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World Food Crisis: Imperfect Markets Starving Development, A Decomposition of Recent Food Price Increases

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WORLD FOOD CRISIS: IMPERFECT MARKETS STARVING DEVELOPMENT

A DECOMPOSITION OF RECENT FOOD PRICE INCREASES

by

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WORLD FOOD CRISIS: IMPERFECT MARKETS STARVING DEVELOPMENT

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The recent decade has experienced two rather substantial food price spikes. This thesis sets out to provide an in-depth look at the recent food price increases by achieving two goals: assessing the forces driving food prices, and determining the magnitude of those forces. These goals are reached by reviewing selected rhetoric on the recent food price increases, analyzing case studies, and lastly determining our modeling capabilities in decomposing food price changes. Additionally, this thesis will serve as a tool for stakeholder's to better address critical policy issues surrounding food, agriculture, and energy policies.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

> "Here at home, just as in the third world, hunger is an outrage precisely because it is profoundly needless" (Lappe 1998).

World hunger beats its way into the rhythm of humanity, a constant to the point of reliability in a universe where the only thing that is certain is uncertainty. In the recent past food prices have increased to record highs. Food price volatility stresses the most vulnerable groups. 925 million people do not have enough to eat and 98 percent of them live in developing countries (FAO 2010). These high food prices are starving development, quite literally. Long-run trends in food prices are not the only increases we have encountered. Encompassing all the factors known to influence food prices, then singling out the abnormalities of the past decade hints us towards explaining the distortions away from food price trends. What exactly is behind these recent food price increases? Everything we are seeing in terms of food prices are not new to the past decade, yet the occurrence of food price spikes has increased. What are the driving forces creating volatile food prices?

This thesis sets out to provide an in-depth look at the recent food price increases by achieving two goals: assessing the forces driving food prices, and determining the magnitude of those forces. These goals are reached by reviewing selected rhetoric on the recent food price increases, analyzing case studies, and lastly determining our modeling capabilities in decomposing food price changes. Additionally this thesis will serve as a tool for stakeholder's to better address critical policy issues surrounding food, agriculture, and energy policies.

Chapter 1.1: Background

When we say food prices have increased in the recent past, what do we mean? It

becomes exceedingly necessary to diagnose the statement further. Perhaps we are merely experiencing inflation, and the seemingly widespread panic is unnecessary. Our approach also suggests this to be a negative. Assuming food price increases are negative without discussion would be a bias. It is now imperative to take a look at historical food prices, adjust our analysis for inflation, and then continue on with diagnosing our original statement's implications.

Taking a look at the FAO's statistics we are presented with figure 1.1, indicating international food prices in 2011 have reached levels higher than those seen in the 2008 spike. The value of the index in February of 2011 was 236, which was an all-time high. Commodity prices saw up trends and volatility from 2010 to 2011, except these indices cannot rule out attributing these price increases solely to inflation. We should turn our attention to real data; figure 1.2 displays the FAO's international food price index in nominal and real terms. The trend, as expected shows food prices in 2011 spiked significantly.

FIGURE 1.1: FAO Food Price Indices

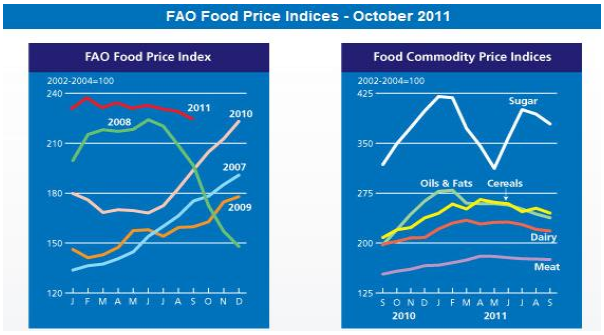


FIGURE 1.2: FAO Food Price Index

"This is the highest level (both in real and nominal terms) since FAO started measuring food prices in 1990. Prices of all monitored commodity groups registered strong gains in

January, except for meat, which remained unchanged" (FAO 2011). With prices reaching these record highs after a spike just 3 years ago, it's not likely the two incidents are mutually exclusive. Another point of interest becomes the correlations between the 2008 spike and now the more recent 2011 spike. As we continue our process of decomposing the price increases, special attention should be taken to relating back to 2008 price rise conditions. After all, if history repeats itself, a gap of only 3 years could be cause for concern. Yet this again leans towards a position of food price increases being inherently negative.

Chapter 1.2: The Good Vs Bad Debate

Pressing us further into the issue of proving these particular food prices are negative. Saying food price increases are inherently bad is a fallacy. As with every economic issue, the answer remains: it depends. Yes, we have reached that mantra. Calling it a food crisis alone predisposes people to believe it is bad. However, there are arguable upsides to increases in the price of food. The economist held a debate back in July of 2008 discussing just this, "There is an upside for humanity in the rise of food prices" (The Economist, 2008). The proposition resting on the increases serving as incentives for desperately needed agriculture investments, dictated the fundamentals of higher prices drawing out higher production. Building from there the protagonist, Mr. Homi Kharas, made some strong valid points, "The reality is that the impact of high food prices depends on each household's income and consumption patterns...the impact also depends on what happens to labour, land and credit markets" (The Economist Debates 2008). And so we are entrapped to our mantra once again. Or are we?

Despite the propositions efforts of capitalizing on the food increases being a solution to the initial problem of food scarcity in the long run, we are stuck here in reality

and not a principles textbook. Worldwide the food increase has left the poorest of people, the ones spending large portions of their income on food, with lower real incomes. Now they are not only faced with malnutrition, but are spending less on education, health care, sanitation, and clean water. An impact by development studies we know to be a dangerous and multiplying one. Access to social protection in developing countries is limited at best. The poor then are selling their productive assets off, making this a downward spiral of attempting to not starve, and sacrificing their welfare (Apergi and Rezitis, 2011).

In essence we have a realization that increased food prices in the short run exploits the imperfections within the food markets and offhandedly creates an incentive for solutions. Decidedly the food price increase is then a negative by virtue of its overall impact being an on average and widespread problem that requires immediate attention. The upside to increased food prices is based on the optimism of their being some just out of reach agricultural technology, and/or policy fixes to create a balance in the food markets. The likelihood of the 2008 and now 2011 food price spikes being the marginal push that agriculture markets needed for investments and ultimately a boom in production seems slim.

According to the FAO's October 12th report on Crop Prospects and Food Situation, production has increased, except they expect the economic slowdown to be the culprit of future price decreases and global food security remains uncertain. The increase in production not being the result of tapping the untapped potential housed in agriculture markets around the world. It did not come from higher yields, but rather cultivation of more land. High food prices resulting in a sustainable increase in production would be cause for reconsidering the negative stigma of our food price increase. However, this has

not been the case. It is then the volatility in food prices that are causing concern; “food inflation spiked so quickly, up 50% in 2008 households couldn't have had time to respond efficiently” (FAO, 2011). 40 percent of the world's population earns a living by producing food (Westhoff 2011).Who does the recent price spikes help? If food price increase is good for farmers, some of the poorest people throughout the world are farmers; this could combat the negative stigma.

Except the price increases are not reaching farmers. The farmers’ share of the consumer food dollar has declined. For the US, “In the early 1970s, the farmers’ share of the consumer food dollar was 32 to 35%. Today, the farmers’ share of the retail food dollar is down to only 20%” (Alexander 2008). Farmer's profits are not higher, increased costs of inputs has made sure of this. Not to mention the pricing pressures farmers face by large distributors. Farmers in developing countries do not have the market position to benefit from the increased prices. Poor farmers are not the ones seeing the increase, and poor consumers are starving because of it, development altogether takes steps backwards.

During a time of low prices these farmers are suffering as well, again because of the market's imperfections. When food prices are low, rural and developing nation's farmers are out-competed by modern industrial agriculture. More so, they lack the access to capital to compete effectively. These practices are leading to institutions like the FAO and OECD to conclude the constant negative outlooks for developing nation farmers. The prices are high or the prices are low, the outlook for the developing nation's farmers remains negative. Sure, in theory a food price increase that is sustainable, may add to investments in agriculture and increase productivity, consequently production, but the imbalance of the markets are what lead to the negative stigma surrounding agriculture.

Adding to the negative stigma, the food security concerns that come with price increases of food tend to disrupt the social stability of developing countries; threatening the economic recovery as well as creates violence within the social realm. We see a continuing loss of purchasing power; more and more people are desperate for survival. As a result food protests have broken out around the world. Violence over food security has broken out in Egypt, Jordan, Haiti, Tunsia, Algeria, Yamen, Morocco, and Mozambique. Food price increases bring about turmoil and pushed millions into poverty. Threatens the future livelihood and practices surrounding agriculture (Ortiz 2011). Life as we know it cannot be sustained with our current status quo. As such recent food price increases are, at the very least, threatening, and a force for change. It is an environmental stimulus to which we have for the most part reacted poorly. At the risk of not getting caught up further in the debate, this will suffice as our evidence that the recent food inflation, and it's volatile nature, are negative for humanity (World Bank$_1$ 1990, 2008).

Chapter 2: Elements Affecting Recent Spikes in Food Prices

Identifying the influential elements affecting food prices strengthens stakeholder's abilities to make more effective decisions. Consulting the literature lead to 7 fundamental elements, these are: supply shocks, demand shocks, macroeconomic factors, policy inadequacies, market structure, and unstable global financial markets. Under these 7 fundamental elements exists a series of influential factors driving food prices. A breakdown of these fundamental elements can be found in the Chart in Appendix E. The influential factors within each of the fundamental elements are mentioned below.

Supply shocks come in the form of adverse weather conditions, land availability, water availability, climate change, input price increases, and low productivity. Demand shocks are found in two large forms. The first shock is biofuel demand, and the second,

income growth in emerging markets. Macroeconomic factors include inflation, real public deficit, real money supply, the real exchange rate, and financial speculation. Policy inadequacies encompass a large collection of international policies surrounding food, agriculture, and energy. Examples include biofuel policies, trade policies, fiscal and monetary policies, policies of abundances, policies of shortages, WTO goals, high export tariffs, export bans, and CAP reform. Market structure brings up poor logistics systems, energy intensity of agriculture sector, weak institutions undermining production incentives, subsidies, and market inelasticity. Lastly the fundamental element of unstable global financial markets remains largely self-explanatory. Global economic turmoil nested within the financial markets has had its effects on food price volatility.

All these factors together sum to the environment surrounding food prices, and as such leaves us a very daunting task of deciphering just how strong of an influence these forces are. Furthermore should we choose to quantify them, do the modeling capabilities available allow us such liberty, or are we limited in the scope our analysis can take? In the following chapters each fundamental element and its influencing factors will be drawn out into more detail. Beyond that a few case studies help us examine the magnitude of the forces affecting food price increases. Lastly we investigate the modeling abilities available.

Chapter 3: Supply Shocks

Simply put, someone could say the recent food price increase is a result of supply not meeting demand. This would in principled economic fashion result in a price increase. However, simple is left in our principle courses cushioned with assumptions separating us from reality. Regardless, the complexities do have to start somewhere. Thus

here we are, explaining the Supply utilization shocks contributing to an increase in food prices.

As mentioned earlier, adverse weather conditions, land availability, water availability, climate change, and low productivity serve as the supply shocks we are seeing in 2010-2011. The forces driving prices are then not entirely mere short term, and extend to a much larger issue of resource utilization. Taking the price increases of food into a much more gloomy outlook on the status of our planet. Understanding that all of the price drivers are linked, interactive, and correlated, lets us momentarily compartmentalize the supply shocks we have run into over the past couple of years.

Chapter 3.1: Adverse Weather Conditions

It's no stranger to the news the amount of adverse weather conditions farmers are being faced with around the world. Since day one, farmers have fallen captive to natural disasters. There is little in our power as humans for us to fight these inevitable turns of, well some could term it fate. Perhaps that seems a less human approach as of late than any. Indeed evidence would suggest the contrary, we are the ones causing these fateful turns of events. You can argue to what degree as much and for as long as you would like, but there is simply no denying that human use of resources has had an impact on the environment. Resources dictate our capabilities, and it is a cause for concern the changes we are seeing in the patterns of our world's resources. One pattern in particular over the past couple of years has added complications to the world's food supply, weather patterns.

Weather has taken its toll on the world's food supply. Table 3.1 lists recent extreme weather conditions between June and December 2010. Droughts in Russia lead to a decrease in grain productions by 35-37 percent. The drought reduced production for other crops as well; sunflower seeds, potatoes, fodder grass, and vegetables all saw

TABLE 3.1: Extreme Weather Events Between June and December 2010

Weather Event	(Most) Affected Area
Severe winter and/or snow fall	1. Europe (Western) 2. United States
Drought and wildfires	1. China, People's Republic of (Shandong) 2. Russian Federation (mainly west) 3. United States (California, Texas, Alabama)
Cyclone, flooding, inundation	1. Australia (Queensland) 2. Pakistan 3. China, People's Republic of 4. Malaysia, Myanmar, Philippines, Thailand 5. United States (Arkansas)

Source: U.S. National Climactic Center

decreases in production. The dryness became so severe that fires became a very series problem. The drought's impact led Russian leaders to put an export ban on wheat in an effort to allow their depleted supplies and stocks to meet domestic demand (USDA$_1$ 2010). Russia banning wheat exports springs us into a little taste of the policy issues surrounding the food price increases. Since they were once the second largest exporter of world grains, global grain prices reflected their policy change. However, sticking with our discussion of weather droughts decreased production in other parts of the globe as well.

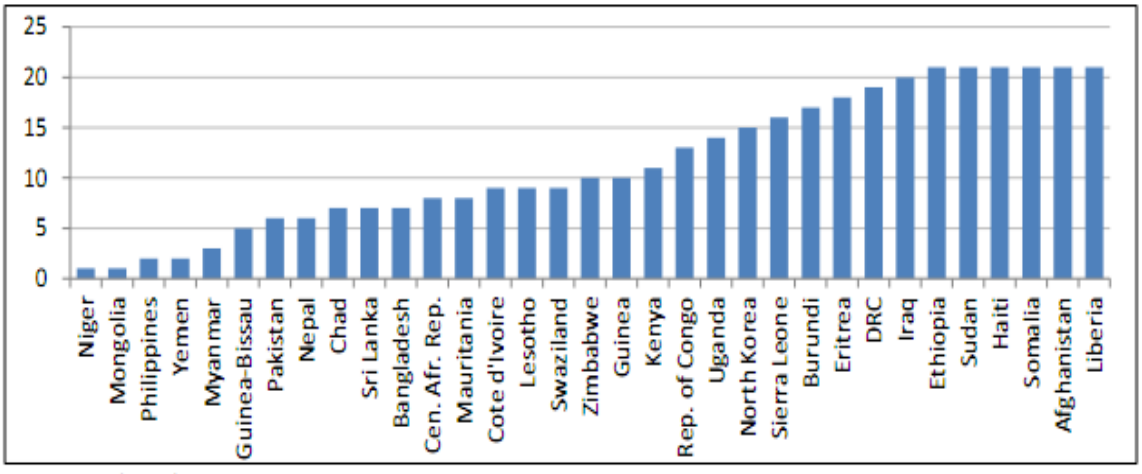
The black sea region saw its fair amount of adverse weather this past year. Droughts and coastal flooding led to the depletion of stocks in the black sea region. France and Germany experienced some severely dry weather; this has not gone unnoticed in the quality of their crops, if not the production itself. The Ukraine and Kazakhstan also suffered from the drought. Famine struck West Africa ruining crops in parts of Uganda and Djibouti, but mainly the stretch of land where the borders of Kenya, Somalia, and Ethiopia meet. South America and the Midwestern US saw the effects of La Nina, dryer than normal temperatures. Canada saw excessive rain; parts of the US also saw severe flooding. Heavy rains were not limited to North America; Australia also experienced crop

damage from their rains. Bad weather all across the globe added to the price increases of food (IISS 2011).

These droughts and famines however were not completely unexpected, aid agencies warned governments of the probability of a future famine. Yet Governments did not take the precautions necessary to safeguard against the effects following such droughts. Stocks are being depleted not only in the country's experiencing the droughts, but as well as in the major importers of the commodities taking the production shortfalls. Countries are now forced with replenishing stocks to mitigate their vulnerability in the future, as well as to meet current demands without depleting their stocks down to dangerously low levels. A few of the major buyers include: Algeria, Egypt, Jordan, Lebanon, Morocco, Turkey, and Libya (UPI 2011).

These countries are experiencing food emergencies. The buying up of stocks is not going to mitigate their issues overnight. Figure 3.1 helps put into perspective the long term consequences of adverse weather conditions and riots resulting from food price hikes. Some food emergencies, according to the FAO are expected to last over 20 years.

FIGURE 3.1 Duration of Current Food Emergencies (years)



Source: FAO (2010i)

Let's not limit our weather conditions to affecting crop yields. Livestock and poultry are endangered or have difficulties growing properly when weather doesn't cooperate. Cows may produce less milk, chickens lay less eggs. Cattle feeding on dryer lands will not gain weight as well. Regardless, weather remains a powerful force affecting prices. It is the main reason for changes in crop yields from year to year. Technology changes are not implemented fast enough. Tillage, fertilization, seeds, pesticides, and weed control all affect yields as part of the production process. However, these changes are minimal in yield outcomes compared to the effect of heavy rains, droughts, rain at the wrong time.

Then again yields can see large increases with favorable weather as well. Rain during the right stage in crop growth can mean a better harvest, happier cows. "In 2004, near-perfect weather led to record grain crops in the United States, the E.U., and the world as a whole" (Westhoff, 2011). Corn yields per acre in the US for 2004 were almost 13 percent higher than the old record yields. World cereal production went up by almost 10 percent largely as a result of higher yields per acre. Even with increased grain consumption in 2004, the higher yields allowed replenishing of global grain stocks. These came in handy in 2010/2011 with droughts in East Africa, East Asia, and Southern United States, as well as with floods in Central America, Australia, South Asia, and South Africa. Consequently this same cushioning method has to be sustained. Depletion of world stocks presents as another factor pressuring food prices.

In the end there is no denying the link between weather and food prices is a strong one. Granted there are ways of preparing, hence stockpiling, and genetic modifications. Food production is then attracted to suitable land with sufficient water resources.

Limiting the exposure to bad weather translates into limiting the risks of lower crop yields, creating food security for a country, or as most food production ventures go increasing profits.

Chapter 3.2 Land Availability

Land is one of the utmost important elements regarding agriculture. It is imperative to discuss two issues surrounding land: people's access to land, and surges in the demand for land. Efforts to maintain protectionist policies and fight food price volatility have lead many countries to purchase or lease land in developing countries, outsourcing their food production. Investors from the private sector and OECD member countries bring money and infrastructure to rural farming communities. This could result in employment opportunities, technological advancements, except it tends to bring added competition for land and water resources to regions already struggling with attaining these resources. Smallholder farms are being alienated in their rights and controls over land in their rural communities. The demand for agro-fuel brings commercial agendas to rural developing nations.

Multinational companies gain access via joint ventures, or by contracting local farmers. Increasing incentives, some nations have changed laws in order to compliment the investments. However, the additional capital flows heading into the rural communities are not necessarily leading to benefits of the smallholder farms, or community members in general. In Tanzania, an investment to plant Jatropha in the Coast Region of the Kisarawe District sparked “allegations that the villagers were not consulted and their compensation was not adequate” (S. Haralambous 2009).

Not all investments have trended to negative allegations. For the most part the investments have not been monitored completely and are just in the beginning phases. So

many countries are jumping on board, and outsourcing their agriculture production. Brazil has invested in Caribbean, African, and even Pacific countries. Media touts the rural communities are not being displaced, and compensation measures are being taken. However, this may be difficult to maintain once you are reaching higher and higher levels of foreign investment. For example, applications for land by foreign investors in Mozambique were over twice the total area of land cultivated in the country (V. Songwe 2009). Although, not all the applications were approved it's just an idea of the massive amounts of foreign demand for developing country land.

Delving further into the outsourcing food production, the Philippines has a Spanish bio-diesel company, Bionor Transformacion S.A. Buying up over 100,000 hectors for Jatropha plantation (Palawan Sun 2008). Also investing in Jatropha crop land, 50,000 hectares in Mindanao went to Sarangani Bio Corporation, a company consisting of South Korean, Philippians, and Japanese investors (Renewable Energy Magazine 2008).

In the interest of food security, Gulf States are making deals to acquire land. Private and public firms from the United Arab Emirates were reported to have invested in the Baluchistan Province of Pakistan, where they plan to perform mechanized farming under irrigation (S. Khan, 2008). Hail Agricultural Development Company, a private Saudi Arabia company has invested in the north of Karthoum (W. Wallis 2009). Plans to grow basmati rice in the Indonesian islands of Paupa, Sulawwesi and Western Java have been made by The BinLadin Group (Grain 2008). Ventures by Saudi Arabia are not limited to rice but also include larger projects geared towards agrofuels using maize, soy beans, sugar, and sorghum. 240 Saudi companies obtained investment licenses in Ethiopia, intent on growing cereals (M. Chebsi 2008). State Trading Corporation along

with 15 Indian companies leased 10,000 hectares in Brazil, Uruguay, and Paraguay growing soybeans and oil seeds (D. Sharma 2008). The list goes on, and on. Countries are investing in land all over, snatching up the productive resource creating the new frenzy termed, “land grabbing”.

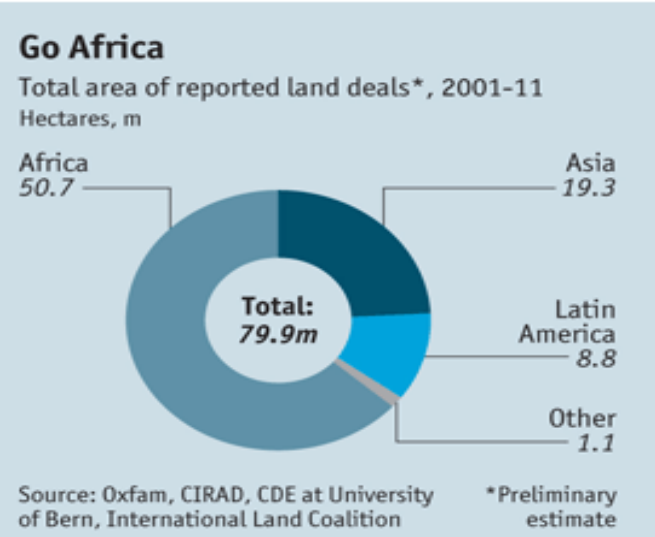
Of course some would like to create a much more positive light on the land grabbing situation and cite the investments bringing financial resources, agricultural technology, and improving infrastructures in the developing world. Only, on average, even in large scale this is not the reality we are faced with. In theory there is the possibility for a “win-win situation”. Unfortunately lack of regulation on these foreign investments, issues of control over the land, water availability, and the environmental impact of mechanized agriculture projects all contribute to sticky situations for the local communities involved. It is argued that the additional production found through the outsourcing is necessary to meet world demands.

Saudi Arabia and China have invested in land in Africa. Rather than selling the production to Africa states, they are using the production as an alternative to trading with Africa. Taking profits and production space away from the already hurting African states. Not to mention the demand for land being driven by biofuel production, the use of crops in Africa for biofuel do not help with the problems of food security in Africa. Saudi Star Agricultural Development Plc, owned by billionaire Sheik Mohammed Hussein Al-Amoudi, plans to produce wheat in the Gambela region of Ethiopia then export the essential food source. Currently the company is growing rice on 10,000 hectares. Yet he plans on expanding his investment to 250,000 acres and agreed to only export 60 percent of production, which Al-Amoudi sees as helping the local communities by way of foreign currency, job creation, and increased domestic food production (Sisay 2011).

Unfortunately the story doesn't end with the opportunities, arable land being sold or leased out to foreign investors has many consequences. Some investors are simply not producing anything on their land, and are just capitalizing on the increases in land prices that have coincided with the land grabbing outbreak (Kersting 2011).

Land is becoming more and more of an issue, scarcity and degradation brought on by climate change and demographic pressures make the increase in demand rather complicated. To paint the picture more clearly there is an estimated 13.5 billion hectares of total land in the world, Now the land "available for expanded rain-fed crop production" brings us to just 2 billion hectares, minus a 500 million hectares for environmental reasons. We are down to 1.5 billion hectares of land open for crop production, 80 percent of this available land is found in sub-Saharan Africa, and in South America (FAO_3, 2008). Half of this 80 percent can be narrowed down to seven developing countries: Argentina, Bolivia, Brazil, Colombia, and Angola, Democratic Republic of Congo, and Sudan. Limiting the scope of land available for agricultural expansion doesn't even begin to express the scarcity issues. Population growth, climate change, and geopolitical environments add in new factors to be considered in association with land availability.

FIGURE 3.2 Area of Land Deals 2001-11



Recent research has led to an estimated total of 79.9 million hectares of land being wrapped up in these foreign investment deals from 2001 to 2010 . Figure 3.2 displays a breakdown

of the near 80 million hectares that have passed hands over the past 9 years. Africa accounting for over half of these deals is of particular importance given the state of their food security. Putting the amount of land into perspective: “80M hectares is more than the area of farmland of Britain, France, Germany, and Italy combined” (The Economist 2011). The map found in Appendix B links the land grabbed to the purchasing country. Countries owning the land are open circles, while the solid circles represent the country in which land is owned.

Land-use changes not only displaces local inhabitants, it often creates further food security issues, upsets environmental balances, tend to raise bio-diversity concerns, and pulls local resources away from current productions. Once commercial investments sweep up the most attractive land cites, marginal lands are being left for the activities of local farmers. “These lands could, in turn, become subject to increased pressure, exploitation, degradation, and conflict” (Haralambous 2009). There are numerous instances in which the consequences of land grabbing have become realized.

