agri benchmark

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A new Paradigm for Global Agricultural Commodity Markets?

Thesis paper to challenge the hypothesis of a lasting increase in commodity prices

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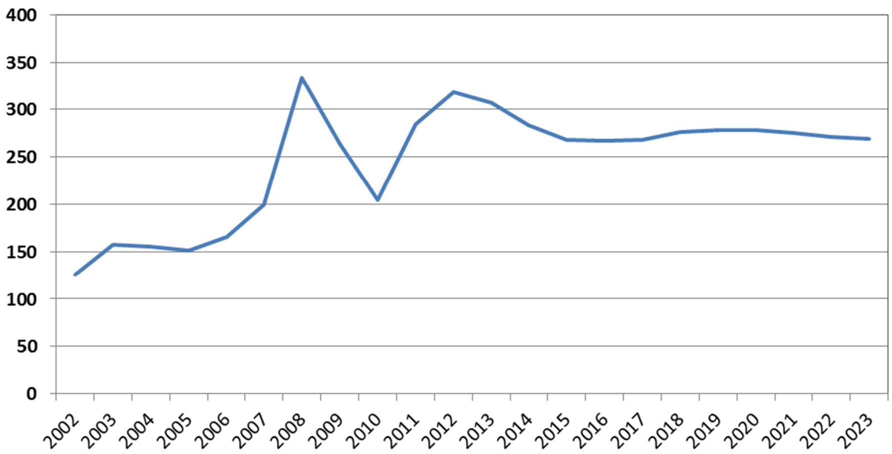
Yelto Zimmer[1]-

Background

Global agricultural commodity markets have been characterized by a downward trend in real prices for more than 100 years. The general understanding among ag economists regarding this phenomenon is that growth in productivity of land through improved seeds, increased use of fertilizers and crop protection products as well as better crop management have been the main drivers. In addition, a slight increase in agricultural land has contributed to an overall increase in produce available. Generally, this increase in supply was greater than the increase in demand. Since agricultural raw products are perfect commodities, any such improvement in productivity was passed on to consumers in the form of declining real prices for commodities.

Only recently, leading international agricultural economic research institutions such as FAPRI/CARD or OECD have been issuing price forecasts. Already in 2011, IFPRI was predicting a 50 % increase in corn prices until 2050. OECD is projecting from 2015 until 2023 a more or less stable price level in wheat of about USD 270/t in nominal terms (see Figure 1). All other major global commodities are also expected to be priced much higher than they used to be.

Figure 1: Evolution and OECD projection world market prices wheat (USD/t; in nominal terms)



Source: OECD (2014).

In comparison to pre-2007/08 levels, this would constitute an increase of about USD 120/t or almost 100 %. It is worth mentioning that this projection was not driven by assumptions about a massive expansion in global biofuel production due to respective policies. Rather, the authors foresee only a modest ongoing increase.

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Such a development – provided it lasted for a decade - would constitute a historical change. However, the question is whether it is realistic to assume that such a fundamental and lasting increase in commodity prices is going to happen.

This paper attempts to systematically develop and challenge the hypothesis that supports the assumption for such a fundamental change in ag commodity prices. While others like BALDOS & HERTEL (2014) used a global modelling approach in order to challenge the projection of long-time price increases, this paper will apply a bottom-up approach by looking at cost of production figures, mainly derived from ***agri benchmark*** Cash Crop[2].

I. Some theoretical considerations regarding the perspectives and the economic characteristics of agricultural commodity markets

The increase in global population as well as rising per-capita, real income which has led to a change in diets that now includes greater shares of animal protein and vegetable oil, are referred to in the public debate as the main drivers for high, long-term commodity prices.

However, the increase in global per-capita real income and respective change in diet is not a recent phenomenon and has been observed over at least the last 100 years. Furthermore, estimates from ALEXANDRATOS/BRUINSMA (2012) published by FAO indicate a significant slowdown in growth rates in global demand. While between 1970 and 2007 the annual growth rate used to be 2.2 %, it is projected to go down to 1.4 between 2007 and 2030 and even as low as 0.8 % between 2030 and 2050. The main reasons are:

(a) A slowdown in population growth rates.

(b) An increasing share of the global population for which no significant increase in food demand can be expected - saturation levels have been reached.

(c) A growing share of elderly people who tend to consume less food.

Even though these projections are uncertain it does not seem reasonable to assume that future demand will exceed previous growth rates. This in turn implies that there is good reason to assume that challenges for the global ag sector to feed the world will become lesser than before.

In the long run supply is more responsive than many people think

But not only do the future challenges from the demand side seem to be overestimated by the general public and by many stakeholders, the ability of the global agricultural sector to expand supply in the long run also tends to be underestimated.

