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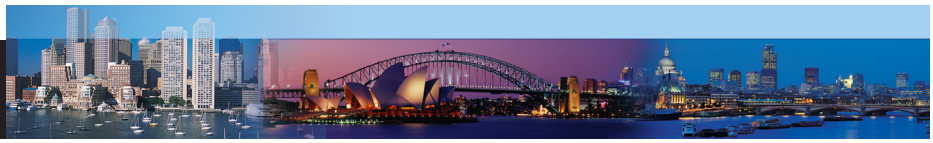
Quarterly Letter



July 2012

Welcome to Dystopia!
Entering a long-term and politically dangerous food crisis

Jeremy Grantham

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When Bad Things Happen to Cheap Assets

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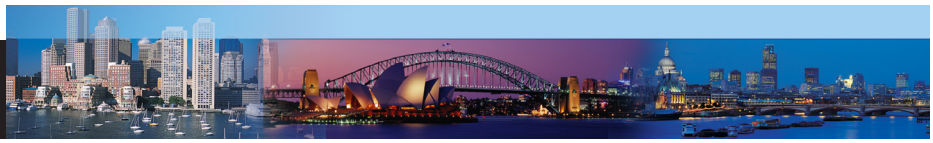
GMO

QUARTERLY LETTER



July 2012

Welcome to Dystopia![1]
Entering a long-term and politically dangerous food crisis[2]

Jeremy Grantham

"Them belly full but we hungry ...
… A hungry man is a angry man ...
… A hungry mob is a angry mob."

—Bob Marley, "Them Belly Full"

"Anyone who believes exponential growth can go on forever
in a finite world is either a madman or an economist."

—Kenneth Boulding, Economist

Summary of the Summary

We are five years into a severe global food crisis that is very unlikely to go away. It will threaten poor countries with increased malnutrition and starvation and even collapse. Resource squabbles and waves of food-induced migration will threaten global stability and global growth. This threat is badly underestimated by almost everybody and all institutions with the possible exception of some military establishments.

Summary

1. Last year we reported the data that showed that we are 10 years into a paradigm shift or phase change from falling resource prices into quite rapidly rising real prices.
2. It now appears that we are also about five years into a chronic global food crisis that is unlikely to fade for many decades, at least until the global population has considerably declined from its likely peak of over nine billion in 2050.
3. The general assumption is that we need to increase food production by 60% to 100% by 2050 to feed at least a modest sufficiency of calories to all 9 billion+ people plus to deliver much more meat to the rapidly increasing middle classes of the developing world.

1 Dystopia: a society characterized by human misery, disease, oppression, and overcrowding.

2 This report is an update and extension of "Time to Wake Up," April 2011 and "Resource Limitations 2: Separating the Dangerous from the Merely Serious," July 2011. Each is available with registration at www.gmo.com.

4. It is also widely assumed that at least the lower end of this target will be achieved. I believe that this is substantially optimistic. At very best, if we reach that level we will not be able to hold it. Much more likely, we will not come close because there are too many factors that will make growth in food output increasingly difficult where it used to be easy:

   - Grain productivity has fallen decade by decade since 1970 from 3.5% to 1.5%. Quite probably, the most efficient grain producers are approaching a "glass ceiling" where further increases in productivity per acre approach zero at the grain species' limit (just as race horses do not run materially faster now than in the 1920s). Remarkably, investment in agricultural research has steadily fallen globally, as a percent of GDP.
   - Water problems will increase to a point where gains from increased irrigation will be offset by the loss of underground water and the salination of the soil.
   - Persistent bad farming practices perpetuate land degradation, which will continue to undermine our long-term sustainable productive capacity.
   - Incremental returns from increasing fertilizer use will steadily decline on the margin for fertilizer use has increased five-fold in the last 50 years and the easy pickings are behind us.
   - There will be increased weather instability, notably floods and droughts, but also steadily increasing heat. The last three years of global weather were so bad that to draw three such years randomly would have been a remote possibility. The climate is changing.
   - The costs of fertilizer and fuel will rise rapidly.

5. Even if we could produce enough food globally to feed everyone satisfactorily, the continued steady rise in the cost of inputs will mean increasing numbers will not be able to afford the food we produce. This is a key point that is often missed.

6. On the positive side, scientists are now very optimistic that they will be able to engineer more efficient photosynthesizing "C4" genes (corn belongs to that family) into relatively inefficient but vital "C3" plants such as rice and wheat, in 20 to 30 years. If successful this would increase output up to 50% and would buy time for a less painful transition to a sustainable population.

7. Many of these increasing difficulties were reflected in the original 2008 food crisis and the 2011 rebound. The last six weeks' price rise is more threatening because it occurred despite very much larger plantings than were available in 2008. Global demand is now so high and rising so fast and reserves are so low that price sensitivity to weather setbacks has become extreme.

8. It seems likely that several countries dependent on foreign grain imports have in fact never recovered from the 2008 shock. Countries like Egypt saw the percent of their consumer budget for food rise to 40%. At this level, social pressures may be at an extreme and probably have already contributed to the Arab Spring. Any price increases from here may cause social collapse and a wave of immigration on a scale never before experienced in peacetime. Another doubling in grain prices would be catastrophic.

9. Strong countermeasures to prevent a food crisis would be effective in curtailing the current crisis and preventing the development of a much greater crisis, but these measures will likely not be taken. This is because the price signals for the rich countries are too weak – they can afford the higher price – and there is inertia in all parts of the system. Also, the problems of malnutrition in distant countries are not generally felt as high-order priorities in the richer countries.

10. If food pressures recur and are reinforced by fuel price increases, the risks of social collapse and global instability increase to a point where they probably become the major source of international confrontations. China is particularly concerned (even slightly desperate) about resource scarcity, especially food.

11. The general public, the media, the financial markets, and governments badly underestimate these risks. Only the military of some countries, including the U.S. and the U.K., seem to appreciate them appropriately.

12. Natural gas supply increases buy some time, mainly for the U.S., but seem more likely to create complacency and continued dependence on hydrocarbons. The energy situation is less pressing globally in the short term than is the food problem. Supplies are sufficient to cause merely a slow and erratic price increase. The main problem with oil is in its contribution to the food problem through higher farming costs and generally increasing cost pressures on poorer countries.

13. In the longer term, in contrast, energy costs and absolute shortage in the case of oil form a serious problem second only to food shortages and will result in prices so high that they will impact global growth and even the viability of modern, rather fragile, economies.

14. On paper, though, the energy problem can be relatively easily addressed through very large investments in renewables and smart grids. Those countries that do this will, in several decades, eventually emerge with large advantages in lower marginal costs and in energy security. Most countries including the U.S. will not muster the political will to overcome inertia, wishful thinking, and the enormous political power of the energy interests to embark on these expensive programs. They risk being left behind in competiveness.

15. Availability of metals is, in contrast, a minor problem in the next few decades. The prices will steadily rise but the consequences will be less. In the long run though, metals are the most intractable problem. There is no brain-intensive solution as there is for agriculture (i.e., organic farming), nor is there any capital-intensive or technology-intensive solution as there is for energy. We will just slowly run out and prices will rise.

16. The results of these problems will be felt mainly as price pressure in rich countries. The need to obtain adequate resources will squeeze national budgets, profit margins, and economic growth. For poor countries, though, it is literally a matter of survival.

17. We are badly designed to deal with this problem: regrettably we are not the efficient species of investment theory, but ill-informed, manipulated, full of inertia, and corruptible. Only once in a blue moon – like World War II – do we perform anywhere near our theoretical capabilities and this time the enemy is amorphous and delivers its attack very, very slowly. But the stakes globally are very high indeed. We must try harder.

18. The following comments on this topic are mine personally and reflect my Foundation's portfolio (and a total lack of career risk!). These comments are based on a time horizon of 10 years and beyond. The portfolio investment implications are that investors should expect resource stocks – those with resources in the ground – to outperform over the next several decades as real prices of the resources rise. Farming and forestry, though, are at the top of the list. Serious long-term investors should have a very substantial overweighting in a resource package. I suggest for long-term investors a resource position of at least 30%. Another relative beneficiary of resource pressure is the quality group of equities. Resources are a smaller fraction of final sales than average and higher profit margins make them more resilient to margin pressures.

19. Perhaps more importantly, the resource squeeze, coupled with other growth-reducing factors (to be discussed next quarter), is likely to reduce the return from the balance of the portfolio.

P.S. A 24-minute video of similar material from a recent interview at University of Cambridge, Programme for Sustainability Leadership, can be accessed at www.gmo.com; however, only those qualified investors with client IDs will be able to access it.

Introduction

In the 15 months since my letter on resource shortage, "Time to Wake Up," I have tried to keep up on the current details and to catch up on the historical background since the ground-breaking "Limits to Growth" was published in 1972. Disturbingly, the more research I did the worse things looked: we indeed seem to be running out of cheap resources, and everywhere – even including China – the problem is underestimated. The consequences are that we continue to squander those lower-cost resources that remain and suffer from the large, unnecessary increase in the associated output of waste, particularly CO2 – which has already begun to have significant effects on our weather stability and, hence, our ability to grow enough food. The price of corn (maize), wheat, and soy in just the last five weeks rallied 30 to 50% to reach and exceed the 2008 crisis levels, this time despite enormously increased planting. Social reaction in poor countries will not be far behind.