The loss of Sheanut trees in the White Volta River basin of Ghana hurts those dependent on this commodity for their livelihood. Used to make medicines, cook, and in the production of soaps and cosmetics. Most importantly it serves as a source of income for women. Gender oriented studies of development have given evidence as to the particular importance women's income has on the welfare of a household. Women tend to spend their incomes on more essential items for the household: food, clothing, and education, “a recent World Bank report confirms that societies that discriminate on the basis of gender pay the cost of greater poverty, slower economic growth, weaker governance, and a lower living standard of their people” (Chuston 2002), hardly a

positive outcome for a developing region. Allegations ensued after a mining company based out of London invested USD 510 million on 30,000 hectares in the Southern District of Gaza was given land promised to 1,000 displaced families. The Government of Mozambique gave away the land in a contract for the company to grow sugar, complicating the issue further was the availability of water in the region.

Another example of the consequences brought on by "land grabbing" comes from Central Sierra Leone. Expecting 2,000 jobs, and protection for the bolis swamps in which rice is grown, Makeni farmers agreed to grant a Swiss company a 50-year lease on 40,000 hectares. 3 years later, in their venture to grow biofuels for Europe only 50 new jobs exist. Perhaps worse yet, irrigation damaged the bolis swampland. Thus we are presented with mounting evidence that the development that does come from these ventures brings environmental, social, and economic expenses in the short-run, and more solidly in the long-run for local communities involved. The investments being made are driving up the costs of food by limiting the amount of land available, disrupting local community's livelihood, and displacing existing smallholder farms in developing nations.

New technology, higher tax revenues, better infrastructure, and more jobs, definitely sounds like a great deal for the host country. However, these upsides are for the most part non-existent. Labor that does open up is often filled by outsiders. Tax holiday's, and corrupt governments lead to small if any contributions to the local public purse. Sadly, "it is not unusual for foreign investors to pay less tax than local smallholders" (The Economist$_1$ 2011). There seems to be overwhelming evidence against land grabbing. Yet in Madagascar we saw both sides of the investments, the bad and the good. After offering a South Korean company half of their arable land, the approving government was

overthrown. Years later, research found the land deals had fallen significantly, and investment projects brought benefits to the social infrastructure. Investors built schools, and clinics as part of the land deals. If this were the case in just some of the investments we may have a decent argument for the proposition of land grabbing. Perhaps someday this will be the case, for the time being evidence has found "land grabbing" to be a "combination of high levels of corruption with low levels of benefit" (The Economist$_1$ 2011)

Chapter 3.3 Water Availability

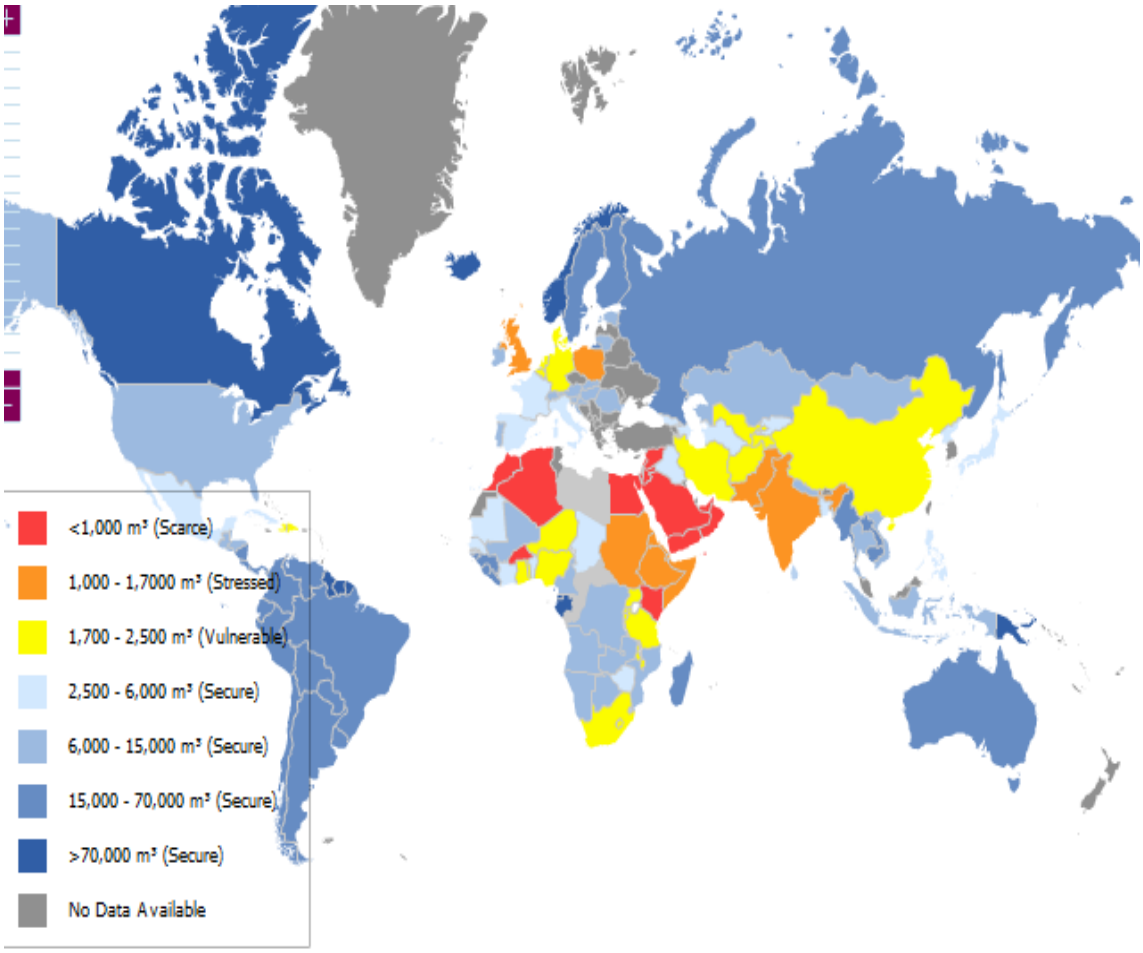
> "We have a looming water crisis. This crisis is the response to growing population, changing dietary habits, and competition for water from other sectors of the economy. Lack of water for growing food will be one of the most critical issues for us to overcome in the twenty-first century"
>
> -Colin Chartres & Samyuktha Varma, 2010

Water without doubt, for obvious reasons, ranks among most important resources. Nothing about the security of water is simple. We can operate on a rule of thumb: water interacts with the environment. Without launching ourselves into a full scale discussion on the ins and outs of water security, we can limit ourselves to the interactions that strictly concern agricultural practices. Mainly: Groundwater overdrafting, and overuse and pollution of water harming biodiversity. Overdrafting occurs on a widespread basis as countries attempt to satisfy their growing water needs. Specifically China, India, and the United States all participate in overdrafting. These big grain producers "along with a number of other countries where water tables are falling, are home to more than half the world's people" (Brown 2010). The US Ogallala aquifer, the Saudi aquifer, and the deep aquifer under the North China Plain are all fossil aquifers, thus are nonreplenishable. More arid regions lack the option of reverting to lower-yield rain-fed crops, and could

mean the end of agriculture, heightening the upward pressure on food prices.

Significant productivity changes stand as a result of water availability. Wells in Beijing require a depth of 1,000 meters, over half a mile, to reach fresh water. Increased depth of wells translates into increased costs of supply (Brown 2010). Biophysical realities have caught up to human ambition, suddenly the apparent bliss of the impact our agricultural practices are having on the environment is coming to a breaking point. Aquifers across the globe cyphered, wetlands were drained, streams modified. Several river basins have been closed in response to our disruption of natural water flows: Colorado, Darling, Murray, yellow, Indus, Amu Darya, and others.

FIGURE 3.3 Water Availability Map



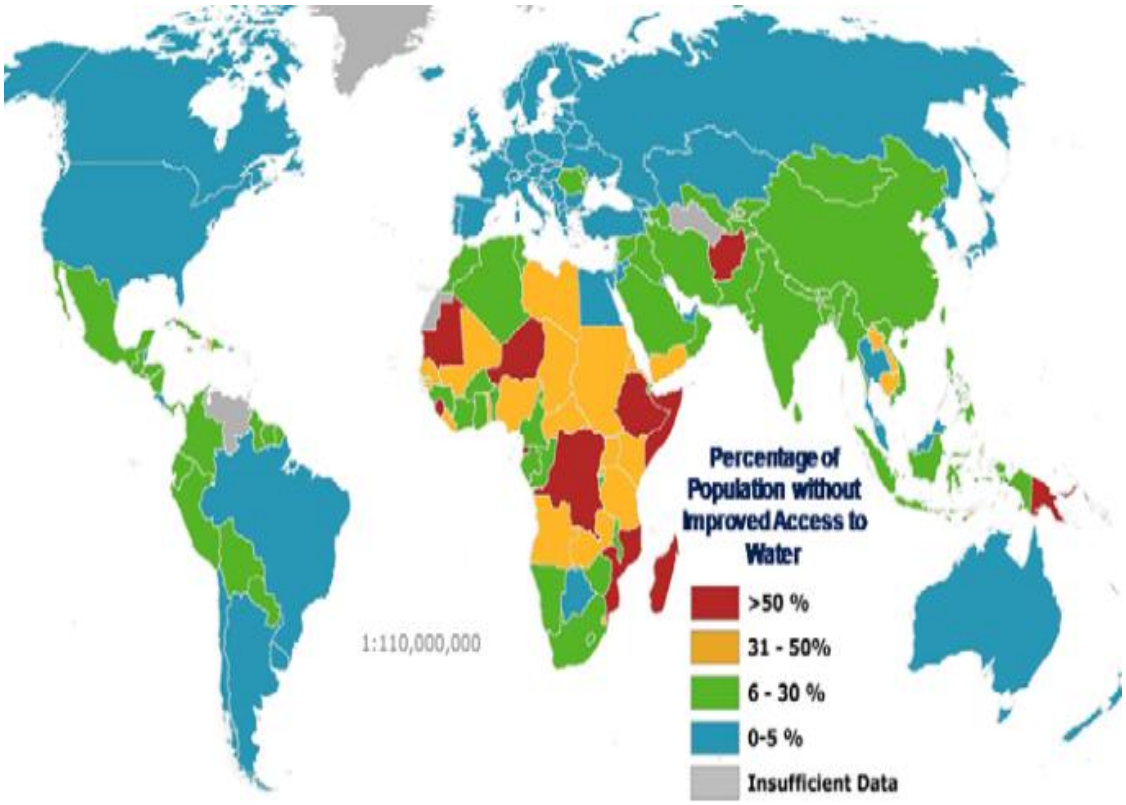
Source: analysis prepared by DAI for USAID in 2010

As seen in figure 3.3, the areas most threatened by food security tend to be the areas also most threatened with water security. This comes as no surprise given the links between the two. However, it does add to the stress of those nations in solving their food crisis concerns, when water availability is a large limiting factor. The map shows water availability below 1,000m^3/capita/year hurts economic development, and a population's well-being. Keep in mind this indicator is not taking into account the quality or access to water itself.

According to USAID, "Global demand for water is doubling every 20 years, and more than 2.8 billion people will live in either water-scarce or water-stressed regions by 2025" (USAID 2010). The Agricultural sector consumes over 70 percent of the world's available water. Access to water often dictates the livelihoods of rural populations; relocation becomes imperative when crops and incomes suffer from a loss of water. It is then the job of a government and national infrastructure to help provide water. A lack of access to water threatens human health, and undermines economic development (USAID 2010).

The less water available in a region, the more expensive this water is. The prices of food reflect a region's water availability. Access to water, seen in figure 3.4 illustrates the world picture of water access in 2010. The world's accessible renewable fresh water is limited to an estimated 12,500km^3 (Brown 2010). Again in figure 3.4 we see a similar pattern as in 3.3, the regions facing food security issues are also the ones with limited access to water. This taps further into the issues surrounding the previous section on land

FIGURE 3.4 Global Access to Water (2010)



Source: USAID/ABRI/ DAI August 2010

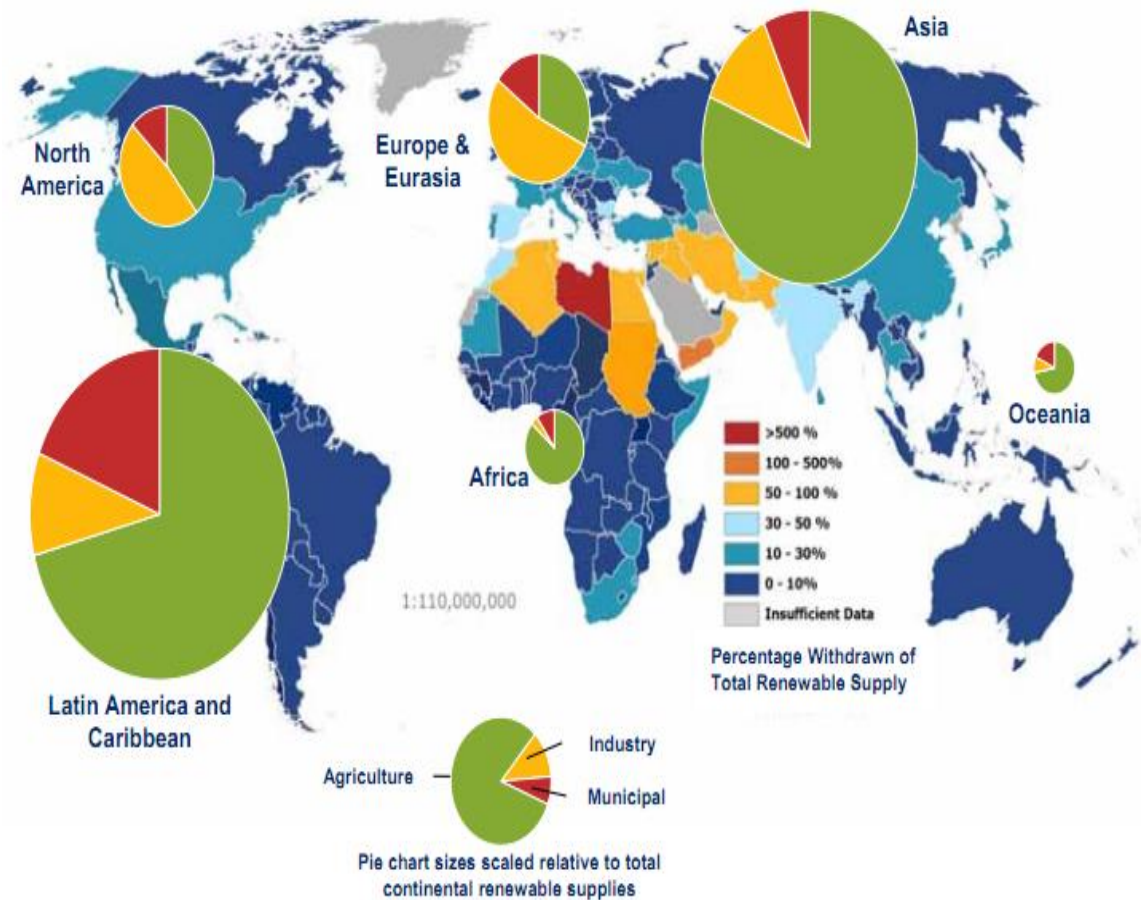
availability. These same regions are the areas where land investments are being made by commercialized farming entities. The increased demand for water cannot be met with easy solutions in these regions of lower access to water. Disrupting the natural flow of water affects hydrological conditions. The impact our agricultural practices have on the ecosystem need to be addressed to further understand the complexities surrounding the issue of water availability. The impacts of irrigation include: reduction of downstream river discharge, evaporation, groundwater recharge, ground subsidence, soil salinity, alkaline soil, and bioretention. Elaborating further would lead us to a rule of thumb: water utilization by agricultural practices negatively impacts the ecosystem.

Water extraction methods are not cheap. Saudi Arabia "is as water poor as it is oil

rich" (Brown 2010). Using oil money, Saudi Arabia subsidized its expensive irrigated agriculture; wheat prices 5 times the world level. Wheat harvests dropped 71 percent after the government cut subsidies in 2005. Gaining access to water is environmentally taxing, fiscally taxing, and culturally taxing. States with weak infrastructures and poor governments are not likely to help their people gain access to water. Systems, in which we are seeing exploitation on the basis of land, also tend to have similar problems surrounding their water supplies.

The links between water and food security create a better understanding as to the water availability issue driving food prices. Figure 3.5 demonstrates this link. The map

FIGURE 3.5 Water and Food Security (2010)



Source: USAID 2010 [Millennium Development Goals Indicators/UNEP]

shows two things: the percentage withdrawn of total renewable supplies (country colors), and the utilization of these withdrawals in the pie charts. Pie chart sizes are proportional to the continent's total renewable supplies. North America, Europe and Eurasia use a larger portion of their renewable water for industrial purposes than they do agriculture. Explanations could mean these countries have implementing water management practices in their agricultural sector that result in higher water efficiency. However, since the nonrenewable water supplies are not represented, such conclusions are simply speculative.

Access to water for agriculture and other household needs often results in more disastrous outcomes than simply higher supply costs. Water wars are perhaps a testament to the base survival instincts that govern human actions. Violence is another issue brought on by a lack of access to water. Forget about wars over black gold, thirsty humans will be fighting over blue gold. Egypt has seen skirmishes for centuries over the Nile. In 1967 Israel's war against the Arab Armies was for water, according to prime minister at the time, Ariel Sharon (Arsenault 2011). Water Conflict hotspots pop up generally in the same areas we have seen in our previous graphs. Sudan, Somalia, Yemen, Egypt, Kenya, India, Pakistan, China, and Ethiopia, are just some of the areas facing physical conflicts over water resources (Arsenault 2011). Understandable so given the stress of lower access to low amounts of available water is likely to spark conflicts. Water resources are often used as territory lines, “263 river basins (home to 40% of the world’s population) are shared by two or more countries” (USAID 2010). When water is scarce people fight for their right to it, or relocate. Water availability and access dictates human behavior.

The availability and access of water contributes to food prices. Both indirectly via

lowering of yields, and directly as an input cost where extraction methods are concerned. Land availability and water availability both tie into the productivity of agriculture. If the recent food prices are seeing less available land for agriculture, as well as less water availability, then the two situations come into play when crop yields are analyzed. We have established agricultural land is becoming more scarce, and water is also becoming more scarce, both contributing to higher food prices.

Chapter 3.4 Climate Change

Previous discussion began building the issue from the ground up, quite literally, impacts of recent climate change already resulted in reductions of food supply. At the risk of being redundant, the droughts and excessive floods cited earlier attest to the poor harvests brought about by climate change. Rising temperatures threaten crop susceptibility to viruses and pests, while simultaneously strengthening these threats. China and India stand concerned over the rapid melting of glaciers that feed into key rivers: Yellow, Yangtze, and Ganges; which they draw heavily on for wheat and rice production. Put together China and India account for over half the world's wheat and rice production, making this a global concern. In our attempt to produce cheap food we are exploiting scarce resources and destroying the environment (Ikred 2008).

Polluting streams and groundwater with run-offs from fertilizers and pesticides, farms are currently not ecologically sustainable. Touching briefly on the industrialization of agriculture, recent technological “advances”, “may well have done more damage to the ecologic and social resource base of rural areas than any societal benefit they may have created in terms of more efficient food production” (Ikred 2008). Saving the full onset of the impact changes in agriculture for a later chapter, it is important to realize here that the

technology may not be aligning society's best interests with food production practices. The natural environment is being impacted by our actions, agriculture among the most disruptive of human activities affecting the globe today. Mentioned earlier the effects of irrigation alone are enough to alarm even the most audacious. In his report for the International Policy Institute, “Climate Change: Impact on agriculture and Costs of Adaptation”, Gerald Nelson concludes “agriculture and human well-being will be negatively affected by climate change” (Nelson 2008).

Climate and agriculture are interactive. Adaptations occur in response to climate changes, these adaptations affect the climate, relating the two dynamically. To be more specific, agriculture interacts with the environment in 4 ways: greenhouse gas (GHG) emissions (soil management and livestock), altering atmospheric CO_2 levels, biomass displacement of fossil fuels, and heat absorption of Earth's surface. Agriculture GHG emissions make up roughly 7 percent of U.S. GHG emissions. Of that 7 percent, nearly half comes from soil management, 30 percent from eccentric fermentation (digestive process in animals that produces methane), 12 percent from manure management, and a final 14 percent is attributed to energy use (Climate Techbook 2011). Land-use practices and changes fluctuate the amount of Carbon stored in soil and plants. Fluctuations are either a release or an uptake of carbon. On average, “forests and wetlands generally store more carbon than grasslands, which in turn tend to store more carbon than cropland”, hence the need to manage land usage.

According to the Climate Techbook, “agricultural lands in the United States act as a small carbon sink, storing more carbon than they release. Putting this into perspective, forests in the U.S. store about 20 times more carbon than the entire U.S. agricultural

sector (Climate Techbook 2011). Without land use management techniques the release of carbon from agricultural practices, naturally, is expected to be much higher. Agriculture has the potential to reduce GHG emissions through its ability to substitute fossil fuels with biomass. Here we will not go much further into details, as you can imagine an entire section will no doubt be devoted to biofuels. Yet this work would be remiss if we did not mention the potential of reduction in emissions has much more to consider than the outright use of biofuels versus fossil fuels. There are climate impacts on the production end of bioenergy. In the section dedicated to biofuels we will cover the life-cycle of emissions resulting from biomass: "land management practices, land use change, conversion processes and associated energy use, and transportation" (Climate Techbook 2011). As end users of transportation and energy, the agricultural sector commits further impacts on climate change.

Change to the climate system by agriculture results in a local warming effect. Solar energy reflected by the surface of the Earth increases with lighter surfaces, such as snow, and ice. These are said to have a high albedo, or a larger fraction of reflected solar energy. Now surfaces with a low albedo, dark surfaces, absorb a larger fraction of solar energy. Soils and darker vegetation have a low albedo, they absorb more solar energy and thus release more heat. More heat into the atmosphere creates this local warming effect, which in turn affects the entire global climate system as a hole. "Agricultural land, which includes cropland, managed grassland, and permanent crops, occupies about 40-50 percent of the world's total land surface" (Climate Techbook 2011). According to *Synthesis Report* from the Climate Change Congress - University of Copenhagen (Richardson et al., 2009):

> “Recent observations show that societies and ecosystems are highly vulnerable to even modest levels of climate change, with poor nations and communities, ecosystem services and biodiversity particularly at risk. Temperature rises above 2°C will be difficult for contemporary societies to cope with and are likely to cause major societal and environmental disruptions through the rest of the century and beyond.”

We are locked into this man versus nature mentality, fighting off the wild beasts, willing the land and water to cooperate with our every whim. Settling in deserts and flood lands, using dams and dykes, we disrupted natural flows of water. Now the sediment once found to replenish topsoil for fertile farmlands after periodic flooding now rests in lakes and reservoirs. Wiping out species as we fight more battles against nature, cultivating lands, and urbanizing where we please, humans manipulate the environment. Curing diseases and killing of pests only to create super germs, more resilient diseases. Abandoning diversity, thanks to modern chemical pesticides, yet “we still lose the same percentage of crops to pests as we did in earlier times” (Ikred 2008). Are we winning yet?

Let's consider the impact some of our actions in regards to agriculture have had on climate throughout the past. Granted we are being unimaginably brief here considering the scope spans across time, globally, and is often undocumented. Regardless, we need to peek into the past to know the effects. Starting close to home; The U.S. drained a significant proportion of wetlands in its Midwest regions. The disruption of natural flows of water resulted in serious complications just recently, “The recent disastrous floods in the U.S. Midwest would have been far less damaging if wetlands in the region hadn't been drained decades ago” (Leahy 2008). Wetlands serve several ecological purposes: capture carbon and methane, home to biodiversity, aid in water sanitation, and as mentioned crucial for flood control. Wetlands all around the globe have been, and are

being drained for agricultural purposes. This drainage Releases large amounts of carbon and methane, 21 times more potent than CO_2, into the atmosphere. Taking this to a global level:

> "Some 60 percent of wetlands worldwide - and up to 90 percent in Europe - have been destroyed in the past 100 years, principally due to drainage for agriculture but also through pollution, dams, canals, groundwater pumping, urban development and peat extraction" (Leahy 2008).

As if draining wetlands is not enough of an issue, deforestation has taken its toll on our climate. Rainforests, "the lungs of the world", are being destroyed at alarming rates all across the globe. The effects are: displacement of indigenous people, loss of Oxygen source, silting rivers, exacerbating floods, and soil erosion. In Sao Paulo, Brazil, all but 3 percent of forests were destroyed. Brazil's Cerrado has lost over 60 million hectares to soybean crops and grazing pastures. Only, Brazil's large rapidly growing population is not the real reason for these encroachments. Slashing and burning of the forests, planting crops then moving on once the soil has been exhausted, is not a necessity to feed the Brazilian population. There are larger factors at play here. Soy bean exports have become a large business in Brazil. Large mechanized soybean growers are the real culprits, encroaching on the forest's frontiers. Buying up small farms, to the extent that the largest farm units, "comprise 1.6 percent of all farms, but 53.2 percent of all agricultural land" (Lappe 1998).

In Central America tropical rainforests are meeting the same fate, being removed entirely for cattle ranching and agriculture or home to logging corporations. Here we begin to see a theme. Export agriculture displacing smallholder farms, searching for work in the export industry that displaced them. Periods of booms and busts dictate worker

employment, some are forced to migrate. They move further into the forests, clearing away new land for cultivation, since the land available for cultivation is owned by a few rich patrons. Behind them are the cattle ranchers, looking for more grazing lands. Meanwhile demand for the exports is higher than ever, international financial institutions and governments alike cannot get enough, bananas, soybeans, recently wheat, and whatever the cash crop of the year is. When the smoke from the forest fires clear, humans are left with lands that are further susceptible to natural disasters. Actions impacting our climate, more frequent weather volatility and extremes are expected, furthering inequality and development concerns for already hurting poor regions of the world. Now on top of that, add in the result these recent supply shocks have had on food prices. The picture begins to get gloomy. At the risk of being a "chicken little", someone had to scream out, "the sky is falling!"

