of that increase was being spent for food.

Then we come to 2008. We see precipitous slowing in the global economy. We first started experiencing the cyclical downturn. Then came the credit crisis. The upshot of that was the global economy in the aggregate actually contracted about a half percentage point in 2009.

Now, here we are almost halfway through 2010 and, as the bar indicates, the forecast is for global GDP growth to exceed 4 percent. The IMF is reasonably bold and has forecasted for the next five or six years. You can see the forecast is for a return to what's called the trend growth potential for the global economy to grow in the 4 to 5 percent range.

Taking GDP growth and breaking it down a little bit more, where that growth is going to occur is exceedingly important to our industry. You can see the world is broken into the developing countries and the developed countries, with the developing countries being the green line at the top. In the first part of the past decade, you can see the developing countries were

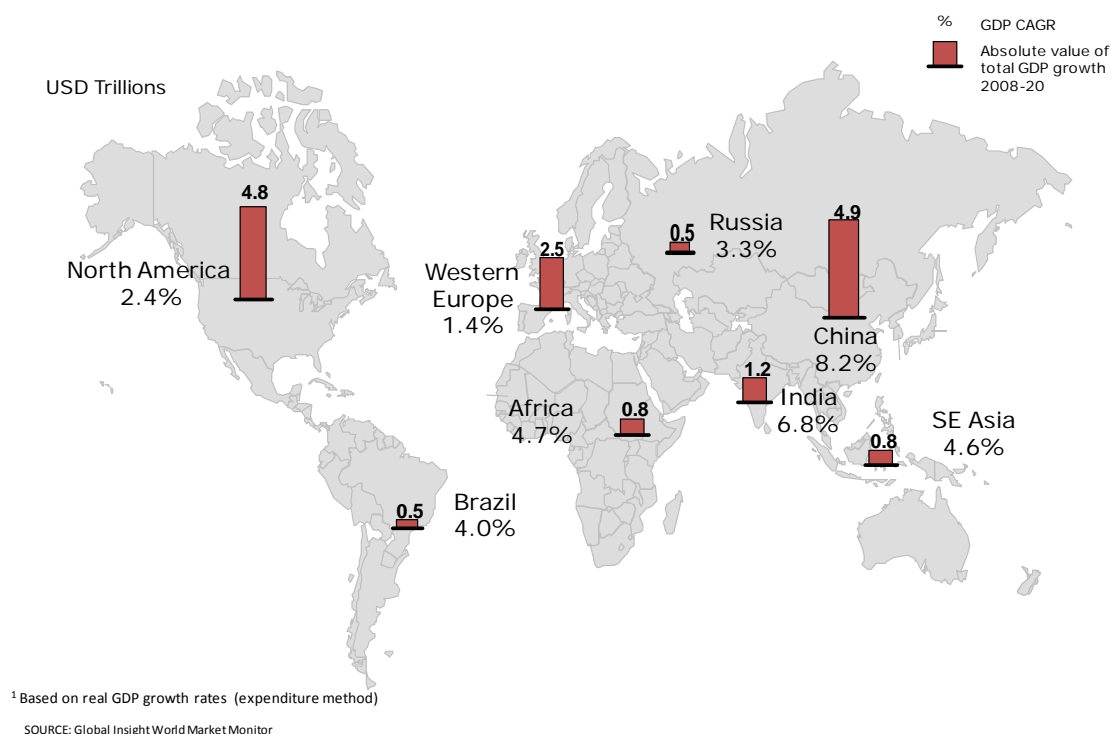
growing at about twice the pace of the developed world. When the recession came, it was certainly a slowdown in growth for the developing countries but not a contraction for them as a group. Led by India and China, growth slowed but it didn't contract, which is exactly what happened for the developed countries, shown by the blue line at the bottom.

The IMF is showing here a V-shaped recovery (there was a lot of talk about what size this would be). You can see pretty clearly they are expecting a bounce-back to the trend growth path and for that to be true for the developing countries, as well as for the developed countries that produce that overall growth in the 4 to 5 percent range. It's extremely important the growth in the developing countries continues apace.

Chart 3 projects in both absolute value of GDP and in the rate of growth. You can see the map of the world faintly in the background. There are a couple of things that are evident from this chart. First of all, the growth rates in the lower latitude of the world are much higher than they are for the developed countries in the upper latitudes.

The second thing is, if you add the absolute value of GDP growth for the Asian region – for China, India, Southeast Asia, you see it amounts to about \$7 trillion. If you add the absolute value of GDP growth for North America and Western Europe – the developed part of the world – you can see it amounts to about \$7 trillion. What we are seeing emerge in this century is a multipolar economy. No longer do you have the First World and the Third World, but you now have several poles of economic activity and that, again, is extremely important for the food market and extremely important for the food and agricultural business. This is something we have not had before.

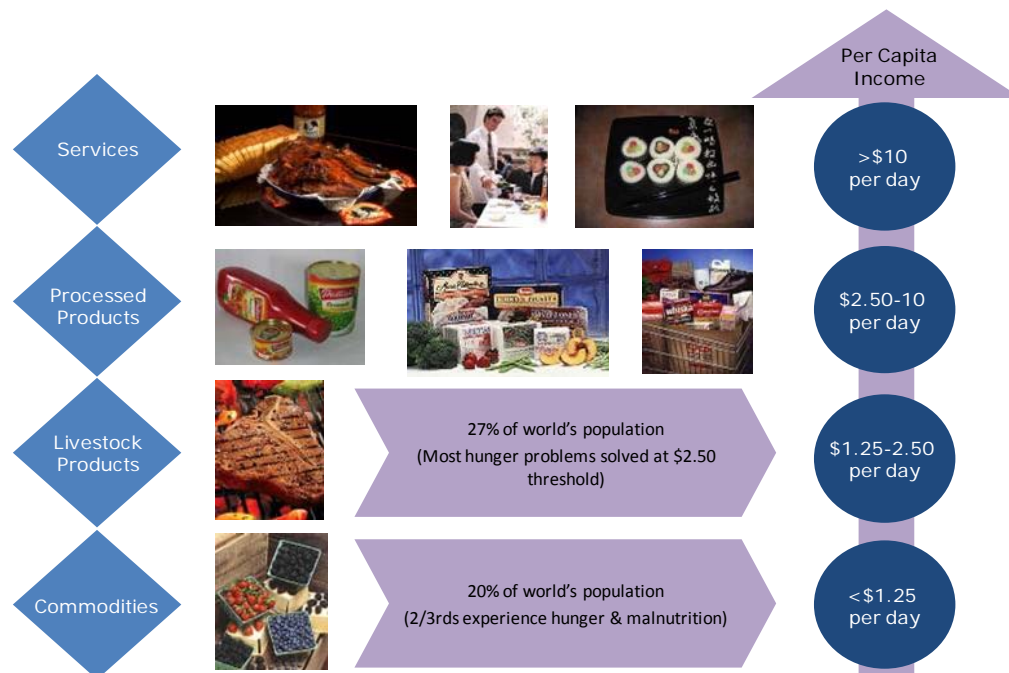
Chart 3: World GDP Growth by Region – 2008 to 2020



When you look at the number of consumers and where they are located, you look at the incomes and how fast they are going to be growing and where that's occurring in the world, that brings you to the dynamics of food demand and a little bit more of what that means for our business.

On the right-hand side of the following chart is the income ladder (Chart 4). You can see we have about half – 47 percent – of the world's population today of 6 billion people live on less than \$2.50 a day. These were the people who were the most affected by this dynamic and widespread GDP growth we had in the first half of the decade. These are the people who were quickly moving up the income ladder, spending most of that additional income for food.

Chart 4: Dynamics of Food Demand



Source: World Bank, 2008

On the left-hand side of the chart, you can see what happens as incomes rise. People move away from staple foods, from basic commodities, and the first thing they want to add is more animal protein to their diets. As incomes continue to increase, they add more animal products and they add more services to the food products.

Again, when you look at population growth and income growth and where all of that is expected to occur, you are seeing this dynamic work itself out for our business as we look just 10 or 15 or 20 years ahead.

What are the implications of all this? As I indicated, we are in a multipolar economy now. We have engines of growth outside of the developed world. We've certainly seen that in this past

recession in the case of India and China. We no longer have the Third World. This “emerging market economy” label is now more appropriate than probably “developing countries.”

The other thing these projections for population and income suggest is that by 2030 – just 20 years hence – we are going to have to produce 50 percent more agricultural products than we produce today. By 2050, we will perhaps have to double the amount of agricultural products we produce today. I say again, to 2030 is not a very long. To 2050 is not a very long time to essentially double the agricultural output.

In 2005, if you add up the volume by weight of all of the agricultural output, it was slightly more than 7 billion tons. By 2030, we are going to have to produce an additional 3 to 4 billion tons. Just imagine the investment required. It is not only the production of that amount, but it is the storage, the transportation, the processing, and the distribution of that amount. Think of the huge investment in transportation infrastructure, storage infrastructure, and all the other things required to do that.

Another implication of these population and income numbers is the increased role of trade. The world is becoming increasingly urban. In 2007, we passed the halfway point. More than 50 percent of the world’s population now lives in urban areas. That is projected to be as much as 70 percent by 2050. We are increasingly in a situation where the population centers are in one part of the world, the surplus food production is another part of the world, and to meet the demands we have to increase trade, which highlights the importance of having more liberalized rules, cheaper transactions, and certainly a more robust rules-based trading system.

Very quickly, I want to say a couple words about the market characteristics. In the developing countries, the food markets are still concerned about price: the price of food first and foremost, then getting a sufficient number of calories, and improving and upgrading those diets. Once they pass that, it’s a concern about basic food safety and then it’s about reducing spoilage. Waste and spoilage are a big portion, because of the lack of infrastructure, so the focus is on trying to improve the infrastructure and reduce the wastage.

But in the developed countries, and certainly in the North American market, the concerns and pressures are much different. Production agriculture today in North America is being criticized from many vantage points. We are seeing already a big emphasis on trying to collectively change the national diet.

The U.S. Department of Agriculture issues new dietary guidelines every five years. A new set of guidelines is to be issued shortly. It is expected there will be a big shift away from animal products and into more fruits and vegetables and away from fats. There are new school feeding regulations for breakfast-lunch school programs.

The FDA is reexamining the role of salt in the diet. There are lots of state bans on trans fats, for instance. Sin taxes are coming into vogue again, where you tax sugar products or you tax sweetened sodas.

There is a lot of concern about obesity. It's no longer just a health concern. It's now a part of the food and agricultural policy issue. A lot of discussion is held about local foods, eating smart, home gardens. There are a lot of pressures. There are a lot of shifts characterizing the markets in the developed countries today.

The point is there is a lot of change likely coming. It's going to require adaptation all across the food system from changing production patterns for farmers to also changing patterns for processors, sellers, and for everyone in the system. That concludes the discussion of the principal demand drivers for our industry.

Now I want to say a little bit about the supply system, the condition we find it in today, and then the expectations for it. First, in the surplus food producing regions, we have seen a big investment in research and development over time. We have seen a lot of technological innovation. Producers have been quick to adopt these new techniques. As a result, we have seen tremendous productivity growth in the crop sector and in the livestock sector.

In the food-deficit regions, we see the opposite. There has been a long-term neglect for the agricultural and rural sectors in developing countries. There has been virtually no investment in research and development for three decades or more: no development of extension services, marketing services, very little investment in basic infrastructure such as farm-to-market roads or water containment, flood control, irrigation, or storage facilities. We also see very poor policies – both macro policies for countries and sectoral policies as they affect the agricultural sector. And, certainly in a lot of these countries, very little emphasis is placed on trade.

The result of this is that in the fall of 2006 we saw commodity prices worldwide start to move up and these prices peaked in the middle of 2008. We all remember \$8 a bushel corn and \$15 a bushel soybeans. Those prices prompted a reexamination of the global agricultural production system. The result is what I just described for you there.

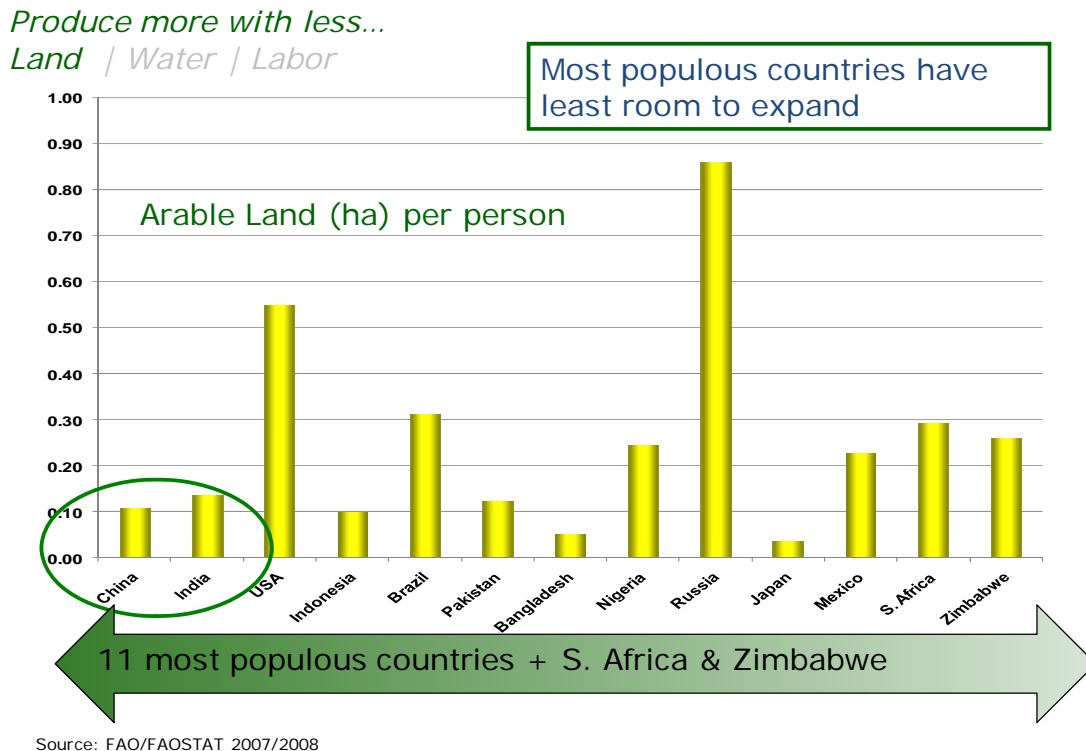
After the price increases beginning in 2006, farmers responded. They haven't repealed the laws of economics. Farmers responded by expanding area and increasing input intensity. By 2008, we saw a big increase in crops, just as the recession came along, which dampened demand. The result today is we have a much better balance in terms of supply and demand, commodity prices have moved down, and the carryover stocks are at more comfortable levels. This came about in large part because the recession gave us a breather.

The question is what do we do now? What happens to the supply side as we look forward 10 years, 15 years, and 20 years? I would suggest, as we try to meet these growing demand requirements, we are going to face some increasing constraints.

We all know about the land constraint. Most of the good farmland in the world today is already under cultivation. Any additional land you bring in is going to require increased capital investment, because it is not of the same quality as land we are already using. There is no consensus as to how much additional land might be available. The estimates vary, but they

generally gravitate toward something in the 10 to 12 to 15 percent range. Again, any expansion in the land base for farming purposes is going to be costly and is going to be controversial.

Chart 5: Growing Resource Constraints - Land



We are all aware of environmental and other concerns. We are aware of the indirect land-use issue. So any additional expansion of area is going to be both costly and controversial. Chart 5 further illustrates that point, because it shows the 11 most populous countries in the world. It shows the arable area per hectare and it certainly reveals the most populous countries have little room for further expansion.

Water may be the more constraining resource – more so than land – as we look to the future. Agriculture is the big user of available fresh water today, using 70 percent or more worldwide (Chart 6). The competition is increasing from urban and industrial uses. We’re already experiencing water-scarcity problems in many parts of the world. We certainly see that here in North America.

Chart 6: Growing Resource Constraints - Water

Produce more with less...

Land / Water / Labor

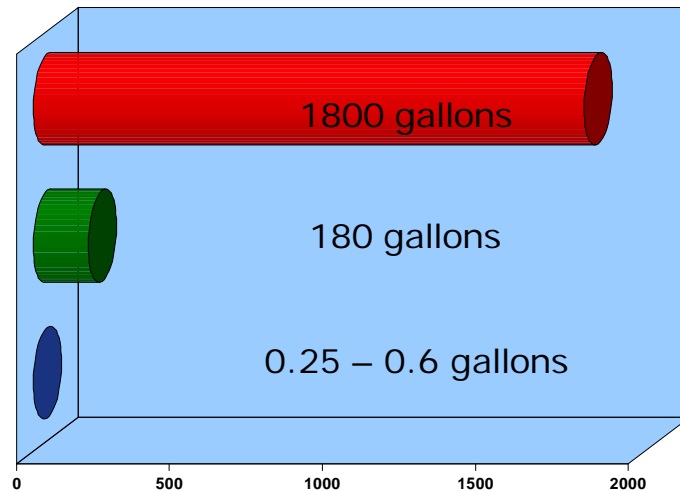
10X more water needed to raise 1 pound of beef than 1 pound of wheat

Amount of water required for:

One pound of beef

One pound of wheat

Daily drinking requirements



Source: UN-Water and FAO

As agriculture is called upon to produce more, the pressure is going to grow for increased irrigation, because that is one way you can boost yields on the land you are already farming. But we are also going to have to use the water more efficiently. That's going to call for more investment in new irrigation technologies and more capital investment in the adoption of those new technologies as they are developed. This chart, again, emphasizes the added pressure on water, as we see the dietary transformation around the world that includes more and more livestock products in the diet. So not only are we going to be required to irrigate more, but as we produce more animal products then more and more water is going to be required.

I want to mention labor. It seems a little strange to be talking about labor as a constraint if we are going from 6 billion people to 9 billion people, but it is already occurring. In fact, I've seen a spate of articles in the last few days about labor shortages in China. The world's most populous country is already having problems in finding available labor and labor with appropriate skills. That is certainly going to be the case in the agricultural industry and in some segments of food processing. So the big consideration is going to be, what does that do to the capital structure? What does that do to the cost structure of food production and processing as we go forward?

Despite all the recent controversy about climate change, there is still a large body of technical experts who believe climate change is going to affect the agricultural industry in the next 40 years and most of that effect is going to be adverse. There is further consensus that most of the adverse effects from climate change are going to be in the lower latitudes of the world in

the emerging market countries, where the production plants are the least able to adapt to climate change, which is also the part of the world where the diets are already the least adequate. We are going to have another emerging controversy, because it is the upper latitudes of the world that will be alleged to have caused the climate change. It's the lower latitudes that will be bearing the brunt of that climate change. We're probably in for another controversial issue there.

The point I'm making is, in addition to the other constraints I've just enumerated, climate change – if it is real and if we see the onset of it – is going to further constrain the ability to produce food and fiber.

The implication of having the production plan in the condition it is in today and having constraints is we have a very big challenge in front of us. We are going to have to feed more people, feed them better, and we're going to have to do it with about the same bundle of resources, or maybe even less, than we have today. And we're going to have to do it less intrusively by reducing the environmental footprint of the global agricultural plan. That is quite a challenge indeed.

All is not gloomy. There are a couple of positive things that have happened on the supply side I want to briefly mention. One is structural change that has occurred slowly, but has occurred nonetheless in U.S., European Union, Australian, and New Zealand farm policies. That is the reduction of artificial incentives to produce specific crops.

As you know in North America, for a long time farmers just continued to produce regardless of what the market signals were indicating. We produced huge surpluses that overhung the market and masked the price signals. Most of that is gone today, so we have a much more robust system. We have a just-in-time inventory system. We produce a crop in the Northern Hemisphere, and we start to consume it, just as we are producing a crop in the Southern Hemisphere. Then we start to consume that one. So we have a much more responsive and robust system today.

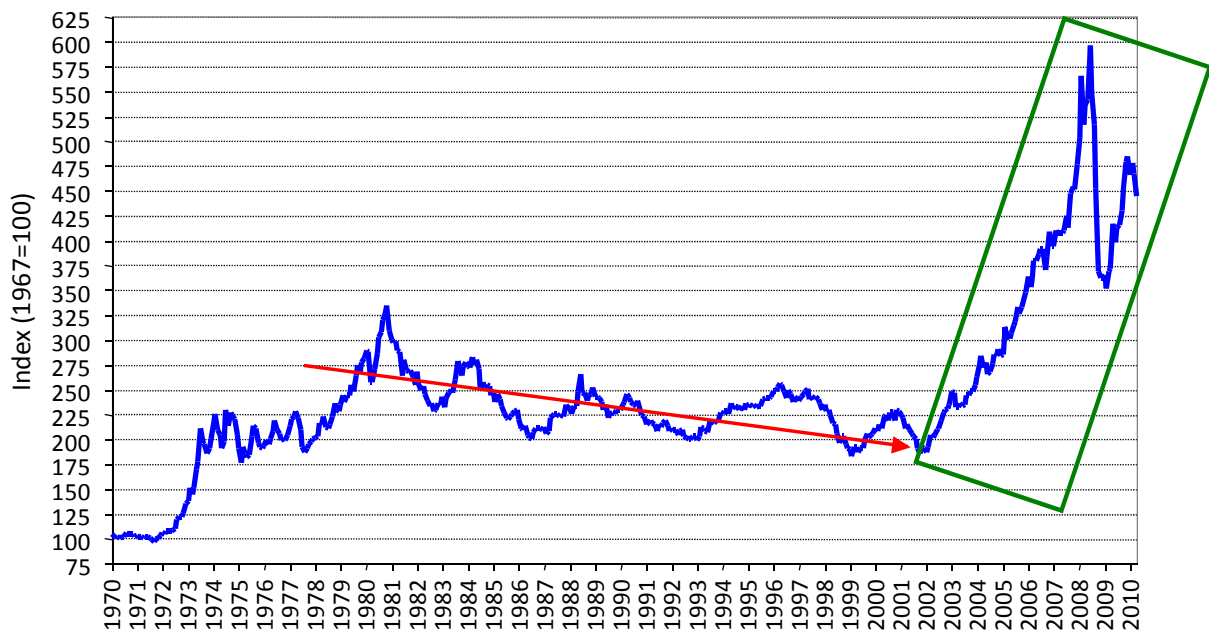
A second positive aspect is, following the price spikes in 2008 and the political turmoil following those spikes, we saw increased attention once again to the condition of the agricultural plan. There were a lot of multilateral initiatives, such as the G-20 pledge of \$20 billion for agricultural development. The United States has a new initiative on food security with an additional \$3 billion.

Many emerging-market governments, especially in Africa, pledged 10 percent of their national budgets to be devoted to agricultural and rural sectors. In addition to all of the governmental activity, we have seen a lot of investor attention. The sovereign wealth funds and individual investors – hedge funds and others – are focused on obtaining access to agricultural resources and producing agricultural products. I was in Africa a couple weeks ago visiting some of the big investor projects involving 25,000 hectares and more. That is occurring and it is occurring much more widely than I had recognized.

The big question about these new sources of supply expansion in my view is, is it different this time? Will it continue? History tells us, as commodity prices go up, everybody focuses on agriculture. As commodity prices go down, attention soon wanes. These governments forget their pledges and these investment projects begin to shift their capital to places where returns are higher. The question of whether this time is really different or not is going to depend on what happens to commodity prices in the future.

This is a rather interesting chart (Chart 7). I'll leave it up to you to interpret as you wish. This is a 40-year sweep of commodity prices – all commodities, not just food and agriculture but all commodities that are traded on the futures exchange. Out of this index, food and agricultural commodities make up 41 percent and petroleum makes up 26 percent, which equal two-thirds. Metals and minerals make up the other third. This is all commodities.

Chart 7: CBS Futures Index



Source: Informa Economics, May 2010

You can see down to the turn of the century we had a decided downward trend. About the time of the turn of century, when we started experiencing this robust, widespread global economic growth, you can see what happened to commodity prices. They shot up.

Next, you can see what happened when the Great Recession came. Commodity prices fell. To me, the interesting thing in this is, despite having endured the greatest recession since the Great Depression, commodity prices have not returned to their pre-crisis levels. What accounts for that? That is where you can interpret it as you wish. I think it suggests there are structural changes that have occurred – the most important one probably being new sources of demand. We

have suddenly seen this vast growth, especially in the Asian region. We've seen the dietary transformation that has occurred in that part of the world. That is probably one.

The second one is this structural change in the farm programs, so that farmers can now respond. That is no longer masking the signals. We can see much more clearly what is happening.

Third, what this reveals is, after the price spike in 2008, we've unmasked the condition of the production sector. A lot of people now realize the condition of the global agricultural production plan in many parts of the developing world and the markets are taking that into account.

The final thing is probably the emergence of value investing. Virtually everybody now – the hedge funds and the others – want to have commodities as a part of their portfolio. That is a relatively new thing. Maybe that plays some role in what we're seeing here today.

After the review of the main demand drivers and the characteristics of the supply plan today and then the prices, I want to move on and say a quick word about policy drivers.

We have a whole host of policies that affect our business: immigration policy, financial regulatory reform policy, energy policy, climate change policy, macroeconomic policies, and monetary policy. A lot of these policies are pending in North America and a lot of these are going to be decided by the Congress before long. They will have an impact on our business.

I want to take a longer look at the things that could affect the outcome of the fundamentals I've just described. The first of these is the failure to liberalize the global trading system. I've already made the case, I hope, trade is going to be increasingly important because production is going to be in one part of the world and consumption in another. We're going to need to have a strong rules-based trading system and we're going to need to have the barriers reduced to a minimum. We're also going to need a strong dispute-resolution system. And sanitary and phytosanitary rules increasingly coming into the trade agenda are going to need to be dealt with.

The other issue is infrastructure investment in the emerging countries. I've talked about that and have said there is a lot of attention being given to that. There is a possibility we are getting a misinterpretation or we're getting a garbled message. A lot of those activities are focused on state-driven development with minimal involvement of the private sector, minimal harnessing of private-sector capital.

The one thing we have learned is central planning doesn't work. If the effort crowds out the private sector, if the private sector doesn't have a very big role in the investment in these agricultural systems, then we will waste a lot of money. We are going to see a lot of scarce capital invested into production systems that are not sustainable. I am concerned about that. As you look at the plans by a number of these governments, you can see it has much more of central-planning focus than it has of a market-driven focus.

Finally, in innovation we need improved policies certainly. We need investment certainly, but we also need research and development. I want to mention briefly the Global Harvest

Initiative. This is an organization created a couple years ago by Deere, DuPont, ADM, and Monsanto. The purpose of the organization is to highlight the situation just described and to focus on what we call the productivity gap. Over the last 50 years, global agriculture has experienced some increase in the rate of productivity of global agriculture.

But, if we are going from 7 billion tons of output to 10 or 11 billion tons to 14 billion tons, then the rate of productivity growth is going to be some multiple of what an extrapolation of the trend rate of productivity growth has been. We have a gap. We have one line going this way and one line going that way. We need to close that gap. The Global Harvest Initiative is focusing on the most meaningful ways to close that gap.

Of course, if we don't close the gap – if demand outruns the ability to supply it – then we will have expanded hunger and malnutrition, beyond what we have today. We will have trade disruptions and environmental degradation. We'll have a drag on global GDP growth and we've already seen global GDP growth is a big, big driver in our business.

Finally, we'll have what we all dread, which is political instability. We saw riots and fragile governments grapple with the food price increase in 2008, so you can imagine if this occurs on a more frequent basis what will happen to fragile governments. In some key parts of the world, that could result in regional hostilities, disruption of shipping, disruption of all kinds of economic activity, and we'd have a much more unstable world than we have today. That is not good for our business. That is not good for the world.

To make a couple of final key points: One is I think the fundamentals underpinning our business, looking ahead 10, 20, or 30 years, are quite strong. The basic fundamentals are really quite good.

There are some real challenges for the global food system. Trying to meet these demands with a smaller bundle of resources and with these additional constraints from society is indeed a daunting challenge, but it is one we can meet. There is no doubt we can certainly meet the challenge. The people who thrive, the people who do well, and who are profitable are the people who are flexible and adapt. The pace of change is only going to accelerate, so we are going to have to be very adept in adjusting to that change.

Overall, it is an absolutely fabulous time to be in agriculture. For much of my career, we have focused on saying we have the production capability, if we only had the demand. And we looked for new uses for agricultural products. Looking ahead, the situation may be just the opposite. We have the demand. Can you produce it? So I think it is an absolutely fantastic time to be in agriculture.

Financialization of Commodity Markets: Non-linear Consequences from Heterogeneous Agent Behavior

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During the two decades following the oil shocks of the seventies the issue of commodity prices lost prominence in academic and policy debates. However, in the last five years we saw that nominal peaks in many commodities were accumulating in an impressive row. Records were broken in almost every month from the last part of 2007 and to the first half of 2008 in main commodity markets such as oil, copper, nickel, soybean or rice just to mention a few. But the rising trend in prices was spread out all over commodity varieties. It is now crucial to understand the global causes and consequences of this sharp increase and its following violent reversion.

Policymakers and academics did neither forecast the intensity nor the speed of recent commodity price movements. Therefore, the ongoing research agenda includes two problems: to understand what elements explain price movements; and to review policy responses in the light of this new scenario. In this paper we cover the first issue of the agenda, although we will point out the main policy challenges at the end of the document.

In explaining the commodity price movements there are roughly speaking two stories not necessarily well connected, as Krugman (2008) has advocated. The first story is basically about fundamentals. It says that world income is growing at a pace that is not matched by the supply side of the commodity markets. China and emerging Asia are the main characters here because living standards are increasing more than proportionally precisely in countries that have high income commodity demand elasticity due to Engel law (IMF, 2006; Kaplinsky, 2006; OECD-FAO, 2008). There is also room in this view for big dollar movements. The influence of this variable over commodity prices has been discussed in other historical booms and busts cycles (Ridler and Yandle, 1972; Dornbusch, 1985; or Borensztein and Reinhart, 1994). Also loose monetary conditions and excess of international liquidity are critical elements of this view, since they add inflationary pressure which tends to be reflected rapidly and with more intensity in auction markets like commodity ones (Frankel, 2006; Lipsky, 2008).

Finally, if the focus is posited on food commodities it will be necessary to add biofuels as a new determinant of prices (UNCTAD, 2006; IMF, 2007). The second story points out speculation as the driving force of recent commodity price movements. It stresses the relevance of the so-called “financialization of commodities”, a process according to which a number of non-conventional actors such as investment banks, hedge-funds or pension funds have been investing in commodity-linked instruments.

Of course it could be asserted, as we do in this paper, that both stories overlap and are connected and that a complete picture should take all the pieces together in a coherent way. We argue that the impact of financialization and speculative activity is reflected on short run price dynamics, but not in the long term equilibrium. Specifically, we propose that financialization generates a non-linear adjustment pattern of commodity prices to its fundamental value.

Thus, in the theoretical front, we develop a simple heterogeneous agent-based model in commodity markets that include chartists, fundamentalists and portfolio managers. An outcome of this framework is that price adjustment to equilibrium is reached in a non-linear way, being more intense as long as the past gap between the spot price and the equilibrium price increases.

Concerning this commodity price equilibrium, we assert it depends on determinants highlighted by previous literature: world demand, real exchange rate of the United States, real interest rates and the Prebisch-Singer hypothesis.

A novel characteristic of this paper is that it employs an empirical methodology that allows us to distinguish permanent and transitory movements in prices once the long run equilibrium is estimated. Thus, in modeling short run dynamics we make use of a smooth transition autoregressive model (STAR) which is suitable for testing the hypothesis derived from our heterogeneous agent based model in commodity markets. The intuitive idea of the STAR model is that the discrepancy between current and fundamental prices plays a double role. On the one hand, it is the force that drives price changes in the required direction to fill the existing gap as in any traditional error correction model. On the other hand, the misalignment acts also as a transition variable, governing the state of the model – the larger the misalignment, the faster the speed of convergence.

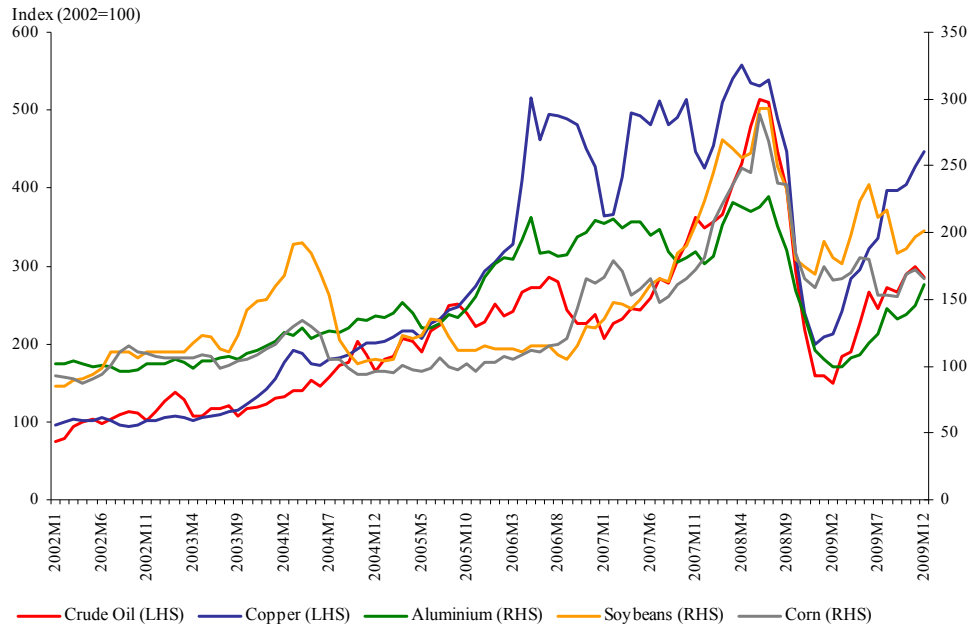
The organization of the paper is as follows. In the next section the past pattern of commodity markets is described. The analysis suggests there are significant differences in the commodity outlook depending on both the time window employed and whether real or nominal indexes are considered. After that, we review theoretical and empirical literature of long run commodity price determinants. The issue of financialization is discussed in the third section. We conclude from it there is some evidence that at least does not contradict our hypothesis that financialization is important in influencing short run price dynamics rather than equilibrium levels. Following this, we present a stylized model of heterogeneous agents in commodity markets that gives support to our hypothesis. In the next section, the econometric methodology is summarized. The empirical evidence is shown in the sixth part of the paper considering both long run and short run commodity behavior. Finally, the conclusions and policy challenges are presented.

1. Stylized facts of commodity prices

Up to the intensification of the financial slump during the second part of 2008, commodity prices grew in nominal terms at a strong pace for six consecutive years. However, the crisis has showed us again that commodity price flexibility is remarkable and those record values by

June-July, 2008 were cut at least by a 30% at the end of October. In Figure 1, we have drawn the evolution of some key commodity prices from 2002 to 2008.

Figure 1. Key Commodity Price Indexes



Contrary to the common belief that commodity prices have reached currently historical high levels, long-run perspective shows stagnant or decaying prices if we incorporate into the analysis the world inflation. In Figures 2 and 3, the long run trends of food, metals and oil in nominal and real terms are presented. The real series are deflated using US consumer price index (CPI).

Figure 2: Food and Metal Price Indices

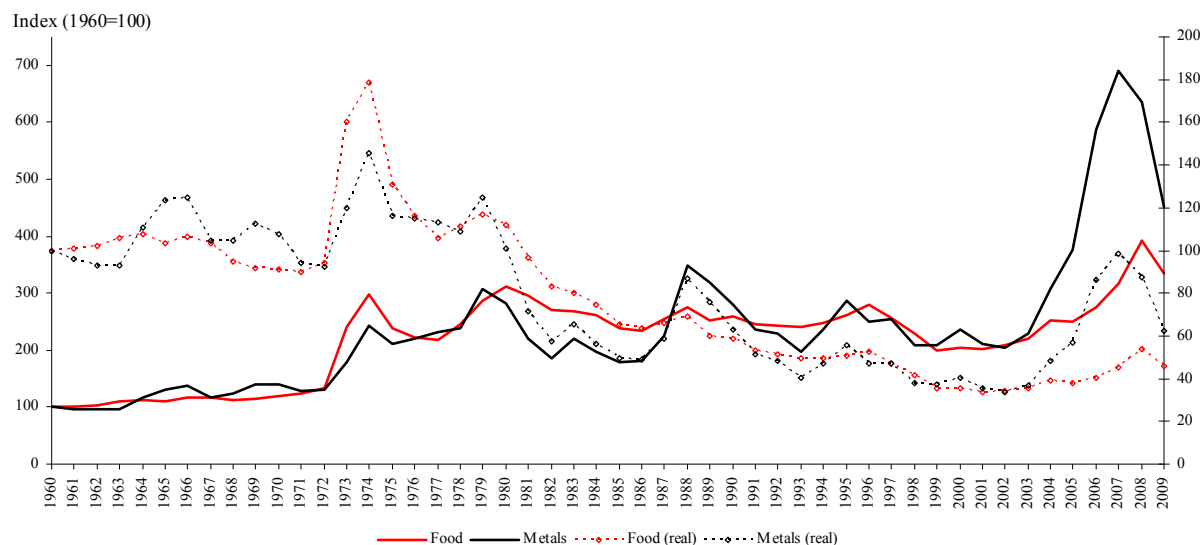
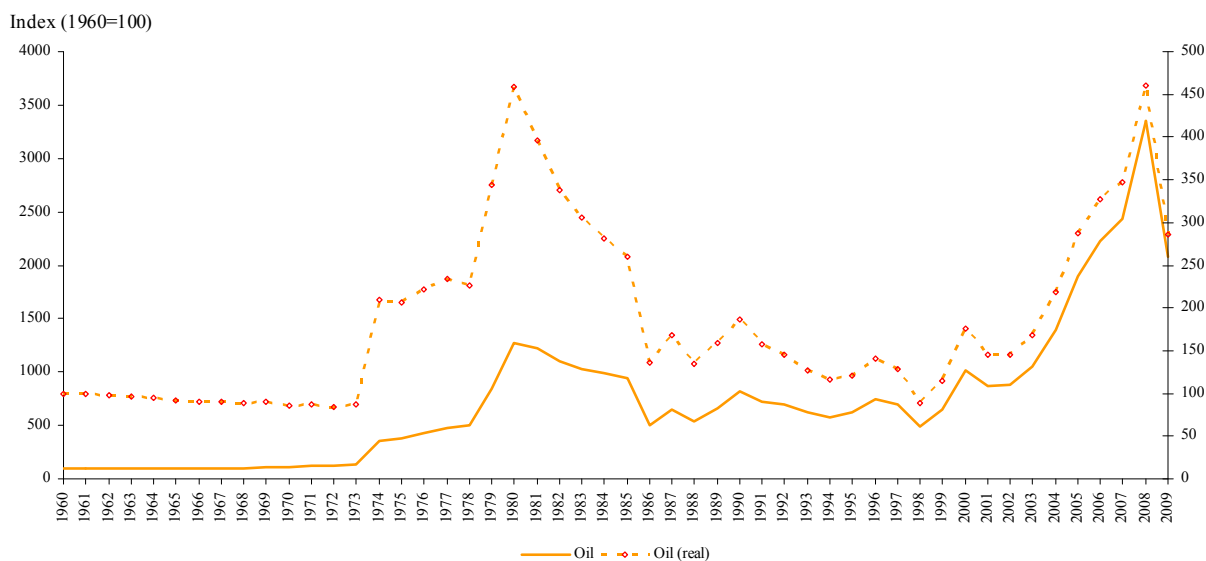


Figure 3: Oil Price Indices



When food and metals price indexes in real terms are analyzed, for example, we indeed verify between 2002 and 2008 an increase of 170% and 290%, respectively. Nevertheless, when the period 1960-2008 is considered, we observed that even after the last boom, real food prices are far below of their level in 1960 (-41.84%) and real metals prices have just recovered the levels exhibited in that year. The oil story is quite different. Real oil price have risen strongly in the last decade, being its current level five times the figures it presented in 1960.

Some authors have stated that, instead of long-run trends, the most remarkable feature of commodity price dynamics is short and medium term volatility. According to Deaton (1999)

“what commodity prices lack in trend, they make up for in variance.” Cashin and McDermott (2002) find that commodity price volatility has increased notably since Bretton Woods breakdown at the beginning of the seventies. Figures 4 and 5 depict the real price volatility measured by the standard deviation of the monthly real price changes using a rolling window of 12 months.

Figure 4. Food and Metal Real Price Volatility

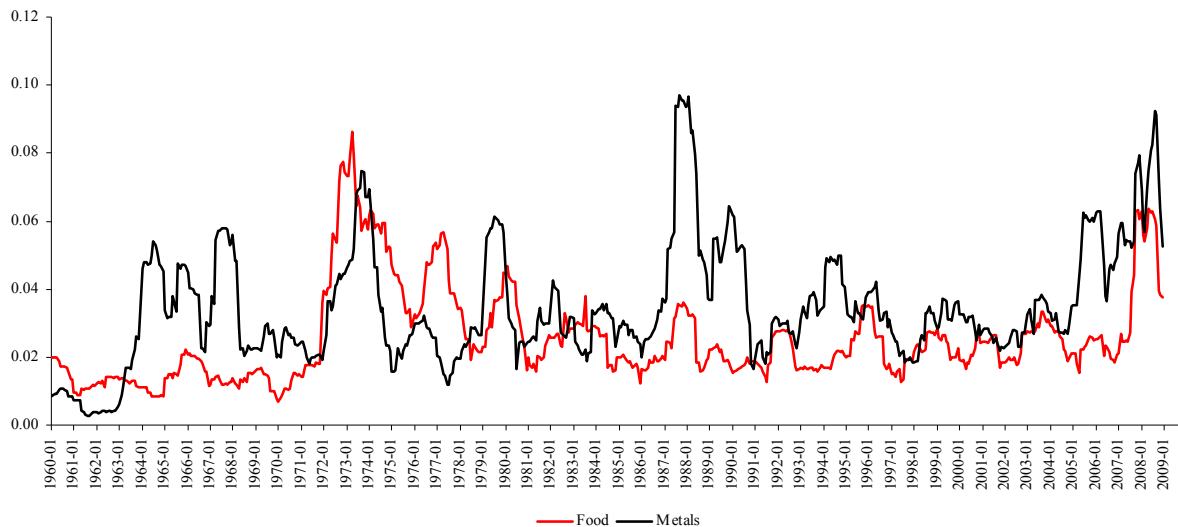
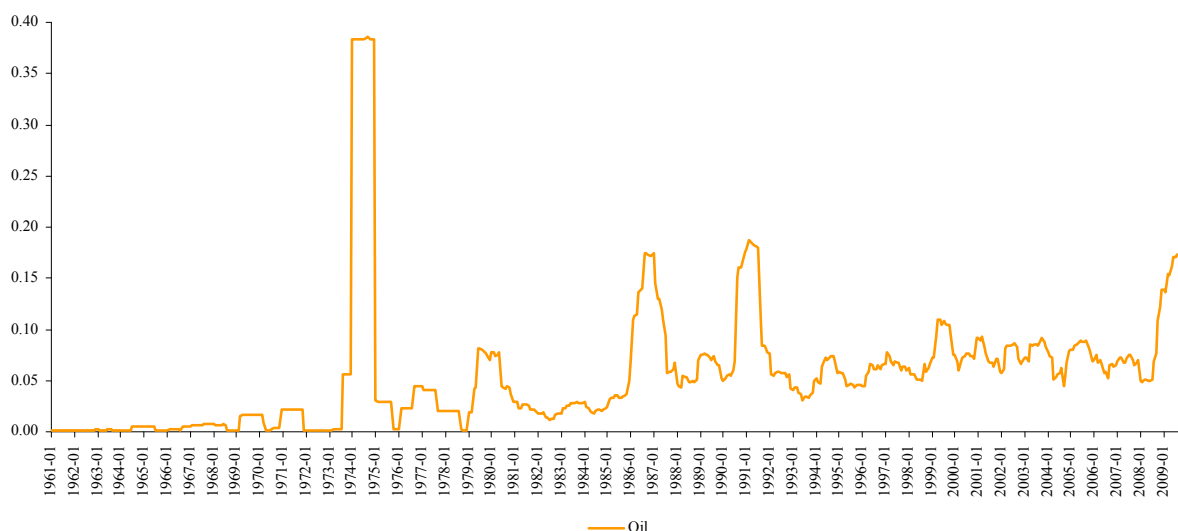


Figure 5. Oil Real Price Volatility



We found that, in fact, average volatility in post Bretton Woods era has doubled with respect to the 1960-1972 period in the case of food, while it has risen 40% when the metal price index is analyzed. Oil has exhibited a more abrupt price volatility increase. During the first phase the volatility measure averaged 0.0058 whereas in the second one that figure reached 0.069.

After summarizing stylized facts, we will disentangle the underlying factors that influence commodity prices in the long run – obtaining an “equilibrium” or “fundamental” price; and the mechanisms that generate, strengthen and eventually correct short run deviations with respect to that equilibrium after the Bretton Woods breakdown.

2. Long run drivers of commodity prices

In one of the most controversial thesis in the international economics field over the past century, Prebisch (1950) and Singer (1950) claimed that, contrary to the classical view, primary product prices would fall relatively to those of the industry. Prebisch (1950) asserted this tendency would be the outcome of a fundamental asymmetry in the international division of labor. Thus, while countries at the "center" had kept all the gains of their productivity increases, "the periphery" had conceded parts of the benefits of its own technological progress. The influence of this hypothesis over empirical research on commodity prices has been substantial and explains why the primary way of studying these prices has been through univariate methods such as unit root test or structural breaks tests.¹

A different approach for studying commodity prices begins by asking which macroeconomic factors could have a clear connection or act as determinants of them. In this sense, the pioneering model of Ridler and Yandle (1972) uses comparative static analysis in a single-good model to demonstrate that an increase in the real value of the dollar (i.e. a real exchange rate appreciation) should result in a fall in dollar commodity prices. Dornbusch (1985) constructs a simple two country, supply-demand model to highlight this effect. In that paper, the elasticity of commodity prices to United States real exchange rate (RER) should conform to the following relationship:

$$\frac{\partial \ln\left(\frac{P}{CPI}\right)}{\partial \ln\left(\frac{CPI}{eCPI^*}\right)} = -\frac{\beta^*}{\left(\frac{\beta\eta}{\eta^*} + \beta^*\right)} \quad (1)$$

where P is the price of a representative commodity basket; CPI and CPI^* are consumer price indexes in the United States and the rest of the world respectively; e is the multilateral nominal exchange rate (therefore $\frac{CPI}{eCPI^*}$ is the RER); η and η^* are demand price elasticities of; and β and β^* are market shares of each country in the world demand. According to this theoretical

¹ See for instance Grilli and Yang (1988), Cuddington and Urzúa (1989), Bleaney and Greenaway (1993), Cashing and McDermott (2002) or Ocampo and Parra (2003). The evidence that emerges from these papers is that negative growth rates tend to prevail when commodities are compared to industrial products considering the very long run. However, there is not a clear consensus about growth dynamics. While some authors have argued there is a decaying constant trend, other papers have stressed the importance of structural negative shifts that are not fully recovered during the upward phase of commodity prices cycles.

model, this elasticity should lie between 0 and -1. However, in empirical research it has usually been the case that it overshoots its theoretical value (i.e. is lower than -1).²

World demand is obviously another important driver of commodity prices. There is general consensus that Engel's law is an accurate framework to predict the impact of income on food commodities (Houthakker, 1987; Hamilton, 2001). Hence, aggregate food income-elasticity in each country would fall as long as the transit to development is completed. In the case of metals, it has been argued there is an inverse U-shape relationship between its use and income level. Thus, the consumption intensity of metals increases up to a point in which GDP per capita reaches approximately 15,000 or 20,000 purchasing power parity adjusted U.S. dollars (IMF, 2006) and then it starts to go down. In empirical models, indexes of world industrial production have been employed to measure world demand. Apart from real exchange rate and industrial production, a third variable has been suggested as a determinant of commodity prices – the real interest rate.

Explaining the excess of co-movement of commodity prices with respect to fundamentals, Pindyck and Rotemberg (1987) consider that these movements are the result of herd behavior in financial markets since its participants could believe that all commodities tend to move together. The authors claim that, as storable assets, commodities are affected by expectations. Interest rates might affect the harvest or production in a number of commodities, thereby changing its future supply and current prices. It could also affect expectations about future economic activity and then future commodity demands which, again, impact on spot prices.

Frankel (2006) remarks that rising interest rates are transmitted to commodity prices through three channels: i) by increasing the incentive for extraction (or production) today rather than tomorrow; ii) by decreasing the desire of firms to carry inventories; and iii) by encouraging speculators to shift out of commodity contracts into treasury bills. The three channels of transmission work to reduce spot prices. In fact, the author has argued that nominal records during 2006 in some commodities could be a signal that monetary policy has been too loose.

In our empirical non-linear model we will allow all these variables to play an explicit role determining the “equilibrium” or “fundamental” long run price of a selected commodity basket.

3. Financialization of commodity markets

The debate regarding the issue of financialization in commodity markets has been intense and positions are diverse in this point. Some authors have blamed financial markets as the only element responsible for violent price movements, while others have neglected their influence on prices. Hence, the key issue among financial market participants, academics and policymakers is trying to establish to what extent the financialization of commodities influence spot price levels and its stochastic properties.

² Dornbusch (1985), Gilbert (1989), De Gregorio et al. (2005).

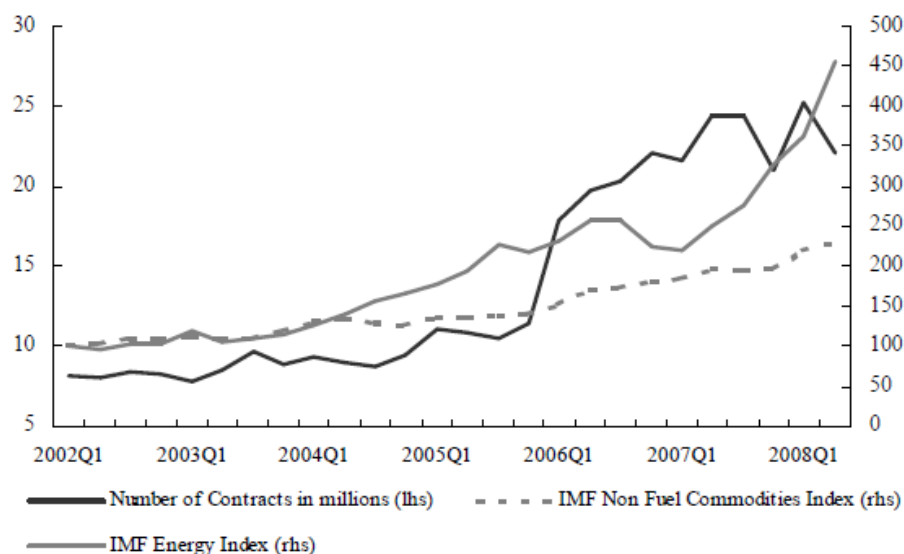
According to their characteristics, the market for each commodity is divided into two parts. On the one hand, it is the physical spot market in which the consumers demand these goods to the producer and the spot price is determined. On the other hand, it is the financial derivative market where long and short traders agree on a future settled price. Derivative markets can be further decomposed in two categories: exchange markets where standardized contracts are traded through a central clearing entity, and over-the-counter markets (OTC) in which tailored contracts are negotiated, usually by means of a market maker.

With the term “financialization” of commodities the literature usually makes reference to two different, though partially linked facts. The first fact is that derivative market activity has experienced an impressive growth in the last years. The second issue is the increase in the participation of financial investors in futures markets that occurred simultaneously.

Hence, one of the reasons to believe there is a close connection between price dynamics and speculative activity rests on the idea that we observed, during the past five years, a consistent rise in commodity prices in conjunction with a notable increase in turnover on commodity-linked instruments. In fact, trading volume in these instruments is several times higher than that of the physical production. Just to mention an example, Domanski and Healt (2007) have pointed out that contracts in derivative commodity markets tripled between 2002 and 2005; while in the same period the ratio of financial activity of crude oil and copper to their world productions increased from 3.2 to 3.9 and from 30.5 to 36.1, respectively.

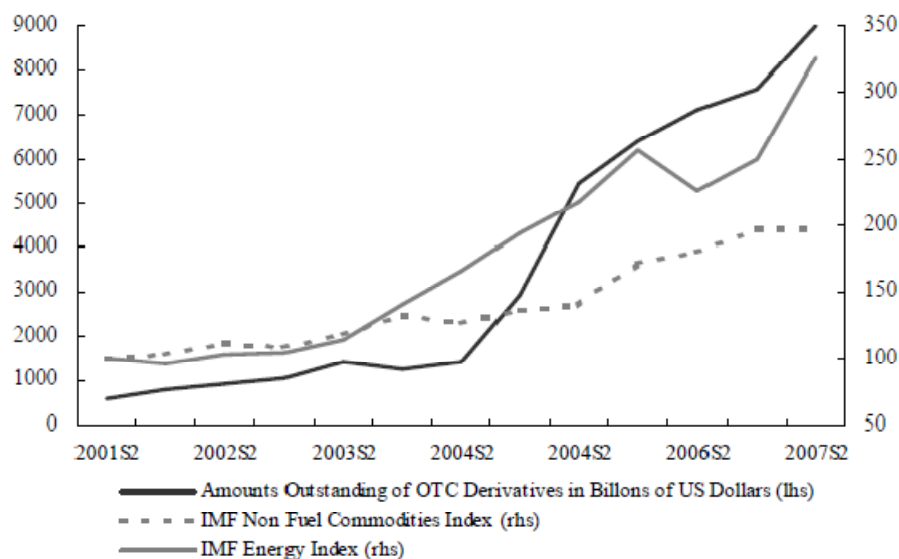
It is possible to illustrate this hypothesis comparing both the evolution of the number of outstanding commodity contracts and the amounts of USD outstanding OTC derivatives in conjunction with nominal commodity price movements. The exercise is presented in Figures 6 and 7 using the energy index and the non-fuel commodity index elaborated by the IMF.