The New Food Crisis

Last year's letter showed that 10 years ago we entered a new era of rising resource prices after at least 100 years of steadily falling prices. It now appears that about five years ago we also entered a period of sustained food crisis for several of the poorest countries. This situation seems likely to continue for the indefinite future. If it does, it will cause the social structure of several countries to break down, resulting in waves of immigration on a scale unknown in modern times, outside of major wars. In the drive for resources, particularly food but also energy, country relationships are also likely to be destabilized, causing risks to global security. China, more concerned with future resource security than others, will find it particularly tempting to throw its increasing economic and military weight around. This risk also seems to be ignored or underestimated by national governments, although the military arms of several, including the U.S., seem to be exceptions. Not needing to be re-elected, military leaders have far longer time horizons than other branches of government and can afford to pay attention to both the long-term consequences of resource shortages – particularly food and water – as well as the growing effects of increasing temperatures and weather instability on the long-term security and well-being of their countries.

The vulnerabilities from food pressure can be easily demonstrated and are already beginning to play out beneath our noses. In developed countries, food accounts for only 10 or 12% of our total budget. For several poorer countries though, including Egypt, food costs have risen to 40% and above of their total expenditures following the surge in global grain prices since 2002. (Wheat is the critical source of calories in Egypt and the rest of North Africa and much of their wheat is imported so they are directly exposed to global price moves.) Global grain prices almost tripled in the last 10 years. If they were to double in the next 20 years it would be painful indeed even for rich countries, but simple arithmetic will show you how impossible the situation becomes for those poorer countries that start out with a 40% share of food in their budget. It is not even clear that the existing 40% share can be easily tolerated: grain prices are thought to have already played a substantial role in the Arab Spring, particularly in Egypt. Any material increases in real grain prices from here on are unlikely to be easily manageable.

Egypt heads into food trouble

Why focus on Egypt? Because it is treated as a more or less serious country by the U.S. for geopolitical reasons whereas Somalia or Sudan, for example, can be easily ignored and are. Egypt was home to three million people when Napoleon invaded in 1800. Today it crowds 84 million into the limited arable land around the River Nile! Its population age profile and its current family planning practices (which are not particularly bad, merely not particularly good) more or less guarantee that by 2050 the population will swell to a staggering 140 million! Today they feed about 55 million of their people with their own food (with the benefit of several doubts). By 2050, if they behave very sensibly and if their society stays reasonably stable, they might optimistically move this number up to 80 million. But today they already run a $25 billion trade deficit, basically importing food, critically, wheat. With their recent meetings with the IMF and a little help from their friends, no doubt they will finesse this recent year. But as the population grows so will their trade deficit. Who will pay for their increasing need for imported food as the years go by? I believe the short answer is no one. To survive in one piece, let alone thrive, they need inspired sustainable

agriculture – it is already very productive by normal standards – and a shift in their fertility rate. They do not appear to have the time to wait for the typical reduction in fertility caused by advancing wealth. In the short term the only possible ace up their sleeve may be undeveloped conventional oil and gas, which might, if developed rapidly, be used to buy them, say, a decade or two of time. If you realize that several countries are in this position and quite a few are worse off, then you realize how perilously thin the veneer of global stability is. The global food crisis is not just a prospect for the distant future, it seems to be well on its way already and better weather in the future would seem unlikely to buy it more than a year or two of reprieve. Food scarcity is the product of many sub factors, each complex issues on their own. Let's update since last year and expand a little on several of them.

Water shortages

Water constraints are worse than I thought a year ago. Squabbles or even wars over the division of rivers that flow through different countries seem more likely: Ethiopia, Sudan, and Egypt over the Nile; China and India, Pakistan, Bangladesh, Cambodia, and practically all of South East Asia over the flow of Himalayan rivers. Over pumping is also a bigger problem than I represented. About 300 million Chinese and Indians (125 and 175 million, respectively) among many others are fed through the use of declining aquifers. When entirely depleted, these perhaps then half a billion people will be thrown back onto already overstressed surface water. As with some other resource problems, there is an easy enough solution – desalination. And as with other easy solutions, it comes with a dreadful drawback – ultra high cost. (Singapore, ahead of the curve as usual, has addressed its critical water problem correctly: by pricing all of its water at the cost of the next marginal liter. Uniquely, their next liter of water is from desalination plants, so they are paying many multiples of the water price that is paid by the rest of the world, drowning as it is in subsidies. Even then, despite their Draconian policy with locally generated water, Singapore still benefits from the hugely underpriced water used to produce the majority of their food, which is imported. And Singapore is not representative of our problems with water in one very important way. They are now just about the richest people around with incomes per capita of more than $50,000 U.S.!) That changes from the old normal climate patterns exacerbate water problems seem to be revealed by the week: unpredictable monsoons (that as this year are sometimes weaker), less snow cover to run off in the spring, and unnervingly common severe droughts that we must hope are at least partly non-recurring.

Erosion

Erosion, at least, is as I thought: it can be remedied through massive adoption of no-till agriculture, but with a starting point currently at under 10% globally, can it be adopted rapidly enough (say, in 40 years) to prevent further critical loss of arable land, every inch of which will be needed? With current unchanged practices and with 1% loss of soil per year the math at least is quite simple: we run through all of our soils in 100 years and starve.

Potential fertilizer crisis and possible organic solution

The risk of phosphate and potash fertilizer running out is the one area in our report of last year that has improved. This is fortunate for you will remember, I hope, how intimidating was the story told then: potassium (potash) and phosphorus (phosphate) are necessary for the growth of all living matter; they cannot be made or substituted for and are mined and depleted. This recitation still gives me goose bumps! But the good news is that there are at least the substantial reserves we showed a year ago and it is likely that there is considerably more. Thus, even with our current prodigal ways, we have 100 years or more to see the light. More importantly there is a very good chance that existing reserves can be greatly stretched out by the adoption of organic farming, which, when done well, can reduce the need for extra doses of potash and phosphates to a very small fraction of that used in current "Big Ag." Perhaps at its very best, say at least some soil experts, organic farming could totally remove the problem. If true, this would be very good news for if current practices continue, even if it took us 200 years, we would simply run through the onshore reserves and, as with erosion, end up very badly off indeed. Although, with phosphorus and potassium at least, the very rich at that point could retrieve them from the ocean and the ocean bed. My hope – and actually my belief – is that as fertilizer prices rise in the longer term (and they could certainly fall considerably in the short term) we would

be forced to be more resourceful and open-minded about organic farming and then would never need the last resort of ocean-based recovery.

Some pros and cons of organic farming

We have talked before about the essence of organic farming. It is the nurturing of the soil's complexity in microorganisms, insect life, worms, and nutrients without the use of chemical insecticides and pesticides, which have the effect of sterilizing all of the above, leaving just dirt, which is then completely dependent on the new application of all three major fertilizers each year, especially the energy-intensive nitrogen. We have spent considerable time trying to determine the possible reduction in output in the short and intermediate term that you might get from moving to organic farming. The majority opinion (I am not arguing for this as a way of settling research issues, merely passing on facts and opinions) is that immediate output of grains and soy would be reduced by 20 to 30% by moving to fully organic farming. The higher range is applied to irrigated land and the lower range to rain-fed land because organic soil retains more moisture and holds up better as conditions get drier – a very useful trait these days. In a long-term war of attrition, though, because organic soil holds up in quality and even improves, and because it resists erosion better than standard farming, the equation shifts and in several decades may close much or all of the gap, given the starting assumptions.

But to make matters more complicated, some researchers in organic farming[3] believe that when organic farming is done well – fine-tuned by both trial and error and scientific research – it can (and has in their 20+ year tests) reach parity with current standard-practice farming. Because the use of increasingly expensive fertilizers in particular is much reduced with organic practices, such farming can be equally profitable also, even without the considerable premium now paid for the modest quantities of organic grain produced. But the key weakness in this argument is the brain intensity required of this kind of farming: it has to be fine-tuned for each crop and each type of soil and there is a skimpy body of existing knowledge, available advice, experienced practitioners, or even good training programs. To compare the best organic farming with ordinary conventional farming is obviously an unfair comparison. And how would you persuade the typical farmer, a 60-year-old, to adopt a much more complex system that is therefore riskier at least initially and harder to insure? The bad news is that to gear up for 100% organic farming is a herculean task that will take decades of effort, including government participation and considerable research. The worse news is that this is a task for which there is absolutely no alternative in the long run for the status quo will guarantee that we will run out of potash and phosphorus as mentioned earlier and eventually come to a very bad end. The good news, though, is that this vital job can without doubt be done and when done would guarantee for the first time a sustainable basis of food production.

The Moroccan quandary: a sting in the fertilizer tail

On the topic of phosphate reserves, last year I mentioned another snag with long-term availability – the extreme concentration of resources in Morocco. Follow-up research confirms that given currently known reserves, as much as 70% of all high-quality, low-cost reserves are in their hands, a number far in excess of the whole of OPEC collectively for oil. (The best dream of the Saudi oil minister is that they would be in that position rather than having so many obstreperous colleagues to deal with.) So, yes, we may have up to 200 years of phosphate reserves even if we continue in our present ultra-wasteful ways. But if we do so, Morocco, already increasingly considered to be the price setter, will have in a relatively few decades the most important quasi-monopoly in the history of man! We should at the very least be very prepared, I believe, for a steady rise in the price of phosphates, and how that will steadily shift the cost benefits toward the more frugal organic farming.