Perhaps too little to late, but humans have began to realize that we are this nature we are fighting, and scarcity has been impacting our lives in a larger and larger degree, daily. It is easy to get caught up in the actions of harvesting, mining, and further exploiting nature to feed this human consumption. We are already wrapped up in it: lower supply not meeting demand, the premise of this food crisis. Productivity the fixation of our value oriented mindsets. Sustainable agriculture is a relatively new response to the scarcities at hand. It comes with the harmonious balance of three tiers, "ecologically sound, economically viable, and socially responsible" (Ikred 2008). Entertaining the realistic characteristics of such a harmony will occur in a later chapter. For now we should refocus on the impact climate change has as a price driver for world foods.

Paul Krugman addressed the price driver of climate change in an article he wrote

for the times in February of this year, “these severe weather events are exactly the kind of thing we'd expect to see as rising concentrations of greenhouse gases change our climate – which means that the current food price surge may be just the beginning” (Krugman 2011). He seems to attribute a large enough portion of recent price spikes to climate change, since he suggest it would mean the surges in prices being, “just the beginning”. One could say climate change presents a challenge to future agricultural practices. It does mean that there could be a higher variability in the weather pattern, and consequently more frequent adverse events lowering stocks, yields, and productions. Adapting to this variability then becomes the determiner of the price associated. “Neither climate change nor short-term climate variability and associated adaptation are new phenomena in agriculture (Schmidhube 2007).

Climate events are as much apart as our future as they are the shaping of it. New technologies, population growth, and economic expansion all as much a product of climate change as they are caveats. Adaptation to anthropogenic climate tends to dictate the direction socioeconomic development heads. Lines blur in attempts to distinguish between the two. Developing countries clearly hold a deficiency as far adaptation to current climate is concerned. Poor countries are more vulnerable to the climate; perhaps it is better to specify poor people. Poor people in general, measured in terms of a specific country are the ones who are most vulnerable, it is common sense. Can't afford to plant seeds that are more resistant to environmental factors, farmers are more vulnerable to the environment. Thus we are not surprised to find, “"there is evidence that higher measures of development indicators like per capita income, literacy and institutional capacity are associated with lower vulnerability to climate events” (Noy, 2009; Bowen et al., 2009).

This does suggest, as one would expect, adapting to climate change comes with associated costs. Measures to adapt include: enhancing water use efficiency, changing regulations on buildings, air conditioning, constructing sea walls, altering farming practices, and requiring varied crops. Actors taking this measures can be both private and public, investments made towards improving infrastructures, technology, policies, and ultimately human behaviors. Trade-offs to these adaptations must be assessed under the appropriate context. The nature of these estimates results in critical assumptions being made to form a baseline of costs. The exposure of assets to climate change and the interactions following is highly sensitive in terms of percentages, since we are dealing with a large magnitude of baseline costs. A shift in estimates of 1 or 2 percent translates into a rather large change in the outlay costs of adaptation. Table 3.1 outlays some of the projected costs for Developing countries to adapt to climate changes. Four different

TABLE 3.1: Estimates of adaptation costs in developing countries, for 2010-2015

Source	US$ billion p.a.	Comments
World Bank (2006)	9-41	Cost of climate-proofing FDI, GDI and ODA flows
Stern (2006)	4-37	Update, with slight modification of World Bank (2006)
Oxfam (2007)	>50	Based on World Bank, plus extrapolation of costs from NAPAs and NGO projects
UNDP (2007)	86-109	World Bank, plus costing of PRS targets, better disaster response

Source: Agrawala and Fankhauser (2008)

Note: FDI = foreign direct investment, GDI = gross domestic investment, ODA = official development assistance, NAPA = National Adaptation Programme of Action, PRS = poverty reduction strategy

groups have taken up the empirical work here; note these estimates are linked to each other and may not be entirely independent in terms of methods used.

As you can see the estimated costs are rather daunting, and not surprisingly very

wide ranged. Current quantification as to the costs of climate change on food security are highly limited, “the existing global assessments of climate change and food security have only been able to focus on the impacts on food availability and access to food, without quantification of the likely important climate change effects on food safety and vulnerability” (Schmidhube 2007). Yet the simulations and models have led us on some paths. A need to address current climate change conditions in agricultural practices has influenced us to analyze the costs and procedures associated.

Market and regulatory mechanisms are to be used in efforts of encouraging the public sector to take on the bulk of the adaption process. By the use of policy instruments, government should encourage self-interested moves toward effective and efficient adaption. Facilitating autonomous adaption requires the public sector to engage the public sector, instruments available include: “insurance schemes, price signals/markets, financing schemes via Public Private Partnerships (PPPs), regulatory incentives, and research and development incentives” (Agrawala 2008). Like the ones in figure 3.1, several studies have made their projections into the future and estimated what adaptations to climate change would cost, even further the residual damages that are inevitable. We have won battle after battle against nature. The irony, it's killing us. Our egos are at it again if we think we are capable of overcoming climate change by conquering nature; further pushes to attempt to control the changes set into motion may cause us even more harm on the long run.

At present we do not have the technological capabilities to battle all of the symptoms climate change will cause, let alone the symptoms we are facing at current. Schematics point to avoiding the first percentages of damage to be relatively cheap and

hold increasing marginal costs after that. Making avoiding the last little bits of damage perhaps more cost intensive than society is willing to pay. Thus we may not be willing to aim for a complete coverage of presumed damages to climate change in the future; instead we will try to mitigate the effects, or try to eliminate the effects that cause harm to human welfare. Presumably some climate effects will be cheaper to avoid than to bare. Unfortunately, we do have budget constraints, becoming more evident with the onset of global financial instability. Not to mention a feasibility issue, we may have the know-how necessary to combat adaptation on the intellectual front, but the tools and implementing cause further complications.

Either way the idealistic abstraction associated with mitigating climate change is morphing into a collective combative forethought; sustainability is working its way into the system. As a species, we don't have any other choice. Finite resources dictate adaptations be made, costs associated are heavy no matter which side of the fence we fall. Climate change is set to cause further disruptions in food supply, “crop Yields will decline, production will be affected, crop and meat prices will increase, consumption of cereals will fall, leading to reduced calorie intake, and child malnutrition will increase” (Nelson 2000). Adaptation requires further investments into agriculture, developing methods and strategies for increasing food production under a sustainable agricultural system takes incentives, fiscal backing. Debate it whichever way you'd like, the costs of adapting or not adapting to climate change will have an effect on food prices. As we have seen, climate change is already influencing food prices.

Chapter 3.5 Low Productivity

Increases in price are supposed to provide incentives for increases in supply.

However, the decrease in supply being a main price driver in recent price spikes tends to limit the ability of producers to respond to price hikes as theory dictates. Agricultural advancements have kept prices on the decline for quite some time. Over the past decade the Agricultural Industry has not been able to change enough structurally to compensate for the increased demand. A concept we will visit quite extensively in the chapters to come. In reference to production, the price increases over the past two decades are not explained by overall world production numbers, but are rather a collection of the actions taken to maintain and in some cases increase crop production under the current world conditions.

Using the World Agricultural Report put out by the USDA Foreign Agriculture Service on October 12th, 2011, the Area, yields, and productions of major world crops will give a better understanding of what's happening on the supply end of world food markets. Under the background of scarce resources, adverse weather, and climate changes, we will interpret the quantitative results of recent food production. Figures represent the production figures released in the USDA's October 12th crop report. As of October 12th 2011, Wheat and barley are seeing drops in area yields, and consequently production. Corn yields are down 2.3% from last year. Productivity is lower, and stocks are lower, combined the pressure of decreased supplies has taken its toll on world crop prices.

Upon discovering figure 3.6, the global conditions discussed start to link themselves to the outcomes of world production. Wheat the victim of droughts over the past year reflects this with a loss in production of 5.3%. Main regions bringing about the production loss are Afghanistan, Iran, Argentina, and the U.S. Barley dropped 17.6% over the past year. Germany, Iran, the U.S., France, Austria, and Australia round off the top

percentage losses. Corn Yields dropped by 2.3%, however cultivated land increases made for a minimal increase in production.

FIGURE 3.6 World Production For Past Two Years

		Area	Yield	Production
		Mill. Hectares	mt/hectare	mmt
Wheat	2009/10	227.31	3.01	684.4
	2010/11	222.47	2.91	648.16
	% Change	**-2.1%**	**-3.3%**	**-5.3%**
Barley	2009/10	55.69	2.7	150.49
	2010/11	50.76	2.44	124.07
	% Change	**-8.9%**	**-9.6%**	**-17.6%**
Corn	2009/10	157.76	5.19	819.42
	2010/11	163.43	5.07	828.29
	% Change	**3.6%**	**-2.3%**	**1.1%**
Rice	2009/10	156.02	4.22	440.33
	2010/11	157.3	4.3	451.38
	% Change	**.8%**	**1.9%**	**2.5%**
Soybeans	2009/10	102.16	2.55	260.84
	2010/11	102.71	2.57	264.12
	% Change	**.5%**	**.8%**	**1.3%**
Sorghum	2009/10	40.68	1.49	59.26
	2010/11	40.83	1.59	64.85
	% Change	**.4%**	**6.7%**	**9.4%**

Source: FAS (2011) USDA PS&D online database

Seeing the year differences in world production only makes one more curious as to the changes across the board from spike to spike of increased food prices. During the first recent food price spike, 2006/07-2007/08, wheat production dropped over 25% in Argentina, Afghanistan, and the Kazakhstan Republic. With the worst of these Afghanistan, suffering a 55% drop in wheat production from 2006/07 to 2007/08. What changes are occurring from price spike to price spike? Figure 3.7 satisfies this curiosity.

FIGURE 3.7 World Production 2007/08, 2010/11

		Area	Yield	Production
		Mill. Hectares	mt/hectare	mmt
Wheat	2007/08	218.23	2.8	610.6
	2010/11	222.47	2.91	648.16
	% Change	**1.9%**	**3.9%**	**6.2%**
Barley	2007/08	57.56	2.31	133.21
	2010/11	50.76	2.44	124.07
	% Change	**-11.8%**	**5.6%**	**-6.9%**
Corn	2007/08	160.61	4.93	792.26
	2010/11	163.43	5.07	828.29
	% Change	**1.8%**	**2.8%**	**4.5%**
Rice	2007/08	154.34	4.17	431.14
	2010/11	157.3	4.3	451.38
	% Change	**1.9%**	**3.1%**	**4.7%**
Soybeans	2007/08	90.82	2.43	220.86
	2010/11	102.71	2.57	264.12
	% Change	**13.1%**	**5.8%**	**19.6%**
Sorghum	2007/08	40.53	1.57	63.73
	2010/11	40.83	1.59	64.85
	% Change	**.7%**	**1.3%**	**1.8%**

Source: USDA (2011) Foreign Agriculture Service; PS&D online database

Production is up along with area and yields for all but one of the commodities observed, barley. Although coming in with a strong yield increase across the period, barley's production was down 6.9%, which is perhaps explained by the lower area. Soybean Area increased a rather large amount, something we should keep in mind for later discussions involving Soybean demand. Staying focused on production, it seems surprising that we are not seeing lower yields and even lower overall productions in the commodities observed. This tells us that from spike to spike we saw increases in production, making the 2011 price spike, not about low productivity.

Recent price increases, do not seem to be explained away by lower yields or lower productions of commodities. Yet these are world figures. The trade policies along with specific production components of a specific country could be cause for additional weight on production in the food price increases seen for that country. So Supply in physical terms is not contracting in respect to previous supplies, that is for most of the commodities. Wheat and Barley are in fact the exceptions, their supplies are contracting with respect to previous year supplies, making production components a larger factor in price increases, than they may be for other commodities.

Intensive production, the pressure to meet growing demands has lead agriculture to seek profit maximizing measures which are harmful to the environment. It's extremely difficult to draw a line and pinpoint when agriculture became more about making profits than feeding people. Technology has evolved over time, advanced. Skills, tools, and knowledge all building, leading humanity on a path. The direction of this path has led to many shortfalls. Agriculture is no different; advancements in agricultural technology do not translate into progress. Changes brought about in the name of increasing yields, productivity, and quality of agricultural goods, may not have been the best direction. Commercial farming: the answer to our production shortfalls, or the culprit to our hunger crisis? Perhaps it's both, but analyzing food price increases requires substantial attention be paid to agricultural technology.

Production itself holds several key driving factors. Looking at production as a whole and quantifying end figures doesn't capture the whole story. Farmer's need to think about the many variable factors concerned with production: seed availability and quality, planting times, costs; fertilizer use, availability and cost; pests, types, challenges, and control; fungal diseases, and seed dressing, Weeds, herbicides, and burning, weather,

floods, frosts, landslides, hail, and any climate shift, Civil disturbances, wars, raiding, and theft; population disturbances, settlements, migration, and political pressures; market control measures, taxes, restriction on trade, environmental regulations, and government incentives; Machinery, mechanical power, spare parts access, and fuel availability; access to credit and costs associated. As if this was not enough of a headache the fixed factors perhaps play larger roles: access to land, labor availability, and water availability. Society demands a lot of the agricultural industry. We want more than just to have food to eat. The developed world has been conditioned. We roam the supermarket shelves and into the produce section, searching for the glossiest apple, or the perfect pare. For most, without little more than a second of inspection, throwing in the least blemished fruit or vegetable. Not realizing how unnatural our prize picked plums actually are.

For which we have pesticides to thank. A hotspot for debate over agricultural practices, pesticides have become like most input practices a necessary evil in the effort to compete. “Worldwide, pesticides now add 25.5 billion to farmers' costs annually, while the human health toll is even more staggering” (Lappe 1998). In 1998, estimates suggested 25 million people were infected with pesticide poisoning each year, and the pesticides seen in the third world are the worst of the worst. Chemicals banned for use in the U.S. are exported from the U.S. Where do they end up? You guessed it, Farms in the developing world, where safety of these chemicals is of little or no concern to farm owners. “In the Philippines, the Ivory Coast, and Central America, we found pesticides being indiscriminately sprayed from airplanes, and from canisters strapped to the back of unprotected workers” (Lappe 1998), all those chemicals out into the environment, into water supplies. In the U.S. the EPA found 10.4 percent of community water wells are contaminates with a pesticide. The kicker, all this pesticide use has been in vain, “Despite

a tenfold increase in the amounts and toxicity of pesticides since their commercial introduction in the late 1940s, crop losses to insects have nearly doubled" (Lappe 1998), all to fend off and additional estimated 1 or 2 percent of crop losses that would occur sans pesticides. Their effectiveness is not impressive, "0.1 percent of the pesticides applied to crops actually reaches targeted pests" (Lappe 1998).

One case study showed increasing pesticide usage, did not increase yields. In Pakistan we are seeing relatively low yields, and "in Pakistan the use of chemicals and fertilizer nutrients are increasing and some of the chemicals being used are banned in other countries" (2003). Then we read another case study in 2010, outlining that pesticide use is economically feasible and it did increase production. However, this case study does specify, "pesticide use definitely helps in improving the crop productivity and quality if right type of pesticide is used at right time with right dose" (Khan 2010). Perhaps it's like everything else, moderation maximizes returns. Go too far one way or the other on the pesticide spectrum and you're done for. Thus current literature encourages Integrated Pest Management (IPM), using pesticides wisely. Either way modern agriculture has created a pesticide treadmill. Once you hop on, you have to start running, else you'll fall off. Yet again, "we still lose about the same percentage of our crops as we did in earlier times" (Ikerd 2008).

Chapter 3.6 Biotechnology

Using modern chemicals we can kill most insects, diseases, parasites, and weeds. Moving us into the abandonment of diversified family farms to realize lower food prices associated with the industrialization of agriculture. We have adopted a mechanistic worldview, and are treating science as a religion. Science has shifted from being about understanding to manipulating, reaching toward an end goal of power rather than of

wisdom. Agriculture has been infected by the movement into systematic production. Machines, selective breeding, commercial fertilizers, irrigation, processing, storage, and transportation all create an assembly line turning farms into factories. These factories become part of the food supply chain, an ever tightening market. Fooled into the illusion of competition and choice by the myriad of names, the food system has consolidated.

Appendix C displays a mapping of the Seed Industry, which consolidates down to "the big Six": "Monsanto, DuPont, Syngenta, Bayer, Dow, and BASF collectively own or partially-own hundreds of formerly-independent seed companies -- and Monsanto, of course, dominates them all" (Huff 2011). With the first 5 of these companies being chemical or pharmaceutical companies, the oligarchy is shaping itself into a monopoly, with the power to dictate farmer actions.

In the past, thousands varieties of rice were grown, over 5,000 kinds of potatoes were cultivated worldwide; in the 19th century more than 7,000 varieties of apples were grown in the U.S. Along came the 20th century, Nitrogen bombs modified into nitrogen fertilizers, and nerve gas modified into insecticides. Agriculture technology made yields increase and brought more food to market at cheaper prices. Increases in production did follow. Monoculture creates an ecological vacuum; diseases could wipe out entire crops. One example: the potato famine in Ireland killing 1 million. Today only 4 varieties of potatoes are widely grown, 90% of the vegetables grown at the beginning of the 20th century are now extinct. This lack of biodiversity makes crops more vulnerable to diseases and thus farming more dependent on the technologies of pesticides, fertilizers, and genetically modified plants.

At the peak of these, Monsanto's round up, praised for its ability to kill weeds. Biotechnology gave way to the "green revolution" becoming the "gene revolution".

Monsanto came out with a roundup ready seed, a genetically modified soybean crop. Now the same company selling you the seed is selling you a pesticide that kills everything except the crop, industrializing food at the cellular level. Patents were allowed in the 1930s for genetically modified plants. The genetically engineered corn Monsanto makes is classified and an insecticide itself, a corn bore will die if it eats any part of the plant (Future of Food 2007).

Starting in 1978 with a genetically engineered microbe that ate oil, life was allowed to be patented; animals, human genes, even body parts all became patented. “Companies now have the power to own, and control a species of the Earth” (Future of Food 2007). These corporations have gone so far as to going into the seed banks and patenting all the seeds that have yet to be patented. Monsanto is said to have over 11,000 seed patents. Transgenic research comes with risks. Species resist foreign DNA, overcoming this resistances requires cell invasions. The known ways to do this is through bacteria and viruses. Using E. coli bacteria, combining roundup resistant bacteria, and soil bacteria that causes tumors in plants, they inject their genetic mutations into the plant's nucleus. The other two methods available are: streams of electricity to infiltrate cell walls, and a gene gun that blasts particles of gold coated with the engineered DNA. All methods require a promoter gene to turn on desired characteristics. This gene is drawn from a virus.

Moving genetic material that doesn't normally move requires these risky invasion purposes. Engineers also put in antibiotic marker genes, the catalysts for the concern over these genetically modified plants (GMs or GMOs). The medical community is concerned over the implications this has for the effectiveness of antibiotics. Genes function in complex networks, and are unpredictable. Once these GM plants get out, they cannot be

controlled, they will reproduce. The first GM to hit the market, flavor savored tomatoes, was found to cause lesions in the stomachs of rats. Genetically modified foods are apart of the every day diet, yet in the U.S. They are not required to label their products as genetically modified. The USDA did not require a single environmental assessment. Falling into the GRAS category, government does not require testing or labeling of GMOs (Genetically Modified Organisms).

The same multinational corporations, who told us pesticides such as DDT were safe, are now telling us their new products are safe. Protests for labeling were defeated by Monsanto's 4.6 million dollar campaign to prevent the labeling act from passing. Research shows 80-90 percent of Americans want GMOs labeled, except the act to do so is still waiting, since 1999, to be voted on. 75 percent of European public did not want genetically engineered food, they require labeling. There is a reason Corporations fought against it, no traceability without labeling thus less accountability. Health effects go undocumented in relation to the genetic modified food, eliminating the links between the health effects and GMOs. At this point it's become another case of implementing technology without an understanding of the full effects of their impacts (Future of Food 2007).

The biotech industry claimed they were safe and increased yields. Monsanto, “Roundup ready soybeans”, genetically modified seeds, designed to be sprayed by Monsanto's famous Round Up. These new seeds were the answer, pest resistant, strong safe, marketing ran away with themselves on the impressive new seeds of the future. Surprisingly, they didn't look at routine stresses. Researchers found decreases in size of the root system, up to 25 percent in drought conditions (Future of Food 2007). They also had not tested the effects of spraying roundup on the roundup ready soybean plant's

ability to affix nitrogen. Yet despite a lack of complete understanding of the biotechnology, already released out into the environment, the field has little if any regulation in the U.S.

Whatever moral implications you would like to attach to the industry, the market power and control they have is impressive. Monsanto's CEO Hugh Grant recognizes, "satisfying the demand curve is a great business opportunity" (Urquhart 2008). Rushing to develop drought resistant transgenetic crops, Monsanto prepares for the mass adoption of GM technology. Is biotechnology the answer to increasing the food supply? Where do food prices come into play?

Are these monoculture-opolies producing more food? Some say no, "biodiverse systems actually produce more food" (Shiva 2008). Others say, "the key to increasing yields is to ensure that even the poorest farmers have access to improved seed varieties, chemical fertilizers, organic matter to replenish soil nutrients, and where possible, small-scale irrigation methods, such as a pump to lift water from a nearby well" (Sachs 2008). This has been the case since the 1960s, agricultural technology has resulted in lower food prices across time, and the reason: increased efficiencies in production.

Nobel Prize winning agronomist Norman Borlaug insists that the genetically modified foods are the answer to world starvation. Sustainable farming is a romanticized view, and molecular biotechnology is the only way for third world farmers to increase their yields (Borlaug 2004). He views biotechnology under the light of offering higher yields, more resistant crops, requiring less land, and fewer chemicals. Utilizing less scarce resources, but allowing the same output in a more efficient manner. "No negative health or environmental effects have been observed" (Borlaug 2004). He further places limitations on our abilities to live sustainably, touting "the world cannot feed all its 6.9

billion people from organic farms or power all of its cities and industries by wind and solar power" (Borlaug 2004). Aligning with Borlaug, Jeffery Sachs sees technology as the key to increasing yields. "Traditional farming uses few inputs and gets poor yields" (Sachs 2008).

The Union of Concerned scientists tell us a different side, Molecular biologist Mellon brought the realistic side of biotechnology to light:

> " 'Let's be clear here: there are no crops on the market today genetically engineered to directly maximize yields' ...'there are no crops on the market engineered to resist drought. And there are no crops on the market to reduce fertilizer use. Not one'" (Union of Concerned Scientists 2008).

Marketing ploys and all the hyping is not enough to convince these scientists that genetically engineered crops can produce enough food to feed the world. These increased yields and drought tolerant plants are a figment of the Biotech companies' dreams. In reality the genetically engineered crops are resistant to certain pests, and can withstand glyphosate, your weed killing miracle in the Round Up formula.

Perhaps we are not at odds here. Perceptions and interpretations have led to similar paths, in which we are forced to decipher the intentions of semantics. It seems genetic engineering has the potential to increase yields, yet the environmental and health hazards have not been fully realized before mass implementation of the technology has taken place. The technology available currently, that does not involve genetically engineered crops has the results the world is looking for, Mellon explains, "' Traditional plant breeding, crop rotation and marker-assisted breeding...and ecological farming systems that use such methods as crop rotation and cover crops, have a long history of boosting food crop yields'" (Union of Concerned Scientists 2008). He does recognize the future possibilities of GE crops playing a larger role in food production, but currently the

realistic side shows the push of GE crops to be more of a market takeover by the biotech industry.

The profit driven corporate agendas are clouding this potential for the technology to make a difference in the developing world. Biodiversity is not mutually exclusive to genetic engineering. The mechanized viewpoint of agriculture is causing destructive patterns to emerge. Furthermore current agricultural practices are not sustainable. Biotechnology may very well be the answers to food production needs; however the strategies and ethics associated with it today are amounting to more market failures, further development concerns, and even greater corporate control. The sales pitches are overshadowing our best tools to address food security, "in paces like Africa, fertilizer, better grain storage, and improved roads would be much better and more cost effective options than expensive patented biotechnology seeds that so far offer so little"' (Union of Concerned Scientists 2008)

It is not pertinent to discuss the production changes, and even supply as a whole without determining their growth and contraction in relation to demand. Thus we need to draw on the available information for consumption over the past decade in order to draw more thorough conclusions on the status of world production, and ultimately the velocity in which supply factors are driving current food prices.

Chapter 4: Demand Shocks

The demand side of the food crisis houses more of the controversies than the supply side. It is not as easy to argue the role of supply in driving up prices, but the very nature of demand leaves a fair amount of open room for criticism and debate to fester and coddle itself. Given the limitations and scope of this paper, only two aspects of demand

will be discussed, granted at length, but still only two aspects. These two major aspects of demand are biofuels, and income changes.

Chapter 4.1: Biofuels

Receiving much of the rhetoric these days, biofuels migrated their way into a social taboo. A topic often avoided at dinner tables, so as to keep the peace. Almost everyone is familiar with the basic premise of the debate, “food versus fuel”. Both sides are perfectly adequate at framing their analysis. The same world, same data, and same stimuli, all lead to two opposing responses. How can it be? We'll show you.

Table 4.1 will allow us to demonstrate the power of framing. Furthermore, to recognize the context data is not only estimated in, but interpreted in. The table shows some simple measures from the yearly cereal supply and use data put out by the USDA. Often time these data sets become the soul premise for arguments for or against biofuels. The story seems more impressive when spun using 2007/2008 figures, however the recent estimates will work just fine in our efforts to determine the power of perception.

Beginning the story with a pro biofuels position, the world used 2.2 billion metric tons of cereals in 2010/2011. Of which, over 2.1 billion tons were used to feed the livestock, poultry, and people of the world. Corn used by ethanol plants in the U.S. amounted to less than 6 percent of total world cereal use. These estimates don't take into account the byproducts of the ethanol process. Thus the numbers are overstating the amount of grains used for food. Livestock feed and vegetable oil come from the ethanol process, and go on to food and feed markets. If this modest amount of world cereal use is to blame for the price hikes in food, it does not make sense to have a higher availability and increased use of cereals worldwide. Table 4.1 shows the world use for all cereals increased by 24 million metric tons. Showing us the world is capable of producing both

food and fuel. Note that the increase in corn consumption was over 9 million metric tons

TABLE 4.1 World Cereal Consumption 2009/10 - 2010/11

World Consumption	2009/2010	2010/2011	Absolute Change	Percentage change
Corn	822.7	842.41	20	2.40%
Wheat	620	642	23	3.65%
Milled Rice	434	443	10	2.25%
Other Cereals	327	299	-28	-8.53%
All Cereals	2203	2227	24	1.10%
U.S. Corn Consumptions	332	331	-0.78	-0.24%
Corn Used in U.S. Ethanol plants	115	126	10.72	9.34%
World Cereal use except corn used in U.S. Ethanol plants	2088	2102	13.48	0.65%
Corn Used in U.S. Ethanol plants as a share of world cereal use	5.21%	5.63%		

Source: Author Calculations based on USDA PSD Online Data set and World Agricultural Supply and Demand Estimates, Oct. 2011

greater than the increase in corn ethanol use, making the increase in demand for reasons aside from biofuels.

