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Rethinking the global food crisis: The role of trade shocks

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ABSTRACT

Although fundamental factors were clearly responsible for shifting the world to a higher food price equilibrium in the years leading up the 2008 food crisis, there is little doubt that when food prices peaked in June of 2008, they soared well above the new equilibrium price. Numerous arguments have been proposed to explain overshooting, including financial speculation, depreciation of the United States (US) dollar, low interest rates, and reductions in grain stocks. However, observations that international rice prices surged in response to export restrictions by India and Vietnam suggested that trade-related factors could be an important basis for overshooting, especially given the very tangible link between export volumes and export prices. In this paper, we revisit the trade story by closely examining monthly data from Thailand (the largest exporter of rice), and the United States (the largest exporter of wheat and maize and the third largest exporter of soybeans). In all cases except soybeans, we find that large surges in export volumes preceded the price surges. The presence of these large demand surges, together with back-of-the-envelope estimates of their price impacts, suggests that trade events played a much larger and more pervasive role than previously thought.

Background

> *"Since the market events of 1972, most market observers consider exports to be the great uncertainty underlying commodity supply, demand, and price forecasts. In 1972, the Soviet Union made unexpected purchases of large amounts of U.S. grain. Prices for corn, wheat, and soybeans climbed to record-levels in 1973, then to still higher levels in 1974. Congress responded by mandating export sales reporting by USDA beginning in 1973." From Randy Schnepf's (2006) Congressional Research Services Report for Congress, entitled "Price Determination in Agricultural Commodity Markets: A Primer".*

The surge in international cereal prices over 2007 and 2008 was truly a crisis. From 2003 to their peak in mid-2008, the international prices of maize and wheat roughly doubled, while rice prices tripled in a matter of months rather than years (Fig. 1). No one knows for sure how many people were driven into poverty by the food crisis, but the World Bank puts the sum at over 130 million people, while the FAO predicts that 75 million additional people became malnourished (OECD–FAO, 2008; USDA, 2008a). Yet while the scale of the recent world crisis was on par with the 1973–1974 crisis, the most popular explanations of the 2007–2008 food crisis seem inconsistent with the quote above in that they are largely unrelated to exports or trade. The laundry list of popular explanations includes rising oil prices, growing biofuels demand, evolving Asian diets, declining research and development in agriculture, slowing yield growth, low stocks, macroeconomic imbalances, financial speculation, droughts, and export restrictions. Whilst a few of these explanations can be directly or indirectly linked to trade events, few if any observers have emphasized trade shocks as "the great uncertainty" underlying the most recent volatility in food prices. Was this most recent crisis fundamentally different from earlier food crises, or are trade shocks still a central feature of international price volatility?[1]

Of course, many early analyses of the food crisis were hastily conducted in response to the pressing demands of policymakers and the media, while some of the factors listed above were independent research interests for many years prior to the food crisis (such as evolving Asian diets, declining research expenditures on agriculture, and slowing yield growth) that were then called upon when the crisis hit. Subsequent and more thorough analyses of the crisis eventually did a better job of sorting the wheat from the chaff, albeit with few formal methods and quantitative estimates, and with ongoing debates regarding certain channels of impact (Abbott et al., 2008, 2009; Gilbert, 2010; Headey and Fan, 2008; Mitchell, 2008; Piesse and Thirtle, 2009; Schepf, 2008; Timmer, 2010). Importantly, most of these studies distinguished between long-run drivers of food prices (meaning those that appeared to be moving the world from a lower to higher food-price regime)

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[1] See Abbott et al. (2008) for a summary of publications on the food crisis.

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and short-run factors that led to the so-called "overshooting" of food prices in late 2007 and the first half of 2008.

Topping the list of long-run drivers is the demand for biofuels that has emerged over the past decade. This entirely new demand source consumed as much as 30% of the US maize crop in 2007/2008, presenting a very tangible explanation for the switch to a higher food-price regime. Rising oil prices (Fig. 1), which have been driven by long-run demand and supply factors as well as by short-run overshooting forces, are also estimated to have substantially increased the cost of agricultural production and trade, even beyond their impacts on the demand for biofuels. Another is that diet changes in fast-growing Asia helped drive the price surge. Virtually all of the abovementioned studies rejected this hypothesis on the grounds that China and India are essentially self-sufficient in cereals, while Indonesia (which is often a large cereal importer) has actually decreased its cereal imports in recent years. However, for a number of years now China and India have significantly contributed to the surging demand for energy and metals (Headey and Fan, 2008), substantially decreased their grain stocks (largely because of policy choices rather than surging demand), and imposed export restrictions that had significant impacts on grain markets (see below). A more general Asian-led commodities boom could also have spilled over into agricultural commodities through other means, such as exchange rate movements and financial speculation (Gilbert, 2010). Asian demand for soybeans and oilseeds also rose significantly, albeit since the mid 1990s rather than more recently (Headey and Fan, 2008).

On the supply side, Timmer (2009), Abbott et al. (2009), and Piesse and Thirtle (2009) have all argued that the long period of low real food prices in the 1980s and 1990s led to under-investment in agricultural production. Consistent with this hypothesis, global food demand outstripped production for a number of years prior to the food crisis. Because of the buffer provided by the depletion of stocks, however, prices did not rise and farmers failed to increase production. However, Headey and Fan (2010) reject the notion that there was any crisis in global grain production. Instead, their examination of grain production data show that the global-level decline seen from the 1980s to 2006 was chiefly due to decreased grain production in the former Union of Soviet Socialist Republics (USSR). Yet despite decreased production, several former USSR countries have actually increased their exports to the rest of the world since the end of the Cold War, suggesting that their decline in production did not contribute to rising export prices.[2]

Perhaps more pertinent than production trends is the aforementioned role of stocks, which constitute an important buffer against the various shocks that inevitably hit agricultural markets. Writers such as Abbott et al. (2009) and Piesse and Thirtle (2009) saw stock declines as a major factor, but acknowledged that stocks (being a residual factor) were depleted because of deeper factors and conscious policy decisions. Headey and Fan (2008) also stress the importance of policy decisions, particularly the Chinese government's decision to reduce excessive stocks at the start of the decade. When data from China were excluded, global stock declines were still evident, but they were far less stark (Headey and Fan, 2008). Nevertheless, since stocks act as a price buffer, the reduction of major grain stocks could help explain the overshooting of food prices in 2007/2008. Piesse and Thirtle (2009) also argue that the decline in stocks encouraged speculation.

Macroeconomic imbalances have long been regarded as a significant channel of overshooting in commodity markets (Frankel, 1984; Schuh, 1974). Low real interest rates and crises in the housing and stock markets, especially in the United States, could have caused money to flow out of interest-bearing instruments and into foreign currencies, emerging market stocks, other securities, and commodity futures markets. The depreciation of the US dollar could have significantly boosted US agricultural exports, leading to higher prices in the United States and lower price increases elsewhere (all else being equal). Previous research has indicated that depreciation of the dollar increases commodity prices with an elasticity of between 0.5 and 1.0 (Gilbert, 1989). Taking 0.75 as a midpoint elasticity, Mitchell (2008) calculated that the depreciation of the dollar increased food prices by around 20% during the recent crisis. Comparing the recent spike in food prices with historical episodes, Abbott et al. (2009) argued that the weak dollar accounted for closer to 50% of the recent spike. However, the econometric evidence regarding the impact of dollar movements on commodity prices has so far failed to provide a consensus on the importance of exchange rate movements (Orden and Cheng, 2007; Piesse and Thirtle, 2009).

