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The Effect of U.S. International Food Aid on Prices for Dry Peas and Lentils

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JEL Classification Numbers: Q11, O13

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1 Introduction

The United States government spends approximately $2 billion per year providing food aid to developing countries. Food aid spending is primarily allocated to purchasing food commodities and transporting them to recipient countries. Unlike other major food aid donor countries, nearly all US food aid is "tied": US food aid must be US-grown and a majority must be shipped on US-flagged vessels (Schnepf, 2014). In the last decade, US presidents from both parties have sought to untie US food aid. Their proposals are backed by research showing that local and regional procurement (LRP), that is purchasing donated food in or near the recipient area, could provide more timely benefits at lower cost to a greater number of food-insecure households (Elliott and McKitterick, 2013; Lentz, Passarelli, and Barrett, 2013). Yet the US maintains its preferential procurement policy; in spite of the president's initiative to untie food aid, the 2014 Farm Bill made no substantive changes to this policy.

Political support in the US for the provision of international food aid appears to be conditional on the policy generating benefits for groups in the US. Barrett and Maxwell (2005) identify three domestic beneficiaries of tied US food aid: US farmers and commodity merchants who supply food aid commodities, the US maritime shipping business who benefit from restrictions on vessel flagging, and US non-governmental organizations who receive grants in the form of donated food commodities. They liken these groups to an "iron triangle" that undergirds US food aid policy. This coalition of farmers, merchants, shippers, and NGOs asserts that US food aid "creates jobs and economic activity here at home" (Coalition of Industry Associations, 2013) Similarly, politicians supportive of tied US food aid say it "...provides economic benefits at home, stimulating our farm and transportation industries." (United States Senate, 2013). However, none of these groups provide empirical evidence of the existence or magnitude of this stimulus.

US food aid purchases are one source of demand for US-grown food commodities. Their benefit to US farmers as a group depends on the magnitude of the demand shift caused by these purchases. Barrett and Maxwell (2005) argue the benefit of US food aid to US farmers is negligible because food aid purchases are small: "Because food aid represents such a small share of the U.S. food market, it has proved too small to move markets in a way that generates any identifiable effect on farmgate prices in all but very exceptional circumstances." One of these exceptional circumstances may be pulse crops such as dry peas and lentils. Between 2002 and 2012, food aid procurement was 17 percent of production and 24 percent of exports for dry peas and 28 percent of production and 38 percent of exports for lentils (World Food Program - Food Aid Information System, 2014; Food and Agriculture Organization, 2014). In some of these years, the majority of U.S. lentil and dry pea exports were shipped as food aid.

This paper estimates the effect of food aid procurement on prices in the market where food aid

is procured. While other studies have considered the impact of food aid on prices in the recipient country (e.g. Donovan et al., 1999; Tadesse and Shively, 2009; Garg et al., 2013), there is a dearth of attention paid to donor country price effects. To my knowledge, this is the first empirical test for food aid's economic stimulus as touted by supporters of tied US food aid. I consider this effect for the cases of dry peas and lentils. If tied food aid benefits US farmers by increasing demand for US-grown commodities, then these benefits should be most evident in markets where food aid procurement comprises a significant share of demand.

Measuring the domestic price effect of food aid purchases addresses two outstanding questions about US food aid. First, why are US farmers so supportive of tied food aid? While the US has operated the world's largest food aid program since the 1950s, other developed country agricultural exporters have been large food aid donors over the same period and have untied their food aid procurement. For example, Canadian food aid was until recently sourced almost entirely from Canadian production. Policy reforms beginning in approximately 2005 ended preferential procurement in Canada. These reforms were supported by a broad cross-section of Canadian farm groups (Cornelius, 2005). It is unclear whether Canadian farmers supported food aid reform because they realized that food aid procurement did not drive farm commodity prices higher, or because of an altruistic urge to "see beyond their own interests" (Cornelius, 2005).

Second, considering the donor country impact of food aid addresses a longstanding debate in the economic literature on food aid about the effectiveness or "additionality" of international food assistance (e.g. Barrett, Mohapatra, and Snyder, 1999). In addition to concerns about the magnitude of US food aid, another explanation for minimal price impact is that food exports shipped as food aid displace commercial exports. Thus food aid shipments do not represent additional food demand. Instead, demand that would be satisfied through commercial channels is relabeled as aid. Economic theory suggests that policy and market developments have made displacement of commercial sales less likely, but again there is limited empirical evidence for this assertion.