Now for the opposing side, table 4.1 suggests the demand for ethanol was a critical driver in cereal price increases between 2009/2010 and 2010/2011. World cereal consumption increased by 24 million metric tons. Despite a large drop in other cereals, corn consumption was up 20 million metric tons. U.S. Ethanol plant consumption, 11 million metric tons, accounts for over half of the world's increase in corn consumption. Population growth from 2009 to 2010 matched the increase in total cereal consumption. Per capita cereal consumption stayed nearly unchanged from 2009/2010 to 2010/2011. Making the increase in U.S. Corn use for ethanol of 11 million metric tons, almost half the increase of total world cereals, rather alarming. Corn ending stocks in the U.S. dropped 34 percent. The increase in ethanol use of cereals is stressing the balance

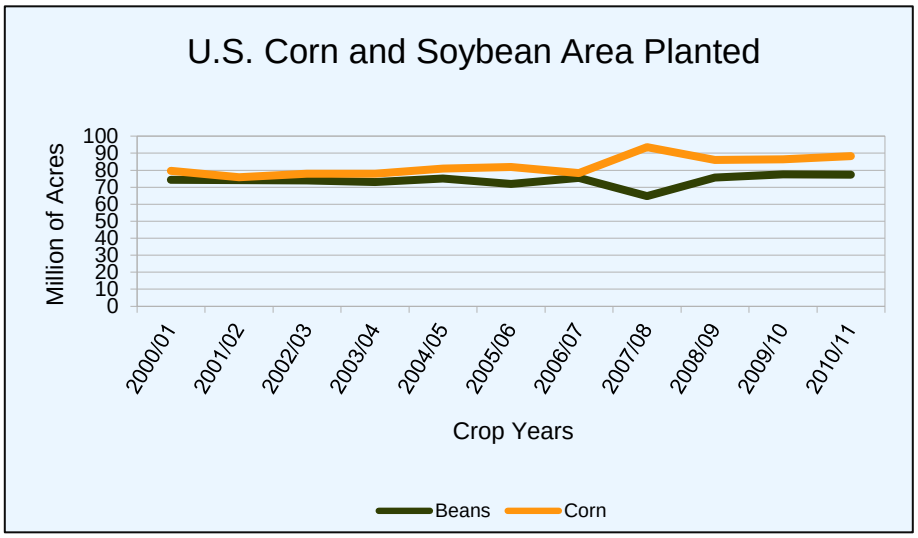
between supply and demand. Increases in cereal prices, and food prices in general are being impacted by this stress ethanol demand has caused.

Framing, two sides same data table, manipulation of perception tow very different directions. The complexity of the issue alone is cause for caution when arguing sides and deciphering the truth. However, throw in these framing strategies and you have yourself a game of collecting and interpreting information to get the conclusions desired. This game has no rules, and the playing field stretches from production capabilities, to environmental benefits and costs. So then, how much of the food price increases can we attribute to biofuel production?

Looking at changes in consumption, in a table that merely shows amounts consumed and then U.S. ethanol use of corn, gives us a rather limited snapshot of the biofuel industry. Consumption and demand lead us to make rather meaningless conclusions when the costs are not discussed. However, there are broad conclusions which remain solid, "the rapid increase in biofuel production between 2005 to the middle of 2008 increased the total world demand for grain, sugar and vegetable oil" (Westhoff 2010). This demand shift helped put upward pressure on world food prices, yet we know there were other factors at play.

Higher expected prices for corn, with the biofuel demand spiking translated into more acres of corn being planted. Figure 4.1 shows that in 2007/08 59 percent of the total acres for corn and soybeans went to plant corn. Past farming patterns kept land shares relatively even, since farmers would rotate between the two crops often. However, the biofuel industry created incentives to shift acres over to corn. Growth in the ethanol industry leveled off around this same time. Prices across the board fell in the later half of 2008.

FIGURE 4.1: U.S. Area Planted For Corn and Soybean Last Decade



Source: Author Calculations based on USDA PSD Online Data set

Biofuel production also increases the demand for vegetable oils and animal fats. With soybean oil in a higher demand, crushers can afford to pay more for raw beans, resulting in higher soybean prices. Indirectly poultry, meat, and milk prices are affected by biofuel production. “Most of the world's corn is fed to livestock and poultry” (Westhoff 2010). Increases in ethanol production causing higher corn prices raise production prices for turkey, pork, beef, chicken, eggs, and even milk. Higher production costs may result in lower production, making prices higher. According to their demands of corn feed, and soybean meal, livestock industry has limited leeway in adjusting to price changes. Biology dictates the time at which producers can respond to price changes for feeds. Beef and pork industries remain fairly inelastic in the short-run to higher feed prices. Distiller grains from biofuel production allows for some of this inelasticity to be alleviated. Yet, the byproducts do not hold as many calories; most calories in the corn get turned into ethanol. The net effect is a decrease in feed availability, but this does not necessarily mean this is the case with increases in biofuel production.

The scenario changes slightly with the production of biodiesel from soybean oil. Increased demand for soybean oil means higher soybean prices, resulting in increased production of soybeans and soybean meal, and lowering the costs of production for livestock industries. Yet, we are forgetting the tradeoff that seems to exist between corn and soybeans, higher soybean production would suggest less corn produced, making corn prices higher. Either way you look at it, higher biofuel production means higher input prices at the farm-level. This does not often translate into a significant markup of costs in developing countries. In high income countries the value added along the supply chain after leaving the farm tends to be where the true costs of food begin to add up, making food prices more sensitive to increases in energy prices for transporting and processing food. This is not the case for developing countries. Low-income countries have shorter supply chains with less value added, they primarily eat staple foods. And their food prices are more sensitive to farm-level costs.

Demand for biofuels puts upward pressure on prices, but was it a major driver in the price increases seen over the last decade? Higher U.S. corn prices in 2007/08 would not lead us to expect an increase in corn exports. However, this is what we saw: increases in ethanol use, and increases in exports. Farmers got wind of the increasing growth of the ethanol industry, planted more corn, and harvested record crops. With a reduced grain production in Europe, a weak dollar, and strong world economic growth (at the time), U.S. exports increased along with ethanol production. These exports declined once the dollar strengthened, the world economy slowed, and world grain production recovered (Westhoff 2010). This year we saw a similar drop in exports of corn, soybeans, and wheat in mid September, resulting from Russia ending its export ban, and supply in the black

sea region flooding markets. Reminding us of how interconnected the factors are, domestically and globally (HFP 2011).

Increased investment and growth in the ethanol industry raised corn prices in 2006 and 2007, but the biofuels industry does not seem to hold as much responsibility for the price increases of late 2008 and early 2011, given the slowed growth, idol, and even shutdown ethanol plants. One thing remains certain biofuel demand from any crop results in displaced agricultural land, “Unless there is an offsetting factor, the result would be at least some reduction in crop or livestock production and an increase in food prices” (Westhoff 2010).

Perhaps this is too lenient an assignment of responsibility to the industry. For our purposes, we will continue to avoid biofuel policy issues; these are discussed at length in a later section. Although, dissociation of the policies and politics surrounding the issue, do serve to discredit the effect it has on prices, however we will restrict ourselves for all intensive purposes to the production practices, supply and demand elements. Biofuels are said to distort food markets. In their use of corn and vegetable oils, their encouragement of land use (okay so a little bit on the policy side), and their sparking of financial speculation biofuel production has made a bad name for itself. Well then, what are the redeeming qualities? Are biofuels the answer to a greener less oil dependent future?

In true economic fashion, our mantra again, it depends. If we are talking about U.S. biofuel production using corn, ethanol production, then we are growing closer and closer to a no. If it's Brazilian biofuel production from sugar cane, then we see the benefits in a more powerful presence. What are the differences? Personally I like the description given by Brazil's President Luiz Inácio Lula da Silva, "'Ethanol is like cholesterol...good ethanol helps to tackle the pollution of the planet and is competitive.

Bad ethanol depends on the fat of subsidies'" (Foley 2008). By good ethanol Lula was referring to Brazil's sugar-cane based industry. Known to be more efficient, with "an energy balance seven times greater than ethanol produced from corn" (Budney 2007). Production costs less, uses less land, reduces more GHG emissions, is less carbon intensive, and is more productive (Goettemoeller 2007).

As far as costs are concerned, perhaps U.S. Ethanol production may have minimal upward pressure in food prices, it certainly comes with a price to the Government, the OECD "estimates that biofuel support costs between USD 960 to USD 1700 per tonne of greenhouse gases (carbon dioxide equivalent) saved" (OECD 2008). Moving forward with biomass, switchgrass, wood chips, and maybe even yard waste has the potential to serve the purposes of the biofuel goals better than current corn ethanol processes. In fact Ken Vogel from the University of Nebraska's Agricultural Economics Department found switchgrass ethanol delivers 540 percent of the energy used to produce it, much more appealing than the 25 percent more energy return we receive on corn based ethanol. Even more optimistic, "switchgrass shows great tolerance to heat, drought, and nitrogen stress"(Schill 2007).

Despite the encouragement and the intentions of lowering greenhouse gas emissions, biofuels have a larger impact on the environment than burning fossil fuels. Between land use changes, irrigation, fertilization, residue burning, and tillage both maize-based and sugarcane based biofuels are worse for the environment than fossil fuels. When you analyze the carbon life cycle of the process you can come up with net gains or net losses, but this is not the only analysis needed to determine the full environmental impact biofuel production has in regards to its minimal gain in reduced GHG emissions. In a study earlier this year, researchers found, "direct N2O emissions

from sugarcane fields due to nitrogen (N) fertilization result in an emission factor of 3.87±1.16% which is much higher than suggested by IPCC (1%)" (Lisboa 2011).

Even earlier research done in 2009 suggests similar conclusions of the environmental impact of biofuel production, but in terms of water use. Sugar cane based ethanol uses 2,500 liters of water for every 1 liter of ethanol produced. Soya ethanol uses on average 14,000 liters of water for every 1 liter of biodiesel, and has even less favorable ratios in Aisia than Western Europe. The study notes, use of the whole plant versus just the sugar, starch or oil will reduce the water demands. However, this then questions the resulting byproducts from ethanol production being used for feed. If more of the plant is used in production, then less of the feed is available. Instead of the food or fuel debate we enter a drink or drive debate (U of Twente 2011).

Biofuel production increases prices at the farm level, translating into market effects across the board. Variations of efficiency exist for production and its ability to reduce GHG emissions. The production process currently has a more costly impact on the environment than benefit. The policy encouragement for biofuel production is also a cost driver, which we discuss in a later section. Corn-based ethanol seems to be the least beneficial pathway to biofuels. Other biomass substances have the potential to replace corn-based ethanol, with more powerful net gains.

The biofuel industry is not largely responsible for recent price spikes, however the policies for biofuels and speculation surrounding industry news have a larger responsibility than the actual production itself, again an issue we address in the policy section of this paper. Thus in terms of the production process itself, the biofuel industry does add upward pressure of prices in the food market, however it is not as large of a player in recent price spikes as other factors. Table 4.2 puts the scope of studies on the

impact of biofuels into a little bit grander perspective. Put together by the World Bank in August of 2011, the table gives some empirical findings for the impact of biofuels on food prices.

As you can see, the wide array of estimates leads us to conclude there must be several discrepancies surrounding the core data. It is with these results that we question methods and modeling capabilities. Each study is going about things in so different a way that comparing them is a new game in itself. All the global food index percentages tend to be within the 6-10% range, when taken over a shorter term basis, but the long run measurements, 2002-2008 seem to attribute a large markup in food inflation to the biofuel industry. Perhaps it is due to the rapid growth of the industry seen at this time.

TABLE 4.2 Estimated Percentage of Food Inflation due to Biofuels

Source	Estimate	Commodity	Time period
Mitchell [47]	75%	global food index	Jan 2002 to Feb 2008
IFPRI [59]	39%	corn	2000 to 2007
	21-22%	rice and wheat	2000 to 2007
OECD-FAO [51]	42%	coarse grains	2008 to 2017
	34%	vegetable oils	2008 to 2017
	24%	wheat	2008 to 2017
Collins [15]	25-60%	corn	2006 to 2008
	19-26%	U.S. retail food	2006 to 2008
Glauber [25]	23-31%	commodities	Apr 2007 to Apr 2008
	10%	global food index	Apr 2007 to Apr 2008
	4-5%	U.S. retail food	Jan to April 2008
CEA [42]	35%	corn	Mar 2007 to Mar 2008
	3%	global food index	Mar 2007 to Mar 2008
Rajagopal et al. [54]	15-28%	global corn price	2007 to 2008
	10-20%	global soy price	2007 to 2008
Hoyos and Medvedev[16]	6%	global food index	2005 to 2007

Source: The World Bank Development Research Group Environment and Energy Team August 201 [Hachman 2011]

Chapter 4.2 Income Growth

A fair amount of current literature attributes the recent price increases of food to shifting diets in India and China. The income growth of these “emerging economies” are said to shift demands for food, so much so that the prices of food world wide are being impacted. The basic premise resides around the notion of rising incomes in china and India are causing people to shift their diets, consuming less grains and more meat. Further, this additional demand for meat is driving the price of grains up as well with the increase in demand for feed. Higher incomes would then be responsible for upward pressure on prices of food from an increased demand of meat, consequently of feed. Sounds believable enough, large populations of people shifting their diets pull prices upwards. Although, the nature of the recent price strikes were rather sudden and spiked steeply within a few months span. This demand for meat did not pop up out of nowhere, the changes in incomes did not occur suddenly. However, when China makes up almost one-fifth of the world's population, and India not far behind with 17.4 percent it's hard to dismiss the effect changing diets would have on world food markets.

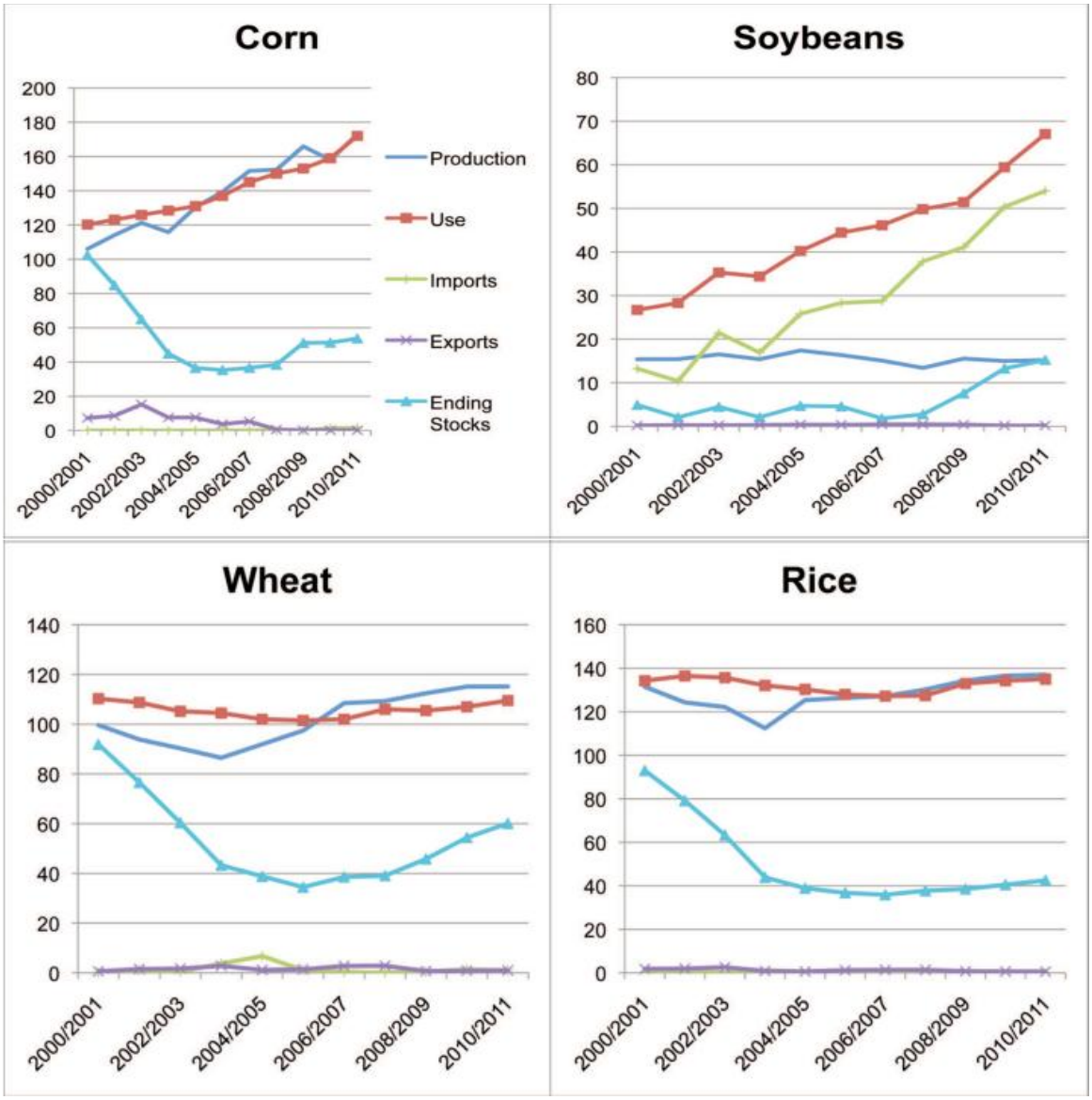
There are myths and realities surrounding the growing concerns of, “Who Will Feed China?” as Lester Brown's 1995 book title asks. For the past three decades China has been a net food exporter, so why are we caught up on who is going to feed China? “Claims during the 2006-2008 food crisis that increased demand for food in China and India was the key factor in the sharp rise in prices have been shown to be without much substance” (UN 2009). In fact China seems to transcend the notions of scarcity, increasing production without sacrificing production in other sectors. China, with 8 percent of the world's land, feeds 20 percent of the world's population, and remains 90

percent self-reliant. Perhaps each additional unit of income is already having a smaller and smaller effect on food, China's income growth could have reached this level. Only with all it's self-sufficiency China has turned to the world for one commodity. The oilseed sector sees China as, “the largest importer in the world” (Westhoff 2010). Diets in China are changing, consuming more meat, poultry, and dairy. Rather than importing these items, China is importing soybeans.

Let's first understand China's behavior in terms of key commodities. As far as grains go, China tends to be self-sufficient and isolated. Net trade in grains amounts to less than 1 percent. However, in Soybeans China imports around 82 percent of China's domestic consumption. Policies of self-sufficiency lead the income growth effect in China to stay relatively isolated from world prices. However, in the Soybean market China has become more open to world trade, ever since 1990. Here in figure 4.2 this behavior is reflected in China's utilization balances (Tyner 2008; Heady 2010). These increased demands for Soybeans suggest Soybean crushers in China are turning to outside markets to meet feed demands. Feed for the hogs, cattle, sheep, and chickens Chinese people afford to eat. Decreases in grain demand become offset by the increases in oilseed meals for animal protein.

Soybean meal use by China has more than doubled from 2000 to 2008 (15mmt to 32mmt). Along with it, production of milk, chicken, beef, and pork have increased significantly. Now, let's not get hasty and remember our talk of population growth. From 2000-2008 the Chinese population increased by over 85 million. In any case, with a population as large as it is, china actually shifting its diet has an effect on food markets.

FIGURE 4.2 China's Supply Utilization Balances for Major Grains and Soybeans



SOURCE: Abbott 2011: Purdue university, Farm Foundation Issue Report

That effect gets determined by the time of shift, and whether domestic markets are prepared to handle the outcomes, otherwise policy incentives and export tariffs on commodities can only go so far. If the demand is not met, China will, as it has in soybean meal, turn to the world market. In doing so, cause a rippling across the food system worldwide. “Grain and oilseed prices may be part of a general commodity boom that is surely being driven, at least in part, by rapid economic growth in developing

economies" (Abbott 2011). China's role in driving prices has been exaggerated.

The increase in Soybean demand is said to remain limited to building up stocks, which are now at 37 percent of use. As far as grains go, China's lack of openness became more evident this year. Drought threatened wheat crops in China; however the news did not result in price increases, because Chinese wheat stocks have always been high. Should the drought cause a major decrease in supply, China will resort to drawing on those stocks. However, increases in income and globalization have lead to changes in consumer preferences regarding the quality and safety of agriculture products. The retail food sector in China is growing rapidly. Consumers want more convenience, higher quality, value-added foods.

Yet their persistence in policies to remain self-sufficient lead to strains on land and water resources. The agriculture sector in China is a product of China's history of central planning and Government run monopolies (Westhoff 2010). Land intensive grain production "has a high opportunity cost in land-scarce China" (Gale 2002). Markets in China lack the logistics of other high-income countries, "transportation and logistics costs account for an estimated one-fifth or more of retail prices, much higher than in developed countries" (Gale 2002). Liberalization of China's agricultural trade in conjunction with joining the WTO hurt rural farmers, the peasants.

Accession commitments of reducing agricultural import protection, and eliminating agriculture subsidies are set to make China more dependent on world markets. Even further, to upset the livelihoods of the massive amounts of people dependent on agriculture for income. Lack of investment in the agriculture industry, ecological limitations, and industrialization, built up to the strains China now faces. Export-oriented industrialization has lead to inequality between Urban and rural

populations.

Corruption, taxes, and price discrimination in regards to agricultural products has added to this inequality. Displacement of farmers will lead to further dependence on world markets for soybeans, cotton, sugar, and possibly other commodities. Violent protests mark the growing discontent of the peasant population. The Communist Party rose to power on the backs of peasants. Ironically, development has left peasants worse off. Changes in Chinese incomes and food system dynamics are leading to more open markets. Perhaps the self-sufficiency has held back the full effects of these changes, however, the stresses within the country are building up. Likely further dependence for agricultural products will fall to outside markets (Bello 2009).

China's shifting diet, and increased demand for food has already caused shifts in land use in Brazil. Forests are being burned, additional land cultivated, because there is a demand for soybeans to the emerging market of China. Agribusinesses are more than eager to be the ones who satisfy Chinese demands. Perhaps these shifts have little effect on prices of foods in the short-run. “The rise in Chinese demand for food contributed little to the contemporary food price increase” (Bello 2009). The environmental impact it is causing will unlikely go unnoticed in future prices.

India also demonstrates self-sufficient policies disconnecting domestic grain markets from world grain markets (Timmer 2008; Abbott 2011). Given the country's culture, meat is avoided by much of the population; income growth has resulted in an increased demand for poultry and dairy. In China this increase in demand was happening slowly with changes in the income effect, the surges in demands we saw were in responses to replenishing stocks. However, the demand for feed was increasing, with the “meatification” of Chinese Diets. India largely Hindu, and vegetarian, sees beef as a

taboo food. However, poultry, fish, and even pork are acceptable meats. Demand increases for meat are met mostly with poultry. Dietary changes in India occurred on two fronts: income-induced, and globalization induced.

Economic growth during the 80s resulted in increased demands for food, except the type of food remained traditional. Globalization changes in diet brought about demand involving more Western diets: foods with higher oils and sugars, processed foods, and more convenient foods. Globalization saw increases in demand for animal products, and some vegetables. Negative income elastic foods have experienced a decrease in demand, rice and some cereals. Consistent with Engel's theory, increases in per capita income reduced demand for cereals, and increased demand for non-cereal food items. This shift tends to be correlated with modernization of agriculture (Mittal 2006). Surprisingly Mittal's paper presents a positive outlook to the situation, “the growing demand for livestock products gives an opportunity to increase incomes and employment and to reduce poverty in rural areas” (Mittal 2006). Only, the rural agricultural sector has not seen this increase in income as a result of production shifts to compensate the increase in population, and the new dietary patterns of India.

India's top food imports include: Sugars, dried vegetables, coffee, spices, dairy products, and cereals (Import export databank 2010). India's growth has come with a tradeoff, “India’s supply of arable land is second only to that of the United States, its economy is one of the fastest growing in the world, and its industrial innovation is legendary” (Sengupta 2008), except its neglect of the agricultural sector has resulted in an inability to produce enough wheat and rice to meat population demands. Agribusinesses have come into the country by way of globalization. The impact has been devastating on the agricultural sector, “a decade and a half of globalization's perverse rules have led to

200,000 farmers committing suicide because they couldn't make a living anymore—all there money goes to make profit for Monsanto or Cargill" (Shiva 2008).