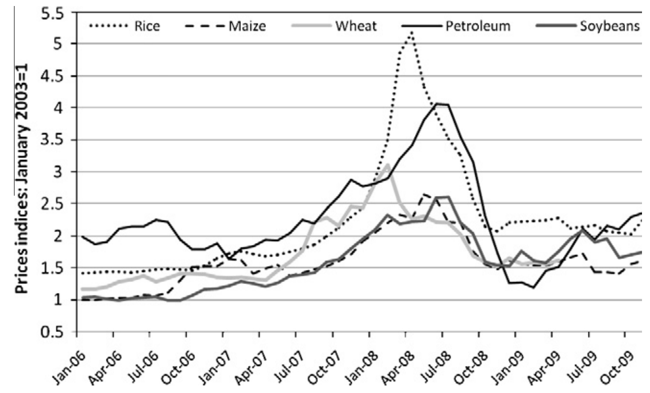

Fig. 1. Trends in the nominal prices of cereals and oil: January 2003 to May 2009. *Source*: calculated by the authors from IMF (2010). All prices are deflated by the US Bureau of Economic Analysis gross domestic product (GDP) deflator, available at http://www.bea.gov/national/index.htm#gdp.

The impact of macroeconomic imbalances on commodity prices via futures market activities is even more controversial. Gilbert (2010) argues that that futures market activity can only affect agricultural prices via inventory levels or stocks. If the futures price is driven above its market clearing level, stocks should accumulate. However, in the short run stocks are largely predetermined by the carryover level from previous harvest, suggesting that increased demand may be accommodated by increased prices rather stock accumulation. Empirically, Robles and Cooke (2009) and Gilbert (2010) find time series evidence that futures market activity might have led to rising spot prices. Yet Irwin et al. (2009) find contradictory pieces of evidence, while Sanders and Irwin (2010) and Headey and Fan (2008) observe that commodities with less speculative capital often experienced greater price increases than commodities with large speculative capital.

Speculation could have taken other forms, of course. In the case of rice, Timmer (2009) argued that the large number of small producers and traders meant that the information available on the true level of stocks was unreliable, thus encouraging speculation, hoarding and panic purchases. Indeed, nearly all the most prominent reviews of this issue have identified export restrictions as significant determinants of price overshooting in late 2007 and 2008, especially in the relatively thin international rice market. But in this paper we explore the broader hypothesis that trade shocks (export restrictions and import surges) were a larger and more pervasive factor in the food crisis. While the case of rice is well

[2] Fuglie (2008) also reported that although he found strong regional variations in productivity growth, although there was no evidence of a productivity slowdown in global agriculture. In any case production would seem a more direct determinant of prices than productivity.

known, to our knowledge only Dollive (2008) has documented the importance of export restrictions in the wheat and maize markets. In this paper, we go one step further by systematically tracking monthly export volumes in the world's largest grain markets: the United States for maize, wheat, and soybeans (for which we also track Brazilian exports) and Thailand, Vietnam and India for rice. Since export volumes are an important direct determinant of international prices (as the above quote from Schepf suggests), the detection of export-volume surges preceding price surges would provide a strong indication that "trade shocks" were a significant factor in the current food crisis.

A second objective of this paper is to estimate the quantitative importance of these trade shocks. Although this is difficult to assess in the absence of reliable econometric or modeling evidence (discussed in 'A short note on methods'), we use back-of-the-envelope calculations similar to those reported by Mitchell (2008) and Timmer (2009) to provide ballpark estimates that at least shed some light on the magnitudes of these trade shocks. A third but far more difficult objective is to at least touch upon the motivations that have driven trade events over the past few years. While many theoretical and modeling approaches depict the behavior of private agents buying to supply their processing and consumption channels, governments around the world are major players in international grain markets (importing and exporting), and speculators could also have purchased and hoarded stocks to resell when prices rose even higher. Although the broad range of countries involved makes it difficult for us to strictly define these behaviors, we at least identify events in the rice market that clearly point to the importance of governments in determining trade outcomes through export restrictions, discretionary government-to-government purchases and other trade policies. Importantly, these types of "trade shocks" effectively served to restrict grain supplies to the rest of the world at a time when larger supplies were needed. Hence, we find that trade events provide an explanation of how a tighter world food situation rapidly turned into a full-blown crisis.

A short note on methods

As we noted above, most of the prior studies on the crisis lack formal analyses such as simulation models or time-series econometric analyses. In fact, the very nature of the crisis revealed the limitations of existing methods. In the case of simulation models, organizations such as the Food and Agricultural Organization, OECD, USDA, and IFPRI all have global simulation models that predict (among other things) the effects of various economic trends and policy actions on food prices. However, although these models gave some indications that food prices would increase (von Braun et al., 2005), they are largely used to forecast medium term price trends of 10–15 year time spans, so none of them really predicted the food crises observed in 1974 and again in 2008.

Indeed, we doubt that these models could have predicted the scale of the recent crisis, even retrospectively. For one thing, these models crucially rely on supply and demand elasticities that are typically derived from econometric estimates relating to the behavior of individual agents (consumers and producers) acting under normal conditions (including normal policy conditions). However, prices rose abnormally fast during the food crisis, thus encouraging panic buying, precautionary purchases, hoarding, large scale government interventions, and so on. This meant that the effective short-run demand and supply elasticities experienced sharp value changes, while the demand for stocks could even increase as prices increase. Government policies were also particularly influential in the food crisis. There were countless cases of export restrictions, tariff reductions, import subsidies and government-to-government purchases, while some governments (for example, Argentina) changed their export policies every few months throughout 2007 and 2008 (see below for more detail).

Given the deficiencies of simulation models, one might be tempted to think that time-series econometric techniques could be a more promising approach, especially since they can utilize monthly or even weekly data. This might be true in principle, but in practice we are highly skeptical of the capacity of time-series techniques to really unravel the drivers of short-run price movements. For example, if supply and demand elasticities experience changes in their sizes during a crisis, then time-series data obtained before the crisis become irrelevant. However, since the price surges in question occurred over the space of a few months, restricting the sample to 2007 and 2008 would give us only 20 or so observations. A second set of problems relates to specification, particularly the exacerbating effects that stock levels have on all sorts of supply and demand shocks, as well as significant substitution effects between crops (below, we discuss substitution effects between maize and soybeans, and between wheat rice). However, existing time series efforts in this literature have not modeled substitution effects or interaction effects. Moreover, none have explicitly measured or tested trade policies (which has its own difficulties).

Finally, the identification of causality remains problematic, even with the use of Granger-causality tests. This is especially true regarding tests of financial speculation, because expectations are vitally important to both the futures market and the spot markets. Hence, justified expectations of higher prices could drive up activity in the futures market, which could in turn drive up spot-market prices. Or expectations of higher prices could simultaneously drive up prices in the futures and spot markets. However, in both cases speculation would not be a genuine cause of the crisis even if some measure of speculation Granger-causes spot prices. To borrow a useful analogy, Christmas cards may Granger-cause Christmas, but they are hardly a real cause of Christmas (Atukeren, 2008).

Of course, we do not mean to imply that simulation models or time-series techniques are without merit. On the contrary, simulation models successfully gave some early warning that biofuels might be a problem for food prices, and the recent OECD–FAO (2009) model has yielded interesting quantitative estimates on the current drivers of world food prices. Likewise, time-series techniques have resulted in some interesting if somewhat contradictory findings on the role of financial speculation. Instead, our argument is that there is a gap in this literature related to the role of short run trade shocks, and that this gap is not easily filled with either simulation or econometric models. Hence, the present study – which chiefly relies on descriptive data, historical analysis, and small bits of econometric analysis and back-of-the-envelope calculations – should be seen as a complement to the existing literature.