Figure 6. Evolution of Derivative Commodity Contracts and Commodity Prices



Source: IMF International Financial Statistics and BIS Quarterly Review

Figure 7. Evolution OTC Derivatives and Commodity Prices



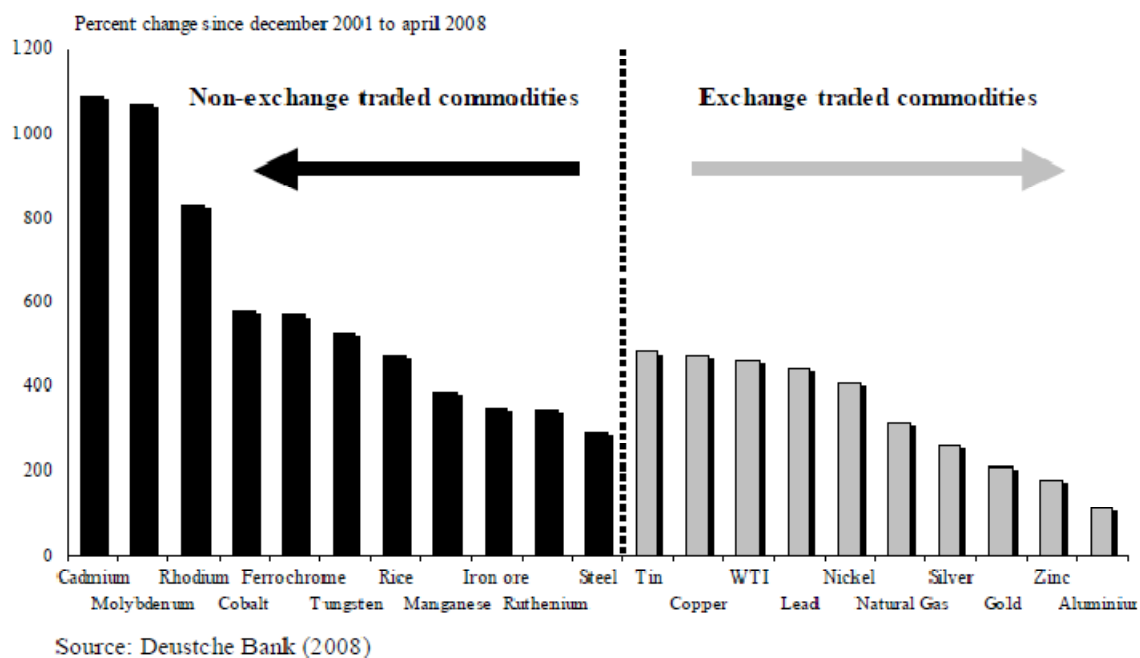
Source: IMF International Financial Statistics and BIS

As it was mentioned before, there is evidence of a considerable rise in derivative market activity when the so-called “boom” cycle of commodity prices from the beginning of 2002 to the second quarter of 2008 is observed. During this period, total commodity contracts grew by 170%; while energy and non-energy commodity prices increased by 350% and 120%

respectively. Moreover, the evolution of OTC derivatives in nominal US dollars was even more impressive (Figure 7). Thus, in the light of this evidence it results quite natural to associate this significant increase in financial commodity market deepening with soaring prices.

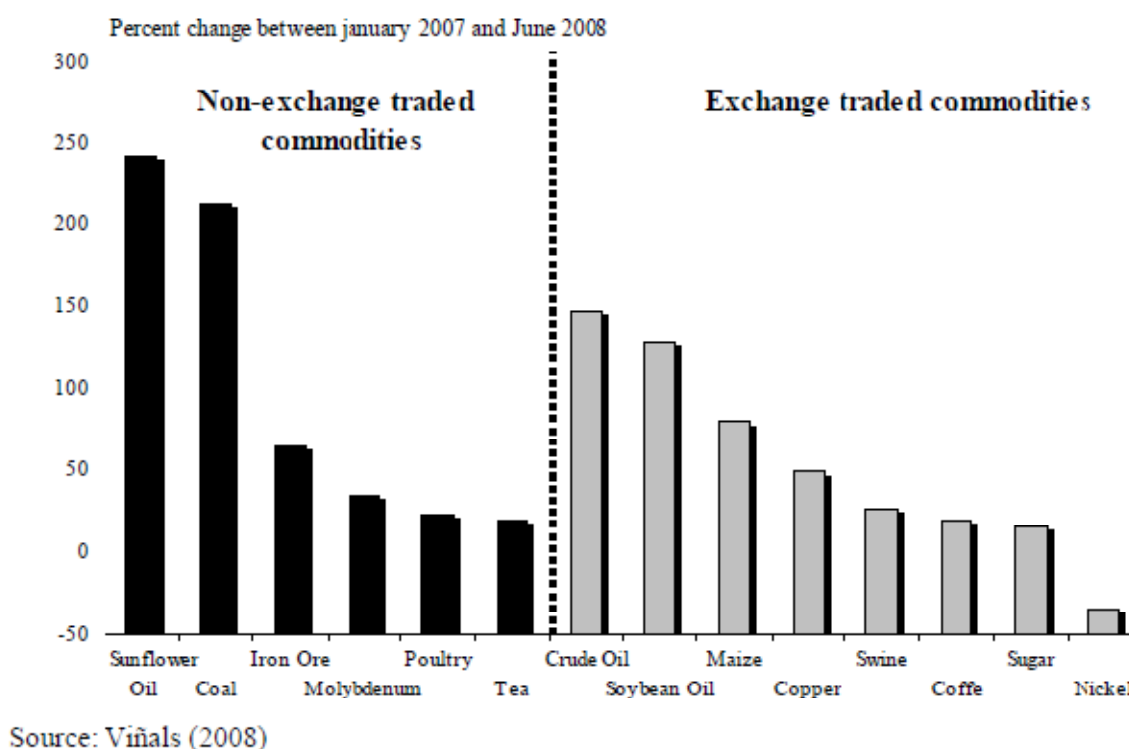
However, there is an important caveat in this line of reasoning. Specifically, if financialization has actually played a fundamental role in boosting commodity prices, we would expect lower growth rates for those commodities that lack derivative markets. Figures 8 and 9 reproduce the exercises carried out by Deutsche Bank (2008) and Viñals (2008) consisting in calculating price increases in both exchange and non-exchange trade commodities.

Figure 8. Price Changes in Selected Commodity Markets



In Figure 8, we observe that prices of exchange traded commodities have appreciated by a similar, if not lower, amount to non-exchange traded commodities where financial activity is not possible. Viñals (2008) has performed a similar exercise considering just the final part of the commodity boom (Figure 9).

Figure 9. Price Changes in Selected Commodity Markets



Again, we cannot establish a clear cut line between exchange and non-exchange traded commodities in terms of price variations. In some sense, this refutes the claim that commodity price increases that took place until the first half of 2008 were driven largely by speculative activity.

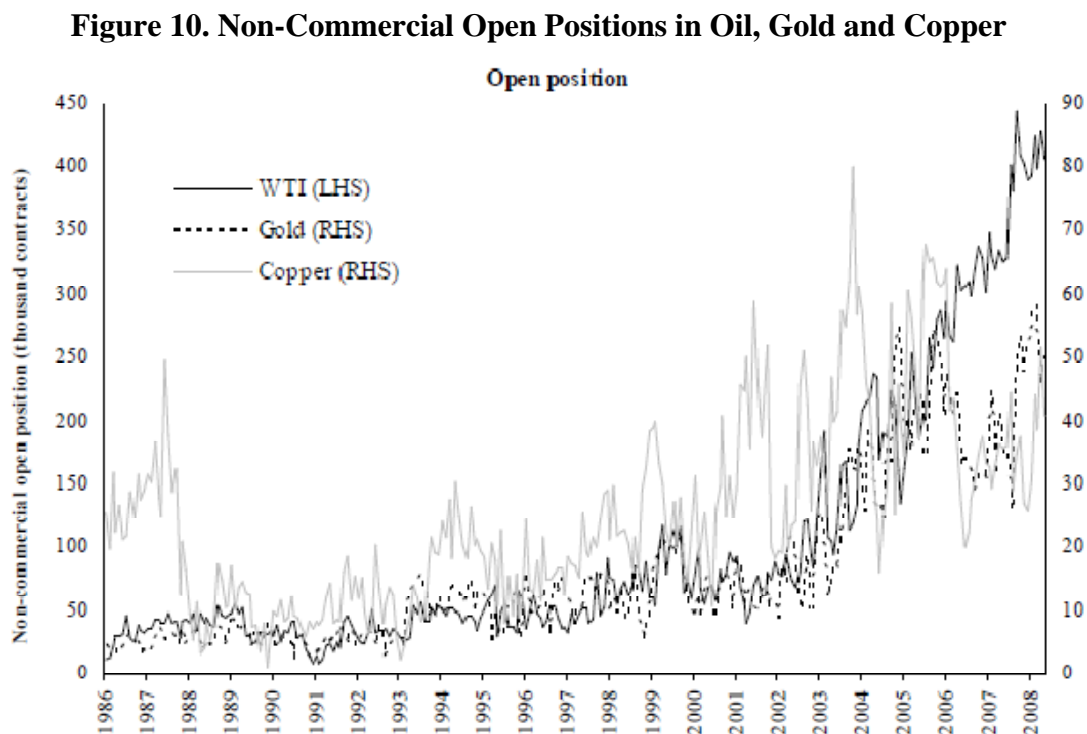
A more careful analysis of the issue of financialization requires going deep into the microstructure of derivative markets. Among of these market participants, there is a first wide division between commercial hedgers and financial investors.

Commercial hedgers are buyer or sellers of the physical commodity who use derivatives to hedge against the risk of price fluctuations. In the end, this type of agent is interested in the evolution of future spot prices of the underlying commodity (IMF, 2006).

Financial participants have different incentives from commercial hedgers. We can distinguish two strategies among them. On the one hand, there are “buy and hold” investors who pursue fully collateralized long-only future strategies, i.e., acquiring a long position in futures and investing the same amount in treasury bills as collateral. This strategy is usual among pension and mutual funds and it has historically had excess returns similar to those of equities. Additional interesting properties of commodity futures as a buy and hold strategy is that their returns are negatively correlated with equity and bond returns, and they prove to be a good hedge against unexpected inflation (Gorton and Rouwenhorst, 2004; Erb and Harvey, 2005).

On the other hand, we have a broader group of investors pursuing more complex strategies. Hedge funds have recently played an active role. Their operations are characterized by freedom in using a wide range of instruments and the ability to short sell and high leverage (Stefanini, 2006). Also, retail investors are becoming increasingly important since they could participate in new instruments such as Exchange Trade Commodity Funds or Structured Commodity Notes (McNee, 2006; Bienkowski, 2007).

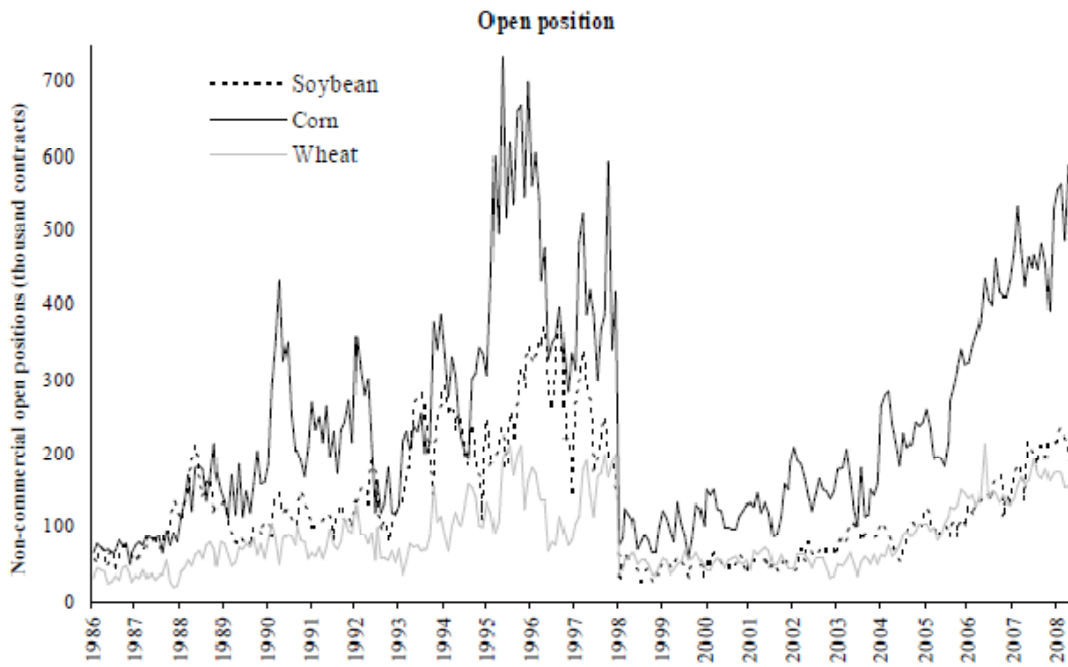
Although it could be argued that the action of financial investors has increased in the last years, this is not new. Figures 10 and 11 depict the number of open positions (long plus short) of financial participants in key future commodity markets since 1986. We observe a strong increase in the number of contracts opened by financial investors in the oil, gold and copper markets since the beginning of 2002; but the activity previous to that date was far from negligible.



Source: Calculations based on Deutsche Bank data

The picture is quite different from soft agricultural commodity markets in which we observe a sharp drop in financial activity connected to the Asian crisis of 1998 (Figure 11). After that, the number of open contracts just recovered its previous levels. From this evidence we conclude that financial activity has intensified in the last five years but could not be viewed as a completely new fact.

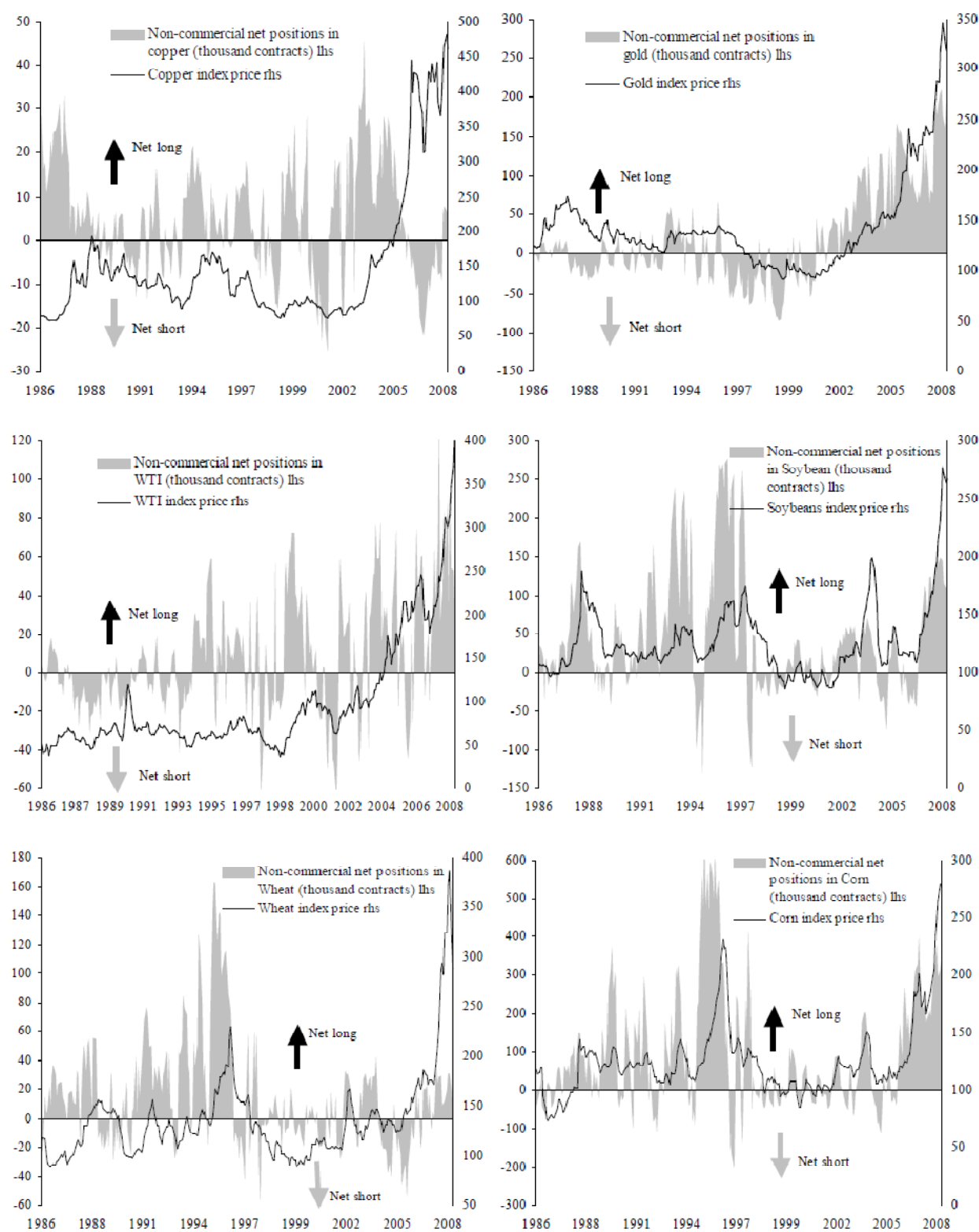
Figure 11. Non-Commercial Open Positions in Soybean, Corn and Wheat



Source: Authors calculations based on Deutsche Bank data

Besides, the impact of speculative activity on prices could depend more on net positions (long minus short) rather than open positions. In Figure 12, we have drawn these net positions of financial participants in selected derivative markets and the corresponding spot price (expressed as an index).

Figure 12. Net Positions of Financial Investors in Selected Commodity Markets



Source: Authors calculations based on Deutsche Bank and IMF data

There are several relevant points to highlight from this figure. Firstly, it seems that the mean position of financial investors throughout time tends to be a long one, but this fact could be partially explained by institutional investors going into long “buy and hold” strategies. There is a positive “long bias” among non-commercial participants.

In the second place, we can observe that net financial positions tend to be volatile which means that non-commercial investors could either act as a push or pull factor of influence over prices depending on specific circumstances.

In the third place, it seems there is a positive correlation between the net position and the spot commodity price which indicates that high price levels induce appreciation expectations of financial participants.

Finally, with the notable exception of copper, it was the case that the last phase of high prices from 2005 went along with short net non-commercial positions. However, it is important to note that apart from the most recent case of copper, there were other phases in the past in which net long positions coexisted with stagnant commodity prices. In wheat for instance, we observed a 200% increase in prices between 2005 and 2008 which coincides with a slight long position during the whole period. Moreover, we could also note from Figure 12 that price drops were not necessarily followed by aggressive net short positions. Explicitly, all this evidence means it is not necessary to have neither derivative markets nor aggressive financial investor participation to observe sharp price fluctuations.

In the financialization debate there is a last remark connected with the issue of causality. We think that a hypothesis that deserves some attention is that higher prices during the past five years could have caused an increased interest in commodity investment, and not the other way around as it is usually stated. To shed some light about this hypothesis we have calculated in Table 1 the correlation coefficient between net financial positions and the growth rates in various commodity prices using different time windows. We take the net financial positions at the end of the month and compute firstly the contemporaneous correlation with the price variation taking place between this date and the previous month. Then we consider both backward and forward price variation windows of up to three-months. In this way, the pairwise correlation between open positions and price changes at $t + 3$ considers the accumulated three month forward price variation. As a complementary exercise we have added the corresponding Granger causality test to establish if changes in financial positions anticipate spot price changes or if it is the other way around.

Table 1. Net Financial Positions and Commodity Prices, Correlations and Causality, 1986-2008

	COPPER	GOLD	SILVER	WTI	SUGAR	SOYA	MAIZE	WHEAT
<i>T</i> vs <i>T-3</i>	0.35	0.64	0.53	0.39	0.09	0.52	0.58	0.34
<i>T</i> vs <i>T-2</i>	0.37	0.59	0.50	0.39	0.07	0.51	0.56	0.37
<i>T</i> vs <i>T-1</i>	0.38	0.50	0.46	0.40	0.05	0.47	0.50	0.39
<i>T</i> vs <i>T</i>	0.39	0.42	0.44	0.41	0.02	0.40	0.42	0.37
<i>T</i> vs <i>T+1</i>	0.22	0.27	0.17	0.16	0.07	0.20	0.26	0.21
<i>T</i> vs <i>T+2</i>	0.19	0.29	0.13	0.11	0.15	0.15	0.24	0.20
<i>T</i> vs <i>T+3</i>	0.20	0.34	0.14	0.12	0.18	0.12	0.21	0.17
Granger Causality Test								
Price Variations do not Granger Cause Changes in Net Financial Positions	1.77820**	0.67559	0.86989	0.80581	0.30402	0.98956	1.57599*	0.82225
Changes in Net Financial Positions do not Granger Cause Price Variations	0.76235	2.785***	1.05728	1.29875	0.80934	2.09115**	1.21476	1.56979*

Source: Authors calculations based on Deutsche Bank and IMF data

It is clear that in all the cases there is a strong positive correlation of past price variation at time ($t - 1$, $t - 2$, $t - 3$) that tend to lower in subsequent periods. This fact could indicate that financial speculators take long positions when they observe price increases in the recent past with the expectation of further increases in the future. In the next section, we will refer to this type of behavior as driven by simple “rules of thumb” or “chartist analysis.” The evidence of Granger causality tests, however, does not reveal any clear causality pattern. This means the issue of causality remains open and further research would be needed.

Taking together, we interpret this preliminary evidence as an indication that financial participants could induce price fluctuations or excess volatility in some markets, but do not have a long-lasting impact on equilibrium prices which are ultimately determined by fundamental supply-demand factors. In the next section, we develop a simple model to stress a potential mechanism in which financialization alters the dynamic adjustment of prices to equilibrium. We will test then how actual commodity data fits with this hypothesis.

4. Heterogeneous agents in commodity markets

The model assumes that the change of the commodity price in the next period is determined by the interaction of three different agents³ called fundamentalists (F), chartists (C) and portfolio managers (PM) in accordance to the following expression:

$$\Delta P_{t+1} = a_1 E(\Delta P_{t+1}^C) + a_2 E(\Delta P_{t+1}^F) + a_3 E(\Delta P_{t+1}^{PM}) \quad (2)$$

³ Pioneering work on heterogeneous agents literature corresponds to Frankel and Froot (1987a,b and 1990), DeLong et al. (1990a,b), and Shleifer and Summers (1990).

where $E(\Delta P_{t+1}^C)$, $E(\Delta P_{t+1}^F)$, and $E(\Delta P_{t+1}^{PM})$ are the price change expectations of each agent and a_1, a_2, a_3 are fixed weights that measure the relative importance of each group.

The expectations of the fundamentalists are based on the notion of commodity price reversion towards its long run equilibrium. The particular specification is:

$$E(\Delta P_{t+1}^F) = -\alpha (P_t - F_t(X_t)) \quad \alpha > 0 \quad (3)$$

where F_t is the fundamental price of the commodity (or the relevant commodity price index) in time t . This price is a function of a vector of variables (X_t) stressed by empirical literature such as world demand for commodities, the real exchange rate of the United States and the real interest rate.

According to equation (3), fundamentalists expect decaying (increasing) prices when current prices are higher (lower) than fundamental prices. Thus, they are prone to sell or buy the commodity in a counter-cyclical fashion. It is not necessary to assume that fundamentalists know exactly which the long term value of the commodity is. We can think instead they can obtain a consistent estimation of this equilibrium. For instance, it could be assumed that these agents have an imperfect knowledge about the real model because there exists uncertainty regarding the true value of the parameters, but they build their expectations based on an econometric regression without making systematic errors (Bray and Savin, 1986 and Fourgeaud et al., 1986).

Chartists, on the contrary, employ technical analysis and follow the current trends in prices. One way to formalize this type of strategy is:

$$E(\Delta P_{t+1}^C) = \delta (P_t - P_{t-1}) \quad \delta > 0 \quad (4)$$

Every time prices increase, these agents will take a long position in commodities because they expect that this trend will continue in the future. From the correlation analysis of the third section we know this is compatible with the actions of financial participants.

The key factor of this simple model is the inclusion of portfolio managers who are assumed to have an information advantage, in the sense they know the way the other market players form expectations. In order to take advantage of their knowledge, PM agents adjust their expectations employing a weighted average of expressions (3) and (4):

$$E(\Delta P_{t+1}^{PM}) = (1 - w_t)E(\Delta P_{t+1}^C) + w_tE(\Delta P_{t+1}^F) \quad 0 \leq w_t \leq 1 \quad (5)$$

It is crucial here to note the role of the variable w_t which governs the weight given to each type of expectation in time t . We assume that w_t adjusts endogenously in response to the size of past misalignment. Thus, the w_t variable is the source of non-linearity into the model. We propose, in particular, the following exponential function:

$$w_t = 1 - \exp\left(-\gamma(P_{t-d} - F_{t-d}(X_{t-d}))^2\right) \quad \gamma > 0, d \geq 0 \quad (6)$$

The intuition behind the specification of equation (6) is that the gap between actual and fundamental prices (lagged by d periods) is the element that determines the weights assigned to the expectations of F and C agents by the portfolio managers. When $F_{t-d} \equiv P_{t-d}$, then w_t will show

a very small value encouraging portfolio managers to follow the behavior of chartists. In the limit, when $F_{t-d} = P_{t-d}$, ($w_t = 0$), the price change will be given by:

$$\Delta P_{t+1} = (a_1 + a_3)E(\Delta P_{t+1}^C) = (a_1 + a_3)\delta(\Delta P_t) \quad (7)$$

If we are interested in empirically studying commodity price dynamics, expression (7) suggests employing a purely autoregressive econometric specification.

As long as the gap between F_{t-d} and P_{t-d} increases, portfolio managers start to bet against this misalignment. That is, the larger the misalignment, the larger the weight they give to F expectations. Again, in the extreme case, $\exp(-\gamma(P_{t-d} - F_{t-d}(X_{t-d}))^2) \rightarrow 0$, and consequently $w_t = 1$ and $E(\Delta P_{t+1}^{PM}) = E(\Delta P_{t+1}^F)$. After some substitutions, the law of motion for the price dynamics will be given by:

$$\Delta P_{t+1} = a\delta(P_t) - (a_2 + a_3)\alpha(M_t) \quad (8)$$

where we have defined $M_t = P_t - F(X_t)$.

The parameter γ is also relevant in this scheme, governing the speed in which portfolio managers adjust their expectations through the w_t variable. If γ is quite high, for instance, even a small misalignment will induce PM agents to form expectations as the fundamentalists.

The general expression of commodity price changes can be obtained by replacing (3), (4), (5) and (6) into (2) and rearranging terms:

$$\begin{aligned} \Delta P_{t+1} = & (a_1 + a_3)\delta\Delta P_t - a_2\alpha M_t - a_3\delta[1 - \exp(-\gamma M_{t-d}^2)]\Delta P_t \\ & - a_3\alpha[1 - \exp(-\gamma M_{t-d}^2)]M_t \end{aligned} \quad (9)$$

Thus, price dynamics depends on several factors. The first two terms are based on a standard error correction model: a purely autoregressive term and a linear error correction factor. The remaining terms are those which generate the non-linear adjustment pattern. In the empirical analysis the emphasis will be placed on the non-linear adjustment coefficient of the price deviation from the long-run equilibrium.

Summarizing, we have developed a theoretical model in which fundamentals continue to be the only real force that drives long run prices. However, heterogeneity in expectations among market participants is important in determining the adjustment properties to equilibrium.

It will be shown in the methodological section that a specific type of smooth transition autoregressive model (STAR) tracks the commodity price dynamics derived from the model and described by the equation (9). With this econometric specification it will be feasible to study both the fundamental equilibrium and the potentially non-linear adjustment properties of the implied misalignment.

5. Econometric methodology

In recent decades there has been a growing interest in the use of non-linear econometric techniques. Among them, models with switching regimes turn out to be particularly attractive because they incorporate a law of motion that governs the shift from one state to another. This law could be deterministic or stochastic. In the first case, the regime is determined by past values of observable variables, and it is known with certainty by all economic agents. In contrast, the state is stochastic if the regime is known only with some probability at every moment of time.

The simplest autoregressive model with deterministic regimes corresponds to the case of sudden changes and was developed by Tong (1978, 1990), Tsay (1989). In brief, it compares the transition variable (TV_t) with a threshold (c) in order to split up the linear model into two sub-models. If an autoregressive specification without explanatory variables is assumed, then the threshold model will be:

$$y_t = \begin{cases} (\phi_{1,0} + \phi_{1,1}y_{t-1} + \dots + \phi_{1,p}y_{t-p}) + \varepsilon_t & \forall y_t \leq c \\ (\phi_{2,0} + \phi_{2,1}y_{t-1} + \dots + \phi_{2,p}y_{t-p}) + \varepsilon_t & \forall y_t > c \end{cases} \quad (10)$$

In equation (10), the switch between states is determined by the comparison between the transition variable (y_t) and the threshold (c), and it occurs abruptly. The idea that the transition can be done gradually represents an important progress in this literature. It theoretically corresponds to the notion that economic agents do not react simultaneously when new information is spread or when a shock hits the economy. This empirical strategy is also valid if the effects of structural changes materialize slowly.

Moreover, whenever economic intuition or theory suggests that a relationship among variables is valid under certain circumstances but is no longer true if these circumstances change, then a smooth transition autoregressive (STAR) model will be suitable for its empirical test. Chan and Tong (1986); Granger and Teräsvirta (1993); Teräsvirta (1994), or Franses and van Dijk (2000) are pioneering references of this approach.

The representation of a smooth transition autoregressive model of p order or $STAR(p)$ is as follows:

$$y_t = (\phi_{1,0} + \phi_{1,1}y_{t-1} + \dots + \phi_{1,p}y_{t-p})(1 - F(TV_{t-d}; \gamma, c)) + (\phi_{2,0} + \phi_{2,1}y_{t-1} + \dots + \phi_{2,p}y_{t-p})F(TV_{t-d}; \gamma, c) + \varepsilon_t \quad (11)$$

Alternatively:

$$y_t = (\phi_{1,0} + \phi_{1,1}y_{t-1} + \dots + \phi_{1,p}y_{t-p}) + (\lambda_{2,0} + \lambda_{2,1}y_{t-1} + \dots + \lambda_{2,p}y_{t-p})F(TV_{t-d}; \gamma, c) + \varepsilon_t \quad (12)$$

where the following conditions are satisfied:

$$\lambda_{2,0} = \phi_{2,0} - \phi_{1,0}, \lambda_{2,1} = \phi_{2,1} - \phi_{1,1}, \dots, \lambda_{2,p} = \phi_{2,p} - \phi_{1,p} \quad (13)$$

$$E(\epsilon_t \Omega_{t-1}) = 0 \quad (14)$$

$$E(\epsilon_t^2 | \Omega_{t-1}) = \sigma^2 \quad (15)$$

$$\Omega_{t-1} = (y_{t-1} \dots y_{t-p}) \quad (16)$$

In equations (11) and (12), the expression $F(TV_{t-d}; \gamma, c)$ is known as the transition function. It is a continuous function whose image is the interval $[0, 1]$.⁴ The γ parameter measures how fast the adjustment between regimes is, while the parameter c , establishes the limit point after which the switching between regimes start to take place. Finally, TV_{t-d} refers to the transition variable with d lags. There are very few technical restrictions on the sort of variable(s) that could be TV_{t-d} . Usual options include lags of endogenous variables, exogenous variables, functions of endogenous and/or exogenous variables or a time trend (van Dijk et al., 2002).

On some occasions, however, a theoretical hypothesis suggests which variable can be regarded as a determinant of the transition. This is precisely the case of commodity prices and their possible pattern of non-linear equilibrium correction. From the heterogeneous agent model we obtain a specific theoretical restriction establishing that past misalignment between the current price and the fundamental value not only acts as a determinant of price changes but also as the variable that governs the transition between regimes.

Usual TV_{t-d} functions are either logistic or exponential:

$$F(TV_{t-d}; \gamma, c) = \frac{1}{1 + \exp(-\gamma(TV_{t-d} - c))}, \gamma > 0 \quad (17)$$

$$F(TV_{t-d}; \gamma, c) = 1 + \exp(-\gamma(TV_{t-d} - c)^2), \gamma > 0 \quad (18)$$

The logistic function⁵ allows us to distinguish between two regimes or states, named high and low regimes, respectively. The high state arises from positive and large values of $(TV_{t-d} - c)$, since $\exp(-\gamma(TV_{t-d} - c)^2)$ tends to zero, and hence the expression (17) tends to 1. By contrast, the regime is low when $(TV_{t-d} - c)$ takes low values and so $\exp(-\gamma(TV_{t-d} - c)^2) \rightarrow \infty$ and $F(TV_{t-d}; \gamma, c) \rightarrow 0$.⁶ The logistic specification is valid when it is believed that the transition takes place in a monotonic way.

On the contrary, the exponential function is useful if the value of absolute deviation of the transition variable with respect to parameter c is the important feature. This specification is known as ESTAR model (exponential smooth transition autoregressive model) and restricts the dynamics of the equation to be the same alongside the extreme values of $F(TV_{t-d}; \gamma, c)$. Thus, in

⁴ Both properties differentiate a smooth transition autoregressive model from a threshold model, because in the latter the transition function is direct, taking only two values: 0 or 1.

⁵ A logistic smooth transition autoregressive (LSTAR) model is obtained when function (17) is applied.

⁶ Since the transition function can take any continuous values between zero and one, characterization of a STAR model with only two regimes may look quite arbitrary, particularly in those cases in which the smoothing parameter is low and, therefore, there are many intermediate values of the transition function. In this sense, van Dijk et al. (2002) argue that the STAR model can be thought of as a methodology that allows a "continuous" set of regimes.

an ESTAR model the asymmetries between regimes are given by the absolute magnitude of the differences rather than by their sign.

Some well-known applications of STAR models could be found in papers studying misalignment of the real exchange rate regarding its fundamental value given by the purchasing power parity (Michael et al., 1997; Taylor et al., 2001, or Chen and Wu, 2000); in the literature of non-linear adjustment of deviations from uncovered interest rate parity (Sarno et al., 2006); or in those works that test non-linear mean reversion in stock futures (Monoyios and Sarno, 2002). The extensions of STAR models to multivariate contexts (VAR models or systems of equations) have been studied, among others, by Weise (1999), van Dijk (2001), Camacho (2004) and Mendoza (2004). The general structure of a non-linear equilibrium correction model is:

$$\Delta Y_t = \Pi_{1,0} + \Gamma D_t + \alpha_1 M_{t-1} + \sum_{j=1}^p \Pi_{1,j} \Delta Y_{t-j} + (\Pi_{2,0} + \alpha_2 M_{t-1} + \sum_{j=1}^p \Pi_{2,j} \Delta Y_{t-j}) F(TV_{t-d}; \gamma, c) + \varepsilon_t \quad (19)$$

where ΔY_t is a (nx1) vector, $(\Delta y_1, \Delta y_2, \dots, \Delta y_n)$, D_t is a (mx1) vector of dummies which control for outliers and Γ (mxn) is the respective matrix of coefficients. Also, $\Pi_{1,0}$ and $\Pi_{2,0}$ are (nx1) vectors containing the constants of the linear and non-linear part in each case. The $\Pi_{1,j}$ and $\Pi_{2,j}$ are (nxn) matrices for $j:1, \dots, p$ that correspond to the autoregressive coefficients. The equilibrium correction term is denoted by $M_t = \beta' X_t$, where β is the (nxr) matrix of coefficients of the long-term relationship and X_t is a (nx1) vector which stands for the variables in levels. Finally, α_1 and α_2 are (nxr) matrices formed by the adjustment coefficients of deviations from long-term relationships, where r indicates the number of cointegration equations. These coefficients play a fundamental role in the model since they capture the linear and non-linear adjustment pattern.

Concerning the operational steps needed to implement a STAR model, Teräsvirta (1994) proposes a procedure for the univariate case, whereas Granger and Teräsvirta (1993) examine the multivariate case and Camacho (2004), among others, extends it to a multi-equational approach. In all cases, the process encompasses basically four stages: i) estimating a linear model ii) testing non-linearity; iii) estimating the non-linear model, and iv) computing non-linear impulse-response analysis.

The first step is to estimate a linear model that will serve as a benchmark to contrast the non-linearity hypothesis. The estimation sequence follows common techniques of time series analysis. In this point, it is important to control for outliers and to check the behavior of the residuals regarding autocorrelation and heteroscedasticity.

The second stage consists of a linearity test. If the alternative hypothesis to the linearity is the smooth transition exponential model (STAR)⁷, Teräsvirta (1994) suggests using a first order Taylor expansion (T_1^e) to obtain an auxiliary regression which may serve as a base to contrast the

⁷ The auxiliary regression is modified when the specification is done throughout a logistic function. There is also evidence that expression (20) is appropriate when there is no knowledge (or no prior intuition) whether the relevant alternative is the expression (17) or (18). In this regard, see Luukkonen et al. (1998).

null hypothesis. To this end, one should take equation (18) and calculate T_1^e in $\gamma = 0$. After some simplifications, the following auxiliary regression will be achieved (vector notation):

$$Y_t = \beta'_0 X_t + \beta'_1 X_t TV_{t-d} + \beta'_2 X_t TV_{t-d}^2 + w_t \quad (20)$$

where $X_t = [1, y_{t-1}, y_{t-2}, \dots, y_{t-d}]$; $\beta_0 = [\beta_{0,0}, \beta_{0,1}, \dots, \beta_{0,p}]$; $\beta_1 = [\beta_{1,0}, \beta_{1,1}, \dots, \beta_{1,p}]$; and $\beta_2 = [\beta_{2,0}, \beta_{2,1}, \dots, \beta_{2,p}]$. In (20), testing the linearity hypothesis is equivalent to prove that $\beta_1 = 0$ and $\beta_2 = 0$.

According to Teräsvirta (1994), the recommended procedure consists of an F -test with the following sequence: i) estimate the model under the assumption of linearity and compute the residual sum square (RSS_0); ii) estimate the auxiliary regression (20) to obtain RSS_1 ; and iii) compute the critical value of the LM statistics:

$$LM = \frac{(RSS_0 - RSS_1)/l_1}{RSS_0/l_2} \quad (21)$$

The l_1 degrees of freedom are calculated as the difference between the number of parameters in the unrestricted and restricted models, whereas l_2 is calculated as the number of observations minus the unrestricted model parameters. If the linearity test is performed on a list of possible transition variables, it will be necessary to define which variables will be considered. In such a case the highest LM statistics is employed to select the transition variable.

The third step is the estimation of the STAR model, which can be done by any conventional non-linear method. This will require the definition of initial conditions. An appropriate selection of these conditions will increase the probability of reaching a maximum in the likelihood function.

The usual practice to find initial conditions is conducting a two dimensional grid search on parameters γ and c . It is important to note in this regard that once the values of both parameters are fixed, the function $F(TV_{t-d}; \gamma, c)$ will lie in the interval $[0, 1]$ in each observation, being equation (11) linear in all its arguments. The grid search iterates different values of γ and c taken at intervals that are relevant in accordance with their respective scales of variability. The conditional estimation can be done by a linear method as OLS or SUR. The configuration of (γ, c) which generates the restricted model with the maximum likelihood will be selected. Then, its parameters are used as initial conditions to estimate the unrestricted STAR model.

Theory could also provide some conditions for the smoothing parameter (γ) or the threshold (c). In those models where the misalignment is the state variable ($TV_{t-d} = M_{t-d}$), the condition $c = 0$ is often imposed because of the symmetry in the economic concept of misalignment itself. Thus, when the differences between actual and fundamental prices are very small, then $F(TV_{t-d}; \gamma, c = 0) = 1 - \exp(-\gamma(M_{t-d})^2) \rightarrow 0$, and so we will observe the system operating in one of the extreme regimes. In papers about purchasing power parity, transaction and transportation costs limit arbitrage and thus small mismatches are interpreted as a state variable, where PPP do not hold. The corollary is that the exchange rate behaves like a random walk if M_{t-d} is low.

Finally, a useful tool in a STAR model applied only to systems of equations is the computation of generalized impulse-response functions. A methodological description of these impulse-response functions is beyond the scope of this paper. However, the intuitive idea is that in a STAR model the effects of shocks depend on the history, size and sign of disturbances. For instance, the effect of a shock will not be necessarily the same if the shock occurs when there is a small misalignment with respect to the case of a high initial gap between current and equilibrium commodity prices. Also the size of shock could be relevant since it could involve different future dynamic trajectories of the endogenous variables. These characteristics are not incorporated by traditional impulse response functions estimation methods. We follow the bootstrapping methodology of Koop et al. (1996) to compute the generalized non-linear impulse response functions. We suggest reviewing this reference for a complete discussion of technical details.

6. Non-linearity in the adjustment of commodity prices: empirical results

With the aim of organizing the presentation of the empirical model, this section has been divided into four parts. In the first part, the variables and the data sources are described. Subsequently, we discuss the estimates of the long-run equilibrium equation of commodity prices and show the time path of the implied misalignment. In the third sub-section we present the non-linearity tests results, the interpretation of the transition function and its regimes, and the estimation of the non-linear system. Finally, impulse response analysis is performed to investigate the short-term reaction of commodity prices to shocks in fundamentals under both high and low misalignment regimes.

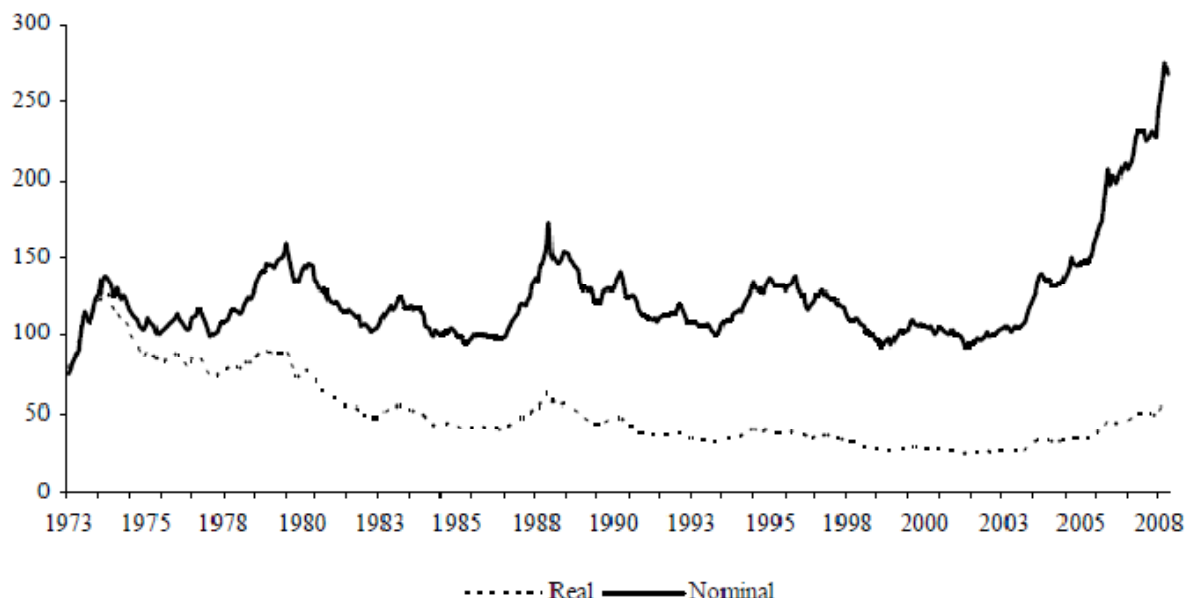
6.1 The variables of the empirical model

Our empirical analysis is based on monthly data belonging to the post Bretton Woods era, from January 1973 to May 2008.

After defining the period of analysis, we have to choose the commodities whose prices will be explained. Given that our theoretical framework is general enough and holds for a broad set of assets, we opt for studying an aggregated index. Particularly, the Food Index and the Metals Index from the International Finance Statistics (IFS) were averaged out to construct the All-Comm Index. To deflate the series, US CPI from the same source was used.⁸ Figure 13 shows the evolution of the index in both nominal and real terms.⁹

⁸ It is worth mentioning that oil was not considered because several authors such as Beenstock (1988) or, more recently, Cheung and Morin (2007) have stressed it has its own dynamic with low connection to other commodities.

⁹ A clarification related to the issue of commodities as financial assets is needed. Price indexes we use are elaborated with data from spot prices and not from futures or other similar derivative instruments, which are in strict financial terms the real investment vehicles. However, the argument is that spot prices are very good indicators of the financial returns of commodities. In this sense, Gorton and Rouwenhorst (2004) show that the return on a future position and the current price has a correlation close to one.

Figure 13. Commodity Price Index

As highlighted in section one, the outlook for commodities dramatically changes whether nominal or real indexes are considered. Both series have exhibited an important growth since 2002; while the former has increased 166.3% up to 2008 from then, the latter has risen 124.3% in the same time interval. However, the overall performance has been very different: whereas in the first semester of 2008 the nominal index averaged a value 2.6 times higher than the figure of 1973, current real prices are roughly a half of the value observed at the beginning of the sample.

Regarding price fundamentals definition, we have the US real exchange rate (*RER*) in the first place. The broad multilateral version published by the Federal Reserve Bank of New York is employed. The variable is defined in such a way that it rises when the dollar is appreciating against the currencies of main trading partners. The real international interest rate (*IR*) is the one-year Treasury constant maturity rate from the Board of Governors of the Federal Reserve System. Again, US CPI is the deflator.

The price fundamental whose measurement presents serious difficulties is the commodity world demand proxy, especially because a series in monthly basis is required. Industrial Production of the developed countries is the alternative usually employed in studies on this topic. However, Asian emerging countries have become crucial players in commodity markets and they should be incorporated into the analysis. Therefore, we consider an Industrial Production Index (*PRO*) which also takes into account the industrial output of Korea, India, Malaysia and China. All the indexes come from the IFS, except from China whose series is built using the Industrial Value Added provided on an annual basis by the IMF World Economic Outlook and linearly extrapolating to become monthly. We use the share of each country in the industrial added value

(IVA) as a weighting factor.¹⁰ The seasonally unadjusted series is corrected applying the X-12 ARIMA method.

In addition to the price determinants reviewed in the first section, the Dow Jones index deflated by US CPI (*DOW*) is also included. Our aim is to control for the return of alternative assets and to investigate if conditional covariance indicates substitution or complementary effects between these asset classes. As it was mentioned before, authors like Gorton and Rouwenhorst (2004) or Deutsche Bank (2005) have studied this link and they have found that the non-conditional correlation between returns of commodities and other assets (bonds and equities) is negative and very significant in the long term. In Domanski and Healt (2007) the ratio of net long contracts for non-commercial agents is negatively correlated, though slightly, with stock indexes.

6.2 The structure of the model, equilibrium estimation and the misalignment

The structure of the model to be estimated is similar to a VECM but includes non-linear terms in the commodity price equation. In this sense, we move away from the seminal work of Weize (1999) that specifies a symmetrical smooth transition VAR; which means all the equations present non-linear terms. Our decision is based on the fact we only have a theoretical rationale for non-linear adjustment in the price dynamics. An alternative empirical strategy could have been using a single-equation STAR.¹¹ However, that option would have implied abandoning the possibility of studying the short-term commodity price response to shocks in fundamentals and we would not be able to study interactive effects.

In particular, we take (19) as a benchmark and work with the following system:

$$\Delta P_t = \beta_{11} + \alpha_{11}(M_{t-1}) + \sum_{j=1}^p \Pi_{l1,j} \Delta X_{t-p} + (\beta_{12} + \alpha_{12}(M_{t-1}) + \sum_{j=1}^p \Pi_{l2,j} \Delta X_{t-p})(1 - \exp(-\gamma TV_{t-d}^2)) + \varepsilon_t^p \quad (22)$$

$$\Delta RER_t = \beta_2 + \alpha_2(M_{t-1}) + \sum_{j=1}^p \Pi_{2,j} \Delta X_{t-p} + \varepsilon_t^{RER} \quad (23)$$

$$\Delta IR_t = \beta_3 + \alpha_3(M_{t-1}) + \sum_{j=1}^p \Pi_{3,j} \Delta X_{t-p} + \varepsilon_t^{IR} \quad (24)$$

$$\Delta PRO_t = \beta_4 + \alpha_4(M_{t-1}) + \sum_{j=1}^p \Pi_{4,j} \Delta X_{t-p} + \varepsilon_t^{PRO} \quad (25)$$

¹⁰ The weights we obtained by this criterion were increased by 50% in the case of emerging countries for two reasons. The first one is that emerging economies are underrepresented in the sample. The second reason is that these countries have a greater intensity of commodity consumption per unit of output. Capturing a specific amount of increase of this coefficient is beyond the scope of this study, but increasing it seems a better alternative than to ignore the two above-mentioned effects.

¹¹ This is the strategy adopted by Westerhoff and Reitz (2005) to explain mean reversion in corn prices. Other difference of that model in comparison to our empirical framework is these authors do not use an exponential specification for the transition function.

$$\Delta DOW_t = \beta_5 + \alpha_5(M_{t-1}) + \sum_{j=1}^p \Pi_{5,j} \Delta X_{t-j} + \varepsilon_t^{DOW} \quad (26)$$

where $X = [P, RER, IR, PRO, DOW]$ and the threshold coefficient c is set equal to zero because of theoretical reasons discussed in Section 5. As before, $M_t = P_t - F(X_t)$ and TV_{t-d} is the transition variable.

The main focus of the empirical analysis is centered on the expression (22) as it contains the price dynamics which is similar to that derived from the theoretical model (equation (9)). Particular interest should be given to the estimates of α_{11} and α_{12} which represent the price adjustment coefficients to the deviations from the long-term equilibrium.

The econometric strategy adopted is in line with the Engle and Granger proposal. In essence, we estimate in a first stage the long run equation for commodity prices and test for cointegration. Then, if a cointegration relationship is found, the whole error correction system will be estimated using $M_t = P_t - F(X_t)$ as a regressor.

To carry out the first stage requires coping with non stationary series.¹² As it is well known, if I(1) variables are cointegrated the OLS estimator of the coefficients of the long run relationship will be consistent. However, it will have a non-normal distribution, and inferences based on t-statistics will be misleading. Several econometrics techniques have been developed to overcome this problem. We apply the Dynamic OLS (DOLS) estimator developed by Stock and Watson (1993) which adds leads and lags of the changes in the right hand regressors in the standard long run equation. That is,

$$P_t = \beta_1 + \beta_2 X_t + \sum_{j=-p}^p \beta_3 \Delta X_{t-j} + \beta_4 t + \varepsilon_t \quad (27)$$

where X_t stands for the price determinants and p represents the number of leads and lags considered. DOLS estimator of β_2 results from OLS estimation of equation (27).

If the variables are cointegrated, the DOLS estimator is consistent and efficient in large samples. The methodology deals with potential simultaneity and small sample bias among the regressors by the inclusion of leads and lags. Besides, Monte Carlo experiments show that DOLS performs better, particularly in small samples, compared to alternative estimators of long-run parameters as those proposed by Engle and Granger (1987), Johansen (1988), and Phillips and Hansen (1990).¹³ Finally, standard statistical inference remains valid when heteroskedastic and autocorrelation consistent (HAC) standard errors are employed. We apply this methodology to obtain the coefficients of the long run equation of commodity prices (Table 2). We use six leads and lags but the estimation was robust to changes in the value of p .

¹² The usual unit root tests were implemented confirming all the series are non stationary. Results are available upon request to the authors.

¹³ See Stock and Watson (1993) or Montalvo (1995) It is worth mentioning that DOLS estimator is asymptotically equivalent to the Johansen estimator (Stock and Watson, 1993).

Table 2. DOLS Estimates of long run equation

Variable	OLS	DOLS	
	Coefficient	Coefficient	p-value
Industrial Production Index	3.6124	4.1368	0.0000
US Real Exchange Rate	0.7270	0.5994	0.0000
Real International Interest Rate	-1.0907	-1.5452	0.0138
Real Dow Jones Index	-0.1299	-0.1086	0.0163
Time Trend	-0.0097	-0.0111	0.0000
Constant	-4.1659	-6.9366	0.0000

Before analyzing these results it is necessary to perform a cointegration test. If there exists no cointegration among variables, it is not possible to evaluate the estimates because of the spurious regression problem. As it is remarked by Choi et al. (2008), DOLS is employed in many applications but few cointegration tests have been developed for it. These authors propose a Hausman-type test but it does not allow for regressions with time trends as is the case of our model. Therefore, we use the test proposed by Shin (1994) which admits all kind of deterministic components. An interesting common feature of both tests is that their null hypothesis is the presence of cointegration, in contrast to the no cointegration null hypothesis of standard ADF-type tests. Shin (1994) and Ogaki and Park (1998) argue that cointegration is the desirable null hypothesis in several applications. The Shin cointegration test statistic takes the following expression when a constant and time trend are present in the long run equation,

$$C_{\tau} = T^{-2} \sum_{t=1}^T S_t^2 / s_{\tau}^2(l) \quad (28)$$

where $S_t = \sum_{j=1}^t \varepsilon_j$, ε_j are the DOLS residuals from equation (27), and T stands for the sample size. Finally, $s_{\tau}^2(l)$ is the semiparametric consistent estimator of the long run variance of ε_j . We find a value of 0.07796 for C_{τ} which is lower than the 2.5% critical value (0.088).¹⁴ Thus, there is evidence of cointegration among commodity prices and their determinants.¹⁵ Then, we can analyze the results showed in Table 2.