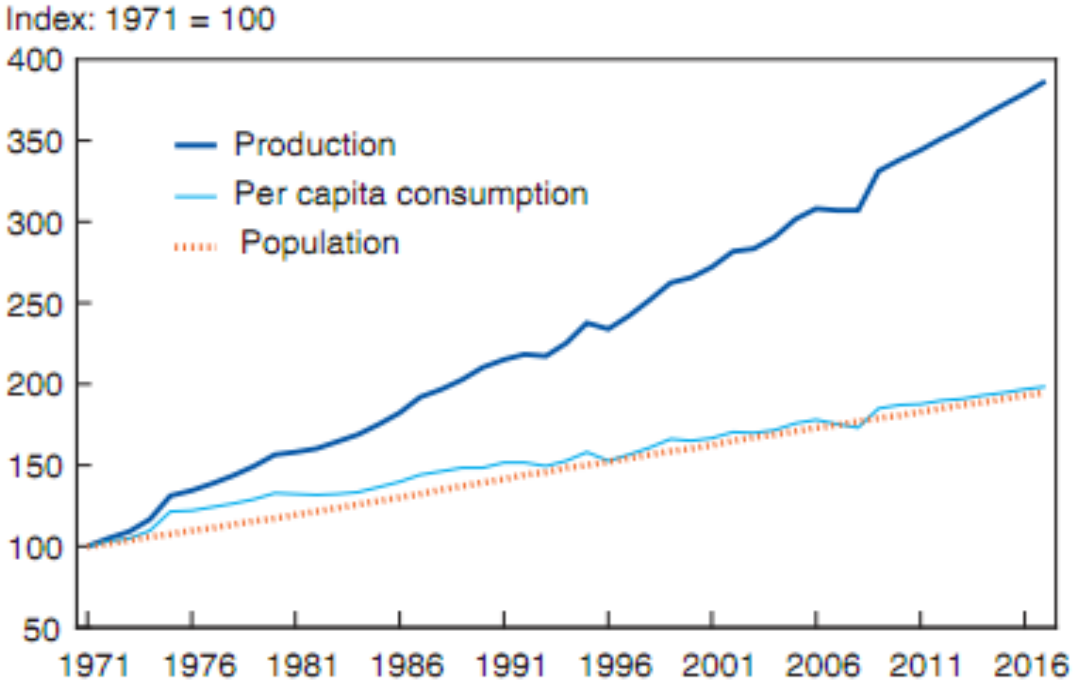
Media tells us Indians are getting richer, and are eating more. Yet underneath the growing GDP percentages, India has more hungry people than Africa. About a million kids, under the age of five, per year die due to the lack of food. Malnutrition is a huge issue for Indian children as well. "Per capita entitlement to food has dropped in a decade and a half from 177 kg to 152 kg per year" (Shiva 2008). India used to be food self-sufficient, food was affordable. However, globalization and liberalized trade, and perhaps population growth, stretched this growing economy to its limits. Agriculture accounts for 52 percent of employment in India, with a population as large as India's this is more than a cause for alarm.

Most farms in India are small and rain-fed, also the infrastructure presents serious drawbacks, "a long and inefficient supply chain means that the average farmer receives less than a fifth of the price the consumer pays" (Sengupta 2008). India thus has the potential to be self-sufficient, and even an exporter in the food markets, however inefficiencies over time have added up to a loss in capabilities of its agricultural sector to keep up with demand. One food item India does export in large quantities is buffalo meet, which is stemmed from the demand for dairy products. They use buffalo for producing milk. Despite these positive sub-sectors, India has fallen subject to its lack of attention of the agricultural sector. Government policies and prices are not helping the situation. When the domestic market lacks the capability, and/or the incentive to produce the crops demanded, India turns to world markets. Given it's sheer numbers "When [India] goes to market to import, it typically puts pressure on international market prices, and every time India goes for export it increases the supply and therefore mitigates the price levels"

(Sengputa 2008).

The trends in China and India don't have to be isolated to these two emerging economies. Taking a look at the world increases in demand for foods will allow us to see this trend is global, although the percentage of the world population held by India and China does mean a fair amount of global trends are generated by these two countries. Demand for meat shown in figure 4.3, gives us a picture of demand growths for meat in relation to population growth. Production has increased substantially, while per capita consumption has been growing along with the population (Trostle 2008). The increases in meat consumption translate into an increased demand for feed; one pound of beef takes roughly 7 pounds of feed. Per capita consumption of grains and oilseed are not increasing as steeply as this might imply. Yet there is a persistent demand for feed, that logically grows along with meat demand.

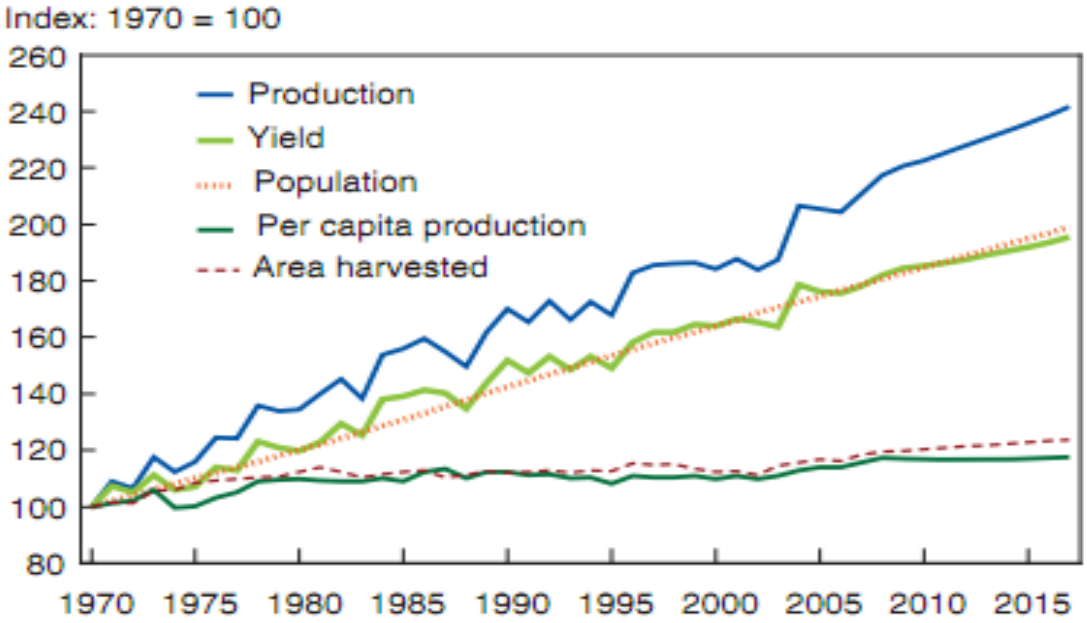
FIGURE 4.3: Global Meat, production, per capita consumption, and population



[1]Total meat = beef + pork + chickens & turkeys.

Source: USDA Agricultural Projections to 2017.

FIGURE 4.4: Total World Grain & Oilseed



[1]Total oilseeds = soybeans + rapeseed + sunflowers.

Source: USDA Agricultural Projections to 2017.

This increase in meat consumption results in a decreased demand for some cereals. Feed consumption has increased, but per capita levels remain relatively stable. This can be seen in figure 4.4. Per capita consumption growth has fallen below population growth, suggesting a shift in diet. A shifting diet globally is not a new thing. The economic growth we have seen across time is what brings about these shifts, making the increased demand for meat, and thus feed long term trends. Naturally this occurs with population increases.

The alarming part, that part making the upward pressure on prices is the lack of growth in agriculture. Yield growth rates are decreasing, while land area being used for production is increasing. However, population growth is also slowing. World economic growth rates from 200-2007 actually showed an increase from those of the previous two decades. Yet the dispersion of these growth rates and the dip in growth rates for 07/08 contributes to price pressures on commodities (Trostled 2008). Growing demands, with

production not keeping up, world stocks-to-use ratios for grains and oilseeds make for tight markets. This contributes to price increases. Increases in the demand for food correlate with increases in demand for oil. Oil prices increase the prices of pretty much every other product in the world. Increased demands for food, call for more energy use, thus the stress on the crude oil market comes in a large part from the food industry.

Here we cannot help but be reminded of Malthus' population theory. Malthus suggested mankind's development is limited by the pressures of population growth on the availability of food. Population increasing faster than food supply would thus result in the demise of a fair amount of the human race. Critics of Malthus boast in the apparent ability of the human race to overcome this limit, "technological improvements and capital accumulation are strong enough forces and may relax the population pressure and improve the condition of individuals, even in the presence of growing population" (Abramitzk, 2001). Defenders of his viewpoints claim these improvements in technology only provide temporary increases in living standards, allowing for the impending doom of humanity to occur in the long-run.

In the long-run population size will trump technological capabilities. Empirically Malthusian eras have been seen in poorer societies throughout history, but much of the evidence tends to disprove Malthus' idea of human advancement having limits in terms of scarce resources. Our innovation has carried our will to survive and boost living standards; population growth is thus an autonomous factor affecting the productivity of agriculture. Population growth is seen to bring increased productivity by improving agricultural practices, under more efficient divisions of labor. Neo-Malthusians mark these claims as short-run observations, touting that Malthus will in the end be correct. The human race is limited to the resources available; it is only a matter of time before the

pressures of population growth catch up to these limits. Malthus himself recognized the ability for advancements in technology, he understood improvements can and will be made. However he held that there was some point at which improvements are capped:

> "No man can say that he has seen the largest ear of wheat, or the largest oak that could ever grow; but he might easily, and with perfect certainty, name a point of magnitude, at which they would not arrive. In all these cases therefore, a careful distinction should be made, between an unlimited progress, and a progress where the limit is merely undefined"
>
> -Malthus T.R. 1798. *An essay on the principle of population*. Chapter IX, p72

It may seem that we are discussing a battle between optimists and pessimists. The idealistic optimism of the human race being capable of overcoming the limits of our environment is in conflict with the pessimism of limiting resources. It would be in our best interest that humanity is capable of overcoming the scarcities of the earth, but Malthus recognized not just some end point, but the narrowing to some unforeseen limit. Meaning advancements in technology have to overcome the pressures of population on the environment in a timely manner, else the effects will be seen. Viewing it from this angle we have already realized Mathlus' theory in a number of societies across history and are currently experiencing the phenomenon on a larger scale. Food supplies are not meeting food demands; population being a key driver in the demand for food has invariably set into motion the scarcity of food. As Malthus predicted, such limitation bring about decreases in the standard of living. More people moving into poverty as a result of the current food price increases would seem to directly relate to Malthus' theory (Abramitzk, 2001).

The theory itself has had minor details be disproved, but in general the concept seems to be extremely relevant to the recent food price increases. Malthus did in fact recognize man's capabilities to increase their means of support. He was not theorizing the

human knowledge was necessarily the fixed element, but population growth was encouraged without proper financial preparations. “Increase the demand for agricultural labour by promouting cultivation, and with it consequently increase the produce of the country, and ameliorate the condition of the labourer, and no apprehensions whatever need to be entertained of the proportional increase of population” (Malthus 1798). He saw agricultural investments to the laborers of the farms as the key to increasing produce. Attempts made in another way to increase production of food were considered, “vicious, cruel, and tyrannical”, and consequently they would fail. This can be interpreted to mean a fair amount of modern attempts to increase agricultural production.

Perhaps the deeper concern is not the growth of population, but more so where the growth is concentrated. Diverging growths in world population show that poorer countries are growing at higher rates than the rich developed countries, this is inconsistent with Malthus's theory, but adds to the stresses on food security. Countries experiencing higher levels of food price volatility and scarcer resources necessary to mitigate food crisis are the ones seeing higher population growth rates (PRB 2008). The scarcity of resources coupled with population growth both put upward pressure on food prices.

Chapter 5: Macroeconomic Factors

Previous factors remained fairly exclusive to the agricultural markets. Determining the cause of recent food price inflation requires an inquiry to the determinants surrounding inflation itself, furthermore those actions in the Macroeconomic realm that influence commodity prices. Underneath all the supply-utilization events we find fluctuating macroeconomic variables. Inflationary expectations, interest rates, business cycles, and exchange rates all reacting to stimuli in the economy

work there way into the commodities market, and have an affect on food prices. Interdependence exists between macroeconomics and agricultural economics. Defining this relationship sparked attention after the agricultural price hikes in the early 1970s.

Numerous studies have sought to define this Macro-agricultural economic nexus, and the resulting influences on food prices, and farm incomes. Literature dedicated to analyzing the impact of macroeconomic variables on agricultural prices include: Orden and Fackler (1989); Saghaian, Reed and Marchant (2002); Peng, Marchant and Reed (2004); Asfaha and Jooste (2007); Kwon and Koo (2009); Khundrakpa & Das (2011). Their findings denote agricultural responses to monetary shocks to be faster than other sectors of the economy, monetary shocks can lead to overshooting of agricultural prices in the short-run, and "in economies with less developed financial markets, money supply as a monetary policy instrument has a much stronger impact on agricultural prices than interest rate" (Khundrakpa & Das 2011). The concept of agriculture being more flexible to money supply changes is rooted in standardization and lower transaction costs associated with agricultural versus manufactured goods. "Even in the traditional explanation through supply and demand imbalances also, as agricultural production takes a much longer time, changes in demand will, in the short-term, get reflected more in price changes than change in the volume of production" (Khundrakpa & Das 2011).

Thus we have launched a debate of theories surrounding price increases and the macroeconomic environment, causality being the focal point. Do food prices increase via structural shocks, and then the macroeconomic environment causes a persistence of these increases, or do food prices increase as a result of the changes in the macroeconomic environment, or perhaps both, the macro-agricultural nexus? Monetarists would suggest prices increase because of "autonomous increases in money supply, and not just a

reaction to accommodate real shocks in the economy" (Shahnoushi 2009). While on the subject of money supply, Khundrakpa and Das found that an increase in the money supply raises food prices, "1% percent increases in money supply leads to a 0.32 per cent and a 0.18 per cent increase in food and manufacturing prices, respectively"(Khundrakpa & Das 2011). Their work lead them to conclude, "increase in money supply leads to a rise in food prices, but not manufactured prices" (Khundrakpa & Das 2011).This paper also indicates food price rises cause the money supply to increase, while manufacturing price increases result in a decline of the money supply. Explanations point to the inelasticity of food demand translating into a faster response to increases in the money supply, and higher demands of money to satisfy an inelastic demand for these now higher food prices. Yet we are conditioned into understanding that an increase in the money supply results in inflationary pressures across the board. Turning to historical food price spikes, and the U.S. money supply, perhaps we can see a relationship between the two.

Chris Riley looked for such a relationship; he found it to be a conditional relationship, and not very strong. Food prices spiked significantly in 1975, but monetary growth was not steep. The 80's and 90's had declines in food price growth, despite substantial monetary growth during this time. What we begin to notice is money supply growth not being accompanied by economic growth. Increasing economic growth is marked by increases in productivity and consequently lower prices. However if the money supply increases without proportional economic growth, prices do not decline with productivity. Stable prices result from monetary growth matching economic growth. Monetary growth in the 70s did not keep food prices stable because productivity was decreasing. The 80s and 90s saw declines in food prices since money supply was increasing at a slower rate than productivity was increasing (Riley 2010). This is

consistent with our current situation of decreased productivity, slow economic growth, and, thanks to QEI and QEII, large increases in the money supply.

The work of Kwon and Koo present an empirical study examining the global macro-agricultural economic nexus. Using all variables as endogenous to capture the dynamic nature of macroeconomic variables, they found aggregate macroeconomic shocks account for 28.97%, 24.63%, and 20.70% percents of error variances in agricultural prices, income, and exports, respectively (Kwon and Koo, 2009). However, the macroeconomic variables account for 88.17 to 98.64% percent of own variations, making this influence one sided. Intra-agricultural relationships are strong, "the variations of agricultural income and exports are due to shocks in agricultural price by 30.18% and 42.86%, respectively" (Kwon and Koo, 2009). The reverse however only amounts to minimal effects on agricultural price by exports and income, 17.24% and 5.27% respectively. Exchange rates and interest rates have the largest impact of all the macroeconomic factors on the agricultural sector, with exchange rates and interest rates accounting for 13.52% and 8.11% percent of agricultural price variations. Money supply shock was found to consistently account for 5% percent of agricultural income variation (Kwon and Koo, 2009).

Thus we are given an idea of the relative magnitude of the relationship between the macro-economy and the agricultural economy. Historical observations lead to the following conclusion, "expansionary (contractionary) monetary policies and the depreciation (appreciation) of the U.S. dollar were followed by prosperous (depressed) agricultural economy along with the increase (decrease) of agricultural prices and exports"(Kwon and Koo, 2009). Empirical analysis confirms these observations, and suggests magnitudes within the dynamic nexus. The influences of the macro-economy on

the agricultural economy are of concern when determining monetary and fiscal policies.

It would seem logical to discuss food inflation under the context of general inflation. We have seen the food price spikes occur in real terms as well as in nominal, in varying degrees across regions, but for the most part the spikes are not mitigated too much by adjusting for inflation. Relative agricultural prices are systematically altered by the same macroeconomic variables that generate general inflation. Money prices (interest rates), inflation, and exchange rates all alter agricultural prices (Grennes & Lapp, 1986). The food price spike in the U.S. during the 1970s was argued to be "considerably the result of macroeconomic factors" (Apergis & Reziti 2011).

Food and energy prices make up a large share of CPIs. Thus higher food prices mean higher inflation, unless you are looking at core inflation which excludes food and energy prices due to their volatility. Also, food expenditures account for larger amount of consumption in developing and emerging economies, making their CPIs more vulnerable to food price fluctuations. In a 2008 report the IMF noted that there might be a process of convergence to world prices driven by high food prices in neighboring countries. Domestic prices are found to be the result of external sectors determining inflation, in the long-run. This long-run time frame may come into play more once we consider the transmission time of a price shock in the external economy to be passed through to retail prices, and vice versa. The IMF, "estimates of an average propagation lag of about 9-12 months for the transmission of oil price shocks, and up to 30 months for the transmission of food price shocks" (Groen 2011).

Particular attention has been paid to exchange rates, since commodities are quoted in dollars, the appreciation and depreciation of the dollar becomes an area for volatility to sneak into prices. Exchange rates demand strategic attention from market stakeholders.

Exchange rates in today's global financial world have a large impact, trade levels in the market will always differ along with exchange rates as long as there are differences in currency values. “Food prices measured in dollars increase when the dollar weakens against other currencies and decrease when the dollar strengthens” (Westhoff 2010). World prices never tell us the whole picture, it becomes relevant to admit the indicators discussed are useful, but imperfect. Prices change daily, and regionally; the price a farmer in Nebraska receives for their corn can be significantly different from the price a poultry producer in Carolina buys corn.

Now stretch this difference across currencies and you have opened yourself up to larger price differentials. The U.S. exports most of their corn to Japan and Mexico. The prices drop and rise according to not only the price of the corn itself in dollars, but also in terms of the yen to dollar ratio; “the price of corn measured in dollars only fell by 1 percent between December 2006 and December 2008, the same price measured in yen fell by 23 percent” (Westhoff 20110). This same time period saw an increase in the price of corn by 21 percent in terms of pesos. Yet the exchange rate alone does not always have as strong of an incentive for imports as expected. The amount of corn imported by Japan during this time, did not reflect the expectations the exchange rate difference would expect to bring about in Japan. The strengthening of the dollar against the peso did seem to decrease the demand for U.S. corn, as one would expect.

The main premise here being, food prices generally denominated in dollars will cause the price of food to increase when the dollar depreciates for two reasons: lower prices in terms of other currencies increase demand for US food imports, and the increase of US domestic demand also puts upward pressure on food prices since exports are now more expensive. Crude oil is also denominated in dollars, making dollar depreciation a

main factor in demand for oil imports world wide (Trostle 2010). And suddenly the interconnection between exchange rates, inflation, demand for energy, and demand for food begin to impress.

Currency appreciation decreases a countries balance of trade. If this along with net factor income and net transfer payments add to a deficit for a country's current account, then this country is spending more on foreign trade than it is earning. Current account deficits lead to an increased demand of foreign currency, more than it receives from exports. Its own country's currency being supplied more than foreign demand, consequently the exchange rate lowers. Prices become cheaper via exchange rate lowering, until there is enough demand for cheaper exports and imports are too expensive.

So we have established foreign demand's role in influencing the exchange rate. Things that affect this further include: public deficits, terms of trade, political stability, differentials in interest rates, and differentials in inflation. Indirectly, directly, interdependently these factors influence exchange rates, and food prices. So when we say the price of food has spiked in recent years, we cannot really make so many assumptions on aggregate influences on prices. Price decomposition is in itself imperfect. Our inferences on any one of these factors are imperfect. Less we limit ourselves here, it becomes increasingly important to establish ourselves at the root of complexities. Food price increases affect behaviors, and the reverse remains as true as ever in recent price spikes (Gittins 2005).

Chapter 6: Self-Fulfilling Prophecy

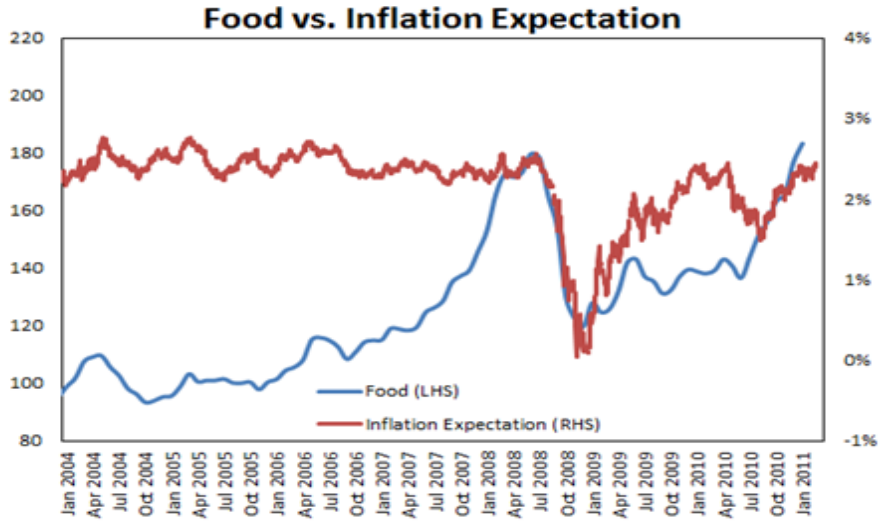
In true social science fashion analysis should include the role of inflationary expectations, information, and speculation. Expectations in the world of macroeconomics

often become cases of self-fulfilling prophecies. Expectations presumably affect people's behaviors. In turn expectations affect economic decisions, decisions regarding savings, investments, consumption choices, wage negotiations, and more. Consequently the real economic activity becomes influenced by inflation expectations. Central banks monitor these expectations, using market-based and survey-based measures, to align monetary policy objectives with current inflationary expectations.

Brazil gives us an excellent example; twenty years ago they had hyperinflation. The currency at the time, cruzeiro was unstable. Printing new money, regime changes coming in and out freezing prices, then failing, citizens expected the money to not hold value. Finally four economists came up with a plan to trick people into thinking money will hold its value. They denominated everything in terms of URVs (Unit of Real Value). Prices in URVs remained constant, however the current currency stayed in use. URVs were worth varying amounts of cruzeiros, but everything was listed in URVs: taxes, wages, all prices. Eventually this “fake” currency became the new currency of Brazil, thus the Real was born. The result, “inflation did end, and the country's economy turned around. In the years that followed, Brazil became a major exporter, and 20 million people rose out of poverty” (JOFFE-WALT 2010).

What were expectations doing during the recent food price spikes? Looking at Figure 6.1, we see US food inflation being graphed against inflation expectations. After the food price spike of 2008, the correlation between expectations and food prices becomes significantly stronger. This could be from the concerns of consumers being more focused on food prices in general, this also closely follows energy prices. Given the economic recession that hit, the anchoring of expected inflation could have been thrown

FIGURE 6.1: US Food Prices and US Inflation Expectations



Source: IMF, St. Louis Fed

off and now increased volatility can be seen. Most attribute this change to the actions of the Fed. However it is not isolated to the US. An IMF working paper on inflationary expectations and monetary policy in India found the same trend, "prices of primary articles account for a little under a third of expected inflation, reflecting the importance of food prices, in particular, to people in anticipating future inflation"(Patra 2010). The paper found 40 percent of the variations in inflation expectation can be contributed to food and fuel price changes. Expectations and food prices are a two way street, a conditional two way street, that up until recently was seen to be weakening. Studies were beginning to find the Phillips curve was becoming flatter, inflation expectations seemed to be responding less than previously to economic variations. However, this insensitivity has dropped away since the recession, volatility has been coming in across the board economically (Patra 2010; Hester 2008).

This should come as no surprise, the economic environment under these price spikes have raised people's concerns to the economy. Inflation expectations are indeed becoming un-anchored; the Fed uses expectations for their policy strategies. With

everyone panicking about their nest-eggs, inflation expectations saw a pop up to 20 year highs at the beginning of 2008. The Fed's actions to fight the recession, have not led to mitigation of inflation expectation volatility. Thus the importance of inflationary expectations on food prices has become more important during these past two price spikes. The interaction between spikes in food prices and inflation expectations have augmented other economic shocks, simply through the power of behavior responding to environmental stimuli: expectations of "sticky", or higher food prices to come (Luca 2010).

Chapter 7: Speculating on Speculation

Short-term volatility in markets has a lot to do with information. The power of news in affecting prices, granted this news has implications regarding economic activity in markets, is impressive. Information in an economy is what presumably leads to efficient allocation of resources. The ways in which information is generated and used in the various financial vehicles become ever more important. Prices under a neoclassical mind frame are indicators of scarcity and value. Sadly the exploiting of such information in markets by certain agents tends to result in markets being distorted, rather than an "invisible hand" bringing things to equilibrium.

Keynes' Chapter 12 in his "General Theory" addresses speculation, in perhaps one of the best accounts of the psychology of panic. "Speculators may do no harm as bubbles on a steady stream of enterprise. But the position is serious when enterprise becomes the bubble on a whirlpool of speculation" (Keynes 1936). Financial innovation makes investments more liquid, reducing the demand for cash, but increasing the scope of speculation, and consequently increasing volatility. This is exactly what we have seen in today's markets, the "social purpose" of financial markets are not being realized. "When

the capital development of a country becomes a by-product of the activities of a casino, the job is likely to be ill-done" (Keynes 1936).

At the hands of speculators, commodities markets have been another source for rising food prices. People like Dwight Anderson entertained us, "with stories from the world of big money" (Balzi 2008). Tight supplies in Brazilian grain farms and Malaysian Palm Oil Plantations made him excited. Completely aware of the rises in world hunger that would result, he focused only on the profitability. He was "The Commodities King" on his throne, the largest in the world: Ospraie Hedge Fund. Betting on agricultural markets, and flaunting the investment bargains worldwide hunger brought him, soon brought a negative light. He now owns the rights to all photos of himself and avoids the media, shame?