We also note that future simulation and econometric work could perhaps improve on our more descriptive analysis by incorporating flexible econometric techniques (for example, switching models with time-varying parameters) or creating simulation models that account for more complex behavioral functions and political-economy factors (such as hoarding, precautionary purchases, and perhaps even "panic"). Particularly important is the critical role of stock behavior. It is clear from the analysis below that countries that are heavily dependent on one or two cereals, such as rice and wheat, can react very sharply to relatively mild price rises, or to expectations of future price increases. Indeed, while the demand for cereals as food may follow a normal downward sloping demand curve, the demand for stocks and strategic reserves is often observed to increase as price increases. India's export restrictions were motivated because of concerns over rice and wheat reserves, and the Philippines procured 1.4 mmt of rice imports in early 2008 when international prices were already very

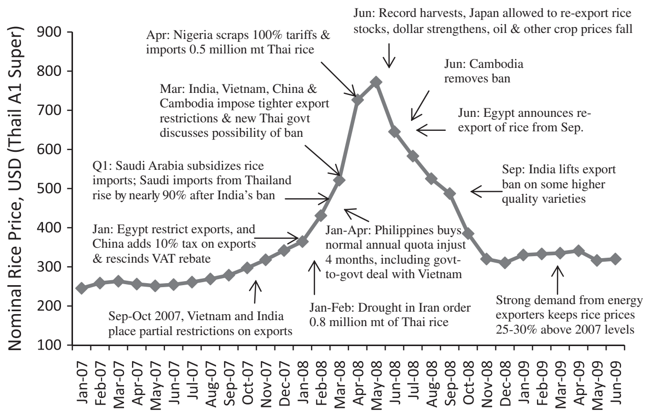

Fig. 2. The effects of export restrictions on rice prices. *Source*: Authors' construction based on the collation of various media articles and USDA Foreign Agricultural Service reports.

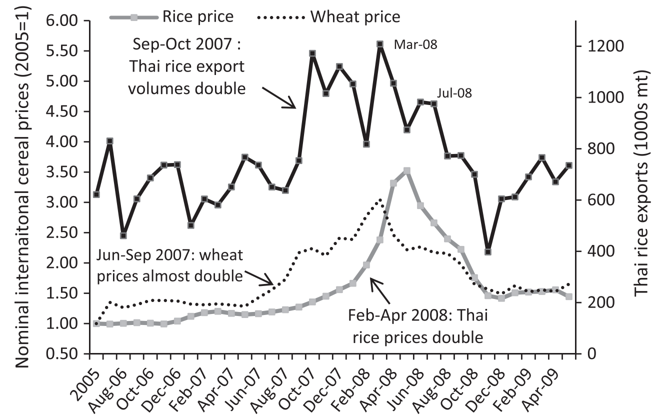

Fig. 3. Wheat prices, rice prices, and the surge in demand for Thai rice exports. *Source*: Thai rice export data are from the Bank of Thailand (2009) while rice and cereal prices are from FAO (2009a). Abbreviation: mt, metric tons.

high, also because government reserves were perilously low. So although high prices normally dictate reduced demand, it is the somewhat perverse demand for strategic reserves that propels international prices even higher, causing a contagion of further panic. Better understanding this behavior – or, ideally, modeling this behavior – should therefore be a higher research priority in the future.

Rice markets

With an analysis of rice-market events, we intentionally begin at the end of the crisis rather than the beginning. As shown in Fig. 1, rice prices started to rise in early 2007 (much later than maize prices and just after the first rise in wheat prices), and then surged dramatically beginning in December 2007. Rice is distinctive in that it is thinly traded; only around 25 million metric tons (mmt) have typically been traded in recent years, or about 7% of global production. Rice is also heavily dominated by Asian exporters (Thailand, India and Vietnam account for 60% of global exports), mostly produced by smallholders, and forms a large proportion of the diets of millions of people (Timmer, 2009). Thus, rice is very important to numerous Asian governments, and is subject to a variety of trade distortions even in normal times. In the context of the food crisis, it is already well known that discretionary trade actions played a major role in driving up rice prices, but we aim to provide a more in-depth analysis of why trade restrictions were imposed in the first place. We also aim to quantitatively gauge the importance of these actions.

The usual story told about rice markets is demonstrated in Fig. 2 (see, for example, Headey and Fan, 2008; World Bank, 2008. The beginning of the surge in rice prices coincided with the October 2007 decisions of Vietnam and India to restrict rice exports. According to the United States Department of Agriculture (USDA),[3] Vietnam placed a partial ban on new sales in late September of 2007 because it had over-sold in the global market, which raised concerns within the government about rising domestic food prices. India also announced an export ban on October 9th in response to rapid increases in domestic food prices and strong demand for its exports, although on October 29th it lifted the ban and replaced it with a minimum export price of $425 per ton, which was still around $100 higher than comparable prices in Thailand's export market (Dorosh, 2009). Since India and Vietnam each accounted for around 15% of global exports, their export restrictions spread further panic into world cereal markets. Fig. 2 also shows that in early 2008, export bans were imposed by Egypt in January, while China increased taxes on exports. Then in March Cambodia, India, and Vietnam imposed export bans, although these were generally not universal – India made exemptions for Bangladesh, Bhutan and several poor African countries, and Vietnam promised to fulfill existing orders and still made discretionary government sales.

Nevertheless, these restrictions still resulted in widespread concern among major rice importers. One of the largest net importers of rice, the Philippines, arguably engaged in panic buying, importing 1.3 mmt of rice in just the first four months of 2008, an amount that exceeded their entire import bill of 2007. Most of these imports were sourced from Vietnam in a government-to-government deal. Nigeria, also among the largest importers of rice, waived its 100% tariff on rice in early 2008 and procured 0.5 mmt from Thailand. Anecdotal evidence suggests that Saudi imports from Thailand rose by nearly 90% after India's export ban,[4] and Saudi Arabia December 8, 2007, the the government began to subsidize rice imports in January 2008 to the tune of $266.67 per metric ton (USDA, 2008b). A drought plus high inflation also caused concern in Iran, which ordered 0.8 mmt from Thailand. And a number of governments – Malaysia, the Philippines and Indonesia, for example – announced that they would double or triple government held stocks, largely through increased imports. In addition to these more observable acts are the unobservable forms of hoarding that individual rice consumers and small rice farmers inevitably do in such situations (Timmer, 2010). Indeed many governments announced serious penalties for hoarding.

Obviously the surge in rice prices could not last forever. Rice prices were so high in May 2008 that even cashed-up oil exporters were reluctant to buy at such inflated prices. Record harvests in mid-2008 also indicated that supply was unlikely to be a constraint. In May, Japan was also permitted to re-export some of its rice stocks, and although it has been reported that these re-exports never actually took place, the announcements may have helped calm markets (Nakamoto and Landingin, 2008). In any event, the turnaround in late May was followed by further price declines as trade restrictions eased, other commodity prices fell, and the dollar strengthened. If speculative hoarding were also at play (Timmer, 2009), then it too would have petered out as speculators realized that prices could not continue to rise.

[3] See http://www.ers.usda.gov/news/ricecoverage.htm.

[4] *Source*: Zawya, 2008. "Authorities Take Steps to Boost Rice Imports". 20th May, 2008. Riyadh.

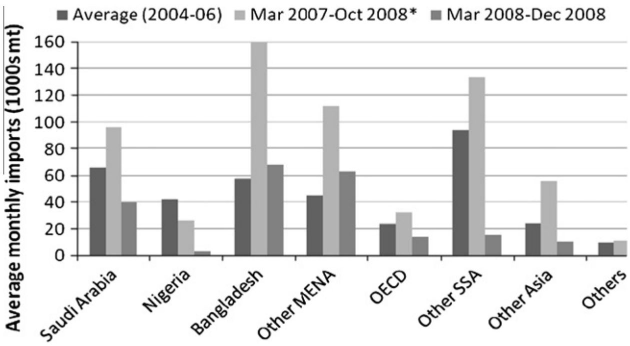

Fig. 4. Average monthly Indian rice exports by destination: 2004–2008. *Notes*: Abbreviations: MENA = Middle East and North Africa; SSA = Sub-Saharan Africa. *We were only able to obtain annual figures for the year running from March to February. Since annual figures disguise the surge in Indian rice exports from March 2007 to October 2007 (due to the rice export ban from November onwards), we obtained an estimate of monthly rice exports for March 2007 to February 2007 by dividing the annual figure (March 2007 to February 2007) by eight months instead of 12. Bangladesh, Bhutan and 'Other SSA' countries were the exception here; these countries were excluded from the export ban, so their annual figures were divided by 12. *Source*: Department of Commerce, Government of India. http://commerce.nic.in/eidb/Default.asp.