(a) Globally there are millions of hectares of arable land that can be used much more productively than currently. Proper fertilization and better crop management alone would allow for a dramatic increase in yields (see FISCHER et al. 2014). For

[2] Details about the methodology applied by *agri benchmark* can be found here: www.agribenchmark.org/cash-crop/publications-and-projects0/methodology.html. The typical farm approach is explained in more detail here: www.agribenchmark.org/fileadmin/Dateiablage/B-Cash-Crop/Misc/SOP-cashcrop-0512.pdf.

example, in wheat the so-called yield gap between agronomic potential and actual yields is more than 40 % globally.

(b) On a global scale there are still millions of hectares of prime arable land available[3], hence in physical terms there is no lasting limitation to respond to higher commodity prices and to increase supply.

(c) In principle, in most places worldwide there is no lasting barrier to entry – "anyone" who so desires, can start producing and selling agricultural products. Of course there are a number of restrictions on trade, but they are not wide spread enough to cause the global agricultural sector to remain unresponsive to increases in demand.

On the supply side the only great unknown is the effect of climate change. However, even the most pessimistic scientists do not claim that these effects will become significant in the next 10 years.

Against this background, it seems rather reasonable to assume that the global agricultural system will return to a situation in which – in the long run – the growth in output will exceed the growth in demand. The global ag commodity market will become a "buyers" market again. This is a pattern we have grown used to for at least the last 100 years and this is why globally, we have experienced an ongoing decline of real agricultural commodity prices. Given that OECD projects constant nominal prices, they do not question this pattern as they foresee an implied reduction in real prices.[4]

Therefore, in this paper it will be assumed that changes in cost of production as well as in transport and logistics will be decisive for long-term projections for global commodity prices. The only possible massive change in demand which will be considered is the one caused by the so-called "bushel barrel correlation".

Whose cost of production does matter?

Given the fact that cost of production – especially when not considering land cost – should vary rather strongly across the globe, it must be noted that cost of production of the marginal producer counts. The marginal producer represents that production system or site with the highest cost of production and which contributes the "last" unit of output on the global supply schedule needed in order to match supply and demand.

Since the produce needs to be available to global markets, what matters in the end are costs at a harbor that is well connected to global markets. Therefore we have to deem cost of domestic transport a key figure.

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[3] Even though in the public debate the global scarcity of arable land is a very popular topic, scientific analysis e.g. by FISCHER (2008) suggests that there is, even under very restrictive assumptions, at least another 700 million hectares of arable land available. Compared to now, with 1.6 billion hectares in use, this resource constitutes a theoretical increase of arable land of almost 50 %. Argentina and Brazil alone have the option of expanding their arable production by more than 70 million hectares in the short run without making use of rainforest land. Other major land resources are available in Africa – however given high political and economic risks and poor infrastructure, this will be mobilized only in the long run.

[4] It is worthwhile mentioning that a reverse assumption would imply that global society would encounter the so-called Malthusian catastrophe: Growth rate in supply is constantly lower than the growth in demand, real ag commodity prices go up "forever".

The empirical data presented in this paper mainly focus on wheat, only in some cases figures on soybeans or corn are used because no respective data on wheat is available or even meaningful (e.g. wheat transport cost for export in Brazil). Given the very strong interaction between all major commodity prices on global markets[5], such a transfer of figures makes sense.

Hypotheses to look at

A lasting increase in ag commodity prices could be caused by one or more of these structural changes in global crop production:

(1) Linkage between ag commodity and energy markets through the option to produce biofuels (bushel-barrel-correlation).
(2) Increasing marginal cost because production has to be expanded in new regions where cost of production is higher because of less fertile land and/or because more remote regions have to come into production which drives up transport cost and ultimately free-on-board (f.o.b.) cost at the harbor.
(3) Intensification of input usage in order to boost output as a response to respective price incentives from the commodity markets may have caused cost of production to go up.
(4) Increases in energy and fertilizer prices have led to an overall increase in cost of production.

However, before analyzing these issues in greater detail, the capacity of land rents to buffer increases in cost of production will be revisited.

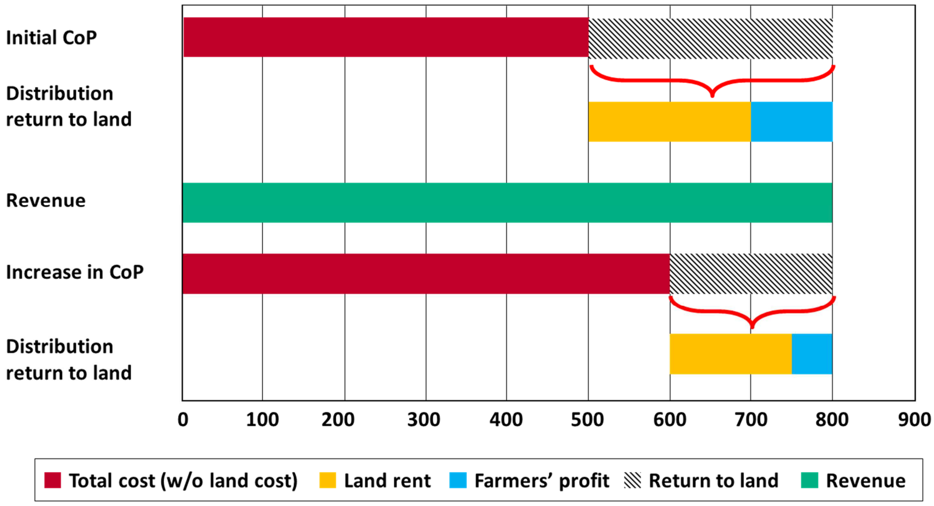
II. Land rents are an important buffer for increases in cost of production preventing them from (proportionally) showing up in rising agricultural commodity prices.