Commodity speculation has been given a bad reputation. Futures markets are a place for farmers and grain wholesalers to find protection; protection against weather and excessive price fluctuations. These markets allow for a farmer to plan on how much to plant for a given year, allows them to sell their harvests ahead of time. Futures contracts allow locked in quantities, prices, and delivery dates. These can stretch into crops that have yet to be planted. Speculators reach in, buying at lower prices, betting they will rise and making a profit. Investors are said to have flooded the market, driving up short term prices. These profit-hungry investors are not the familiar market participants. Farmers and silo operators are being crowded by large index funds. Never taking delivery of a given crop, these investors do not see themselves as a cause to price increases. Futures prices do affect real world behaviors, but we have to decipher how much of the price movements are due to unjustified speculation versus the fundamentals of supply and demand.

ABN Amro a financial giant offered up their innovation to the profit-oriented members when they “became the first bank to offer certificates allowing small investors to place bets on rising rice prices on the Chicago Futures Exchange” (Balzi 2008). Asia's most important staple food was falling subject to famine, hunger and political unrest were the talk amongst experts worldwide, meanwhile ABN launched its new ad campaign, As India imposes a ban on rice exports world rice supplies have declined to a minimum. Traders find whatever reasons they want out there to buy sand sell contracts at a given price: weather, exchange rates, past prices, oil prices, and all sorts of factors affecting supply and demand for a crop. Information transfers and analysis eventually prices are bid up to ration out available supply, or down to discourage further production. Hindsight gives us an edge of confidence, but we are not naive. Identifying and even understanding the movements of fundamentals doesn't give us an edge on predicting the persistence or volatility of changes in short term supply and demand elements, or their effects on prices. Extending this to suggest the speculative bubble has led to “higher-than-justified prices”, and blaming irrational speculative behavior for price spikes would in itself be irrational. The timing would tend to favor speculation as a guilty culprit of higher food prices. Index speculators grew seven-fold from January 2003 to March 2008; “these speculators held 64 percent of outstanding wheat contracts in 2008” (Westhoff 2010). The increased volumes of money are seen to distort the futures prices from cash prices. Then in the last months of 2008, large volumes of money flowed out of the market as prices fell, the speculative bubble popped.

So far the timing and the ethical implications are stacking up against speculators, they certainly look like the guilty Yet we are left to our own limitations of speculating about speculation. Sophisticated statistics might lead us to a more clear cut answer,

however certainly not a definitive one, but alas this is beyond the scope of this paper. The International Food Policy Research Institute's economists found “that speculative activity affected market prices” (Westhoff 2010). The 2009 report by IFPRI evidenced this affect through: increased ratios of noncommercial long positions to total positions in Rice and Wheat, this same ratio but for short positions in maize and soybeans, index trader's net positions, and ratios of volumes to open interest in wheat and rice. The study cites, “rising expectations, speculation, hoarding, and hysteria...played a role in the increasing level and volatility of food prices (Robles [IFPRI] 2009).

Opposing this, Scott Irwin of the University of Illinois, did not find speculation to play an important role on market prices. If we see the market having prices be high, without these fundamentals concluding that market prices should be high, then we could probably point to speculators as being a dominant driver in food prices. Yet the market fundamentals lead us to see little by way of anomalies caused purely by speculation. Noting also, speculation based on fundamentals would translate into prices that reflect fundamentals and not profit hungry investor's actions. So, the intentions of those actions may not be outright malicious. We can look at past corn prices and say they did not need to be as high as they were in 2007/2008, and that we would indeed have as much as we did in 2008/2009 without such high prices. Except we did not know this at the time, and as it became clear production was meeting demand, prices fell in the last months of 2008. Speculation can be a good thing, or a bad thing for food markets. They provide liquidity, and have been known to mitigate volatility over time. Still, if prices are driven away from fundamentals, prices will be distorted.

Outside of the contract world, there are options, swaps, and other tools used to hedge risks, or bet on price movements. Government regulations are around in the

market, they have disciplines in place to restrict market distortions. Arguments on these measures will continue on. We can decipher better methods to determine the role speculation plays on markets, but we do already know one thing: "market speculators can push prices higher or lower, but fundamentals eventually rule" (Westhoff 2010). Now the more important point we can take away here are the reactions to the markets. All kinds of institutions watch the markets, then react based off of what the market is telling them in regards to the fundamentals of food supply and demand.

Some studies suggest the responses to economic shocks are not as drastic under certain market conditions: high volumes of trade, freer trade, and more flexible macro environments. Even further, the credibility of the regime monitoring inflation tends to have an influence on the impacts of price swings. Another thing to note, the relationships discussed earlier between macro and agricultural economics could be affected by the size and endurance of price swings. Recent food price spikes were intense in size, thus the impact ensuing may have been more lasting.

If persistent, the increases in food prices result in reductions of real consumption, savings, and investments, these combine to lower aggregate demand dampening economic activity. As mentioned earlier, studies have found food prices to be more responsive than non food prices to macroeconomic variables. Further, the increase in food prices is larger than that of non-food prices, theoretically we should then see farm net incomes increase under conditions of inflation. This is exactly what we saw for US net farm incomes, they rose from before 1992 up to 2008, and then they dropped from 2008 to 2009. This is consistent with our discussion of food prices having stronger relationships with macroeconomic variables than non-food prices (Baek and Koo 2010). In all we are seeing evidence of changes in the macroeconomic environment affecting

performances of agricultural economies. Directly, and indirectly, and perhaps more long term through the provoking of actions of stakeholders.

Chapter 8: Policies

Policymakers being apart of those provoked stakeholders, have been hard at work over the recent decade. Government food policies undoubtedly affect food prices. Not to mention the livelihoods of the 40 percent of the world's population depending on food production for a living. Of all the debate surrounding the food price increases, one consensus seems to be more prevalent than any other; policies are exacerbating food price volatility. Rebuilding stocks, controlling domestic prices, and export bans are seen as the protectionist measures raising prices higher. Tariffs raise import prices, and occasionally spark trade wars. Subsidies boost production and give incentives for lower food prices. Biofuel policies encourage the allocation of crops to fuel versus food, driving prices up. Food aide programs lower food prices for beneficiaries. Conservation programs give incentives for farmers to not plant crops, decreasing supply. Agricultural resource can lead to new uses for crops increasing crop demand pressuring prices to move upward, and/or introduce productivity increasing methods allowing prices to move lower. At any given time, a country has multiple food policies, often times these policies are contradictory.

Prices are seen as too high by one group, consumers, and too low by another group, farmers. Farmer's want to make a decent living and consumers want food to be affordable. Before 2007, most of these food policies have escaped our attention that is aside from traditional farm subsidy programs. As world food prices began to rise in 2007, Governments took action. In efforts to limit food price inflation, exporting countries adopted export bans, or restricted exports. This allows for domestic food prices to lower

in adjustment of increased supply. Meanwhile, importing country prices increased reflecting the reduction in supply from exporting countries. Food importers lowered or removed tariffs to encourage imports, which did put downward pressure on prices, but in effect increased world prices since the world demand for imported food increased. Both protectionist policy measures aimed to reduce domestic prices, consequently both raised world prices. Government actions to make domestic prices more stable, can lead to more volatile food prices in other countries. India restricted rice exports drives up the food price of rice in Latin America and Africa (Westhoff 2010).

India was not alone in the wave of protectionist policy measures. China imposed a tax on grain exports in 2007/2008, and their stock building strategies have raised pressures on Soybean prices. The EU suspended export subsidies on their dairy products, and reduced grain import tariffs. Russia's export taxes on wheat turned into bans on wheat and coarse grain exports after its recent drought. Argentina raised export taxes on grains and oilseeds. The Ukraine banned Wheat exports, and Vietnam banned rice exports. In all over 30 countries restricted agriculture exports in 2007/2008, the first spike saw restrictions on exports mostly from major exporting countries. These policy responses have been a root cause of higher food prices.

Supply and demand fundamentals are not consistent with the sharp price increases. Specifically in the prices of Rice for 2007/2008, “world rice production actually exceeded rice consumption in 2007/2008” (Westhoff 2010). Ending stocks were larger than the beginning of the year rice stocks. Indicating, without these export bans world rice prices would not be nearly as high. IFPRI “attributed about three-quarters of the increase in the price of rice in 2008 to government policy responses like export restriction” (Stewart 2011). Such restrictions tend to lead markets into a panic;

stakeholders see the sharp increase in food prices from a further restricted supply of food. Now the already tight supplies are tighter, import dependent countries are forced to accept higher prices, and everyone in the market suffers from the distortions left in the wake of export bans. Although trade policies are not as simple as these export bans make them out to be.

Conor Foley, a humanitarian aid worker sees Western policies as the enabler to the food crisis. High income countries have long been criticized for their subsidy programs, “The average European cow receives more financial support than half the world's population has to live on”(Foley 2008). Funding Foley feels would be better spent developing agriculture in the South. Yet we tend to see subsidies and such funding do just the opposite, flood out foreign developing markets with cheap(er) food. In fact when you step back at look at the whole thing, you can find OECD trade policies are rather indefensible. We are exacerbating if not creating the development issues we are supposedly aiding.

“Across all OECD countries, government subsidies and policies that keep domestic prices above world market levels account for about one-fourth of total farm receipts” (Westhoff 2010). Policies differ vastly between countries. Agricultural policies include: trade policies, subsidies, food assistance programs, and other food policies. Each of these has specific effects on food markets, and thus food prices. Many of these are targeted at the consumer level. Many of them have intentions beyond prices, such as safety and regulation for health purposes. These regulations and policies can transfer additional costs to producers and in turn be passed on to the price of food products. Government stocks, and agricultural research projects need funding are organized through policies. Public policies restrict or aid research, such as we have seen with

genetically engineered crops. Environmental agricultural policies have costs, aimed at soil erosion reduction or conservation efforts. Animal welfare rules have found a place in the food system. Subsidies tend to get the most political attention. Despite their impacts being more on the income of farming families than the food prices, subsidies are seen by many of the public as the root of hunger.

One point that is abundantly clear, policies made by rich countries tend to counteract the supposed aid efforts of these same countries. In the words of Collier from his book, " The Bottom Billion", "It is stupid to provide aid with the objective of promoting development and then adopt trade policies that impede that objective" (collier 2007). It seems particularly fitting to use a childish adjective one is generally more accustomed to hearing on the playground. Except that is exactly what this is, a world agricultural trade playground. Complete with bullies kicking sand around, shoving little scrawny kids in the dirt. Teachers come along and make them apologize. They help the little kid stand again, only to get right back at their aggressive behavior next recess. Rich OECD countries, our bullies, undermine the benefits of trade with their subsidies, and in the past decade with biofuel policies.

Chapter 9: Biofuel Policies

> "Government support of biofuel production in OECD countries is costly, has a limited impact on reducing greenhouse gases and improving energy security, and has a significant impact on world crop prices, according to a new study of policies to promote greater production and use of biofuel in OECD countries" (OECD 2008).

Most everyone agrees, biofuel policies increase food prices, however the jury is still out as to the magnitude of the effects. If the costs of supporting the biofuel industry are high, and the benefits low, then where is the reasoning for the support? Earlier we discussed biofuel production, but now we are focusing in on the support policies adopted.

Take away the three major US ethanol support policies, and according to a 2009 Food and Agricultural Policy research Institute report production drops by an average 36 percent (Westhoff 2010). Under the premises of becoming energy independent and environmentally responsible, the US boosted its biofuel industry. They put in place three main policies to encourage the use of biofuels, subsidies, tariffs on ethanol imports, and mandates requiring minimum use levels. Tax credits and tariffs on ethanol and biodiesel led to an expansion of the US biofuel industry. In 2005 the Renewable Fuel Standard (RFS) mandated biofuel use levels; throughout the years this mandate minimum has been raised. In 2007 the US enacted the Energy Independence and Security Act (EISA). Although, in recognition of the increased corn prices from the RFS, the EISA set a maximum for corn-based ethanol counting to wards the 2015 RFS level of 15 billion gallons.

Expectations of industry growth caused plants to pop up everywhere, thus raising demands for corn and soybeans used in biofuel and biodiesel production. Hence we see the policies facilitating the upward movement of prices. The food price decline does not coincide with any biofuel policy changes. Regulation confusions and uncertainty for the industry did come with the economic crisis and widespread plant shutdowns. The impact biofuel policies have on food prices are estimated to be rather high, without biofuel policies, “The FAPRI-MU study estimated that corn prices would fall by 13 percent” (Westhoff 2010). The same study estimated drops of 7.4 and 5.6 percent for wheat and Soybeans, with the removal of biofuel policies.

There is a relationship seen between oil prices and the price of biofuels, since they are substitutes, “when oil prices are high, the ethanol tax credit can encourage more ethanol production and use , which in turn causes more corn use and higher food prices”

(Westhoff 2010). However, these policies weaken that link between food and oil prices when oil prices are low, since low oil prices will drop biofuel production and use to mandated minimum levels, which will not increase demand for corn and soybeans enough to make demand as inelastic as it is with higher oil prices.

The price impact of the industries actions may be ambiguous and draw on a fair amount of models and assumptions to measure, but the costs of policy support tends to be more readily available. Policies have more concise cost structures. In any case, the OECD found, "Current biofuel support measures alone are estimated to increase average wheat prices by about 5 percent, maize by around 7 percent and vegetable oil by about 19 percent over the next 10 years" (OECD 2008).

Chapter 10: The Good Guys?

Mainstream media would have you believing the WTO rescues developing nations, and are the ones working to solve global problems. However, what do we really know about the actions of the WTO, further more what about the IMF, the FAO, the World Bank, and the UN? Unfortunately, there seems to be a rather alarming track record when you start to look into the actions of these global institutions. The mantra of "free trade" comes with strings attached for countries joining the WTO.

> "third world governments 'agreed' to reduce or eliminate tariffs, but with the Uruguay Round accord, third world countries have through treaty law been locked into further reductions and have lost their right to use nontariff barriers—including subsidies or other favorable treatment for locally produced goods-- to protect their domestic food markets" (Lappe 1998).

yet the Northern countries were given less strict rules. Some tariff reductions and cutting a few farmer's subsidies, and they were good to go. The rules of the game favored Northern countries and multinational corporations. Impartial trade policies were not

existent, and developing nations had very little say in trade negotiations. “The WTO...was given far greater authority over trade in agricultural commodities than existed under the GATT” (Ikred 2008). A fair amount of resistance has been building up against the WTO, led by peasant farmers, in their plight for “food sovereignty”. In large part resistance is a response to the double standards seen at the Doha Round of trade negotiations.

It seems the US is in favor of free trade for the rest of the world, but protectionism for themselves. Free trade has left poverty in its wake in many cases. Philippines' entry into the WTO mirrors Mexico's experiences with adhering to NAFTA. Imports in agriculture rose substantially, lowering prices, and lowering production via lack of incentives. Corn farmers rather leave their corn rot in a field than harvest because it simply was not worth it with the low import prices. Campaigns to ratify came from the World Bank handlers, promising compensations in other new export industries. Needless to say, no such export industry materialized. In the end, “trade liberalization was the swift transformation of an agricultural economy with a high degree of self-sufficiency into one that was permanently import-dependent, its small farmers steadily marginalized” (Bello 2009).

Critics have been after the World Bank for its conditional loans, equivocating the bank to a war weapon. The conditions are viewed to open up under-developed economies to corporate exploitation. The IMF and the World Bank have stumbled of late, with failed policies and “a credit glut brought on by spiraling oil prices” (Urquart 2008). With food prices spiking to new highs, the World Bank and the IMF were given new opportunities. With a giant PR launch, the Bank announced an available 1.2 billion for facilitating vulnerable countries during the food crisis. Among these countries, Haiti, Libia, and Djibouti all received grants. However, “moves to restructure the global economy to

protect small producers from market fluctuations and the predations of agribusiness giants were strikingly absent from the bank's response, just as they were absent from the outcome of the Rome Summit itself" (Urquart 2008). Even the FAO has become caught up in corporate agendas. "The FAO shut its ears to alternative notions of agricultural development, turning its summit into a rubber-stamping exercise that put profit firmly before people and land" (Urquart 2008).

FAO findings from convened International Assessment of Agricultural knowledge, Science and Technology (IAASTD) went missing. Civil society representatives asked to the summit were admitted through the rear entrance, given 90-minutes and a strict agenda. However, according to Patrick Mulvany a senior policy adviser for Practical Action (A UK based NGO), private sector participants were escorted to a round table upstairs to meet with the head of the FAO, Jaques Diouf, Kofi Annan, and of all people, representatives of agribusiness giants, among them Monsanto and Syngenta. Even the UN is used as a diplomatic tool, complete with corruption, infamously its Oil-for-Food Scandal in 2006 benefiting corporations. The UN has even received allegations of collaborating with Google to de-list one of its most prominent critics, Inner City Press. The UNDP and Google partnered up in November of 2007 to "achieve anti-poverty goals", but when Inner City Press' founder Lee asked why Google hadn't signed a global human-rights and anti-censorship contract, which are part of the UN's Millennium Development Goals, the Website for Inner City Press was removed from Google News.

Corruption happens, it is apart of cultures worldwide, hidden, unhidden; socially acceptable and not. The list of market imperfections stemming from acts of corruption are far too many for this paper to delve much further into. NGOs and governments alike out

to provide aid in the midst of the food crisis can fall victim to misconceptions, corruption, and diminishing returns. That's right, diminishing returns, "when aid reaches about 16 percent of GDP it more or less ceases to be effective" (Collier 2007). In all aid, over the past thirty years has only managed to increase economic growth rates in the "bottom billion" countries by 1 percent per year. Before you start shaming rich countries, and wallowing in their guilt over the developing world's poverty know this, "poverty is simply the default option when economies malfunction" (Collier 2007). Malfunctions in the agricultural economy take root in the supply and demand fundamentals, natural resource scarcities and allocations, policy responses, and market imperfections. The food system is surrounded with market imperfections. Policies are merely the icing on the cake.

The crux of current policy controversies center around globalization. Globalizing markets affects the global economy, ecology, and society. This is where the timeless conundrum of conflicting rights, the rights of the individual versus society. To be more exact we are presented with a theme in evolutionary biology – the conflict between individual selfishness and group altruism. Economics, in the neoclassical sense tends to favor humans as having a healthy enlightenment of self-interest governing all choices in terms of satisfying their wants.

It is very easy to make the case for this in my own world views as well. The gutters of the house in which I am renting a room are cluttered, to the point they will not function come melting snow. Yet, I am moving shortly, the cost of clearing out the gutter will not benefit me. Of course it will benefit future generations of tenants in the home. I am not inclined to think about these tenants when deciding not to clear out the gutter. I am leaving my environment worse off for following inhabitants. The choice to ignore

cluttered gutters parallels our economic environment today. We are operating in the short-term, exploiting resources. Thankfully, unlike my gutter, the world is reaching out for sustainability in markets, sustainability in agriculture. Only the market imperfections are hindering our abilities to do so, starving development.

Chapter 11: Market Matters

"Our current economy favors systems that exploit the natural and human environment for short run gains" (Irkerd 2008).

As discussed in the biotechnology section, agriculture fell subject to industrialization. It has been restructured under the mechanistic worldview. Operating under neoclassical economics, the final arbitrator is the consumer. All actions adding value to the product are aimed at satisfying the consumer's needs and wants with scarce resources. Efficient allocation of these resources is assumed by maximizing economic value relative to economic costs. Conventionally water, air, and land are not specifically assigned economic value. Like every other industrial practice, agriculture began to specialize, and standardize.

Things on the farm turned routine enough to be mechanized. Trying to make a biological process more predictable, reliable, and repetitive has drawbacks. Farmers are producing standardized products, making them price takers in the market. "The only marketing decisions conventional farmers make is to decide when to establish a price for the things they produce". Using forward contracts or options, and hedging their positions in the futures market they can manage risks. Sure they can decide to defer pricing until at delivery, before or after delivery, but the price is set and they either take it or leave it. Contracts requiring a fixed amount of return per unit of production helped farmer's feel

less risk, but locked them into being, “a contract laborer for an agribusiness corporation” (Ikerd 2008).

The system encourages farmers to exploit each other and natural resources. The old economic views of best serving society by pursuing our own self-interest have proven detrimental under current conditions. We are not witnessing competitive capitalism. The conditions are not here, sufficient buyers and sellers, perfect information on price, performance, and products, freedom of entry and exit, sovereignty of consumer tastes and preferences. Today's economy is not the capitalism we read about in textbooks. We have large corporations holding market power dominating the industry, and consolidating further at alarming rates. Barriers to enter the agriculture industry are large initial capital investments, patents, and copyrights.

Agriculture has not escaped the wave of industrialization and corporatization that spawned globalization. Farmers adopted new practices, lower costs and consequently raising profits. This meant specialized, standardized, and mechanized agriculture. Farmers became obsessed with getting larger: produce more, farm more, more labor, more capital. Innovation and competition led to the survival of larger farms wining out against smaller farms. Competition wanes until you are left with capitalism giving way to corporatism. The separation of corporate entities from their operation's performance leads to higher risk taking behaviors, to ethics and social responsibility being reduced to legalities. “The overriding motive for public investment and ownership is to realize profits and growth in economic value” (Ikred 2008).

Theoretical principles of competitive capitalism argue this being the best result for society, efficient allocation of resources via free markets has led to the best outcome. Corporations tend to not have the needs of a society at the forefront of their decision

making grids. Capitalism is rooted in privatization, ownership by individuals, and competition among many individual firms. Yet, “most private property in the United States today is owned by corporations, not individuals” (Ikred 2008). Capitalism did not advocate government involvement in the economy, yet we are seeing government and corporate interests blend. Power blocks, and “revolving doors” ensure that government and corporate boards are on the same page. The pursuit of short-run self-interests by corporations has removed social and moral restraints to selfishness.

Take Monsanto's track record. They patented their genetically modified seeds, sued farmers left and right for having crops that contained this seed. They illegally dumped thousands of tons of highly toxic waste in the UK, knowing the contamination liabilities, which were found polluting the groundwater 30 years later (Monsanto 2005). Bribery in Indonesia, and false advertising in France, serve as two more accounts of Monsanto’s rather unethical footprint. If it could, India would declare war on Monsanto, blamed as the major cause of farmer suicides, and alleged to employ children in the manufacturing of their high cost bt cotton-seeds. The work involves handling poisonous pesticides (Shiva 2008; Monsanto 2007). Global trade institutions tend to favor this result, the corporations coming in and creating larger industrialized farms. The differences in farming practices between peasants and agribusinesses can be seen in Table 11.1.Agribusinesses are not necessarily all bad, we do have to recognize the increased outputs, the innovation they usually bring about, table 11.1 allows a comparison of peasant farming, and we can see the systems have pros and cons. The productivity and output of agribusinesses are beneficial to society; however they tend to have larger environmental and social costs within a community.

TABLE 11.1: Peasant Versus Agribusiness

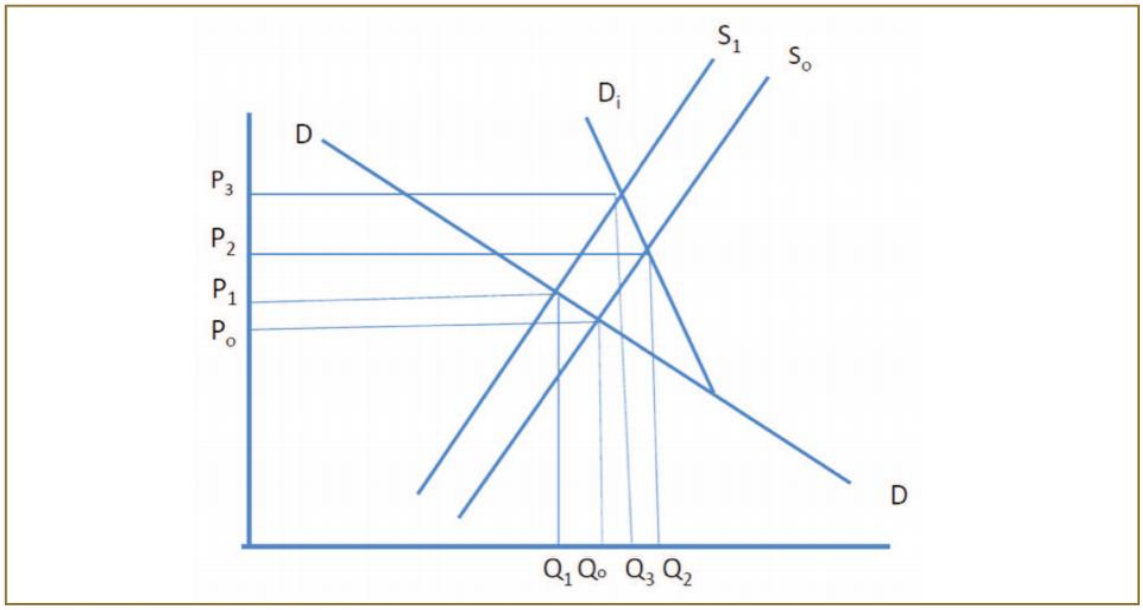
	Peasant	Agribusiness
System	Subsistence + near subsistence	Commercial
	Multi-product	Single product
	Vulnerable	Protected
	Risk averse	Risk taking
	Traditional	Progressive
	Low input / low output	High input / high output
Land	User rights based	Owned or leased
	Unsurveyed	Surveyed
	Tribal / state land ownership	Secure tenure
	Marginal	Favoured
	Structurally deficit (often)	Area size suited to enterprise

Source: Annex 11, FAO

The market structure change is not limited to agricultural industrialization. We are seeing the elements mentioned come together to make more inelastic food markets. Price responsiveness is being restricted by land scarcity, water scarcity, biofuel policy constraints, higher livestock prices with persistent feed demands, lower stocks, isolation protectionist trade policies, all come together to lower the elasticity of food markets. The price increases in the recent decade are a direct result of the market's inability to adjust supply and demand. All the above factors are more inelastic than they have been in the past. Decomposing each one allows understandings, but when they combine, we are allowed to visualize the bigger picture of why food price spikes are happening, and why volatility in food prices has increase. Land alone has become scarcer in 2011 than in 2008, contributing to more inelastic food prices. Figure 11.1 shows the impact of short-run inelastic demand, and decreases in supply. This is what the corn markets have seen

with the recent price spikes, other crops have seen similar inelastic demand curves and decreases in supply. The upward pressure of prices, with these fundamentals shifting allowed for the price spikes. Other elements added to distortions of food markets from long-run equilibrium as well.