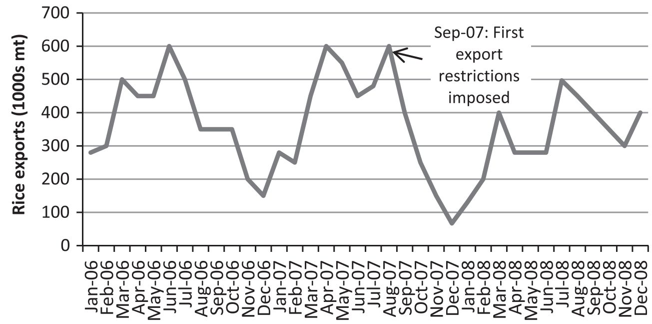

Fig. 5. Monthly rice exports from Vietnam, 2006–2008. *Source*: General Statistics Office of Vietnam (GSO, 2009); http://www.gso.gov.vn.

The above account of events in the rice market is conventional; similar stories are told in several other studies (Abbott et al., 2008, 2009; Brahmbhatt and Christiaensen, 2008; Dorosh, 2009; Headey and Fan, 2008; Mitchell, 2008; World Bank, 2008). However, the Vietnamese and Indian governments' decisions to restrict rice exports cannot be treated as exogenous events. In fact, rice export markets were under tremendous pressure prior to these restrictions, and we argue that much of this initial pressure was a spillover effect from wheat markets. Our argument is supported by Fig. 3, which shows international wheat prices, Thai rice export prices, and monthly Thai export volumes. Thailand's export market is particularly important because Thailand is the largest rice exporter in the world (comprising around 30% of global exports), and Thai export data are at least unbiased by explicit export restrictions.[5] Hence, they can be used as a relatively good indicator of demand patterns, including trade-diversion effects and precautionary purchases.

The chronology of the wheat-rice story in Fig. 3 is as follows. First, wheat prices almost doubled from June to September 2007. In September and October, the demand for Thai rice exports doubled within virtually a single month. These levels stayed high well into 2008, even as rice prices surged. A similar surge in mid 2007 is also evident in the Indian rice export data (Fig. 4). From April 2007 until the ban on rice exports in November 2008, there was a large surge in demand for India's rice exports from Bangladesh, the African countries, the Middle East and North Africa (MENA), and several Asian countries. And although the surge was milder in Vietnam, Vietnamese export data also demonstrate that there was strong demand for their rice exports prior to the first export restriction in October, with rice exports around 8% higher in the first nine months of 2007 than they were in the corresponding period of 2006 (Fig. 5).

The Thai and Indian export data demonstrate particularly well that the international demand for rice experienced a sharp increase directly after wheat prices rose. How can we explain this apparent connection between wheat and rice? First, India is a large producer and consumer of both wheat and rice. A poor wheat harvest in 2006/2007 put pressure on India's wheat stocks and the country's PDS (which keeps stocks of both wheat and rice). In 2006/07, the government's stocks of wheat fell short of buffer stock norms, and about 6 mmt of wheat was imported (Dorosh, 2009; Gulati and Dutta, 2009). Although rice was in surplus, and India exported more than 4.5 mmt of rice that year, the fear of a food shortage weighed heavily on policymakers, especially given that international wheat prices were surging sharply in early to mid 2007, and export restrictions on wheat were beginning to emerge. Thus, if we look at it purely from the Indian point of view, there was a very strong connection between events in the domestic wheat and rice markets.

However, there is also a strong but not widely recognized connection between wheat and rice on the international scale. Specifically, wheat prices can have a strong impact on rice prices, rather than vice versa, because:

(a) the demand side of the international rice markets is quite concentrated, whereas wheat markets are large and much less concentrated; and
(b) many of the largest rice importers, who can substantially affect rice prices because the market is so thin, are also large wheat consumers.

Table 1 lists wheat and rice consumption and trade data for the largest rice importers. All of the countries listed in Table 1 imported at least 0.7 mmt of rice per year prior to the crisis, and together they comprised around a quarter of the world's pre-crisis rice demand. Moreover, many of these countries were either large wheat consumers (Iran, Iraq, Saudi Arabia, and the European Union (EU)) or large wheat importers (the Philippines, Nigeria, Indonesia, and Japan). There is a strong correlation (around 0.40) between wheat and rice imports across countries, whereas rice and maize have a lower degree of correlation (0.20). Finally, using monthly data from 1957 to 2009, we find that wheat prices do indeed Granger-cause rice prices (but not vice versa), with an elasticity of around 0.10. However, for the reasons outlined in 'A short note on methods', it is quite likely that this elasticity would be considerably higher in tighter market situations, such as 2007 and 2008. So when wheat prices surged in early to mid 2007, it seems probable that many wheat-importing countries switched some of their cereal demands over to rice.

In summary, the roots of the rice crisis probably lay in tighter wheat markets, which in turn triggered higher rice demand, higher rice prices, and the resulting cascade of export restrictions and

[5] However, as one reviewer pointed, the Thai government intervenes very actively in the domestic rice economy, with significant implications for its level and price of international trade in rice. According to Brahmbhatt and Christiaensen (2008) Thailand raised its support price for rice to $825 a ton for 3.5 million tons of its production, which might have curtailed exports somewhat. It also maintained relatively large government buffer stocks of 2 mmt (Slayton and Timmer, 2008), which was around 13% of domestic production, but over a quarter of domestic consumption. The Thai government also openly considered invoking exports restrictions in March of 2008. However, relative to other rice exporters, Thailand did relatively little to curtail exports, as the data in Figs. 3 and 6 suggest.

Table 1
Connections among wheat consumption, wheat imports, and rice imports. *Source*: Wheat consumption data are from the FAO (2009b). Trade data are from USDA (2009c).

Largest rice importers	Dependence on wheat in diets and trade			Importance in rice trade	
	Wheat consumption (% total calories)	Wheat imports (mmt)	Share in world imports (%)	Rice imports (mmt)	Share in world imports (%)
Philippines	8	8.3	2.5	1.6	3.1
Nigeria	5	10.0	3.0	1.5	2.8
Iran	45	1.7	0.5	1.4	2.6
Saudi Arabia	28	0.2	0.1	1.3	2.4
EU-27	20[a]	19.0	5.7	1.2	2.2
Indonesia	6	15.4	4.6	1.0	1.9
Iraq	45[a]	10.9	3.3	0.9	1.7
Cote d'Ivoire	5	0.9	0.3	0.8	1.5
South Africa	16	3.5	1.0	0.8	1.4
Malaysia	15	3.8	1.1	0.8	1.4
Japan	13	17.0	5.1	0.7	1.3

[a] Wheat consumption data for Iraq were not available and were approximated using data from Iran, which has a similar diet. Wheat consumption data for the EU were approximated by averaging data for Germany, France and Spain. Data relate to 2004–2006.

Table 2
Estimating the contribution of export restrictions and import surges to changes in international rice prices in 2007/2008 based on a counterfactual of zero change from 2006/2007. *Source*: Rice prices are Thai export prices reported by the FAO (2009a), with price changes depending upon the variety (Thai A1 Super and Thai 100% B). The authors' calculations of export volumes are from USDA (2009c) data on exports and imports, except for Vietnam (see notes below).