Except for the issue regarding the bushel-barrel correlation, all other hypotheses about possible causes for a lasting increase in commodity prices stem from increases in cost of production or higher transport costs. Before concluding that those increases in cost of production have to result in lasting increases in global commodity prices, it is necessary to understand the economic features of land cost as a residual figure.

In Figure 2 the grey area symbolizes the return to land, which is the margin over gross revenue (green bar) and cost of production (red bar). Depending on the characteristics of land markets, this return to land will be shared between the land lord and the farmer. In well-developed and rather dynamic land markets such as in the U.S., the farmer's profit tends to be rather low while in countries such as Russia or Ukraine, with rather inflexible and non-transparent land markets, farmers can make the most of the return to land.

[5] A regression analysis indicates that the variation of world market prices for these major commodities can be explained by about 90 % by each other. In order to calculate the corresponding corn price for the wheat prices which will be used, the reader may use this formula derived from a regression on price quotes published by FAPRI: corn price = 0,8663 * wheat price - 18,42. For example the price projection in wheat (USD 270/t) corresponds to a corn price of about USD 215/t.

Figure 2: Scheme: Interaction between costs of production (CoP), return to land, land rent and farmer's profit



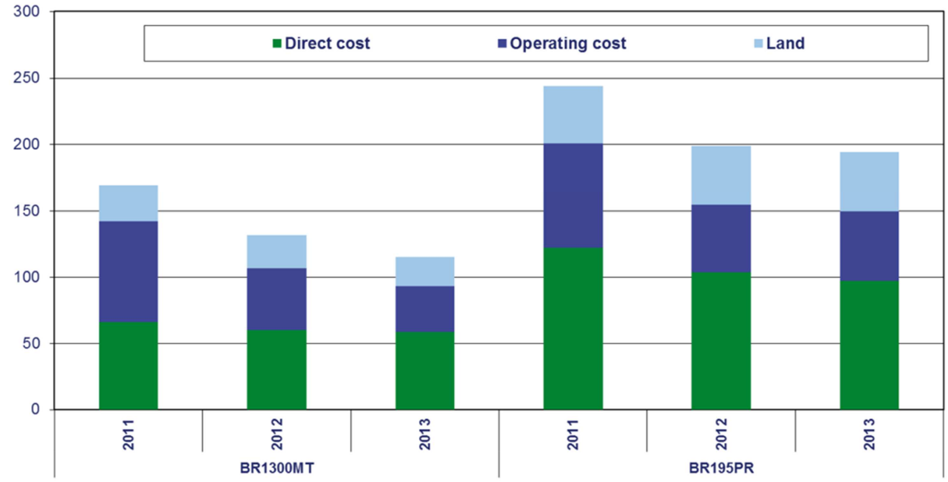
Source: own illustration.

Irrespective of whether land lords are able to capture a larger or a smaller share of the return to land, when costs of production go up in general, the *return to land* goes down and so does – at least in the long run and with land market functioning – *land rent*.

As can be seen from global comparisons of *agri benchmark* data, land cost indeed constitutes a significant cost factor to growers in most parts of the world. For example in wheat, they can amount from USD 60 to USD 100 per tonne or more (see Figure 5 on page 8 of this paper). This is true across the board for typical farms in the main wheat producing countries. With regards to increases in cost of production, these figures suggest that – at least in the long run - there is significant room to buffer any such cost increases.

When considering *new remote land* coming into production, a similar situation is to be expected: Land rents in those regions will reflect higher transport and logistics costs. Data for two Brazilian *agri benchmark* farms illustrate this effect very nicely (see Figure 3): While the farm BR195PR in Parana is relatively close (700 km) to the harbor, the one in Mato Grosso (BR1300MT) is about 2,200 km away from Santos. Land rents for the farm in Parana are in the range of USD 220/ha, those in Mato Grosso are at about 140 USD/ha – even though yields are similar.

Figure 3: Impact of farm location on land cost per tonne of corn – the case of typical Brazilian farms in Mato Gross vs. Parana (Ø 2008 – 2013; in USD/t)



Source: ***agri benchmark*** (2014)

The conclusion: land rents indeed are a buffer for differences in transport and logistics costs. This in turn implies that the different possible causes for increases in cost of production, which will be discussed in greater detail in the subsequent sections of the paper, will only partially –if at all – lead to higher commodity prices since they will be compensated by lower land rents in the long run. Of course this depends on (a) the cost increase relative to current land cost and (b) the responsiveness of land markets and (c) the time horizon we are looking at.