My test for food aid's price effect is a test of whether food aid purchase announcements constitute news about demand and whether food aid purchases made under the current preferential procurement policy are able to drive a wedge between US and global prices. I present background information about US food aid policy, US food aid procurement procedures, and international pulse crop markets. I review past economic analyses of food aid relevant to my empirical analysis. in particular, I consider the conditions under which food aid might constitute a demand shock and the conditions necessary to identify demand shocks in the observed time series of dry pea and lentil prices. Finally I describe the empirical model and its results.

2 US Food Aid Policy Background

US food aid is governed by a complex set of legislative and administrative institutions. Most food aid programs are authorized under legislation known as the Food for Peace Act or Public Law 480 (PL 480), but additional legislation establishes other programs. Two government agencies, the Foreign Agricultural Service (FAS) of the United State Department of Agriculture (USDA) and the United States Agency for International Development (USAID) jointly administer ten separate programs to provide food aid to developing countries. While legislation put forward different objectives for each of these ten programs, the overwhelming majority of US food aid falls under Title II of PL 480, which "provides for donations of US agricultural commodities to meet emergency and non-emergency needs in foreign countries" (Schnepf, 2014).

The prevalence of Title II food aid is important to my analysis for two reasons. First, food aid procurement under Title II is more likely to be driven by demand-side rather than supply-side factors. The current predominance of Title II food aid reflects a shift by the US and other major food aid donor countries in the composition of food assistance. Food aid is commonly categorized as emergency, project, or program depending on how it is procured and distributed (e.g. World Food Program - Food Aid Information System, 2014). As defined by Barrett and Maxwell (2005), emergency food aid is distributed in response to natural disasters, economic shocks, or civil conflict. Project food aid is distributed to recipient governments, development agencies, or non-governmental organizations for use in development projects. Project food aid may be "monetized" by recipient organizations, or sold with the proceeds funding other development projects. Program food aid is the direct government-to-government transfer of food, often in the form of concessionary sales to developing country governments.

Figure 1 shows the increased prevalence of emergency and project food aid and the near abandonment of program food aid by the US between 1988 and 2012. Program food aid provided under Title I of PL 480 made up the majority of US food aid in the earlier part of this period, but fell to near zero by 2008. In the past, US program food aid was largely sourced from US government-owned stockpiles and the quantity delivered was strongly correlated with US food commodity inventories (Diven, 2001). Food aid under this policy regime was often viewed as a way to dispose of government-held surpluses. Modeling the price impact of program food aid is therefore difficult because the quantity procured and delivered is clearly endogenous to production and prices.

Since the year 2000, emergency food aid has been the largest of the three types used by the US. Emergency food aid should be more responsive to food deficits in recipient countries and there is empirical evidence suggesting that total US food aid delivered is increasingly correlated with food production shortfalls and violent conflict abroad (Young and Abbott, 2008). More generally, observers suggest US food aid is driven more by political and humanitarian objectives than

by circumstances specific to US agricultural supply and demand (Schnepf, 2014). Therefore, observed US food aid procurement under Title II may be considered an exogenous shock to US food commodity markets to the extent that these external objectives rather than price levels determine observed procurement.

Even though Title II food aid is a source of demand for US food commodities, Title II food aid may have additional characteristics that make it particularly supportive of US farmers and agribusinesses since it is linked through the legislative process to other programs that support US farmers and agribusinesses. Title II programs are authorized through the US farm bill and annual agricultural appropriations bills. For example, the 2014 US farm bill authorized up to $2.5 billion in annual funding for Title II food aid (Schnepf, 2014). This level of food aid spending was supported by farm groups who lobby legislators with respect to the farm bill.

US Food Aid Procurement and Pulse Crops

US food aid is jointly administered by USDA and USAID, but food aid procurement is conducted by the Kansas City Commodity Office (KCCO) of the USDA. The KCCO releases invitations for bids or tenders that specify the quantity, quality, delivery location, delivery date, and other characteristics of food commodities requested by USDA and USAID for delivery as food aid. To be eligible to bid on these tenders, businesses must be based in the US and meet certain qualifications. Food delivered against a tender must be grown in the US. After the release of a tender, businesses submit bids to fill some or all of the quantity requested. The timing and quantity of the tender is uncertain. Even though much of US food aid is delivered in unpredictable emergency situations, tenders may not coincide with food emergencies. The KCCO may purchase and pre-position food commodities at US ports for eventual shipment as food aid, so tenders may occur prior to emergencies, and approvals for food aid procurement may be delayed, so tenders may occur after emergencies. Food aid procurement is also affected by prevailing market price levels and government budget appropriations for food aid programs (Barrett and Maxwell, 2005; Janzen et al., 2006).