Country/region	Export/import volumes (millions mt):			Percentage change (%)	Change relative to world trade (%)	Impact on prices, all else equa[c] (%)
	2006/07	2007/08	Change			
Total rice trade	31.44	31.19				
Major exporters						
India	5.74	4.65	−1.09	−18.9	−3.5	23.0
Vietnam[a]	4.07	3.11	−0.96	−23.6	−3.1	20.4
China	1.34	0.96	−0.37	−27.7	−1.2	7.9
Egypt	1.20	0.75	−0.45	−37.7	−1.4	9.6
Sum: supply shocks	12.35	9.48	−2.87	−23.2	−9.1	60.9
Major importers						
Energy exporters[b]	5.43	6.43	1.04	19.2	3.3	22.0
Philippines	1.82	2.57	0.77	42.8	2.4	16.3
Bangladesh	0.76	2.04	1.28	166.2	4.1	27.1
Sum: demand shocks	7.96	11.05	3.09	38.7	9.8	65.4
Sum: demand and supply side shocks						126.3
Actual change in world rice prices: July 2007 to June 2008						117–149

[a] Data for Vietnam from USDA (2009c) contradicted Vietnamese government data, the source for which is Vietnamese (GSO, 2009). We considered Vietnamese government data to be reliable and hence used these in the calculations above.
[b] Energy exporters mostly include oil exporting countries in the Middle East, as well as Nigeria.
[c] To calculate the potential change in rice prices, we assume a net short-run demand elasticity of −0.15, as in Timmer (2009).

demand surges. But while it is important to identify these events, it is equally important to at least estimate the quantitative importance of these trade shocks. In the first column of Table 2 we list the major sources of rice trade shocks on both the export side and the import side, while the next four columns list trade volumes in 2006/2007 and 2007/2008, the absolute change between these two years, and the percentage change. On the export side we see that the largest reduction in trade volumes in 2007/2008 came from India, which imported over 1 mmt less than it did in 2006/2007. This was closely followed by Vietnam (0.96 mmt), with much smaller reductions from Egypt and China. On the demand side the shocks are larger. Bangladesh imported an extra 1.28 mmt of rice, while energy exporters like Saudi Arabia, Oman, UAE and Nigeria also increased exports, often on the back of import subsidies (Saudi Arabia) or large tariff reductions (Nigeria), as well as huge oil windfalls. Together these countries imported an extra million mt of rice in 2007/2008. Finally, the Philippines imported an extra 0.77 mmt, mostly from Vietnam in a government-to-government deal. Given that the rice trade was about 30 mmt in 2006/2007, the export shocks listed reduced global rice exports by just over 9%, while demand shocks added about 10% to global import demand. Hence these shocks are certainly significant.

We can approximately gauge how significant by relating these trade shocks to price responses through an assumed net short-run elasticity of demand. To do so, we borrow parameters from the model of cereal price transformation used in Timmer's (2009) analysis of the crisis in global rice markets. This model has a long run component which is obviously not pertinent to our analysis of the short run, which pertains to a matter of months rather than years. So we instead focus on the net short-run elasticity of demand, which is the difference between the short-run demand and supply elasticities. Timmer (2009) assumes that the short-run demand-response parameter is −0.10. But since rice is mainly produced by smallholders, he argues that the short-run supply response is relatively low at +0.05. Hence, the net short-run demand response is −0.15. In the last column of Table 2 we divide the size of each 2007/2008 trade shock (measured as a percentage of global 2006/2007 trade) by this elasticity to obtain an estimate of what could be expected to happen to global prices from each trade shock. We find that each of the major trade shocks could *each* have added 15–27% to global prices. The export side alone could have added 61% in aggregate, while the import shocks could have added 65%. The sum of these price increases (125%) falls within the price range actually observed in Thai markets from July

2007 to June 2008, which was 117–149%, depending on the rice variety.

Of course, these are only back-of-the-envelope estimates, so they obviously come with caveats. For example, while these shocks pushed prices upwards, they were certainly countervailing supply and demand forces. Thailand increased exports as did a number of smaller exporters, and Indonesia – one of the largest importers of rice prior to the crisis – reduces its exports by over 1.5 mmt in 2007/2008. The elasticities we have assumed could also be too high or too low, but at least the assumptions are transparent and easily subjected to some easy sensitivity analysis. Moreover, our results are broadly similar to the findings of the more formal appraisal of the impact of India's export ban on rice prices by Mitra and Josling (2009). And if the parameters employed in these models are even broadly accurate, it is quite clear that trade shocks were the primary cause of the rice crisis.

Wheat markets

In this section, we continue to work our way backwards by investigating events in the wheat markets, which, as we observed above, seem to have precipitated the rush on the rice markets. As with rice, we concentrate on the largest wheat export market, the US market, which plays a significant benchmarking role in determining prices elsewhere.

There are two good reasons why trade events could have been extremely important in determining US wheat prices. First, exports accounted for around half of the total wheat usage in the United States (excluding restocking), and over 2000–2008 US wheat exports were around five times as volatile as domestic food use (which was highly stable). Second, although the US wheat market is the world's largest, the United States only accounts for around 25% of world exports. Since the global wheat market has some other big players, there is a strong likelihood that export restrictions had an important influence on wheat prices. The top 10 wheat exporters are listed in Table 3, which also notes which of these exporters experienced drought and/or export restrictions (i.e. "trade shocks"). For example, a severe and rather long-term drought in Australia (which accounted for 12% of world exports over 2000–2009) put pressure on the world's wheat markets for several years. However, export restrictions were also imposed in five other top-10 countries, which together account for 25% of world exports.

Dollive (2008) regards the Ukraine's export ban (later modified to an export restriction) as the most critical of these. He showed that Ukrainian grain exports in 2007 were 77% lower than those in 2006, and he reported that many of the Ukraine's largest grain clients switched entirely to other grain markets, such as those of North America, France, Australia, Argentina, Russia and Kazakhstan. The last two countries are particularly relevant because the Ukraine's export ban increased demand for Russian and Kazakh grain exports, putting greater pressure on these markets and halving their stock-to-use ratios. By early 2008, Russia and Kazakhstan had both implemented export restrictions in an effort to protect prices in their domestic markets. So as with rice, there was a clear contagion effect. Argentina

Table 3
Shares of world wheat exports: 2000–2009. *Source*: Authors' calculations based on USDA (2009c) trade data.

United States	25.0%	Russia (restrictions)	7.8%
Canada	14.1%	Ukraine (drought, restrictions)	3.8%
EU-27	13.5%	Kazakhstan (restrictions)	4.6%
Australia (drought)	12.0%	India (drought, restrictions)	1.9%
Argentina (restrictions)	8.6%	Others	8.7%

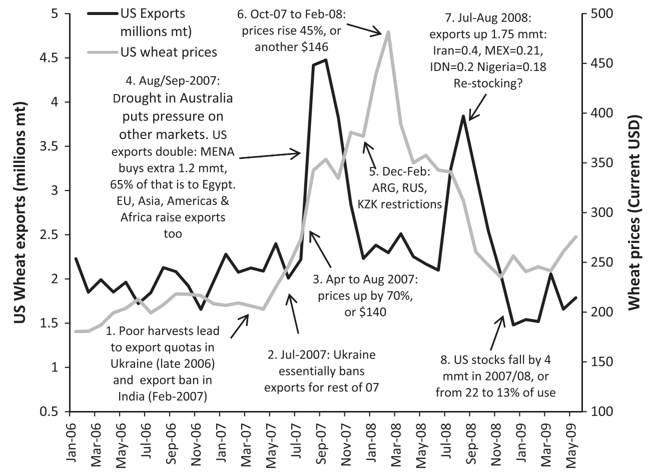

Fig. 6. Demand surges and price increases in the US wheat market. *Notes*: The wheat price relates to US Wheat No. 2 Hard Red Winter, but the trends for the soft red were very similar. Abbreviations: mmt = million metric tons; MENA = Middle East and North Africa; ARG = Argentina; RUS = Russia; KZK = Kazakhstan; MEX = Mexico; IDN = Indonesia. *Source*: Authors' construction from USDA (2009b) export data and FAO (2009a) price data.

also began to indirectly restrict exports by closing its export registry in March 2007, although this only really slowed exports later in the year when the existing registrations began to expire (Dollive, 2008). In November 2007, the Argentine government raised its export taxes on wheat (to 28%), before re-opening and then re-closing the export registry in January and February of 2008, respectively.