First, it is remarkable that all the variables are statistically significant and their signs are in line with the theoretical predictions. Next, regarding the value of the coefficients, we observe that a real devaluation (fall) of the dollar by 1% implies a 0.60% increase in commodity prices. This elasticity is lower than one in absolute value as suggested by the Ridle and Yandle (1972) model. It is also relevant to highlight the high elasticity of commodity prices to industrial production (4.13%). Stock market performance impacts negatively on the price of commodities. Along the findings by Domanski and Healt (2007), the substitution effect between the two asset

¹⁴ Shin (1994) provides the critical values for his cointegration test statistics.

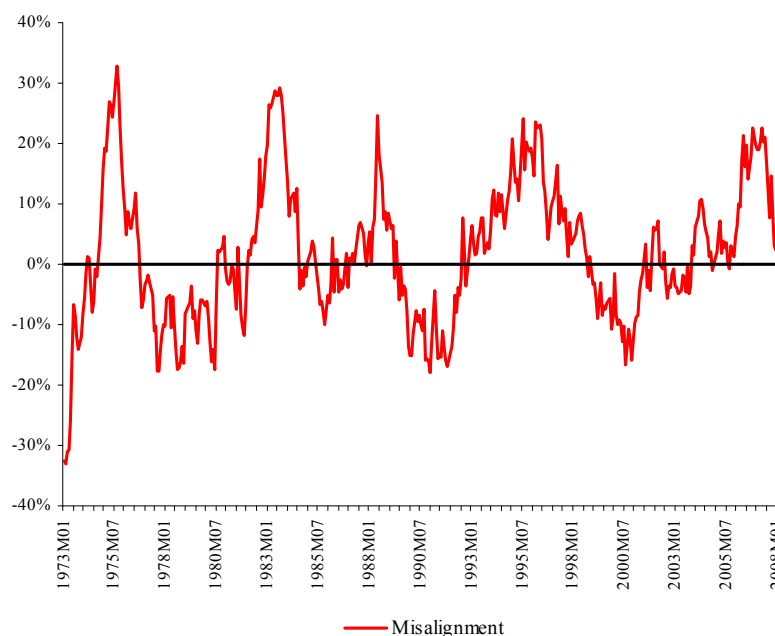
¹⁵ For robustness check, we carried out the standard ADF non-cointegration test based on OLS residuals and we rejected the null hypothesis of unit root residuals.

classes tends to predominate. As for the coefficient of the real interest rate, it is slightly bigger than -1 in absolute value (-1.09). Finally, the negative sign of the time trend supports the Prebisch-Singer hypothesis. This result corroborates the first sight intuition suggested by Figure 13, where declining real prices were observed. In Figure 14, actual and “equilibrium” price series are depicted while implied misalignment is portrayed in Figure 15.

Figure 14. Commodity price index: actual values and equilibrium (logarithmic scale)



Figure 15. Commodity prices: estimated misalignment



From both figures we emphasize the fact that the magnitude of the misalignments observed during 2006-2007 are similar to those observed in the previous years to the 1980s debt crisis and both Asian and Russian Crisis (roughly 20-25%). In the next section we will see how misalignment plays a dual role: as an adjustment variable of short term deviations, and as a potential determinant of the state.

6.3 The short-term model and nonlinear equilibrium adjustment

As it was stated in Section 5, testing the nonlinear equilibrium adjustment hypothesis requires estimating a linear model which acts as benchmark. To this end, we specify a linear symmetrical vector error correction model (VECM) using the previously calculated misalignment. The Akaike Information Criterion (AIC) suggests using five lags for the changes in the variables. In addition, under this specification the residuals do not present autocorrelation.¹⁶

The adjustment coefficient (α_{11} in equation (22)) takes a value of -0.01921 and is statistically significant at 10% when Newey-West HAC standard errors are considered. Thus, there is evidence that, at least in average, correcting forces emerge when commodity prices are in disequilibrium. However, as our theoretical model of section 4 predicts, it is really possible that there exist some states where misalignments are high and so correcting forces operate, while in other states characterized by low misalignments the gaps remain. This is the intuition behind the non-linear equilibrium adjustment hypothesis.

Once we have estimated the benchmark linear model, we carry out the linearity F-test on the commodity price equation as it was described in the methodological section. The auxiliary regression takes the specific following form:

$$\Delta P_t = \beta'_{0,p} \Delta X_{t-p} + v_1 M_{t-1} + \beta'_{1,p} \Delta X_{t-p} TV_{t-d} + v_2 M_{t-1} TV_{t-d} + \beta'_{2,p} \Delta X_{t-p} TD_{t-d}^2 + v_3 M_{t-1} TD_{t-d}^2 + \varpi_t \quad (29)$$

where $\Delta X = [l, \Delta P_{t-p}, \Delta RER_{t-p}, \Delta IR_{t-p}, \Delta PRO_{t-p}, \Delta DOW_{t-p}]$, TV_{t-d} stands for the transition variable, and $p; 1, \dots, 5$. Note the first two terms in equation (29) correspond to the linear specification of the commodity price equation (22) in the VECM model described above. As we have already stressed, our theoretical model suggests the regimes are governed by the size of misalignment. Thus, we propose as potentially transition variables five ones. One of them is simply the misalignment (M_{t-d}) and the others result from averaging out the current misalignment and those of the previous j periods (AV_{jt-d}), where j ranges from 1 to 4. Besides, we consider $d =$

¹⁶ We performed the Serial Correlation LM test with 12 lags and we failed to reject the null hypothesis of no autocorrelation at 5% statistical significance.

1,...,12 lags for each of them.¹⁷ Table 3 shows the test results for the ten variables which exhibit the lowest p-values.¹⁸

Table 3. Linearity F-test results

Transition Variable	Lag	LM Statistic	p-value
AV1	1	1.38647	0.04912
AV4	12	1.38309	0.05040
AV3	12	1.21178	0.16396
AV4	11	1.19485	0.18166
AV1	6	1.15964	0.22287
AV2	1	1.15512	0.22859
AV2	12	1.12511	0.26910
AV2	6	1.12423	0.27036
AV4	4	1.12396	0.27074
AV3	5	1.12106	0.27490

Remember that the null hypothesis is a linear adjustment in the commodity price equation (22). We find evidence of non-linearity in equation (22) at 5% static significance when the variable AVl_{t-1} is considered. That is, the regime in each moment t would be defined by the average value of the misalignments registered in $t - 1$ and $t - 2$. Therefore, we will estimate the non-linear system (22)-(26) considering AVl_{t-1} as transition variable. In Section 5, we have anticipated that it is necessary for this to provide proper initial conditions for all the coefficients of the system. Those conditions can be found by estimating the linear system which is obtained after fixing the value of the parameter γ in equation (22). Instead of carrying out a grid search, we select a value of γ such that the transition function averages 0.5 in the whole sample. Intuitively, this means that portfolio managers assign the same weight to both fundamentalist and chartist agent expectations in average. Consequently, the initial value of γ approximately should satisfy the following expression:

$$W_t = \frac{1}{T} \sum_{t=1}^T \{1 - \exp(-\gamma AVl_{t-1}^2)\} \cong \frac{1}{2} \quad (30)$$

We find that $\gamma = 133.77$ numerically solves (30) for the January 1973 to May 2008 period. Then, after setting γ at this value, the system (22)-(26) is estimated by SUR and initial conditions for all the coefficients are obtained. Once we have these conditions, we proceed estimating the unrestricted non-linear system also by SUR.¹⁹ In order to evaluate our hypothesis, analysis is centered in the adjustment coefficients of the commodity price equation, namely α_{11} and α_{12} . The linear error correction coefficient α_{11} appears not statistically significant

¹⁷ We do not test $TV_{t-1} = M_{t-1}$ because of perfect multicollinearity problem when system (22)-(26) is estimated.

¹⁸ This test was programmed on E-views. The code is available upon request.

¹⁹ The E-Views code used in this section is also available upon request to the authors.

(p-value=0.2914) and takes a positive value of 0.035. Contrary, the non-linear adjustment coefficient α_{12} is significant at 5% (p-value=0.0418) and is equal to -0.109. Moreover, the γ parameter reaches a magnitude of 55.22 with a p-value equal to 0.0292.

These estimations support our non-linear adjustment hypothesis due to heterogeneous agents in commodity markets.²⁰ To see this, we define the Global Equilibrium Correction Factor (GEC) as the two terms of the price equation (22) containing the price deviation from its long run equilibrium (M_{t-1}).

$$GEC = (0.035)M_{t-1} + (-0.109)M_{t-1} * w_t = \{(0.035) + (-0.109)w_t\}M_{t-1} \quad (31)$$

When misalignment is low enough (low regime), w_t tends to zero and the second term of (31) vanishes. In this case, portfolio managers mimic chartist investors and initial misalignment is widened at a 3.5% monthly rate. Under these circumstances, there is no equilibrium correction.

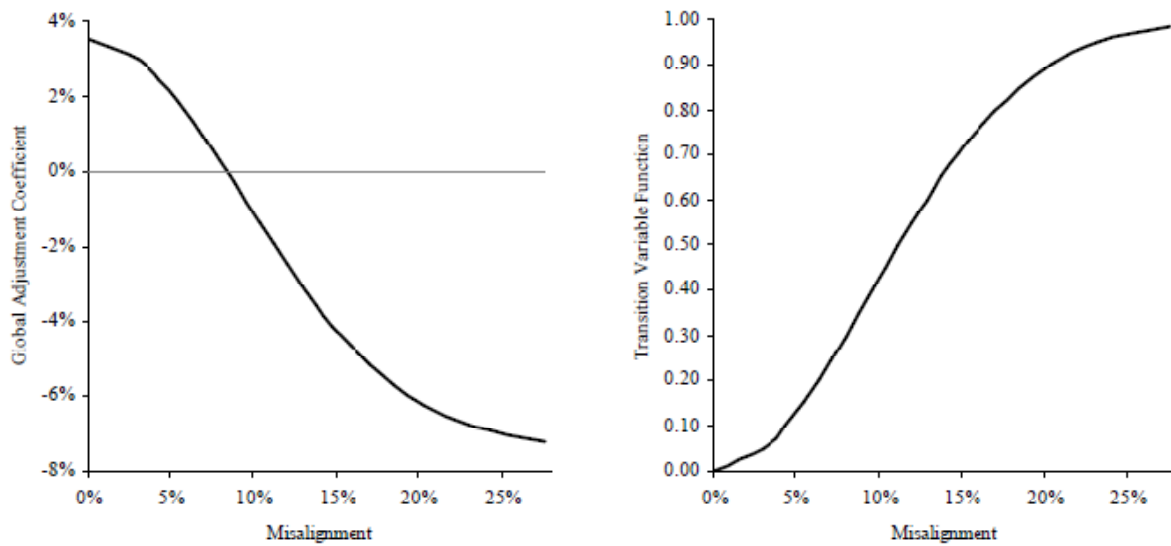
However, when the gap between actual and equilibrium prices reach a sizable value (high regime), w_t tends to one and the GEC adjustment coefficient attains a maximum of -0.074 ($= \alpha_{11} + \alpha_{12}$). Intuitively, portfolio managers assign a larger weight to fundamentalist investor expectations when misalignment is high and therefore we will observe price reversion toward the equilibrium.²¹

A key question is to determine what high and low commodity price misalignment means in our model. Figure 16 provides information to answer it. The LHS panel of Figure 16 reveals that price correction forces prevail in the market only when gap is larger than 8.5%. Considering the transition variable function (RHS panel), adjustment to equilibrium predominates when TVF (and w_t) exceeds 0.32. Furthermore, both panels show that non-linearity implies bigger adjustment coefficients, the higher the misalignment is. Maximum reversion speed (-7.4% monthly) is attained when spread between actual and fundamental commodity prices surpasses 25%.

²⁰ Most of the arguments will be stated considering positive misalignments, but the same applies for negative gaps because of the symmetry of exponential function.

²¹ Given that non-linear adjustment coefficient (α_{12}) is negative and larger than α_{11} in absolute terms, the overall stability of the price equation is guaranteed.

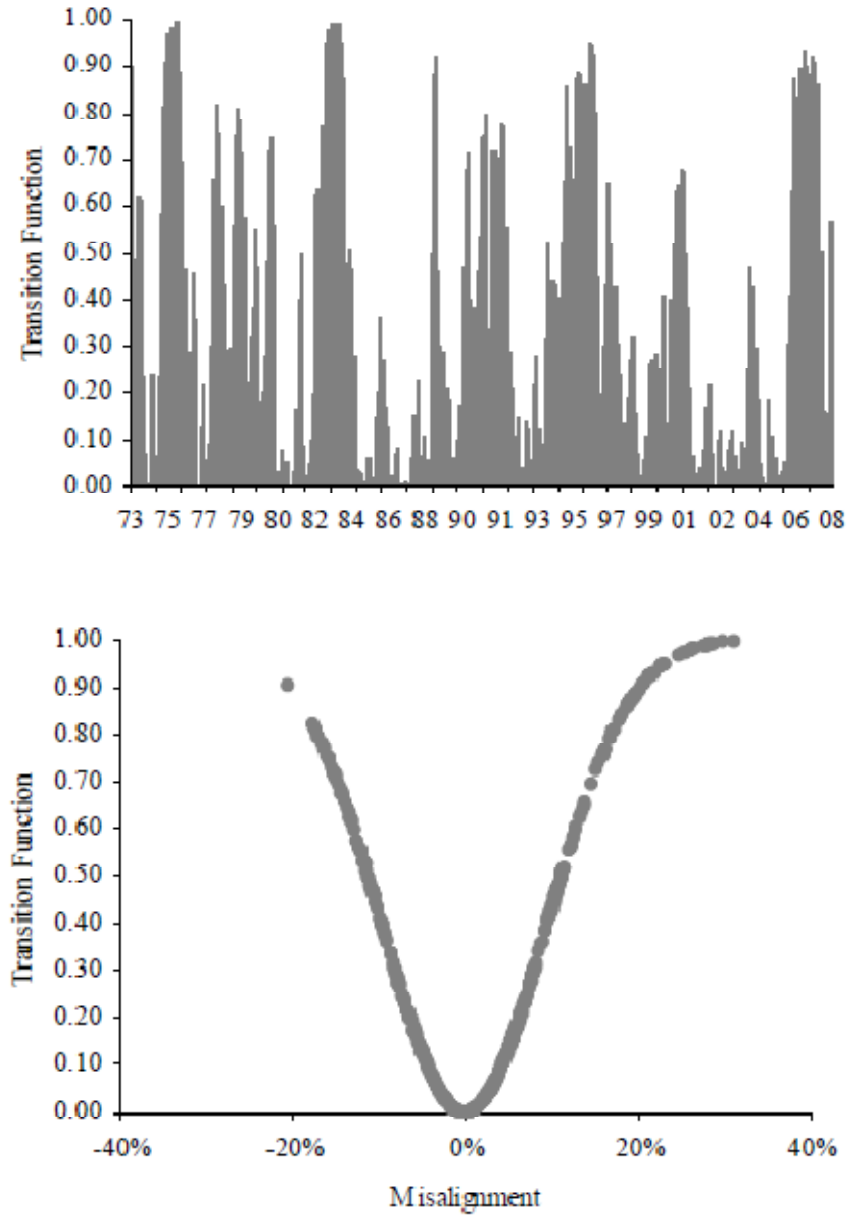
Figure 16. Misalignment, Transition Function And Global Adjustment Coefficient



The corollary is that higher misalignments in the past (measured by AVI_{t-1}) involve higher values of the transition function and this will indicate stronger future trend reversals. Finally, Figure 17 depicts the transition function in the period considered. In order to analyze the distribution of the states, we will assign observations to low regime if transition function takes values lower than 0.30 whereas we will consider they belong to high regime every time transition function exceeds 0.70.²² The remaining observations form the “transition regime”. Given this criterion, we find 56% of the time the market is dominated by chartists while fundamentalists only prevail about 18.85%. The rest of the time (25%) corresponds to transition periods.

²² These figures imply that global adjustment coefficient is positive in the low state and larger in absolute value than -4% in the high state.

Figure 17. Transition Function Over The 1973-2008 Sample



Transition function averages out to be 0.34 in the whole sample. Therefore, mean price change expected by portfolio managers is as follows

$$E(\Delta P_{t+1}^{PM}) = (1 - \bar{w}_t)E(\Delta P_{t+1}^C) + \bar{w}_t E(\Delta P_{t+1}^F) = 0.66E(\Delta P_{t+1}^C) + 0.34E(\Delta P_{t+1}^F) \quad (32)$$

The GEC coefficient associated to this figure is just -0.18%.

Summarizing, results support the hypothesis that high discrepancies between actual and equilibrium prices tend to be corrected relatively fast, while small misalignments tend to persist

over time without any endogenous correcting force taking place. In the next section we perform impulse-response analysis following the theoretical guidelines exposed in the fifth section.

6.4 Non-Linear Impulse Response Analysis

As it was stressed in the methodological section, in an exponential STAR model the effects of shocks depend on the history and size of disturbances.²³ These properties are not incorporated in traditional impulse response analysis. Before presenting the results we will indicate just two technical issues. In the first place, to carry out the generalized impulse response function of Koop et al. (1996) requires assigning each observation to different regimes. We do this adopting the same allocation criterion stated in the previous section. Then, sampling of shocks is performed.

Secondly, initial state is defined by the analyst but after shock takes place, it could endogenously change as consequence of the system dynamics. Figures 18 to 21 show the accumulated change of commodity prices to one-standard deviation shock in the fundamentals for both high and low initial misalignment states. In the Appendix the effects of three-standard deviation shocks are depicted. The dashed lines are the 10% confidence bands.

²³ This is the case when the transition function is an exponential function. If we had selected a logistic specification, the sign of the shock would also matter.

Figure 18. U.S. Effective Real Exchange Rate Shock

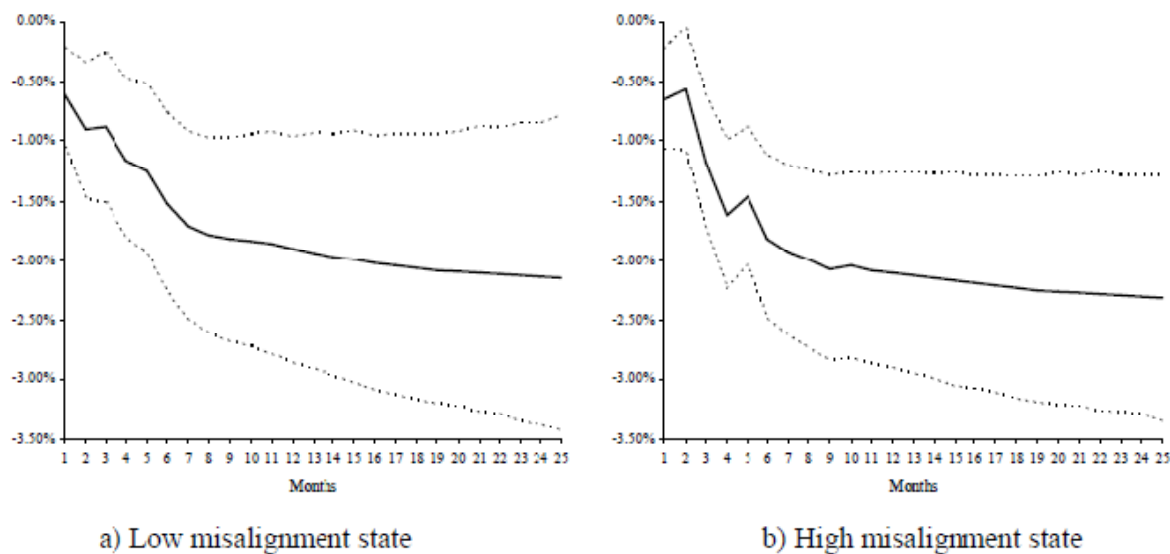


Figure 19. Industrial Production Shock

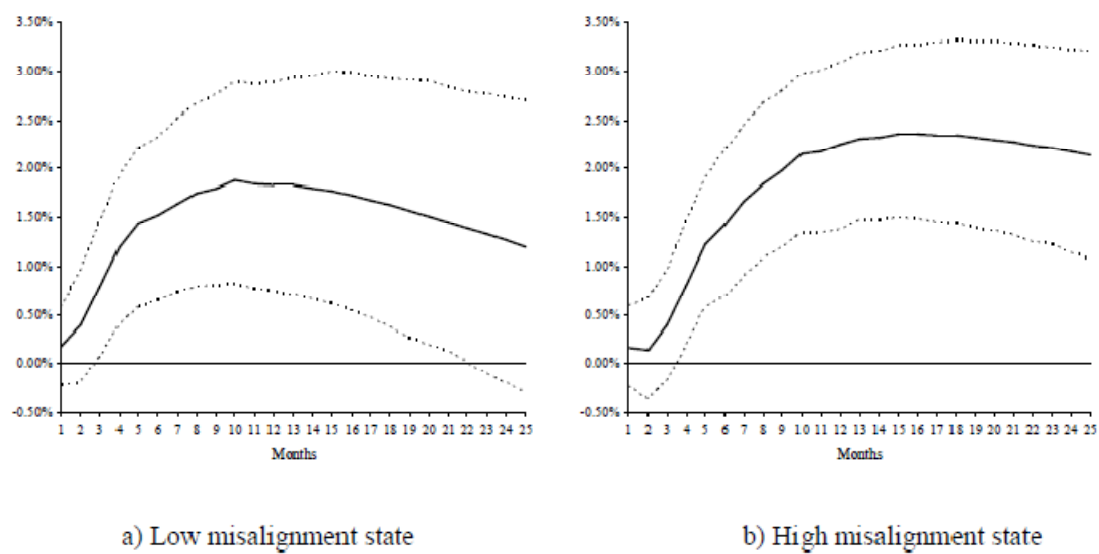
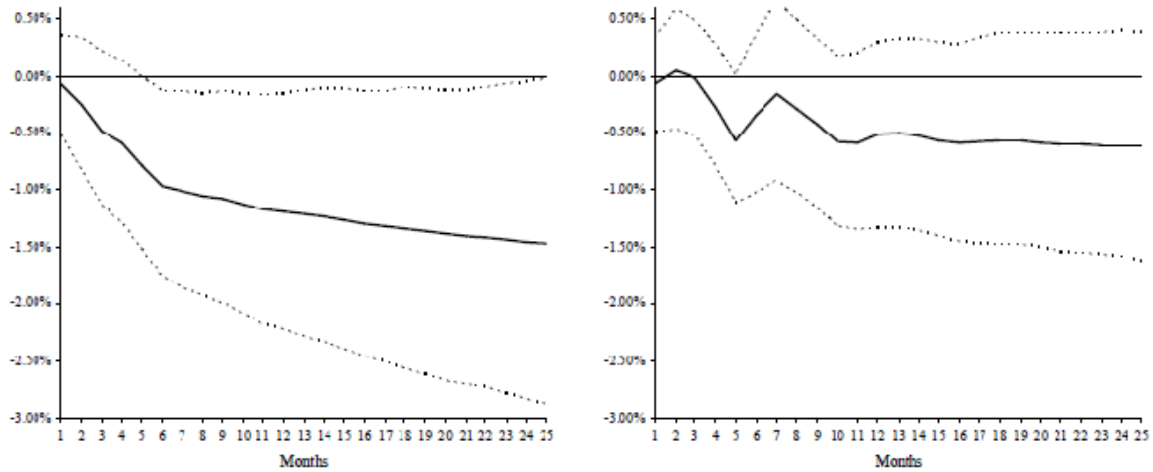


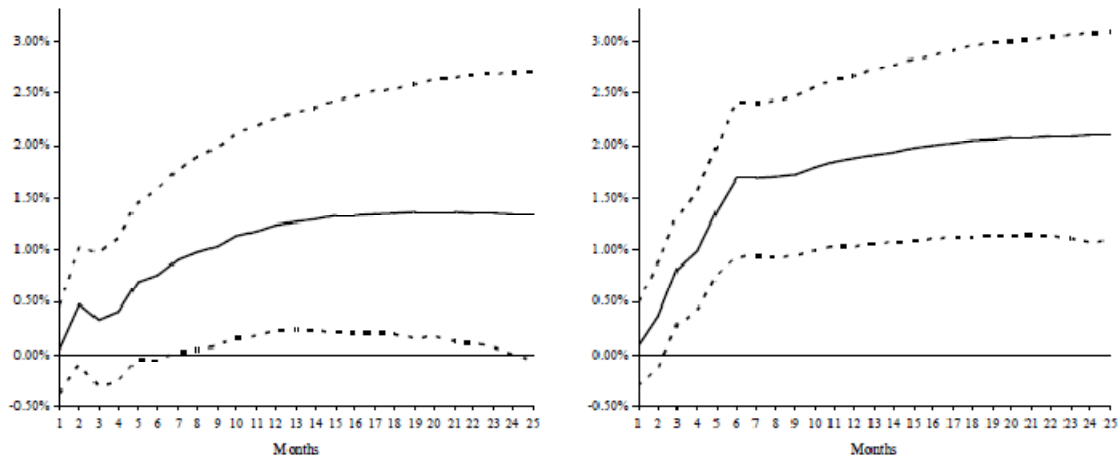
Figure 20. U.S. Real Interest Rate Shock



a) Low misalignment state

b) High misalignment state

Figure 21. Real Dow Jones Index



a) Low misalignment state

b) High misalignment state

The main conclusion we could draw from the figures is that, in general, the responses obtained are in line with both the theoretical predictions and the long-run relationship estimation. The only exception is that we find a positive impact of the Dow Jones index in the short run. Furthermore, it is noteworthy that price dynamics responses do not exhibit significant differences either the initial state is low or high. The effect of real interest rate shock differs from this general picture. If the shock occurs in the high regime, the commodity price reaction is minor and statistically non significant.

The same remarks apply when we study the consequences of bigger shocks (three-standard deviation). There are not important discrepancies when the effects of small and big shocks are compared, except for the interest rate shock response which becomes statistically significant whatever the initial regime is.

7. Conclusions and policy implications

From the policymaker perspective, the distinction between permanent and transitory movements in macroeconomic variables is one of the main challenges in order to make proper economic decisions. An important objective of applied economic models and empirical estimations is trying to give a consistent framework to rationalize those decisions. With this aim, we have proposed employing a non-linear multivariate STAR methodology to reach a better understanding of underlying causes for commodity price movements, once an explicit role for the financialization issue is incorporated.

It is appealing to think financialization is an amplifying factor of commodity price cycles. We develop a framework in which fundamentals and financialization interact each with other, treating speculative activity as an element that mainly affects short run price dynamics, but not the long run equilibrium.

This hypothesis appears satisfactory after summarizing the discussion regarding the financialization issue and showing evidence that it is not necessary to have neither commodity derivative markets nor strong net long positions of financial participants to experience a commodity price boom or a bust.

Thus, in our theoretical model, commodity fundamentals continue to be the only real force to forecast long run prices. However, heterogeneity in expectations among commodity market participants is important in determining the characteristics of the equilibrium adjustment.

Regarding fundamentals we have empirically confirmed some standard roles for macroeconomic variables, namely the real US exchange rate, aggregated industrial production as a proxy of world demand, and real international interest rates. We also verify a negative conditional correlation between our real commodity price index and the real return of stock markets. The short run dynamics shows the most remarkable results. Our findings support the idea that commodity prices tend to correct toward equilibrium, but this correction only takes place if past misalignment is sufficiently high. Thus, in the low misalignment regime, correcting forces do not prevail and prices can move in any direction, possibly depending on market sentiments.

Finally, regarding policy implications, we want to point out that for commodity-dependent developing countries, commodity price misalignments should be carefully monitored: price reversions tend to be abrupt when the gap between actual and fundamental price is higher than 20-25%. We cannot forget that commodities shape almost every macroeconomic policy stance in

these countries: from output growth and inflation to income distribution, national savings or fiscal revenues.

It is also important to note that factors affecting commodity prices (like real international interest rates and the real US exchange rate) are similar to those that influence capital flows. This explains why it is hard for developing countries to cushion terms of trade shocks with external finance. The same fundamentals that worsen terms of trade affect negatively the access to international credit markets. An appropriate policy mix should include in this case structural actions to smooth external cycles and alleviate commodity dependence when prices are at high levels.

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Appendix. Impulse-Response Analysis (Three Standard Deviation Shocks)

Figure A1. U.S. Effective Real Exchange Rate Shock

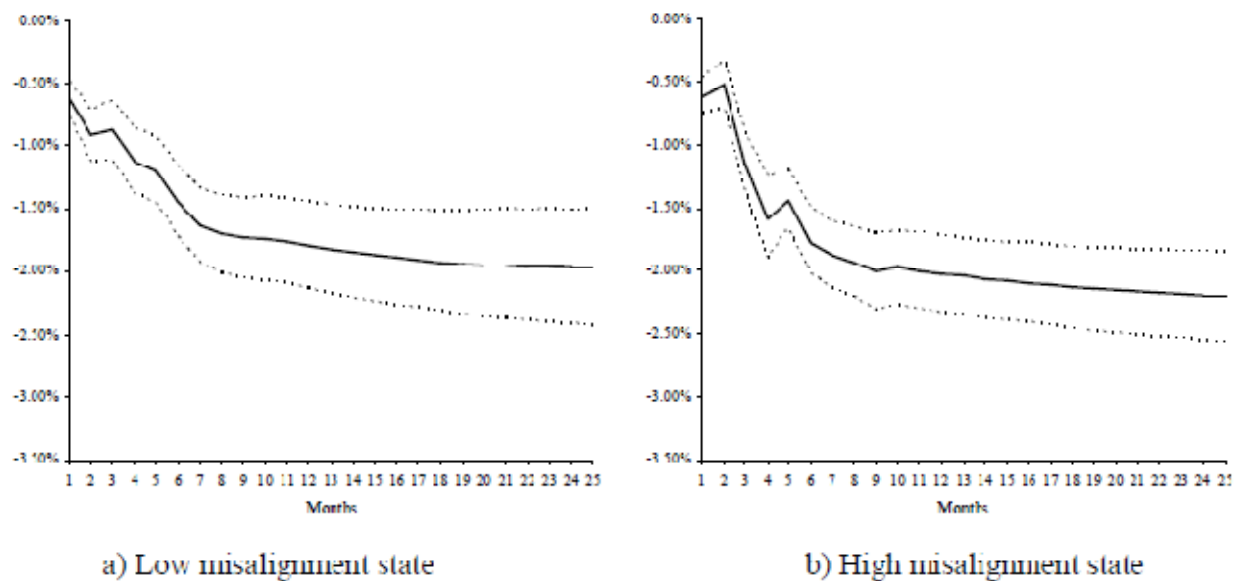


Figure A2. Industrial Production Shock

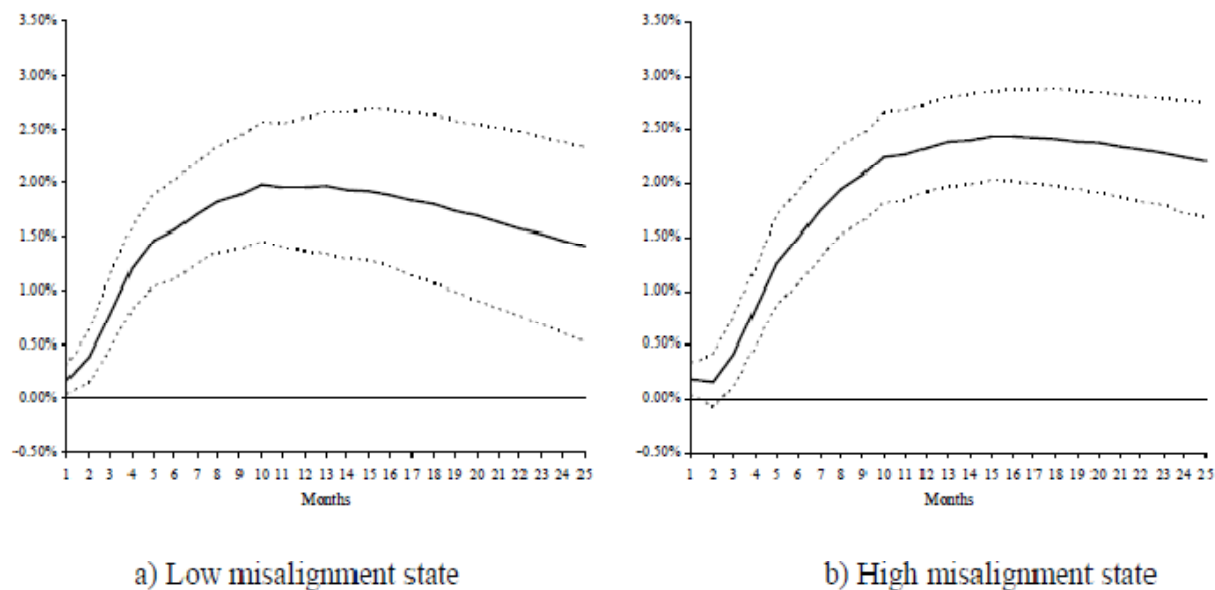
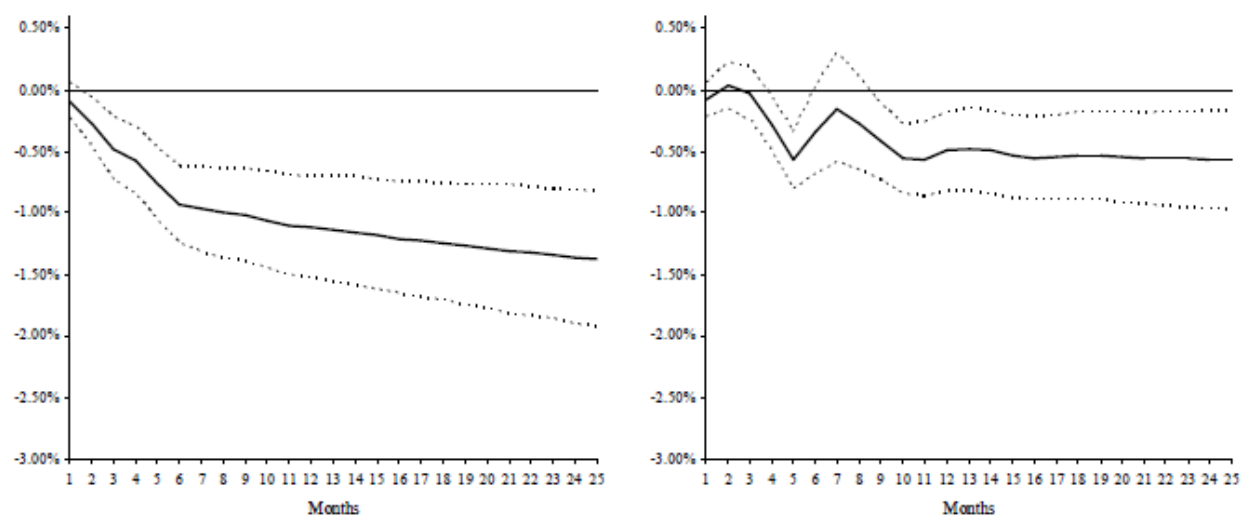


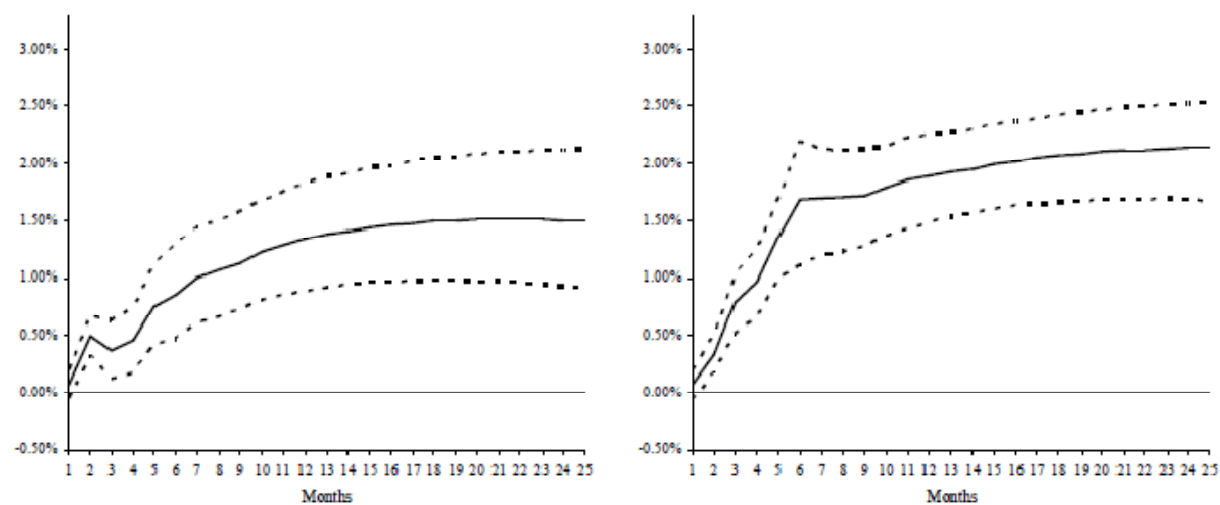
Figure A3. U.S. Real Interest Rate Shock



a) Low misalignment state

b) High misalignment state

Figure A4. Real Dow Jones Index Shock



a) Low misalignment state

b) High misalignment state

General Discussion

Agricultural Profitability in the 21st Century

*Jason Henderson, Moderator
Vice President and Omaha Branch Executive
Federal Reserve Bank of Kansas City*

Mr. Henderson: Why don't we talk about China and its growth in a long time period? What are some of the risks if China's growth doesn't materialize as we expect it?

Mr. Penn: That's a good question, Jason. What I tried to do in my presentation, as I said, is to rise to 30,000 feet and look at the fundamentals and I hope that is what I have done.

Lots of things can occur that will cause one to alter the outlook. There are things on the positive side that could occur – breakthroughs in technology and things of that nature. There are also things on the negative side. China is a big driver, as my numbers indicate, and there is concern about the pace of growth of the Chinese economy. It has been growing at near double digits for the past two decades. It grew about 12 percent in the first quarter of this year, the last reporting quarter. There are a lot of people who are very much concerned about an asset bubble. There are people who are concerned about the basic model of the Chinese economy. It's focused on the external sector for growth, but it needs to shift focus to the internal sector. Its currency may or may not be overvalued, depending upon who you listen to.

Any way you look at it, the ability of the Chinese economy, the ability of the authorities to manage that economy, is going to be a really key factor going ahead. Now I wouldn't bet against them. They have had a good track record. Look at how well they have done. Look at how well they did with the stimulus package. They are not a democracy, so they don't have to deal with a pesky Congress, 535 members who have their own agendas. So when they decide to do something, they can do it. If it is the right thing, then usually they are successful. So China is a big unknown. It is a big uncertainty. It is a big item to watch in the unfolding of the business environment for our industry.

Mr. Lortscher, Bern, Kansas: Gary Lortscher, former owner of a small ag business in a little town of Bern, Kansas. I am glad our lender was here to hear your positive future in the ag industry. I'm glad he was here to hear that. I have a couple of questions. [Question on African agriculture]

Mr. Penn: That too is a very interesting question and we could have a whole seminar on Africa.

First of all, we talk about Africa as one huge continent. As we all know, it is composed of many countries and the situation is very diverse. At Deere, we look at it as North Africa – Mediterranean-type agriculture – and that is assigned to Europe. Then we have Sub-Saharan

Africa, down to South Africa. We tend to look at that as a group. Then South Africa we look at as a separate entity.

You make a really good point in that I didn't say in my presentation, but of a lot of this new investment in Africa, some of it is by national governments. The Chinese have a lot of projects there, for instance. Some of it is by investor groups out of the Middle East. Some of it is by investor groups out of Brazil and a lot of other countries. Some of these projects focus on producing staple foods for the local market. Some of these others focus on producing cash crops for export markets. Others focus on producing food crops that go back to the home country of the investors.

When we have another crunch, it is going to be highly controversial. If you have a continent suffering from a shortage of food and you load boats and ship it somewhere else, it seems to me that is going to be very problematic. To the extent these investment projects are there and they are creating jobs and providing foodstuffs at reasonable prices to local markets – vegetable oil and things of that nature – then that is going to be a big plus.

There is a lot of question about stability in the Sub-Saharan African countries and in all the African countries. My sense now is that we have a perception of Africa as being a place in great turmoil. If you look at Africa as a continent, it is striving to be another one of these poles of growth. And Africa has been growing at 5 or 6 percent across the continent for the past several years. It slowed during the downturn for sure, but it is picking up again. There is more democracy, when you look at all the countries in Africa, than in a lot of the Asian regions. We hear a lot about famine and we hear a lot about the hostilities in a few particular places. But, again, Africa is a very big place. There is a lot of stability there and a number of those countries have turned around.

It is too important a potential market, if you are in the food and agricultural business, not to be there today. It may be a 15, 20, or 25-year play, but I don't think you can afford not to be there. If you aren't there, the Chinese are going to be there. It seems to me it is a country you have to pay a lot of attention to.

As to land titling, you are absolutely right. One of the biggest constraints on the continent is there is no secure system of land titling. We all know land is the asset used as collateral. It enables lending systems to thrive. So that is a big problem and it is being addressed a little bit but not nearly to the extent nor at the pace it needs to be to really spur agricultural development. Thank you.

Mr. Gabriel: Steve Gabriel at the Farm Credit Administration. I wonder if you could provide your views on the outlook in the future for the biofuels industry.

Mr. Penn: Steve, this is a Midwestern conference. Guys from the East Coast are not supposed to come here and ask questions. I'm surprised the organizers didn't tell you that. You have Bill Lapp and others who follow that far more closely than I do. As you know, that's a very complicated and controversial area. Today we have about a third of the corn crop being used for

corn ethanol. The EPA is considering increasing the allowable blend level, so we have that. We have a duty on this. We have a blenders' credit. We have a biodiesel credit that has lapsed. You know all of the complexities that are there. We have to see how the political situation shapes up. This is much more a political issue than it is an economics issue or than it is a markets issue. If you are going to forecast what happens to that industry, you have to be a political forecaster rather than a market forecaster or a market analyst, I think. There are people who are much better positioned to address this than I am, Steve. So I am going to let them handle that one for you.

Mr. Henderson: Dr. Penn, I'm Lynn Henderson, Publisher of Agri Marketing Magazine. How does a company like Deere view its future, given the diversity around the world? What product offerings and services do you expect to be involved with over the next five to ten years in this marketplace?

Mr. Penn: Thanks, Lynn. That is a question I can go on for some time about. Given the time constraints, I won't. We're in the farm equipment business. As you know, we are in the construction-equipment business, we are in the forestry-equipment business, we have a credit operation, and we are also very big in precision irrigation. It's all of those things we focus on as we look to the future. We've been around now for 174 years. Most of the people take that longevity as a pretty heavy burden. The senior leadership certainly wants to make sure the company continues in good health on their watch. So we are naturally focused on where the farming activity will be around the world in the future, over the next 10, 20, 30, and 40 years. Where will construction activity be, a lot of it infrastructure construction and things that relate directly to agriculture like farm-to-market roads and storage facilities that need construction equipment?

This also ties in directly with forestry equipment. That is why, as you may have heard, we have opened a new facility in Russia. Russia has more forestry sources than any other country on earth. So forestry goes right along with construction, housing, and development of infrastructure. Of course, you need to be able to finance all of that. That is our credit operation.

Where you are going to see farming activity, construction activity, and irrigation activity around the world, that's where we have to be looking as a multinational company.

Mr. Andrew: Dr. Penn, Jim Andrew, an Iowa corn and soybean farmer. I've spent a great deal of my life promoting those crops around the world and wondered if you have any idea as to how soon we can expect fortress Europe in the EU to approve biotech crops. The influence of that on starving countries and their ability or desire to import those crops to feed hungry mouths, in my sense, is morally irresponsible. What can we look forward to? I see some thawing, but what do you see?

Mr. Penn: I can certainly opine on that and will, but I also see Jim Borel from DuPont has finally made it. He follows this much more closely than I do. So you'll want to get him with the same question here a little later in the afternoon.

My sense is the same as yours. First, we have seen some thawing. We have seen some movement on acceptance of biotech by the governmental structures in the European Union. I don't know that the consumers are changing their mind a lot, but the governmental structures are moving in that direction.

Second, we are seeing the fundamentals I showed in my presentation, which certainly underscores the need for productivity enhancements, new technologies, and innovation. You can't deny biotechnology holds more promise than many other things we've seen.

Third, we've talked a lot about Africa. The per capita food production in Africa has actually been declining. In some part, it is because of the reluctance to accept GMOs in Africa. They are reluctant because they sell primarily to the European Union and the European Union says, "We don't want it."

So they discourage them from accepting it. I see that beginning to thaw, as well. There are a lot of activities on the African continent with AGRA, the new green revolution for Africa that involves Gates, Rockefeller, and others. So, at the ground-roots level, there is a lot of activity working on the science and on acceptance. Like you, I am optimistic. I can't predict a time certain, but my sense is that we'll get there.

Mr. Andrew: Is it possible that, in Europe, Greenpeace holds the moral high ground, but they really don't deserve it and over time it will erode, as we make the case for biotech being the helper of the world in feeding all the hungry?

Mr. Penn: My sense is that Greenpeace's stock went down a bit in 2008, when we had high food prices. When you get to the point of being very much concerned about food security, availability, and price of food, then this argument by Greenpeace and others begins to have a lot less appeal. It is one thing if you're talking about the rich EU where consumers can have a choice and can afford to pay for different kinds of products, than it is if you're spending 75 percent or more of your income for food and the price is rising. My sense is there is some movement there, as well. Thank you.

Mr. Henderson: One more question. We'll take one more question right now and then J.B. will be back with us after the next speaker to field more questions.

Mr. Gottschalk: My name is Andy Gottschalk, Denver, Colorado. If you could please, put the chart back up on the CRB Index. I noted with interest in the 1970s the CRB Index went from 100 to 325. We've just experienced a similar move percentagewise from 200 to 600. If we look at commodity prices historically over centuries, we see similar patterns, where prices spiked to new levels and then follow a pattern very similar to what we saw in the 1970s where we moved sideways for a lengthy period. What makes this time different than what we've seen before?

Mr. Penn: I said I knew there are many different interpretations of what's going on on that chart. So remember I said everybody gets to interpret it for themselves. Your interpretation is as good as the next person's. I suggested four things that have occurred, as I mentioned. It is new sources of demand we haven't had before. It is also the structural changes that have come about

quite slowly in the European Union, the United States, Australia, and New Zealand farm programs, for instance. It's the entrance of new money, hedge funds, and others into the agricultural and other commodity markets that probably wasn't there before.

Also, it is the markets taking a longer view of agricultural commodities than they used to take. For instance, we used to produce a corn crop in the fall and then the markets focused mostly on how we were going to use that crop over the course of the next few months until the next crop.

Today, you notice the futures markets look out a lot farther than they used to and they are more concerned about this just-in-time inventory situation about the crop status in North America and then it shifts to focus on the crop status in South America. So I think the markets are taking a longer view. That makes people look at these price trends different than they used to and may alter their investment behavior.

Those were my suggestions as to why this is occurring. You've had structural changes – the demand one being the biggest of course. But you are right. Oil is 26 percent of this. Back in the 1970s you'll remember we had another little difficult period with petroleum at some point. That can have an impact on this.

Mr. Henderson: We just heard a presentation, where Jorge talked about how portfolio managers are switching between futurists and chartists and have the short-term fluctuations. Here in the United States we are undertaking financial reform. A big topic of that are derivatives. What are your thoughts on the regulation of derivatives and how does this impact agriculture?

Mr. Carrera: I was following also into the G-20 as a representative of the Central Bank of Argentina this discussion about the relative participation of nonfinancial investors. The role of futures markets is important in order to have a good setup for investment in the long run. Markets are very good in order to discover, as J.B. Penn said, and to introduce a lot of information into the decision of the producer.

It is clear, for example, naked short selling could be damaging for the stability of the market. Into the political decision of the G-20 and the Financial Stability Board, these two boards are trying to find a compromise between some European countries, like Germany and France that are highly against short selling and more importantly against the participation of noncommercial traders in this market. The position of England – the United Kingdom – is to maintain things more or less like this now. In some cases it is important to regulate and to put some limits on the act of short selling.

General Discussion

Agricultural Profitability in the 21st Century

*Jason Henderson, Moderator
Vice President and Omaha Branch Executive
Federal Reserve Bank of Kansas City*

Mr. Henderson: Why don't we talk about China and its growth in a long time period? What are some of the risks if China's growth doesn't materialize as we expect it?

Mr. Penn: That's a good question, Jason. What I tried to do in my presentation, as I said, is to rise to 30,000 feet and look at the fundamentals and I hope that is what I have done.

Lots of things can occur that will cause one to alter the outlook. There are things on the positive side that could occur – breakthroughs in technology and things of that nature. There are also things on the negative side. China is a big driver, as my numbers indicate, and there is concern about the pace of growth of the Chinese economy. It has been growing at near double digits for the past two decades. It grew about 12 percent in the first quarter of this year, the last reporting quarter. There are a lot of people who are very much concerned about an asset bubble. There are people who are concerned about the basic model of the Chinese economy. It's focused on the external sector for growth, but it needs to shift focus to the internal sector. Its currency may or may not be overvalued, depending upon who you listen to.

Any way you look at it, the ability of the Chinese economy, the ability of the authorities to manage that economy, is going to be a really key factor going ahead. Now I wouldn't bet against them. They have had a good track record. Look at how well they have done. Look at how well they did with the stimulus package. They are not a democracy, so they don't have to deal with a pesky Congress, 535 members who have their own agendas. So when they decide to do something, they can do it. If it is the right thing, then usually they are successful. So China is a big unknown. It is a big uncertainty. It is a big item to watch in the unfolding of the business environment for our industry.

Mr. Lortscher, Bern, Kansas: Gary Lortscher, former owner of a small ag business in a little town of Bern, Kansas. I am glad our lender was here to hear your positive future in the ag industry. I'm glad he was here to hear that. I have a couple of questions. [Question on African agriculture]

Mr. Penn: That too is a very interesting question and we could have a whole seminar on Africa.

First of all, we talk about Africa as one huge continent. As we all know, it is composed of many countries and the situation is very diverse. At Deere, we look at it as North Africa – Mediterranean-type agriculture – and that is assigned to Europe. Then we have Sub-Saharan

Africa, down to South Africa. We tend to look at that as a group. Then South Africa we look at as a separate entity.

You make a really good point in that I didn't say in my presentation, but of a lot of this new investment in Africa, some of it is by national governments. The Chinese have a lot of projects there, for instance. Some of it is by investor groups out of the Middle East. Some of it is by investor groups out of Brazil and a lot of other countries. Some of these projects focus on producing staple foods for the local market. Some of these others focus on producing cash crops for export markets. Others focus on producing food crops that go back to the home country of the investors.

When we have another crunch, it is going to be highly controversial. If you have a continent suffering from a shortage of food and you load boats and ship it somewhere else, it seems to me that is going to be very problematic. To the extent these investment projects are there and they are creating jobs and providing foodstuffs at reasonable prices to local markets – vegetable oil and things of that nature – then that is going to be a big plus.

There is a lot of question about stability in the Sub-Saharan African countries and in all the African countries. My sense now is that we have a perception of Africa as being a place in great turmoil. If you look at Africa as a continent, it is striving to be another one of these poles of growth. And Africa has been growing at 5 or 6 percent across the continent for the past several years. It slowed during the downturn for sure, but it is picking up again. There is more democracy, when you look at all the countries in Africa, than in a lot of the Asian regions. We hear a lot about famine and we hear a lot about the hostilities in a few particular places. But, again, Africa is a very big place. There is a lot of stability there and a number of those countries have turned around.

It is too important a potential market, if you are in the food and agricultural business, not to be there today. It may be a 15, 20, or 25-year play, but I don't think you can afford not to be there. If you aren't there, the Chinese are going to be there. It seems to me it is a country you have to pay a lot of attention to.

As to land titling, you are absolutely right. One of the biggest constraints on the continent is there is no secure system of land titling. We all know land is the asset used as collateral. It enables lending systems to thrive. So that is a big problem and it is being addressed a little bit but not nearly to the extent nor at the pace it needs to be to really spur agricultural development. Thank you.

Mr. Gabriel: Steve Gabriel at the Farm Credit Administration. I wonder if you could provide your views on the outlook in the future for the biofuels industry.

Mr. Penn: Steve, this is a Midwestern conference. Guys from the East Coast are not supposed to come here and ask questions. I'm surprised the organizers didn't tell you that. You have Bill Lapp and others who follow that far more closely than I do. As you know, that's a very complicated and controversial area. Today we have about a third of the corn crop being used for

corn ethanol. The EPA is considering increasing the allowable blend level, so we have that. We have a duty on this. We have a blenders' credit. We have a biodiesel credit that has lapsed. You know all of the complexities that are there. We have to see how the political situation shapes up. This is much more a political issue than it is an economics issue or than it is a markets issue. If you are going to forecast what happens to that industry, you have to be a political forecaster rather than a market forecaster or a market analyst, I think. There are people who are much better positioned to address this than I am, Steve. So I am going to let them handle that one for you.

Mr. Henderson: Dr. Penn, I'm Lynn Henderson, Publisher of Agri Marketing Magazine. How does a company like Deere view its future, given the diversity around the world? What product offerings and services do you expect to be involved with over the next five to ten years in this marketplace?

Mr. Penn: Thanks, Lynn. That is a question I can go on for some time about. Given the time constraints, I won't. We're in the farm equipment business. As you know, we are in the construction-equipment business, we are in the forestry-equipment business, we have a credit operation, and we are also very big in precision irrigation. It's all of those things we focus on as we look to the future. We've been around now for 174 years. Most of the people take that longevity as a pretty heavy burden. The senior leadership certainly wants to make sure the company continues in good health on their watch. So we are naturally focused on where the farming activity will be around the world in the future, over the next 10, 20, 30, and 40 years. Where will construction activity be, a lot of it infrastructure construction and things that relate directly to agriculture like farm-to-market roads and storage facilities that need construction equipment?