Food aid commodity procurement is generally short-run in nature. Farmers are unable to adjust production in response to tenders because of the biological lag inherent in crop production, so supply is fixed over the length of run relevant to the the tender announcement. Thus the response to the demand shock represented by the procurement announcement will be a price response. Barrett and Maxwell (2005, p. 90) suggest short-run market responses are particularly evident near the end of the government fiscal year and other periods when food aid purchases cluster together, "causing a sudden surge in demand on a particular day or week, thereby sparking temporarily higher prices."

Barrett and Maxwell (2005, p. 90) also identify dry peas and lentils as markets where food aid procurement "represents a significant share of the total market". All else equal, food aid is most

likely to have a significant price impact when food aid shipments are large. Figure 2 illustrates the importance of US food aid procurement to distribution and usage of US-grown dry peas and lentils between 2002 and 2012. As stated above, food aid shipments were 17 percent of dry pea production and 28 percent of lentil production over this period. Note that the US has shipped fewer lentils and more dry peas over time. Production of both crops has generally expanded over time as the primary production region for pulse crops in the US has shifted from Washington and Idaho to North Dakota and Montana.

3 Food Aid and "Additionality"

Even though food aid makes up a substantial portion of demand for some commodities, it may not have a price impact if food aid procurement simply displaces commercial trade. If the recipient country would have otherwise imported the same quantity of the commodity without the intervention of the donor country government, then observed food aid quantities are not indicative of shifting demand. The economic literature on food aid refers to this potential displacement effect as the "additionality" of food aid: how much additional food is shipped between donor and recipient countries because of aid?

The question of additionality is directly addressed by a number of domestic and international regulatory mechanisms related to food aid. Under the Bellmon Amendment to PL 480, USAID and USDA must ensure "that the distribution of commodities in the recipient country will not result in a substantial disincentive to, or interference with, domestic production or marketing" (Government Accountability Office, 2011). Similarly, the United Nations Food and Agriculture Organization Consultative Sub-Committee on Surplus Disposal commits its members (including the US) to not displace commercial trade (Barrett and Maxwell, 2005). To do this, USDA conducts assessments known as Usual Marketing Requirements (UMRs) for each country and commodity where it delivers food aid. The maximum level of food aid permitted under the UMR is the difference between expected consumption needs and domestic production plus historic commercial imports (Government Accountability Office, 2011) The UMR suffers from two problems: first, it relies on projected consumption which is unobservable, and second, there is no effort by the USDA to analyze *ex post* whether food aid shipments exceed the UMR. Therefore UMRs are not informative regarding the true additionality of food aid.

According to Barrett (2002), displacement and additionality are not issues of the absolute quantity of food aid shipped, but of how food aid delivery is targeted and how integrated are donor, recipient, and global food markets. He emphasizes the role of Engel's Law in the additionality of food aid, which states that the income elasticity of demand is decreasing in wealth so the neediest households have the highest income elasticity of food demand. If food aid donations target

the neediest households, food demand in commercial channels will be less effected because poor households continue to spend a significant portion of this increase in real income on food. Because income elasticities of food demand are generally below one for most households, some displacement is likely. That said, food aid targeted to needy households in emergency situations where access to food markets is limited is more likely to be wholly additional than other forms of food aid. Recall that emergency food aid is now the largest type of US food aid, so food aid may not displace commercial exports to the extent it did in the past.

Barrett (2002) compiles a set of studies suggesting 30-70% of food aid shipments displace commercial trade. These estimates are in line with estimates of the income elasticity of food demand in developing countries. For example, Barrett, Mohapatra, and Snyder (1999) use a vector autoregression to model the dynamic relationship between US food aid quantities, commercial imports from the US and other countries, and domestic production in a set of food aid recipient countries. They find 70% of US commercial imports are displaced by food aid. However, this study considers US food aid under an earlier policy regime where emergency food aid was less prevalent.

The degree to which US food aid displaces commercial trade is important for my estimate of the donor country price impact of food aid. If food aid completely displaces commercial trade, so that food aid flows are simply some relabeled portion of commercial flows, I would expect zero domestic price response to US food aid procurement tenders. However, displacement is not the only explanation for zero price response. If I find a significant price response to food aid procurement, it suggests food aid flows are additional to commercial flows.