The effects of these export restrictions in India, the Ukraine, Argentina, Russia and Kazakhstan are also apparent in the descriptive data (Fig. 6, notes 1, 2 and 4). The Ukraine imposed fairly tight export quotas as early as the second half of 2006, when monthly exports dropped by two-thirds (Grueninger and von Cramon, 2008). India imposed an export ban in February 2007. Then, in late June, the Ukraine announced new export quotas that virtually imposed a complete export ban, such that from July 2007 to March 2008, the Ukraine exported almost no wheat. Coinciding with the Ukraine's effective ban on wheat exports, US wheat prices rose by 70% from April to August of 2007. These initial price increases led to a rush of demand for US wheat exports. US wheat exports doubled from their July 2007 level of 2.2 mmt to 4.4 mmt in August and September of 2007 (Box 4). The August–September surge was principally fueled by an increase of 1.2 mmt of exports to the Middle East and North Africa (55% of the total surge); two-thirds of this 1.2 mmt went to Egypt alone. Other regions (South Asia, East Asia, South America, Africa, and the EU) increased their demands for US wheat exports by around 0.15–0.22 mmt each.

Although not quite as spectacular as events in the Thai rice export market, a doubling of demand for US wheat exports in two successive months should be considered significant, and it is notable that the surge in US wheat exports preceded a second run-up in wheat prices, suggesting that the surge in foreign demand substantially contributed to the total rise in wheat prices. A second effect of the demand surge was to run down US wheat stocks. The extra 4 mmt of exports in August–September of 2007 corresponds exactly to the decline in US stocks from July 2007 to June 2008, when they reached just 13% of total use (domestic consumption plus exports). Insofar as wheat suppliers typically base their prices on existing stock levels, the stock run-down in 2007/2008 probably had a second-round effect on wheat prices. Hence, the combination of low stocks and further export restrictions by Russia, Kazakhstan and Argentina significantly contributed to the price bubble seen in

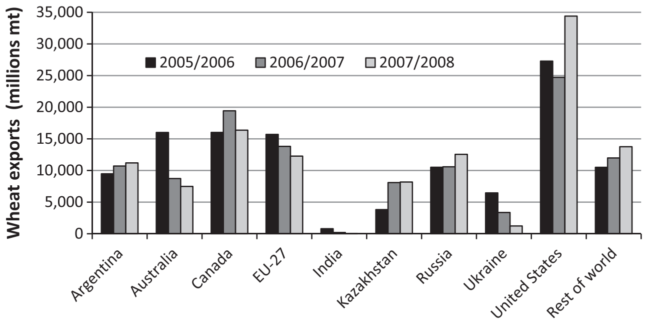

Fig. 7. Global wheat exports: 2005/2006–2007/2008. *Source*: Authors' construction from USDA (2009b) export data.

early 2008. In summary, the message that can be drawn from Fig. 6 is not a simple one, because there is arguably a complex causality at work, with droughts, export bans, price rises and demand surges all intermingling with each other.

As for how quantitatively important these demand surges were, we again perform a simple back-of-the-envelope calculation, this time based solely on the growth in US wheat exports. Table 4 shows US wheat exports grew from 24.7 mmt in 2006/2007 to 34.3 mmt in 2007/2008, and increase of almost 40%! Meanwhile domestic consumption declined slightly, meaning that total demand for US wheat grew by 13.1%. If we again assume a net short-run elasticity of demand, we can use this to estimate the predicted impact on prices. Since wheat is mostly produced and marketed by modern firms in middle- or upper-income countries, however, the short-run supply response could be stronger. We therefore select an elasticity of 0.10. As for the demand side, wheat demand is likely to be more elastic in rich countries, but it could still be quite high in low- and middle-income importing countries. If we again double this elasticity to -0.20,[6] we get a net short-run demand elasticity of -0.30, which is twice the equivalent elasticity that we assumed for rice markets. Simply dividing 13.1% by 0.30 suggests that the surge in US exports would result in wheat prices being around 44% higher in 2007/2008 than they were in 2006/2007. In actuality, wheat prices were 72% higher in 2007/2008 (Table 4), suggesting that the surge in US exports might account for around 60% of the total wheat price increase. Of course, our elasticity might be too low or too high, but given that virtually the entire surge in US exports took place in July and August of 2007 it is possible that trade shocks account for an even larger share of this 72% price increase.

The last remaining question is how much of this trade shock to US wheat markets was due to export restrictions, the drought in Australia, or panic purchases aimed at securing supplies before prices increased further or before additional restrictions were imposed. Fig. 7 shows the trends in wheat exports by country for from the 2005/2006 season to the 2007/2008 season. The Australian drought was the largest shock to global wheat markets, accounting for 48% of the global fall in wheat exports from July 2006 to June 2008. Ukraine's drought and export restrictions accounted for 29% and the EU for 19%.[7] In 2006/2007 the Australian shortfall was mostly made up for by increased exports from Canada and Kazakhstan. However, in 2007/2008 the ongoing shortfall was chiefly made up by the large increase in US wheat exports (Fig. 7).

Maize markets

Despite the importance of trade events in rice and wheat markets, there has been virtually no discussion of trade events being an important factor in maize markets. This omission is understandable in light of some important facts regarding the global maize market. First, the United States heavily dominates the global maize trade, accounting for around 60% of world exports, so trade restrictions elsewhere have less scope to influence international price. Second, maize is used as livestock feed in much of the world (whereas rice and wheat are very much staple foods) so the demand for maize may be relatively elastic; i.e. less sensitive to trade shocks. And even in the US feed demand makes up the dominant share of total maize demand. Third, previous studies have shown that rising oil prices added significantly to maize production and transportation costs (Headey and Fan, 2008; Mitchell, 2008). Finally, the diversion of US maize to biofuels use is such a new and large shock to the US maize market, that trade-based explanations of rising maize prices would seem unnecessary.

However, despite the intuitiveness of this *a priori* position, there is some existing basis for thinking that trade events might also have affected maize markets. For example, maize exports as a share of total maize use in the United States might be small, but the export component is significantly more volatile than the feed or biofuels components. As for the elasticity of demand, it is also possible that the demand for maize is more inelastic that we think because some of the countries that use maize as an input into livestock production might have few feed alternatives in the short run, especially with strong demand for soybeans from countries like China. Lastly, several export restrictions were imposed by some of the largest maize exporters, including Serbia, Argentina and China. The latter two are the largest maize exporters after the United States, and Dollive (2008) demonstrated that the export restriction imposed by China could have diverted a significant amount of demand to the US market, particularly from South Korea, which is typically the second largest maize importer in the world. Our own calculations from USDA (2009c) data suggest that the Chinese restriction withdrew at least 5 mmt of maize from the world market, although countries such as India and the Ukraine picked up much of the slack.

In any event, since the United States is easily the largest maize exporter in the world, it is essential that we look at both US exports and US domestic consumption (since the latter comprises 80% of US maize use). As in the previous sections, we plot monthly US exports against US prices, but here we also plot the domestic use of maize in the United States. Astonishingly, Fig. 8 shows that US maize exports have surged twice in recent years, from March to May of 2006 and August to November of 2007, and that these two import surges preceded two large price surges. The first export surge involved a 2 mmt (or 54%) increase, which was followed by a 59% price increase. The second export surge, totalling 3 mmt (65%; August–November 2007), was followed by a 75% price increase from September 2007 to May 2008. So as we saw in the rice and wheat markets, large export surges again precede price surges. In fact, the export surges in the US maize market so neatly precede the price increases that we are forced to question our *a priori* position that trade events were only a minor factor in maize markets.