III. Due to the interaction between agricultural commodity markets and energy markets (the so-called "bushel-barrel-correlation"), in the long run agricultural commodity prices will follow energy prices and therefore increase.

Given the technical possibility to convert the energy content in agricultural produce to fuel, this assumption seems very reasonable. Suppose for a longer period agricultural commodity prices are traded below their value as a raw product for biofuel production; there will be entrepreneurs who will take advantage of this and start building and running factories to realize this arbitrage. This expansion will go on as long as the margin between the market price of the feedstock and its value as a fuel is high enough. The longer the expansion goes on, the more ag commodities will be withdrawn from the market and prices for those commodities will go up. The upper limit is the price of the ag commodity which equals its processed value as a fuel.

However, empirical evidence for this interaction is weak for two reasons: Firstly, almost the entire current global biofuel production is not driven by market forces but rather by more or less vigorous political interventions. They include subsidies/tax credits and mandatory blending in the EU and the USA while even the Brazilian government is creating economic incentives to produce ethanol by managing domestic fuel prices.

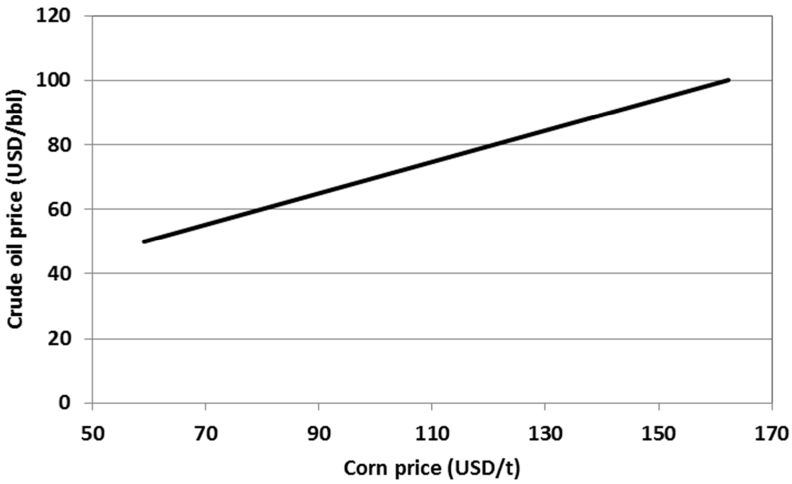
The second reason for the lack of empirical evidence is the fact that ag economists seem to lack interest in really understanding this interaction. So far all major research done has been based on analysis of the interaction of (recently) observed prices for the two commodities. Looking at the interaction of prices only is most likely misleading because

(a) there is good reason to believe that in recent years the co-movement of ag commodity and fuel prices only happened by chance and

(b) biofuel production was driven by political interventions rather than by market forces.

Only very little empirical work has been undertaken so far on the fundamental understanding of the interaction of the two markets since SCHMIDHUBER (2007) published his landmark paper on the concept of a floor price created by energy prices. One of the few publications on this very topic is from TYNER (2007) who analyzed US ethanol production based on corn.

Figure 4: Indifference prices for corn for a US ethanol plant



Source: according to TYNER (2011)

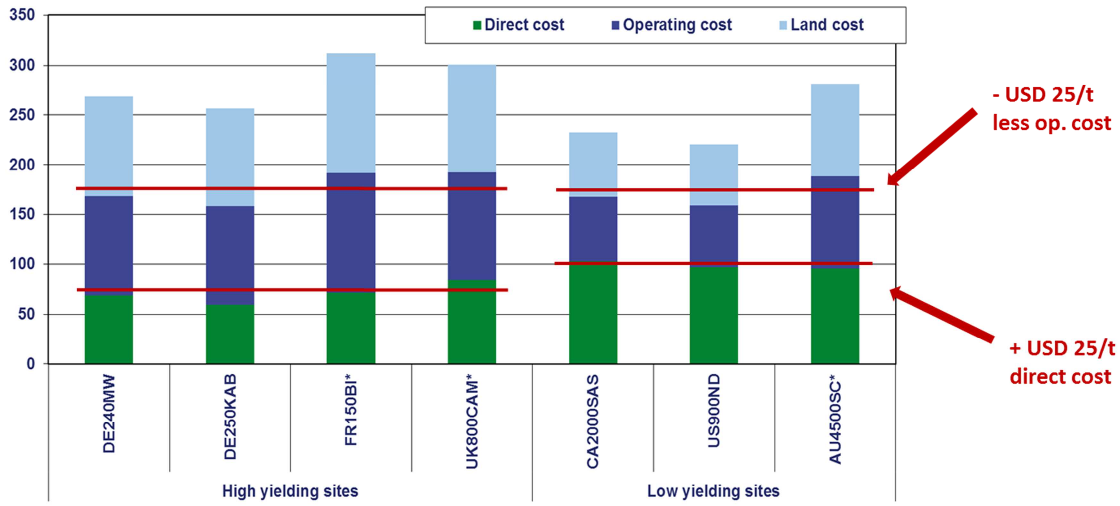
The conclusion from Figure 4 is that without policy interventions at a crude oil price of 100 USD/barrel, the threshold price for corn is in the range of USD 160/t. That means, only at corn prices below that level is it possible to profitably produce ethanol without any subsidies or other form of political intervention. Provided this figure is correct, a price level of 270 USD/t for wheat cannot be explained by the bushel-barrel-correlation.