This also ties in directly with forestry equipment. That is why, as you may have heard, we have opened a new facility in Russia. Russia has more forestry sources than any other country on earth. So forestry goes right along with construction, housing, and development of infrastructure. Of course, you need to be able to finance all of that. That is our credit operation.

Where you are going to see farming activity, construction activity, and irrigation activity around the world, that's where we have to be looking as a multinational company.

Mr. Andrew: Dr. Penn, Jim Andrew, an Iowa corn and soybean farmer. I've spent a great deal of my life promoting those crops around the world and wondered if you have any idea as to how soon we can expect fortress Europe in the EU to approve biotech crops. The influence of that on starving countries and their ability or desire to import those crops to feed hungry mouths, in my sense, is morally irresponsible. What can we look forward to? I see some thawing, but what do you see?

Mr. Penn: I can certainly opine on that and will, but I also see Jim Borel from DuPont has finally made it. He follows this much more closely than I do. So you'll want to get him with the same question here a little later in the afternoon.

My sense is the same as yours. First, we have seen some thawing. We have seen some movement on acceptance of biotech by the governmental structures in the European Union. I don't know that the consumers are changing their mind a lot, but the governmental structures are moving in that direction.

Second, we are seeing the fundamentals I showed in my presentation, which certainly underscores the need for productivity enhancements, new technologies, and innovation. You can't deny biotechnology holds more promise than many other things we've seen.

Third, we've talked a lot about Africa. The per capita food production in Africa has actually been declining. In some part, it is because of the reluctance to accept GMOs in Africa. They are reluctant because they sell primarily to the European Union and the European Union says, "We don't want it."

So they discourage them from accepting it. I see that beginning to thaw, as well. There are a lot of activities on the African continent with AGRA, the new green revolution for Africa that involves Gates, Rockefeller, and others. So, at the ground-roots level, there is a lot of activity working on the science and on acceptance. Like you, I am optimistic. I can't predict a time certain, but my sense is that we'll get there.

Mr. Andrew: Is it possible that, in Europe, Greenpeace holds the moral high ground, but they really don't deserve it and over time it will erode, as we make the case for biotech being the helper of the world in feeding all the hungry?

Mr. Penn: My sense is that Greenpeace's stock went down a bit in 2008, when we had high food prices. When you get to the point of being very much concerned about food security, availability, and price of food, then this argument by Greenpeace and others begins to have a lot less appeal. It is one thing if you're talking about the rich EU where consumers can have a choice and can afford to pay for different kinds of products, than it is if you're spending 75 percent or more of your income for food and the price is rising. My sense is there is some movement there, as well. Thank you.

Mr. Henderson: One more question. We'll take one more question right now and then J.B. will be back with us after the next speaker to field more questions.

Mr. Gottschalk: My name is Andy Gottschalk, Denver, Colorado. If you could please, put the chart back up on the CRB Index. I noted with interest in the 1970s the CRB Index went from 100 to 325. We've just experienced a similar move percentagewise from 200 to 600. If we look at commodity prices historically over centuries, we see similar patterns, where prices spiked to new levels and then follow a pattern very similar to what we saw in the 1970s where we moved sideways for a lengthy period. What makes this time different than what we've seen before?

Mr. Penn: I said I knew there are many different interpretations of what's going on on that chart. So remember I said everybody gets to interpret it for themselves. Your interpretation is as good as the next person's. I suggested four things that have occurred, as I mentioned. It is new sources of demand we haven't had before. It is also the structural changes that have come about

quite slowly in the European Union, the United States, Australia, and New Zealand farm programs, for instance. It's the entrance of new money, hedge funds, and others into the agricultural and other commodity markets that probably wasn't there before.

Also, it is the markets taking a longer view of agricultural commodities than they used to take. For instance, we used to produce a corn crop in the fall and then the markets focused mostly on how we were going to use that crop over the course of the next few months until the next crop.

Today, you notice the futures markets look out a lot farther than they used to and they are more concerned about this just-in-time inventory situation about the crop status in North America and then it shifts to focus on the crop status in South America. So I think the markets are taking a longer view. That makes people look at these price trends different than they used to and may be alters their investment behavior.

Those were my suggestions as to why this is occurring. You've had structural changes – the demand one being the biggest of course. But you are right. Oil is 26 percent of this. Back in

the 1970s you'll remember we had another little difficult period with petroleum at some point. That can have an impact on this.

Mr. Henderson: We just heard a presentation, where Jorge talked about how portfolio managers are switching between futurists and chartists and have the short-term fluctuations. Here in the United States we are undertaking financial reform. A big topic of that are derivatives. What are your thoughts on the regulation of derivatives and how does this impact agriculture?

Mr. Carrera: I was following also into the G-20 as a representative of the Central Bank of Argentina this discussion about the relative participation of nonfinancial investors. The role of futures markets is important in order to have a good setup for investment in the long run. Markets are very good in order to discover, as J.B. Penn said, and to introduce a lot of information into the decision of the producer.

It is clear, for example, naked short selling could be damaging for the stability of the market. Into the political decision of the G-20 and the Financial Stability Board, these two boards are trying to find a compromise between some European countries, like Germany and France that are highly against short selling and more importantly against the participation of noncommercial traders in this market. The position of England – the United Kingdom – is to maintain things more or less like this now. In some cases it is important to regulate and to put some limits on the act of short selling.



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Session 2:
Reshaping Global Agricultural Production

Reshaping Agricultural Production: Geography, Farm Structure, and Finances

James M. MacDonald, Eric O'Donoghue, and Robert A. Hoppe¹
Economic Research Service
U.S. Department of Agriculture

This session announces an enormous topic, *Reshaping Global Agricultural Production*. We are not going to try to cover all that the session title implies, but will focus on a few topics that we can be informative about. Much of what we have to say will draw on USDA data and analyses.

First, we discuss likely changes in the location of global production in the next decade, drawing on USDA annual baseline projections. The USDA projections are far from certain, but they are a good reflection of the consensus views of some well-informed people, and the global macroeconomic assumptions underlying the projections provide a good starting point for thinking about alternative futures in a reasonably disciplined way.

Second, we summarize the major ongoing changes in U.S. farm structure, as well as the reasons for those changes and their likely impacts. Those changes are obscured in aggregate farm statistics and may not be widely known, so we spend some time on them. We use farm-level data from the Census of Agriculture, as well as annual farm-level data drawn from the Agricultural Resource Management Survey (ARMS), USDA's primary source of data on farm finances, farm production practices, and farm household well-being.²

Third, we touch on changing farm structure in some other countries. The U.S. looms large in most discussions of farm structure, partly because of the size of the U.S. agricultural sector but also because of the deep reservoir of U.S. farm data. Recent efforts to develop databases on farm structure in other countries have softened that judgment, and we draw on those data in this analysis.

Finally, changes in U.S. farm structure are tied to changes in how farms access capital for the enterprise, and how farms arrange for the sale of their output. We discuss the impacts of the financial crisis and swings in farm prices on farm financial arrangements and farm structure.

¹ The views expressed herein are those of the authors, and do not represent the views of the U.S. Department of Agriculture.

² ARMS is a large annual survey directed to over 30,000 farms, with 21-22,000 useable responses in each year. The sample is designed to be representative of all U.S. agriculture, and a major strength of the survey is that it links production, production practices, and marketing decisions to farm financial measures.

The Big Picture: USDA Baseline Projections

USDA produces annual baseline projections, ten years ahead, for global agricultural production and trade.³ This is a useful starting place for thinking about some key drivers of structural change, and their impacts on the geographic organization of production.

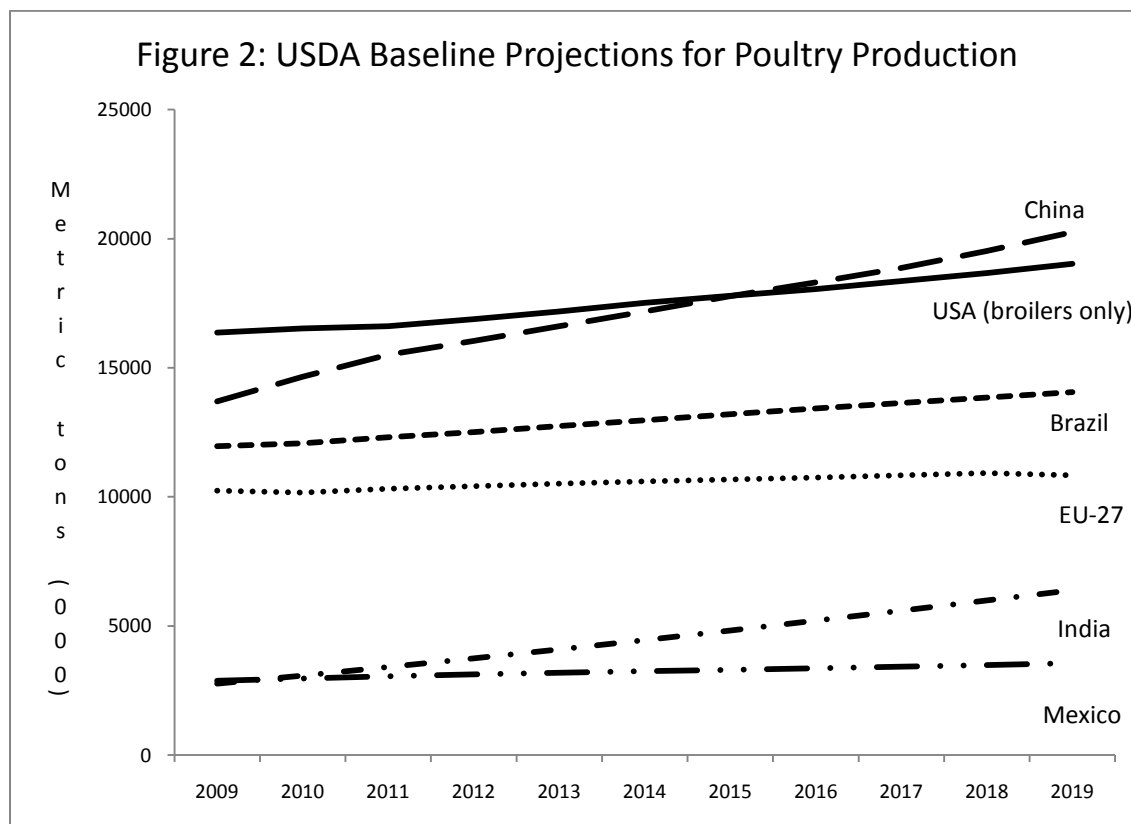
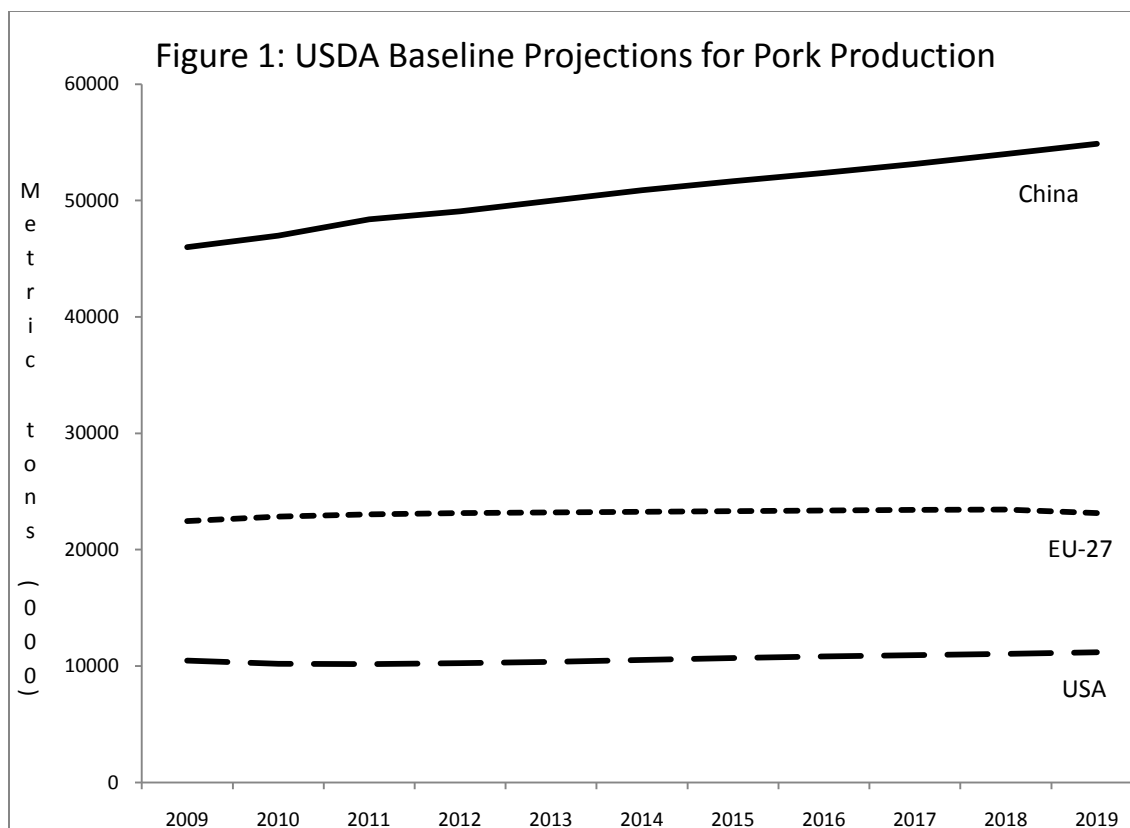
Baseline projections are a conditional, long-run, scenario: a Departmental consensus about what would be expected to happen under a continuation of current policies, normal weather, and specific assumptions about international and U.S. macroeconomic conditions and agricultural productivity growth. For our purposes, the key assumptions include:

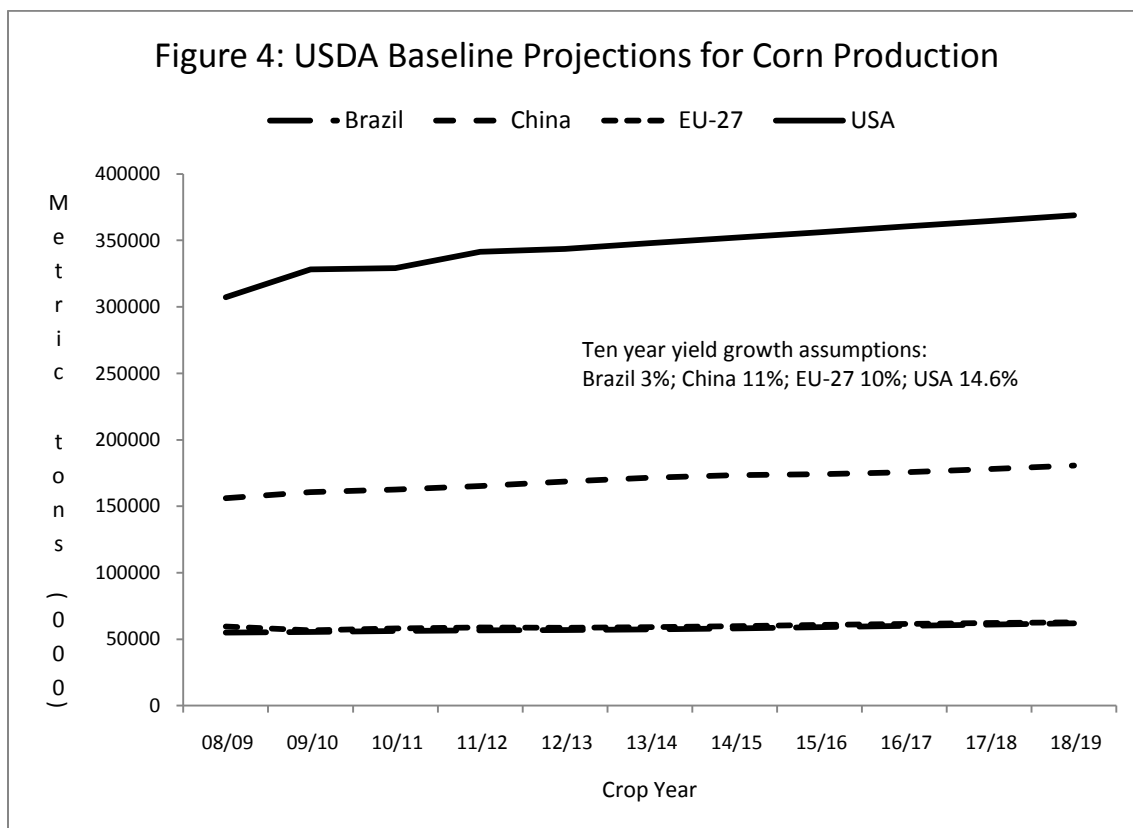
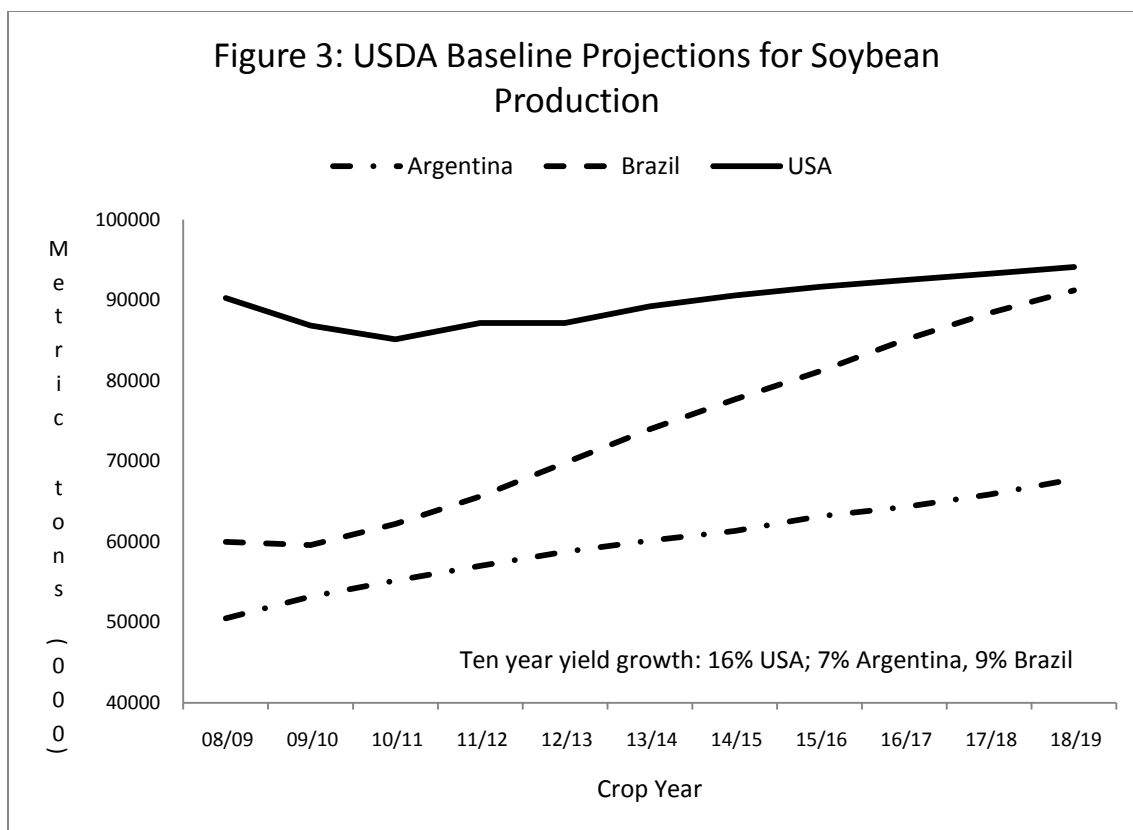
- A rebound of global economic growth to an annual average of 3.3 percent, and a resumption of high growth rates in China and India.
- Real increases in crude oil prices, with refiner acquisition costs projected to be \$100 per barrel by the end of the period.
- No change in biofuels policies, and continued growth in the ethanol industry.
- Corn, wheat, and soybean prices remain historically high, with farm-gate prices of \$3.65, \$4.75, and \$9.20 per bushel, respectively, at the 2019 projection.
- The U.S. dollar is projected to depreciate through the projection period, and thus will continue to positively impact U.S. exports.

Economic growth in China and India will drive significant increases in their meat consumption, and those dietary changes will have major impacts on global agricultural production and trade. Figures 1-4 illustrate several structural impacts likely to arise from expanded global meat consumption, and the associated expansion in animal feed production. While Indian and Chinese meat imports increase, expanded consumption is largely fueled by domestic production, with Chinese pork production projected to grow 19 percent between 2009 and 2019, compared to 7 and 3 percent in the U.S. and the EU, respectively (Figure 1). Similarly, growing poultry consumption will be met largely by domestic production (Figure 2), with major 2009-2019 increases projected in China (48 percent) India (130 percent), and Brazil (23 percent).

While USDA projects increased Chinese soybean production, most of the derived demand for soybeans will be met through imports. In turn, USDA projects a major expansion of soybean production in Argentina and Brazil, accomplished largely through expanded acreage, with projected 2118/19 acreage nearly a third greater than the 97.6 million acres in the two countries in 2008/09 (Figure 3). While Chinese corn imports are expected to grow, domestic production is projected to account for most of the increase in corn use in China. In turn, the U.S. and the EU are projected to expand corn production, but the USDA projection does not envision major structural changes (Figure 4).

³ We rely on the baseline projections for 2010-2019, issued in February, 2010, at <http://www.ers.usda.gov/Publications/OCE101/OCE101.pdf>





The USDA projections point clearly to two major changes in the geography of global agricultural production in the next decade: major expansions of domestic poultry production in developing countries and of soybean production in South America. The USDA projections also point to sharp increases in U.S. production, exports, and imports of horticultural products (fruits, vegetables, and tree nuts). USDA projects a 10 percent increase in US acreage, with most of the increase in fruits and tree nuts, and a 30 percent increase in import volume. This sector has seen important shifts in recent years, with U.S. and European supermarket chains organizing global procurement networks relying on a tight degree of vertical coordination. The projections suggest that we will see a greater shift in this direction.

Structural Change at Ground Level: Farm Organization in the U.S.

In the U.S., structural change at the farm level encompasses three closely interrelated features: larger farms; more complex farm business organizations; and more formal contracting in place of cash market relationships.

Production is steadily moving to larger farms in most livestock and crop commodities. But the magnitude of the shift can be obscured in aggregated statistical summaries by another feature of U.S. farm structure--the growing number of very small farms. We outline the aggregate shift with Census of Agriculture data (Table 1). There, a farm is defined as a place that produces, or normally would produce, \$1,000 in farm commodities. In 2007, 60 percent of the 2.2 million U.S. farms had sales below \$10,000, and just over half of those were below \$1,000 (Table 1).⁴ In contrast, the 55,500 farms (2.5 percent of the total) with sales of at least \$1 million accounted for 59 percent of U.S. production.

Table 1: Changes in U.S. Farm Structure, 1982-2007

	Farms		Market Value of Sales (millions of 2007 \$)	
	1982	2007	1982	2007
Total	2,240,976	2,204,793	189,151	297,220
Sales Class	-Distribution of farms and sales, by sales class-			
Less than \$10,000	42.6	59.8	1.8	0.9
\$10,000-\$249,999	50.8	30.7	40.8	14.2
\$250,000-\$999,999	5.9	7.0	30.0	25.7
\$1,000,000 or more	0.7	2.5	27.4	59.2
All	100.0	100.0	100.0	100.0

Source: USDA National Agricultural Statistics Service, Census of Agriculture

Notes: Values for sales in 1982 are adjusted to 2007 dollars using the Producer Price Index for Farm products.

⁴ Places that do not have \$1,000 in sales can meet the threshold because they have assets, such as inventories of animals or holdings of cropland, which would normally produce at least \$1,000 in sales if the farm sold crops or animals (USDA/NASS, 2009; O'Donoghue, et al., 2009).

Table 1 also shows how farm sizes changed between 1982 and 2007. We measure farm size by agricultural sales, and adjust all 1982 sales figures for price changes, to compare distributions in constant-dollar values. The aggregate number of U.S. farms, 2.24 million in 1982, fell slightly to 2.20 million in 2007. But that seeming stability masked major changes. The number of small commercial farms (sales of \$10,000-\$250,000) fell by over 40 percent, but the number of farms with less than \$10,000 in 2007 sales increased sharply, as did the number with sales of \$1 million or more, whose numbers grew by 243 percent (Table 1).⁵

This hollowing-out of the middle shows up in production numbers as well. Farms with at least \$1 million in sales (2007 dollars) increased their share of production by 30 percentage points between 1982 and 2007, while the share held by small commercial farms fell by 27 percentage points.⁶

Enterprise data—for specific commodities on farms—also show major shifts to larger farms. We can use physical measures of production, such as bushels, harvested acreage, or animals, to measure size in enterprise statistics without the need for adjustments for price changes. However, because production is so highly skewed, simple mean comparisons of enterprise size are not very informative. To understand the issue, consider Table 2, with measures of average enterprise size for dairy and tomatoes.

Table 2: Comparing Measures of Average Size for Two Commodity Enterprises

	1987	1997	2007
Dairy			
Mean herd size (cows)	61	78	133
Weighted median	80	140	570
Tomatoes			
Mean harvested acres	26	29	17
Weighted median	400	589	820

Source: USDA National Agricultural Statistics Service, Census of Agriculture

Mean dairy herd size—the number of milk cows divided by the number of farms with cows—was 61 cows in 1987, and it grew to 133 by 2007, as small dairies exited. For contrast, we identify an average size from the point of view of production: the median of the distribution of cows by herd size. At this weighted median, half of all milk cows are in smaller herds and half are in larger herds. The weighted median wasn't much higher than the simple mean in 1987 (80,

⁵ Some of the increase in very small farms reflected inflation. The USDA farm definition is not adjusted for inflation, and it therefore took fewer animals or acres to qualify as a farm in 2007 than in 1982. But the increase also reflects USDA methodological changes designed to more effectively locate and identify such farms, and as well as an actual increase in rural residences (USDA/NASS, 2009, p. 31).

⁶ Almost all of the growth in large farm sales is accounted for by more farms, rather than increases in the size of large farms—real sales per farm increased very little.

versus 61). But the weighted median increased more than six-fold, to 570, in the next 20 years. By 2007, most cows and most production occurred on farms that were far larger than 133 head, and the weighted median provides us with a useful way to track structural change in production.

Tomatoes provide a striking example. Mean size fell from 26 acres in 1987 to 17 in 2007. Most production occurs on much larger farms: the acre-weighted median, 400 acres in 1987, grew to 820 by 2007. The different trends mirror larger patterns in agriculture: production shifts to larger operations combined with major increases in the number of very small farms. The 1987 Census recorded 15,500 farms with tomato production, and half (7,700) had less than an acre. In 2007, 17,500 farms (out of 25,800 in total), had less than 1 acre. Some of that increase may have been real, but it may also have followed from Census efforts to track more very small farms.⁷

Weighted medians for 20 selected commodities are reported in Table 3, which clearly shows major shifts of production to substantially larger enterprises.⁸ The dairy and hog industries, with dramatic recent structural upheavals, show changes that can only be described as massive. But the midpoint (weighted-median) size also doubled over 20 years in fed cattle, broiler, and cow-calf enterprises. The first two underwent major changes in organization decades ago, and have not seen the sort of upheavals evident in hogs and dairy. But the data still show important ongoing shifts of production to larger enterprises.

Table 3: U.S. Production Shifted to Much Larger Enterprises

Selected Commodities	1987	1997	2007
	Herd size (cow-weighted median)		
Dairy	80	140	570
Other livestock	Annual sales (animal-weighted median)		
Broilers	300,000	480,000	681,600
Hogs	1,200	11,000	30,000
Fattened Cattle	17,532	38,000	35,000
Cattle, <500 lbs	50	65	128
Selected Crops	Harvested acres (acre-weighted median)		
Corn	200	350	600
Soybeans	243	380	490
Wheat	404	693	910
Cotton	450	800	1,090
Rice	295	494	700

⁷ Farms with less than an acre of tomatoes—two thirds of all farms with tomatoes in 2007-- accounted for 1 percent of total tomato acreage in that year.

⁸ These are drawn from a larger list of about 80 commodities drawn from Census data, and the patterns shown here mirror those in the larger list.

Table 3: U.S. Production Shifted to Much Larger Enterprises (continued)

Selected Commodities	1987	1997	2007
Selected Crops	Harvested acres (acre-weighted median)		
Asparagus	160	200	240
Lettuce	949	1,461	1,815
Peppers, Bell	88	180	300
Potatoes	350	556	990
Sweet Corn	100	173	250
Tomatoes	400	589	820
Apples	83	122	146
Almonds	203	292	450
Oranges	450	769	1,113
Peaches	92	100	120

Source: ERS calculations, from Census of Agriculture data

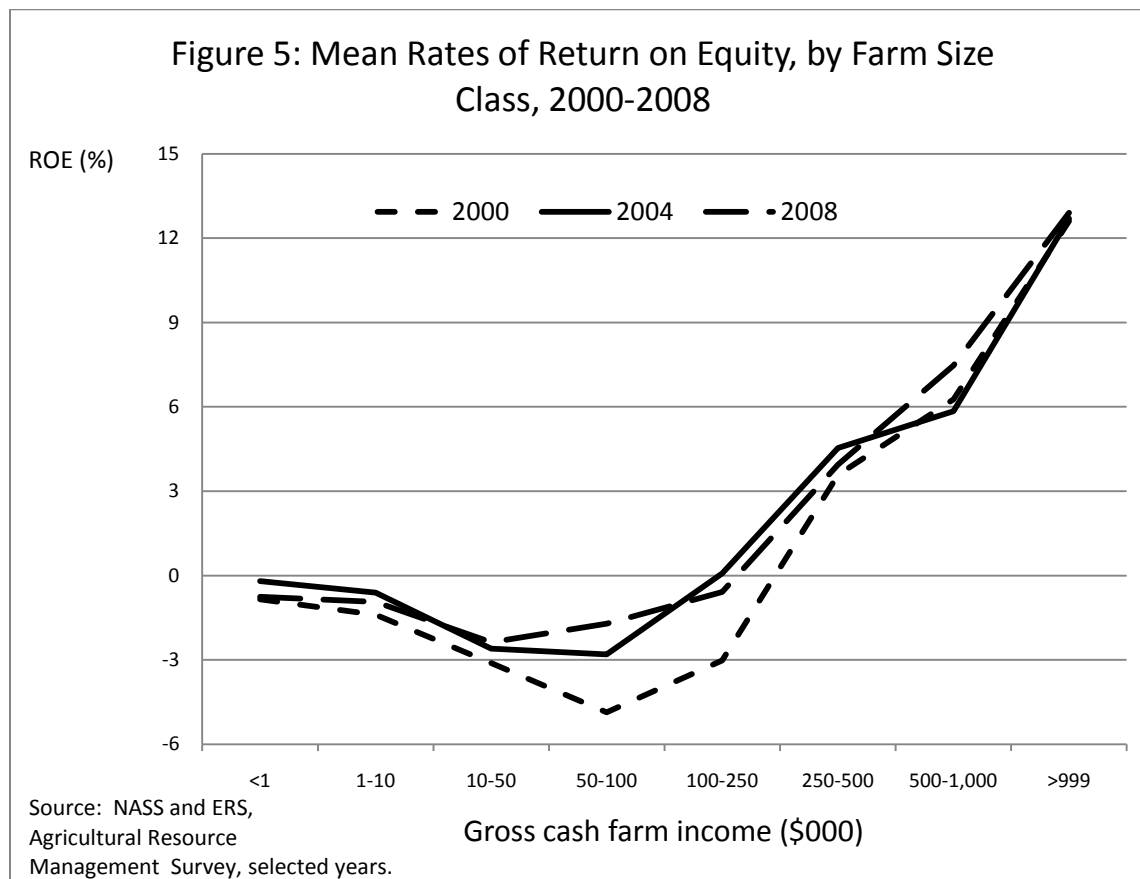
Note: The “cow-weighted median” is the herd size at which half of all milking cows are on farms with at least that many cows and half are on farms with no more. For other livestock, we use sales instead of inventories: half of all sales or removals came from farms that sold at least that many head, and half came from farms that sold no more than that number. For crops, we use harvested acreage: half of all harvested acreage of a commodity was in farms that harvested at least the median value, and half was on farms that harvested no more than the median.

Structural change in the livestock sector is well-known. But production shifted rapidly to larger crop operations as well. The midpoint corn enterprise tripled in size, from 200 acres to 600 acres, between 1987 and 2007. Some of this increase probably reflects the sharp increase in total corn acreage in 2007, and thus a shift away from soybeans, wheat, and cotton. But weighted medians increased by at least 100 percent in each of the other field crops as well. Moreover, fruit, nut, and vegetable commodities show similar patterns—increases in each 10-year time span shown and large overall increases over time. Particularly striking are the shifts in almonds, oranges, bell peppers, potatoes, and sweet corn, where midpoint sizes more than doubled in each case.

What’s Driving the Movement of Production to Larger Farms?

Financial performance plays an important role in driving structural change, and farm size and financial performance are strongly related. Farms with at least \$1 million in sales earned average rates of return on equity in excess of 12 percent in 2008, the most recent year for which we have complete data, substantially higher than farms in the next largest sales classes, while on

average small farms with less than \$250,000 in sales recorded losses (Figure 5). This pattern has remained quite stable over time, and the continued strong size-profits relationship suggests that production is likely to continue to shift to larger farm operations.



Why are farm size and financial performance related? One possibility is scale economies in production that yield lower production costs for larger operations. But the evidence for scale economies is actually rather mixed--strong for livestock production, but much weaker for crops.

Allen and Lueck (2002) argue that technological innovations in livestock production, particularly in poultry, cattle feeding, and hogs, allowed farm operations to escape some biological and seasonal constraints and gravitate toward large-scale, factory-style, routinized production processes. Analyses with ARMS data support their argument: we find substantial scale economies in hog and dairy production, and those economies have been important drivers of the major structural changes in those sectors (Key and McBride, 2007; Mosheim and Lovell, 2009; MacDonald and McBride, 2009). Other ARMS-based research finds that there are continuing modest scale economies in broiler production (MacDonald and Wang, 2010), consistent with the steady shift toward larger enterprises.

But we just don't see the same strong evidence in field crop production. ERS develops commodity cost of production estimates for major field crops, based on ARMS enterprise surveys, and has published analyses of the data in the "Characteristics and Production Costs..." series (<http://www.ers.usda.gov/publications/sb974/>). The analyses find small cost advantages to size in one case (corn) and no apparent size advantages, once production exceeds 100 acres, in others. These findings are also consistent with prior analyses. Kislev and Peterson (1982), in assessing the large increases in mean acreage per farm that occurred between 1930 and 1970, argued that scale economies were not apparent in contemporary empirical analyses of field crop production, while Allen and Lueck (2002) argued that field crop operations had not mastered the constraints imposed by nature to the same degree that livestock operations have.

However, crop enterprises are growing much larger (Table 3). If scale economies don't account for the shift, what does? ARMS data provide one hint, again drawing on the commodity cost of production data. In 1996, farmers devoted an average of 2.7 hours of labor for each planted corn acre (Foreman, 2001). In the 2001 survey, that labor commitment fell to an average of 1.8 hours (Foreman, 2006), a striking decline in such a short period.

Labor commitments, per acre, are not strongly related to enterprise size—there is little evidence of scale economies in these analyses—but they fell across all sizes of operations between years. The driving forces appear to be the combined shifts toward conservation tillage and genetically modified (GM) seeds; each innovation reduced the number of passes of machinery in fields, and therefore the labor hours needed for field operations.⁹ Beyond the short period covered by the comparison, the use of conservation tillage and GM seeds continued to spread, and innovations in machinery reduced the time needed to cover a field of a given size. Farmers could use the saved time for off-farm work, or for leisure, or for expanded farm operations. Today, we see many small field crop operations, whose operators combine off-farm work with the operation of several hundred acres. But full-time farmers can manage much larger operations than they could in the past, and many now do so.

The technological innovations may have affected farm size not by expanding the range of scale economies, but by expanding the range of production that is subject to constant returns.

This shift is consistent with a model of farm size developed by Kislev and Peterson (1982), in which relative factor prices and technological change, combined with a fixed quantity of family labor, could account for growing farm size without reference to scale economies. In this case, the shifts described above could be viewed as technological change that augments family labor hours, and that allows an operator and family to effectively operate more crop acreage.

Key and Roberts (2007) investigate another possible element in farm consolidation: the impact of government payments. They analyzed changes in the weighted median farm size in

⁹ Fernandez-Cornejo and McBride (2002) found that GM seed adoption saved farm operators' labor and management time through three channels: adoption reduced the time needed for field operations, allowed farmers more flexible time windows for applying chemicals, and reduced the time needed to spend on planning and decision-making for pest and weed control strategies.

counties and zip codes—at this weighted median, half of a county’s farmland was on larger farms, and half was on smaller (obviously, this is most relevant for crop operations). Key and Roberts established that the weighted medians grew substantially over time in most locations, and that rates of growth were closely associated with the incidence of government payments. Specifically, counties with higher levels of government payments per acre had faster growth in this measure of farm size. The association was large and robust, and it also held when measured at the zip code level. Acreage shifted to larger farms in most counties, but the shift was much more pronounced in counties with high levels of government payments per acre.

The authors argued that the association was causal and that the likely avenue of causation was that government payments supported the provision of liquidity and credit: farmers with higher payments could attract more credit for farm expansion. While this explanation helps to explain why farm consolidation might occur more rapidly in some counties, it doesn’t really explain why larger operations realize higher returns. Moreover, a weakness of this explanation is that it applies to crops supported by commodity programs, and consolidation appears to cover a much wider range of commodities (Table 3).

We also need to consider factors that may be related both to payments and to changes in farm size. For example, locations with high values of payments per acre also tend to have cropland that is relatively flat and contiguous, which is best suited for the intensive application of large and fast machinery. Thus the innovations most effective in freeing farmers’ time for expanded production may have been best suited for these locations.

Structural change is one driver of aggregate productivity growth. According to the most recent USDA estimates, total factor productivity (TFP) in U.S. agriculture grew at an annual rate of 1.74 percent between 1999 and 2008, a rate that compares quite favorably with the rest of the U.S. economy.¹⁰ Where scale economies are important, structural change toward larger enterprises directly increases productivity. For example, Key, McBride, and Mosheim (2008) find that TFP in hog finishing grew by 6.3 percent annually between 1992 and 2004, and that half of that was due to the exploitation of scale economies. Scale economies appear to be less important in crops. Yet many of the innovations that have allowed for increased farm sizes also contribute to productivity growth, through intensified use of labor, capital, and materials, and structural change was the avenue by which those innovations spread through the sector.

International Comparisons of Farm Structure

International comparisons of structure are hard to do. National statistical systems have different farm definitions: some countries include many very small farms in their statistics, while

¹⁰ The data can be found at <http://www.ers.usda.gov/Data/AgProductivity/>. For the entire 1948-2008 period, annual TFP growth in agricultural was 1.52 percent (compounded, that amounts to 147 percent more output, for a given level of inputs, over the period). Annual TFP growth amounted to 2.32 percent between 1979 and 1989, and 1.53 percent between 1989 and 1999. For comparisons to the rest of the economy, see Jorgenson, Ho, and Stiroh (2005), chapter 7.

others have much higher production or sales thresholds. As a result, measured mean farm size may differ widely even if the commercial farm sectors of each country are quite similar. Comparisons of dollar sales figures require close attention to currency values, which may fluctuate sharply for reasons having little to do with agricultural production, while comparisons of things like acreage may flounder because of differences in land quality and commodity mix.

We can, however, draw on recently released data from the Brazilian Agricultural Census to compare structural *change* in the U.S. and Brazil. The Brazilian Institute of Geography and Statistics (IBGE) recently reported on a 2006 Agricultural Census, following up on an earlier Census in 1996. We report farm structure data in Table 4, using the same framework as that used in Table 1 for the U.S. Size classes are defined in Brazilian currency—the real, which through 2006 traded at about 2.16 real to the U.S. dollar. Sales in 1996 are adjusted for inflation and reported in 2006 \$R.

There were 4.9 million Brazilian farms in 2006, 6 percent more than in 1996, and the real value of sales grew by about 25 percent in the decade. Three structural features stand out (Table 4). First, Brazilian farm structure is highly skewed, as in the U.S. Farms with less than \$R10,000 in sales accounted for 63 percent of all farms but just 7 percent of total sales in 2006. Second, what we might think of as small commercial farms—the 1.77 million farms with \$R10,000 to \$R249,999 in sales—accounted for 59 percent of Brazilian farm sales in 2006. Third, production is shifting, rapidly, to much larger operations. Farms with at least \$R250,000 in sales accounted for more than a third of total sales in 2006, up from 11.9 percent ten years earlier.

Table 4: Changes in Brazilian Farm Structure, 1996-2006

	Farms		Market Value of Sales (millions of 2006 R\$)	
	1996	2006	1996	2006
Total	4,624,617	4,900,876	44,544	55,982
Sales Class	-Distribution of farms and sales, by sales class (%)-			
Less than \$R10,000	74.3	63.5	11.9	7.2
\$R10,000-\$249,999	25.7	36.1	76.2	59.1
\$R250,000-\$999,999	0.07	0.4	11.9	22.9
\$R1,000,000 or more	0.0	0.02	0.0	10.8
All	100.0	100.0	100.0	100.0

Source: Calculations, by Costanza Valdes, USDA/ERS, based on data from Brazilian Institute of Geography and Statistics (IBGE), Agricultural Census.

Notes: Values for sales in 1996 are adjusted to 2006 dollars.

We have more limited comparative data for three other countries. Recently, under the auspices of the Farm Accountancy Data Network (FADN) and the Organization for Economic Cooperation and Development (OECD), analysts in several countries have begun to develop comparable measures of farm structure. At this time, we cannot make temporal comparisons of

structural change, and are limited to a single year comparison. But the findings so far suggest that farm structure is comparably skewed, with output concentrated in a small share of farms.

The analysts start by defining a comparable cross-country farming universe as the set of farms accounting for 90 percent of agricultural production. Because the U.S. has a very expansive farm definition, the threshold screens out all U.S. farms with less than \$71,000 in gross farm income (77 percent of U.S. farms), leaving the 494,680 largest farms that accounted for 90 percent of U.S. production. Call these “commercial farms,” for purposes of this discussion.

The analysts sorted each country’s commercial farms into four quartiles based on size, as measured by gross farm income, and developed summary statistics for each quartile and for commercial farms as a group (Table 5). Focus on farms in the largest quartile, which in the U.S. included 123,670 farms (one fourth of all commercial farms). Farms in the largest quartile accounted for 61 percent of U.S. gross farm income, and mean gross income among those farms was \$1.46 million. Since mean GFI among all U.S. commercial farms was \$543,806, the mean farm size in the largest quartile was 2.68 times the mean farm size among all commercial farms; it was 8.2 times the mean farm size (\$178,000) in the smallest quartile.

Table 5: Farm Structure in Four OECD Countries

Country	Largest 25 percent of farms (Q4)		
	Q4 share of receipts	Relative farm size	
		Q4/all	Q4/Q1
Canada	68	2.6	11.7
Germany	63	2.5	12.9
Netherlands	59	2.3	9.3
United States	61	2.4	8.2

Notes: to facilitate comparisons across national statistical systems, analysis is limited to largest farms accounting for 90 percent of farm production. Within that group, farms are sorted into four quartiles according to size, with Q4 containing the largest 25% of farms

What’s interesting about the international comparisons is that these simple measures are quite similar across the countries who have reported so far (Table 5). For example, the largest quartile’s share of gross farm income ranges from 59 percent (Netherlands) to 68 percent (Canada), and the ratio of mean farm sales in the largest quartile to that of the sample mean ranges from 2.3 to 2.6.

Organizing Large Commercial Farms

Large commercial farms in the U.S. are tightly held businesses. Most are still family farms.¹¹ Most non-family farms are owned and operated by a small number of unrelated people, organized into partnerships or small corporations (Hoppe, Korb, and Banker, 2008). This feature distinguishes agriculture from other U.S. industries.

Tightly held businesses can respond nimbly to changing markets, weather, and technologies, and operators have powerful incentives to operate efficiently. While such farms can be large enough to take advantage of the economies of scale that do exist in agriculture, accessing capital for growth can be a challenge, and the shifts in farm and enterprise size noted above, combined with asset price increases, have substantially increased the total capital investment required in commercial farm operations.

With Corn Belt cropland selling for \$4,000 an acre, a farmer aiming to produce 600 acres of corn and 500 of soybeans, close to the weighted medians in Table 2, would face a fixed capital requirement of nearly \$5 million for land, equipment, and structures. A dairy farmer with a herd of 1,000 milk cows, large enough to realize most economies of scale, and who also produces some feed on-farm, will likely need to assemble about \$7 million worth of livestock, land, buildings, and equipment.¹² The farm-level investments required for a poultry or hog enterprise can require capital investments of \$500,000 for small-scale entry (two houses), and considerably more for a producers who wish to build 6, 8, or more houses. Those who also intend to produce crops (for which the manure will provide fertilizer) also need to assemble the land and equipment for a cropping enterprise.

Several features of agricultural production ease access to capital. Farmers rent cropland, and share equipment with others by renting, or by either purchasing or providing custom services. In 2008 ARMS data, farms that produced between 800 and 1500 acres of corn and soybeans rented half of their cropland, on average, and 64 percent shared equipment through rental or custom service purchase or provision. Dairy farmers with herds of 500-1500 head rented nearly half of their land, and over 90 percent shared equipment through at least one of the three channels noted above.

U.S farmers also use production and marketing contracts to manage risk and capital needs. By obtaining a production contract with an integrator, hog and poultry growers can obtain loans from banks for the construction of the houses. They can also apply their own resources to other farm enterprises. Larger farms are considerably more likely to use contracts than smaller farms, and recent ERS analyses show that farms with production contracts were able to grow more rapidly than those that did not, suggesting that contracts provided a channel for accessing capital (Hoppe, Korb, and banker, 2008; Key, 2010).

¹¹ Defined by ERS as farms on which the primary operator, and people related to the operator by blood or marriage, own more than half of the business.

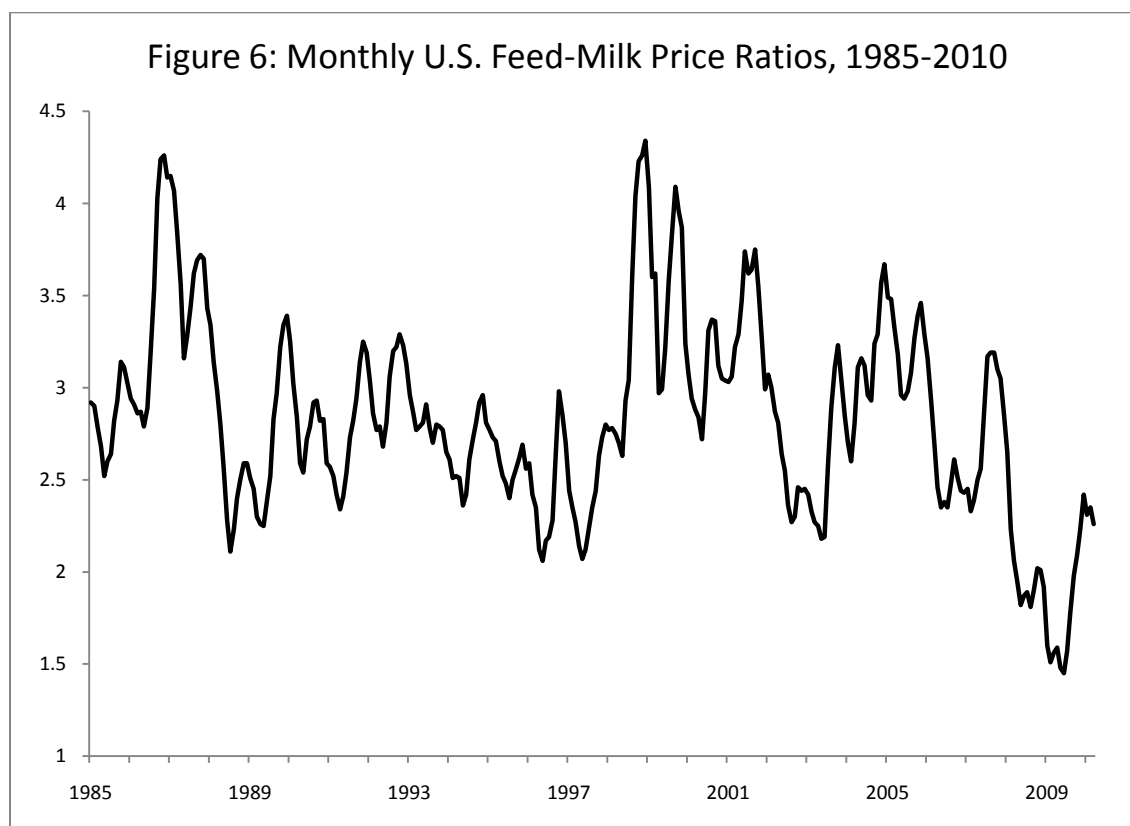
¹² These estimates are drawn from asset values reported in the 2008 Agricultural Resource Management Survey, as are the data on accessing capital.

The Financial Crisis, Commodity Prices, and Livestock Operations

ERS estimates that net farm income fell by 20 percent in 2009, and forecasts a modest recovery—up 11.8 percent—in 2010 (<http://www.ers.usda.gov/Briefing/FarmIncome/>). Prices for livestock animals and products fell in 2009 while crop prices declined from 2007-08 peaks. The severe recession cut demand for some protein foods and off-farm income for many households. Moreover, the broader financial crisis affected some major agricultural lenders, and limited some lending, while farmland prices began to fall in 2008-09, after strong gains for many years.

Evidence through 2009 shows little sign of liquidity problems in the sector: on the whole, debt loads remain low relative to asset values, and servicing requirements look manageable. However, financial performance varied sharply across commodities. ERS reports that net cash income for all farm businesses fell by 10.6 percent, on average, in 2009, but it fell by 82 percent for dairy farms and 52 percent for hog farms (Harris, et al, 2009). Dairy and hogs are the sectors with the most dramatic recent organizational and structural change, and they are more heavily leveraged than other agricultural sectors. Financial pressures there could have an outsize impact on organizational forms, contracting, and structural change in the future.

The 2008-09 price movements are at the heart of their current travails. With milk prices falling rapidly from a 2007 peak, and feed prices falling off slowly, the ratio of milk to feed prices fell from 3.19 in the summer of 2007 to 1.45 by June of 2009 (Figure 6). Feed price ratios also fell sharply for hogs, as demand declines led to sharp hog price declines in late 2008.



Growers with hog production contracts are largely insulated from price movements, but independent growers and integrators faced the full brunt of adverse hog and feed price shocks. Five large integrators in North Carolina, including the 22nd and 25th largest in the country, filed for bankruptcy during 2009, and their contract growers (over 100 each in the case of the largest failures) were then left without hogs, or fee revenue, for their houses.¹³ Most contract hog producers, particularly in the Midwest, operate diversified farming operations and therefore could generate earnings from crop production. But integrators tend to be specialized businesses.

Dairy farms accounted for 8.5 percent of all farm cash receipts in 2009--but held 12.2 percent of farm debt and 20 percent of non-real estate debt. With the sharp decline in cash incomes, some faced severe liquidity problems. Vreba-Hoff, a company that develops large-scale dairies, ran into financing problems, leaving clients with unfinished farms and bankruptcies (Etter, 2010). One of the company's primary lenders halted a program to finance large dairies, and instituted foreclosure proceedings against 8 farms sponsored by Vreba-Hoff.

The poultry industry faces an aging stock of housing as production growth rates declined after 2000 and then went negative in 2009 (MacDonald, 2008). Housing is one important channel by which innovations are spread in the industry, and the industry may need to adjust production contracts to encourage more replacement investment. Faced with growing capital requirements, more operations may seek wider equity participation in different farm assets.

Conclusions: Structural Challenges for the Future

Start with several well-known points. First, continued economic growth in China and India, with associated dietary changes, will have major impacts on production and trade of feed grains, oilseeds, and livestock products. Second, we are likely to see significant expansions of soybean and poultry production in South America, particularly in Brazil. Third, the growing global network of production and trade in horticultural products is likely to continue. Each development will lead to expanded opportunities for agribusiness firms in the financing, production, or marketing of agricultural products.

The projections that underlie the above points make several strong assumptions. In particular, note the current USDA baseline projections for yield growth, cited in figures 3 and 4. U.S. projections match historic growth rates, but those for other major producers are quite modest. Most of the expansion in Brazil and Argentina is driven by projected acreage expansions. The USDA projections call for Brazilian soybean yields to expand by 9 percent over the next decade, consistent with yield growth during 1995-2006, but well below growth rate prior to 1995. Yield growth projections for Brazilian corn are well below historic patterns. Higher than projected South American yield growth will affect world prices and production projections. There have been substantial expansions of public R&D support in developing countries,

¹³ Similar challenges faced broiler growers. Production in 2009 fell 4.5 percent, after average annual growth of 4 percent for the previous half-century. Since growers are insulated from price risks, growers who received birds were unaffected by the downturn, but some were left with significant production and therefore fee revenue shortfalls.

particularly in Brazil, and these investments could lead to improved yield growth, along with downward pressure on world prices, in the decade ahead.

There is a second major uncertainty to the USDA projections—macroeconomic policy in China, and in Asian countries generally (Wolf, 2008). They are currently running large current account surpluses, offset at the global level by deficits in the US and, to a lesser extent, the UK. In China alone, it appears that savings (household and government) accounts for 60 percent of GDP. At the margin, investments from those savings, in US securities, appear to have very low returns. Analysts disagree about the continued sustainability of the current pattern of global imbalances, but the effect of the policies is to allow the US and UK to consume substantially more than they produce, while limiting consumption in Asian countries. A modest relaxation of Chinese policy, leading to greater consumption by Chinese households out of national income, could lead to substantially greater dietary changes than are currently forecast, with attendant consequences for global meat and feed grain production and prices.