Another puzzling question relates to which maize-importing countries contributed to this surge. As we indicate in Fig. 8, although South Korea was a major part of the smaller surge in early 2006 (along with Mexico, Indonesia, and North African countries), the much larger 3 mmt surge from August to November of 2007

[6] Since the 2007/2008 price increase was 74% and the decrease in US wheat consumption was 8%, this would imply a domestic short-run elasticity of -0.11. Thus, demand might be more inelastic than the figure we assumed. Global imports stayed constant, however, implying they are very inelastic in the short run.

[7] These figures were calculated simply by assuming that each country's exports remained unchanged from their 2005/2006 levels.

Table 4
US wheat exports and their estimated contribution to rising US wheat prices. *Source*: Authors' construction from USDA (2009b) export data and FAO (2009a) price data.

	Demand (millions mt)		Change in demand (%)	Predicted change in prices[a]	Actual change in prices[b]
	2006/2007	2007/2008			
US exports	24.7	34.3	39.0		
US consumption	30.9	28.6	−7.5		
Total demand	55.6	62.9	13.1	43.8%	72.4%

[a] This estimated is based on a net short-run demand elasticity of 0.3.
[b] The wheat price relates to US Wheat No. 2 Hard Red Winter. The change in prices is calculated as the average monthly price from July 2007 to June 2008 less the corresponding average for the previous 12 months.

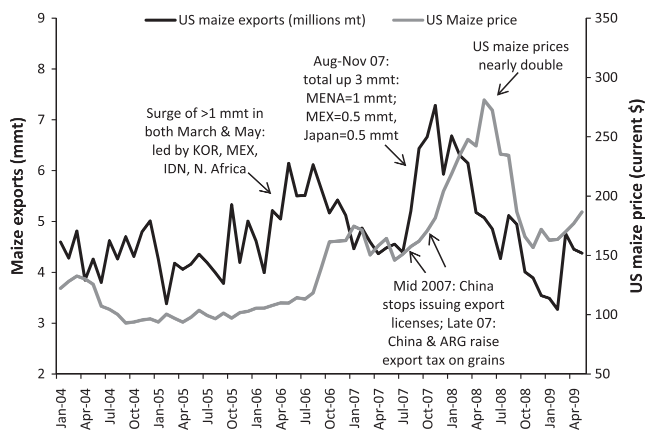

Fig. 8. Surges in demand for US maize exports precede maize price surges. *Notes*: The maize prices relate to that of US No. 2, Yellow. Abbreviations: mmt = million metric tons; MENA = Middle East and North Africa; SSA = Sub-Saharan Africa; KOR = South Korea; MEX = Mexico; IDN = Indonesia; ARG = Argentina. *Source*: Authors' construction from USDA (2009b) export data and FAO (2009a) price data.

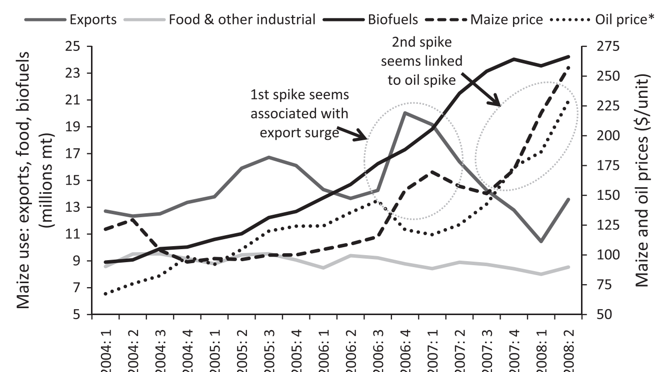

Fig. 9. Trends in different uses of US maize production: 2004:Q1–2008:Q2. *Source*: Author's construction from USDA (2009d) data.

was driven by rapidly increasing demand from the Middle East and North Africa (MENA, which imported an extra 1 mmt over that period), as well as from Japan and Mexico (which each imported around an extra 0.5 mmt). Of these three regions, only Japan imported significant amounts of maize from China (430,000 mt), so China's export restrictions only seem to be a small part of the story. The situations in the other countries are something of a puzzle. Mexico basically imports US maize for feed use, but given the importance of domestic maize in the Mexican diet, future research should look more closely at substitution effects and at the elasticity of demand for maize feed, especially given the so called "tortilla crisis" in Mexico in 2007 and 2008. As for the MENA region, we have no particular evidence of panic, but we conjecture that demand could be quite inelastic there in the short run, perhaps because of the importance of meat consumption in the region's diets.

The remaining puzzle with regard to maize prices relates to the fact that exports are a relatively small proportion of total US maize use. Feed demand is still the largest use of US maize, typically accounting for around 50%. However, we face a data problem when seeking to analyze feed demand, because the USDA groups feed with residual uses (such as restocking), meaning that the series on "feed and residual use" is highly seasonal. In the September–November period of 2006, however, the United States "feed and residual use" series was 13% (or 7.5 mmt) higher than in the same quarter of 2005. This suggests that there was some increased demand from either the livestock industry or the residual components.

Nevertheless, the most likely alternative to a trade story is undoubtedly a biofuels story. Fig. 9 shows quarterly US data for biofuels demand, US food demand and foreign demand, with maize and oil price series given on the right axis. The black line shows that biofuels production more than doubled over 2004–2008, indicating that this was, indeed, an enormous new source of demand for US maize and one that undoubtedly had profound effects on farm areas, land-use decisions, and the expectations of market players. Nevertheless, the growth in biofuels demand does not rule out the importance of trade shocks. As noted above, biofuels demand increased quite smoothly and predictably, which in turn prompted an increase in the amount of land allocated to maize production. Hence, expansion of the maize supply would have at least partially offset the price effects of the demand surge. Granted, the seasonality of maize production means that lags in the supply response could still have induced price spikes in the short run. In particular, the 2006/2007 season (when prices first spiked) did not produce a large maize crop. However, Fig. 9 shows that although 2008 exports were lower than biofuels demand in absolute terms, exports were significantly more volatile than biofuels demand. The first maize price spike in mid 2006 seems to be closely linked to its preceding export surge. Specifically, exports in the last quarter of 2006 were 6 mmt larger than those in the preceding quarter. Total US maize use in the last quarter of 2006 was almost 16 mmt higher than it had been in the same quarter of the prior year; increased foreign demand accounted for 36% of this increase, while "feed and residual" accounted for 48%, and biofuels for 29%.

Lastly, Fig. 9 suggests that the second maize price surge (from late 2007 to mid 2008) seems to more closely coincide with surges in the price of oil, which is a significant determinant of US maize production costs. Headey and Fan (2008) and Mitchell (2008), for example, suggest that rising oil prices could have added as much as 40% to the maize price increases seen in 2008. In any event, we conclude that while trade events were by no means the sole determinant of the increases seen in maize prices, they were certainly a significant driver of US maize prices over this period. This has not been recognized by most of the prior studies on the crisis.

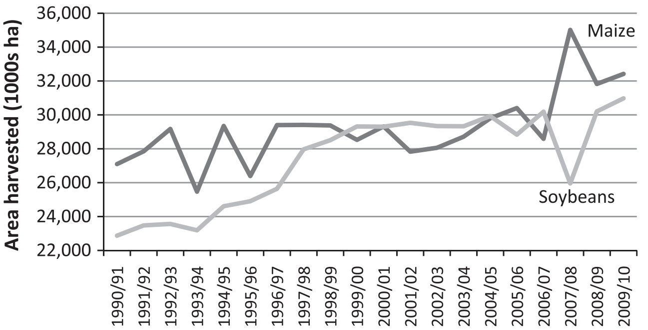

Fig. 10. Trends in harvested areas for US maize and soybeans: 1990–2009. *Source*: Authors' calculations based on USDA (2009c) trade data.