IV. In order to expand supply, more low yielding land (and therefore higher in cost of production) needs to be cropped globally.

At first glance this hypothesis looks rather plausible: all variable inputs (such as seeds, fertilizers or crop protection products) as well as capital and labor input do yield less output when applied to land that is less suitable for arable production as compared to an application on high yielding land. International comparisons from *agri benchmark* Cash Crop on the economic productivity of fertilizers and plant protection input (as the main cost factor regarding variable inputs) suggest that it is indeed an indication that their productivity is somewhat lower for low yielding sites compared to high yielding sites (see Figure 5).

Of course the differences in direct cost per tonne could have been caused by differences in input prices. The only cost category for which such a comparison is meaningful[6] is fertilizer prices. When comparing these figures, it shows that they have been almost identical[7] for the farms compared here.

Figure 5: Key cost elements in wheat for intensive production systems on high yielding sites vs. extensive, low yielding sites (Ø 2008 -2013; in USD/t)



Source: ***agri benchmark*** (2014)

When compared to high yielding sites, the disadvantage of low yielding sites in cost of production in wheat, for example, is about USD 25/t (see Figure 5). This difference in direct costs is compensated by lower operating costs. The low operating costs reflect the ability to use productive machines and to use labor input more productively (see KRUG, 2013, p. 90 ff). Therefore total cost of production for those two sites tends to be in the same range. However it must be noted that farms in a low yielding environment in Canada, Australia or the USA tend to be much larger than those for example in the EU. Hence their cost advantage in operations is at least most likely also caused by economies of scale and not directly associated with natural conditions.

6 Since *agri benchmark* does not provide figures for individual active ingredients, a comparison of plant protection is not meaningful. A comparison of seed cost does not work either because by definition high yielding sites spend more on seeds because they typically run at a higher seed density (plants per m^2).

7 The major cost component in fertilizer cost is nitrogen. The farms in the EU on high yielding sites on average had to spend USD 1.19/kg N while those on low yielding sites spent USD 1.26/kg N.

Beyond this consideration, there are a number of reasons why the hypothesis on "low yielding land use" is not very promising in explaining the higher floor price:

(a) Currently, the world is already using a huge amount of very low yielding land for commodity production. This is true for almost the entire grain and oilseed production of Australia, for major parts of Canada, Siberia and the whole of Kazakhstan and even the northern parts of the USA. And it's not only that these sites are of "any" use – they comprise rather, the origin of about 80 % of global wheat trade. In all these regions, the average wheat yield is in the range of 1 to 3 t/ha.

(b) Most recent information on the expansion of global land use stems from countries where natural conditions for arable production are in fact excellent: Argentina, Brazil, Mozambique, Angola or Myanmar – just to name a few.

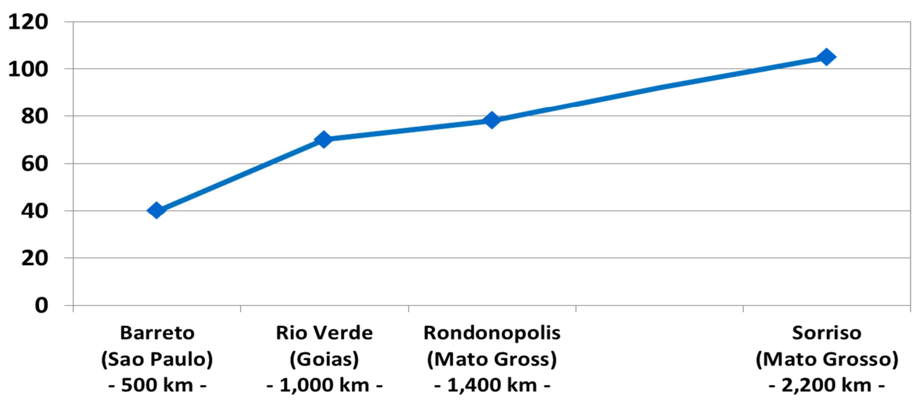
Given this information, the hypothesis of *cost increases due to expanded use of low yielding sites* will not be considered in the final conclusions.

V. Since more remote land is used to increase output, this marginal production is faced with higher transport cost, hence commodity prices must go up. Furthermore, there needs to be an incentive to invest in land cultivation (e.g. clearing of bushes, basic fertilization).