4 Data

My empirical analysis requires data on pulse crop prices and food aid procurement in the US. I measure farm-level pulse prices using weekly grower bids reported by the USDA Agricultural Marketing Service (USDA-AMS) and the Saskatchewan Ministry of Agriculture. The USDA collects bid data for two regions: Washington and Idaho (WA/ID) and North Dakota and Montana (ND/MT). Bids are available for the WA/ID region since 2002 and for the ND/MT region since 2006, reflecting the relatively recent adoption of widespread pulse crop planting in ND/MT. Corresponding Saskatchewan price data is available since 2002. From prices for the many varieties of peas and lentils, we use prices for three varieties: whole green peas, whole yellow peas, and medium green lentils. These are the most widely grown varieties with the most consistent price reporting.

USDA-AMS reports high and low bids over the course of a week. I use the midpoint of the reported range in my empirical application. In weeks where regional pulse markets are less active

and few bids are available, USDA-AMS neglects to publish pulse price data for that week for that region. To fill gaps in the time series for the ND/MT price series, I interpolate unobserved price changes using one period ahead forecasts generated from non-missing WA/ID price changes where available and linear interpolation where WA/ID price changes are not available.

Saskatchewan price data reflects a single price point on a specific day of the week, usually a Wednesday. I match these Wednesday bids to USDA-AMS bids reported for the same week. Saskatchewan pulse prices are reported in Canadian dollars per hundredweight for lentils and Canadian dollars per bushel for peas. I convert these values to US dollars per hundredweight using daily exchange rates from the Federal Reserve Economic Database. The price series for each crop and location are found in figure 3.

I use data on invitations for bids for pulse crop food aid reported by USDA-AMS. The announcement of these invitations represents news regarding the demand for pulse crops. Approximately monthly, the KCCO releases invitations for bids for pulse crops through its online supply chain management system. These invitations specify the commodity to be procured, for example "Split Yellow Peas" or "Lentils, bagged with a Federal Grain Inspection Service certificate", and the quantity to be purchased in metric tons. Any invitations to tender offers for lentils, yellow peas, or green peas are reported in the USDA-AMS weekly Bean Market News publication. The KCCO may revise invitations depending on USAID requirements and market conditions. I ignore revisions to initial invitations since it is difficult to assess how "newsworthy" these revisions might be.

Figure 4 shows the quantity of requested bids for weeks in which a non-zero bids are observed. For clarity, weeks without a tender are omitted from this figure. Consistent with the annual data shown earlier, there is a downward trend in tenders for lentils and an upward trend in tenders for yellow peas. Food aid procurement of green peas is smaller than procurement of other pulse crops over the entire sample period and tenders for green peas have negligible since about 2008.

While invitations for bids from the KCCO for pulse crops are generally released monthly, tender offers may occur more or less frequently depending on USDA and USAID requirements. Analysis of the duration between tenders shows that on average, the KCCO releases invitations for bids every 4.1 weeks for lentils, every 4.0 weeks for yellow peas, and every 5.3 weeks for green peas. Rarely in my sample, new tenders are released as frequently as every week. The longest duration between tenders in the sample is 18 weeks for lentils, 24 weeks for yellow peas, and 38 weeks for green peas.

5 Estimation and results

The aim of my empirical analysis is to identify pulse crop price variation in the United States associated with food aid tenders put forward by USDA. Observed pulse crop price variation is caused by many complex (and unobserved) supply and demand shifters. To make improved inference about the relationship between observed tenders and observed prices, I filter out price fluctuations related to non-food-aid supply and demand shifts by considering the spread between US and Canadian prices. The Canadian price represents a global benchmark, since Canada is the world's largest pulse crop exporter and US and Canadian pulse crop exports compete for market share in many countries (Food and Agriculture Organization, 2014). The Canadian price is subject to many of the same weather shocks that affect supply in the US since major production regions in the US (North Dakota and Montana) and Canada (Saskatchewan) are adjacent. The major difference between US and Canadian markets is that the Canadian price should not be subject to food aid related demand shocks because Canadian pulse crops are not deliverable against US food aid tenders.