Grain productivity gains slow

A year ago I mentioned the declining rate of increases in yearly productivity per acre for grains. It had fallen from an astonishing 3.5% a year in the Green Revolution, say, 1970, to a still considerable 1.5% in 2010. This rate of increase, I pointed out, was disturbingly close to the same as the growth in global population. The good news here,

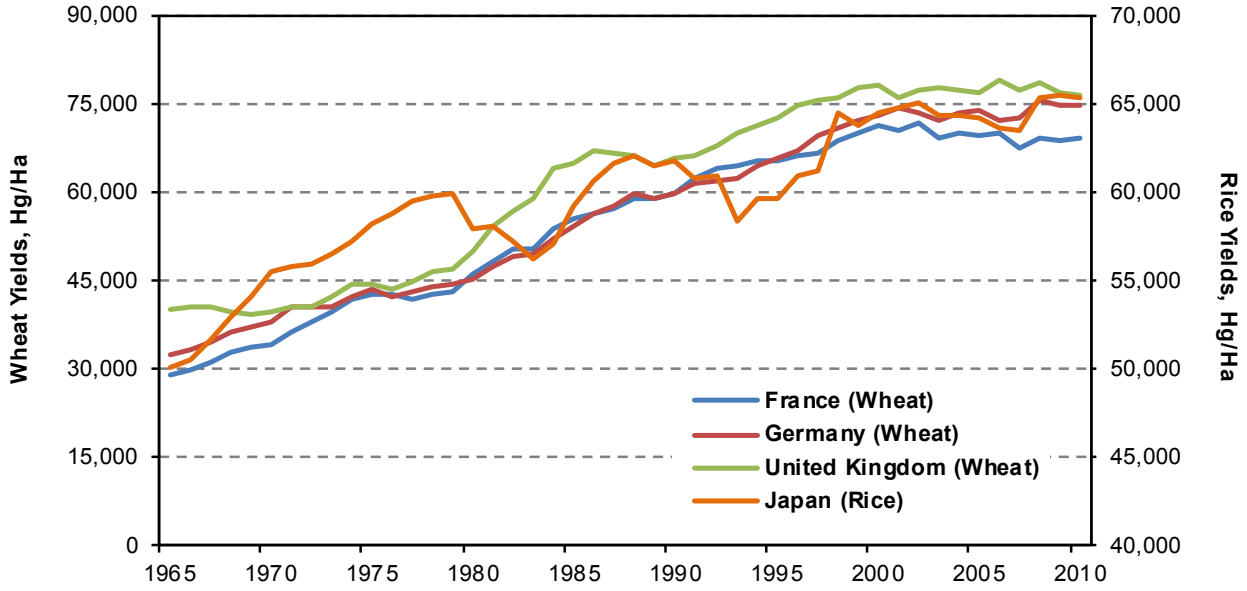
[3] Rodale Institute.

as we update, is the near certainty that population growth will continue to slow. Indeed, the number of new babies born each year has already leveled off and the global population continues to grow only because earlier cohorts of babies who are now, say, 60-year-olds, were much smaller than more recent ones. This is not because they have died off, but primarily because they had never been born. As the new, larger but now stable cohorts of babies grow old, in 80 years the population approaches a peak of 9 to 10 billion (in 2090). There is also a good probability that fertility (reproduction rate) will continue to decline beyond the current stabilization and that the number of births will start to decline (even without possible help from chronic food scarcity). And it had better do so, for currently we are well beyond the long-term carrying capacity of our planet. The bad news is first that the increases in grain productivity are also likely to decline, and second that as the very rapidly increasing middle class of the developing world continues to demand more meat – one pound of dressed beef currently replaces 30 pounds of grain! – the safety margin between potential supply and future demand would disappear. Indeed, it may have disappeared already.

Glass ceiling

In grain productivity there is an unexpected problem known as the "glass ceiling." Each species has a theoretical limit. A real life example is that of race horses, bred for over 5,000 years for speed – nothing was more macho for a chief than a fast horse! Well, horses have apparently reached a ceiling. Despite the ingenuity and expenditures of horse breeders, horses do not run measurably or dependably faster today than they did in the 1920s. They break more legs trying and they get more chemical encouragement, but they just can't run any faster. Disturbingly, there are signs that this may be happening with grains. Not surprisingly, you would look for this glass ceiling – it is called this because you can't see it coming until you get there – amongst the farmers who have the greatest output per acre. Exhibit 1 shows the yield per acre for wheat in England, France, and Germany and the yield for rice in Japan. These top-producing countries for the two most important cereals for direct human consumption have failed in the last 10 or more years to increase productivity. This puts the burden of major increased production on the poorer producers, and there is indeed on paper much more room for improvement. It is important to remember, though, that many of these under-producing acres have been suboptimal more or less forever. If it were easy to correct, it would have been corrected. Yet capitalism has some great virtues: one of them is that high price is probably the best teacher of all.

Exhibit 1
Crop Yields (5-year moving average)
Wheat – France, Germany, United Kingdom; Rice – Japan



Source: UN Food and Agriculture Organization As of 12/31/10

Diminishing returns from increasing fertilizer use

Commercial fertilizer use has increased globally by five times since 1960 and, remarkably, by over 50 times in China! It was the major reason for the Green Revolution: first, selecting seeds that could utilize more inputs of fertilizers and turn them into more plant growth, and second, providing them with the extra fertilizer. But beyond a certain point more fertilizer does not improve returns. It does, on the other hand, do increasing environmental damage, mainly by over fertilizing waterways and helping to create dead zones near river mouths. There are still big areas, particularly in Africa, that could process more fertilizer, but in general they are already priced out of the fertilizer market. The net result is that we are deep into diminishing returns with fertilizer and can hope for only modest and decreasing help from this source in the future for increasing the productivity of grain.

The negative effect of climate change on grain production

I used to think that "climate change" was a weak, evasive version of "global warming" but not anymore, for weather extremes – drought, floods, and bursts of extreme heat – have turned out to be more devastating for food production than the steady rise in average global temperatures. Droughts and floods were off-the-scale awful three growing seasons ago, and I forecasted some improvement. But with impossibly low odds – based on the previous weather distribution pattern – severe weather events kept going for two more growing seasons. Just as with resource prices, detailed last year, when the odds get into the scores of thousands to one, it is usually because the old model is broken. So in the resource case, the old model of declining resource prices was broken and a new, very different era had begun. Similarly, the odds of three such disastrous years together are just too high to be easily believed and the much safer assumption is that the old weather model is broken and a new era of rising temperature and more severe droughts and floods is upon us. All-time heat records in cities across the world are falling like flies and the months of March through May this year were the hottest in U.S. history. As with the equally unpleasant fact of rising resource prices, this new, less desirable climate has to be accepted and adjusted to. Once again, the faster we do it, the better off we will be. Several industries like insurance are already deep into the study of the new consequences. Farming must also adjust, and not just to the rising prices. With skill, research, and, above all, trial and error, farmers will adjust the type of crop and the type of corn seed they use to the changing weather. And I have no doubt that they will mitigate some of the worst effects of increased droughts and floods. But the worst shock lies out quite far in the future: grains have developed over many thousands of years in an unusually moderate and stable climate (moderate, that is, over a scale of hundreds of thousands of years); and selective breeding of the last few hundred years also was done in that moderate environment. Grains simply do not like very high temperatures. By the end of the century, the expected rise in temperature globally is projected by the IPCC to reduce the productivity of grain in traditional areas by 20% to 40% – numbers so high that the heart sinks given the other problems. Yes, northern climates will benefit (so Canada once again looks like a good ally) but more world-class grain land will be lost than is gained. And do not for a second think that the scientists can be dismissed as exaggerators in the pay of evil foundations as right-wing think tanks would have you believe. The record so far has been one of timid underestimation. Much the majority of scientists hate being in the limelight and live in dread of the accusation of the taint of exaggeration, so severe a crime in the academic world that it is second only to faking data. What the timid scientists forget (this is all driven by career risk just as with institutional investing) is that in this unique case it is underestimating that is dangerous! To put the science clearly in the public domain – a task so far totally failed at – is left to a brave handful of scientists willing to be outspoken.

Talk privately to scientists involved in climate research and you find that they believe that almost everything is worse than they feared and accelerating dangerously. A clear example is in the melting of the Northern ice, now down in late summer by 30% from its recent 30-year average to 2005. It is at a level today (and last month was the least ice cover of any June ever) that was forecast 15 years ago for 2050! Dozens of ships last year made commercial voyages across the Northern waters where none had ever gone before 2008. A dangerously reinforcing cycle is at work: the dark ocean absorbs heat where ice reflects it, so the water warms and more ice melts. Other potentially more dangerous loops might also start: the Tundra contains vast methane reserves and methane acts like supercharged CO2. It warms the air and more Tundra melts and so on. For agriculture, which is very sensitive indeed to temperature shifts, it has

become a very dangerous world. There is now no safety margin to absorb unexpected hits as we are seeing in the global crisis playing out in the Midwest today.