Again, in principle this argument is quite plausible: When, for example, looking at new frontier regions in Brazil (Maranhão, Piauí, Tocantins and Bahia) which are currently coming into production, long transport distances plus poor technical infrastructure add a significant cost element to f.o.b. cost. Or to phrase it differently: There needs to be a certain price incentive in order to make it profitable to produce commodities in those regions.

When looking for empirical evidence, there is only selected and more or less anecdotal data available. For example FLIEHR (2013) has done some intensive research in analyzing transport and logistics costs in Brazil (see Figure 6).

Figure 6: Gradient of soybeans transport cost in Brazil – destination: Harbor Santos (in USD/t)



Source: FLIEHR (2013)

It turned out that when looking at the transport and logistic system between Mato Grosso and the main export harbor Santos, marginal cost for adding another 500 km was in the range of USD 20 to USD 30 per tonne of soybeans.

Of course these rather selected figures are not scientific proof for a global analysis, but they at least suggest that indeed, those more remote sites will only come and stay "on board" global commodity production if commodity prices go up compared to pre-2008 levels.

The other economic issue associated with arable land use expansion is establishment cost. For example, in Brazil new arable land needs to be cleared from shrubs and the pH of the soil has to be lifted by adding lime. Farmers will only make this investment if they foresee a reasonable return, which implies they need to be convinced that- at least during a pay-back period for this investment- profitability of crop production will be high enough to recoup the investment with a certain internal rate of return. In short, commodity prices need to be high. However, once the investment has been made they will calculate, as every other producer does, by looking at the re-investment cost – at least in the long run. Therefore, the initial special price incentive is needed, although in the long run these producers will be no different than others. The same argument holds true when considering special political risk associated with an investment in the expansion of crop farming.

Sticking to the example of Brazil, one has, however, to keep in mind that also before 2008, a significant and increasing expansion of crop production in rather remote regions such as Mato Grosso had taken place. During that time no special incentive from crop prices was in place – just the opposite was true.

VI. Since commodity prices have gone up, producers have been motivated to boost output by using more (or any) and better inputs such as seeds, fertilizers and crop protection products which resulted in higher cost of production and hence prices have to stay high.

Provided only one factor – for example nitrogen – is used more intensively, this hypothesis is in line with conventional economic theory although it is very hard to quantify this effect. As far as the developed world is concerned, the intensification effect from higher commodity prices is most likely rather marginal. At least typical *agri benchmark* farms in these countries did not experience any significant changes in intensity after the price spike in 2008. The hypothesis is that production systems in the developed world tend to operate at or close to the agronomical maximum and the production function at this stage is rather flat. In other words: a change in intensity will lead to only marginal changes in output.

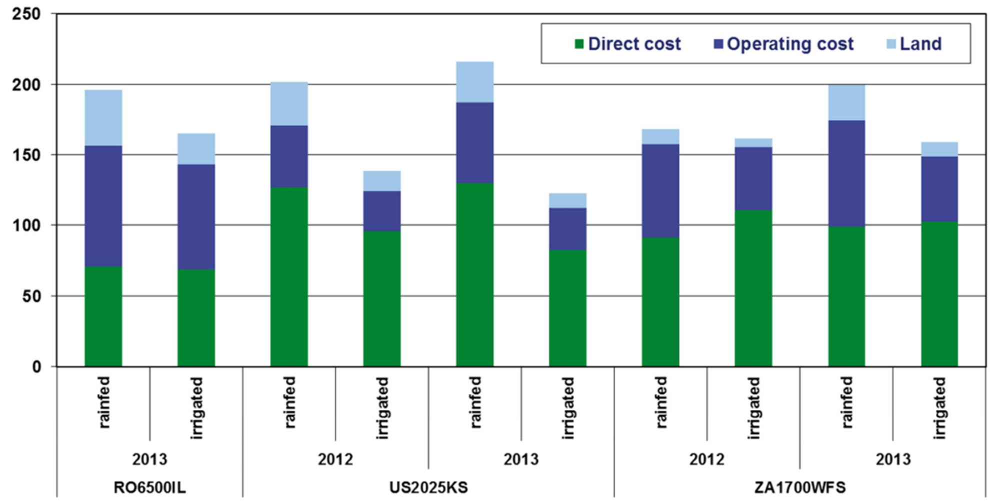
This situation is of course rather different for growers in countries such as the former Soviet Union, new EU member states in Eastern or Central Europe, or Latin America. Given the rather low intensity in - for example - fertilizer use, any substantial increase in prices will lead to a higher intensity in order to boost production.

Unfortunately, there is no systematic and internationally comparable data available for different farming systems at identical sites in the countries mentioned. When comparing *agri benchmark* data from all different intensity levels globally, the following results can be found: Taking the nitrogen input per hectare as one important indicator for intensity, there is absolutely no correlation between the intensity and the cost of production per tonne – neither in direct cost nor in operating cost or in total cost of production. The same holds true when using expenditure for crop protection products.