Figure: 11.1 Inelastic Demand for Food and Supply Decrease



Source: FAS (2011) USDA PS&D online database

One market aspect that is not helping the situation, adding further pressure to the price spikes, is the monopolization of the food industry. Yes we mentioned industrialization and moving to a more mechanistic world view. Even hinted at the market power some corporations have managed to sink their teeth into, but it is time we looked further into the food industry. Who is bringing the food from the farm to the table? We can see a clear change in the industry; shifts to fewer players in the industry have led to price increases. Economics tells us the result of monopolization is higher prices, fewer

output, and a welfare loss for society. This is exactly what we are witnessing in the food industry, corporate consolidation of agriculture.

We have already discussed the seed market's consolidation down to 6 corporations. Three decades ago, there were dozens of pesticide companies, in 2010 just ten companies control nearly 90 percent of agrochemical sales worldwide. Fifteen years ago around 1,000 biotech companies started up, in 2010 just ten companies hold three-quarters of the industry's revenues. Pharmaceutical companies can be considered in our corporate takeover discussion. Fifty-five percent of global pharmaceutical sales go to ten companies; a few names: Pfizer, Merck-Schering-Plough, Roche, Johnson & Johnson, Sanofi Aventis, Glaxo. Over sixty percent of the US grain industry is controlled by four companies: Cargill, Archer Daniels Midland, ConAgra Incorporated, Bunge Corporation. The US meat packing industry dwindles down to four large companies: Tyson, Cargill, Smithfield, Swift and Company. Tyson is the world's largest meat producer. Cargill takes corporate consolidation to a whole new level. “With $120 billion in annual revenues, Cargill is bigger than the economies of more than two-thirds of the world's countries, including Kuwait, Peru, and Vietnam” (Windes 2010). To put this in perspective, their sales are larger than the combined sales of Kraft Foods, PepsiCo, and Disney. The corporate consolidation of the food industry is enough to make you sick, literally (Windes 2010).

The regulations and safety standards are questionable when these large corporations get involved. Factory farm conditions encourage diseases. Roughly 70 to 80 percent of pigs have pneumonia when they are slaughtered (Lilly, 2002). Hormones and antibiotics add more to the story. Hormones used to increase milk production in cattle, brought to us courtesy of Monsanto, resulted in increases of utter infections and

lameness. Milk from these cows had increased levels of Growth Factor One (IGF-1). Which is known to be a fuel cell for cancer growth; it is associated with rapid cancer growth. Hormones are carcinogenic; they disrupt DNA (Balter 1999). The more you know about processed food, the less you wish you knew. Your local stray dogs and cats are ground up along with their euthanasia drugs and fed to livestock. Now before you simply object on account of this being little Bengi or Socks, the problem lies more with the drugs inside these animals rather than the source itself (Truong 2007). More concerning is the feeding of same species to livestock, or perhaps the dried poultry waste and sewage sludge fed to cattle (Lilly 2002). We are what we eat.

Campaign contributions marry political agendas with corporate interests. Consolidation has occurred in every industry from defense to agriculture. At times the line between food and weapons becomes blended. Governments recognize the power of actions within the food industry, and as such strategies in foreign relations often involve using food as a weapon. The pattern appears throughout history, colonization had its agendas. Food from colonies was a main interest for imperialists. “In Indonesia, the Philippines and Vietnam as well, the plantations threw back their labor forces' subsistence requirements on impoverished peasants, who struggled to squeeze more and more from less and less land” (Bello 2009). In Latin America, we saw the notorious “latifundo-minifundo” complex. Dual economies exist, exports to support metropolitan economies while peasants are pushed further into the outskirts and expected to support growing populations with less resources. Bretton Woods had an agrifood system leading to further protectionists policies for food, and ultimately an exclusion of agriculture from the GATT (General Agreement on Tarriffs). Transitioning us into the current predilections against

the WTO we covered earlier. Perhaps a more clear distinction of food as a weapon is the outright withholding of food aid in efforts to control a political outcome.

Stalin and Hitler used food as a reward, a punishment, and to destroy opposition. During the Cold War, food was used as a form of influence and propaganda. Food aid in most any situation between countries is not as innocent as publicly perceived. Granted today food is generally not embargoed for humanitarian purposes, but the practice of food as a leverage in geopolitical strategies is very much active. Economic sanctions are an implementation of international policy, and the role food plays within this often leads to genocidal starvation, which is still an accepted strategy. There are reports of these practices occurring all over the world, of course most of the allegations are underground and not credited, and thus many of them fall to conspiracy. Yet the historical accounts of food as a weapon are readily available. The lack of humanitarian interests when a powerful country, or any regime for that matter, determines their agendas are carried out by such means is sickening (Bello 2009).

Chapter 12: Summary

> '[T]his time there will be no "silent tsunami". The situation is different from 2008. The world is aware of the risks. The global community, the UN and Bretton Woods system, is fully engaged, more coherent and prepared to act . . . ."
>
> -Paul Gulleik Larsen
> Director of Multilateral and NGO Relations
> UN World Food Programme
> February 18, 2011

The past decade has experienced two alarming food price spikes. The causes and responses have launched the world into as frenzy of analysis and projections, reforms, and plan implementations. In the midst of economic turmoil, the food crisis has led to setbacks in development. The above factors have contributed to recent food price spikes.

A full table of factors and their relative effects can be viewed in Appendix E. The table demonstrates the relative magnitude of these elements in the price spikes of the past decade. As you can see the magnitudes are not decisive, complex matters of economic environments need to be established in order to reach more conclusive quantitative results. Long term factors are seen as have upward trend influences on food prices, and are given one plus in the final two columns of the chart to indicate their influences accordingly. Thus the chart found in Appendix E. is not exclusive to the factors causing the spikes in food prices, but are in whole the factors providing upward, or downward, as the case may be pressure on food prices. In the case of no assignment, the influential relevance is simply minimal enough to be excluded,

Table 12.2: Governments' Policy affects on Food Prices

	Domestic Food Prices	World Food Prices
Tariffs and Import Restrictions	**Higher**	**Lower**
Export Subsidies	**Higher**	**Lower**
Payments to farmers		
-tied to current production	**Lower**	**Lower**
-not tied to current production	**Small**	**Small**
Farm Input Subsidies	**Lower**	**Lower**
Land Retirement Programs	**Higher**	**Higher**
Public Stock Management	**More Stable**	**More Stable**
Biofuel Policies	**Higher**	**Higher**
Price Ceilings	**Lower**	**Higher**
Domestic Food Assistance		
-effect on beneficiaries	**Lower**	**-----**
-effect on others	**Higher**	**Higher**
Research and Educaiton	**Depends**	**Depends**

source: Westhoff, 2010 page 207

Policy reactions to recent food price spikes have exacerbated the food crisis. Table 12.2 displays governments' policies and their effects on both domestic and world food prices. Many countries have conflicting policies acting within the food industry. Actions of global institutions are impacting the world food crisis. The change of agriculture into an industrialized mechanistic practice should be addressed further. The market imperfections seen have resulted in starving development. During the recent food price spikes, we have seen supply and demand fundamentals indicate market disequilibrium. It is important to note, a fair amount of

these factors are not unique to the food price spikes, but are rather a collection of food price influences on long term trends. That is to say land and water availability are not unique to the spikes, but are leading to the overall upward trend in food prices across the long run. Imperfections by way of policy responses, more inelastic markets, information flows and expectations, and corporate consolidation of the industry lead to further disequilibrium. All of which have interacted to create the growing volatility of food prices.

Chapter 13: Case Studies

There comes a time when merely overviews of all the elements driving food prices become trivial. All these factors affect specific country economies uniquely; even further the differentials amongst regions vary, and further still are the differences amongst individual stakeholders. Food price increases should then be addressed on a case by case basis. Only by analyzing the drivers under specific contexts can the price increase be quantified, that is to the best of our current modeling abilities. In an effort to reach a more quantitative conclusion on the recent food price spikes we look at three case studies. These three case studies center around countries: Greece, Pakistan, and Asia. The previous discussions tended to take a horizontal approach to the impact of food price increases. We looked at specific drivers and their roles on world prices, or often times just in the US. In discovering the impact of recent food price increases on a country case level, we can be more definitive in the economic environment, and create more exact results than we have on the global scale.

Greece has been given a fair amount of attention over the past few months, making for a rather interesting case study in terms of economic environments in relation

to the recent food price spikes. Nicholas Apergis and Anthony Reziti performed an analysis of food price volatility in Greece. Wanting to see how the volatility of food prices are affected by short-run deviations between food prices and macroeconomic factors. When there is an increase in the volatility of food prices as a result of shocks to the system, then investigating the behavior of conditional variance as a function of short-run deviations from the equilibrium path allows for a measurement of the shocks impact on food prices, and possible costs associated.

A positive effect would show short-run deviations affect conditional means, and variances. The farther food prices deviate from these macroeconomic factors in the short run, the more uncertainty there is, making predictions of food prices harder. The modeling here is taken from Engel's ARCH model, autoregressive conditional heteroskedasticity. Observed time series data of the macroeconomic conditions are used to model conditional heteroskedasticity as a function of lagged error correction terms. If the uncertainty is serially correlated the ARCH model serves as a method for measurement. To include more information the general model is extended to use the GARCH-X model. It allows for a term to be added denoting short-run deviations, it is a squared lagged error-correction term often written simply as EC, error correction.

The method requires modeling food prices as a function of macroeconomic variables in the long-run, the cointegration vector function can be viewed in figure 13.1., this is the second vector regression the study develops. The first did not include a structural break for the CAP policy change. Figure 13.1 displays a mean equation for relative food prices. It demonstrates a long-run relationship between relative food prices and the macroeconomic variables used in this study. RDEFY is the public deficit to income ratio.

FIGURE 13.1 Relative Food Prices as a Function of Macroeconomic variables (LR)

$$\underset{}{pp} = \underset{(4.33)^*}{0.395\,RDEFY} - \underset{(-4.05)^*}{0.213\,rm} + \underset{(3.95)^*}{0.174\,re} + \underset{(4.11)^*}{0.159\,ypop} + \underset{(3.63)^*}{0.104}$$

Source: Nicholas Apergis and Anthony Reziti, GARCH-X estimates, Greece case study, 2011, Southern Agricultural Economics Association

The real money supply is denoted by rm, real exchange rates by re, and ypop denotes per capita income. The results suggest a positive effect of deficits and exchange rates on food prices in the long-run, and a negative impact by the money supply. These are consistent with the literature reviewed on the global level. Moreover the Greece study takes this analysis into the short run. In Greece, the short-run analysis with the GARCH-X model found a positive effect for the error correction terms. Short-run deviations on the conditional variance indicate an increased deviation between food prices and macroeconomic variables is correlated with increases in food price volatility. Given the current state of the Greek economy, the problematic fiscal position of Greece serves as a dominant role in its macroeconomic environment. The study found that for Greece, "Fiscal policies seem to exert a more powerful effect on relative food prices than policies based on the monetary spectrum" (Apergis 2011). Thus we begin to see the power of a case study, the usefulness of more specific and contextual analysis.

The Pakistan case study takes a very different approach in assessing the impact and costs associated with food price shocks. In measuring caloric intakes of households, the impact of food price shocks are compared across market bases under specific contexts. Market vulnerability to food prices, climate change, and potential shocks are all

profiled by region. For food prices the context is through indicators of market integration, and price transmissions. Here the case used actual price increases from 2005/2006 and 2010/2011 across 20 commodity prices and wage rates in each providence (WFP 2011). This information and other data are imputed into a simulation model. This model "examines the impact of previous or potential shocks on household income, expenditure and food consumption" (WFP 2011). Linking crop monitoring, and market monitoring, with modules on income generation, budget allocation, and food consumption, the model measures household responses to price changes.

A Scenario was on the model, in which recent flood events in 2010 were combined to the baseline simulation developed with actual past price changes in Pakistan. Results were not surprising, "among urban livelihood groups, price increases had a larger impact on households' undernourishment than floods" (WFP 2011). The higher the income, the less the impact, "the shock impact simulation shows that a larger proportion of households of low income groups became undernourished as a result of price increases in both rural (12.5 percentage points) and urban (9.0 percentage points)" (WFP 2011). The flood shock only saw increases in undernourishment of low-income households in rural areas. The breakdown of regional markets and their vulnerability to specific shocks allow policymakers on the local level to safeguard against these impacts, and help create meaningful steps to prevent potential increases in undernourishment of specific households.

The recent price spikes held differences across regions of the globe. One case study isolates Asia, and investigates the impact of food price inflation for Asian Economies. China saw an increase in meat and poultry because of a disease in their pig supply in 2007, this exacerbated food price spikes for China. Indonesia and Thailand

experienced more rapid rates of rising cooking oil prices than other economies. Food weights are 50% of the CPI for the Philippines, making larger shares of income being allocated to food in the short-run. These are important considerations to follow up on when discussing food price increases, local factors can be overshadowed by global supply and demand fundamentals.

The study notes the importance of a credible monetary framework, as well as the power of inflationary expectations to create a secondary effect on price increases. “Based on higher ex post inflation, consumers may form higher inflation expectations for the future, and set prices and wages accordingly, generating second-round effects on price”(Cheung 2008). In observing food inflation rates outpacing general inflation rates in the Asian economies, questions arose. Analyzing the impact of these recent food price increases in relation to general inflation and further more economic growth became a priority.

Using an augmented Phillips Curve, the Asian economies' relationships between inflation and unemployment (an output gap in this case) mapped. A main point of concern for this case study became the slowdown in economic activity and its role in future inflationary pressures. The curve is estimated with inflation being a function of supply shocks and the output gap. Included in the supply shocks are: past inflation, real effective exchange rate, and changes in food prices. Theory presumes an increase in inflation will be seen in regards to a widening output gap (underemployment of an economy's resources), food price increases, and past inflation rates. An appreciation of the exchange rate is seen as a decrease to inflation. The Phillips Curve estimation brought about a one way analysis of the interactions food prices have on general inflation. They found, “ CPI would increase by almost 2.5 percentage points after one year due only to the food-price

increase in the first quarter of 2008" (Cheung 2008). This study takes food prices at face value as an element in the overall inflation.

However, they recognize the background environment in which the higher food prices took place. The persistent structural elements at work here are making prices "sticky". Of particular importance to the region is the shift in demand structure, and the inability of supply to keep up. That is in the short-run, and alarmingly even more so in the long-run when the scarcities for land and water are more prevalent. Having separated the region into newly industrialized economies, and the Association of Southeast Asian Nations (ASEAN) economies, further inferences were allowed in respect to monetary regimes, and their effectiveness in managing inflation. The ASEAN countries would have more buffers against increases in commodity prices, such as subsidies and other price controls (Cheung 2008).

Vietnam, a major food exporter did not escape the recent price spikes. Tung Phung Duc and Hermanm Waibel looked at the impact of food price increases on welfare in Vietnam. Using disaggregated production, consumption, and price data from households, they examined the impacts of food price changes on both households' welfare and behavioral responses in the short-run. Vietnam's background and demographic profile helps them to create a more accurate and specific analysis of the impact recent food price spikes had on the rural, and the poor sectors of Vietnam. As a net rice exporter, the world price increases would be perceived as beneficial for Vietnam. However, the study allowed for a more thorough understanding of changes on the supply side, costs of production have increased substantially.

They did find, as we have in our discussion, "the reaction of the producers on the supply side and consumer in demand side are moderately (except poor consumers)" (Duc

2009). Price movements of food items were found to be heterogeneous among Vietnamese households, as well as the food items themselves. It is their belief, that current papers are then overestimating the impact of food prices on the incomes of Vietnamese households. Equations for tracking the changes in net food incomes, as well as for changes in food consumtion develope a net benefit ratio. The equations collect the data and decipher changes in welfare due to the changes in food price. The decomposition used allows for interactions between the changes in the prices and the changes in quantities, the changes in price of self-produced food and purchsaed food can be measured, even if they are the same type of food (Duc 2009).

Their results are as we would expect, net sellers gained, while net buyers lost. The regional effects are consistent with these expectations. "On average, the welfare of the households living in rural area increased about 12.7% while urban households lost about 8.0% of their welfare due to food price increase" (Duc 2009). The impact the food price increase had on poverty was also distributed unevenly, as expected, food price increases "reduced the poverty rate in net seller group only by 3.2 percentage points while it increased the poverty rate of net buyers by 7.1 percentage point" (Duc 2009). Yet we have to report here, there were areas in which decreases in poverty were seen, which is consistent with the notion of food price increases being beneficial to farmers, the small decreases in poverty were found in two regions where poor households participated in rice production. High urban populations who import more tended to be the regions seeing the most increases in poverty rates. Perhaps this serves as a justification to country's reacting to higher world food prices with protectionist policies.

The study further examines the food price impact on welfare of these regions. In following with the debate of food prices, the Vietnam study provides some evidence for

the increases being good, on average, "the rising in food price increased the welfare of the households in Vietnam by 7.5% and it is driven by the impact of the rising in rice price" (Duc 2009). However, these findings should be looked at on a regional, perhaps even household basis rather than as a whole. Middle-income groups saw the most favorable outcomes with increases in food prices. The changes were mainly driven by consumption adjustments, and their quantity and interaction effects were smaller than their price effects. Perhsaps most importantly we see these welfare gains are not evenly distributed, "the percentage of better-off people (gained) from the rising in food price and rice price are smaller than the worseoff people (lost)" (Duc 2009). The number of poor increased, and the welfare of the poor decreased. Here in vietnam we see the good versus bate debate being realized. Gains from increases in food prices do not make for increases in development, because of the inequality of those gains.

All of these case studies seem to end with disclaimers. For example the Asian regional analysis warned readers, “based on this finding, which is necessarily crude and should be interpreted with caution, there may not be a meaningful reduction in the inflation rate without policy tightening in the region”(Cheung 2008). The dynamic nature of the data and inherent stochastic behavior of the system make modeling complex. All of the aforementioned conclusions have been supported by empirical findings. Empirical means that are in themselves imperfect, and the data collection itself opens up room for error. This brings into question our ability to capture the movements of prices in the economy, their drivers, and ultimately their impacts.

Chapter 14: Modeling Capabilities

Let's not pretend our assumptions pit us in the real world, and these multilinear regressions tell us something other than correlations. Economies encompass so many

elements, dynamic elements. This complicates our ability to analyze what's happening at any given time in an economy, let alone to make projections into the future. Economists are notorious for their guesswork. However, we are not attempting to improve our models in vain; modeling capabilities have improved since the days of Adam smith, and Malthus. Except, what are our current models capturing? We know the drivers of the recent food price spikes, are these factors being incorporated into the econometric models of today?

Models are needed not only to measure the price drivers, but also for forecasting purposes. When approaching the world food crisis, there are several angles to asses the global economic environment with. We can take a look at the price changes and their affect on the economy, all the way to the household level and measure changes in welfare. We could, like the Pakistan study use calorie intakes as a measurement of vulnerability in the agricultural system. More in line with the World Bank we can use decomposition methods to see the effects of policies on changes in domestic food prices. Looking into the methods for decomposition further, William Liefert develops a method for decomposing prices based off of the World Bank method (Liefert 2007).

Equation (1) below presents the World Bank's decomposition equation, after converting to natural logs and differentiating with respect to time:

$$\dot{P}^{d} = \dot{P}^{w} + \dot{X} + \overbrace{(1 + t^{p})}^{\cdot} \qquad (1)$$

The residual, or the nominal protection coefficient, $\overbrace{(1 + t^{p})}^{\cdot}$, measures the effect that policy has on domestic prices, $P^{d.}$. The domestic price is decomposed by attributing its changes to the changes in world prices, the real exchange rate's changes, and policy changes. Essentially, this method is useful, in determining if the nominal protection rate has changed after a policy of fixing domestic prices occurs. However, we lose out when

the decomposed price is independent of the variables we use to decompose it.

This does not necessarily imply some other method is more useful in cases where policy determines the real producer price for a country; it just means there is questionable economic sense in decomposing the real producer price in such a case. The way around this problem of transmission prevention is to make, yup you guessed it, and assumption. If it is assumed the policy change was in response to changes in the world price and the exchange rate, then the change found in domestic prices is attributed completely to those changes in the world price and the exchange rate. Yet the relevance for the decomposition comes more into play when policies allow for transmission, which is the current world trend.

Except we can immediately spot a deficiency in the World Bank's method, there are not any interactive multiplicative terms in equation (1). The attributions to changes in the domestic price will be incorrectly allocated as being apart of policy affects, caught in the residual. The assumption is made that these multiplicative terms are small enough to be neglected. Thus the interaction they have on each other, while simultaneously changing is assumed to be negligible. Liefert further denotes the World Bank method to be amiss simply from its lack of information.

His revised method allows for more information to be included in the decomposition process. The World Bank's method limits us to direct price effects and policy effects, however there are plenty of other variables to attribute price changes to. That much is evident from our earlier discussions. Poor infrastructures affect the market in costly ways. Transportation costs can be rather high, with insufficient supply chains to deliver a product to market. Isolation may not allow for the flow of price information to reach a producer, thus they are merely unaware of the value of their products. Weak

infrastructures are open to delayed payments, corruption, due to “localized market power by processors and distributors” (Liefert 2007), making the real value of their payments decrease as the time passes with inflation. Poor infrastructures result in incomplete transmission of exchange rate changes or world price changes on the domestic price.

Liefert's method takes these shortfalls into account, and has provided a revised method. Equation (2) displays this revised version of the World Bank's decomposition method:

$$\dot{P}^{d} = \underbrace{\frac{P^{w}X\,\dot{\overbrace{P^{w}X}}}{P^{w}X\,(1+t)}}_{\text{C}} + \underbrace{\frac{P^{w}X\,t\,\dot{\overbrace{P^{w}X\,t}}}{P^{w}X\,(1+t)}}_{\text{D}} - \underbrace{\frac{k\,P^{w}X\,\dot{\overbrace{P^{w}X}}}{P^{w}X\,(1+t)}}_{\text{E}} - \underbrace{\frac{k\,P^{w}X\,t\,\dot{\overbrace{P^{w}X\,t}}}{P^{w}X\,(1+t)}}_{\text{F}} \qquad (2)$$

It's advantage lies in its ability to “allow one to isolate and measure the direct price effect, policy effects (both explicit and implicit), and incomplete transmission effect on P^{d},” (Liefert 2007).Looking at equation 2, t represents a tariff rate. Term C captures the changes in the domestic price, P^{d} as a result of the price effect occurring from the changes in the world price and real exchange rates. D measures the changes from explicit and implicit policy effects, and in terms E and F, measure the change in the domestic price resulting from incomplete transmission. Altogether the revised method captures affects on the domestic price as a result from changes in the world price or exchange rate combined with incomplete transmission; noting the policy actions may have less to do with the price change than the deficient market infrastructure (Liefert 2007).

Even so the decompositions mentioned do not seem to be able to provide adequate projections or even hold much information on an economy. We should move into methods in which we are housing data in matrices with vectors interacting rather than limiting ourselves to the assumptions of a small country with limited market power as the

revised World Bank method does. Before jumping to a full scale stochastic dynamic programmed model it is useful to mention measures of volatility and shocks.

Techniques available for measuring volatility include: ARIMA modeling, VAR Models (Vector Autoregression), Vector Error-Correction Models, and exponential smoothing. These models allow for a better analysis of shocks to the system and projections into the future than the aforementioned decomposition methods. Forecasting food prices becomes of the utmost importance when we see the effect of food policy reforms on economies resulting in hunger. It is not the job of this paper to describe or inform readers as to the workings of Vector Autoregressions, and their subsequent impulse response functions that result. However, in mentioning the capabilities of modeling in assessing food price increases we will discuss their capabilities and shortfalls, but under a presumption of minimal familiarity with the topic.

There are a few advantages to using VAR models, they are a simple way of forecasting. Arguably, they are fairly accurate for how simple they are. They are easily programmed, often have a small amount of variables, and are thus updated quickly. Possibly seen as a disadvantage, they do not have to estimate as many parameters as larger models. Not enough information or expertise is not a problem; VAR models just avoid this altogether. Of course if you are operating outside of the pure form and require subjective add factors, then you lose this avoidance convenience. Two disadvantages are the multicollinearity when dealing with lagged values of time series data, and the inability to reflect relationships well when the number of variables is increased. Perhaps not the most effective form of forecasting, but sometimes the quick, easy, cheaper way is just as good if not better than the large model expensive, and time consuming methods (Schlegel 2011).

From a methodological point of view, both partial and general equilibrium models can be used to assess the impact of an increase in prices on households. Thus we should expand away from measures of volatility and measures of price decomposition and stretch further into what we are really after, the effect these changes in price will have on well being, and the future implications these price drivers will have in terms of costs and continued price spikes. AGLINK/COSIMO, IMPACT, FAPRI, and FASOM present as useful partial equilibrium models. The OECD made projections on the impacts of 2006 biofuel policy targets. Their studies used the AGLINK and COSIMO models in several countries, finding a 2% price increase for oilseeds, but a near 60% increase in sugar prices by 2014. Msangi et al. Used the IMPACT model to simulate the impact of biofuels on regional food prices. In a scenario depicting rapid global growth in biofuel production, operating with current conversion technologies, results showed 30-76% increases in major crop's prices by 2020. Meanwhile, malnutrition in Sub Saharan Africa was significantly large (Msangi 2007).