The one piece of hopeful news for food

Over millions of years, an increasing minority of grass species – now up to 43% – have made a mutating jump into much greater efficiency in processing nitrogen, water, and the sun's energy. The majority of grasses are relatively inefficient photosynthesizers and belong to the family botanists known as C3. This group unfortunately includes rice and wheat, the two most important grains for human consumption. The smaller family that has made the jump, known as C4, luckily includes corn (maize) and sugar cane. Among other things, this means that under their present genetic circumstances, however hard you try to grow wheat and rice you will never get more than about half of the output of corn.

Up until now, genetic engineering of grains has shown little or no increases in actual yield, despite success in changing other seed characteristics. Nevertheless the "Holy Grail" of seed engineering, according to the Millennium Seed Bank of Kew Gardens, is to engineer efficient C4 genes into inefficient C3 grasses. This, it is thought, could increase productivity of wheat and other C3 plants by up to 50%! The work is apparently going well and has been described as "simply engineering" by involved scientists, without, I hope, too much hubris. They believe it will be done in less than 20 years. Even if it is done in 30 or 40 years, it would be that rare bird – a game changer. Hundreds of millions more could be fed, buying time for a more graceful population decline than is currently likely.

Food prospects for 2050

The literature on this topic agrees that a very large increase in global food production is "needed" by 2050. The two most commonly used numbers in the last several years (almost clichés) are that we either need to double food production or to increase it by 70% by 2050 to keep up with expected demand. Recently, U.N. sources have estimated that we are likely to be able to increase food supply by 60%.

Given the long litany of farming problems, it will come as no surprise that I believe that even the lower U.N. forecast is highly unlikely to be met and that the higher numbers are complete pie in the sky. Yes, a 60% increase is necessary to meet the realistically forecast 30% increase in population to 9 billion+ together with the anticipated increase in meat consumption. But given all of the difficulties already described, it is just not going to happen**,** at least on any sustained basis. (I know statements like this love to come back and haunt people but on this one I look forward to an unhaunted life, and afterlife, for that matter.) The increasing demand from a growing population will be there in 2050, although it is far from certain that it will be the full 9 billion+ if some large poorer countries begin to unravel. But this is where Mr. Market intrudes: long before an extra 60% in food supply is reached, rising prices will have made food too expensive for hundreds of millions. To balance the books, a series of serious (but still doable) steps must occur. First, the entire world must consume less meat than is assumed in the estimate of a doubling. Sensible governments will encourage it: poor countries to reduce increasingly expensive grain and soy imports and rich countries to contain the epidemic of obesity that is sweeping outwards from the U.S. and threatening the long-term health costs of each country that catches it. (If any issue needs a "nanny state" feature this is it!) With an aging population, a wave of extra health costs would be likely to break several national budgets. Second, food wastage runs – from farm to stomachs – at a shocking one-third globally. (Some sources claim the number is considerably higher.) This waste must be much reduced if we mean to have any chance at all of muddling through to 2050. Third, major food-producing countries will have to be more serious about investing more in sustainable production with increased investments in irrigation, farm education, and research. Taking serious steps to lower the longer-term costs of fuel and, of course, protecting against continued deterioration in the climate will also be vital. But the main contributor to reducing the food imbalance between supply and demand is once again likely to be price: more of the poor will eat less and some, regrettably, will eat nothing.

To deal with food and other resource problems, developed countries could respond early and decisively to economize on use and improve efficiency. There will no doubt be a little of this, but the price signal is still quite faint for

the affluent countries. We have enormous inertia. We are in general badly led on this issue – only Scandinavian countries and China might get even a passing grade. And we in the U.S. are constantly told that all will be just fine. So our collective under-response to these developing problems will cause unnecessarily sharp rises in the prices of resources, particularly food. Unintentionally, but thoughtlessly, we will cause and already are causing, unnecessary malnourishment and starvation in the poorer countries, which is only bound to get worse.

Of course they – the poorer countries – should respond with much increased urgency. Population growth in particular could be more actively discouraged. Educating women and making family planning available have worked well in some countries. Yet there are still 80 million unwanted conceptions a year, often in those very countries whose food future is most perilous. But will many of these countries respond vigorously within the time scale of the problem? As food and energy conditions worsen, they seriously weaken the remainder of the economy and the ability of government and society to respond. Finally, as states fail, they lose all hope for determined action.

Fortress North America

For Fortress North America (ex-Mexico), or what we might call Canamerica, these problems are relatively remote. When corn crops fail we worry about farmers' income, not about starvation. In the long run, the truth is that Canamerica seen as a unit is in an almost unimaginably superior position to the average of the rest of our planet. Per capita, the U.S. alone has five times the surface water and seven times the arable land of China! And Canada has even more. We are very large exporters of food. Canada, our very, very good friends (please!) has huge deposits of potash and the U.S. has a respectable amount of phosphate, although that probably is our weakest link. (Ironically, perhaps, we have been exporting this relatively limited resource as fast as foreigners demand it and the second largest mine just closed in Florida, reserves exhausted, the month before last.) It is hard when dealing with this kind of problem, which is a tragedy of the global commons if you will, to get the winners to worry too much about the losers. And we, the rich countries, do not worry and probably will not as far as the eye can see, for such a broad recognition of the problem would require a profound cultural and ethical change. A perfect symbol of our carefree and careless attitude is in our policy toward corn-based ethanol. It is an indirect, back-door subsidy (disguised as a mandated requirement) for farmers who today, with much higher crop prices, are already relatively well-off compared to normal. Despite corn being almost ludicrously inefficient as an ethanol input compared to sugar cane and scores of other plants, 40% of our corn crop – the most important one for global exports – is diverted away from food uses. If one single tankful of pure ethanol were put into an SUV (yes, I know it's a mix in the U.S., but humor me) it displaces enough food calories to feed one Indian farmer for one year! To persist in such folly if malnutrition increases, as I think it will, would be, to be polite, ungenerous: it pushes the price of corn away from affordability in poorer countries and, through substitution, it raises all grain prices. (The global corn and wheat prices have jumped over 40% in just two months.) Our ethanol policy is becoming the moral equivalent of shooting some poor Indian farmers. Death just comes more slowly and painfully.

Once again, why single out Indian farmers? Because it was reported last month in Bloomberg that the caloric intake of the average Indian farmer had dropped from a high of 2,266 a day in 1973 to 2,020 last year according to their National Sample Survey Office. And for city dwellers the average had dropped from approximately 2,100 to 1,900. It was also reported[4] that per capita consumption of food grains had fallen from 177kg in the early 1990s to 153kg in 2004 (about 1934 levels!). These are not drops you would want to repeat in the next 30 years if you wanted a good day's work! And, perversely, these declines occurred while the official average income of urban dwellers more than doubled. Apparently a free hut in the country became an expensive hut in town for the migrant. Now he has to pay for cooking fuel and transportation to work. And he has to buy food, expensively shipped in from the country, with incredible "only in India" quantities of wastage, and too many middle men and, bingo, he is twice as rich as measured by GDP but cannot afford to buy sufficient food. Even more shocking, over 40% of India's children under the age of three are undernourished and underweight, a ratio worse than most even poorer African countries. This is a number that threatens India's future. And meanwhile there is an amazing increase in new Indian millionaires. Well, good for

[4] Utsa Patnaik of Jawaharlal Nehru University.

them. But a little more food for the poor, and a lot less waste and food theft and outright corruption would be a good idea. The point of this story, though, is to reinforce a point: this crisis is playing out now!

Metal

To move on (at long last, I can hear you say) in our update to metals, the story is not really as serious in the near term, where price declines are more likely than rises because of growing weakness in the global economy. Nor is it as bad in the 20- to 40-year horizon as food or energy for there are quite a lot of reserves (let's say about 50-100 years) and there is substantial ability to substitute. Again it is "just a question of price" as economists like to say about everything. High-quality resources are depleted and prices rise, but in my opinion not enough to materially affect economic growth as it does with energy and food, but it is certainly a modest hindrance to growth and one that is an add-on to the other two more immediate constraints.

The big problem with metals, though, comes in the long term and the very long term where metal availability becomes the most intractable problem of all. For entropy in metals is merciless. However hard we try to recycle and however low our growth in physical output, metals will still slip slowly through our fingers. They are never replaced. Metals prices will rise slowly if we behave very well. If we behave less than well, which seems much more likely, then metal prices will rise more quickly. Until one day, the price pressure will insist we behave better, recycling close to 100% and raiding those rich 20th century dumps.

Energy

Massive capital spending for alternatives

Energy shortages are the easiest to handle of our resource problems. At least on paper. All it takes is real leadership from our leaders; common sense from the general public; a willingness of hydrocarbon interests to back off from politics and propaganda and a herd of flying pigs! We need to build a very large, very smart grid, covering the whole of the U.S. and one day perhaps including Canada. Among many tricks, it needs to be able to reach into smart homes and turn off the refrigerators and so on for a few minutes when needed. It is, in fact, all state–of-the-art already and in the 10 or 20 years it would take to build, the technology and engineering would no doubt greatly improve, given the great scale, helping to drive down the cost. Behind the grid we would need a truly massive investment in storage technologies and all renewables, especially solar and wind power. Solar costs have unexpectedly crashed in the last three years, down by over two-thirds, and finally today, in ideal conditions (even without coal carrying its full environmental costs), solar is competitive. In a happy variant of Moore's Law, solar costs, driven by scale and engineering as much as new technology, will continue rapidly downwards. (Although there is of course a physical limit to how much energy can be extracted from sunlight and the good/bad news here is that we should be close to it in 30 years or so, there is no such limit on price reductions.) Wind power costs will also fall, if substantially less fast, and it too is already competitive in very good conditions. In contrast, the costs of hydrocarbon energy of all kinds will implacably, if erratically, rise. To carry out such a program even in crash mode (son of Manhattan project, if you will, but actually cheaper as a percentage of our current GDP than that remarkable effort) would take 20 or 30 years, but long before then the marginal costs of operating and maintaining such a system would cross the rising costs of our current system as cheap hydrocarbons steadily disappear. By 2050, cheap hydrocarbon sources will be a distant memory. Electric grids based solely on hydrocarbons would by then, after desperate struggles and brownouts, likely have turned totally black and economies based on such grids would be under very severe stress. If I'm wrong in this assertion for some countries, simply add 10 or 20 years onto the timeframe.