I use the logarithmic difference between the ND/MT price and the Saskatchewan price: $\ln spr_t = \ln(p_{ND/MT}) - \ln(p_{SK})$, plotted in figure 5. I test for potential unit roots in each spread variable using the Dickey-Fuller Generalized Least Squares (DF-GLS) test. I reject the null hypothesis of a unit root for one to five lags for all three spread variables, lentils, green peas, and yellow peas.

The tender data contain a significant number of weeks of zeros, where the USDA does not put out a request for bids. This intermittency in the tender data is problematic; tender data is asymmetric and censored causing numerous problems in times series modeling (Kilian and Vigfusson, 2009). I accommodate intermittency and censoring in tender data by replacing zero values with step-ahead forecasts using Croston's method of intermittent demand forecasting (Croston, 1972; Boylan and Syntetos, 2007). Without this adjustment, I have difficulty interpreting negative shocks to food aid tenders since the lowest values in my sample are clustered at zero. With this adjustment, a negative shock represents a week where observed tenders were below this forecast.

I estimate separate bivariate structural vector autoregressions (SVAR) for lentils, green peas, and yellow peas, including log-adjusted-tender quantity and the log-price spread as endogenous regressors, y_t). The reduced-form representation of this model is:

$$y_t = \begin{pmatrix} \ln adj\text{-}tender_t \\ \ln spr_t \end{pmatrix} = (B_1 L - B_2 L^2 - ... - B_p L^p) y_t + D x_t + \varepsilon_t$$

By placing the variables in this order, I assume that shocks to tender process can affect spreads contemporaneously, but other shocks to the spread can only affect tenders with a one-week lag. Information criteria such the Akaike and Schwarz-Bayesian Information Criteria suggest including up to 3 lags (i.e. $p = 3$). I also include as exogenous regressors, x_t, a marketing year indicator and

a linear time trend.

The estimated reduced-form model yields a series of structural shocks and a set of orthogonalized impulse response functions representing the domestic US price reaction (above any reaction in Canadian prices) to unanticipated shocks in food aid quantities tendered. These impulse response functions and their 95% confidence intervals are shown in figure 6. They describe the magnitude and persistence of lentil, green pea, and yellow pea price shocks related to US food aid purchase announcements.

In general, these results suggest that the domestic price response to food aid tenders is limited in magnitude and persistence. A positive, one standard deviation shock to the quantity tender yields a maximum price response of approximately 1% for lentils, 1.5% for yellow peas, and a basically negligible response for green peas. The maximum impact of a tender shock is seen 2-3 weeks following the tender. Only the yellow pea price response is significantly different from zero and this significant response persists for 12 weeks following the tender shock.

6 Discussion and conclusions

The relatively weak relationship between food aid procurement and US pulse crop prices suggests that farmers as a group do not garner significant long-lived benefits from tied US food aid. Accordingly, proposed changes in US food aid policy such as a switch to local and regional procurement would not affect production incentives for U.S. farmers. One explanation for this result may be that US food aid displaces commercial trade in pulse crops, but my model does not allow for a direct test of this hypothesis. Barrett and Maxwell (2005) suggest that any benefits of tied US food aid procurement accrue to agribusinesses who actually submit bids in response to USDA tenders. These agribusinesses supply processing, bagging, fortification, and other services that increase the cost of US food aid procurement. Again, my results are consistent with this theory but do not prove it conclusively.

One additional explanation for my finding of a weak relationship between food aid procurement and US pulse crop prices is the potential for nonlinear response. Pulse crop prices may only respond to abnormally large food aid tenders. Accordingly, future econometric analysis of this relationship should accommodate nonlinear response using threshold autoregression or other nonlinear methods. An additional shortcoming in my analysis is the simplification of the time series process for food aid tenders. I do not explicitly model the probability that USDA will issue a invitation for bids in a particular week. Future analysis should model this process to better understand the relationship between food aid procurement and food markets.