With partial models we are missing a big part of the picture, resources are finite. Such a strong theme throughout this paper, land, labor, and capital are constrained in the real world. Households have budget constraints, hence the whole premise of world hunger occurring. People are unable to gain access to food. These finite limitations are overcome by moving to a general equilibrium approach, or a Computable General Equilibrium (CGE). Here we can use real world economic data put into Walrasian's theoretical framework, to reach equilibrium levels of supply, demand, and prices. Applications of CGEs spun out from finance and trade into the new frontiers of energy and biofuel policies. Impacts of green house gas policies are among the capable realms of analysis. Recent biofuel studies used CGEs: USAGE, LINKAGE, and GTAP

Hertel 2002

The models above begin to branch out into models that account for climate change. The DICE-2010 model (Dynamic Integrated Climate-Economy Model) incorporates climate change under neoclassical growth theory constructs. Refraining from consumption today is done only to increase consumption tomorrow. A term for "natural capital" is introduced, in which pollution emissions are a negative to the account. The model itself is comprised of a global aggregation of countries' output, capital stock, gas emissions, and technology. There exists a world social welfare function outlining preferences. Consumption is tied to population, making consumption increases larger than population increases a negative. Two normative parameters, "the pure rate of time preference and the elasticity of the marginal utility of consumption" (Nordhaus 2010) allocate the importance of a generation. Together these parameters set the discount rate for goods, which we know to be a critical element in inter-temporal economic choices. However, these parameters need set to be consistent with economic outcomes.

The model allows for economic and geophysical constraints. Decision variables include: overall savings rate for physical capital, and a GHG emissions control rate. A single commodity is used for either consumption or investment. The model encourages consumption to "be viewed broadly to include not only food and shelter but also non-market environmental amenities and services" (Nordous 2010). Technology and population growth are exogenous and region specific. Capital accumulation is found through optimizing consumption flows over time. Using purchasing power parity exchange rates the regional outputs and capital stocks are aggregated. Output itself is determined via a Cobb-Douglas production function that involves not just labor and capital but also energy. Energy is classified as either carbon-based or non-carbon based.

The advantage of this DICE model is it's incorporation of geophysical relationships within the economy. A few of these relationships are: “the carbon cycle, a radiative forcing equation, climate-change equations, and a climate-damage relationship” (Nordous 2010). Computations for the model use the CONOPT solver in GAMS, based on the GRG (generalized reduced gradient) algorithm. With 1263 equations and 1381 variables the model finds a global optimum. The RICE model is the regional breakdown of the DICE model. The model even includes a sea level rising damage function. This model is the sixth version of the DICE model, making it evident that the field is adapting to new discoveries in geophysical relationships, and making use of integrated analysis in economic modeling.

A chapter on modeling capabilities with regards to food prices is not complete without discussing the CARD-FAPRI model of world agricultural markets. This system of agricultural supply and demand curves is updated each year. The model is solved for world and some country specific, “market-clearing prices” for dairy, beef, swine, poultry, and of course major crops. They phase in changes, policies and even new special features. One feature allowing for a fertilizer module.

Yet there are some setbacks, corn is corn, the system does not model product differentiation. It also assumes that acreage responds to price, but not yields. Another pitfall, it has this annual time step where markets clear each year, as mentioned. Long-run equilibrium conditions are capable of being imposed. A similar model, GTAP allows for some product differentiation, and assumes yield and acres are responsive to prices. GTAP moves from one equilibrium to another, unlike the yearly time step of FAPRI. Perhaps the most important difference, GTAP is run by many countries (US included), while the CARD/FAPRI can only be run by the US (Babcock 2011; ISU 2011). It seems we have in

our arsenal of models some fairly capable tools for capturing the impacts of changes within the economy.

Modeling may not be able to pinpoint the exact percentages of food price increases and allocate them accordingly to the mixed bag of factors that came into play across this past decade. However, we have elaborate dynamic models complete with GHG emissions, sea level rises, land uses and fertilizer uses; it appears price decomposition of recent price spikes would be capable given these tools. It becomes of great concern here to stress the quality of the data. The models can be better than ever before, without quality data the results are worthless. Thus we are improving in all manners. Stakeholders have information available for them, but often the results of a scenario in a data do not hold as much weight as a lobbyist. There remains imperfections in the market, ones the models are incapable of including. Uncertainty continues to haunt out will to predict the future.

Chapter 15: Conclusion

Many misconceptions surround the recent price spikes, and food security in general for that matter. It is a result of the mechanistic world view adopted via short-run economic profit driven societies. The state of the world is our doing. Tv shows are capitalizing on our lack of self control when it comes to consumption. “Terra Nova” a recently debuted television series depicts a family in the future being penalized for having a third child. Everywhere someone travels they wear an air filter mask; the smog has taken over the skies. The sight of an orange is rare and children have never seen stars. A reality we are headed towards in our current state. Saying this at the risk of being labeled a naysayer, overcrowding is an existential problem. The stress on our environment is perhaps more of an issue than the sheer numbers of people.

If you would much rather live in bliss and continue on in your current state of consumption, this paper may have been difficult for you to swallow. I would be impressed if you could walk away from the rest of this conclusion without an era of depression and desperation. Materialistic consumption hungry societies are eating away at natural resources. It's a good thing the developing world is not like the US, we would need four planets the size of Earth to feed this consumption rate. The US, with less than 5 percent of the world's population consumes over 30 percent of the globe's raw materials. The exploitation of our Earth is leading towards biological and environmental collapse. Scared yet? You should be, coal, crude oil, wetlands, and arable land, all nonrenewable, we are culprits in the exploitation. This leads us to evolve, find new energy sources, to reverse the effects of our exploitation.

Yet the consumption rates seem to have run away with our greed before we understood the consequences. In this I sympathize on the side of the hypocrites. How can I maintain my current lifestyle without exploiting the scarce resources? I am certain many are inclined to tune out long before reaching this point in a human destruction lecture. No one likes to hear this part, we all are responsible and have to change in order to help the planet part. Not putting myself on a pedestal here, I drove my car today, performed acts of gluttony over Thanksgiving, and used more than my fair share of hot water to shower. My consumption levels are not justified; my actions have an impact on the world's food security. Granted I am not as much of a culprit as Monsanto, Syngenta, Cargill, or Con Agra. Regardless being conscious of our environment is a step in the right direction.

Being conscious of the social, ecological, and economic environment in which we live is important for us, the human race. The recent price spikes are tribute to our changing environment. Our modeling capabilities are capturing the findings of current

literature; however there is always room for improvement. And as such matters bring up the question of quality data; the agencies in charge of data collection are imperfect. All of it, imperfect, after all we are navigating through a realm of economics incorporating virtually everything we can from human behavior to weather patterns. Of course there is going to be uncertainty in the results.

Current literature leads us to see recent food price spikes as the interaction of supply and demand fundamentals under a dynamic macroeconomic and agricultural economic environment. Our best determinations as to the magnitude of recent price spikes were presented throughout the chapters in a somewhat contradictory pattern. That is we cannot definitively go through and pick and choose which studies provide us with the most accurate quantities. One could argue this as a possibility; however the time and ambiguity involved would become much clearer upon performing the beginnings of such an action. We do know, no one factor can take the blame for the cause of the global food crisis, but "root causes have been structural adjustment, free trade, and policies extracting surplus from agriculture for industrialization, all of which have destroyed or eroded the agriculture sector of many countries" (Bello 2009). Experience here tells us we are presented with information, empirical and otherwise. With which we draw inferences from, and consequently construct a belief pattern in response to these findings.

This thesis has provided stakeholders with a readily available arsenal of current literature on the recent food price spikes. A discussion on the influential elements on food prices presented us with factors responsible for long-term upward trends in prices, as well as those unique to the recent price spikes. Specific case studies demonstrate the manners with which price decomposition and impacts of recent prices are analyzed contextually. The complexity of recent food price spikes calls into question our current modeling

capabilities. Of which we discussed and find adequacy is also specific to individual case studies, and their empirical wants. That is the modeling framework should be chosen to best fit the needs of specific works. Some models capture a wide array of dynamic data, others provide simple projections. If anything a policymaker at least knows their options. The information, and tools presented in this paper allow stakeholders to make more knowledgeable choices in response to the recent food price spikes. As well as provide a base for potential future reactions to food price increases.

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APPENDIX

A. Production Charts

FIGURE 3.8 **Wheat Area, Yield, and Production** (October 12, 2011)

Country/Region	Area (Million hectares)				Yield (Metric tons per hectare)				Production (Million metric tons)				Change in Production			
			2011/12 Proj.				2011/12 Proj.				2011/12 Proj.		From last month		From last year	
	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	MMT	Percent	MMT	Percent
World	227.31	222.47	222.63	222.37	3.01	2.91	3.05	3.06	684.40	648.16	678.12	681.20	3.08	0.45	33.04	5.10
United States	20.19	19.27	18.59	18.50	2.99	3.12	3.04	2.95	60.37	60.06	56.51	54.65	-1.86	-3.30	-5.41	-9.01
Total Foreign	207.12	203.20	204.04	203.87	3.01	2.89	3.05	3.07	624.03	588.10	621.60	626.55	4.94	0.80	38.45	6.54
China	24.29	24.32	24.40	24.40	4.74	4.74	4.80	4.80	115.12	115.18	117.00	117.00	0.00	0.00	1.82	1.58

Source: USDA (2011) Foreign Agriculture Service; PS&D online database

Country/Region	Area (Million hectares)				Yield (Metric tons per hectare)				Production (Million metric tons)				Change in Production			
			2011/12 Proj.				2011/12 Proj.				2011/12 Proj.		From last month		From last year	
	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	MMT	Percent	MMT	Percent
World	157.76	163.43	168.41	168.18	5.19	5.07	5.08	5.11	819.42	828.29	854.67	860.09	5.42	0.63	31.80	3.84
United States	32.17	32.96	34.15	33.97	10.34	9.59	9.30	9.30	332.55	316.17	317.44	315.81	-1.63	-0.51	-0.36	-0.11
Total Foreign	125.60	130.47	134.26	134.21	3.88	3.93	4.00	4.06	486.87	512.13	537.23	544.28	7.05	1.31	32.16	6.28
China	31.18	32.50	33.00	33.00	5.26	5.45	5.39	5.52	163.97	177.25	178.00	182.00	4.00	2.25	4.76	2.68

FIGURE 3.9 **Corn Area, Yield, and Production (October 12, 2011)**

Source: USDA (2011) Foreign Agriculture Service; PS&D online database

Country/Region	Area (Million hectares)				Yield (Metric tons per hectare)				Production (Million metric tons)				Change in Production			
			2011/12 Proj.				2011/12 Proj.				2011/12 Proj.		From last month		From last year	
	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	MMT	Percent	MMT	Percent
World	55.69	50.76	50.64	50.45	2.70	2.44	2.62	2.63	150.49	124.07	132.58	132.58	-0.01	-0.01	8.50	6.85
United States	1.26	1.00	0.97	0.91	3.93	3.93	3.79	3.73	4.95	3.93	3.66	3.38	-0.29	-7.84	-0.55	-13.99
Total Foreign	54.43	49.76	49.67	49.54	2.67	2.41	2.60	2.61	145.54	120.15	128.92	129.20	0.28	0.22	9.05	7.53
Russia	9.09	7.21	7.96	7.96	1.97	1.16	1.95	2.07	17.88	8.35	15.50	16.50	1.00	6.45	8.15	97.60

FIGURE 3.10 **Barley Area, Yield, and Production**

Source: USDA (2011) Foreign Agriculture Service; PS&D online database

FIGURE 3.11 Rice Area, Yield, and Production

Country/Region	Area (Million hectares)				Yield (Metric tons per hectare)				Production (Million metric tons)				Change in Production			
			2011/12 Proj.				2011/12 Proj.				2011/12 Proj.		From last month		From last year	
	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	MMT	Percent	MMT	Percent
World	156.02	157.30	160.28	160.82	4.22	4.30	4.29	4.30	440.33	451.38	458.38	461.39	3.02	0.66	10.02	2.22
United States	1.26	1.46	1.06	1.06	7.94	7.54	8.15	7.98	7.13	7.59	6.13	6.00	-0.13	-2.07	-1.60	-21.01
Total Foreign	154.77	155.83	159.22	159.76	4.19	4.27	4.26	4.27	433.20	443.78	452.25	455.40	3.14	0.70	11.61	2.62

Source: USDA (2011) Foreign Agriculture Service; PS&D online database

FIGURE 3.13 **Soybean Area, Yield, and Production**

Country/Region	Area (Million hectares)				Yield (Metric tons per hectare)				Production (Million metric tons)				Change in Production			
			2011/12 Proj.				2011/12 Proj.				2011/12 Proj.		From last month		From last year	
	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	MMT	Percent	MMT	Percent
World	102.16	102.71	104.76	104.70	2.55	2.57	2.47	2.47	260.84	264.12	258.99	258.60	-0.39	-0.15	-5.51	-2.09
United States	30.91	31.00	29.88	29.82	2.96	2.92	2.81	2.79	91.42	90.61	83.97	83.28	-0.69	-0.82	-7.33	-8.09
Total Foreign	71.25	71.71	74.88	74.88	2.38	2.42	2.34	2.34	169.42	173.51	175.02	175.32	0.30	0.17	1.81	1.04

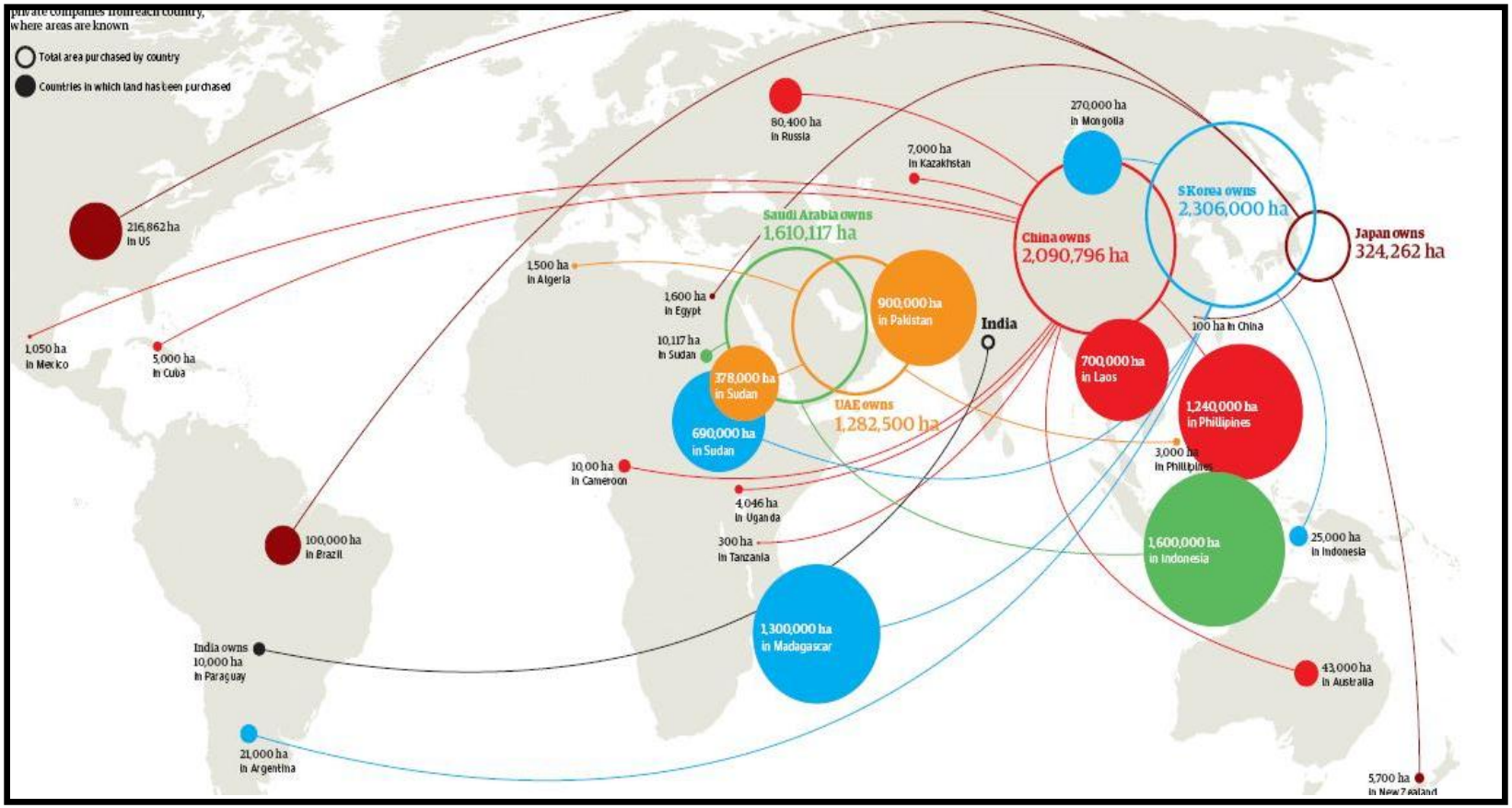
Source: USDA (2011) Foreign Agriculture Service; PS&D online database

FIGURE 3.14 **Sorghum Area, Yield, and Production**

Country/Region	Area (Million hectares)				Yield (Metric tons per hectare)				Production (Million metric tons)				Change in Production			
			2011/12 Proj.				2011/12 Proj.				2011/12 Proj.		From last month		From last year	
	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	2009/10	Prel. 2010/11	Sep	Oct	MMT	Percent	MMT	Percent
World	40.68	40.83	40.66	40.62	1.46	1.59	1.50	1.49	59.26	64.85	60.80	60.59	-0.21	-0.34	-4.26	-6.57
United States	2.23	1.95	1.78	1.79	4.35	4.51	3.49	3.45	9.73	8.77	6.20	6.19	-0.01	-0.11	-2.58	-29.41
Total Foreign	38.45	38.89	38.88	38.83	1.29	1.44	1.40	1.40	49.54	56.08	54.60	54.40	-0.20	-0.37	-1.68	-3.00

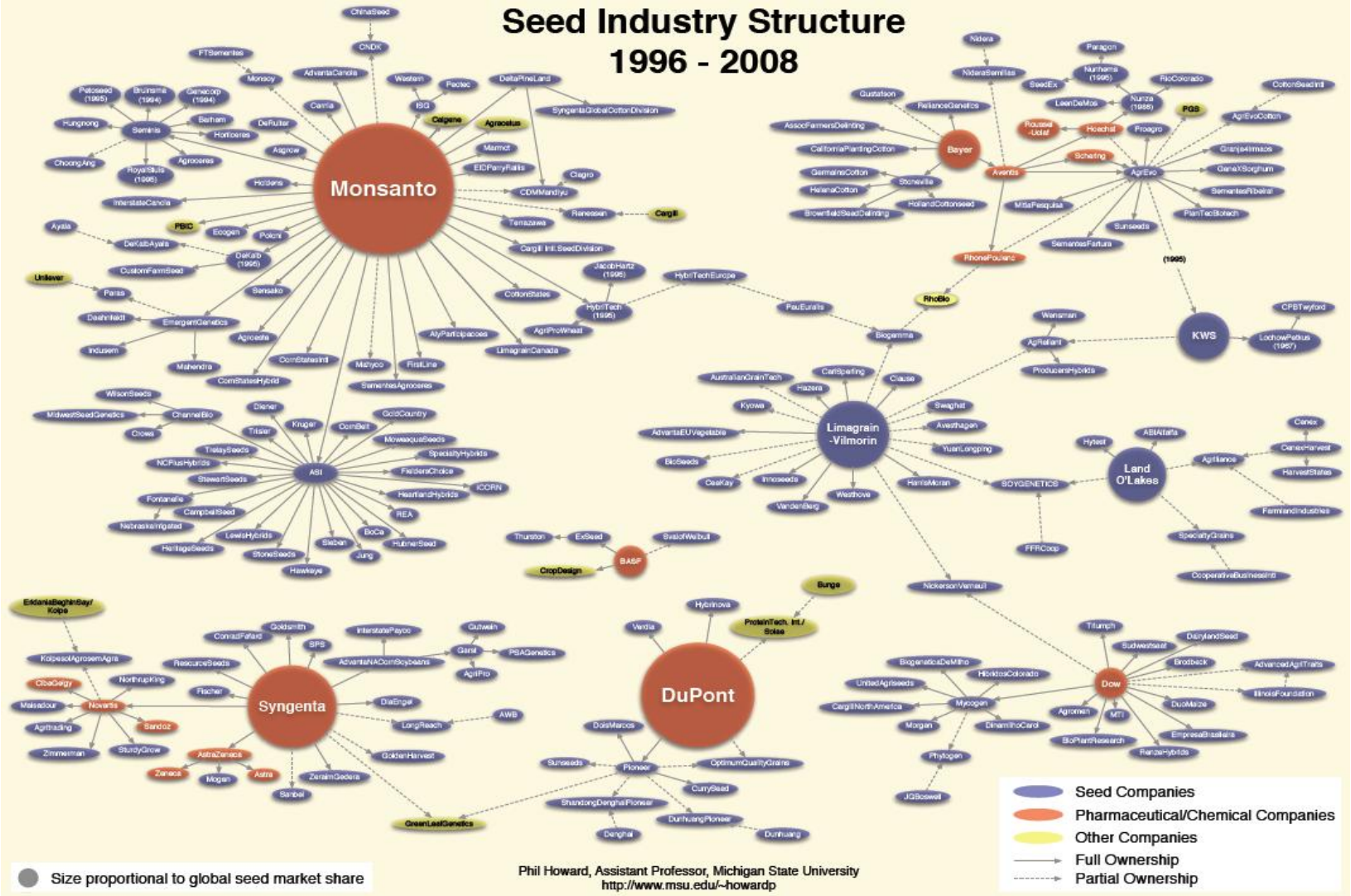
Source: USDA (2011) Foreign Agriculture Service; PS&D online database

B. Land Grab Ownership Links (2008)



Source: Edwards, Charlie."Monday's Map Returns" 2008;http://www.globaldashboard.org/tag/biofuels/

C. Seed Industry Map
http://www.naturalnews.com/files/seedindustry.pdf



D. Price Ending Stocks Data 200-2010

PRICE & ENDING STOCKS DATA, 2000-2010

PRX_IMF_Start_PricesTable, GTB-11-02, Mar-08-11

Line	Item	Units	Crop Year (Sep-Aug), with latest year = year-to-date										
			00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
	World Commodity Prices (IMF)												
1	Crude Oil (WTI & Brent Avg)	$/bbl	28	23	28	33	48	64	63	103	59	76	85
2	All Energy	index	54	44	54	64	91	118	117	191	117	140	158
3	Agricultrual Raw Materials	index	100	90	96	100	99	106	114	116	94	115	142
4	Food	index	81	80	87	100	98	106	118	160	133	139	169
5	Ocean Freight (Gulf-Asia)	$/mt	22	19	29	54	55	39	63	114	43	65	57
	World Major Crop Prices (IMF)												
6	Corn	$/mt	89	93	106	116	97	106	156	218	173	163	239
7	Soybean Meal	$/mt	187	180	195	281	199	193	225	369	350	323	373
8	Wheat	$/mt	127	129	155	158	149	178	211	357	238	197	290
9	Rice	$/mt	176	187	195	226	280	295	318	612	600	537	532
10	Sugar	cts/lb	9	6	7	7	9	15	11	12	14	20	28
11	Palm Oil	$/mt	221	314	394	455	371	388	595	972	590	745	1058
12	Cotton	cts/lb	56	42	57	69	54	58	60	74	60	81	147
	World Major Crop Ending Stocks-to-Use (USDA)												
13	Corn	pct	29	24	20	16	19	18	15	17	19	18	15
14	Soybeans	pct	20	19	23	20	24	25	28	23	20	25	23
15	Wheat	pct	36	35	28	23	25	24	21	20	26	30	27
16	Rice	pct	37	32	25	20	18	18	18	19	21	22	21
17	Sugar	pct	31	27	29	27	24	22	23	26	18	18	17
18	Cotton	pct	54	58	49	49	56	54	51	50	56	37	37
19	All Grains & Oilseeds	pct	28	26	22	18	20	19	17	17	20	22	19

Source: IMF Primary Commodity Prices, https://www.imf.org/external/np/res/commod/index.asp

USDA Foreign Agricultural Service, http://www.fas.usda.gov/psdonline/psdhome.aspx

E. Layout of Price Increase Drivers and Their Relative Importance

	Mechanism	Effects on Food Prices	2007/2008	2010/2011
SUPPLY				
Agriculture Production Changes	Mechanistic world view, industrialization and ultimately corporatization of the agricultural sector, increased social and environmental stress, increased yields, increased exposure to crop diseases, pests, and fungi.	**DECREASE**	-	-
Adverse weather conditions	Droughts, Floods, Hurricanes,	**INCREASE**	++	+++
Water Availability	depletion of nonrenewable water sources, deeper well drilling, irrigation, run-off contamination, disruption of natural water flows, corporate takeover of water supplies, access to water decreasing, water wars	**INCREASE**	+	+
Land Availability	Land Grabbing, Land Use Changes,	**INCREASE**	+	+
Climate Change	Wetland Drainage, increased adverse weather spikes,	**INCREASE**	+	+
Input Prices	Energy Intensive Agriculture: oil, fertilizer, and seed costs all increased	**INCREASE**	+	+
DEMAND				
Biofuel Production	Increased Demand, mainly for corn, and sugar.	**INCREASE**	++	+
Income Growth	Emerging economies are experiencing an income effect, shifting diets	**INCREASE**	+	+
Population Growth	increases in population growth rates across time, increased demand for all food products	**DEPENDS**	**DEPENDS**	**DEPENDS**
MACROECONOMY				
Macroeconomic Variables	Dollar Appreciation and Depreciation Effects, Terms of trade changes for countries, Inflationary expectations, money supply, public deficits	**DEPENDS**	**DEPENDS**	**DEPENDS**
Increase Speculation	Increased amount of Index Fund investment into agriculture markets	**INCREASE**	++	+
POLICIES	biofuel policies, trade policies, fiscal and monetary policies, policies of abundances, policies of shortages, WTO goals, high export tariffs, export bans	**BOTH**	+++	++
MARKET STUCTURE				
Lack of an efficient logistics systems	increased costs of distribution, poor supply chain	**INCREASE**	+	+
Weak institutions	Political environments providing instability for food prices, inflationary expectations and civil order, undermining of agricultural investments	**INCREASED VOLATILITY**	+	+
More Inelastic Supply and Demand	Supply and demand elements combined to decrease the elasticity in food markets	**STICKIER PRICES**	++	+
Global financial turmoil	Unemployment, decreased investment, lower consumption, lower economic growth rates	**INCREASED VOLATILITY**	+++	++