The U.S., as in so many aspects of the resource problem, is relatively blessed in energy resources. The new reserves of natural gas and extra oil from new drilling technology will uniquely allow this country to improve its energy position. The worm in the apple is that it will also allow for complacency. In this we will be encouraged as always by the Cornucopians, telling us we will never need to worry about running out of gas or anything else. It is easy to imagine that this would leave us sticking loyally to depleting hydrocarbons while Germany and others, possibly including

China, forge ahead with renewables until they dominate these new, relatively job-intensive industries and eventually end up with much lower marginal costs. Their advantage would steadily increase as renewables fall in price and those for hydrocarbons rise. Still, with the new fracking reserves it will be exciting for a few years to have some very cheap energy, and it will surely stimulate the U.S. economy in the range of 0.25 to 0.50% a year of GDP for several years. In the longer run, though, it is ridiculous to underprice natural gas, a premium, irreplaceable fuel, just because of odd royalty arrangements. The major disadvantage of all of these extra reserves, though, is that they will give us more rope with which to hang ourselves by frying the planet. (Recent estimates by Cornell University,[5] which are preliminary and therefore, I hope, mis-measured, estimate that almost 8% of fracking gas leaks from drill to stove burner. Anything more than 4% (and it may be as little as 3%) makes natural gas even more dangerous to a warming planet than coal. Methane (which is what natural gas is) is 20 to 100 times worse than CO2 in its greenhouse effect. Depending on the time horizon, it is up to 100 times worse in the very near term, declining to 20 to 1 times worse over 100 years or so. Unlike other environmentalists, I worry less about other of the several negative effects of fracking: boiling the planet makes other negatives seem to me relatively inconsequential.

China's unique opportunity in energy

Time out here to take a look at China on this point. China has been in a class of its own in taking seriously this topic of future availability of resources. It has a long Confucian tradition of thinking very long term and its politicians do not have to worry about being re-elected or about voters and funders as much as ours do. It has also shown a degree of entirely justifiable panic on this resource issue as reflected in massive agricultural land deals outside of China and in a willingness to acquire foreign-based mineral resources. My colleagues worry that the Chinese save and invest too much, approximately half of all their income, a level never before reached in history. One of the reasons for so high a level is that in their attempts to stimulate their economy, notably after the global financial crisis, they found giant infrastructure-based public spending to be the most scalable and manageable. My colleagues also worry about the capital inefficiency in China: too many roads and fast rail lines and completely unnecessary regional airports and too many empty middle class apartments and even empty cities. (For my money, though, this still compares favorably to using public funds to bail out the banking system's errors and even protecting bonuses! But, I digress.) But for undertaking a completely renewable energy system, what a set-up! If the Chinese feel they must maintain a 50% capital spending ratio (or at least come down gracefully to avoid an outright depression), there are few projects big enough to both absorb the giant quantities of money available and have a good return on investment at the societal level in the long term. Building a renewable energy system achieves both aims. As a first mover they would quickly be able to build fewer coal utilities and, eventually, none. In 30 or 40 years they could phase out the last of them and stop slowly poisoning their urban residents while at the same time helping to stop slowly cooking the Earth. (Perhaps, though, the last coal plants could be kept in carbon capture and recycling mode – in which field they are undertaking today the first semi large-scale test in the world – for such plants would make load balancing that much easier by providing some base load to smooth out the variability of wind and solar.)

The Chinese are already becoming leaders in wind and solar power construction and research. At much higher scale, their cost advantages would be hard to match, and if a renewable energy system were to be completed, their biggest long-term worry of all – energy security – would be gone. Compare their problem – "How do we spend all of our money?" – with ours – "How do we pay back all of our debts?" – and you can see why our hurdles are so much higher. It will, in comparison, need much more heroic leadership from us and plenty of those flying pigs. In the meantime, a major Chinese effort would be both a great example and a commercial goad to encourage others to follow. Go China!

The need for research

As renewable projects for solar and wind go forward they should be accompanied by research and financial encouragement for other promising renewables. This would include converting algae and other vegetal matter into liquid fuels, perhaps research into Thorium-based nuclear, and possibly even fusion, for which the risks (of eventual failure) are high, but so are the returns – almost infinite supplies of incremental energy. (It is probably worth

[5] Professor Robert Howarth, "Climate Change Letters" (105:5), May 2012.

mentioning here that, courtesy of the second law of thermodynamics, you cannot indefinitely heat up the world. All heat must be dissipated through infrared radiation. This is why cities with more waste heat are warmer than the countryside. Given energy growth of just 2.3% a year, for 400 years, even if the supply is 100% renewable or fusion [to remove the need to consider the greenhouse effect], the planet's temperature would reach boiling point and only a few recently discovered organisms would be left. In this world, where hydrocarbons are still burned and where facts rather than opinions hold – although sometimes you would never know – the greenhouse effect in the next 100 years is likely to be 300 times the thermodynamic effect.) But perhaps the greatest need for research is in power storage, which will become by far the weakest economic link in the desired renewable energy system. There are almost weekly announcements of new, ingenious approaches, but they seem always to be just around the corner. This would be a good area to have some of that "infinite capacity of the human brain" one hears so much about from the perma-optimists, and for once even I, a cheerful realist (which is no mean feat!), believe there will indeed be, eventually, some real breakthrough, at least in cost if not heavy science. It would certainly be helpful.

The need for a serious effort now

In earlier pieces I tried to convey the sheer impossibility of any perpetual rate of steady growth in people or physical output: 1% compounded for 3000 years, I noted, would multiply people or possessions by seven trillion times the original number. But for those with shorter horizons, the thermodynamic effect on its own, as we've seen, puts a quite separate ceiling of a mere 400 years' growth in energy use at a modest 2.3% growth a year. Throw in climate change effects and our species would be toast long before 400 years would pass if present trends continue. We simply cannot have exponential growth on a finite planet, but no politicians (understandably) and almost no economists (almost unbelievably) will deal with this topic. The longer we delay in facing up to resource shortage, especially the need to go to renewables, the more severe the problem becomes. For example, by the time hydrocarbon prices go "critical," some countries may not have the capability – political, social, or economic – to meet the substantial investments required and they will be left more or less permanently floundering behind. In the late 1930s, Churchill faced intractable unwillingness to deal with unpleasant news – German rearmament and hostile intentions – on the part of both politicians and the general public. Finally, as the problem became obvious even to the most block-headed, he could not resist a little "I told you so." He said, "The era of procrastination, of half measures … of delays is coming to its close … In its place we are entering a period of consequences." This time we can already see the early consequences but we still delay.

But we still delay…

The reasons for delay and even denial are varied. In the U.S., some politicians are understandably desperate to protect jobs, in the short term, in their state. In return for so doing, some receive help from hydrocarbon interests in getting re-elected. They, the hydrocarbon companies, are in turn protecting the value of their huge current and future reserves in the ground, which often represent all of their market value. They also presumably feel that they are acting in their shareholders' interest, which interest is interpreted in the currently fashionable and extremely narrow sense of maximizing intermediate-term profits. Other possible stakeholders, including the country of origin and the well-being of its current and future citizens, typically play no role at all. Some delayers are libertarians who just hate government intervention regardless of the facts or circumstances. But far, far more numerous are the ordinary people who would just dearly love for everything to work out well and the future to be as easy as it used to be in the good old days. But thinking and hoping will not make it so, and delay and denial are dangerous, even potentially lethal, games to be playing.

Finally, who are we?

This brings me to my final point on our food and resource problems: all of our resource problems (and most of all of our other problems for that matter) are soluble if we rise to the occasion and use all of the abilities that, on paper, we have. Most of the more optimistic calculations and estimates that I see are based on the assumption that we will do just that, that we are homo economicus (just as in investing): rational, smart, well informed, well-intentioned,

and incorruptible. Well, it just ain't so. We are badly informed, passionately prefer good news, and easily evade unpleasant facts; our views are easily manipulated by vested interests; we are sometimes desperately inefficient; and we are apparently corruptible as heck. It is on this assumption of ordinary, unenlightened humans that our global food outlook and, in consequence, our future political instability, looks so dangerous.

But once in a blue moon we really do rise to the occasion. The last time was World War II in general and The Manhattan Project in particular. Of course, we were a much more cohesive society then and we had a Congress much more willing to compromise. We also had a clear and immediate enemy who brilliantly (for us) galvanized and united the country by a sneak attack. But, all in all, what a magnificent effort and what a rebuttal to those today who think no government can ever do anything right. If that were indeed true, the war would have been lost and the world would have become a very different place. The threat today, though, is more technical and very much slower burning and the enemy seems amorphous. On the other hand, the penalties this time will be even greater and for the whole planet if we collectively do not start to act soon. It is time for another blue moon. Go world!