If we are to sustainably meet projected long-term increases in feed and energy demand for crops, we will need continued long-term growth in productivity—through yield gains, livestock feed conversion, and post-harvest retention. There is currently a lively debate in the U.S. on agricultural productivity. Some argue that growth has slowed, the result of slackening public R&D expenditures in the last two decades, and that these trends bode ill for future productivity growth (Alston, Beddow, and Pardey, 2009). Should U.S. productivity growth slacken, yields are likely to fall below those assumed in the projections, with significant impacts on commodity prices and land use. But there's no consensus on this point. While year to year fluctuations in measured productivity growth make for noisy data, USDA productivity indexes do not show a slowdown through 2008 (<http://www.ers.usda.gov/Data/AgProductivity/>). This issue will be of growing public and academic interest.

The financial crisis and recession followed upon years of powerful structural change in U.S. farming, in which production shifted to larger farms, and capital requirements for those farms expanded. Farmers accessed capital through savings, debt, and a variety of contractual relationships. That structural change likely fueled some of the continuing growth in U.S. agricultural productivity.

The feed and livestock price fluctuations of 2006-2009 were driven by sharp changes in energy prices, sudden shifts in international demand occasioned by income and exchange rate fluctuations, and weather-related supply disruptions. There is little reason to believe that these factors will abate in the future. At the same time, economies of scale in livestock operations appear to be real and substantial, while large-scale crop operations offer substantial cost advantages from the opportunity to use fixed resources (principally, operator labor) intensively. Each requires substantial capital investments to realize. In short, there are still strong economic reasons to organize large family farms, and for production to continue to shift to them. But a key question is how to organize and finance those operations.

Producer and government groups will likely seek some important changes in farm policy during upcoming farm bill debates, as they seek ways to adjust to the particular price and liquidity risks apparent in the current environment. They will be doing so in a difficult funding environment as the federal government faces the challenge of unwinding large budget deficits, and with a growing number of stakeholder groups seeking support.

But we are also likely to see widespread interest in, and experimentation with, different ways of writing contracts and accessing capital. Some livestock contract parameters, in both marketing and production contracts, may no longer work effectively in a world of higher and fluctuating feed and energy prices. Contract terms may need to be adjusted if contractors are to continue attracting growers, and we are likely to see continued experimentation with alternative strategies for assigning expenses and designing compensation among contractual parties.

Regarding access to capital, we are increasingly cognizant, in our farm surveys, of alternative housing finance options used by poultry and hog growers: some integrators finance housing investments by growers, some own the houses on a grower's land, and some work with third parties who own the houses and receive rental payments from growers or integrators. As the capital needed to take advantage of scale economics in livestock production continues to grow, we may see more such examples of shared equity stakes throughout agriculture. More broadly, we are also seeing more complicated ownership and management structures for large family farms, with non-operator equity and resource providers, the sharing of assets and services among farms, and complex contractual relationships with input suppliers and with processors. Recent events will likely spur greater interest in such structures.

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Industry Panelist

Transcript

*Wesley Batista, President and CEO
JBS Swift, USA*

I would like to thank the Federal Reserve Bank of Kansas City for inviting JBS to be here. I really appreciate the opportunity to share our views with you and to discuss our sector. Thinking back about JBS and what JBS is and what we do, JBS started 57 years ago. JBS primarily was a beef company, which started in Brazil.

Over these past several years, we became a meat company. Today we operate in beef, poultry, and pork segments and also in the lamb business. We operate in Brazil, Argentina, Uruguay, and Paraguay. We have operations here in the United States, as well as Mexico, Italy, Russia, and Australia. Today we have many investments in United States. In these last 20 years, we invested over \$5 billion in the United States. Our operation today here includes beef, chicken, and pork, and also lamb. We have over 70,000 employees in the United States. Worldwide, JBS has 125,000 employees.

We have been expanding our business in countries that are, in our view, the countries that already lead meat production globally and will continue to be the leaders of meat production. That is South America and North America, so we have been investing in these countries and in these regions, believing we will continue to see growing production for meat in these areas.

And, in other countries also, we have already seen meat production growing. What we are seeing and what we think is happening in the meat sector is when we see consumption growth globally and GDP growth increasing globally also. In our view, in the 1950s, 1960s, 1970s, and 1980s the growth was in North America, Europe, and Japan.

In these last 20 years, we are seeing a big change and in our view this is a fundamental change for all of our business. We are seeing very strong growth in the emergent markets, like China, India, Brazil, and Russia. Brazil – we are from Brazil, a country with 200 million people – has a growth forecast for this year of 5 to 6 percent. China is close to doubling its growth for consecutive years.

In all these countries, this kind of growth is changing the dynamic of all of our business. Feeding people in these countries will increase when they increase their income power and they will improve their diet. This is the first thing to happen. So it is directly related to food consumption.

It is different in the United States, in our view, in our sector for beef, pork, poultry, or lamb. In our view, U.S. GDP can grow 5 percent and we will not see a big meat consumption increase, because people already have a strong and very high per capita consumption in countries like here. The same thing goes in Europe. And we are seeing this when we look at the last 10 years. In Europe meat consumption is flat, but in the United States meat consumption is up 5 percent. In Africa it is up 70 percent. In Asia and the Middle East, it is up over 40 percent. In South America, it is up 37 percent. So we are seeing a very, very strong growth in meat and we believe we will see food consumption increase overall. I used to say about countries like Japan, the United States, or Europe, if the country is growing and if the economy is going well, people buy more cars, more homes, and more durable goods. But specifically, the basic demand for food doesn't change a lot.

This is a fundamental change that we are seeing in our sector and we think we'll see this in these coming years. Even China perhaps will not grow 10 percent in the next five years. Maybe China needs to change, but China will continue to grow. In Brazil, we will continue to grow. All these countries will continue to grow at an important level.

When we see supply, we need to remember that as an example in our sector – cattle – the business cycle in cattle is very long. If demand is very, very strong, for this year or for 2011 or even for 2012, we'll not see beef production increasing. Because to increase beef production is to retain cows, to grow the size of the herd for three or four years or longer to start to produce more beef.

Poultry and pork cycles are shorter, so we can see more of an increase and we think we will see them and we will need to increase production in poultry and in hogs to support the increase in worldwide demand. We are very optimistic about our sector. We are very optimistic about the livestock sector. We think farmers will make money. Of course, we saw some tough years, but we think farmers will make money. Hog, cattle, and poultry producers will make money, because demand will be strong. So we are optimistic.

In our sector also we are seeing strong demand. Every day, the United States will play a very, very important role in our sector. We believe we will see exports from the United States growing over time. As an example, we have been seeing a lot of comments from Russia, that Russia has a plan to be self-sufficient in hog and poultry production. We think we'll see Russia definitely increase their production, but it will not be enough to offset their growth. The United States will continue to increase their presence in the beef sector to supply and to support global growth.

Thank you. I am glad to be here. Are there any questions?

Industry Panelist

Agricultural Innovation in the 21st Century: The Optimistic Science

*James C. Borel, Executive Vice President
DuPont*

Good afternoon. I would like to thank members of the Federal Reserve Bank of Kansas City and the organizers of this panel on “Reshaping Global Agricultural Production.” I appreciate the chance to be here today.

As you all know, economics is often called the “dismal science.” Perhaps the most famous example came when the Reverend Thomas Malthus said that the human race would face horrifying starvation as the growth of population inevitably exceeded the growth of our food supply.

He was wrong. Instead we have produced more food, for more people, and we have done it with less. Agricultural productivity has increased by almost any measure you care to use. And it was enabled by science – science that led to the creation of hybrid corn, for example, by Henry Wallace, the founder of DuPont’s Pioneer Hi-Bred business. Or the science that Norman Borlaug deployed to power the Green Revolution that saved an estimated one billion lives. Or the science of modern farm equipment that enabled farmers to till more acres in less time and with less labor. And all of this science originated from creative individuals or groups and was put to use by innovative farmers that recognized that progress requires change and adopting new approaches. As we look back from the time of Malthus to today, the progress the world experienced demonstrated agriculture’s ability to grow more than many (but fortunately not all) had thought was even possible.

So, I think of what we do in agriculture as the optimistic science. The science in which my company invests over half of our \$1.4 billion annual R&D budget to increasing global food production. That includes developing better seeds that produce higher yields, discovering better products for controlling crop pests and providing food ingredients that benefit consumers.

It’s the science of growing food.

Today, the science of growing food combines advances in conventional breeding with innovations unleashed through the advent of biotechnology and advanced processes that build

more robust seeds. And, like all science, the science of growing food depends not just on the advance of knowledge; it depends on the efforts of people.

My purpose today is to explain the reasons that we should embrace an optimistic vision of science in agriculture. And then shape our efforts – private and public, local and international – to make it so. Through global collaboration and innovation, we can increase the future productivity of agriculture even more than past history would suggest. We can meet the world's demand for more food – and we can do it while improving consumer benefits and raising the standards of environmental stewardship. And, with that, we can avoid catastrophic hunger and all that it brings, including civil unrest. We can empower farmers to be productive in all parts of the world. In short, we can set the stage for the next agricultural revolution.

We know the need is great. In the year 2011, our global population will exceed seven billion people. And it won't stop then. By 2050, the globe will be home to nine billion people.¹

Two centuries ago, Malthus was wrong, but he wasn't asking the wrong question. The question today is how we will feed nine billion people. The answer is clear: Only by nearly doubling food production – and ensuring that the food is available to the people who need it.

Success in this endeavor will require new and sustained levels of “innovation” and “collaboration” by and among all of us in the global food system. With collaborative ingenuity, I'm confident we will build the solutions that will surpass current agricultural trendlines.

But there is, of course, a big “if” – actually a series of “ifs.” We can meet the global challenges of food only if we embrace contributions from all sources, if we empower collaboration, if we ensure that farmers can choose the seeds and other products that work best for them, and if we enhance the ability of farmers in all parts of the world to be as productive as possible.

In the next few minutes, I would like to share my thoughts on how this can be done. Starting, first and foremost, with the people who farm our land.

I. Farmers are the original innovators

I grew up on a farm in Iowa. To grow up in a farming community is to understand the character of farmers. Sometimes I hear farmers described as risk-averse. That wasn't what I saw in the people around me. Careful or cautious, perhaps, but not risk-averse.

You can't be risk-averse and borrow a lot of money to put the crop in the ground in the spring on the belief that you'll make it back, and a profit, when the harvest comes. Successful farmers combine equal parts of effort and experimentation – they innovate.

¹ United Nations, World Population Prospects: The 2008 Revision

That's why farmers need the practical freedom to be creative, to choose the seeds that will work the best for them, in their soil, with their growing conditions. Whether it's a farmer in central Iowa with 1,000 acres of corn, or a small farmer in the Philippines with half a hectare.

And the success of even one farmer starts a virtuous cycle of innovation. A cycle that is not, and Dr. MacDonald's paper is very insightful on this point, dependent on the size of a farm. Better seed improves productivity on farms of all sizes. That's a great advantage because it means that innovation in seed can be useful to all farmers, everywhere.

But first, we need to get the economics right.

II. Economic trends in agriculture favor innovation

No one understands the nature of supply and demand better than a farmer. Produce more than the market wants, and prices go down. Produce less and prices go up. Produce too little and total revenue declines. Innovation that boosts productivity might, therefore, be seen as bad for prices.

I don't believe that is true because demand is on the rise. Not only is the global population growing, the composition of global demand is changing. Most of our population growth occurs in less economically developed places. In 2005, for instance, we added about 81 million people to the globe and about 79.5 million were in the developing world. Urban places are growing especially quickly.² And the rising income in countries like India and China drives demand for more protein in the diet, which in turn demands more grain. In addition, the need for energy, and energy security, is increasing, and agriculture can be an important source of renewable energy. These are all fundamental drivers of demand and there is no reason to believe that they will slacken.

Greater agricultural production will not, therefore, automatically result in lower prices. In fact, we need to drive production increases to avoid price spikes like we saw in 2008. Think about corn prices in the United States over the past century. From an average of 65 cents per bushel in the opening years of the 20th Century, we have reached a plateau, from 2007-09, with an average price of about \$3.95/bushel.

I believe that we have reached a new plateau of pricing and that the long term trends of growth in population and per-capita income will continue to support agricultural demand.

² Population Reference Bureau, 2005 World Population Data Sheet; United Nations Food and Agriculture Organization, The Importance of Food Quality and Safety for Developing Countries

The result favors innovation. Increased demand and the current level of pricing will act as a strong driver of improved agricultural productivity.

And greater productivity is on the horizon. For example, the National Corn Growers Association holds annual yield contests. Already the top yielding hybrids deliver more than 300 bushels/acre³, compared to the record average yield today of about 165 bushels. Perhaps more importantly, we are working toward doubling the rate of genetic gain before the end of this decade using new breeding and biotechnology tools. What's true for corn is also true for soybeans – another of the mainstays of production agriculture. In other words, current projections and estimates based on historical data do not account for our changing world dynamics and the corresponding increase in demand or the impact of emerging technologies. The economics, in other words, support innovation.

III. Agriculture may be the Biggest Innovation Challenge of the 21st century

Agriculture may just be the biggest innovation challenge of the 21st century. But consider the magnitude of the challenge. To double agricultural output by 2050 is daunting. But that is not all. Today, about one billion people – roughly 14 percent of everyone in the world – live in hunger.⁴

In a world of global trade and agricultural exports, it may come as a surprise to know that 85 percent of all food never crosses an international border.⁵ That means that the bulk of food to feed the hungry needs to come from the place where the hungry live.

This does not detract, in any way, from the importance of international trade. U.S. agricultural exports are strong and they must remain strong to meet global needs. But they are not enough.

Indeed, the geography of agriculture is too-often overlooked. We speak of the looming food “gap” between production and population. We don't speak enough of the potential “mismatch” between the location of production and the location of people. Food only feeds those who have access to it and the income to afford it. The potential for an agricultural “mismatch” can only be cured by encouraging all productivity, by ensuring that food flows freely across the globe to places where it is needed and that economic growth supports both local production and the purchase of imports. That will call for changes in trade policy, food aid policy, international development policy and many others.

³ National Corn Growers Association 2009 Yield Corn Contest

⁴ United Nations Food and Agriculture Organization

⁵ United Nations Food and Agriculture Organization

In other words, the innovation challenge can be summed up in two principles: First, we must produce more, everywhere, in increasingly sustainable ways. Second, it must be available – truly available – to those who need it.

How can that be achieved?

On the science side, today, seed companies use a sophisticated toolkit, combining advances in genetics to continuously breed better germplasm for diverse conditions; technological advances in biotechnology to incorporate new plant traits; and advanced processes to build the robustness of crops. The results include:

- **Greater Yield:** Biotechnology tools used to accelerate plant breeding progress is beginning to accelerate the rate of genetic gain. Additional biotech traits, especially in certain combinations, can boost yield. For example, combining our Optimum®GAT® trait in soybeans with the traditional glyphosate resistant trait provides a six percent increase in yield over today's commercial varieties with Roundup Ready® alone. That would be worth more than \$2 billion of increased productivity annually for U.S. soybean growers.
- **Benefits to Consumers:** This week, we received USDA deregulation for a new trait called Plenish™ high oleic soybeans, which offer benefits to consumers and the food industry and industrial sector, in turn providing increased value to soybean farmers. Plenish™ offers a soybased solution to the trans fat challenge with approximately 75 percent oleic content (the highest of any soy product under commercial development), 20 percent less saturated fat than commodity soy oil and 75 percent less than widely used palm oil.
- **Environmental Sustainability:** We are using our improved genetics and biotech expertise to develop drought tolerance, nitrogen use efficiency and new forms of insect and disease resistance.
- **Combating New Threats:** Combining different biotech traits in a single seed can allow farmers greater flexibility in the use of herbicides – an important way to combat the rise of weeds resistant to Roundup® herbicide, or “superweeds,” as the popular press refers to them.

But I believe we must look beyond even these achievements. Because innovation requires collaboration – the ability to harness our collective ingenuity and resources. A single plant, a single farmer, even a single computer, makes for very small advances. A field of plants, a community of farmers, a network of computers creates new forms of value and boosts economic productivity and growth.

So what does collaboration look like in agriculture? It begins, of course, with incentives – chief among them are intellectual-property rights and open, competitive markets. The right incentives not only encourage single companies to invent, they encourage companies to share the benefits of their inventions with each other. Intellectual property rights ensure inventors that they can work with others without fear of losing the legitimate advantage of their invention. For example, Argentina is a nation where greater protection of legitimate intellectual property rights would lead to greater productivity, as more technologies would become available.

Open, competitive markets mean that inventors can reach customers with new innovation. That requires both domestic competition policies and, of course, an international emphasis on enabling trade. With the right mechanisms in place, seed companies will be able to “build” the seeds that have the best combination of components for their customers.

Collaboration also works between research universities and seed companies. The important research done in universities can be invaluable in finding new approaches to seed technology.

Farmers play a critical role themselves. Choosing the best seed for their farm, while broadly encouraging better farming practices and better governmental policies.

And new types of collaboration are forming between foundations, governments and private companies with an aim to accelerate the deployment of key technology advances to regions where the markets today are less developed, but where advances like these could help prime the pump of both agricultural and economic development.

Innovation is not “wishful thinking.” Think of the history of American agriculture – a legacy of experimentation, creativity and education. Diversity of plants. Breeding of crops. Competition in the market.

Or consider the Internet. From computing advances and better networks arose a global ecosystem of Internet innovation. One that has combined intellectual property with a global impulse for creativity and, of course, increased economic productivity and growth.

Agriculture can prosper in the same way. With collaboration, access to capital (and the intellectual property rights that make that possible). With smart governmental policies, ranging from agricultural extension to trade to wise monetary policy. With substantial commitments of R&D from businesses that take risk in order to achieve reward.

IV. Conclusion: Harnessing the Creativity of Collaboration

All of this explains why I believe that farmers will rise to the challenge of producing enough food for the world, growing economies here and around the globe in the process.

With collaborative innovation as our touchstone, American agriculture can:

- Employ biotechnology, conventional breeding techniques, and biological diversity to stay one step ahead of weeds resistant to Roundup® herbicide and similar challenges from Mother Nature, so long as we ensure that we are not “locked in” to a single approach;
- Improve yield per acre substantially with new combinations of technologies making new seeds;
- Develop “output” traits benefit consumers and, with it, the value of crops;
- Use fewer natural resources, while growing more, including biofuels; and
- Foster local farming in virtually all parts of the world.

And we can do one other thing. We are a nation of rising expectations and, as the global population soars, those expectations will be shared by the bigger, more urbanized, more economically-developed nations of the world. Will there be a rising tide of expectations along with the rising tides of population growth and urbanization? Yes, there will be. And I believe that the creativity of collaboration is also the way to surf that wave – because collaborative innovation encourages not just the designs of a few but the contributions of everyone, everywhere.

Thank you.

General Discussion

Reshaping Global Agricultural Production

*Mark Snead, Moderator
Assistant Vice President and Denver Branch Executive
Federal Reserve Bank of Kansas City*

Mr. Snead: It is obvious in the data, economies of scale are critical. You also mentioned technology and you said it was in the full paper. Could you talk a little bit about the role of technology in the shift in the data?

Mr. MacDonald: The striking thing to us is over the years we've done a lot of cost of production studies, as they are called, for crops. Our support from Congress in our data focuses on program crops. So we are talking about field crops largely. The striking thing to me is we don't see very large differences in our estimates of cost per bushel of production when we look at corn, soybeans, cotton, and sorghum production. Nevertheless, we see very strong shifts to larger operations.

What we see is substantial declines in the number of hours per hundred acres that operators have to apply to that. We see that occurring no matter what size a farm is. We think it is being driven by shifts to conservation tillage; it is being driven by shifts in corn, soybeans, and cotton to GE seeds; and it is being driven by shifts to larger, faster, and more effective pieces of equipment.

All of those mean technology is giving you a fixed input – farmer's labor versus full-time farmer or the equipment that can be applied to a much larger operation. My reading is that is a technological force, separate really from scale economies because we don't see it showing up as fewer hours per hundred acres at smaller farms than at larger ones. It gives more hours for a particular farmer to apply to more acres. This is actually consistent with a fair amount of both historical theoretical and empirical work in the agricultural economics literature. There may be others, but those are three types of driving forces that particularly in the crop area are driving shifts to larger farms and basically allow operators to manage a much larger operation.

Mr. Hollon: Good afternoon. My name is Elvin Hollon and I'm with Dairy Farmers of America. I enjoy hearing both of the USDA MacDonalds speak frequently. Your statistic on 70+ out of 80 commodity groups showing dramatic shifts from the larger scale and size and the ongoing probe of the Department of Justice of everything agriculture: Do they read your stuff?

Mr. MacDonald: Yes. I've moderated a couple of their panels. They read my stuff. Pretty much every day I talk with them. I act as the USDA liaison to the DoJ in this work for data anyway, not for policy.

Mr. Hollon: So it shouldn't seem odd to them that agricultural entities, producers who are getting larger and larger and want to go to the market, ought to look at structures to market that are larger and larger?

Mr. MacDonald: Let me step back a little and give you a quick background on where that is. There are a lot of markets in agriculture, right? It's a big complex place. A lot of those markets, particularly on the buying side, are highly concentrated – two, three, or four buyers. Concentration doesn't mean a violation of the antitrust laws, but violations are more likely to occur in highly concentrated industries. In addition, there are a lot of really distinctive business relationships in agriculture that don't appear elsewhere. Production contracts are one I point to specifically.

As background, the DoJ has run workshops like this in the past for a variety of areas. This one is different in that it is much larger. Those previous workshops are a day or two with a small room of experts in Washington. These are five days around the country with rooms of 700 to 800 people.

Part of what is going on is learning about the business. There are very few people in DoJ who actually understand much about the agriculture business, so part is learning that. Part of it is trying to explain what antitrust violations are. There are plenty of things people are angry about that may actually be cause for regulation or not, but they are not antitrust violations. So the second part of that is in a sense communicating to that broader public.

I will leave it at that. I would view it naively and believe it to be accurate. It really is obtaining information about agriculture and that is what will be going on in the next few sessions. The next one is in Madison at the end of June and we'll field a lot of dairy farmers there.

Mr. Hollon: Some of your statistics may make it into that particular session.

Mr. MacDonald: They could.

Mr. Boehlje: Mike Boehlje at Purdue. I wanted to ask you, you showed the return on equity as a function of size and I believe your dataset also shows what happens to debt utilization as a function of size. Can you summarize for me what you recall about the debt-to-asset ratio or something about that? What I'm looking for is this issue of increased vulnerability, or lack thereof, as we go to larger-scale operations as a function of utilization. The industry average is less than 10.

Mr. MacDonald: There are two things I would say about that. One is on the use of debt. I don't believe one should start looking at, say, commercial farms of \$150,000 or above so something jumps out of the data at you relating debt usage to size. It does, when you break it out to particular commodities. So you will see dairy and hog farms with a lot more debt exposure, than you will see other types of large operations.

That leads to the second thing I want to point out, which is also a useful thing to say about that chart. What I showed you in that chart was a mean. I'm sure you guys are well aware of a lot of variance around that mean, as well. Part of my answer to Mike was, "If I look at the big ones, the variance comes in on the top side when I look for credit for dairy and hog users."

I would encourage you to dig into that more, because that really is a goldmine (it could be a minefield too), with a lot of useful data on debt and credit conditions. That's my quick summary and I am not the guy who prepares this credit report.

Mr. Teagarden: I'm Matt Teagarden, Kansas Livestock Association. Maybe a follow-up to the first question relative to the competition workshops: Part of that discussion is some kind of restriction or limitation on contracting, whatever contracting might mean. It might mean different things for different commodities. In your opinion based on what we talked about, the increased capital requirements for the types of operations we have today and the reliance on those types of operations to produce the volume of food we are producing today, can you comment on the impact on our ability to continue to produce that volume of food if contracting is limited or restricted?

Mr. MacDonald: That covers a lot. Let me say two things. One of the key elements if you're looking at an antitrust case on business practices, whether it's contracting for livestock or contracting for seeds, the focus for an antitrust investigation is whether that practice restricts output, drives up prices, and creates market power. The challenge, particularly in any business practice case, is those practices may be efficiency-enhancing. That is basically what the information search is about, whether you are doing these workshops or whether you actually go to court. If the antitrust division is attempting to get rid of a particular business practice, the whole focus of the argument is going to be on whether it restricts entry, raises prices, and even restricts innovation or whether it is efficiency-enhancing.

I would say the first workshop in Iowa, where there is a significant focus on production contracts in hogs, was really fascinating. There was a great deal of information there about what actually goes on in contracts and what you want them to do for you. It worked as a really nice educational tool for a lot of the DoJ people who were there.

One other point I should add, though. DoJ views itself as an advocate for competition. Another part of these workshops is to focus on other areas of law and regulation that don't have

anything to do with antitrust. Some of that actually focuses on USDA and GIPSA (Grain, Inspection, Packers and Stockyard Administration) rules. I suspect if there were contract regulations that come out of this, it'll go through GIPSA, that is, USDA and not the Department of Justice.

Audience Question: Mr. Batista, I am fascinated by your operations around the world. How do you deal with government regulation of slaughter procedures, grading, inspection, and then what are your thoughts of country-of-origin labeling?

Mr. Batista: We follow each country's each government, each regulation. We think some countries have some strong things, but some weakness. We need to respect regulations when we operate in Brazil, Brazil has their regulations and when we operate in the West... Of course, as an industry, we would like to have a presence and to have a voice of our industry to express our view. But, in the end, it is what it is and we need to work and compete with the regulations that are in front of us.

About country-of-origin labels, there has been a big discussion in our sector. Overall, my view is I see how consumers look at this. I have a big doubt if consumers are... We'll give attention to it, because at the end of the day, if it is Canadian beef or if it is U.S. beef, I am not sure if this will change consumers' perception. For me, this is the most important thing. If it's Canadian, U.S., or any beef, it doesn't matter in my view where it comes from. What matters is the quality. What are you looking for? If you are looking for the type of product, you can find in U.S. beef. If you are looking for a different kind of product, maybe you can find it in Mexican beef. For me, this is the most important thing.

Mr. Sneed: Mr. Borel, m question is, can you maybe put your finger on one or two of the most important upcoming technologies and how they might reshape agricultural production and, if they are proprietary to DuPont, feel free to discuss those as well. [laughter]

Mr. Borel: I'll talk about two briefly I believe are known. We've talked about them publicly before. One is drought tolerance in corn, particularly, and maybe we should refer to it as "water utilization." As we learn more about the plant and are able to help the plant manage water better, that is not only going to help farmers in drought-stressed areas receive more consistent yields, but what it will do is allow farmers in places where they don't grow corn today have a much more competitive crop. While our focus at the beginning is going to be helping drought-stressed areas, I would not be surprised at all with this. In fact if you think about our conventional breeding over the years, corn is being raised farther west and north than we remember when I was a youngster. That is primarily because of finding the genes through normal breeding processes. What has happened with the new technology is we're speeding up that process and bringing it to market faster. That is in the United States.

But, if you take that same thing and take it to India, Africa, and places where water is a real problem, we are excited about a project we have with the Gates Foundation around some of these types of things, where we work together with collaboration as I described it. To get some of these technologies put to use in places where the market today might not justify the investment, but you know the technology can have an impact.

The second one I mentioned is nitrogen-use efficiency. It is in early testing. It will be another four or five years before things are on the market. In tests so far, we are finding up to 30 percent reduction in nitrogen and still getting the same yields per acre. We have a bigger issue in the Gulf right now. But, when you think about nitrogen runoff, if we can help farmers get better use of the nitrogen they put on and have less of it lost into the environment, that is a huge thing. It is one of the most expensive inputs farmers have, as well.

Those are a couple we are excited about.

Mr. Lorger: Gary Lorger, retired small business owner. Do you have a concern about intellectual property rights in an open market? I am specifically thinking of economies such as China.

Mr. Borel: Certainly. When you invest as much as we do in research, intellectual property protection is really critical. At the same time, different countries are in different places around the world. China is a concern. They have moved toward intellectual property rights. They have a patent law in place. They are moving forward on those fronts. But we are very careful.

You can't just count on the Rule of Law in all countries around the world to protect intellectual property. So we have additional processes to make sure we know what technology we are taking in and how we manage that. To be frank, in countries where intellectual property protection isn't as strong, oftentimes the technology doesn't get there as quickly. Good intellectual property protection is a very important piece of the puzzle for us as a society to solve the problem we are talking about on feeding the world. It really does provide the protection to be able to get the return on the investment.

Mr. Massey: Ray Massey, University of Missouri. I have one question here. I was reading the book, *Travels of a Tee Shirt*. I don't know if you guys read it. It tells an interesting story about cotton development in the United States. Part of the story is, why has U.S. productivity growth not developed in other countries? It talks about credit access, the illiteracy of the farmers, and the technological understanding of farmers being inefficient or incapable of using some of the technologies that have occurred in cotton seeds.

What is DuPont doing to make sure that, as we are talking about expanding production in other regions of the country, they will be able to use it, given their literacy, credit access, and things of that nature?

Mr. Borel: That is a really good question. First of all, it underlines the importance – it isn't just technology. We can't just provide technology, throw it out there, and expect it will help anyone. I'll give you an example. First, a bit of philosophy: One of the things that is important to our seed business is working directly with farmers. Oftentimes we sell directly to farmers, but even in situations where we have intermediaries in invoicing, being able to get information directly to farmers, helping them choose the right hybrids, and maximizing the use of the products are important.

The example I might give you is of a farmer in Ethiopia, where a number of years ago we introduced hybrid seed corn. It is mostly open-pollinated varieties in that area of the world. It wasn't just taking hybrids in and handing them off. We have a local team and they worked with this farmer, as well as a bunch of his neighbors, and helped them with the management practices and how to get the most use from the grain. He went from subsistence farming (This is just hybrid seed corn. This isn't state-of-the-art technology.) to being able to send his kids to school, put a new roof on his house, and he actually has a cell phone now to be able to check markets.

So it is fascinating the kind of impact you can have, but that wouldn't have happened if we had just shipped some hybrid seed corn in and has a dealer sell it at the corner. It takes a commitment and working directly to help people get the most from the products.

Mr. Algaier: I'm Joe Algaier. I'm from Midwest Research Institute. I am a misfit around here. I am a biochemist.

One thing I have noticed in all the projections that I've seen, there is one factor that is probably difficult to factor in. In Chinese and Third World growth, what about the factor of all the pollution in the water systems over there? I can see the projections dropping precipitously, if that is a factor considered. Could the panel just discuss that in general?

Mr. MacDonald: I'm not an expert, so I'll be short on it.

I'll go direct to where the focus is. If you look at the substantial growth in our projections, where do we show it? We show it in livestock and poultry. So the big issue in terms of the agricultural link is going to be management of the litter. There is some increase we show in pork production, but the biggest shift you see in China production is in poultry. As we know, there are significant pollution problems in China now. It is likely to impose substantial restrictions on industrial growth in the future. That is a real challenge they face.

If you are looking at poultry production growth of 50 percent, likely in fairly centralized complexes, you are right. You are going to have a significant consolidation of poultry litter in those places as well. And that is going to create a real challenge for them. Beyond that – I am not a China expert – I cannot tell you what they are going to do about it.

Mr. Gabriel: Steve Gabriel, Farm Credit Administration. Mr. Batista, I wondered about the business model JBS uses around the world. Is it consistently an integrated grower sort of model or how that might vary around the world and also whether or not you have any cropping operations at all that you may use to grow feed?

Mr. Batista: Basically our business model is the same for Brazil, Australia, Europe, or here. We buy cattle from farmers. Brazil has much more grass-fed cattle; here it is grain-fed cattle. But the business model is pretty much the same. Also it is not different in Australia.

The poultry industry here and in Brazil is the same business model. The pork sector in Brazil varies more, but the business model is pretty much the same.

I couldn't hear what you asked at the end of your question.

Mr. Gabriel: I asked whether you've had any cropping operations anywhere in the world.

Mr. Batista: No, we don't have any.

Mr. Massey: Ray Massey from the University of Missouri again. James MacDonald, you ended your presentation with a question: Do we need new instruments for managing and allocating risk? I was just wondering, do you think the changes that have occurred in the structure might be the private sector's activity to allocate risk as opposed to be the private-sector's way of managing risk?

Mr. MacDonald: As I talk with producers both individually and through our surveys, it strikes me that we have a set of marketing contracts, for example, on hogs. Some of the ways we work our production contracts in both poultry and hogs are really based on low feed prices. Producers look at this and say, "I think we have a different set of risks and we need to think about how to manage those."

And we are likely to see most of that happen through the private sector and happen through changes in contracts. I expect to see more of those happen.

In both our broiler and hog surveys, we ask a lot of questions about the types of contractual relationships farmers have. What strikes me is the heterogeneity in those relationships, many of them done in response to different changes in input price shocks and sometimes in response to some previous output price shocks. I expect you're going to see evolution and continuing changes in those in the future.

The flip side is I also expect we may see a lot more equity participation in farming operations. As someone charged with running surveys, part of my job is to figure out how we write the surveys to capture that as it goes on. But certainly everything I hear suggests we are likely to see a good deal more of that in the future.

Man from Kansas: My question is for Dr. MacDonald. I'm from Kansas and there are a number of acres that are going to come out of the Conservation Reserve Program (CRP) in the next couple years. In your surveys, are you looking at that? Do you have any projections on what the effect will be on crop production and what will happen to that land?

Mr. McDonald: We have ongoing research on it. Clearly, higher corn prices place pressure on the CRP, if you don't do anything about it. What I would suggest is to send me an email and I'll link you to our experts who do that. We have ongoing research on it. It is not an area I work on. We do track it in our surveys. I just make sure we have the questions; I don't analyze those answers.

Mr. Greenwalt: Mr. MacDonald. I'm Bert Greenwalt, Arkansas State University and also a rice and soybean farmer. I wasn't clear on your comments about the relationship or impact of government farm program payments on farm size.

Mr. MacDonald: We had a research program that looked at it. If you look at the measure I showed for the midpoint of farm size, we also calculated that just for cropland acres within agricultural counties, 1,600 or so counties. We also looked at it within zip codes. We have it changing over time. So we have a distribution of changes – in some counties it is growing very rapidly. In some counties, it is growing less. In very few counties is it declining. We take that as a measure of changes in that typical farm size where the cropland is.

We also have data from ARMS and from the Census on commodity payments per acre in a county. That is very strongly related to the growth in cropland size. I say that in the sense it is large and it is robust. It is not a few observations up and you're driving it. It is a very tight relationship.

Personally, what I think is driving it is, if we think about locations with high payments per acre, well they have high yields. They tend to have a lot of contiguous cropland, so we are talking about Delta and Cornbelt counties. In my view, the technologies we've seen driving shifts to bigger farms are more easily adaptable in those counties. That is my speculation, to tell you the truth. I keep trying to get people to test it, but I haven't gotten the right one to do it yet.

What we have is a very strong correlation between payments and farm growth. I don't think it's causal. I suspect there is technology that is driving it, but I'd like to see more work done on it.

Mr. Hoenig: Do you think there is a tendency for payment limitations to be a drag on farm size?

Mr. MacDonald: I don't think so. My flat answer is I don't think they impact many producers at all. They impact structural entities to a modest degree. I don't think they impact producers much.

Mr. Hoenig: What is a farm?

Mr. MacDonald: We actually look in two ways. We look at the FSA's entities. We also in our ARMS data look at what we call an S-farm, a statistical farm, in which we are aiming to get at things that larger than what are called FSA farms. If I look at the income rules for payment limitations, very few producers – the ARMS data we're tracking are household income as well – and very little acreage are affected by the current payment limitations. For that reason, I don't think they impact it much.

Mr. Briggeman: Brian Briggeman, Federal Reserve Bank of Kansas City. My questions are for Mr. Borel and Mr. Batista.

In your prepared comments, you had a fairly bright outlook for agriculture in your respective areas going forward, but I was curious about the challenges that you both see for your industry. In particular for Mr. Batista, the challenges you have in the transportation sector, purchasing livestock to get it to the processors, and to get it to the demand you see rising in China. And for Mr. Borel, in particular I appreciate your comments on trade liberalization and potentially breaking down those barriers for that, as well as any other challenges you might see.

Mr. Borel: First, if I have a concern in the big picture, it is that we don't figure out how to get increased productivity in the developed agricultural areas to where this population needs it. It is going to take more than just trade liberalization. It is going to take economic development. The world is figuring out that trying to skip agricultural development in Africa and go directly to industrial development didn't work. We have to change food aid policy, agricultural development investments, and a number of things to get the economic development for them to be able to afford the imports, as well as to produce more. So that's a complex challenge.

Although I am not lying awake worrying about this, if it didn't work, we didn't get that figured out. We doubled production in the United States and nobody could afford to buy it and we couldn't ship it over there. I'm not lying awake worrying about that, but it is something we need to devote some energy to and no one group can fix that. It takes governments, NGOs, and companies really working together to figure this out.

Mr. Batista: In all our business, one challenge is to work on trade barriers, definitely there are different markets. We are seeing this in the poultry segment for a long time. You asked, "Where can we pressure to fix the issue in Russia?"

But each country is trying to protect itself to some extent, so we are seeing some growth on trade barriers to protect each country's markets. This, in our view, is the biggest challenge to be able to access markets and to have a free market to move products.

Mr. Teagarden: I'm Matt Teagarden, Kansas Livestock Association. Wesley, I am curious. You have been in the beef business two or three years in the United States and you indicated you buy cattle from farmers and ranchers. What is your reaction to their perception of you and your company? How have they embraced your company's entry into the business?

Mr. Batista: As soon as we came to the United States, we felt very welcome here. We think the producers in the United States have a mentality that our sector needs to work together to improve our business overall. We have been talking with producers as a company JBS. At the end of the day for us, it is about demand. If we have more demand and if producers and packers in our business work together to improve the amount here in the United States and abroad, we will have a better business for all. If we have less demand, we will all be squeezed. We feel the American producers have the mentality – we have to do a lot more work – but they have the mentality. The question is not between farmers and packers, the question is about the whole market.

Mr. Andrew: Jim Andrew, Iowa farmer. Mr. Batista, I'm really intrigued. Growing up as a little boy in Iowa and going by packing plants – Hormel, Swift, all of these – and in comes a Brazilian and buys out big. What do you attribute your success to? I can tell by your attitude you are a very aggressive, dynamic, hard-hitting individual. Did American packers get that dumb and lazy? Or did their labor agreements take too many dollars away from their business? Or did they just kind of lay down? You've been very successful. I am just intrigued with how you did it.

Mr. Batista: I attribute that to like my dad used to say, "When you like what you do, you don't have to work, you have fun."

So we have been having fun for our entire career. We like what we do.

Mr. Hurst: Blake Hurst, corn and soybean farmer from a few hours north of here. In both sets of presentations, there was a lot of optimism and a couple of illusions to what I see as a huge problem facing us but nobody is tackling it head on. As an example of what I mean, here in the United States almost ten states have outlawed what I would call "modern meat production."

Earlier this week, they burned genetically modified seed in Chicago. They demonstrated outside the Gates Foundation in San Francisco, all against a donation of a seed corn company which will remain nameless for a donation of seed they made to Haiti. They weren't demonstrating so much against genetically modified seeds, as demonstrating against hybrid seeds.

The Haitian peasant associations have promised to burn the seed when it arrives in Haiti. My question is, are we doing enough to deal with this idea that farming, as we practice it in the West, is harmful to the culture, to the environment, to farmers, and to consumers? Do you see that as a threat to this optimistic picture almost everybody has painted here this afternoon?

Mr. Borel: I think it is absolutely a threat. I still remain optimistic. One of the things that is important about all this is, there are challenges. The question is, what are we doing about it? Are we being proactive? Are we addressing it head on?

First of all, there are always going to be some fringe groups and you have to be careful not to be distracted by those. But, at the same time, there are groups of people who have legitimate views and concerns and you have to engage them. Different groups find different ways of doing that.

We, for example, have had an external advisory panel around biotechnology since we started to do that work over a decade ago. We have an ethics person. It rotates over time, but we've had a bioethicist from the University of Pennsylvania. We have Jason Quaid, the Little Wildlife Foundation, and people who don't think like us and who didn't grow up in companies and think, "Let's put more technology out. That was a great idea."

We have some tough conversations. But it is hugely helpful. As one example, if we just say they are all fringe and ignore it, then you end up with problems you can't get through. But, if you engage, you find there is a lot of common ground.

I had a great conversation the other day with Josh Gratel, who is the head of Slow Food. You talk for awhile and realize ... both of us said it at the time, "Well, we actually have more in common than you would have expected when we sat down."

But clearly we have some differences. From my point of view, let's all engage. Let's talk about the challenges and the issues and things that are important. At the end of the day, farmers' values are something that permeate agriculture. We can be proud of those and they will stand up pretty well to most people in the world if you talk about it. If we don't, then we all assume the worst and end up creating other problems.

Mr. Tiernan: Shane Tiernan from Grundy National Bank. This is primarily for Dr. MacDonald, but then Mr. Borel and Mr. Batista maybe could address part of this also.

You didn't really address the demographic changes taking place in farm producers as to how much influence that has had on the growing size of farm operations. Certainly, if you consider the average age of producers today and a less percentage of producers are age 30 years and younger, if you extend those numbers out 20 years, you have the question is, who is going to farm the ground? What does that profile look like? Do you envision, or do you have an opinion

of, legislative or policy initiatives that could be put in place to increase the attractiveness to younger generations of the production side of agriculture and how we get them in, considering it costs \$5 million to farm 1,100 acres.

Also, for Mr. Borel and Mr. Batista, do you envision a future where corporations somehow control larger and larger segments of the production side of both livestock and commodity production and hire the labor in order to continue to feed the demand we all say is coming down the road, yet there are fewer and fewer producers who are going to grow that production?

Mr. MacDonald: I think the issue you point to is a real one, although I believe it is exaggerated to a degree in our statistics. You quote an average age of 58, which is true. That is the average age of operators you'll see in USDA data and is, of course, substantially older than business owners you see in other industries. The reason why it can be somewhat misleading is twofold.

First, the way you get out of agricultural statistics is to pave your land. That is, a high fraction of the farmers in our statistics are retired. When they say they are retired, they mean they are retired. They don't do anything, but we still count them as farmers. If we get rid of the people who say they are retired, that drops the age down a little. It doesn't make me all that happy. It drops the average age down to 54 or 55.

The second thing, though, is when we survey these numbers, we survey principal operators. At a multi-generation farm, the guy who fills out the census is Dad or maybe it is Granddad. He is the principal operator. More and more large organizations are, of course, multiple generation and multiple operators and employed managers working on that farm. We don't track them well in our statistics.

For that reason, I am not going to tell you you're wrong, because we don't track them. We don't know what they look like. I suspect one avenue we don't follow at all on entry into farming is working as a manager on some of these larger operations. We then see those people cycling in at 40 or so to building their own operations.

It probably is a serious problem. I don't think it is as serious as what our statistics indicate. I am going to stay away from policy advocacy, since I am not a policymaker.

Mr. Borel: I might comment quickly on a couple of elements. The concern about big corporations running the farms, it is happening on the specialty crops already. But, if we are thinking about corn, soybeans, and wheat, we are not expecting that is going to happen. Personally, I hate to see that happen in the sense that even though the operations are larger, closely held family operations are very efficient, willing to take more risk, and are good managers. Hopefully it won't, but I don't think it is going to lead to that. The returns and the

risks are not something that large corporations are going to be very excited to jump into. That's for crops. I don't know much about the livestock side.

Mr. Batista: In our view, it is the same thing for cattle. We don't expect to see, and we don't think that makes sense, for the industry to go in and try to integrate the cattle business is almost impossible. The cycle is too long to do that. The poultry industry is already integrated, so we contract growers to feed chickens and we don't see this will change. This model is not only here. In Brazil, the model is the same. Anywhere, we know the poultry industry works pretty much the same. And the cattle are pretty much the same. We will keep being a packer and buying cattle from producers.

But definitely we think this is a concern. We are not seeing the young generation. It is not only in the United States. You'll see this in Australia, Brazil, Argentina, anywhere. The young generation is not going into farming. They want to go to the big cities and to do a lot of things. We hope we can see long, very strong financial results in the farming sector to stimulate the young generation to stay and work on the farms. But I think we need to see strong results and very good profitability in farming.



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Session 3:
Evolving Agricultural Supply Chains

Evolving Agricultural Supply Chains

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Major changes are occurring in US and global agriculture which ultimately will be changing production and trade patterns, as well as impacting management of global supply chains, and ultimately logistics. The purpose of this paper is to describe some of these changes and their impacts on global supply chains.

Topics that are discussed include:

- Macro drivers to changes in agricultural marketing and the implications for global investments;
- Supply chain management in agriculture with an elaboration on some of the major principals, and the implications for market participants;
- Facilitating mechanisms of efficiency gains in supply-chain management and examples are provided on mechanisms to improve efficiency of supply chains;
- Implications for investment and strategy, particularly as it relates to infrastructure and management

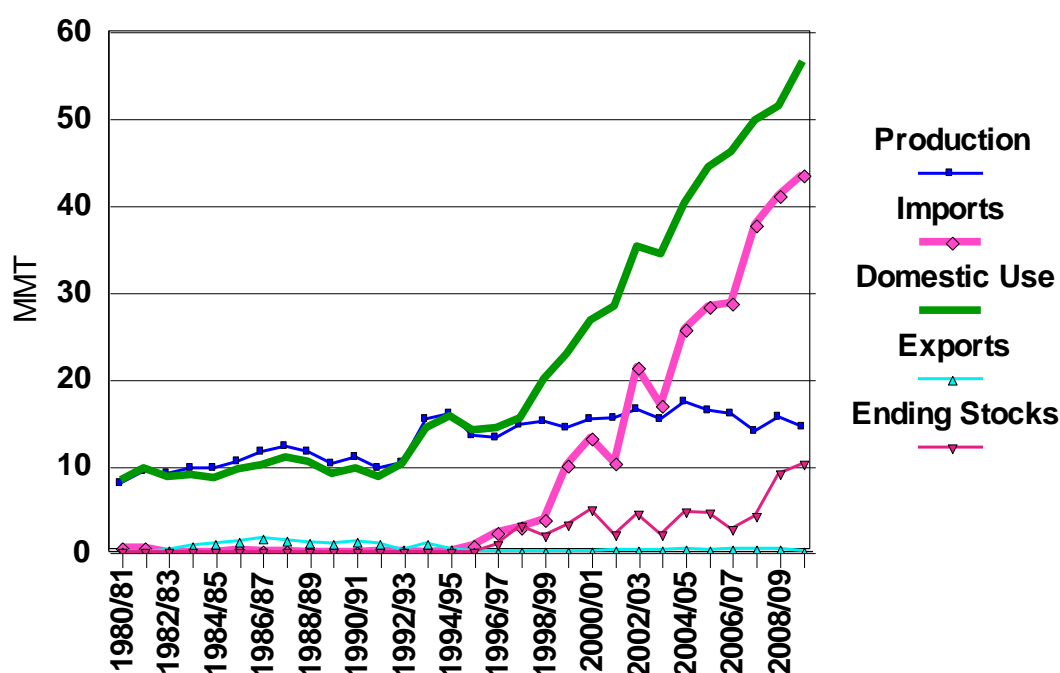
Macro drivers to changes in agricultural marketing

While there are a multitude of factors impacting global agricultural marketing, there are a number that stand out in importance. These include biofuels---which in the United States now takes about 35% of corn area to provide feedstock to the ethanol industry. Second, is volatility---simply agricultural markets are now much more risky (by a factor of about 2 on price volatility compared to the 1980s). As a result, there has been a major dichotomy in terms of agricultural firms making or losing huge amounts of money as a result of effective vs. non-effective risk management strategies. Virtually all food and agriculture firms are in the process of reviewing and/or developing their risk policies. Third, industry managers have become much more sophisticated in terms of their demands for managing supply chains and risks. While 20 years ago, it was primarily US market participants that attended to these issues. Now, buyers from throughout the world are focusing and very ably trying to demand more efficient solutions to supply chains and risk management.

In addition to these there are two sets of issues that are elaborated on in greater detail. These include radically changing global supply and demand characteristics and the growth of agbiotechnology which is a game changer.

Global supply and demand: Globally, there are some very important changes occurring in demands and supply. It is important that growth rates in consumption for most agricultural grains and oilseeds are growing at a faster rate than growth in productivity. Our research suggests that typically, growth rates in demand are ranging in the 2 to 3 percent per year range, depending on crop and country.¹ Demand growth is changing radically and is being driven primarily by growth in income, population, urbanization and resulting changes in diet composition, which are largely irreversible. Most dramatic of course is the growth in demands in China, as well as other countries. In fact, one of the most dramatic changes in world consumption is the growth of soybean imports to China (Figure 1).

Figure 1: China Soybean Supply and Demand.



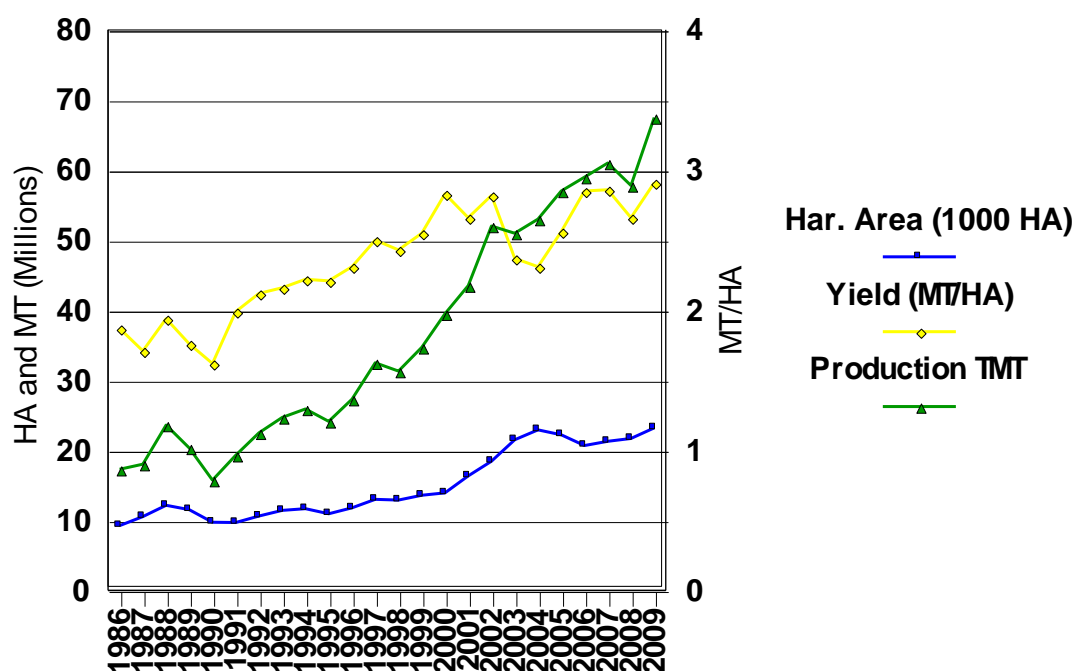
In contrast, productivity in agriculture is less than this, and in the area of 0.8 to 1.3 percent depending on the crop and region. The impact of this dichotomy is that prices have to be high

¹ See William Wilson, Won W. Koo, Richard D. Taylor, and Bruce L. Dahl. 2008. "Impacts of Ethanol Expansion on Cropping patterns and Grain Flows." *Review of Agricultural Economics*, 30(4): 642-663 Winter 2008; Eric DeVuyst, William W Wilson, and Bruce Dahl. "Grain Shipments on the Mississippi River: Longer-Term Forecasting and Risks." *Logistics and Transportation Review*, Accepted Oct 22, Transportation Research Part E. Reference TRE 446; and Wilson, B. Dahl, S. Taylor. "Impacts of Lock Capacity Expansion on Delay Costs For Grain Shipped on the Mississippi River." *Journal of transport economics and policy*, JTEP 2229.

enough, long enough in order to 1) induce new technology into agriculture; 2) induce new lands into production and/or 3) ration demands. Ultimately, each of these will probably be important over time.

There are two regions in the world in which production has notably increased, the Former Soviet Union (FSU) and Brazil. The changes in FSU agriculture are important for a number of reasons.² First, after many years of being an importer, FSU emerged as an important exporter in the past few years. See Figures 2-3. In fact, in recent years, the volume of exports from this region is approaching that of Canada. Second, their focus is mostly on small grains, wheat and barley, which are markets which had already been experiencing only modest growth. Third, they have international logistical advantages in a number of regions relative to North America (e.g., North Africa, European Union (EU), etc.), but in addition to these markets, they have been exporting and trying to develop expanded exports in traditional North American markets. These include Asia,³ Latin and South America, amongst others. Fourth, they have the ability to sell at relatively low prices for a number of reasons. Taken together, these changes are long-lived and will persist in the coming decades. In fact, as they improve the varying aspects of their logistical system and agricultural production, they will improve their ability to penetrate markets.