The possible reason for this is that in the long run, farmers do not only use more fertilizers, but they modify the entire production system. They use better seeds. They place the seeds more precisely and they modify the seed density. They use more precise machinery to spread fertilizers and they split fertilizer applications into additional, separate applications – just to name a few improvements to the entire system. In theoretical terms, they move from one production function to another. In such a scenario, it is quite possible that a comprehensive intensification does not lead to an increase in total cost of production per unit of output, which is what *agri benchmark* figures suggest. Analysis based on the concept of total factor productivity (TFP) supports this hypothesis. FUGLIE/WANG (2012) for example found that between 1991 and 2009 crop yields went up by only 1.4 % per year while TFP increased by 1.6 %. Of course further research is needed to better understand these changes.

When looking at the cost effects from a rather pronounced intensification - moving from rainfed to irrigated corn production – the findings based on *agri benchmark* data clearly indicate a reduction in cost per tonne (see Figure 7).

Figure 7: Rainfed vs. irrigated corn production cost at the same location (in USD/t)



Source: ***agri benchmark*** (2014)

At all three locations in Romania, the U.S. and in South Africa, cost of production (which includes depreciation and finance for farm level irrigation equipment) is lower under irrigation compared to the rainfed system. However, it should be noted that (a) farm level investments for irrigation are significant (which raises the issue of access to and terms of credit) and (b) the yield increase caused by irrigation is rather high in these case studies (4 to 6/ha).

Of course these indications are far from scientific proof that there is no cost effect from intensification, but the conclusion that these effects on total cost of production -

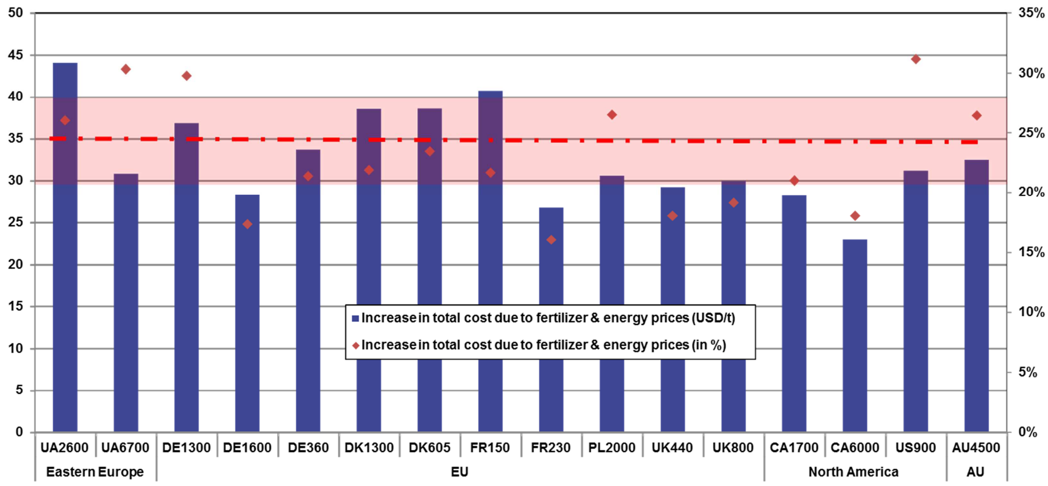
should they exist at all – cannot be the cause for the strong increase in prices seems reasonable.

VII. Since global energy and fertilizer prices are much higher than before, cost of production has gone up.

Clearly crop production is dependent on energy input. This does not only refer to diesel used to run machines but also to nitrogen fertilizers. Since nitrogen production is based on energy, nitrogen prices are almost perfectly linked to energy prices in the long run[8]. Of course energy prices have a broader impact on cost of production since energy is used to produce machinery, transport goods and the like. However, since these effects are relatively minor compared to the above mentioned effects and therefore not very likely to cause the price increase in commodity markets, they will be ignored hereinafter. Between 2008 and 2012, crude oil prices were in the range of USD 100/bll. Compared to the pre-2008 period when crude oil was traded at USD 30/bll, this equals an increase of about 230 %.

Furthermore, in the period mentioned also prices for phosphate and potash have gone up significantly – by more than 200 % and 300 % respectively.

Figure 8: Cost increase in wheat from 2000 to 2012 due to higher energy and fertilizer prices (in USD/t)



Source: ***agri benchmark*** (2014)

Under the assumption that prices for energy based inputs used by growers behaved the same as crude oil prices, one can calculate energy based and fertilizer cost for the pre-2008 period[9]. As demonstrated in Figure 8 , this calculation indicates that due to higher energy and fertilizer prices, the overall increase in cost of production has been in the range of USD 25 to USD 35/t.