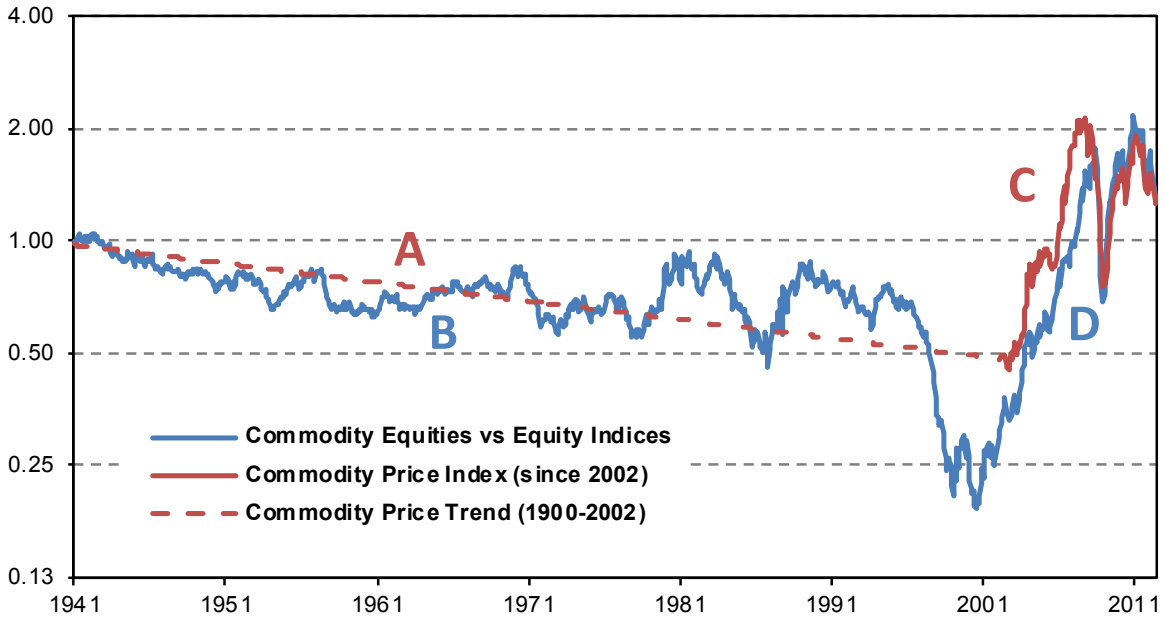
Updated Investment Implications of Resource Limitations

The one-line summary is this: I am very bearish on the problems we humans face and, sadly, very bullish on resources. Not surprising, I am even more convinced than I was a year ago of the inevitability of rising resource prices (and, unfortunately, associated societal and international instability). Therefore I am more confident in my suggested investment battle plan of a year ago. For any responsible investment group with a 10-year horizon or longer, one should move steadily to adopt a major holding of resource-related investments. For my Foundation (i.e., personally as opposed to institutionally where, reasonably enough, we cannot impose 10-year plus horizons on our clients) I had adopted 30% in resources as my eventual target and was slowly averaging in, nervous of near-term substantial price declines, but even more nervous of completely missing my own point. In my Foundation, I have currently reached about the two-thirds point of 20%.

My personal, somewhat arbitrary breakdown of a targeted 30% is to have 15% in forestry and farms, 10% in "stuff in the ground," and 5% in resource efficiency plays. I will change the mix as I become more comfortable with some of the subsets or as I see exceptional opportunities. I do, though, see farms and forestry as the senior or preferred component, if you will, for the longer term: mining and oil companies benefit a lot from rising prices, but they suffer from the need, as capitalist enterprises, to keep replacing their stock in trade every year and this slowly becomes impossible to do completely. Farms, however, also benefit from rising commodity prices but for them their "stuff in the ground" is soil, which, if well managed, has fully renewed growing capacity each year, usually even with a modestly rising trend. There is one component of the potential "stuff in the ground" sub portfolio, though, to which I would give a miss: coal and tar sands. This is not primarily because their incredible cost to the environment hurts my conscience; it is because, in my opinion, the odds will steadily grow as climate damage becomes increasingly apparent, that their use will be curtailed.

Before I leave this topic I would like to throw in a tidbit concerning the strong relationship between real price increases in stuff in the ground and the relative outperformance of those companies that own the reserves. Imagine in Exhibit 2 that I am clicking through on PowerPoint: Click one "A" would show the steady decline in raw material prices to 2002. Click two "B" would show the accompanying steady, very long-term underperformance of mining stocks in that previous environment: every year they took inventory markdowns and every year the value of their main asset lost value, a tough environment in which to prosper. Click three "C" would show the dramatic breakout of resource prices after 2002, and the final click "D" would show the equally dramatic outperformance of the miners. This relationship is a remarkable .52. For other resources it is typically lower – around .3. This is because raw material price rises can help and hurt different parts of a diversified company. Large oil companies, for example, are both sellers of oil and buyers in their capital-intensive refineries, which mutes the direct relationship with oil price changes. In general, though, I think you can confidently expect that if resource prices steadily rise in real terms, then resource stocks should outperform the market.

Exhibit 2
Commodity Equity Performance vs Equity Indices and Metals Commodity Price Index
Commodity Equity Performance vs Indices is for U.S., U.K., Canada



Source: Global Financial Data, GMO As of 6/30/12

Last year I warned of what I saw as a strong possibility of a decline in resource prices. The bad weather – perhaps a 1-in-150-year global event in 2010 – would surely get less bad, I argued, and China looked likely to stumble or at least slow down. Some outright momentum speculation had also been attracted by the rapid and large price recoveries from the lows of 2009. I have been persuaded since then that there was likely some deliberate "go slow" on the part of miners to complete capacity and infrastructure extensions – with the prices so high, who could blame them? – and perhaps some genuine oligopolistic, cartel-like behavior, probably of a just legal variety to keep prices up. Yet at bedrock (pardon the expression) the data allowed for certainty that the main input was a paradigm shift, or phase change, caused by a profound shift in balance between current and potential demand and long-term potential supply: i.e., we are indeed rapidly running out of cheap resources. Today, though, extra metal production is finally coming on line and the boom in new fracking gas and oil production (and reserves) mainly in the U.S. continues. On the demand side, global economic growth, especially in China and Europe, is slowing. As a result prices have fallen by about 25% to 35% from their peaks for most "stuff in the ground" and, with the weather less bad, have also fallen by a similar average amount for agricultural products up to the beginning of June.

Climate problems intrude

Well, a month is a long time in agriculture, particularly these days apparently. For starting in early June there came yet another burst of anomalous global weather. The center of this season's problem is as it was last year: the U.S. Midwest coupled with dry weather around the Northern Hemisphere's wheat belt. Suffering intense drought and 90- to 100-degree searing heat, the U.S. corn crop, the world's largest, has been damaged and the price has jumped an astonishing 50% in a month. A similar story exists for soy beans. In almost no time, two of the three most important crops have gone back to the highs of 2008, which were often described as "never to be seen again." Wheat also is within striking distance of its 2008 high and up over 40% in the last six weeks.

Let's discuss what this means. It is not at all like 2008, when the planted crops were not that exceptionally large. However, since the massive rise of price in 2008 and the unexpected rebound in 2011 from the effects of the crash, unprecedented total acreage has been planted to take advantage of the much higher prices. There was also a strong

case back in 2008 that there was an unprecedented speculative momentum element attracted by prices doubling in a single year. This time, though, just plain awful bad weather blindsided the market despite the massive planting. And as for speculation, just a brief six weeks ago speculators were short grains! World demand is now just so high and growing so fast and reserves so modest that the slack in the system appears to have completely gone and vulnerability to bad weather like this year's has increased enormously.

And let's talk about the weather, for it is indeed beginning to have investment implications that might be expensive to ignore. Globally, 2010 looked to me like a 1-in-150-year event with heroic heat in Russia and elsewhere and biblical floods in Pakistan and Australia. It really hurt global grain output. I suggested then that surely the following season had to be at least less bad, and what did we get? Thailand, the largest rice exporter was knee-deep in floods over half the country, 80-year floods occurred in the Mississippi, Texas sweltered in way-above record heat, and quite severe droughts gripped many other places. Perhaps in total a 1-in-50-year event globally. So, after all, perhaps I was right; it was "less bad" but hardly what I meant. And now, quite suddenly, even while I was thinking about this letter, 1-in-50-year drought and heat have hit our major growing areas. So let's call this a 1-in-20-year globally, for Brazil, Argentina, Russia, and several other areas are also having unusually bad weather. Any statistician starts to get jumpy when looking at 1-in-150, 1-in-50, and 1-in-20 back to back. Long-term weather records are poor and a lot of this is judgmental, but this three-year stretch is, shall we say, very unusual. (The National Oceanic and Atmospheric Administration has said that the chance that this year's heat in the Midwest was not affected by a warming climate was over 1 in 1 million. Other sources have used much punier odds, such as 1 in 100,000. I will settle for "very unusual.") We really have to start factoring into the investment equation increased odds of difficult and volatile growing weather.