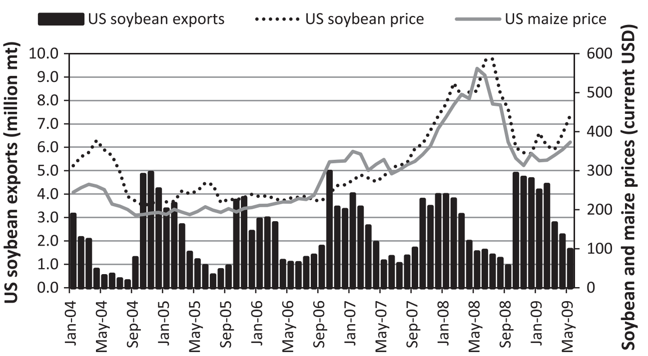

Fig. 11. Trends in US soybean exports, soybean prices and maize prices. *Source*: Authors' construction from USDA (2009b) export data and FAO (2009a) price data.

Soybean markets

In this section we will argue that the increase in soybean prices was almost entirely driven by maize-market events and maize-price movements. Fig. 1 in 'Background' demonstrated that soybean prices tracked maize prices very closely from 2003 onwards (more closely than any other pair of series), and typically with a small lag.[8] Two factors explain this. First, maize and soybeans are very close substitutes, as both are predominantly used for feed in the United States. Second, maize and soybeans compete for land in the United States. Indeed, Fig. 10 shows that a massive 6.4-million hectare (ha) (22%) increase in maize area in 2007/2008 was accompanied by a 4.2-million ha (14%) reduction in soybean area. On these grounds, there is probably not much mystery as to why soybean prices rose. Biofuels demand (in conjunction with surges in maize exports) greatly increased the attractiveness of maize production, with corresponding declines in the amount of land allotted to soybeans, and soybean production. This in turn meant that the US stock-to-use ratio for soybeans declined to 4%, its lowest level ever, such that soybean prices became even more sensitive to changes in maize prices and soybean demand.

Consistent with this, we do not find any evidence of sudden surges in US soybean exports over 2005–2009, with only the usual seasonal variation and some strong but perfectly normal demand in 2006 (Fig. 11). Nor do we find any major export surges in Brazilian export data, although soybean demand was surprisingly strong given the much higher world prices in early 2008

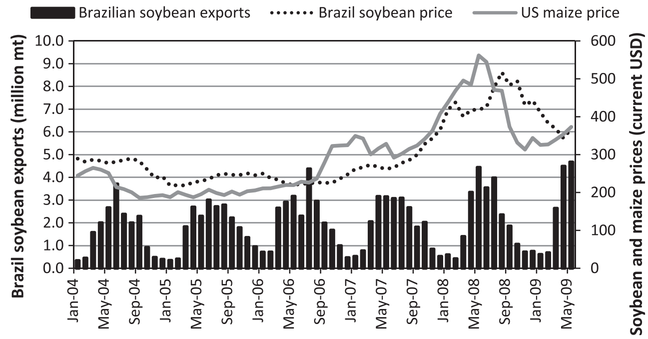

Fig. 12. Trends in Brazilian soybean exports, soybean prices and maize prices. *Source*: Authors' construction from ABIOVE (2010) export data and IMF (2010) price data.

(Fig. 12). However, because of the reduced area planted to soybeans in 2007/2008, US production fell by 14 mmt that year, and the surge in oil prices would also have significantly added to production and trade costs. In any event, from July 2007 onwards, it is clear that soybean prices closely tracked maize prices, typically with a short lag.

Conclusions

In most of the research and media reports on the food crisis, there has been very little emphasis on the kind of short run trade shocks identified in this study. Instead, the vast majority of the attention has focused on biofuels, oil prices, changing Asian diets, declining grain stocks, and financial speculation. Yet the analysis herein suggests that trade events were pervasively important in all of the major grain markets (with knock-on effects on soybeans) and arguably provide the most tangible explanation for the overshooting dynamics apparent in price series data (Fig. 1). This does not mean that one should rule out other factors, because there are obviously important interaction effects between trade shocks and a range of other factors. In a dynamic sense, the deeper non-trade factors discussed in our introductory section probably still played important roles in creating initial pressures in grain markets, which in turn contributed to export restrictions and import surges. And factors like the cheaper US dollar, strong economic growth rates, and surplus foreign reserves, would all have made grain purchases more affordable, even as prices rose in 2007 and 2008. In addition, there was an important interaction between low or depleted stock levels and surges in demand (for example, the Philippines case, where government stocks were relatively low). That said, in the case of US wheat we found stock depletions were chiefly the result of trade shocks, so low US wheat stocks were an outcome of the crisis rather than a cause.

But despite the synergies between a trade-based explanation of the crisis and other explanations, our interpretation of events is still rather different from many existing studies. For example, some authors have claimed that supply and demand fundamentals cannot fully explain the recent drastic increase in food prices, which would tend to suggest that financial speculation could be a driving force behind rising food prices (Robles and Cooke, 2009; Timmer, 2010).[9] But on the contrary, we find that supply and demand shocks

[8] The correlation between soybeans and maize prices is around 0.90 over 2003 to mid 2009, whereas it is 0.81 for soybeans and wheat prices. We also explored Granger-causality tests between variables, and although we found that maize prices Granger-often cause soybean prices, the results appear very sensitive to the utilized time frame. The results are not reported here but are available upon request.

[9] Robles and Cooke (2009, p. 2) write "Changes in supply and demand fundamentals cannot fully explain the recent drastic increase in food prices." Timmer (2010) does emphasize "panic", but more so in rice markets. Of wheat and maize he writes "The actual price panic that resulted, however, had little rationale in the fundamentals of supply and demand" and instead states that "There is a clear case to be made that the sudden spike in wheat and corn prices was heavily influenced by financial speculation." Yet our evidence shows that there were large demand surges for US wheat and maize.

do appear to account for rising food prices in terms of both the timing of the shocks and their magnitudes. If we are correct, then this finding has important implications for where policy efforts aimed at preventing another food crisis should best be focused; i.e. on trade policy rather than regulation of commodity futures markets (although the latter may not do much harm).

Yet the specific trade policy implications of our findings are by no means black and white. Many commentators have advocated freer trade in grains, but food-export restrictions are generally not outlawed under current WTO agreements, nor under proposed agreements (Abbott and Borot de Battisti, 2009). Moreover, it is difficult to believe that poor rice-dependent countries like India, China, Vietnam, or Indonesia would credibly commit to ruling out significant export restrictions. Without the binding agreement of these major players, second best strategies obviously come into play. These include policies to achieve self-sufficiency, larger reserves (monetary or physical), and bilateral or regional agreements. It is clearly beyond the scope of this paper to assess the complex question of which of these strategies is most appropriate for any given country or region. But our paper does provide support for the notion that trade shocks are still one of the "great uncertainties" in world food markets.

Finally, we note one very important research implication of our findings. Simulation exercises show that fundamental factors like oil prices, biofuels demand, and economic growth are predicted to keep equilibrium food prices 40–50% higher in the next ten years than they were at the start of the century (OECD–FAO, 2009; USDA, 2009a). Yet these models suffer from an important omission, namely that the kinds of slow moving pressures listed above can eventually result in trade actions that can turn a tighter world food system into a state of full-blown crisis. We suggest that economic modelers would do well to consider endogenizing trade shocks, or at least exploring how random shocks might affect their predictions. In our view these kinds of trade shocks are like the elephant in the room – too large and too important to ignore.

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