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[8] Since nitrogen is produced from natural gas, the link to crude oil is indirect and only valid in the long run. Therefore, in the short run, it may happen that nitrogen can be produced much more cheaply than what crude oil prices would suggest. This phenomenon can be currently observed in the USA because of the boom in gas exploration which exceeds local demand and has prompted investments in nitrogen production.

[9] Since *agri benchmark* Cash Crop figures are available only from 2008 onwards, this theoretical calculation had to be made.

VIII. Summary and conclusions

(1) Contrary to public and wide spread expert perception, compared to historical data, the future long-term increase in global demand for agricultural commodities will most likely be lower. Unless global policy makers return to aggressive biofuel policy measures such as mandatory blending as we have seen in the USA or the EU, it is unlikely that we will see spikes in demand.

(2) The so-called bushel-barrel-correlation has the potential to lead to a significant and lasting increase in global commodity prices in the long run. First calculations indicate that at a price of USD 100/bbl, the respective equilibrium price for corn could be in the range of USD 160/t. Assuming that this would become the long term floor price for corn, this would of course constitute a major increase compared to pre-boom price levels, but is still light years away from what has been projected by OECD and FAPRI.

However, recent (winter 2014/15) price developments on global energy markets with prices below 60 USD/bbl – which of course could not be foreseen by OECD and others – make this consideration obsolete. It is hard to imagine that at such energy prices the bushel-barrel correlation will constitute any support for global ag commodity markets.

(3) Also on the supply side, there are a number of indications that the ability to expand production in the long-run is dramatically underestimated by many stakeholders and the general public. Not only do we still have massive untapped yield potentials – for example in wheat more than 40 % of the agronomical possibilities are yet to be mobilized. But also land is not in short supply globally. Depending on estimates, about 700 million hectares of arable land is still available – without touching the rain forest or other ecologically sensitive areas.

(4) Against this background, it is reasonable to assume that in the long run, growth in global supply will be able to meet (and exceed) growth in demand again. This in turn implies that agricultural prices will again be driven by cost of production and transport to f.o.b. destinations.

(5) Empirical data from *agri benchmark* Cash Crop does provide some evidence to support the hypothesis on structural changes in global crop production which in the long run should lead to a lasting increase in cost of production and hence ultimately to higher commodity prices. In particular the following findings are important:

    (a) Higher energy and fertilizer prices have indeed led to an increase in cost of production. For wheat, respective figures from *agri benchmark* suggest that this could be in the range of USD 35/t. However, it is important to take into account that crude oil prices have gone down significantly recently due to the expansion of fracking. In a scenario in which crude oil will be traded at USD 60/bbl the increase in cost of production would be halved.

(b) When the increase in output comes from more remote locations, with longer distances to export harbors and a less developed infrastructure, it will lead to higher free on board (f.o.b.) cost. A case study from Brazil[10] suggests that this increase could be in the range of USD 30/t.

(c) The possible cost effects from intensification of production could not be checked in a conclusive manor. However, the analysis of the interaction between intensity in fertilizer use with cost of production suggests that this effect should not be that strong. But of course further research on this topic is advisable – especially for producers in Eastern Europe with strongly underdeveloped production systems.

(6) Theoretical considerations as well as empirical data suggest that at least major parts of these increases in cost of production can and will be borne by land lords through reduced land rents rather than by consumers through higher commodity prices. It was possible to demonstrate, that even at rather low yielding sites, current land rents lead to land costs in the range of USD 25 to USD 50/t of wheat or corn and hence available as a buffer for cost increases.

(7) Of course, based on these selected figures, it is not possible to draw firm conclusions regarding the expected long-term increase in commodity prices but an order of magnitude can be defined:

(a) When looking at the major expansion regions globally (primarily Brazil and Argentina) it appears that they are indeed more remote. Therefore an increase of USD 30/t in f.o.b. cost is a reasonable figure.

(b) Provided energy prices return to the level of about USD 100/bbl, this would affect more or less all sites, hence an additional increase of about 35 USD/t is a realistic scenario.

(c) The gross increase in costs adds up to USD 65/t. In order to be on the safe side,[11] it is assumed that only roughly 50 % of this increase will be compensated by reduced land rents acting as a buffer. This means, an increase from USD 150 per tonne wheat to USD 180/t might be a reasonable estimate for the long term price effect. Of course, if crude oil prices stay at USD 60/bbl, the long-term price level would be at least USD 10/t lower.

(8) One may (and should) challenge details of these considerations and argue about missing bits and pieces (e.g. the unsolved intensification issue or the fact that also other inputs, machinery and labor are becoming more expensive), but in the light of the data presented, it is hard to assume the world will indeed see long-term commodity prices in the range of USD 270/t wheat or the equivalent of USD 215/t of corn.

[10] While the case study in Brazil examined soybean handling, it can be assumed that a comparable calculation for wheat or corn would lead to rather similar figures.

[11] In countries such as the U.S. with rather short-term and rather transparent rental markets, the transmission between reduced profitability of crop production onto land rents is usually much stronger.

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