Possible price declines and regret minimizing

Moving back to the portfolio, there is probably a risk of another 20% or so relative underperformance in the miners and oil companies (as the new supplies of U.S. oil and gas continue to expand) and as China has gone from our "likely to slow" a year ago to definitely slowing, and the euro and fiscal cliff in the U.S. are enough to make even seasoned cool-cat investors jumpy. (And downside results have a disturbing habit of being twice what you counted on.) Grain prices, having bounced once again, are very vulnerable and land prices typically need a couple of bad grain years in a row to have the effect pass through to them. So farm prices have stayed resolutely high, which for potential buyers is both frustrating and dangerous. Farm buyers are forced to look globally – although I advise safe and friendly countries only – and hunt for bargains and special cases. Fortunately, though, farms form a very inefficient market and there are always relative bargains to be had somewhere.

Resource problems are likely to squeeze the balance of the portfolio

So my regret-minimizing advice still holds: average slowly in over the next one, two, or three years depending on developments. But something important in the picture has changed. Not only am I more convinced than a year ago that sensible long-term investors' 7- to 10-year horizons should overweight resources (30% is about two times market weight), but I am now also convinced that rising resource prices will worsen the prospects for the balance of the portfolio, by both squeezing profit margins and reducing overall growth.

If correct, this will have serious implications for longer-term endowment and pension fund returns: among other factors, a lower growth for GDP in the long term may mean lower returns on all capital. That question, along with a discussion of overall GDP growth and why I think it is likely to be lower in the future than generally expected, will be discussed next quarter. In the meantime, it may be worth asking which kind of company will better resist lower GDP growth, especially in the developed world, and be better able to absorb pressure from higher resource prices. Once again, we prefer "quality" stocks. They have much lower resource costs as a percentage of total revenues than typical companies and they have a higher margin base from which to resist margin pressure.

"Groundhog Day"

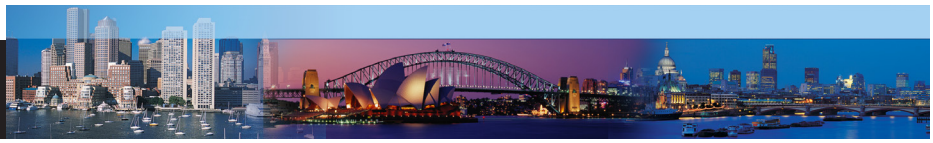
The economic environment seems to be stuck in a rather unpleasant perpetual loop. Greece is always about to default; the latest bailout is always about to save the day and yet never seems to; China is always about to collapse but instead teases us by inching down; and I swear the *Financial Times* is beginning to recycle its reports! In the U.S., the fiscal cliff looms along with debt limits and the usual election uncertainties. The dysfunctional U.S. Congress continues for the time being in its intractable ways. The stock market rises and falls and rises and falls again. It is getting difficult to find anything new to say at client meetings. I, for one, wish that the world would get on with whatever is coming next.

One slight change, though, is that fantastic (almost unbelievable) profit margin and earnings gains have finally weakened a little. They, together with Bernanke's super low rates, have been the twin pillars of the market and not bad ones at all: here we are up 8% for the year in a thoroughly unsettling financial and economic world. With margins weakening, one of the twin pillars is looking shaky and price declines look more likely than before.

Ben Inker's investment comments are attached.

GMO

COMMENTARY



July 2012

When Bad Things Happen to Cheap Assets

Ben Inker

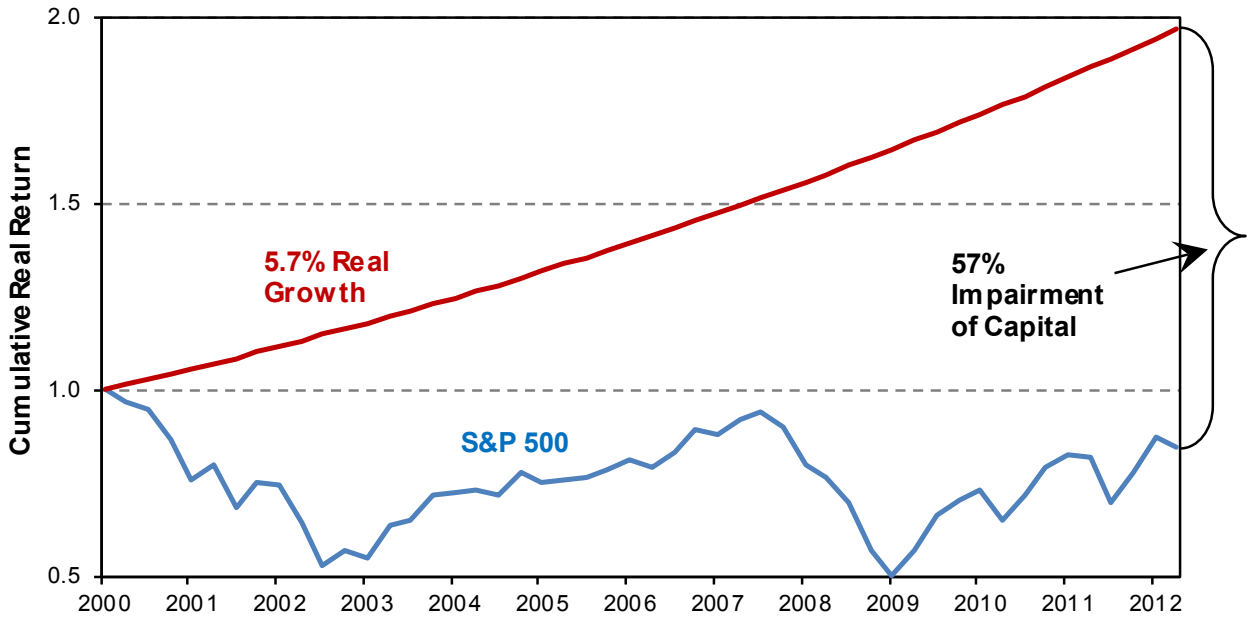
We are value managers. We view it as our job to buy assets when we believe they are cheap. The standard reason value managers give for buying cheap is that cheap assets outperform. We've gone farther than merely saying that. We have claimed that cheap assets not only perform better on average but also have lower risk where risk is considered as the likelihood and size of a permanent impairment of capital. History seems to be supportive of our claim, but the question is how much comfort can we take in this tendency? Or to put it another way, how concerned do we have to be about the potential of bad things happening to cheap assets?

If anyone had ever had a doubt about the potential for expensive assets to inflict a permanent impairment of capital, we hope that the experience of the last dozen years has disabused them of that notion. From March 2000 to June 2012, the S&P 500 lost 15% in real terms. But declaring that to be the permanent impairment of capital from the overvaluation is a significant understatement. Believers in stocks for the long run who invested in March 2000 were not expecting to get their money back in real terms after 12 years in the stock market; they were expecting to get the long-term average return of 7% real per year. The 7% real figure was flattered by the fact that the market had ended at a much higher valuation than it started at in 1900, or 1926, or 1945, or 1970, or quite frankly any starting point in history you wanted to pick. But if we took 5-6% real to be the fair return to owning equities, investors would have expected to earn between 85% and 110% over the period, making the permanent impairment of capital from investing in the overvalued S&P 500 somewhere in the 55-60% range, which can perhaps be more easily seen in Exhibit 1. I'm doing a bit of hand waving in declaring that to be "permanent," but given that we believe that the S&P 500 is still substantially overvalued today, I'd trade off the possibility that the S&P 500 makes a stunning run higher that mitigates the loss against the possibility that we are not yet done with the totality of this impairment.

The losses from 2007-09 were also generally a case of bad things happening to expensive assets. While plenty of assets wound up cheap relative to fair value by the bottom, by and large the places where one is still nursing impairment to capital are those places where the assets came into the period trading well above their historical valuation levels. I say "by and large" here because there are two potential exceptions to the idea that the losses were simply due to expensive assets falling back to fair value.

One exception is banks, which since the market high in 2007 have fallen about 60% in real terms in both U.S. and EAFE markets. Banks are an odd case with regard to capital impairment. First, they are highly levered entities where small changes to assets or liabilities can lead to large changes to equity values. Second, they were large holders of a number of the overpriced assets in 2007, principally corporate debt and mortgages, which is not a problem faced by non-financial companies. And third, due to their leverage, there is a very dangerous feedback loop that can arise when they take losses. Those losses force them to raise equity capital, and if the losses are big, investors will punish them by pushing their valuation below book value. Recapitalizing a levered entity below book value tends to be quite dilutive to shareholders, and this dilution is a permanent impairment of capital. So if you have a bunch of highly

Exhibit 1
Impairment of Capital for S&P 500 since 2000



Source: S&P, BLS *As of 6/30/2012*

levered entities that are bound to give you a permanent impairment of capital in the event that they take large losses on their assets, and they are holding assets that are substantially overvalued, there may not actually be a valuation level at which you can call them "cheap." Once they have taken their losses it is a different matter, and it is possible that the financials are cheap today. For our part, we are still somewhat leery of them since it is not entirely clear what other dangers still lurk on their balance sheets.[1]

The other possible exception is eurozone equities. They have fallen less than the banks – the eurozone ex-financials is down a "mere" 33% from its high in real euro terms. As of October 2007, our forecast suggested that EAFE ex-Japan needed to fall 33% to hit fair value. Assuming the eurozone was priced similarly to the rest of the non-U.S. markets at the time, that suggests that if the markets were at fair value today and there was no impairment of capital, it should have lost 13% (a 33% hit to valuations, but 4.7 years of dividends and real sales growth should have dampened the pain by now). So, is the eurozone cheap, or has it suffered some permanent impairment of capital? We believe it is a combination of both. If we look at the valuation of the eurozone on our 7-year forecasting framework, we see it as having an expected return of around 7.5-8% real, which suggests it is currently about 15% cheaper than fair value. Why is it not cheaper, given that the eurozone would have to rise 30% from here to get to a total loss of 13%? A piece of this is due to the fact that we use slightly tougher assumptions than we did when markets were very overvalued in 2007. That explains about 6% of the discrepancy. The rest, which is about 8% as can be seen in Exhibit 2, is due to our estimated impairment of capital to date for eurozone stocks.