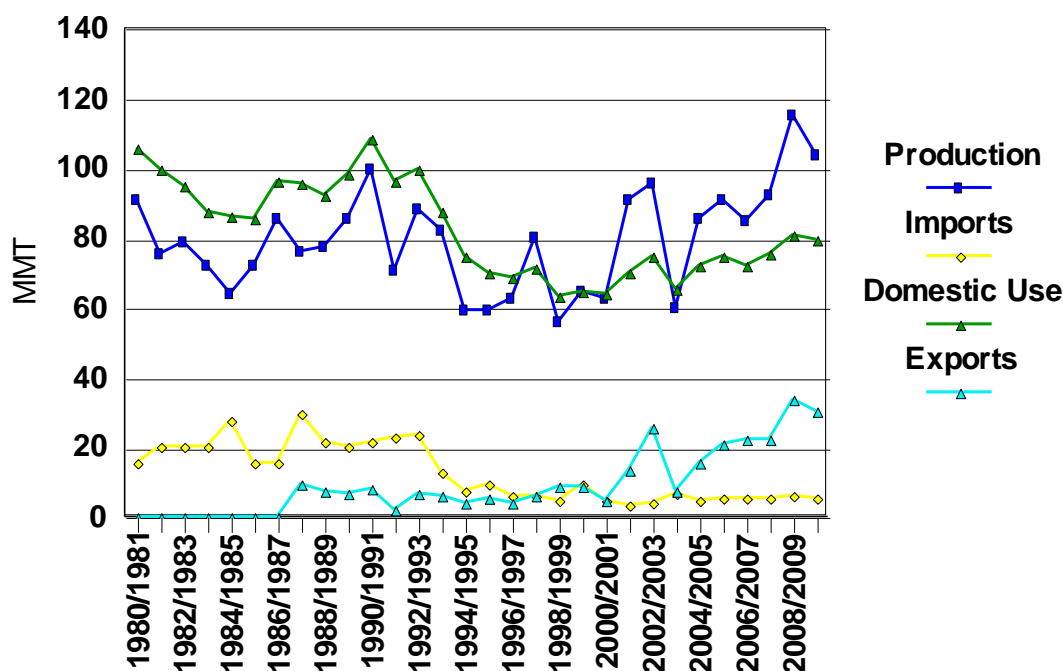
Figure 2: Brazil Soybean Supply and Demand.



² See Kolesnikova and Dreibus, “Russia Fights for World Dominance—in Wheat: It may supplant the U.S. as the world’s top exporter in less than 10 years,” *Business Week Magazine*, June 7, 2010.

³ See Ruitenber, “Japan Considers Buying Wheat From Ukraine, Russia,” *Reuters* June 18 (Bloomberg).

Figure 3: FSU Wheat Supply and Demand.



On a global basis there are numerous demands for investment in global marketing infrastructure. In fact, one of the primary advantages to the United States is its logistical system. These other countries are all in varying stages of improving their systems as well, which will go a long way toward reducing their logistical costs, congestion costs, and improving availability.⁴

In the case of Russia, the primary needs are for interior infrastructure (new elevators), railways, wagons and on-farm storage facilities. It is estimated that Russia roughly needs \$20-25 billion for infrastructure costs and production improvements. This includes \$6-10 billion for on farm, and \$350 million for port infrastructure, railway stations reconstruction, wagons, inland country elevators, etc. For the Ukraine⁵ it has been estimated to need \$20-25 billion investment in production and infrastructure. Further, they noted that even though major firms have already invested, “the market is still wide open for smaller companies...”

Brazil is the other country that has expanded its production of both soybeans and corn. This growth accelerated after 2004 when there were major changes in laws governing production and research of genetically-modified (GM) crops. Initially, this was a change for a one year duration only, but, eventually the one year restriction was lifted. Since then, their productivity growth rates have escalated and the amount of land in production has grown.

⁴ The values below are based on personal communications with individuals knowledgeable on these developments in these respective counties, 2010.

⁵ See *Financial Times* June 2 “Investment Climate will Determine Yield”

Demands for logistical infrastructure in Brazil are well known. Brazil has evolved with rapidly changing agriculture, no traditional institutional mechanism to facilitate investment in logistics infrastructure, changing geography of agriculture, excessive logistical delays and demurrage. As early as about 6 years ago, there was an elaborate plan to address a multitude of problems. The estimated cost of this was \$7 billion. Of course, much of this had been stalled for varying reasons. Nevertheless, there has been some progress. This includes the North-South Railway; Tucuruí Lock, Paving of the BR-163, and the expansion of ALL railway from Mato Grosso to Santos.

More recently, the president allocated funds, and the new president will have to execute the program further. This is commonly referred to as the Growing Accelerating Program under which large investments in infrastructure will be executed. Amongst others, this includes ports \$2.5 billion through 2014, waterways (including dredging) \$1.77 billion in the next 4 years and farm roads \$1 billion. Further, the most important investment needs going forward include port investments to expand the capacities at Itaquí, Santarém and Vila do Conde (mainly). Investment will also be needed for inland terminals: railway and waterway terminals will also demand private investments, and transport including rail and barges.

As a result of these investments, Mato Grosso (mostly) will gain strong logistic advantages, helping to develop the region (adding more storage capacity, enhancing second cropping, etc.). In practice however, there will be difficulties due to regulations, environmental issues/permits and bureaucracy which may delay or even halt those funds. By the end of this year the election of a new president will have to re-assess these priorities.

In summary, as noted by an expert in Brazilian grain marketing,

“Brazil development may not be sustained because we are on the eve of a logistical burnout, simple most of the paved roads, harbors and terminals were made in early seventies.”

Biotechnology: Agricultural biotechnology is having a major impact on agriculture production, marketing and trade, and this is expected to continue in the coming decade. Agbiotechnology has the impact of changing the growth rates in productivity, and, as a result, changes the spatial geography of production, both within the US as well as among countries, in addition to development of numerous differentiated traits. Proposed changes and acceleration in crop technology development (inclusive of conventional breeding, molecular markers and genetically modification) would result in more rapid growth in productivity. Generally, this may result in a doubling of productivity by 2030, which translates to a cumulative growth rate of about 3-3.4 percent per year.

There have been substantial changes in production patterns within the United States, in part as a result of agbiotechnology. Most important has been the shift in production more northerly, and westerly versus historical patterns (Figures 4-8). Generally, throughout some parts of the United States, there have been more cropping alternatives which have impacted traditional crops.

Of particular interest is wheat which has lost 30-40 percent of its area planted during the past couple of decades (Figure 9). In part, this has been lost to crops produced with agbiotechnology.

Finally, with advances in breeding technology, companies are developing and planning to commercialize numerous differentiated traits in the coming decades. For each corn and soybeans, there is expected to be up to 20 new traits under development. Some of these are competing traits, some are a result of partnership initiatives, etc.

Figure 4: Corn Planted Area in 1995.

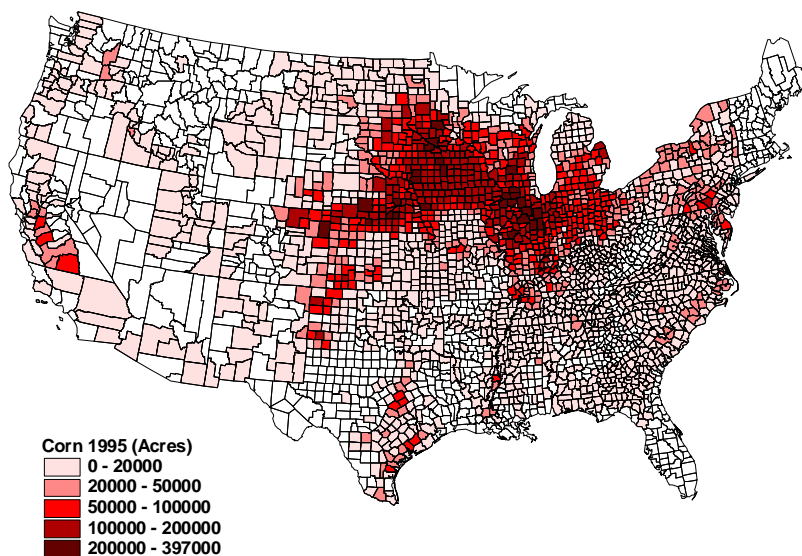


Figure 5: Corn Planted Area in 2007.

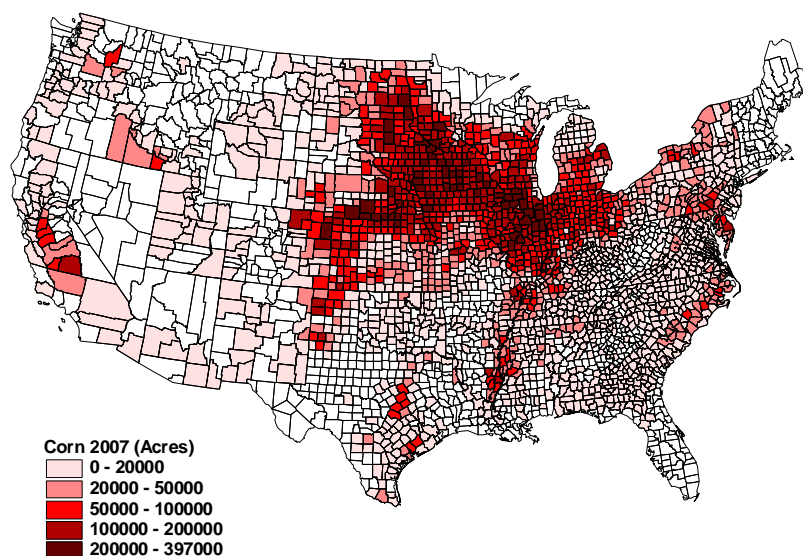


Figure 6: Soybean Planted Area in 1995.

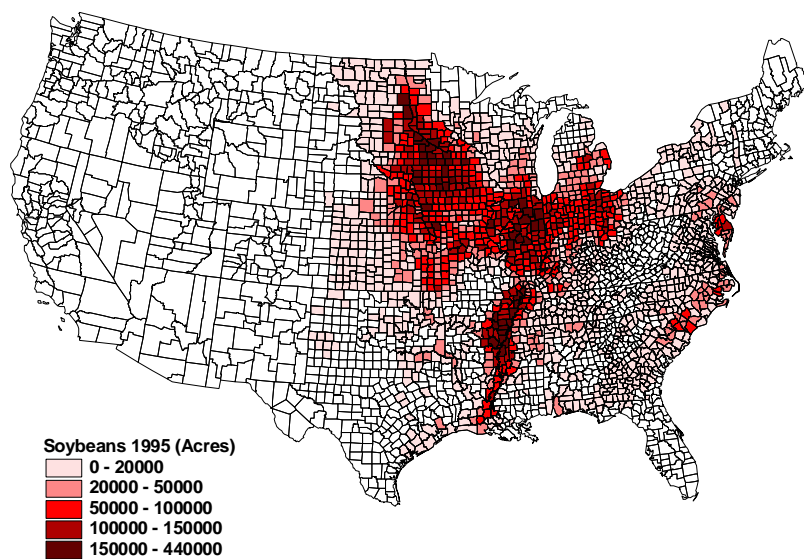


Figure 7: Soybean Planted Area in 2009.

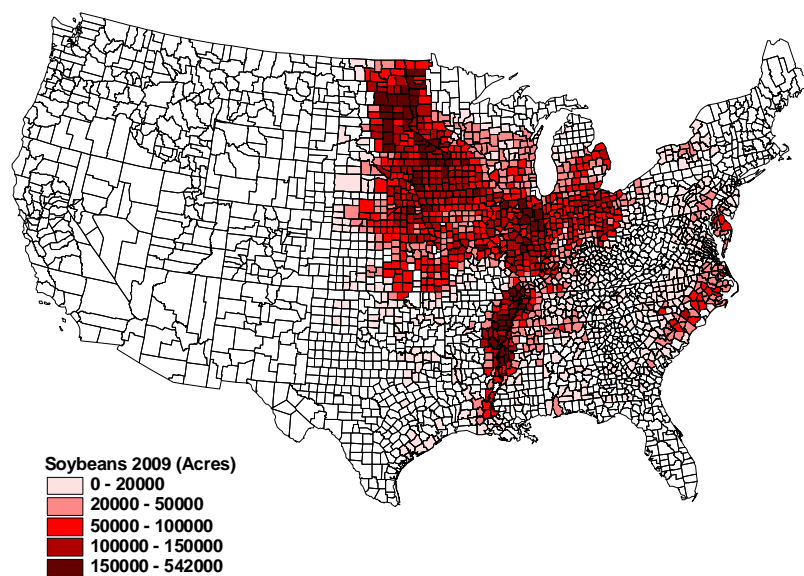


Figure 8: Change in Hard Red Spring Wheat Planted Area 2007-1995.

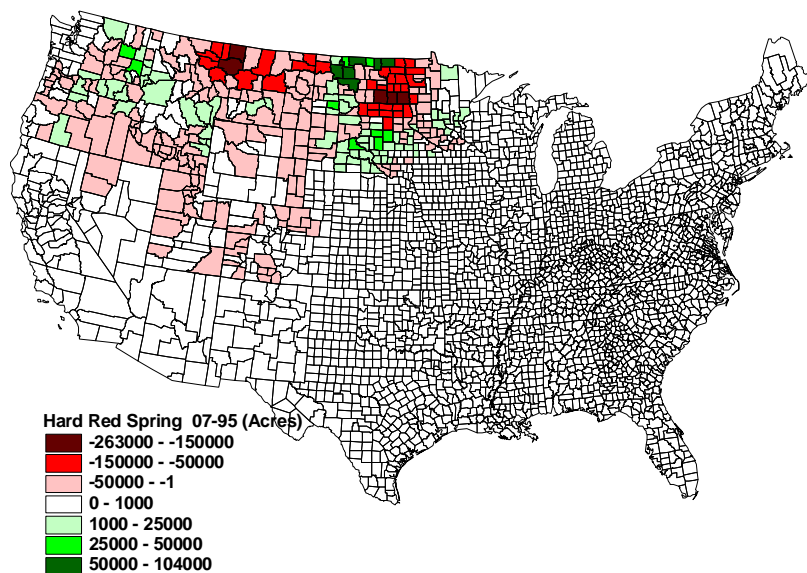
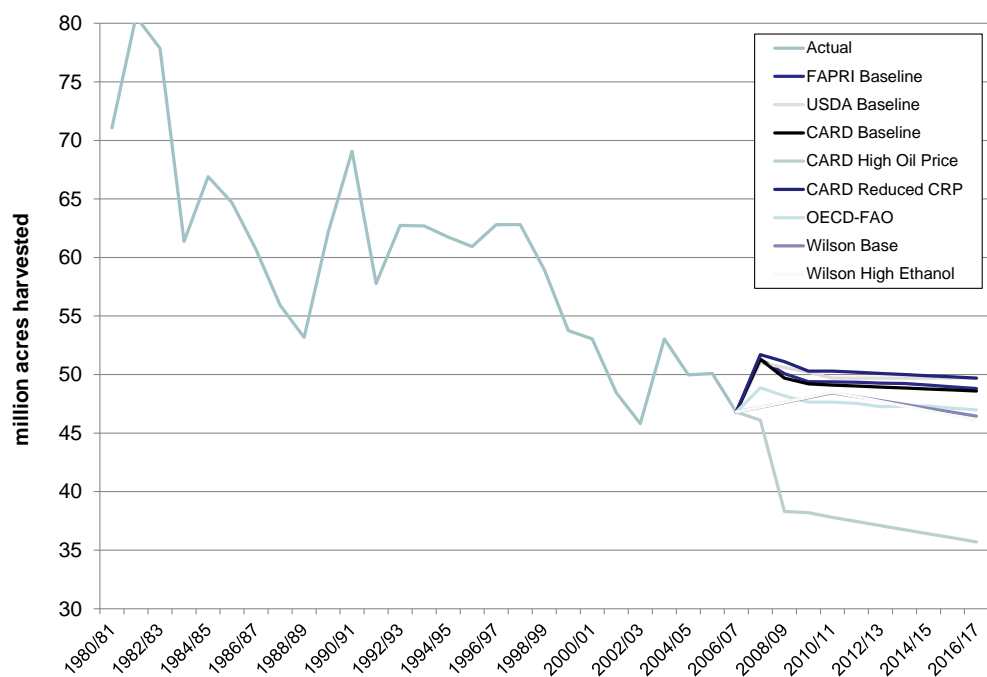


Figure 9: U.S. Harvested Wheat Acres, 1980-2006 and Projections for 2007-2016.



Management Response to Supply-Chain Risk: *Improve Efficiency and Diversify*

There are a multitude of mechanisms that are important in supply-chain management in agriculture. These include varying forms of hedging and cross-hedging, use of contracting mechanisms, geographic diversification and use of buffer stocks. Each are described briefly.

Hedging has been the traditional means of managing risks in the supply chain. This is certainly the hallmark of marketing strategies in agriculture. However, looking forward, hedging mechanisms in agriculture while essential, will pose challenges in further refining supply-chain management risk. There are a several reasons for this. One is that trading futures is really limited to a few large silver-bullet type commodities (e.g., corn, soybeans and wheat). There are many other commodities within agriculture that have exposure to risk that are not covered by futures, in addition to the multitude of emerging specialty crops or crops with special traits, by-products and services. None of these have direct hedging applications, but yet are a very important component of agricultural marketing. Second, for varying reasons the optimal hedge ratios for most commodities have decreased in recent years, ultimately meaning that hedgers are being exposed to greater risk than previously. Third, volatility in futures and basis has escalated drastically in recent years. In our calculations, as a result of the escalation in volatility, there is now about twice as much risk (as measured by volatility of prices; not net returns to production) compared to what existed in the 1980s. Hence, the demands on risk management and risk management alternatives are now very great.

An alternative to complement the use of hedging is direct contracting. While still minor by some standards, there has been an escalation in contracting and we would expect that to continue. The primary motive for this is that direct contracting has the impact of reducing more risk than can conventionally be achieved through direct hedging. Indeed, with the growth of specialty crops and crops with special traits, and battle for acres, the demands for contacting have escalated. However, these are compounded by alternative pricing mechanisms, act-of-God clauses, post-harvest price adjustments, among others,⁶ which is inevitable given the interfirm and intercommodity competition that has emerged in recent years. For numerous reasons, direct contracting is escalating as a means to supply-chain management.

A third strategy for supply-chain management is geographic diversification. Indeed, this is a relevant strategy for firms operating in some of the minor commodities that for varying reasons are being squeezed out of traditional production regions. These include malting barley (northern tier, west and Canada), durum wheat (northern tier, Canada and desert durum), and sunflower, amongst others. In each case, because of the high degree of risk in procuring commodities from a single region, it is in most firms' best interests to diversify geographically. In fact, there is a

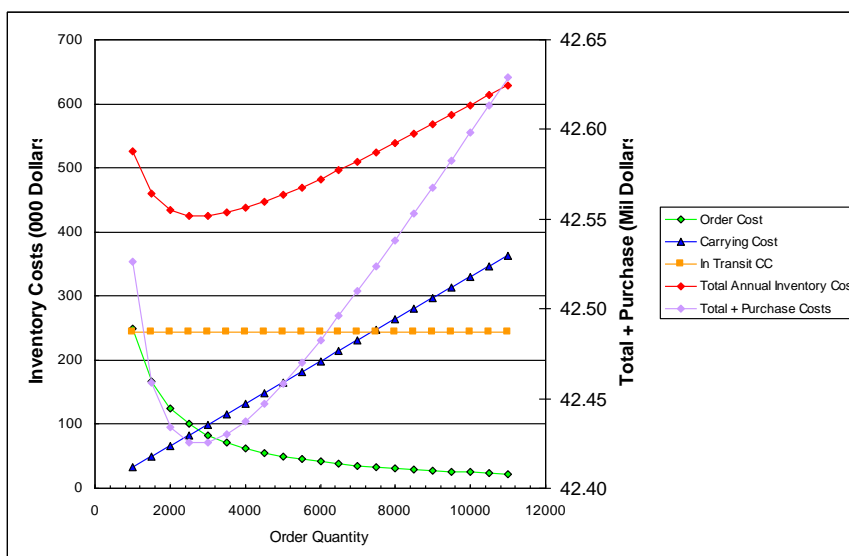
⁶ See Wilson and Dahl William W. Wilson and Bruce Dahl. 2009. "Grain Contracting Strategies to Induce Delivery and Performance in Volatile Markets." *Journal of Agricultural and Applied Economics*, 41- 2(August 2009):363–376; and greater detail in William W Wilson and Bruce Dahl, 2009. Grain Contracting Strategies: The Case of Durum Wheat, Agribusiness and Applied Economics Report No. 648, August 2009.

distinct risk/return tradeoff in these decisions in that diversifying typically results in reduced risks, but, greater costs.

A fourth strategy is inventory holding, or buffer-stocks, which are form of temporal diversification. Indeed, one of the principals of supply chain management is that in those commodities with varying forms of risk, the appropriate strategy is to increase the level of inventories. The purpose of this is to manage risks related to quantity, quality, price risk, as well as logistical risks including risks in modal arrivals, transit times, etc. (see below). Inventory holding is a very appropriate strategy for supply chain in agriculture, despite that it frequently is challenged financially by those promoting just-in-time type strategies. It is particularly appropriate for the commodities that are non-hedgable, and those that have excessive basis risks. A typical buffer-stock strategy would involve stock accumulation when prices are low and, drawing down stocks when prices are high. While costs are important, in many cases stock-holding would be less than the cost associated with market volatility.

While these are complicated and typically not used extensively in practice, they are important in managing agricultural supply-chains. Our approach to recommendations on these is that each is an important element of strategy. The role of strategic risk management requires assessment and use of each of above for portions of purchases. As a result, the important strategic questions are how much should be allocated to each strategy and how should these change over time?

The conventional model used to analyze supply chain strategies is commonly referred to as the economic order quantity (EOQ) model (Figure 10). It allows a quantitative assessment of all the elements of procurement costs, and an assessment of the tradeoffs between costs and inventories. The goal of the EOQ is to balance different costs in supply-chain decisions. Ultimately, the model seeks to minimize total costs and the optimal solution determines purchases, timing of purchases, and inventories. One of the results promoted by just-in-time (JIT) manufacturers is a recommendation of near-nil inventories. However, this is not true in agriculture supply-chain management due in part to the multitude of risks in this industry.

Figure 10: Conventional SGM Models.

Indeed, quantitative solutions to the EOQ problem results in it being appropriate to hold inventories in many cases. In agriculture, this is mostly due to the impacts of anticipated price changes, price risk, and risks related to quantity and quality. All of these result in solutions requiring more elaborate strategies regarding purchases, relations with suppliers, diversification and buffer-stocks. This form of temporal diversification—intercrop year is common in many industries and provides partial risk protection against is just the opposite of JIT.

Finally, as an important observation in agricultural marketing, supply-chain management (SCM) can be viewed as elements of a firm's vertical strategy. During the late 1980's until current, many firms in agriculture pursued varying forms of vertical integration (grain exporters), and in some cases vertical disintegration (e.g., Sarah Lee). The general trend was for originators to become more vertically integrated and processors less.

While debates over vertical strategies will ensue, ultimately, these require very sophisticated quantitative analysis and formulation of combinations of strategies. We are now going to be observing a very interesting evolution on this issue. Anheuser-Busch has traditionally been one of the more strategically vertically coordinated agricultural firms in the United States.⁷ The acquisition of Anheuser-Busch by InBev represents a drastic departure from these vertical supply-chain management strategies. InBev paid a premium for Anheuser-Busch, in part, since it is a premium product (i.e. commands a premium in the market), which was due to a multitude of

⁷ Specifically, without being exhaustive, the goal was to promote their beer was made with the *best available ingredients*, and, fresh/dated. To achieve these goals, they had tight specifications on ag ingredients, and facilities, variety specific, vomitoxin, chemical use, storage, and used a consistent blend of ingredients across breweries by variety composition, and year of production. While not completely vertically integrated (through ownership), they did their own breeding, varieties, elevators, malt houses, and leases rail cars; they would be considered using tapered vertical integration in most functions, had extensive contracts with growers, were highly geographically diversified, and temporally diversified through the use of inventories.

vertical controls and marketing. However, these two firms have radically different approaches to vertical management. InBev strategically outsources as much as possible, uses incentive contracts and base management bonuses (very substantial by industry standards) on cost savings. In practice they would anticipate adjusting product quality if crop quality problems occur (as opposed to retaining the same ingredient specification/composition). If prices increase, their view is that it would be easy to raise prices as competitors would have to as well, assuming competitors are not covered through contracts of inventories (i.e., assuming competitors are not behaving strategically).

This will be a big experiment to monitor. However, other major firms are going through similar, though opposite, changes in strategies. As examples, both Pepsi and Coke had pursued strategies of vertical disintegration. In 2009, each of these firms sought to re-establish vertical integration as a strategy by acquiring bottlers/distributors. And, the *Wall Street Journal* (Nov 30 2009) argued for more re-verticalization (Oracle, and others). This was a major change in strategy and attributable to changes in volatile commodity prices and financial pressures at suppliers. Specifically, they indicated,

The historical view of vertical integration was that “you had complete control of the supply chain and that you could manage it the best,” Today's approach is more nuanced. Companies are buying key parts of their supply chains, but most don't want end-to-end control.” If you're buying fully from a market, you are relying on that market's supply chain,”

Facilitating Mechanisms of Efficiency Gains in Supply-Chain Management

The global logistics industry is going through similar changes. In many countries that are emerging exporters, the primary scope of their changes is to expand infrastructure (as described above). In other countries, notably the United States and to a much lesser extent Canada, there has been growth in more sophisticated shipping mechanisms to improve logistical efficiency with existing or marginally increasing capacity. Indeed, these mechanisms are being evaluated for adoption in the emerging countries as well. The implications of this is that the elements (described below) that improve logistical efficiency provide the United States with a logistical advantage with existing capacity; but, over time, other countries may improve upon their own logistical efficiency.

The United States has experienced quite a drastic change in mechanisms that govern logistics during the past couple of decades, ultimately resulting in reduced shipping costs to growers and greater reliability of service. In the case of rail, the most important changes include transitions or adoptions as listed below:

- Box-car to covered hopper cars; to jumbo covered hopper car shipments;
- Multi-car shipments: 1, 26, 52, cars, etc.

- Development of forward guaranteed shipments by rail: tradable, penalties for non-performance, or late; forward, etc.
- Demurrage: Increase in demurrage to encourage better utilization of equipment
- Shuttle trains: 110+ cars with incentives

For one major grain hauling railroad, 50-60 percent of volume is in shuttles (and DET's), and some of the export markets are nearly exclusively shuttle train shipments.

While the above could be viewed as a continuum of changes, the development, adoption and implementation of shuttle shipping is perhaps the greatest change.⁸ That mechanism requires shipping of 110 cars from one origin to one destination and then provides for continuing like movements throughout the year, or through multiple years. Incentive payments are made to shippers that load in 15 hours or less and unload similarly, and that provide following originations of like volumes.

The cumulative impacts of these changes are that rail costs are reduced and savings shared with shippers. This, incidentally, has provided an immense advantage to rail relative to barge shipping. As a result there has been major investment in rail shipping capacity and infrastructure (\$10+ million and track space). (Figure 11) For most shuttle elevators, turn-over is now 10 to 12+ times per year. The mechanism also has resulted in improved information transparency (See railroad www pages). Primary market results are available and an efficient set of secondary markets/transactions in shuttle commitments has evolved. Ultimately, this has resulted in an industry that is now simultaneously trading commodities and rail freight. In addition, by utilizing equipment more effectively, it has resulted in an effective expansion in capacity (Figure 12). Finally, this has allowed the railroads to evolving toward more “scheduled” shipments.

⁸ These issues are covered in: Wilson, W., S. Priewe, and B. Dahl. “Forward Shipping Options for Grain by Rail: A Strategic Risk Analysis” *Journal of Agricultural and Resource Economics*. July 1998, 23:526-544; Wilson, William W., Donald C. E. Carlson, and Bruce L. Dahl. “Logistics and Supply Chain Strategies in Grain Exporting.” *Agribusiness: An International Journal* 20(4):Autumn 2004; and Wilson, W., and Bruce L. Dahl. “Railcar Auctions for Grain Shipments: A Strategic Analysis.” *Journal of Agricultural & Food Industrial Organization* Vol. 3, No. 2 (Article 3):1-27, 2005

Figure 11: BNSF Shuttle Franchises, 2000 and 2009.

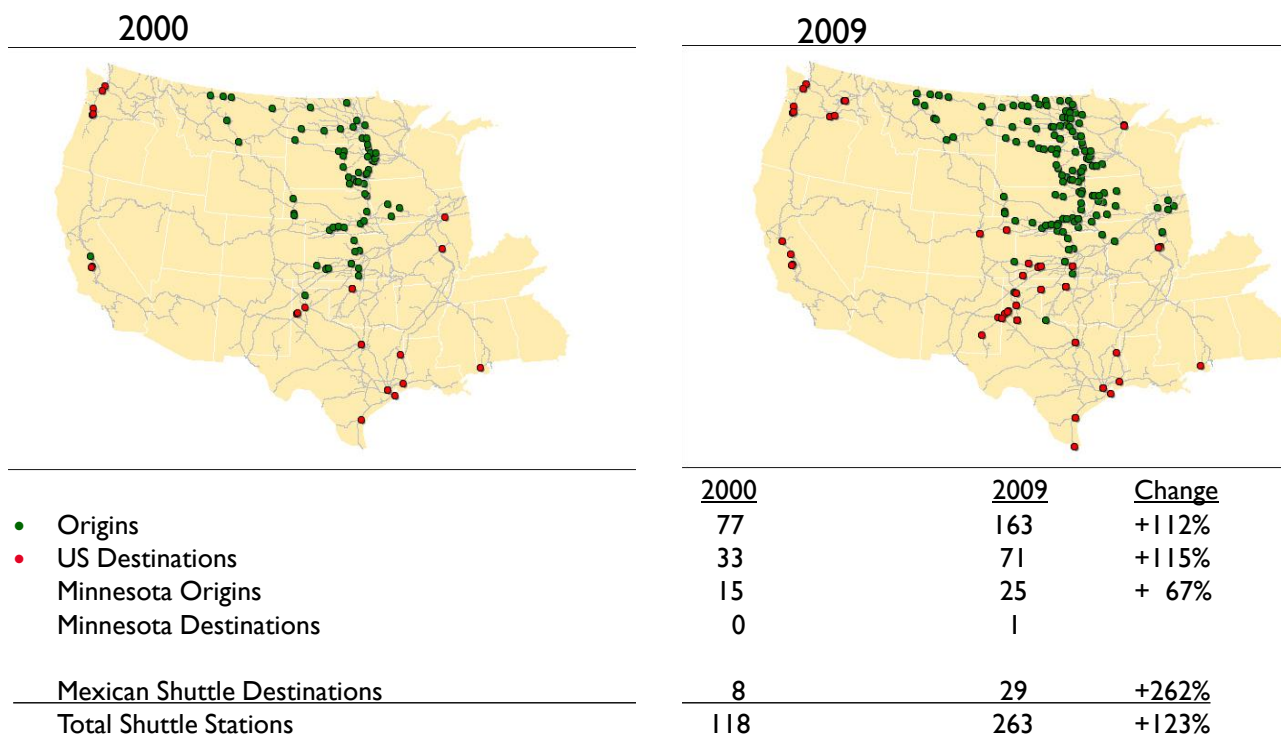
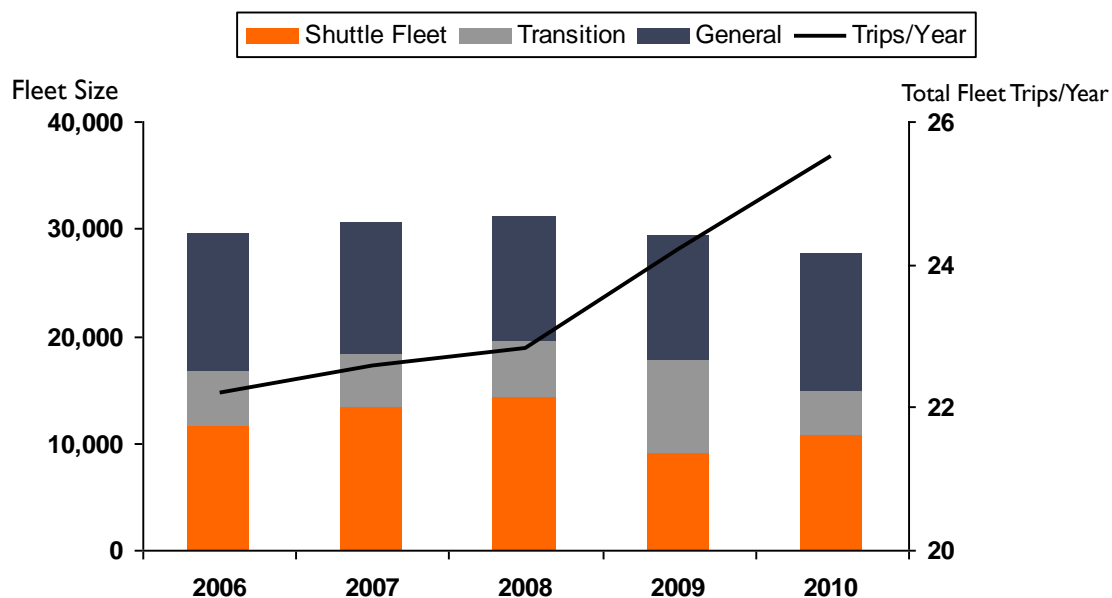


Figure 12: Rail Transportation Capacity and Trips/Year.



Summary Points: Implications

These are very exciting times for agriculture and investment opportunities in global logistics in particular.

From a macro-perspective, it is important that demand growth is exceeding productivity growth (1-4 percent per year). This is being driven by population growth, income, urbanization and changing diets; and, new uses including biofuels. Regions of particular importance with stronger growth include: China, Asia and North Africa. Using conventional technology, productivity growth is about 0.8 to 1.4 percent. With new and proposed advances in breeding (inclusive of molecular breeding and genetic modification), productivity could increase to prospectively 3 to 3.4 percent per year. With these growth rates, most of the increased production (to meet demands) will come from productivity growth and shifts in the geography of production.

There will be some important geographical shifts in production. In general, this will result in the United States increasing soybeans and corn and shifting away from small grains. South America will increase soybeans and corn. The FSU will become more domineering in small grains and non-biotech crops. Biotechnology will be a game changer and induce changes in productivity growth rates, and spatial geography of production.

From a global logistics perspective, major investment in infrastructure is needed in both the FSU and Brazil. While plans are in place for this to occur, it will still be subject to political processes, competitor interactions, and take an elongated period to be realized.

The United States has an important advantage in agriculture due to its existing logistical infrastructure. This is in addition to more efficient management/use of infrastructure through innovative pricing mechanisms. Within the United States there have been increased shipments, notably by rail, in part due to the adoption of shuttle train shipping. In addition, a new export facility is under construction at Longview? These are in addition to more innovative management mechanisms to induce efficiency – having the impact of greater throughput with existing capacity.

The implications of these changes for the agricultural industry are that over time there will be greater competitive pressures for shipments from non-US origins. In the United States, there will be pressures for more forward-looking transactions, including greater detail on shipping mechanisms, requirements and assurances. This requires mechanisms to reduce/manage risks for buyers and sellers for longer periods than previously required. In the future, there will be investment lags/gains (in all countries) to accommodate changing geography of spatial trade in agriculture. There will also inevitably be greater emphasis on managerial control of supply-chains. There will be challenges with escalation of emerging highly differentiated GM traits (i.e. in soybeans and corn), and wheat (10 years). Finally, there will be greater needs to create mechanisms to improve efficiency of supply-chains and to achieve greater volume with existing capacity.

Industry Panelist

Transcript

*Patrick Kleumpke
Executive Vice President
CHS, Inc.*

Thank you. You know I just have to take a moment to get my presentation calibrated on the fact that, although we were very honored we were extended the invitation to come to such a “distinguished group,” I have been asked throughout yesterday afternoon and evening, just who is CHS. Although we do not have a power-point presentation that allows us to very subtly advertise our company, such as some of my colleagues are able to do, I do want you to know that CHS has some of the following attributes I quite honestly believe and hope are going to lend further enhancement to this gathering today.

CHS is a farmer-owned organization. We are based in St. Paul, Minnesota. But we have two primary business operations and that is where we get the connotation of C and HS. C is for Cenex, and it is the farmer-owned organization that developed their business model around refining crude oil. They were emulating the strength of supply-chain logistics and distribution throughout the upper Midwest of the United States.

Harvest States was the farmer-owned coop that did the very same thing: replicated their business model around grain marketing, again logistics and distribution in the United States. These two organizations came together in 1998 and today, although we are truly a commodity-driven entity, we have a global platform that spans across the primary production regions of the world to which I am going to address in my presentation.

We are an organization that runs about \$26 to \$28 billion in annual revenue, excluding any of our joint ventures that are off-balance sheet. You heard about one – Ventura Foods. We also have another joint venture with Cargill in the wheat flour milling business.

At the end of the day it is a farmer organization that is taking the business model and truly emulating it in a global nature. Today we have marketing offices in Calgary, Tokyo, Shanghai, and Hong Kong. We are opening one in Singapore. We are in Buenos Aires. We are in Mexico City, São Paulo, Kiev, Geneva, and in Barcelona, Spain. I don’t say that to enhance. I only say that because I think I now have a better appreciation of why Jason Henderson was rather persistent when he called and said, “I would like CHS to talk about evolving agricultural supply chains and what is going to happen in the middle with these crop input suppliers. Whether they are distributors, wholesalers, or dealers, where do you see that all going?”

Then the light bulb finally came on and I said, “I think we can do that.”

So, with that, I have some remarks I would like to go through for you this morning. Again, our responsibility is to talk about the evolving agricultural supply chains.

To better understand and position today’s debate concerning that question, which is how market or government policy forces are going to influence the crop input industry that serves production agriculture, we have to narrow the focus. I would like to draw your attention to some of the following criteria I believe are good benchmarks for us to better understand how we are going to answer it.

First, I would like to divide production agriculture to include the primary global production regions of the world. I am going to give you some examples. A big, distinctive region of the world we watch and participate in is from the western Canadian prairies to the U.S. delta. That is one distinctive region we have to address when answering this question.

Another is from the state of Mato Grosso in Brazil to the state of Buenos Aires in Argentina, another big production area of the world. We have the respective coasts of Australia that play a very important role and are the third region we participate in.

The fourth is the Black Sea region of southwest Russia, Ukraine, and Romania.

Second, I would like to define production agriculture to include cereals, feed grains, oil seeds, rice, cotton, sugar cane, fruits, and vegetables. These truly are the crops a production farmer identifies with on a global basis.

And third, I would like to define production agriculture to include the farming units of 1,000 hectares, which are approximately 2,500 acres or more. As I travel the globe for our company – and I don’t say this with a degree of arrogance on a farmer – but they will truly tell you, if you are not at that minimum, you’re not really serious about being a farmer.

For anyone involved in the agricultural input supply business, whether you are a manufacturer, a wholesaler, a retailer, or a franchise dealer, it is truly all about knowing and accessing the crop acre, with the farm operator making the ultimate decisions. He or she truly is the gatekeeper.

Here are some emerging characteristics I wrote down to best describe this global farm operator we are trying to get our arms around today going forward. Looking at a number of different sources, I pulled up a number of random ones. At CHS we believe they account for more than 70 percent of all crops produced and represents less than 15 percent of all farm entities globally.

They are more focused on net return per acre, than on yield per acre. It is a business; this is not a way of life. They allocate capital to fixed assets and efficiency enhancements that have priorities based on highest returns over stated periods of time. They manage working capital, so that liquidity is their priority. They separate technical expertise from product placement and

control access to an ever-increasing degree. For all of us who think bundling works, that is not necessarily the case for this group.

They seek out knowledge and expertise beyond the farm gate and they are willing to pay for it. Risk mitigation is as important as price discovery to these farm operators when deciding on a supply channel.

For this farm operator sector, crop inputs such as fertilizer, certain chemicals, capital, and fuel are viewed as commodities. While new-generation seed powers units such as combines or tractors, as well as advisory services, they are technology traits and they have proprietary rights. Commoditized inputs therefore are an expense that needs to be controlled, while technology inputs are an asset that needs to be fully utilized.

To this farm operator, controlling expenses means using only what you need, when you need it, and purchasing from competing vendors, while deploying assets means leveraging attributes that improve productivity and efficiency. And you really have to know what you are bringing to the marketplace. Am I a commodity or am I an attribute?

These common denominators that I have just reviewed have come about in more recent years. It wasn't that many years ago where there was an acknowledged and significant comparative production advantage among those different regions of the world. We have often heard Western European or American farmers with a degree of swagger who thought they would always have the comparative advantage when compared with their global farmer competitors. An example of this point: Western European countries, such as Germany and France, have some of the highest yield value production land known. Government policies and marketing programs have enabled those farm operators over the previous years to enjoy yields per acre that in turn rewarded the multistep input supply business.

Next, the production area of North America – also known for their established and reliable food supply – enabled and embraced the multistep supply channel that served their needs to again maximize yields per acre. These two regions were built on the premise of family farms, a way of life, and increasing yields.

On the other side of the spectrum, in the more recent decades, we have the new lands of the Black Sea region and the Mato Grosso of Brazil being more fully developed. These new lands in the form of previous state farms that were unable to produce for their country – not that long ago – or suitable land never before cropped have redefined the business model of delivering crop inputs to the tilled acre.

In these regions, farm programs or government policy that provide a safety net literally do not exist. Here farm operators who tend to be of significant size have had to rely on self-perseverance and create their own supply channels for access to crop inputs. Couple this with the continued consolidation of farmland into fewer and larger units throughout North America and Australia and you start to see the common theme for certain distribution channels to serve this global farm operator.

One that is starting to emerge is that of a business model that procures the crop produced, while providing a market price at planting time for the crop when harvested along with a commoditized crop input, such as financing or fertilizer, enhances the business transaction and assures delivery at harvest with appropriate lien instruments.

Going forward, global agricultural production will continue to shrink this comparative advantage that currently exists among different regions of the world, meaning the bottom performers are making increasingly greater gains than the top performers. As this comparative advantage shrinks, the crop input business sector will continue to redefine its role in value.

Some common trends already starting to be adopted across multiple regions for both technology products with proprietary rights as well as commodity view products are as follows: For the crop-seed sector that serves this farm operator, farm operators of the size and scope we are discussing are the targeted customer for direct sales from manufacturers. Seed manufacturers have created a more streamlined channel between the seed source and field placement for this targeted producer that often excludes a wholesaler or retailer. Price discovery is limited and negotiated by the manufacturer. Viewed as an asset, herbicide-tolerant seed is highly prized in the United States but has limited markets globally until such time the demand side realizes the true economic value of GMOs. At CHS, we believe GMO is going to continue to be adopted across the wider global platform. Because seed is purchased just once per year for many producers, we view this as another trait or attribute.

We say retailers and wholesalers are often challenged to maintain volume and are relegated to handling second and third-generation seed varieties that account for a declining percent of the overall seed sales.

For the machinery sector that serves this farm operator, irrespective of color, this sector has a well-defined approach to global farm operators. Dealer networks, although franchised, are highly controlled by the manufacturer, so that parts and service are limited and internalized. Margins are maintained, transactions are infrequent, and price discovery is negotiated by the manufacturer.

For the advisory services sector, global farm operators are the primary users. They are looking for risk mitigation and price discovery. They formerly were used to market crop output but now are used for commodity crop inputs as well. They also have established long-term relationships and they truly are viewed as an asset by farm operators.

For the credit finance sector, lenders are demanding crop sales align with exposure of crop input expenses. Today, more farm operators are borrowing from nontraditional sources, such as dealers, manufacturers of inputs, as well as from the crop buyer. Farm operators are starting to embrace structured finance, meaning they bring discipline to their balance sheet and they partake in how they are going to structure financing and not necessarily just the lender or provider.

The price of capital is very transparent and is fixed multiple times throughout the year, depending on need. For the patent chemical sector, as patents expire pricing is becoming more generic. Tremendous marketing and sales expertise is chasing diminishing branded demand.

Rebates are becoming a residual pricing mechanism. Think of the pharmaceutical industry. Many industry wholesaler-retailers live off of rebates. Without rebates, profitability is minimized. Farm operators are starting to appreciate price discovery and purchase from multiple suppliers. Renewed interest in 2,4-D-type herbicides, meaning pre-Glyphosate herbicides that can handle these “Wall Street Journal superweeds,” subject to C-traits, are being developed and will reinvigorate certain premium pricing.

For the fertilizer sector that services this global farm operator, it is becoming globally marketed like grain and has high price transparency. Volatile price swings with limited hedging mechanisms have limited the participation of some wholesalers and retailers in recent years. Farm operators price products numerous times a year and from multiple suppliers.

Nitrogen, phosphate, and potash are generic. But certain introductions of this variable rate application and Micro Essentials from Mosaic are but examples creating new, but limited trends that allow for certain margin enhancements. Stand-alone fertilizer wholesale-retailers are consolidating. Therefore, in the North American market, the outlook for the crop input industry is as follows:

For the stand-alone input retailer, they are seeking alignment commitment with manufacturers in the industry channel with limited success. Offering risk mitigation tools for them is a challenge. Service requirements to this larger farm operator make it difficult for many to be successful in marketing to them. Going forward, significant numbers of retailers will elect not to invest to keep pace with current industry benchmarks.

For the multiproduct output-input retailer, they have significant investments in fixed assets in rolling stock and they truly want to emphasize full service. They are more active in offering financing or crop inputs to purchase harvested crop. In other words, they are trying to package it as a risk-mitigation tool. They tend to have large working capital requirements. And many single-location retailers may have limited growth potential going forward.

For the wholesalers and distributors in the crop input market, they are migrating to a broker status. They often compete on price only. As a new business model or player enters the market, many will consolidate or exit, creating fewer entities overall. The overall view of distributors and wholesalers is that eliminating costs can only take you so far.

For the manufacturers that have targeted this global farm operator, they are always concerned about control and influence of the channel. After the latest round of consolidation in the fertilizer manufacturing sector, manufacturers of crop inputs are in a strong global position. Manufacturers will continue to invest in global sourcing and tighter logistics. They can also influence price and knowledge with multiple product alternatives and markets.

In conclusion, this global farm operator represents a huge and growing market. We have witnessed manufacturing consolidation across a number of crop input sectors. As manufacturers have defined and strengthened their presence with a global access network, so too will global farm operators continue to find and strengthen their presence.

Wholesalers, retailers, and dealers that decide to participate in this sector of the market will be challenged to define their role and strength. For their success, we believe they will need three primary attributes for a successful business model.

They will have to develop risk mitigation tools across a broader spectrum of inputs. They will have to provide commodity inputs at a time and location when needed, not just at their local existence today or not just with one crop input. And, third, we believe to be successful you have to build the footprint that reaches global farm operators in multiple regions of the world if you are truly going to be success at executing this business model.

Industry Panelist

Transcript

*William Lapp
President and Founder
Advanced Economic Solutions*

Thank you for that kind introduction and good morning to everyone. I want to first congratulate the staff, Jason, Alan, and everybody working with them for a tremendous meeting here in bringing all these people together and organizing this so well. It's a privilege and an honor to have the opportunity to address the group today and provide a little bit of insight.

I want to elaborate a little bit on Advanced Economic Solutions. We have one primary competitor, Remedial Economic Solutions, who we typically dominate. They don't stand much of a chance. Advanced Economic Solutions works with restaurants, food manufacturers, a bit up the chain with some feed manufacturers, grain-trading entities, and also with financial firms, which is a new challenge. I'm hoping I can gain more insights during the course of this meeting in how to work with Wall Street types, but it is a different bailiwick.

I'll apologize in advance, before I make my comments, if I happen to be the first to cast any aspersions on the biofuels industry. I know it is considered in some camps to be blasphemous, but I have provided testimony to talk a little bit about what the other side in the balance of using a large share of crops for biofuels might be.

Dr. Wilson gave a great outline on some of evolving trends in the supply chain and some of the growth areas. And Patrick did as well. I think they covered it nicely. I have a bit different part of the food chain that I'm talking about and I want to talk about food manufacturers and restaurants and some of the challenges they're facing today.

It is a highly competitive industry. Growth is limited typically by income and population. It is an industry that has faced tremendous volatility in input costs in recent years. The evolution of larger grocery chains, such as Wal-Mart, has made it challenging for food manufacturers. The quantum leap in commodity prices we saw in 2007 and 2008 – we haven't returned to old levels yet – has been a big challenge in trying to pass those costs through the system to the consumer, which inevitably they will do, and has been problematic for earnings in many cases. I would be remiss if I didn't talk about the challenge of higher input costs created to some extent by policies that promote biofuels as well, of course.

One of things I wanted to talk about today is some of the changes in contracts that food companies are engaging in now. The typical food manufacturer or restaurant wants longer terms.

A similar trend in the ability to extend terms is already in place in Europe. This is helping reduce working capital requirements and lower inventories.

It seems to me in listening for the past two days the theme here is one of risk management. One of the evolutions in the supply chain – and I think I saw it first hand in the cattle-packing industry – is where you play “hot potato” with the risk in the market and it ends up in the hand of the entity or firm that is most capable of managing that risk.

We’ve been taught in economics and in our business world that being the low-cost producer is a priority, but it is also – and maybe these aren’t contradictory – to have a handle on who can manage that risk the best. There are weather risks, changes in demand, and government policies. We have talked about all these already and it is no different. That is one observation coming away from this meeting.

Dr. Wilson talked about some vertical integration in the industry. For restaurants of some of the national restaurant chains, one of the things I’m observing is whether in a vertical integration there is a vertical coordination and maybe that is the same thing. When a restaurant can allow their suppliers to do a lot of work for them, it sometimes involves a lower cost of production, a cost savings, labor is shifted to suppliers, and that levels out labor requirements. And food safety becomes more and more of an issue. So as we pass additional policies that are meant to protect our consumers with good intent, you see some evolution in the chain where there is perhaps vertical coordination as well.

We saw several charts in the past couple of days that showed the sizable leap in commodity prices, similar to what we experienced in the early 1970s. I’ve talked at length with some of my clients and others about this one-time quantum leap we saw in the past couple years similar to what we saw in the 1970s and some macroeconomic drivers – crude oil going up, changes in the value of the dollar, going away from the gold standard, and Bretton Woods.

We’re moving to a different environment. In the next couple years, we have not gone through the whole cycle of shifting this. In my view, we are still in the process of determining who will grow what crop in what location for what purpose. So there are a lot of gyrations, much as we saw in the early 1970s with spikes in prices, as we made those determinations. It was miraculous in 2007 that we saw corn acres in the United States go from 78 million to 90 million acres and we hit on the head exactly how many acres we would need and we’d have the right yield, so there wasn’t further trauma in the markets in terms of price volatility.

There are more costs to be pushed through the system. Livestock producers are seeing some of that. Realize this year, as the economy rebounds, we are seeing sharp increases in cattle and hog prices. Those are translating into higher beef and pork prices that I don’t think consumers have fully realized yet. Then, in the dairy sector, because feed costs are higher we’ve seen a higher milk price realized and we are probably not finished with the volatility in that market.

One thing I wanted to mention was some of the market influences in the drivers we’ve seen. Having spent many years, first at Quaker Oats and then at ConAgra Foods and now on my own,

following some of the same typical fundamentals you can hear about on the news wires on a daily basis – deliverable stocks in Toledo, the weekly crop condition report, the cattle-on-feed report, and the myriad of government data that come out – are the key barometers we've been allowed to focus on in terms of price determination. Just in the past couple years, for a variety of reasons, many more external factors are driving the prices than once were.

On a daily basis, and I did a small study on this, daily moves in commodities such as corn, soybeans, soybean oil, and wheat had correlations of 60, 70, and 80 percent with changes in the value of the dollar or the price of crude oil. So you're seeing these external factors having a much more dominant role. We can talk about index funds and external money coming into this market, a thirst for commodities, an overriding change in the environment, but this is here to stay at least for the time being. This is persisting and likely to persist into the future.

We are also seeing a closer tie to the change in the value of corn to what happens to crude oil, because of the large amount we're using for ethanol. When crude oil prices rise, it creates a floor for the price of ethanol, because ethanol producers are able to make money at a certain level. You see it also in terms of the price of soybean oil being tied to the price of heating oil, which is essentially diesel fuel.

Over the past 24 months, there has been over a 90 percent correlation between the price of heating oil and soybean oil. So it doesn't matter if the stocks are large or small, if the pressure is making money, if Argentina has a weather problem, or if China is buying, what you have to focus on is, are crude oil prices or heating oil prices going up or down today?

So there is a lot of influence from the energy markets as well. I am certainly not saying that is a bad thing, but it is a new reality in the world that is helping increase and decrease margins on a daily basis for livestock producers and food manufacturers in revenues obviously for grain farmers.

As I mentioned, crop shifts are going to continue. There are some crop shifts that have been going on for a long, long time. And Dr. Wilson showed a map where corn acreage was moving into the Northwest. That shift is probably going to continue.

The Red River Valley is an extremely important part of the world for food manufacturers and restaurants. There are a lot of crops grown there that are extremely important that are directly consumed. As we see corn and soybeans become more dominant in that area, you're seeing other crops move to other parts of the world. This is not a new phenomenon.

Dr. Wilson mentioned spring wheat being an important crop in Cass County and I am going to guess, at some point in time, that was the largest oats county in the country as well. It is continuing to make a metamorphosis. We've shifted oats to other parts of the world. Because we have tractors, we don't need as many oats in the United States, because the type of horse power has changed.

We've seen in more recent years durum wheat production and other specialty crops shifting out of the United States and more into Canada. So there are a number of factors that are driving this. Certainly they are not bad, GMO provides incentive to grow those crops where yields are increasing 3+ percent per year and it's going to discourage other crops. They have an economic disadvantage. They will shift to another part of the world, so sourcing those will be a different challenge.

There are other factors that influence that – crop insurance provides some incentives to grow some crops over other crops. The Farm Bill has different subsidy regimes and ethanol usage promotes more corn, just quite bluntly. These are things that, as we go forward, are going to continue to evolve. And it's not a bad thing.

One thing that strikes me I have not heard much discussion or dialogue on, and Rep. Peterson from Minnesota is going to face this challenge in particular as chair of the House Ag Committee, is that there is a tremendous push within the White House Administration now (well, for a lot of things obviously) but the one that most directly impacts is the idea of fruits and vegetables being a more important part of our diet.

We have a Farm Bill that is sizable in terms of the dollar outlays that does not direct much attention toward fruits and vegetables. As we go through the process of the next Farm Bill, I think that is a point of contention we haven't studied closely enough for what might actually end up happening.