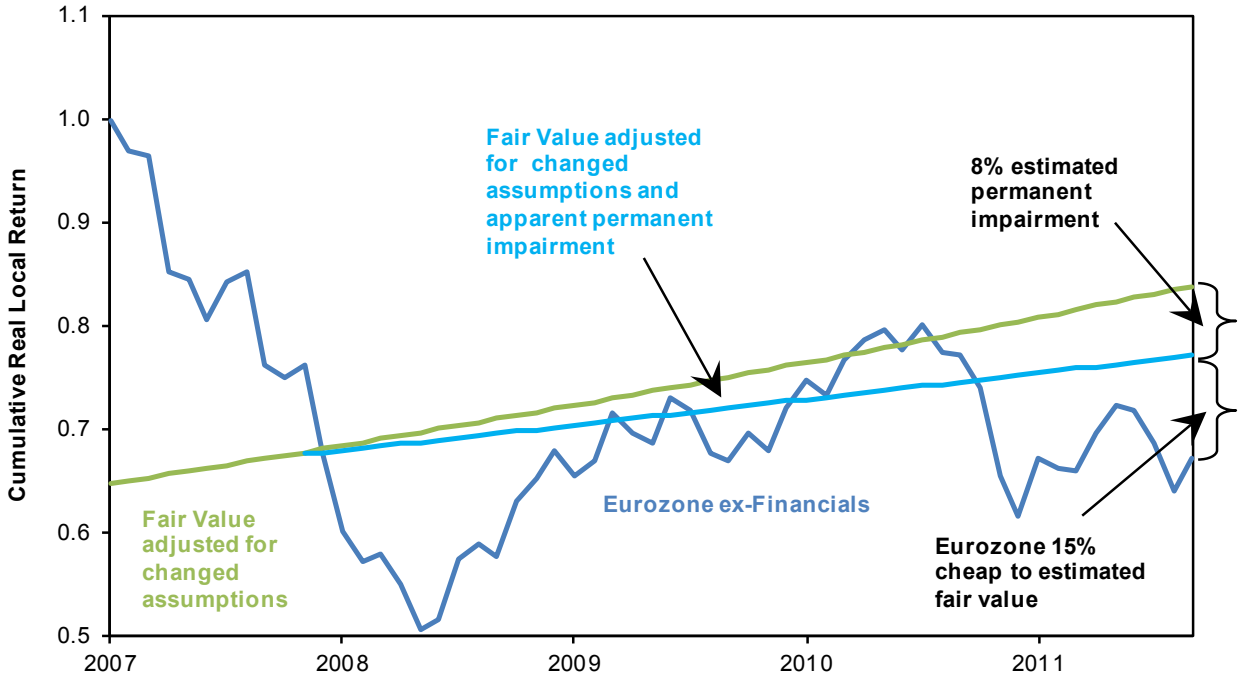
An 8% impairment is actually a pretty big number when one considers that the Great Depression in the U.S. seems to have caused about only four points of impairment, due to lower than equilibrium dividends paid in the 1930s.[2]

But impairment up until today is only part of the story. We also need to ask the question of what impairment there may be going forward. Are eurozone stocks actually 14% cheap today, or is the market correctly estimating that the ongoing crisis will knock another chunk out of their long-term value? In an attempt to answer that question, Anthony Hene of our Global Quantitative Equity group has led an effort into scenario analysis for the eurozone,

[1] Not to mention the potential for further fines and litigation losses driven by shady practices before, during, and after the crisis.

[2] Based on lower dividends relative to trend from 1931-41, the loss was 4%. As it turns out, this loss was more than compensated for by the fact that the market was quite cheap for most of that period and therefore your smaller than expected dollar dividends actually bought a larger than expected quantity of stocks, helping compound out greater returns.

Exhibit 2
Impairment of Capital for Eurozone ex-Financials since 2007



Source: GMO, MSCI, Eurostat As of 6/30/2012

looking at the potential impact of falling EBITDA, covenant breaches, and subsequent forced recapitalizations under various scenarios for the eurozone. While this analysis does not pretend to be definitive, it suggests the potential for a further 10-15% impairment in the event of large-scale government defaults or a euro breakup scenario, versus minor impairment if the eurozone takes an inflationary route to sustainability. It should be noted that this 10-15% impairment is an analysis across all non-financial companies and countries in the eurozone. Some companies would undoubtedly go bankrupt in a government default or breakup scenario, and some countries will fare significantly worse than others. And it is very likely that in the event of a bad outcome, the prices of the stocks would fall by more than 15% as myopic investors overreact to the bad news. But across the whole of the eurozone, 10-15% further impairment is at least an educated guess as to the permanent impact of a bad end to the crisis.

Another way of putting the 10-15% possible impairment would be to say that current valuations of non-financial stocks in the eurozone broadly discount an ugly endgame for the region. If something less bad than that occurs, the stocks are at least mildly cheap. Believing this, after the market fall of April and May we bought a decent chunk of European stocks in our asset allocation portfolios. In our Global Asset Allocation Strategy, benchmarked to 65% MSCI ACWI/ 35% bonds, we have a 5% overweight to eurozone equities. This is a significant bet, bigger than our overweight to emerging equities (2%) and similar to our overweight to Japanese stocks. It is not, however, particularly close to our maximum weight in the region because, while "somewhere between fair value and mildly cheap" is a pretty good deal relative to U.S. stocks, global bonds, or cash today, it is not exactly a table-pounding endorsement. We stand ready to buy more eurozone stocks should prices fall significantly from here, but at the moment it is not particularly close to qualifying as a "Big Bet" in the GMO mold.

Given the decent rally in the eurozone in June and quality's outperformance in the quarter, the second quarter was a pretty good one for our asset allocation strategies in terms of relative performance, with the benchmarked strategies outperforming by 1-2% and thus making up most of the ground lost in the first quarter. Absolute performance was negative given that ACWI was down over 5.5% in the quarter, and consequently our long-biased absolute return oriented strategies struggled with losses of -0.1% to -1.4% depending on the strategy. Only the Multi-Strategy and Mean Reversion Strategies, which have an approximate zero beta at the moment and were therefore unaffected by the general equity malaise, eked out absolute gains, rising about 1% and 3%, respectively.

A quick word on our AA and quantitative global equity strategies in the current environment. We are accustomed to our equity strategies tending to outperform when markets fall, a tendency that has only been intensified in recent years given our large overweight to quality stocks. As and if we shift more toward eurozone stocks, particularly the eurozone value stocks, which today have the most enticing valuations, it becomes more likely that several of our equity strategies may underperform on the down days, particularly if the downdraft is driven by problems in the eurozone (of which there is no shortage). Most of the time, cheaper equities are fairly defensive on the downside, but this may be one of those times when it may go the other way for a while.

Underperformance on the downside would likely be both because bad things were actually happening to cheap assets and because the market will have a knee-jerk response assuming bad things are happening, whether or not they actually are. Owning the eurozone is undoubtedly a nerve-wracking activity at the moment. If we are right, the permanent impairment of capital due to a combination of the financial crisis and breakup of the eurozone could be something on the order of 17-22% for investors in eurozone non-financial stocks. This is a big number, and far larger than the impact of the Great Depression in the U.S. Bad things can indeed happen to cheap assets, and as value managers we need to look out for this possibility and manage our portfolios accordingly. But the damage we are talking about pales in comparison to the impairments driven by overvalued markets such as the S&P 500 in 2000 or the Nikkei in 1989, which cost investors about 55% and 75%, respectively. As conscientious investors, we obsess about all routes to capital impairment. But if you only had to choose one route on which to focus, across history, overvaluation has almost certainly been a much bigger driver of impairment than deteriorating fundamentals have been.

Performance data quoted represents past performance and is not predictive of future performance. Returns are presented after the deduction of a model advisory and incentive fee, transaction costs, commissions and withholding taxes on foreign income and capital gains and include the reinvestment of dividends and other income, as applicable. Actual fees paid by accounts within the composite may be higher or lower than the model advisory and incentive fees used. A GIPS compliant presentation of composite performance has preceded this presentation in the past 12 months or accompanies this presentation, and is also available at www.gmo.com. Actual fees are disclosed in Part II of GMO's Form ADV and are also available in each strategy's compliant presentation. The information above is supplemental to the GIPS compliant presentation that was made available on GMO's website in April of 2011.

Mr. Inker is the head of asset allocation.

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