The final point I'll make is that, in terms of food manufacturing, restaurants, and the end close to the consumer part of the value chain, there has been talk of offshore sourcing being a trend or a model where we draw in commodities. That goes along with my previous comments about shifting crops from other parts of the world. In some cases, it is cheaper to do so, but it is also certainly in many cases riskier. The rule of law is dominant in the United States, but it is dominant in all other parts of the world. So the idea of being a low-cost producer – if I could be the low-cost producers of TV dinners, but it involved sourcing in places where there was less certainty – there has been and will continue to be some trepidation. So management of that risk becomes as much of an important goal as being low-cost producers in many cases.

General Discussion

Evolving Agricultural Supply Chains

*Chad Wilkerson, Moderator
Vice President and Oklahoma City Branch Executive
Federal Reserve Bank of Kansas City*

Mr. Salmen: David Salmen with South Dakota Wheat Growers Cooperative. As a company, we're involved in building two shuttle loaders this year. At what point do you see the BN and Pacific Northwest as reaching capacity?

Dr. Wilson: I have that number. I don't have it just in front of me.

The most constrained part of the U.S. system was the West Coast, with the new investments going on at the West Coast, notably Bunge's investment but other expansion as well. They will expand that capacity fairly substantially. I measure things in terms of the risk of shortage of capacity or the probability of shortages. I remember prior to that investment, the probability of shortage of capacity there was about 0.3 percent.

Question from Audience: In your discussion, I noticed you did not mention river transportation, river systems.

Dr. Wilson: I had to cut off what I was going to elaborate too much upon. We have demands for improving logistics on the river system. There are plans in place through the Army Corps of Engineers to expand. They are expanding on that. I don't know exactly the current status of that, but I presume it is moving forward in terms of infrastructure spending.

Question from Audience: Have you done any work with containerization? What do you see in the future for containerization?

Dr. Wilson: Yes, I have. I am doing a huge project right now for the Army Corps of Engineers on our port areas, particularly the demands for expanding ports and dredging ports to accommodate increased containerization of all commodities, not just agriculture.

In our thinking on the model for this, we have a few pretty big game changers here. One is the expansion of the Panama Canal, which will increase the size of ships – in the case of containers, from about 4,400 TEUs to upwards of 13,000 TEUs through the new expanded canal.

That is going to force bigger ships in all modes of all commodities, but particularly container ships. What will happen is people will build more big ships. It is going to reduce the cost of container shipping.

The bottom line is we are a net importer of full containers. Our growth rate in containers is 10 to 11 percent per year. Even this year, as we come out of the recession, we are going to be growing about 12 percent per year. A lot of those containers prospectively return empty or filled with something of minimal value. So the golden opportunity for agriculture is finding those crops and commodities that can be efficiently utilizing that technology. This is already approved, as you know. DDGs and soybeans are taking full advantage of that, especially in my part of the country. There is more potential, as companies and railroads study more carefully how to tie together programs to those net deficit empty returning containers. So I think there is a lot of optimism for this. And there should be, because the major change in international logistics in the general commerce is containerization.

Mr. Wilkerson: Dr. Wilson, you mentioned buffer stocks as a potential risk-mitigating source. How prevalent is that becoming and what are some of the risks associated with that?

Mr. Wilson: It is prevalent in those products in agriculture that don't have direct, hedgable instruments. The reality is, for just about all agricultural products, there is more volatility than there used to be. The natural solution is to hedge it in the futures market. But there are a lot of things in agriculture that don't have futures markets and they have fairly poor cross-hedges, as well. So one way to reduce that exposure to risk is to carry some form of buffer stocks.

Bill mentioned the number of restaurants that want to have a longer view toward risk management. We have the corporatization of the food industries. Basically what has transpired is they don't want to absorb risk beyond two months forward. They want to find ways to cover that risk for maybe more than one year forward. Then you say, "Well, if I can't hedge it, but I have to manage these risks somehow, one prospective solution is buffer stock strategy."

To be honest, it is pretty common in things like malted barley, durum wheat, and other commodities I am not knowledgeable about.

Mr. Stevenson: Hello. My name is Brian Stevenson and I, like Mr. Lapp, am a consultant. Many of the clients which I have are involved in either the food manufacturing business or even up to and including the retail business.

The thing that has become obvious to me and what I hear from my clients, in the end commodities become products. Then products become brands. But the only way they become brands is through differentiation. What I find interesting is the discussion of moving this huge commodity source we have in the United States, and around the world as well, but yet what I hear from retailers and what I hear from food manufacturers is the true desire and the need for differentiation, which many times implies what would now be called a specialty product. Anything that is not U.S. #2 yellow corn is a specialty product or U.S. #2 soybeans is a specialty product.

The question I would have is, how is the supply chain ready today or may it be ready in the near future to manage these specialty products that are necessary to support these great brands of the likes of Sara Lee, Hostess -- these people? How are we going to manage this?

Mr. Lapp: One thing that comes to mind is it will be done in the least-cost fashion. If the transportation mode won't be multicar 52s, 110s, whatever it is, it will be more single cars and trucking obviously to meet those. There is a lot more potential for a vertical coordination. I see this in some end users of flour and they are promoting their product based on the higher quality of flour they have or are coordinating that all the way back to the producer. That is a fairly small share of the total market, but that is how that is achieved. When you do that, like Dr. Wilson was mentioning, you are prone to carry substantial inventories, which are costly, and the ability to be low cost is secondary to having a unique product you can brand and promote and have consumers identify with.

Mr. Kluempke: I would go on to say I think the logistics of distribution mentality in agriculture has reached the degree of sophistication, that we address those, in fact we are on the search for more. In other words, whether it is in Ventura Foods or whether it is in Horizon Milling, which are two of our joint ventures, or whether it is in our grain marketing, where we are loading containers of GMO-identified crops, I suppose five or more years ago the industry would have said, "Well, nobody really wants to pay for it."

I would tell you today those companies that have gone after that market have gone after it with a higher degree of success and have been rewarded for it. I would go on to say that over on the food manufacturing or on what I'll call the processed food delivery side, there are not necessarily that many entities that truly have viewed it as a big differentiator. It is surprising but a clear reflection there are still a number of food purveyors in this country who are in the retail side of the business who still have more of a commodity mentality where they are trying to push price down. That is still a fact we all have to reckon with.

Mr. Wilson: I will just respond. I've been in this business for a long time. I could tell a couple stories and give you a punch line. The punch line is our marketing system is very competitive and the competitor pressures will allow for ... see what's happened. It has to be buyers who really have to stick their necks out and say, "This is what I want. This is exactly what I want. This is how much more I'm willing to pay for it."

And put out a signal early enough – long term – that marketers can adjust their process.

Early in my career I did a project for a company in South America that bought 6,000 tons a year of white corn. I built a big model and said, "Ah! You should be buying at least a portion from North America."

So we interviewed all the grain companies. It was 1982 and we said, "We want to buy a significant amount of white corn."

They said, "We don't sell #1 white corn. We sell #3 yellow corn."

That was the response. And the company ultimately bought an elevator and started procuring their own white corn. Now, as it turns out, white corn has become a Cinderella-differentiated product in North America. That speaks well to the industry. To this day, they have

annual buying meetings and today the grain companies stand outside their door with seed bag samples of white corn to sell. It is a true story.

But in other commodities, malted barley, the whole industry today is based on variety-specific marketing – variety-specific because of taste profiles. That doesn't happen instantaneously. It is because the buyer has studied it and said, "This is what I want, this is the composition of what I want, and I have to get the signal out ahead of time."

Early, not many years ago, a major brewer involved put out contracts in March and discovered, in order to influence the production decision, they had to put out contracts in November and more recently put them out in August, so they can influence how much fertilizer was applied.

The point I am making is, The market system will respond, but it requires the buyers of the world to decide "what do I want, how much do I want, how much more I am willing to pay for it," and get those signals out through their suppliers very early in the market cycle.

Mr. Wilkerson: I'd like to ask one more question about vertical integration. We had examples of some companies moving more toward that. InBev is a big example of a company not moving toward it. Could you talk a little bit more about other examples? What are the general trends? Bill also talked about the restaurants.

Mr. Wilson: I will just comment and Pat can think about, because he knows about it. What I see, I am just telling you that in the academic world there is the picture-perfect world of how you decide the optimal vertical strategy. People in agriculture and nonagriculture have been experimenting. Where do we want to be on this?

We're having some very big experiments going on right now in terms of how we want to be vertically controlled. I think what will probably happen is there will be some features that will be highly vertically integrated. Certainly the grain-export business today, if you are not vertically integrated in grain exports I doubt you could survive at all. You need assets throughout the system.

In the durum milling business, in particular, that industry between flour milling and semolina and pasta has known become virtual vertical integration, certainly in the case of malted barley. In agriculture, because the stakes are so huge, everyone is going to study it, but they are going to choose toward trying to control certain functions within the vertical market channel, rather than complete and vertical integration. That would be my view.

Mr. Kluempke: And I would concur with that.



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Session 4:

Meeting the Financial Needs of Global Agriculture

Meeting the Financial Needs of Global Agriculture

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The vast majority of future agricultural supply and demand growth will occur outside of the U.S.. Whether they actively participate in it or not, U.S. agricultural producers and agribusinesses will be shaped by this emerging trend. This will increase U.S. agricultural finance's exposure to foreign markets directly and indirectly.

This paper discusses how the financing needs of global agriculture will be met. First, this paper highlights the differential in expected growth between the U.S. and global agricultural markets. Second, it examines the risks and issues that will accompany these developments. Third, the current forms of financing overseas agricultural exports and productions will be covered. Lastly, it will look at the impact of foreign agricultural investment's impact on the U.S. both directly and indirectly. Many of these changes are not new, but the rate of change will accelerate in the next decade. Agricultural companies and their financial partners that do not strategically plan for these opportunities and risks will find themselves severely disadvantaged to those companies that do.

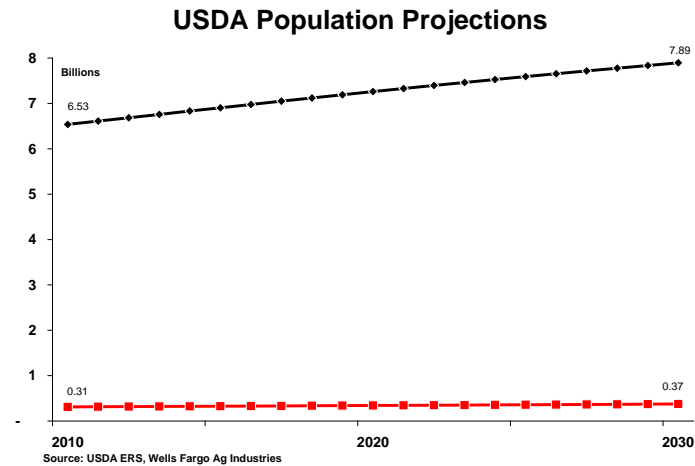
This paper can only start to outline the issues and their related challenges. Financial institutions in conjunction with their regulators will need to formulate the necessary strategies and tactics to solve those challenges. Additionally, it does not require the power of an oracle to predict that some of the agribusiness ventures will fail given volatile, complex and changing global financial markets. Hopefully, this paper will serve to advance the understanding of the risks and rewards in financing an increasingly globalized agricultural market place.

Where the Growth Will Be:

It is a mistake to believe that the U.S. is anything other than the premier agricultural market in the world. The U.S. is the third largest country by population in the world with an estimated 307 million residents in 2009. It has the largest gross domestic product (GDP) in the world at \$13.2 trillion in the 4th quarter of 2009. It has the highest population growth rate of any large and developed country at 0.98 percent annually. And, this population growth rate is projected to remain elevated at 0.87 percent through 2030 adding 66 million new consumers (Chart 1). These consumers will be the highest per capita income consumers in the world. All in all, there is no

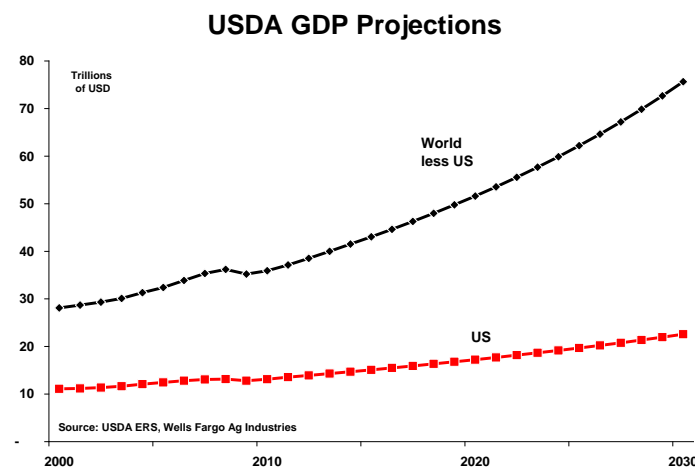
better agricultural market than the U.S. in the world, but even so the future of agricultural growth lies outside the U.S..

Chart 1



While the U.S. is expected to add 66 million new consumers between 2009 and 2030, the world outside the U.S. is expected to add 1.4 billion customers (21 customers globally for every one in the U.S.). The U.S.'s projected GDP growth of 2.8 percent from 2010 to 2030 remains remarkably high. The U.S. should add about \$10 trillion in economic activity, but during the same time period the world outside the U.S. should grow by \$40 trillion in economic activity (Chart 2).

Chart 2



The impact of the economic growth on agriculture will be very disproportionate. As poorer countries add economic activity, a very large percentage of it goes directly to new food

consumption. But in the U.S., very little additional income will be used for new food consumption. In fact, the calculated food and beverage income elasticity of the U.S. is the lowest in the world at .103 (a 1 percent increase in income leads to .103 percent increase in food and beverage spending).¹ And, much of the new “food” spending in the U.S. actually goes to dining outside the home which consists primarily of labor and capital costs. Even “in home” food spending in the U.S. is driven by packaging, advertising and convenience. In contrast, Indonesia has calculated income elasticity for food of .686 (a one percent increase in income leads to a .686 percent increase in food and beverage spending). Given the state of economic development in Indonesia, most new food spending will be on increased quantities of food and better varieties. The average calculated income elasticity of food outside the U.S. is 0.57. The projected global GDP expansion implies a tremendous opportunity for agriculture and agribusinesses.

The impact of GDP and population change has already had an enormous impact on agricultural demand and business opportunities. Table 1 shows the major protein categories and the estimated demand changes. From 2000 to 2010, the U.S. saw a 2 million ton increase in domestic protein consumption (beef, pork, broilers and turkey) with almost all of it coming from increased broiler consumption. At the same time, global demand, net of the U.S., saw a 39 million ton increase in protein consumption. This 20 to 1 ratio will probably continue to widen going forward given the differentials in population and economic growth combined with the relative saturation of food demand in the U.S. relative to the rest of the world.

Table 1: World Protein Consumption

Commodity	Country	2000 (Thousand metric tons)	2010 (Thousand metric tons)	Percent change (2000 to 2010)	Quantity Change (Thousand metric tons)
Beef and Veal	U.S.	12,502	12,080	-3.4%	-422
Swine	U.S.	8,454	8,548	-1.1%	94
Broiler	U.S.	11,474	13,661	-19.1%	2,187
Turkey	U.S.	2,223	2,381	-7.1%	158
Beef and Veal	World net U.S.	40,825	44,065	7.9%	3,240
Swine	World net U.S.	76,415	93,600	22.5%	17,185
Broiler	World net U.S.	41,182	59,699	45.0%	18,517
Turkey	World net U.S.	2,570	2,667	3.8%	97

Source: USDA, Foreign Agricultural Service

Clearly, the global opportunities dwarf the U.S. domestic market as the foreign government/private enterprises race to supply greater amounts of protein and specialty foods to the enormous global population. In the U.S., every small percentage of market-share is fiercely contested with very limited opportunities for higher rates of returns. In the U.S. domestic market,

¹ Income elasticity data for global food consumption were obtained from the U.S. Dept. of Agriculture, Economic Research Service.

to take out an established competitor a company needs to overcome both the differential in variable cost and the embedded fixed cost that keeps their competitor in the market. Many agricultural industries have very limited usage for their fixed assets outside of their specialized purposes. This high “barrier to exit” forces firms to fight to the point where the assets have become obsolete or simply of so little value that the fixed cost no longer justifies staying in the market. This oversupply of capital investment in the U.S. clearly limits returns on investment. An extensive sampling of food industry returns shows that most agribusinesses operate with a 3 percent net profit before tax and a 4 percent return on assets.

In the developing foreign markets, much of the growth is coming from the creation of large-scale specialized producers replacing small-scale general producers. U.S. style confined animal operations, while unloved by certain environmental groups, are extremely productive in terms of supplying high quality, low cost proteins. In fact, many developing countries need to develop consistent and reliable suppliers of proteins to justify the development of the additional links in a food supply that delivers high quality food. High-quality processing and refrigeration are vital to supply meats and dairy products with low bacterial counts and good flavor. However, it is difficult to invest large amounts of capital (even in a situation like China) if there is a fragmented and unreliable supply situation.

The efficiencies of the supply chain overwhelmingly favor collecting milk from one 5,000 cow dairy run by highly skilled managers than from 1,000 farmers milking 5 cows each with limited technical training. Additionally, the large dairy farm can invest in on-farm cooling and sanitary handling that the smaller producer cannot afford. These logistical advantages are true for every protein source. Another issue that drives this increase in the size of the producers is the control of pollution and other environmental impacts. While the individual 5 cow milk producers might seem to be low impact, their cows produce much more manure per pound of milk than the large scale modern facility. Typically, the small agricultural producer also has much lower standards of controlling manure runoff, but with the cows so spread out it doesn’t strike the casual observer as such. It is ironic that countries such as China are actively promoting the increased scale of agriculture while some advocates in developed economies are promoting the exact opposite.

This intensified knowledge approach to agribusinesses is where many U.S. agribusinesses have critical control of genetics, R&D and proprietary knowledge. It is these inputs that the foreign agribusinesses and producers are looking to attract in joint partnerships or foreign direct investment. Additionally, in many developing markets cost of capital is a major hurdle for development. Outside of China, the cost of long-term debt in many countries in South America can easily surpass 20 percent even for very strong agribusinesses. China is a very different story. The Chinese banking system uses bank loans as a form of joint public-private social development. It is very difficult to calculate the real cost of capital given the decision-making process that controls it. If an organization does not worry about profits, why would it worry about relative rates of return on its alternative investments?

The two primary methods for U.S. agricultural and agribusiness firms to participate in this demand expansion are direct export and overseas production. Direct export is the simplest to implement, and it is the one that most U.S. agricultural finance firms are comfortable with for risk management. The U.S. will remain one of the premier agricultural exporters in the world given its comparative and competitive advantages in agriculture. However, both U.S. agricultural producers and agribusinesses are increasing their overseas production. They rely on direct investment and joint partnerships to tap the global demand growth. These relationships are much more complicated than a simple export of goods. In some cases, the U.S. firm brings the capital and expertise to produce goods and services in these developing agricultural markets. In others, the U.S. firm primarily supplies expertise in terms of R&D or management practices. It is this overseas-based production that will challenge U.S. financial firms. These arrangements will be more complex and subject to risk than an export transaction.

What Are the Risks?

The risks in lending to overseas agricultural businesses are the same as lending to domestic plus some additional risks. Lending to domestic agricultural production and agribusinesses encompasses the challenges of volatile input and output prices, weather, government policy, trade disputes, competitive change and management problems. Overseas based lending has all these and adds even more. Even something as simple as language can be a major risk. Although many participants speak English as a business language, it isn't always the case that documents will be provided in English. Overseas lending requires financial institutions to understand additional legal environments and political risks. Collecting on collateral in a foreign country can quickly become problematic. Convincing a foreign court that a U.S. financial institution is entitled to the collateral over the interests of a national entity can be highly challenging in many countries. Additionally, currency volatility can be a major risk when the assets in a foreign country earn in that country's currency, but they need to repay debt in U.S. dollars.

These risks are both a problem and opportunity for commercial banking. Agricultural financing companies that help solve these problems can expect excellent fee based income in addition to loan income. In the U.S., there are many agricultural companies with adequate management for commodity production or processing in the domestic market, but whether they are up to the challenge of dealing with overseas management is an open question. The large multinationals such as Cargill, Bunge and ADM have built up their business overseas for decades, and they have developed their staffing and expertise to deal with the issues. It is very easy to see deals that looked certain come apart from hidden agendas that American agribusinesses do not understand as well as their foreign counterparts.

One of the major problems that U.S. commercial banks have with these foreign relationships is the accounting and asset valuations. In countries such as China and Brazil (the two most important agricultural growth markets), accounting rules might be clear and concise, but the implementation and practice can be very different and misrepresentative. It is a difficult

balancing act between being too naïve and too cynical. An overly naïve approach would say that the “audited” results from China or Brazil are equally valid as audited results from the U.S. or Europe. The overly cynical approach would say that the audited results have no validity at all. The messy truth lies somewhere in between. Additionally, given the lassitude and uneven application of legal rights in developing markets, legal claims on assets have a greater risk as well.

How should a U.S. financial firm start to develop a framework for evaluating overseas lending risk? It can start by consulting a wide variety of rating agencies and governmental assessments. There are a large number of economic consulting groups that prepare ongoing country reports that track economic and political risks. Both the rating agencies and consulting groups charge significant fees for their reports, but it should be considered an ongoing cost of business to be covered by the loans being made. Likewise, the USDA Foreign Agricultural Service (FAS) has mandated country risk rating associated with its support of U.S. agricultural exports. The country ratings and risk premiums are published on their website. The results are public, but their methodology and working notes are not. The appendix contains their current country risk ratings and risk premiums as of May 2010.

Lastly, if U.S. financial firms are going to finance overseas investments for their domestic customers, they need to develop the attitude of “going to see for themselves.” Being physically present in the foreign market is crucial for having positive results. The domestic agribusinesses and producers seeking financing will need to have a strong plan and execution for representing their financial interests on constant basis. Too many U.S. farmers have failed in their overseas farming ventures due to a lack of physical and reliable representation. Just as domestic collateral audits and operational inspection visits are crucial to understanding clients and preventing fraud, these types of interactions are even more important in overseas financing. U.S. financial companies should not underestimate the cost and stress of these foreign visits. There is very little glamour to checking cattle pens in Nebraska and even less in the interior of Paraguay.

How Will Growth be Financed?

The problem for U.S. agricultural companies and the banks that finance them is not a lack of opportunity. Rather, it is how to expand into these markets while maintaining the right risk/reward balance with the firm. Traditionally, many U.S. agribusinesses have been content to export their U.S. based production to the next best global buyer. Historically, even this limited approach was left to the giant agribusinesses such as Cargill, ADM and Bunge among others. Smaller firms didn’t have the staffing and expertise to tap the foreign markets directly. Over the last decade, many smaller firms, especially those with specialty products, have developed their own export operations to tap into the rapidly growing global market. Even though they work with many of the same foreign companies on a repeated basis, they still approached the business as transactional. They typically looked to their financing banks for letters of credit and foreign

currency transactions (including hedges). They also turn to the USDA for guarantees to take out a large amount of the transaction risk.

The U.S. government views agricultural exports as a key support mechanism for U.S. agricultural producers. The Congress has directed the USDA through a variety of agencies to help promote U.S. agricultural exports. The USDA runs trade missions to help showcase U.S. agricultural products. It also has a number of credit risk programs to help U.S. agricultural exporters and their financing banks. The primary idea was that by pooling risk through a government-financed risk program more exports could be made.

Using the federal government's resources as a backstop, the USDA has been able to pool risk through a series of programs; GSM-102, GSM-103, SCGP and the Facility Guarantee Program (FGP). The USDA assumes the bulk of the risk in these programs, but they rely on letters of credit with their discrete transactional nature. This limits the number of factors involved, lowering the risk of the unknowns. Even the FGP is transactional in nature even though it involves term financing for facilities in foreign countries. The program provides payment guarantees to finance commercial exports of U.S. manufactured goods and services that will be used to improve agriculture-related facilities.

Outside of the USDA, another major program for financing agricultural production overseas comes from the Overseas Private Investment Corporation (OPIC). This is a U.S. government-sponsored entity (see the appendix for the OPIC's mission statement). The OPIC program serves non-transactional needs. In a particular example, the OPIC program allowed a company to expand agricultural production in Chile using the Chilean assets as collateral. The expansion faced all the classic problems of encumbering its U.S. assets to obtain U.S. financing of these Chilean assets. Even though Chile has a low risk for country risk rating at 1 (0 being the lowest with 6 being the highest), using collateral in the country was restrictive. Chilean rates of financing exceed 20 percent on an annual basis for in-country financing even for a very strong borrower. All of this simply illustrates the difficulty of expanding operations in a low-risk country that has a free trade agreement already in place with U.S..

The OPIC program helps overcome these barriers by using a governmental risk-sharing approach. OPIC offers a variety of loan structures; corporate finance loans, project finance loans and hybrid loans structures. However, the OPIC program does not come without its own set of challenges. Involvement with a government sponsored entity comes with the goals of the government being considered. OPIC states "OPIC promotes U.S. best practices by requiring projects to adhere to international standards on the environment and worker and human rights." This requirement could potentially require companies to incur a higher operating cost standard than their in-country domestic competitors. To the degree that it does raise the relative costs, the advantage in financing costs would need to be considered as an offset.

The OPIC articles of incorporation have special language concerning job losses in the U.S. and investment in China. OPIC is prohibited from financing projects that essentially transfer U.S. jobs overseas. The companies must show that the jobs created are incremental. Financing to

China has its own set of criteria to meet. This shows the political sensitivity of the lawmakers in providing this financing arrangement. No one wants to be known as promoting overseas jobs ahead of the U.S. or helping China more than the U.S.. These considerations are important to the political process that helps fund OPIC. Even so, OPIC financing can be a very attractive option for companies looking to expand incrementally in foreign countries, but they do not have sufficient free net worth to guarantee the facilities in their domestic operations.

What about Foreign Agricultural Financing in the U.S.?

It is also important to consider the impact of foreign investment and financing on agricultural producers and agribusinesses in the U.S.. This influence comes in both direct and indirect forms. Directly, many leading global financial firms see the U.S. as an excellent growth market. Even with the competitive agricultural lending environment in the U.S., there appears to be more incremental growth and market consolidation in the U.S. than in the EU, Australia and Japan. There are a number of strong foreign banks with a pronounced agricultural focus that entered the U.S. market. Rabobank (headquartered in the Netherlands) has been in the U.S. for a long period of time, and it has a particular emphasis on agriculture. Another, Bank of the West (owned by Paribas of France) has made a significant effort to gain market share in the agricultural production and agribusiness. And, Great Western Bank (owned by National Australian Bank Ltd) has also made a significant investment in the U.S. with focus on agriculture. This is certainly not a comprehensive list of foreign banks with a strong U.S. presence and focus on agriculture, but it illustrates some of the participants.

Why would these banks enter the U.S. agricultural market with its low interest rate spreads and highly competitive agricultural finance sector? They entered the U.S. market because their home markets are even more limited in terms of growth. The EU's projected population annual growth rate is expected to be -0.04 percent by 2020 according to the USDA's estimates. In contrast, Australia has better outlook for domestic population growth at 0.98 percent (roughly equal to the U.S.'s), but its current population of 21.5 million and limited water and arable land are constraining factors. Additionally, many of these markets have already seen considerable consolidation in banking numbers and specialization. This further constrains their ability to grow in the home markets. In contrast, the highly fragmented U.S. market with its \$238 billion in agricultural production loans appears inviting.

One effect of their entry into the U.S. agricultural finance market has been to make a competitive market even more competitive. Well-capitalized entrants into markets need to overcome entrenched lending relationships. Particularly, in the middle markets, banking relationships are centered on personal relationships. Advertising has very little impact on creating opportunities to form new relationships. Instead, banks entering new markets look to hire established bankers with large and successful portfolios in a particular market or segment. Typically, the strategy requires the newly hired bankers to wait out a "non-compete" period before they revisit their previous relationships. During this period, the banker works on

prospecting new customers. And, the new banks offer to participate in multibank deals. They are willing to take a non-agent role simply supplying money to get to know the potential customers. The newly arrived banks need to offer lower rates or more aggressive structures to demonstrate value to prospective customers.

The existing banks react to the new arrivals by strategically matching their offers to retain certain customers. Over a period of time, the market will shuffle agricultural producers and agribusiness between the established banks and new entrants. This leaves the overall size of the market little unchanged, but it typically has lowered interest rate spreads and weakened loan structure. Clearly, this development benefits the individual borrowers, but it has negative secondary impact on the industry. The recent financial stress in the livestock industry is the result of many factors and timing. One factor that should be reexamined is the loan structures and the rate spreads.

The recent stress in the dairy industry primarily involves the volatility of milk and feed prices, but the over expansion of supply and over leveraging of the operations involve the competitiveness of the agricultural finance sector. From the late 1990s to 2009, established domestic commercial banks, the Farm Credit System and newly arrived international agricultural finance focused banks fought aggressively for market share in the large dairy producer sector. As is typical, the battle for market share progressively lowered interest rate spreads and increased allowed leverage. By 2008, the agricultural finance sector was offering dairy producers essentially AAA credit spreads and very aggressive leverage rates. These loans were being made to individuals who in many cases had rudimentary accounting and risk management practices. The industry arrived at this state through very small incremental changes that were relentlessly in favor of the dairy producer over almost a decade.

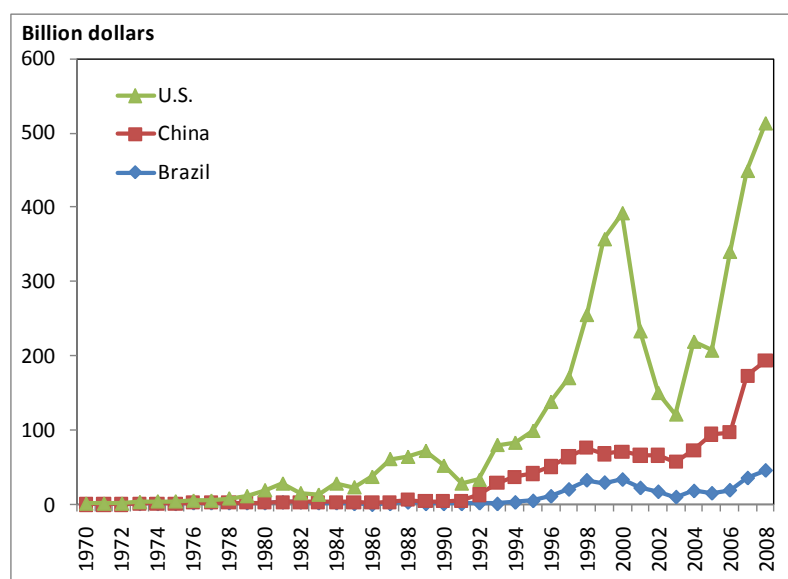
A clear example of overly aggressive structure was the asset value of heifers and feed stocks. From 2000 to 2009, the average value of cull dairy cows was \$550 (1,200 lbs. at \$45 per hundredweight). By the late 2000s, collateral values for heifers ranged from \$1,200 to \$2,000. The argument was that the cost of buying the heifers averaged \$1,600 during the same time period. While it was demonstrably true that dairymen bought the heifers for these prices, it was not true they would have those values in a distressed situation. During the industry stress period of 2009 and 2010, the dairy financing industry found themselves with technically insolvent operations with asset values that did not correspond to reasonable liquidation values. This situation helped impede the orderly reduction in excess supply. Whether the domestic agricultural finance sector would have arrived at the same situation without the pressure from new foreign entrants is debatable. Alternative history theories and econometrics will not provide an answer, but it is quite likely that they played a part in the situation.

The indirect effects of global financing also impact the U.S. agricultural finance system. Agricultural production and agribusinesses are often extremely capital intensive. One long-term advantage favoring U.S. producers and agribusinesses was their relatively low cost of capital. The other global competitors with similar cost of capital advantages were the EU, Canada and

Australia. Competitors in countries such as Brazil and Argentina might have low cost labor and land, but they have high financing costs that limited expansion. Historically, China was an inwardly focused agricultural market with limited capital availability. Clearly, things have changed in a significant manner.

Over the last 5 years, companies such as JBS SA of Brazil has taken advantage of a surging Brazilian stock market, a weak U.S. dollar and investor confidence to raise sufficient funds to buy major U.S. agribusinesses such as Swift (May 2007) and Pilgrims Pride (September 2009). While this is just one company with a unique strategy, it illustrates the dramatic change in the global financial system. While U.S. companies continue to make investments in key markets such as China and Brazil, foreign companies are making large investments in the U.S.. Obviously, these investments are spread out into all the sectors, but agriculture and agribusiness are targeted as well. This foreign direct investment is often influenced by financial institutions from the foreign investors' home market. The impact of these interactions is difficult to calibrate, but they nonetheless have a role in agricultural finance in the U.S..

Chart 3: Foreign Direct Investment, net inflows



Source: World Bank

The last element to consider is the changing global cost of capital and the impact of the differentials. While the U.S. is the premier agricultural market, China is the most influential in terms of future growth. The Chinese banking system has unique characteristics that make it very distinct from “market-based” systems. Capital allocation via bank loans in China is not made independently from the government’s goals and influence. Any review of the literature covering the Chinese banking system makes clear the tangled nature of the ownership and standards. In 1999, to resolve non-performing loan (NPL) issues, the Chinese government created special financing companies called Asset Management Corporations (AMCs). This financial development “improved” the Chinese commercial bank balance sheets by removing the NPLs.

However, the NPLs typically involved state-owned enterprises which were in turn financed by state-owned banks which in turn were helped by state-owned AMC's which were in turn financed by the Central Bank of China which is by definition state-owned.

The only thing that is clear about the Chinese banking system is that nothing is clear. What does this have to do with agricultural finance in the United States and around the globe? If you are going to compete in a capital intensive commodity production business with a firm that can access funds for almost free with very little incentive to produce profits, you might want to reconsider your own future strategy and profitability. Often, it appears that the Chinese state-influenced agricultural system prioritizes employment and output ahead of profitability. This makes competition with them problematic for businesses that need to worry about cash flow and repaying loans.

One clear example of this capital cost factor impacting agriculture comes from the crop chemical market. Glyphosate is one of the most important weed control chemicals in the world. Its price has plunged as it has come off patent, and Chinese firms with state financing have built enormous production capacity. This downward plunge in glyphosphate prices has impacted us, manufacturers, wholesalers, retailers and agricultural producers. Inventory valuations and business plans have been significantly impacted which in turn influence lending arrangements made in the U.S.. This is just one simple example where Chinese growth in a commodity, in part due to their capital costs, has impacted the U.S. agricultural finance system. There are many others with their own unique details but similar dynamics. How this dynamic will continue to play is impossible to predict, but it is a major consideration going forward in the agricultural finance system.

Conclusion

The outlook for U.S. and global agricultural finance is very positive. Population and economic growth will primarily occur outside developed economies. The developing countries will generate enormous demand growth both for more food and higher quality food. While the trend outlook for food production and its financing is positive, the volatility and complexity will also challenge domestic and global agricultural finance firms to properly assess and manage risk. Efficient markets are not markets that do not suffer business failures. Rather, they are markets where the consequences of those business failures proportionately impact the participants who took the risk in anticipation of the rewards. This efficiency is difficult to achieve due to competitive market pressures and government policies.

U.S. agricultural producers, agribusinesses and their financial partners can be influenced in any number of ways from developments outside of the U.S.. Exports, which are a major demand component of the U.S. agricultural system, can be influenced by both country and bank risk from global partners. The USDA has made a significant effort to help share risk through a number of government programs. These tools have been primarily transactional in nature. Additionally, U.S. agricultural producers and agribusinesses continue to expand their foreign direct investment

in agriculture. These investments are more structural in nature, and they require more complex arrangements. Once again, the U.S. government has provided assistance through the Overseas Private Investment Corporation to help U.S. companies expand globally. At the same time, foreign direct investment in the U.S. continues to grow, and the foreign financial institutions have made their presence felt through competition for the U.S. market and its customers.

Lastly, the cost of capital and capital allocation decisions can impact commodity markets in a very profound manner. It is a mistake to view agricultural commodities as “simple” products. In the case of agricultural commodities, they involve fantastically brilliant “embedded” technologies. The embedded technologies involve genetics, mechanization, automation, chemical, managerial and financial transactions that are astonishingly complex. All of these complex embedded technologies involve capital (human or financial) of one sort or another. All these “commodities” get moved around the global, and the embedded capital moves with them. Without a doubt, China’s role in global commodity movements will only grow. The size and complexity of the Chinese competitors will continue to grow. No commodity market or financing arrangement is completely immune to the decisions made by those companies and the Chinese government. All in all, the global agricultural finance markets will only become more complex and competitive in the future.

Appendix

The following comparison guide created by the Foreign Agricultural Service of the USDA highlights the different programs.

A Quick Comparison of USDA's Export Credit Program

GSM-102	GSM-103	SCGP
The GSM-102 Export Credit Guarantee Pro-gram guarantees credit extended by U.S. banks to approved foreign banks.	The GSM-103 Intermediate Export Credit Guarantee Program guarantees credit ex-tended by U.S. banks to approved foreign banks.	The Supplier Credit Guarantee Program guarantees short-term credit extended by U.S. exporters directly to their overseas customers.
Terms: Up to 3 years	Terms: 3 to 10 years	Terms: Up to 180 days*
Financing Instrument: U.S. dollar-denominated letter of credit	Financing Instrument: U.S. dollar-denominated letter of credit	Financing Instrument: Importer's promissory note
Coverage: 98% of principal and some interest	Coverage: 98% of principal and some interest	Coverage: 65% of principal and interest
Application: Most U.S. agricultural products	Application: U.S. livestock and genetics; occasionally used for bulk grains for specific countries	Application: Most U.S. agricultural products

*The 2002 farm law authorizes appropriations to cover repayment of credit up to 360 days. USDA will implement this change in individual markets on a case-by-case basis.

Source: USDA, Foreign Agricultural Service (FAS)

Facility Guarantee Program (USDA's fact sheet)

The U.S. Department of Agriculture's Facility Guarantee Program (FGP) is designed to expand sales of U.S. agricultural products to emerging markets where inadequate storage, processing, or handling capacity limit trade potential. The program provides payment guarantees to finance commercial exports of U.S. manufactured goods and services that will be used to improve agriculture-related facilities.

Emerging markets often lack the infrastructure to support increased trade volume. Export sales of U.S. equipment or expertise to improve ports, loading and unloading capacity, refrigerated storage, warehouse and distribution systems, and other related facilities may qualify for facility guarantees, as long as these improvements are expected to increase opportunities for U.S. agricultural exports.

Under this program, USDA's Commodity Credit Corporation (CCC) guarantees payments due from approved foreign banks to exporters or financial institutions in the United States. USDA's Foreign Agricultural Service (FAS) administers this program on behalf of the CCC. The financing must be obtained through normal commercial sources. Typically, a guarantee covers 95 percent of principal and a portion of interest. FGP regulations are found in the Code of Federal Regulations 7 CFR 1493.

Qualified Projects The Secretary of Agriculture must determine that the project will primarily promote the export of U.S. agricultural commodities or products to emerging markets.

Emerging Market An emerging market is a country that the Secretary of Agriculture determines: (1) is taking steps toward a market-oriented economy through the food, agricultural, or rural business sectors; and (2) has the potential to provide a viable and significant market for U.S. agricultural products.

U.S. Content Only U.S. goods and services are eligible under the program. The CCC will consider projects only where the combined value of the foreign components in U.S. goods and services approved by the CCC represents less than 50 percent of the eligible sales transaction.

Initial Payment An initial payment representing at least 15 percent of the value of the sales transaction must be provided by the importer to the exporter.

Payment Terms Payment terms may range from 1 to 10 years, with semi-annual installments on principal and interest. The applicable program announcement will specify actual payment terms.

Payment Mechanism Payment must be made to the exporter in U.S. dollars on deferred payment terms under an irrevocable foreign bank letter of credit.

Coverage The CCC determines the rate of coverage (currently 95 percent) that will apply to the value of the transaction, excluding the minimum 15-percent initial payment. The CCC also covers a portion of interest on a variable rate basis. The CCC agrees to pay exporters or their assignee financial institutions in the event a foreign bank fails to make payment pursuant to the terms of the letter of credit. The FGP does not cover the risk of defaults on credits or loans extended by foreign banks to importers or owners of facilities.

The OPIC states its mission as follows;

“OPIC Financing provides medium- to long-term funding through direct loans and loan guaranties to eligible investment projects in developing countries and emerging markets. By complementing the private sector, OPIC can provide financing in countries where conventional financial institutions often are reluctant or unable to lend on such a basis.

Business Categories

OPIC's **Small- and Medium-Enterprise Financing** is available for businesses with annual revenues under \$250 million.

OPIC's **Structured Financing** focuses on U.S. businesses with annual revenues over \$250 million and supports large-scale projects that require large amounts of capital, such as infrastructure, telecommunications, power, water, housing, airports, hotels, high-tech, financial services, and natural resource extraction industries. OPIC can also provide long-term working capital and multiple-year capital expenditure programs. The amount of capital needed for any project can be greater than one financial institution can provide on its own due to per-project limits or diversifications guidelines. As a result, OPIC works with other co-lenders, if necessary, to bring sufficient resources to a given project.”

GSM-102 (Premium per US \$100 of coverage) - Annual Payment of Principal							
Tenor	Risk Category						
	0	1	2	3	4	5	6
9 Months ¹	\$0.25	\$0.28	\$0.31	\$0.36	\$0.43	\$0.51	\$0.62
12 Months ²	\$0.30	\$0.34	\$0.38	\$0.44	\$0.52	\$0.63	\$0.75
15 Months ³	\$0.32	\$0.36	\$0.40	\$0.46	\$0.54	\$0.66	\$0.79
18 Months ⁴	\$0.37	\$0.40	\$0.45	\$0.52	\$0.60	\$0.72	\$0.86
24 Months ⁵	\$0.51	\$0.53	\$0.58	\$0.66	\$0.77	\$0.91	\$1.08
30 Months ⁶	\$0.58	\$0.61	\$0.67	\$0.76	\$0.87	\$1.03	\$1.21
36 Months ⁷	\$0.70	\$0.73	\$0.80	\$0.90	\$1.03	\$1.20	\$1.40

	Country		
	Country	Risk Category	Maximum Allowable Tenor
	Albania	5	1.5 years (18 months)
	Algeria	6	1 year (12 months)
	Anguilla	3	2.5 years (30 months)
	Antigua and	4	2 years (24 months)
	Aruba	3	2.5 years (30 months)
	Bahamas	1	2.5 years (30 months)
	Bahrain	1	2.5 years (30 months)
	Barbados	2	2.5 years (30 months)
	Belize	6	1 year (12 months)
	Botswana	2	2.5 years (30 months)
	British Virgin	2	2.5 years (30 months)
	Bulgaria	4	2 years (24 months)
	Burkina Faso	6	1 year (12 months)
	Cameroon	6	1 year (12 months)
	Cape Verde	5	1.5 years (18 months)
	Cayman	0	2.5 years (30 months)
	Chile	1	2.5 years (30 months)
	China	5	1.5 years (18 months)
	Colombia	3	2.5 years (30 months)
	Costa Rica	3	2.5 years (30 months)

References

Kroeber, Arthur. "China's NPLs: Another Financial Time-Bomb?" October 6, 2009.
<http://blogs.ft.com/dragonbeat/2009/10/06/chinas-npls-another-financial-time-bomb/>

Industry Panelist

Transcript

*C. G. (Kelly) Holthus
President and Chief Executive Officer
Cornerstone Bank, York, NE*

Thank you for the opportunity to speak at this important symposium. I will try to address two questions – they are as follows:

How do I see Cornerstone Bank, a rural bank in east central Nebraska, as a part of the “Golden Era” in U. S. Agriculture? The second question is how does global demand affect our bank and our customers?

To start with, I will give you a little background on Cornerstone Bank – We have total assets of \$900 million of which approximately \$600 million are in loans. Of the total loans, 42 percent are in ag-related production and real estate loans. An additional \$200 million are in commercial loans and, in our area, are primarily tied to agriculture. We have a service area of 11 rural counties with a total population of 150,000 people. I asked our Ag Department for information concerning our customer base and they told me the average age of our ag customer is 54 years. They also stated that the average customer has about \$250,000 borrowed from our bank at any given time.

At our bank our core depositors supply the funds we need to take care of our agricultural customers. At the present time our loan-to-deposit ratio is in the mid 70s which is considerably less than many agricultural banks. As a general practice, we do not buy brokered deposits and we only use Federal Home Loan Bank advances as a source of funding for brief periods of time to satisfy liquidity needs.

Other suppliers of credit in our area are commercial banks (The American Bankers Association (ABA) tells us the number of Ag Banks increased by 50 banks to 2,300 banks in 2009). Other suppliers are vendors, such as chemical/seed companies or farm equipment companies like John Deere. Farm Credit Associations are quite active in our area and life insurance companies do work the long-term real estate market. It is interesting that the suppliers of credit have changed very little over the last 25 years, except that Commodity Credit Corporation was heavily involved in the 1970s and 1980s in loaning money on grain that was in storage.

We all know that agriculture is very capital intensive and, therefore, the question – can commercial banks alone supply the credit needs of agriculture in the future? Our answer is probably not.

There are several reasons that our bank is not able to tap other sources for funding for additional loans. One reason is that we are family-owned and do not have the funds to increase capital to meet requirements. The regulators are quite strict on capital requirements for banks such as ours and, therefore, we have to keep that in mind while expanding our loan portfolio. We are also quite conservative in our management style and, therefore, have high underwriting standards.

Accounting rules set down by Federal Accounting Standards Board (FASB) certainly affect our ability to meet capital requirements. One example I will give is that we are required to set aside funds for vacation pay. In our bank that is about \$500,000 that could be used for capital and increase our lending ability. I have argued with our accounting firm that we will never use that money unless we close the bank as we fund vacation time out of each year's current budget and this money just sits in a reserve account and cannot be used to meet capital requirements. As you can imagine, I have never won that argument.

As the demand for agricultural loans varies a great deal from year to year, liquidity requirements are very critical to our bank so that we can service the needs of our agricultural customers.

In our area, our producers are either guaranteed a crop because of deep-well irrigation or financially reimbursed through CRC insurance and crop hail insurance. For many years we relied upon government programs to keep our farm customers solvent. The advent of CRC insurance and better commodity prices has taken a great deal of risk out of agricultural banking in our area. Even with a sure source of income, it takes a lot of capital to finance our producers.

Our customers on occasion have trouble meeting the down payment requirements because our land is selling at \$6,000 per acre. By regulation we require 35 percent down and usually a 5 percent repayment per year. Good farm land is not like buildings, it does not depreciate, but yet we require only 20 percent down on buildings and 15 percent down on houses. We need to work with our regulators to take another look at these requirements and also have the ability to work with these farm borrowers when they have one or two bad years, as history proves the value of the land always comes back to a higher level and as a friend of mine often told me – “they are not making any more land.”

In my 45 years or so of financing center pivots, we have never taken a loss. I say center pivot loans are like government bonds and after the last couple of years, may be even better.

It costs our farm customer \$500 per acre to grow a crop and if he cash rents the land, it would take over \$200 per acre. Plus, the larger farmers all have over \$1 million invested in machinery. As I stated earlier, agriculture is very capital intensive.

The basic rules for financing have not changed (we all need to remember the 1980s) -- they are good management practices, cash flow and earnings, and smart marketing with no speculation.

In our area we are in the “golden era” of agriculture. I do not see a crisis in regard to the availability of funds for agriculture, although the regulations may need some tweaking. Our farms are in strong hands with many being passed from generation to generation. There is no shortage of labor as there is a strong passion to be a farmer. Many of our young people that have left want to come back to the farm. In our part of the world, we are in good shape.

Thank you.

Industry Panelist

Remarks

*Dale Torpey
President and Chief Executive Officer
Federation Bank, Washington, IA*

I am Dale Torpey from Federation Bank in Washington, Iowa. I also serve on the board of directors of the Independent Community Bankers of America (ICBA) and am the chairman of the Federal Home Loan Banks task force for ICBA.

My bank is a \$110 million bank located in southeast Iowa in a town of 7,000 and with a county population of 23,000. We have 4 branches and employ 32 people. Washington, Iowa has been recognized for the past several years as one of the best 100 small towns in America.

Our role in Washington, Iowa is as a provincial financial entity. We support local businesses through lending and by buying goods and services from those local businesses. I serve on several boards and organizations as do nearly all of our employees. We make significant donations to local charities and organizations. We do not originate loans out of our trade area.

Most people in today's world would say you simply cannot compete doing business like this. So how do we compete?

First, as Harold Hill in the *The Music Man* liked to say, "We know the territory." Several of our employees are from farming backgrounds and are still active in farming. Many of our employees grew up on a farm. We know the business. We talk the talk.

We work on relationship building. We make sure our employees are seen in the community and that we contribute to the betterment of our community. We have one large regional bank in our area and quite frankly they are easy to compete against. They rarely if ever make donations in the community and they have several layers of management to go through to get loan approvals. We pride ourselves on making a decision on most loan requests within a 24 hour timeframe.

Seldom can we compete on rate and rate alone. If that is all the customer wants then we likely will not be able to accommodate them. But if they want a relationship then we can make it work. And we are successful at that. But we find many times those customers who left for rate alone come back to us in a year or two because they miss the extras that come with our relationship.

And contrary to what you read in the press or hear from Congress we have money to lend. The debtors have to meet our criteria for our loans, but I want to make sure you know we do have money to lend, as do all community banks.

These are some of the projects we have either been involved in or are currently involved in in our trade territory in the last few years:

- Biodiesel plant - this is a 30 million gallon plant that uses both soy oil and animal fat to produce biodiesel.
- Hog confinement construction - we are one of the largest hog producing counties in the United States. Nearly all of our confinement buildings are on a contract basis. We really only have three major suppliers so we limit ourselves to a few confinement buildings with each supplier. This limits our risk in this industry.
- ACE Hardware next to a Wal-Mart supercenter
- Chicken kill plant
- Organic creamery
- Organic egg plant

We sit in a unique area of the country. We have the largest Amish community west of the Mississippi within a few miles of one of our offices. They are an industrious and innovative group of people. They do organic as a way of life and now that it is all the rage they fit in very well to this new way of life. So we have learned to work with them and help them start up these new organic businesses. They have not been without challenges but they are working through the start up problems and are profitable.

- Wind farm construction - we see great opportunities in wind farm construction and in the production of electricity. The proposed wind farm in northern Washington County will cost nearly \$1 billion and will produce steady income for the farmers whose land the windmills are on. Plus, the property tax revenue produced will help level out property taxes on other property owners in Washington County. When this wind farm is fully operational, Iowa will produce enough electricity from all of the wind farms in the state to nearly meet the electric needs of our residents.

We see opportunities in technology in farming and in our banks that will allow us to compete on any level.

The increase in production on our farms has grown greatly in just the last 5 years and that will continue. Farms will be bigger and will need more capital and operating credit to continue to grow and feed the world. In our area, where land has sold for as high as \$8,000+ per acre, it is not unusual to have 250 bushels per acre for corn and 65 bushels per acre for beans.

One of our biggest challenges is trying to work with government restrictions and subsidies. The best example of this is the biodiesel industry. We helped start a plant in Washington, Iowa.

When the plant was built and started production it worked well. It did not turn the big profits they had anticipated when bean oil was \$.23 per pound, but they were profitable. Then in December 2009 the federal government (meaning the U.S. Senate) decided to let the blender's credit of \$1 per gallon of biodiesel expire. This has caused a loss of 20+ jobs in our plant and several thousand lost jobs throughout the Midwest. It has had a negative effect on the shareholders of the plant, on 23 banks in the Midwest who hold the loan on the plant and on many families who were depending on the plant operating. This is all because our senators have decided that this is going to be used as a political pawn.

So, one of our big challenges going forward is how much do we trust our government when they say they are going to subsidize an industry and when it is in its infancy they pull the subsidy? This will make many banks and individuals think long and hard before investing in any industry that depends on a government subsidy to make it work until it can gain market share and become a seasoned industry.

We also now have to deal with the new financial reform legislation that is working its way through Congress. This will affect everyone in this room in one way or another. It is not necessarily good for all of us, but it is just one more way that the government is intruding on our business and making it very difficult for small community banks to operate. As an example, we spent nearly \$100,000 per year in upgrading computer systems, training people, hiring third party compliance people and making sure we are in compliance for the overwhelming regulations that we have to abide by.

We work very hard to limit the risks in our loan portfolio. We have several models that we use to make sure we have limited interest rate risk on both the asset and liability side of the balance sheet. We have a review system in place that requires us to review each loan in our portfolio that is over \$200,000. We also have an outside third party review 20-25 large loans per year for documentation and for safety and soundness. It is a time-consuming process but because of our small size, we cannot make large loan mistakes.

We are very good with technology and we feel we are much more responsive to our customer's needs because we can react to market conditions quickly. You can look at all kinds of loan modeling, but they do not take into consideration our knowledge of the customer and that is a big issue in using only computer models to make loan decisions.

We do not directly compete with large international banks or national banks. Our biggest competition is with local community banks and farm credit and credit unions. We can compete with them on most deals, but farm credit and credit unions clearly have an advantage because they do not pay income tax on their earnings.

In the next 5-10 years, I think we as community bankers need to consider several possibilities that we are going to have to deal with:

1. Farms are going to get bigger and more complex.
2. They are going to need more capital and operating credit.
3. We as community banks will have to form consortiums between our banks to handle the larger loans that will be demanded by these bigger operators. We already work closely with 3 banks that we participate loans with to make sure we are not violating our loan limits. We will continue to find ways to make sure we take care of our customers and that we limit our risk.
4. We are going to have to search for value-added products that we can utilize to increase income to our rural areas.
5. We need to figure out how to educate the general population on where their food comes from and the processes that are used to get good, nutritious and safe food to their tables.
6. I think we are going to experience a moderate farm land price bubble.
7. We need to plan in Iowa on losing our local county courthouses and local schools. Our tax base can no longer continue to support 100 courthouses and over 330 school districts in a state that has a population of just over 3 million people.
8. We need to stop the sale of land going to investors who really do not care about the land or production but only about the rent payments.
9. We need to figure out how to get young people into farming. This will be vital because when the land owner dies or decides to sell if the family is not in the area we will lose another farm and probably get an investor instead of a farmer. I would suggest that we start a program tailored after the federal home loan banks affordable housing program. The farm credit agency could set aside 10 percent of their earnings and use it as a grant program for beginning farmers. I would also suggest that 10 percent of federal taxes the banks pay to the IRS be returned be set aside in a fund to help with grants to beginning farmers. If we do not do this we will wake up some day and find that we only have contract farmers working for large corporations who control the entire food chain in the U.S. and possibly the world. It is a scary thought.
10. We need to work with China and the South American countries on free trade. These are huge markets and China particularly is not going to be able to produce enough food to feed their population for the near future.

This is the bottomline. I have been a community banker my entire 39 years in banking. We are an independent bunch. We are a lot like the farmers we serve. We are innovative, we can react and make decisions much quicker than the mega banks, we know our customer, we will compete and we will survive and prosper.

Thank you.

Industry Panelist

Transcript

*Douglas Stark
President and Chief Operating Officer
Farm Credit Services of America*

Thank you. I think I am the young and beginning banker on the panel, based on their experience here today.

Hopefully we'll share some thoughts with you, as we talk about agriculture and agricultural finance that will be worthy and spark some thoughts and questions.

I applaud the Federal Reserve Bank of Kansas City for this conference. I am not only honored to be a part of the panel here, but privileged to attend. It's been very stimulating. It's been interesting to hear the diverse thoughts, trends, and implications for agriculture on a global and national level. It is also particularly intriguing to consider the implications of these on our respective parts of the industry, particularly as they would apply to our individual businesses.

As a member of the Farm Credit System and on behalf of Farm Credit Services of America, we are very proud to be a part of the industry we are all talking about and particularly to serve the group we are honored to serve. You are probably aware the Farm Credit System provides debt financing along the whole continuum of agriculture, from the young and beginning farmers that Dale talked about to national and even international agribusinesses. Although we do not have international lending arrangements, we do provide financing to companies that are involved on an international basis.

A couple of points I wanted to talk about specifically have been brought here across the conference, but I think are really appropriate as we consider the lender's perspective in this conference. They are not new to any of you. You've heard them mentioned several times. Dr. Swanson talked about it as well.

The first – and I will not go very deep in it, because they have been talked about already – is, what is the volatility we've seen? Even this morning, Dr. Wilson talked about volatility being twice what it used to be. He emphasized the point of it being twice what it used to be. We, as lenders, and also as producers think about this volatility. We look at all these charts and we look at the averages. It is not the impact of the averages that bothers me as a lender, it is the impact of the exception. As producers and as lenders, we are really looking at those dips and tails in these things that occur and whether we have the financial capacity and wherewithal to really see through these dips and tails we have as a result of this volatility.

Yesterday J.B. Penn and I had a nice dialogue at lunch around this whole supply-demand economics. He chided me a little bit about the Law of Economics has not been repealed, and it has not. But I would tell you, at least from my perspective, it is no longer a simple, linear equation between supply and demand economics. We can all attest to it. There are so many more parts to the equation that come into play today. The issues and the risk are now not only multinational, but they are multidimensional. So it is not as simple as just thinking about, “Okay, we have a balance sheet for #3 yellow corn and this is the usages.”

There are so many other things that go into that in globalized agriculture today. For example, we’ve seen just recently how the euro and then currency valuations can impact issues that happen on our farms and in our communities today. And there is no lapse in time on those issues anymore. When they impact us, they impact us immediately.

Bill Lapp also talked about even oil and energy prices and how they impact and how they are not even driven by agricultural issues anymore. So, when you look at the multidimensional aspect of agriculture, it has really changed the face of what we do, not only as producers and those we interact with, but also as lenders as well.

The other thing I wanted to touch on from an industry perspective was really – and it has been referred to here – the fundamental shifts going on in the industries themselves within the segments of agriculture. I think they are really imperative to understand and I am not sure we’ve figured out what that all means to us. Lenders are trying to figure some of this out and some of our producers are, as well.

It is particularly evident, as has been alluded to here in the livestock sectors – in swine, dairy, and poultry, where we’ve seen the vertical integration. We have seen contractual arrangements come into play much more so than has ever occurred in the past. It has changed the fundamental dynamics of those industries, even right before our eyes. I do not think we have figured out how to react to that.

As lenders, and I look at our own organization, we are trying to sort through it. So what does that mean for lending standards on the front end when you are providing services to customers? How do you structure deals? How do you provide the right kind of services in those kinds of arrangements that may be different than they have been in the past?

Even on the back end, we’re trying to figure it out. So what does that mean when you have a customer that gets challenged by the circumstances in those industries now by one of these tails or dips in the industry. And, certainly, I am not sure we’d say the last 24 months in the swine industry was a dip or a tail. It was much longer than we all anticipated, but that is really a result of what has changed on these fundamental structures. As lenders, we were trying to figure out how you react to that. How do you deal with customers?

Michael and I were talking earlier this morning about whether it is the dairy or swine industry. Are you going to be the lender who pushes your customer out the door, so to speak,

when that is the reduction in inventory that may be needed that brings the industry back around? Those are challenges lenders think about.

How do you work with producers? And who is going to make those adjustments in inventory where either the dairy or the swine industry as examples or even poultry, which participant in this industry or which segment now is going to make those adjustments? Is it going to be the large-scale producers? Is it the small producer? Who is going to make those adjustments? Who is going to blink first and make the corrections that are needed to lower inventory to reduce supplies so we can move forward? Those are some new challenges we have not faced in the past.

I would like to very quickly focus on three issues that will be a part of what determines who will service the finance end of the future of global international agriculture. These are not probably the highest priority. These are three I think are key. They are not the only ones that are going to apply as we go forward, but I want to outline three things from a lender's perspective.

Number one is capacity. When I talk about capacity, I am going to talk a little bit about financial capacity as well as intellectual capacity, because they both apply. We have talked about the human element a little already this morning.

The second one I will touch on a little bit, which is inherent in our business, is risk management. So I will talk about that.

And third is the role of technology and how it will shape the future in terms of the services we provide to producers and customers on a national, local, or even on an international level. It is going to be key as we go forward.

First, in talking about capacity, there are two segments to talk about. Those are financial capacity and intellectual capacity. On financial capacity, we have not heard from a single speaker that says agriculture is going to become smaller and require less capital. Not a single speaker has talked about that over the two days I have been sitting here. Everybody is talking about global agriculture requiring significantly even greater sources of capital.

J.B. Penn in one of his first statements said, "It is going to require a huge investment to meet the needs and the implications of a global agriculture."

I would say that it is going to occur both in debt and equity financing. It is going to be both sides of the equation. It is not going to be just leveraged finance and it's not going to be just debt capital, as the lenders here in this panel probably represent.

In addition, debt capital is going to be even more imperative, as leverage will be used with growing and sophisticated operations. If you remember the chart shown yesterday, as the size of operations grew in terms of total revenue, the return on equity also increased. That drives leverage. If you did not think about that, when the return on equity is greater than the cost of capital, you are going to drive leverage. And you will see sophisticated, large commercial

producers will want to leverage as strong as they can to expand and grow their operation. That dynamic is very true.

But you are also going to see equity capital becoming more of a key source in the agricultural landscape. We see it already. Dale mentioned it a little bit. We see investors in ag real estate that -- we see a bifurcation in terms of who owns ag real estate and who is farming it. More and more investors -- and they might be family members whether parents or grandparents -- owned a piece of Iowa dirt or are involved in that farming operation in subsequent generations, along with others in local communities could be community bankers or it could be other businessmen that are involved in agricultural real estate ownership as investors provide a key source of equity for young farmers even to rent land to get started. So those kinds of things are certainly in play.

We are also seeing investors becoming more involved in agribusiness ownership. We saw that evidence yesterday with JBS and we are seeing that more across the country, as investment funds and individual investors take a more active role in actually owning agribusinesses and being a part of that, not just with investing from a debt standpoint, but also taking a direct ownership position.

If you think about it, all the way from land ownership to agribusiness and the integration we have talked a lot about here over the last couple days, while integration will continue to occur, total vertical integration in most of these industries will not occur, simply because it takes too much capital. You cannot own the land, equipment, provide the labor, and fully vertically integrate in most of the industries we are accustomed to now. Some of them have moved that direction already and it has occurred. In other industries, such as the grain industry, that will be very difficult to accomplish.

In terms of capacity, financial institutions and the amount of money required to finance this growing production sector, as well as the agribusiness sector, are going to require bigger balance sheets. Thinking about the things talked about here already -- land, the technology in seed, equipment, technology costs, crop operations -- that whole aspect is going to take bigger balance sheets, as well as the scope and scale of livestock in agribusinesses. We saw those trends yesterday on some of the charts as well.

Even financing a family farm operation, as was pointed out yesterday, needs several million dollars. It is really challenging. And, as we see those trends continue which have been trends since the early 1900s in terms of the number of acres -- that is not going to change. Financing a traditional family farm operation is going to take several millions of dollars to accomplish and will take a bigger balance sheet than has been potentially available in the past.

As an example, I received a call last Friday from a customer -- actually I rarely get calls from customers -- it was not a customer (prospective customer) an individual I knew who was looking to move their credit line simply because their local lender could not provide the scope

and scale of financing they needed to expand their operation and move and grow in the direction they wanted to move.

Even if you say, “Well, we can put together groups of lenders and participate in those kinds of things,” which are viable options, and we are going to need to do to finance a global agriculture, partners in those transactions expect you as a lead lender or participant to take a significant share of that deal. You are not going to simply originate the deal and pass off all the risk to somebody else. So, you are going to need a bigger balance to really be a player in that game as well.

Additionally, what we have found this last 12 to 18 months has been very revealing in this regard is that a lot of time it is easy to get the commitments from other lenders on the front end in a multi-lender deal, it is not so fun when the deal has a little problem to figure out who the good partners are. You learn some very valuable lessons on who is the right partner to bring to the table. That whole dynamic has changed in terms of simply bringing capital together to finance a global agricultural deal. Some partners are very good at working with you through trouble situations and others you wish you had accepted another partner.

Frankly, borrowers are taking a more active role in participating in the selection of who is in their lending group for that very reason and justifiably so. They want to know who is part of their credit package and they want to know them personally, talk to them, and know they’re here if we do end up having problems.

One other thing I want to talk about here deals with capacity of lenders, but it is a term that has not come up. It has been threaded throughout the message we’ve discussed the last couple days and is counterparty risk. As we see vertical integration occur across the spectrum when we are talking about both producers and agribusinesses, as well as lenders trying to manage risk, one of the new risks that has really evolved over the last few years is counterparty risk.

All you have to do is think back to 2008, a very short time ago if you want to talk about where it came to a head. When a farmer who has paid for fertilizer is concerned and is wondering whether their local elevator or coop is going to be able to deliver on that fertilizer, because of either availability or prices, and/or a grain merchandiser who contracted product is worried about whether the farmer is going to deliver because the price is now \$8 versus the contract price of \$4, or a contract grower – whether it is poultry or pork, for example – that is concerned about whether their integrator is going to file bankruptcy, you now have a great appreciation of counterparty risk. It is a new term that has not been a segment of the agricultural landscape for years and years. It is probably one of the most key risks we face that plays into some of the volatility we talked about before.

That sums up a few thoughts on capacity of operations and the financial capacity side of the banking business. Just real quickly, I will talk about intellectual capacity, because as has been stated here already this is a business of people. We all know we are late on an individual level.

Our producers and people, whether it's on a national, global, or even local level, they are going to interact at a personal level and transactions will occur there.

We believe that in the future, intellectual capacity will absolutely be key. That deals to a degree around expertise. A specialization is critically important, when if you think about it, our financial offices that serve the family farm segment are not the right people to be involved in serving agribusinesses – particularly when you start to talk about multi-lender transactions. So you need the scale of operations, the capacity in your operation to be able to afford the kind of people, much less the critical mass to be able to employ the kind of people, who can work with these specialty operations.

Additionally, specialization is expected by customers. It is also paramount to understanding and tracking sophisticated risk-management practices. Again, you go back to 2008 and think about what happened when you were getting calls for millions of dollars of margin calls on a daily basis from an individual customer, you had better know what you are doing. And not everybody has the capacity or the time to invest in those kinds of activities. So you really need someone who has that specialization to be able to focus on that.

The second area I'll touch on, relative to the three areas for the future of ag lenders, is risk management. It goes without saying we're in the risk-management business. I tell our board all the time, "We are not in the *risk-avoidance* business, we are in the *risk-management* business." All of us involved in agriculture have that perspective.

A unique point of view that comes to my mind as you consider the last several years is the competitive environment in the past decade has bid the risk premium out of our business, as we price loans to customers and we are involved in the business. It has happened in the housing industry. If you think about customers, we had high-risk subprime borrowers paying the same as high-quality borrowers. We bid that out of the business. Because of the prosperity of the last decade with agriculture, as well as the competitive banking environment, we have bid the risk premium out of the agricultural sector as well.

That is going to have some interesting implications as we go forward, particularly as these trends occur when you have highly successful, growing businesses that are going to expect to be treated fairly well. They are not going to stand for, and expect to be paying, the same price as the average customer. It is going to drive some behaviors. For example, successful institutions of the future will not only be able to manage individual borrower credit risk or simply measure institutional return on equity or return on assets, but successful institutions of the future will have to be able to nail down economic capital at institutional levels and measure risk-adjusted returns on capital down to the individual borrower level to be able to respond to the needs of the future ag professionals. That is all I am going to talk about for risk management. There is a whole breadth of things you could talk about here.

In closing, I want to touch on technology. Again, we could have a whole conference on how technology applies not only to the production side, but even to the service segment including

lenders. It is not only going to be used and imperative for us to manage risk. It is not just databases, but it is going to involve integrated systems from frontend customer systems, which we have been used to applying at the customer level, and online banking practices, which are very typical. But it is going beyond that. It is going to apply to behind-the-scenes processing and underwriting systems and data warehouses to analyze and provide useful information for institutions to use to make decisions.

It is going to be critically important in terms of serving customers. This is probably one of the most exciting, innovative, and forward-looking things we have in front of us. Technology is going to have a huge impact on how we as lenders provide service to the marketplace, whether it is on a local, national, or even a global level. If you consider what has gone on in the last two, three, or five years – I even look at our business over the last ten years – what has transpired in our business in the last ten years is mind-boggling in terms of how we serve customers.

Look at all the technologies being released today, from the iPad this year to the iPhones and the capabilities they have, to everyone of you sitting out here with cellular technology and a system where you can interact your with home office on a just-in-time basis. They are going to change the way we transact business with customers. It is not uncommon for any of us as lenders – myself included – I'll call one of our customers and catch them on the tractor on their cell phone. They'll say, "Just a minute, I got a buzz from the markets."

And they'll check the markets. They will get a text from a market service they are subscribed to. How technology is involved in serving customers in the future is going to be critical. Again, this takes a level of scale of operations to invest in technology that is very different from where it has been in the past. It is going to be a challenge for lenders and it is going to be an opportunity for some in the future.

There is a gentleman, Mark Seywright, some of you may know, who is a technology futurist and does work with the banking and financial services industry. He had a quote, "The success of the relationship in the next ten years depends on the degree which you allow self-service."

The up-and-coming producers today want a relationship, but they do not want to see you all the time. A good example of that is I was out on a call with a producer and our financial officer here recently, they were telling the story and having fun around the fact they were setting up their last lending arrangement. Finally, the customer told my financial officer, "Do not call me anymore, just send me a text."

He did not want to see him, did not even want to talk with him, just send him a text. So that is how things are changing relative to technology.

I am going to close from the standpoint of, who is going to be the segment that is able to apply these things? It is going to vary across the board, but I have a quote similar to what you have, Michael, from Charles Darwin: "It is not the strongest of the species that will survive, nor the most intelligent, but the most responsive to change."

We are going to see that in the next three to five years in the lending business. Technology is going to be one of the key drivers of that change. Those who are really effective in serving this national and global market will be those who are willing to change, make adjustments, and be responsive to the marketplace.

With that, thank you.

Industry Panelist

Remarks

*Tony Arthur
Head of Agribusiness Banking
Bank of New Zealand*

My name is Tony Arthur, I am the head of Agribusiness Banking for the Bank of New Zealand. The Bank of New Zealand is part of the National Australia Bank Group which owns Banks in Australia, New Zealand, the United Kingdom and of course here in the United States – The Great Western Bank. Our history in banking and supporting clients throughout the agriculture value chain stretch back well over 150 years and we currently have in excess of \$32b of lending supporting farmers in these countries.

I have been asked by the chair to describe and discuss some of the main global forces shaping the agricultural finance industry from an international perspective and one from a fully deregulated market. For the purposes of this brief presentation I will focus on three of these forces:

1. The mega-trends driving food demand and the impact on agriculture production and farming;
2. Changes to global banking regulations and practices; and lastly
3. The changing nature of investment in agriculture – both debt and equity.

Mega Trends Driving Food Demand:

A rapidly increasing population, especially in emerging countries such as Brazil, Russia, China and India, the 'BRIC' countries, where there has, or continues to be strong economic growth, has seen a step change in demand for protein and more complex carbohydrate food commodities. In these countries, large parts of the population have migrated from rural regions to urban areas, attracted by the opportunity of work, education and progression.

Once people have been engaged in work drawing regular wages, influenced more by the Western culture they are exposed to in emerging cities, we have seen a consistent change in dietary behavior once daily income exceeds \$10 per day. At this point people begin to eat more meat, dairy products, fruit, vegetables and edible oils. An example of this is to note that liquid milk consumption per person in China is estimated to have risen from two liters to greater than

10 liters in the last 7 years. A factor in this process is that on average people in emerging countries spend a higher proportion of every dollar made on food than in developed countries.

This process has been consistently observed in not only developed first world Asian countries such as Japan and South Korea post World War II, but is now evident throughout South East Asia, Western Asia, the Middle East and other developing regions.

Economic forecasters believe that Chinese economic growth in 2010 and 2011 is likely to reach or exceed 10 percent. Whilst there are risks within the Chinese economy that may impact future growth prospects, if this rate of growth was to continue through to 2017, the Chinese economy would effectively double in size from that of today. The effect on all our countries economies and agricultural markets would be enormous.

As global demand for food has increased, world food stocks and the amount of arable productive land available for food production has fallen. From a period after World War II when the world had in excess of 365 days of food stored till now when we have less than 35 days stored – the United Nations forecast that we need at least 70 days of food to be able to manage a sustained period of poor harvests globally. It is also predicted that by 2050, world population will exceed 9.2 billion people. At the same time, productive farmland per capita will have decreased from a 0.25 hectares to 0.16 hectares by 2050.

One may well ask what is the impact on global agricultural finance. In nearly all countries where there is a developed agricultural production with both scale and the ability to export, growing demand for food has seen the process of rationalisation, fewer and larger farms, and corporatisation in farming occur.

This process of rapid aggregation of traditional family-based small scale farming units and emergence of ‘corporate’ and large-scale family farming businesses, some operating globally, continues to provide significant challenges and opportunities for the agricultural finance industry. Increased scale of businesses requires stronger requirement to match banking risk and credit management skills appropriate to the complexity and risk of larger corporate farming operations.

It can also be observed that as these farming businesses have rapidly grown, there is a significant need for their owners to up-skill as well to ensure that their ability to identify and manage risk is appropriate to the scale and complexity of their business. This means owners/shareholders ensuring investment into governance, management information systems, risk identification and management of their businesses.

There has also been a need in many cases to finance throughout the value chain as value chains have continued to rationalize with the emergence of vertically integrated business operating and owning both the farming, processing and commodity distribution. This has created the opportunity for banks to support clients and markets through ensuring they can provide bank products and services at both the production ends as well as the distribution and consumer ends of the value chain – effectively capturing and supporting trade flows across and between

countries and markets. Through this we have seen the demand for more complex risk management product and services such as product centric derivatives, e.g. grain and milk powder futures, as well as products that allow clients greater optionality in managing increased volatility such as interest rate and foreign exchange management.

Changes to Banking Regulations and Practices:

The agricultural industry also provides the global finance industry some unique challenges and opportunities.

In New Zealand, banking agriculture, and more specifically farming, is a capital intensive sector to service. Increases in the price of farm land over the past decade, following a larger trend over the last 50 years, has, by and large, out-paced proportionate returns of products grown off the land. This fact has also driven the need for greater scale and efficiency of farms to continue to provide adequate returns to land owners. As farming operations have grown, markets matured, and the use of debt to drive further growth, banks have been required to develop more robust risk models to be able to accurately and prudentially assess risk in lending.

Speaking from our own experience in New Zealand, there are potential challenges that emerge from these factors which include the potential overleveraging of farming markets where the ability to be able to manage greater volatility through changes to farm input costs, commodity returns, foreign exchange movements etc. becomes strained. The Reserve Bank of New Zealand, New Zealand's Central Bank, has recently signaled to licensed Banks, that they intend to alter bank risk models to ensure that greater capital is required to be held for each dollar lent. Effectively what they are signaling is that the debt to farmers in New Zealand, which has tripled in size over the past 10 years and now exceeds \$46 billion, is too high and they will manage the de-leverage of the industry through either making the allocation of further capital to the rural market less attractive for Banks, or the net cost of debt will increase to incentivize lower debt gearing. Debt to other agriculture markets in other countries continues to grow, and I am certain there are lessons that can be taken from highly deregulated trade markets such as New Zealand.

The use of leverage as an efficient source of capital has also been impacted by the global financial crisis. As debt market impairment became evident, and credit spreads widened, the cost and access of liquidity funding changed for banks around the globe. In many businesses this has led to increased total banking costs as liquidity costs have grown and has driven review of use of leverage throughout the value chain as producers, processors and distributors have sought to strengthen and re-shape their balance sheets to provide greater ability to manage volatility and the cost and access of capital.

Lastly, the changes to cost and access of debt has also created the opportunity for banks to adapt and innovate products and services to meet the needs of their rapidly changing clients and their businesses and create greater value for their clients and themselves. This can be evidenced

by the emergence of traditional full service banks not only providing vanilla term and seasonal debt, but also creating the ability to provide more complex and creative products such as treasury-based risk management solutions, creation and distribution of other types of products such as subordinated debt, hybrid equity and pure equity where opportunities have been identified agricultural businesses where they have bottle necks around the ability to be able to continue to grow and undertake intensification developments without the need to dilute long-term shareholding.

The Emergence of Institutional Investment in Global Agriculture:

I stated earlier that many of the mega-trends driving global food demand have been well documented and described. Many industry participants also have a growing view that these drivers are fixed and transformational in their nature. As part of the emergence of this increase in food demand, the global agriculture market has seen an increase in both individual countries looking to increase investment and activities to secure sufficient food production as well as institutional investment in farming and food value chains and foreign direct investment both within and across countries.

The United Nations data indicates that the total foreign direct investment in agriculture, forestry, fishing and food and beverages has grown from less than \$5 billion in 1998 to over \$60 billion in 2007. More telling is that investment in the front end of the value chain, producing and processing, is growing at a significantly greater rate than investment further along the value chain.

The emergence of institutional investment and foreign direct investment in our agriculture markets provides both challenges and opportunities for the finance industry supporting agriculture.

Large-scale institutional investment is attracted to agricultural markets where consolidation and aggregation of farming land is possible and where well developed value chains are evident. This is accelerating the corporatisation of farming. The transfer of farm ownership out of traditional family-owned businesses changes the nature of the industry from the perspective that family farming has historically been intergenerational in nature and has been willing to accept, during periods of volatility, lower returns, loss and lower dividends or drawing from their businesses than may be accepted by rational institutional investors. The potential is that, as observed in other sectors, capital is liquid and will tend flow to those sectors that provide the profile of risk and return sought by investors. There is the potential, that if as institutional investment grows as a proportion of industry capital, if it were to leave there may not be the availability of debt and equity from traditional sources – including banks – to fill the void.

However the reality, in my Australasian experience at least, is that without equity investment by institutional players, the ability of the current equity and debt sources to provide further growth sufficient that which will be required to supply global demand for food may, in

time become constrained and therefore introduction of institutional investment in farming is a necessity.

Conclusion:

In wrapping up I would like to say thank you for the opportunity to address the Symposium. New Zealand is a small country with a narrow focus in terms of agricultural markets and food production but our continued growth and prosperity will be driven by the same forces that will drive returns to processors and producers here in Missouri, the United States and around the globe.

Thank you.

General Discussion

Meeting the Financial Needs of Global Agriculture

Brian Briggeman, Moderator

Economist

Federal Reserve Bank of Kansas City - Omaha Branch

Mr. Briggeman: In your last comment you talked about debt and equity financing. What kind of interest do you see out there for equity financing at home and abroad within agriculture?

Mr. Swanson: That's a good question. You talk to a lot of hedge funds that want to be long in commodities. But they want to be long in commodities for three months. For them, that's a long position.

It is a good question, because they're stuck. We talk to a lot of hedge funds out of Europe, and they want to be long on commodities, but the only way they can see to be long on commodities is to either physically hold the commodity or to sit on top of futures – index funds of sorts.

If you talk to them about being part of an equity investment, to be part of that commodity production, and there is not much appetite there. There really isn't. You see some of it, but most of the time when you see people who want to get in equity investments, they are really kind of vulture investors. They are really looking for short turnaround. I still don't see much appetite from the investment side to really go long on commodities through a strategic investment of five to ten years. That is just way beyond their time horizons.

Mr. Briggeman: Thinking about what has gone on in Europe in terms of the sovereign debt crisis and thinking about some of the folks worried about – as Mr. Hoenig pointed out last night in his remarks – fiscal concerns here in the United States, how much do those play into the role of looking to finance abroad or finance overseas? You said something to the effect of Colombia in thinking about the high risk. What about on the sovereign debt risk?

Mr. Swanson: I don't really know. My two favorite answers are “I don't know” and “I was wrong.” I don't think that is a long-term issue for agriculture. I think it's a volatility issue. If you are having a sovereign debt crisis, it probably won't just go away and be solved easily. It probably will be like a bad case of disease that erupts periodically. It is going to be an issue of volatility going forward, but not a structural issue. That's just my take on it.

Audience Question: Do you think there is a role maybe for the World Trade Organization, if there are cases where there is dumping where they are selling it here for less than it honestly costs? Are there any channels for people to seek recourse?

Mr. Swanson: No, I think the World Trade Organization is a very ineffectual organization, because what they allow you to do in terms of a countervailing punishment is to tax some inbound article from that country that seems to be a violator of some WTO rule. What that does is it puts the burden, then, on the domestic consumer. For example, if somebody is shipping you Commodity A that's underpriced for some reason, you are then allowed to raise a tariff on Products B and C.

What that does is it hurts the domestic consumer that was buying those products before by putting a higher tariff on them. The WTO doesn't really have any effective mechanism for enforcing those types of things. They can make things miserable for a lot of people, but that is not the same thing as making it an effective mechanism.

The United States is a woeful player in the WTO. The Europeans play it like a violin and we stomp on it like a beer can. We don't have any finesse when it comes to the WTO. So I am not a big fan of the WTO correcting these kinds of trade issue.

Ultimately, it is competitive or comparative advantage of the two traders that solves the problem. It doesn't make people happy, but that's what eventually ends up being the driver. See, economists do give blunt answers once in awhile.

Mr. Briggeman: With the financial crisis and the recent things that have gone on, access to credit has really popped up in the minds of borrowers and of customers you serve, what do you feel are some of the risks going forward that could constrain that access to credit?

Mr. Torpey: In our area, we've had adequate credit. There has been no problem. We have adequate funding to take care of all the credit needs. There is always the movement if the stock market looked like it was going to be and remain strong. Some of the liquidity we have would go into the stock market and come out of CDs. Most people don't like to receive 1 to 1½ percent for their investment, so there is a little danger of losing some of that liquidity. But there are still other sources we could tap. So I don't see it being a real threat in the immediate future.

Mr. Holthus: I guess on that subject, I would say community banks – and we were one of them – we got involved in some participation in commercial real estate in some of these big areas, which tells you how smart we are maybe. We did that for years. Now we have been burnt pretty bad. I think going forward, you are going to see a problem, particularly in urban areas where they want to put up a hotel or a big office complex. There is not going to be the capacity from community banks to go into these areas and say, "We're going to finance that."

That's one of the areas that I see is going to be a problem.

Mr. Arthur: From my point of view, I guess there are a couple of issues on the right. First is Europe. Clearly, there is a deep crisis going on, not just with Korea and Spain. In Portugal,

clearly there are ramifications across the European continent and obviously the way the global financial system works there are implications for everybody, both here in this room and back home in New Zealand.

The second piece I'd probably put on the table is Western economies spend more than they make. We talked about the growth in all our markets over the last 10 to 20 years, where we have seen significant economic growth, but the reality is there is a cost to that and our ability to be able to self-fund further growth is a real challenge, given we tend to spend more than we actually make. I don't know what the figure here in the United States is, but in New Zealand, we tend to spend about \$1.16 for every dollar we make.

Now when somebody in China is spending 50 cents for every dollar they make and they run the surpluses they are, there is clearly a transfer of funding or liquidity from more traditional Western-oriented markets across to the East. It is a challenge for all Western economies to understand how we can transform our financial markets, so they are less prone to fluctuations such as we've seen over the last 18 months that can affect the liquidity in the market.

Mr. Kilmer: Tom Kilmer from the CME Group. Along the same things here, talking tightening credit, something we focused on especially in 2008. The last 18 months really has been somewhat important to us.

When we start to see some tightening credit, as we did, eventually do you get to a point where there is a tipping point in price with farmers out there that constricts hedging and contracting and things like that? If there is such a tipping point, what kind of systemic risk does this really phase to the agricultural market once credit gets to a point where it stops flowing to the ag community?

Mr. Stark: I'd like to make a comment on that. It is interesting that we talk about tightening credit, because it depends upon where you are coming from. Many people in this room who in the ag finance industry would agree we came from a point where credit was really quite lax in terms of structure and spreads.

So, yes, you might be *tightening* credit, but it is a different question than saying that it's *tight* credit. It's very difficult to answer that question, if there is a tipping point where suddenly there is not access to credit and it has a major impact on the ag production side or ag business side. But I don't think we are at tight credit. We are coming from a period of time where we have very loose credit standards and very low spreads for the most part. It's great when you're the borrower, but eventually it has an impact. I'll let other people comment.

Mr. Holthus: I'd say the same thing. There has been good access that ties in with the last question as well. Agriculture has prospered very well through much of this recession. So it has not had near the impact in terms of credit tightening, some to what Dr. Swanson's talking about in terms of the tightening of terms of conditions, but certainly not to the degree it's really impacting the availability of credit at the producer level. Our industry is in really pretty reasonable shape and it continues to enjoy good access to credit overall.

Audience Question: It has been made abundantly clear today and yesterday that agriculture is facing a much more volatile environment than it has in the past, making risk management paramount for survival and thriving. Doug Stark addressed to some degree the risk management issue and spoke to the need for improved loan pricing. I couldn't agree more.

I wonder, Michael Swanson -- and I'd invite the other panelists as well to address --you could identify any specific risk-management practices that bankers need to improve on to get through these more volatile times?

Mr. Swanson: In response to what's happening in the ag sector, it's not the bankers that need to improve, because it is not *our* risk. That is the problem we see so often. The customer comes to you as the banker and says, "What should I do about risk management?"

And your answer is, "Well, you need to hedge or you need to have less debt and more equity."

The problem is, bankers doing risk management is about hedging your interest rate risk, making sure you have adequate structure, all those things. We do that every day as a banker, right? What we're seeing and what is changing is we're seeing cattle feeders, hog operators, and dairymen having to actually move to true risk management. That means selling their output at the same time they buy their inputs in establishing a net position that makes money or doesn't lose too much money. But that's something that is evolving very quickly right now on their side of the table. Maybe it is too brutal, but it is their business and they're the ones who have to learn how to hedge the risk. Bankers have to demand they do it or have them participate with more capital and less debt.

Follow-up Audience Question: Right. But you can't get around the fact that lenders have to manage their risk. When they make that loan, they are taking on risk, right? So that risk has to be managed as well. That risk flows up to the lender from the borrower.

So my question is, lenders can't be operating business as usual in this kind of environment. Are there things that should be done at the lender level that maybe have not been done so much, so well in the future as has been done in the past?

Mr. Swanson: It's a great question. I'll just say, we have a lot of dairy lending out right now. We looked at what we could do to protect our dairy portfolio from credit losses in terms of could we buy calls on milk and buy puts on corn, so the underlying dairy portfolio would be protected in the case of a situation. We looked at that and what we found unfortunately was the cost of setting up margin protection, the cost of protecting our portfolio in terms of what might go wrong with the sector, there is not enough money in the spreads and there is not enough money in the lending relationships to justify *us* taking on a risk position to protect *them* from what might happen to the sector.

We are in the position where we looked at that. We know they have a lot of risk, we know we take on a lot of risk under sector basis, but we have to change. So we've come, at our bank, to

understand we have to change something, because it is not working the way it is working right now.

Mr. Holthus: I would like to answer that also. What I think community bankers need to do particularly is, first, not be so competitive that we have it in our mind that we constantly have to grow. Once in awhile, we have to look at some of these credits and we're going to let them go out the door. A lot of times that is really difficult for us to do.

This last year, we let about \$3 million go out the door and we've looked back on it and we are really glad we did. A lot of bankers have the growth mentality that you have to constantly grow or you've had this customer for 10 or 15 years and you don't want to see him go. We need to change that.

Mr. Stark: I want to make one additional comment that was embedded in my topic. Lenders of the future are not only going to have to manage individual borrower credit risk, which is what is being talked about to some degree here, but you have to be able to roll up the aggregate amount of risk you're taking, either in different industries or exposure to individual integrators, or different counterparties such that you can understand the impact, if something would occur in one of these tails or downturns, of how that is going to impact your institution. So it goes a little bit beyond managing or shifting the risk management piece to the borrower. The other piece that I mentioned was around how you price and how you deal with that on a loan-by-loan basis. Lenders have to do a better job.

The other aspect of that is even how much we take some of these large deals, whether it be participations or whatever, relative to our hold position and/or capital position. Our hold positions relative to capital net income are going to be really critical. Those are decisions we can make behind the scene. They may seem like good credits, but if something happens we can't handle that from a net income standpoint or a capital position, you have to adjust what you are doing there. Those are a couple of additional things that are strictly focused at lenders, not at customers.

Mr. Torpey: One quick comment in regard to risk management: As I see it, the biggest danger both to the producer and to the banker is greed. If we could get rid of greed, risk management would be pretty easy.

Audience Question: I did want to ask, how much does loan losses and increased risk in nonag lending impact the willingness of your institutions to make loans to agriculture? A couple of channels that come to my mind would be the loss in the financial institutions' capital, because you have to put more capital into loan loss reserves, as well as if you have an increase in risk aversion on the part of lenders in general. Some of that you would think would work its way into the rates that financial institutions want to charge borrowers, but I did want to know what you folks think.

Mr. Arthur: Can the foreigner go first? A comment from a foreigner: I am probably the worst person to have sitting here, given I have a bunch of colleagues from The Great Western

Bank in front of me. But, as a National Australia Bank Group, the reason that we've come to the United States is an agricultural play, both in terms of the agricultural market, the regulatory system that exists here, and our belief there is further opportunity to grow and be able to help American farmers be very, very successful.

There are absolutely prudential requirements best practiced around allocation of capital to particular markets, so that you don't overbalance any sort of debt portfolio from a risk perspective. But certainly from our view at The Great Western Bank, it doesn't make a difference at the moment to us, given the state and the nature of business here.

Mr. Torpey: It's also a part of how big you are. For instance, in our bank of \$110 million, if we have a \$500,000 loan go upside down, we have to take it out of our loan loss reserves, it kills our earnings for the year, and it does impact what we have for lending. If Wells Fargo loses \$500,000, that is probably not even a half day's earnings for you guys. Yes, you'd have a problem. With us, if we have to put money into the loan loss reserve or charge off a loan, it does make a difference on how we're going forward on our lending. Again, that has a lot to do with our size.



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Closing Session:

The Agricultural Marketplace in the 21st Century

Farming Finance and the Global Marketplace: A Synopsis

*Michael Boehlje
Distinguished Professor
Center for Food and Agribusiness
Purdue University*

I have been asked to be the rapporteur for this Symposium and I am pleased to do so. As a result, I will try to provide some closing perspective on what we've heard over the last two days, by discussing six takeaways from the symposium. Then I have eight characteristics of the agricultural marketplace in the 21st century I would like to discuss, some briefly and others in more depth. First, my six takeaways.

Six Takeaways

1) Unanticipated Events:

Every speaker suggested a very positive outlook for agriculture long term. That is a supportable perspective based on expected demand growth. But I am concerned we did not talk enough about what sometimes is referred to as "the unanticipated surprises." We did talk about volatility, but that volatility was more in the context of operational volatility. What is the equivalent for agriculture of the oil drilling industries' current crisis as a result of BP's Gulf oil spill? Maybe our past experience with Mad Cow disease or H1N1 is close.

And it could be on the upside as well. So we ought to make sure we don't focus all our attention on the downside. We will talk about the tails later.

2) Consolidation and Concentration

Agriculture will experience increased consolidation and concentration across the entire value chain. The debates will be about whether value chains will be vertically integrated or coordinated -- by that, I mean the difference between ownership across the value chain or various forms of tight linkages without open market transactions. JBS is taking the concept of larger scale vertically aligned systems to the global meat market. This structural change has profound implications for suppliers and buyers in terms of with whom they are going to do business. Production agriculture is moving to a 90/10 industry, 90 percent of the output being produced by 10 percent of the producers. If you don't determine how to do business with those producers as a fertilizer, seed, chemical, or machinery supplier or financier, and how to do so before they get big (because once they are big, they have a tendency to want to stay with who helped them get there), you will struggle in the new marketplace. The agricultural industry will increasingly be more consolidated and more vertically aligned at all levels.

3) Cost of Capital

The global economy is recovering. It is interesting that the big elephant in the room – the cost of money and the cost of capital – has not been talked about in this two-day session. There is concern about the speed of recovery and how sustainable it is, but the consensus suggests we will experience a slow but rocky recovery. The question is the implication for interest rates. We talked about access to capital, but not the cost of capital. I think we have to talk about the cost of capital. Does anybody believe interest rates are going to go down? The only question is how fast and how far they go up. That raises some really interesting questions -- if this industry is facing a higher capital cost than it has for the last three, four, or five years (or, as some people say, since the decade of the 1980s), what does that mean for the sector? We will return to this topic.

4) Risk and Uncertainty

Agriculture will experience increased risk and uncertainty. Increased risk/volatility/change is not necessarily a new idea. But we need to talk about, more than I think we have, what we should do about it. How do we manage our businesses? What do we do to accommodate, to mitigate, to absorb, to transfer that risk? We are going to return to this topic as well.

5) Logistics

Logistics, supply chains, and distribution infrastructure are critical to the performance and global competitiveness of the agricultural sector. Some have argued that the source of the U.S. competitive advantage in global markets historically has not been because we have vastly superior and lower cost production and production systems. It's been our distribution system -- it's the logistics, distribution, water, rail -- our entire system of bringing inputs from the world into rural America and moving products out. If you fast forward 20 years, what's going to be the comparative advantage we used to have, relative to many other parts of the world, in our distribution system? Our locks and dams are 1930's technology. What is Brazil doing? Brazil is modernizing their transportation/distribution system.

6) New Forms of Globalization

Globalization in agriculture has historically been focused on growing foreign demand and the opportunity to fulfill or export to that growing demand. But globalization will increasingly occur as foreign direct investment (FDI). Increasingly, a larger portion of the activity in terms of internationalization will not be shipping products across borders; it will be shipping money and building plants. U.S. companies are building processing facilities in Europe, China and elsewhere, and sourcing raw materials locally to fulfill the in-country demand. The same thing is happening in terms of companies coming to the U.S. as we heard yesterday from JBS.

There will be more FDI and more financial flows in the future across borders. So it's not just, how do we figure out how to develop global markets and export into them? Increasingly it is, how do we compete in a market that has substantial financial capital as well as product flows across borders in various different directions?

Eight Issues for Agriculture

With these six takeaways, now let us use these as the entrée point into my perspective of the eight critical issues in the agricultural marketplace in the 21st Century. We cannot talk in detail about all eight of those, so I will elaborate on the first two and the last one. But let me start by sharing my perspective of all eight.

We'll discuss the first -- ***capital market challenges*** -- in more detail later -- it is not just availability; it is cost and what that means for the industry. We will also come back to the second -- ***resurgence of risk*** -- because I am not sure we have thought enough about what to do about that. Risk has been underpriced in the capital markets. We must more aggressively price risk-- how much risk pricing differential are you doing now in your loan portfolio? We do risk ratings, but we do not do very much differentiation -- not much spread in rates associated with the risk ratings.

The third issue is ***growth/consolidation/structural change***. There is not much question, as we have already suggested, that growth and consolidation will continue. The classic economic arguments are that larger scale and growing businesses generally have lower costs, higher prices and better operating profit margins than small scale operations. But this is not the whole story. The larger operating profit margins per unit of output for larger size businesses when combined with the higher output results in more total income and profit for larger compared to smaller businesses. And larger businesses have lower salaries/withdrawals/payout percentages. This lower cash drain on earnings combined with the typically higher earnings results in substantially more retained earnings for larger scale businesses compared to those of smaller size/scale. A larger absolute amount of retained earnings means that larger scale businesses can acquire more resources and increase their output more rapidly than a smaller scale business that may need to use most of their earnings to support the withdrawals or payouts to the entrepreneur and management team. In this context, growth is a “natural” result of business success (earnings and savings behavior), and larger businesses have more “natural” growth potential because of their typically higher savings or retention rate compared to smaller businesses.

Probably the hottest topic in much of the discussion we have with agribusiness companies today is the fourth issue -- ***the sustainability imperative***. What are we going to do as an industry to respond to this increasing demand or expectation (not yet from the government, but from the retail end of the food chain) concerning agriculture's environmental footprint? By 2015, Wal-Mart expects to implement environmental footprint labeling on every product sold in their store. How are we going to respond to that? What should we be doing? How can we shape this debate so sustainability is not exclusively about cost? Can we create value and a revenue stream in some way?

I would return again to BP's Gulf dilemma. One way you create value is to continue to have what is frequently referred to in the industry as “freedom to operate.” Do you think BP has the same freedom to operate today they had two or three months ago? So what happens to our freedom to operate, if we do not concern ourselves with the fact that even if many consumers are

not willing to pay for sustainability, they do expect, not just safe food, but that they do not have to worry about chemical contamination in their water supply? And, rightly or wrongly, they associate that with agriculture.

What are we doing about sustainability? I want to emphasize this will likely not be government-regulation driven – it will be supply-chain driven. And the opportunity/challenge is different for input suppliers than for those like Coca-Cola or Wal-Mart who are at the end of the value chain where they have a chance to sell to a customer/consumer that might be willing to pay something for “sustainability.” How does Syngenta or an ag retailer doing business selling to farmers – fertilizers, seed, and chemicals – create value for their customer in this sustainability context? There is a big difference in terms of where you are in that value chain in terms of capturing value from sustainability initiatives.

The next issue is ***resource availability/productivity***. Agriculture will have to increase its productivity over time to adequately respond to the growing demand. The most serious constraint for expanding global production is not as much land as it is water. Farmers in the Midwest just do not understand what producers in California live with daily (as well as farmers in much of the rest of the world) concerning water availability. Water is in fact likely the major constraint in terms of our being able to fulfill the growing demand for agricultural raw materials.

Innovation and technology is the sixth issue -- a key to the productivity challenge is innovation and new technology. Three types of technologies that complement each other have the potential to change agriculture profoundly. One is biotechnology and nutritional technology, controlling the growth processes of plants and animals by knowing the biological processes that impact growth. Second is information technology to real-time monitor the growth process and determine what might be impeding that growth process in real time – is the plant running out of water, is there a weed problem, where in the field do we have a weed problem, etc.? With this technology for example, water and chemicals are not applied in a preventive fashion, but when and where they are needed. With irrigation technology, we can do that – center pivot systems and drop nozzles replacing flood or row technology, and now irrigation water is applied when the plant sensor or soil sensor says we need it. And using GPS different amounts of water are applied at different locations. Irrigation technology is an example of process control technology – the third type of technology. So we have three intersecting technology bundles– nutritional and biotechnology, information technology, and process-control technology. These technologies take agriculture from growing “stuff,” which is what it has historically done (but not being very precise about it), to an industry that has the opportunity to be “biologically manufacturing specific-attribute raw materials for unique end uses.” That is a very different industry.

We see this already happening in the livestock sector. The modern poultry barn uses scales, sensors and automation to monitor weight gain, temperature and air quality, and growing conditions and adjust the rations and building environment to achieve desired weight gains. And as we indicated, automated irrigation systems linked to GPS and plant growth monitoring systems is an example of using similar technology in crop production.

The seventh issue is the ***role of the public sector***. Who cares about the Farm Bill today? Even farmers are less concerned or interested than in the past. The public policies that are increasingly more important for agriculture are well beyond the Farm Bill. If you are in California, the most important policy issue is probably immigration policy or maybe water policy. Some argue that farmers receive more money as an indirect subsidy from energy policy (the tax credit of \$.45 a gallon of ethanol passed through from the blender) than they receive in direct payments from the Farm Bill. EPA and environmental rules, global warming and cap and trade, the current USDA/Justice hearings on competition in the markets, transportation policy, energy policy – these are all important policy debates.

But there is a dilemma. Much of the policy shaping agriculture today is policy we in agriculture do not have skill, capacity, credibility, or context to help shape. When it comes to the Farm Bill, we know who to talk to. But we do not have a lot of good friends in EPA. And we are not necessarily perceived in many of those other policy-setting arenas, whether they be in the U.S. House or Senate committees or in particular parts of the Administration, to be credible or even be the “good guys.” We have a dilemma in that a broader set of people are determining the policy constraints and setting the agenda. We in agriculture aren’t even in the room and activists are at the podium. We have to fix that, if we expect to shape the important policies that are going to influence this industry.

Finally, the eighth issue – the growing importance of the ***bioeconomy*** -- we are going to talk in more detail about that later.

So those are the eight critical issues concerning the future of the agricultural sector. Now let me come back and flesh out in more detail the three that are not only important, but maybe haven’t been given enough emphasis, generally in the industry and maybe in this conversation.

I believe – and I’ll give you two of the nine arguments why I believe this – that there is no way we are going to have capital costs do anything but go up in general and for the agricultural industry more specifically. As to interest rates, let me give you some numbers to support this assertion: three month LIBOR futures, June 2010 – 0.41 percent; three month LIBOR futures, June 2015, 4.98 percent. Note this isn’t the yield curve -- it’s the same maturity. It is a thinly traded market out in 2015, but from 0.41 percent to 4.98 percent!

There is another space where I do not think the market is yet fully informed -- in my judgment the market is substantially underpricing inflation. A 2 percent or so rate of inflation, which is what the implied inflation rate is from TIP bonds, is “just not in the cards” given the combination of fiscal and global (I did not just say U.S. Federal Reserve) monetary policy in my judgment. We have ramped up the money supply in this country and in the world profoundly. Everybody understands the concept of too much money chasing fewer or the same amount of goods results in higher prices. It is not just that we ramped up the money supply in the U.S.; because of the sovereign debt problem in Europe, they have reversed course and ramped up their money supply as well. And the U.S. monetary authorities have agreed to backstop the European authorities.

How do you globally unwind that money supply? And we are not talking about a small amount here. We are talking about doubling and tripling the money supply. Our back of the envelope calculations indicate that if we return to the lending and spending behavior of 2007 with our current money supply in the United States, we get price increases that exceed 10 percent per year. I do not believe we are going to have that level of inflation -- we will not return back to the spending and lending behavior that we had in 2007. But what if we return to half that level and do not unwind the money supply rapidly enough? It is not difficult to see inflation rates that are maybe twice what the markets are saying today -- 4 or 5 percent -- not in 2011-12 but in 2013-15.

So what does all this mean? If I look at what the markets are already indicating is going to happen to interest rates on the short end -- a 400-450 basis point increase, we add 200 to 300 more basis points for underpricing of inflation, and we consider a normal yield curve with 250-300 basis points for shorts compared to longs, long-term (7-10 year) rates can easily be high single digit and maybe double digit.

What we're suggesting is that capital costs will be higher. Higher capital costs say something about how you manage your business and what you do about managing debt in that business. I would argue that relative low capital costs have encouraged faster growth rates for many farmers than they might have had otherwise. We have modernized this industry -- we have made significant investments in machinery and equipment, capital expenditures, farmland, etc.. If capital costs are higher, the costs of ownership are higher. So we slow down our growth rate; we use less leverage.

To illustrate the risk of higher interest rates, our analysis of a 40 percent debt-to-asset ratio grain operation (one half of their debt at 3.5 percent and the other half at 5.5 percent) with current operating margins will now meet all credit standards in terms of debt-service coverage ratio, current ratio, working capital, debt-to-asset ratio, etc. But a 200 basis point increase in interest rates takes them out of standard.

What do higher capital costs mean for asset values? I am not suggesting collapsing asset values. We will continue to see secondary repayment capacity in terms of values of land stay fairly strong. That is not true for livestock facilities obviously. But increasing land values will be harder to support with higher capital costs.

What about the commodity and real goods market and the financial market linkages? These markets now have become very interconnected, much more so than they have been in the past, because you have the same participants playing in the "reals" and in the "financials." So the linkages between these markets are much stronger than they have been in the past when different players participated in the different markets. Furthermore financing and funds flows are increasingly global with global participants financing and investing in hard assets around the world including farmland.

So what is the bottom line -- the capital markets are fundamental drivers of location, structural change, business model, risk and reward sharing, etc. The capital markets are huge

shapers of the overall economy. So how these capital markets play out the cost and the availability of funds and how they reward those who are taking the risk and penalize those that are not managing the risk is a really key issue relative to the agricultural sector.

Lenders and investors are no longer just “the providers of funds” to “grease the skids” for businessmen to do what they want to do. They basically set the rules of the game. Capital markets used to be the facilitator of the activities in the “real” sector; increasingly they are the driver of “real” sector activity

The second issue is the resurgence of risk. As to operating risk, the relevant risk is not price risk, it is margin risk. We have experienced the margin risk in the livestock sector – feed costs rising without product price increases. If you take price minus cost and capture the volatility in the cost as well as volatility in prices in grain production, the margin risk has increased by a factor of three to four times. Furthermore, the tools to manage that risk on the operating side (hedging, contracting, crop insurance, government programs, etc.) are much less effective or more costly than they have been in the past.

So, financial management strategies are much more critical than they ever have been for a successful risk manager. Risk can be mitigated by managing the operating side of the business and/or the financial side of the business. If tools for managing operating risk are less effective and operating risk has increased, the only way you manage/mitigate risk is on the financial side. Fixing interest rates is not easily done. We’ve looked at hedging interest rates -- it is very difficult to do today -- the futures market has already priced increases into interest rates. Another strategy is to restructure debt to lock in rates -- restructuring with some of the current debt moved to longer-term fixed rate debt. Increasing working capital is also a critical financial management strategy to manage risk.

But there are other risks -- we have not talked about the capital wipeout risks, the strategic risks. These are the risks that Taleb in the book *The Black Swan*, identify as, “the tails of the distribution” – risks with a low chance of occurring but are disastrous if they do.

The tails count. And we have a tendency to ignore the tails. I am concerned about what is called a fat tail problem. The recent modeling of the financial instruments offered in the securitization of housing loans was based on very short time-line datasets with limited observations in the tails because there were no outliers in that period of time. We learned our lesson. It is important to understand that extremes can happen, whether they are on the upside or on the downside.

I would recommend to you, by the way, another book -- *Risk Intelligence* by Apgar -- that basically says that competitive advantage in the future will not be a function simply of market position or cost. It will be determined by those who have the most intelligence about how to manage risk, as well as having the right supply chain partners that will help you manage/mitigate risk.

And finally, the bio-economy. Agriculture in the future will be a raw material supplier, not just for the nutrition industry but for the energy, industrial products, fiber, polymers and health/pharmaceuticals industries. Right now 33 percent of the U.S. corn crop is mandated to be used for ethanol and not for food. The BP disaster in the Gulf may result in that going up, particularly if we go to a 15 percent ethanol blend. But, we are just starting to recognize the multi-functionality of agricultural raw materials in the energy, industrial products, and health/pharma industries that will present real opportunities for increased demand, but a big dilemma if we encounter short crops and high prices for food. What do we do in terms of giving up energy? Between now and when adequate production capacity is developed to fulfill all of those demands, we might end up with a “significant shortage problem.”

Let me conclude – there are three ways to think about the new economy for agriculture. The first is globalization. That is not really new, except globalization has been expanded in terms of a broader set of new dimensions – product, resources, and finance. If have not read Friedman’s book *The World Is Flat*, you ought to read it.

The second, which we have not spent enough time on, is financialization. These are the linkages between the real and the financial markets that have not necessarily been that explicit until recently. These markets are now more tightly aligned. The capital markets drive the real world and transparency is critical for them to function efficiently and effectively. Another book recommendation is Smick’s *The World Is Curved*. Smick’s argument is that Friedman has it wrong in the financial markets, because “you cannot see over the edge.” The world may be flat, but you cannot see over the edge because we do not have transparency in the financial markets, which results in chaos in both the real and financial markets and pressure for additional financial regulation.

Finally, consolidation/integration/concentration and what might be described as industry convergence. Twenty years from now when the pharmaceutical/health industry and/or the energy and industrial products industries are major users of agricultural raw materials, what is the relationship going to be between that big pharma company and Cargill or ADM? Who is going to be the chain captain? Industry convergence has happened in the information industry and in the communication industry. The implication – people who are not even on our radar screen will now be our customers and/or competitors.