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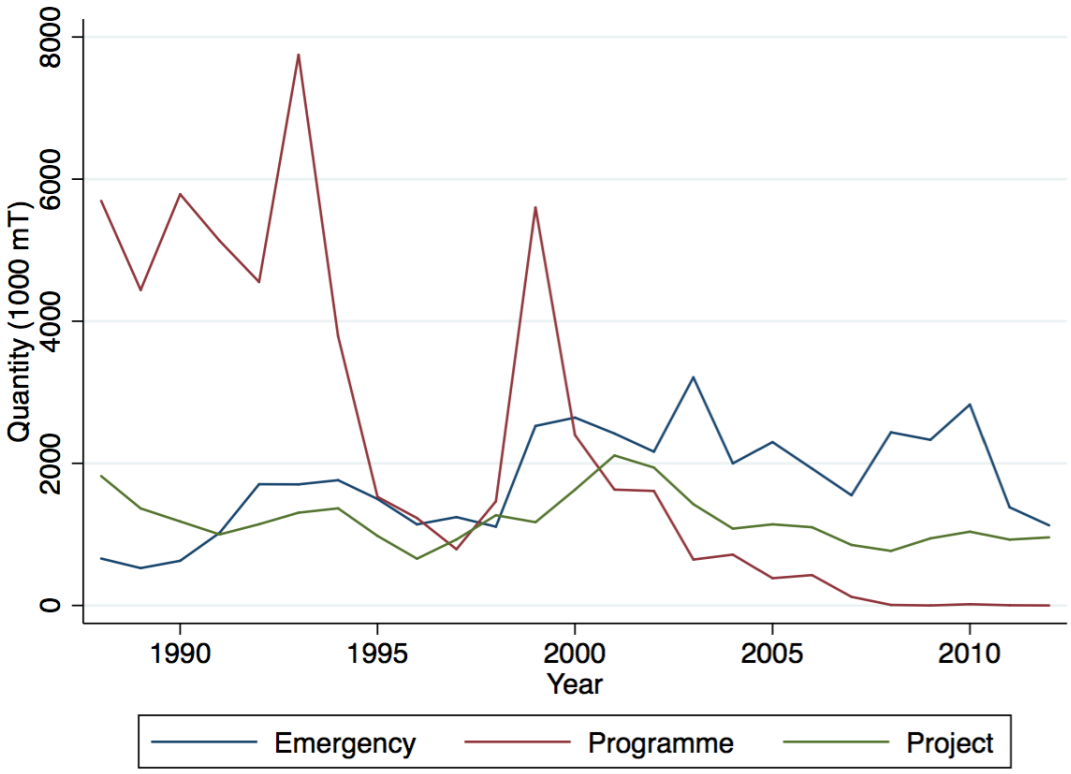
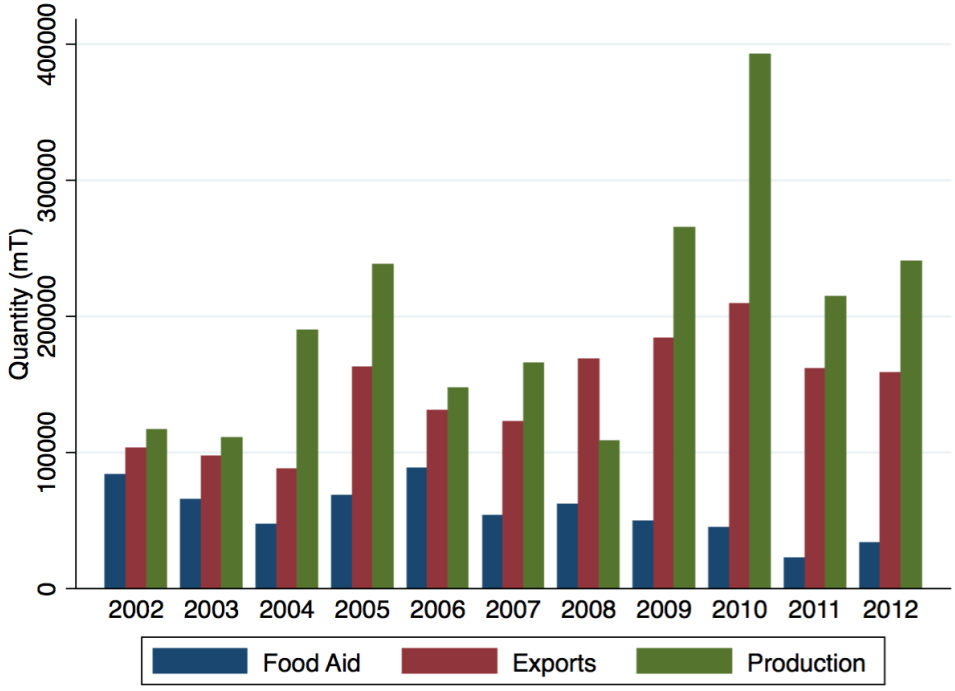
Figures

Figure 1: Quantity of US Food Aid Delivered by Type, All Commodities, 1988-2012

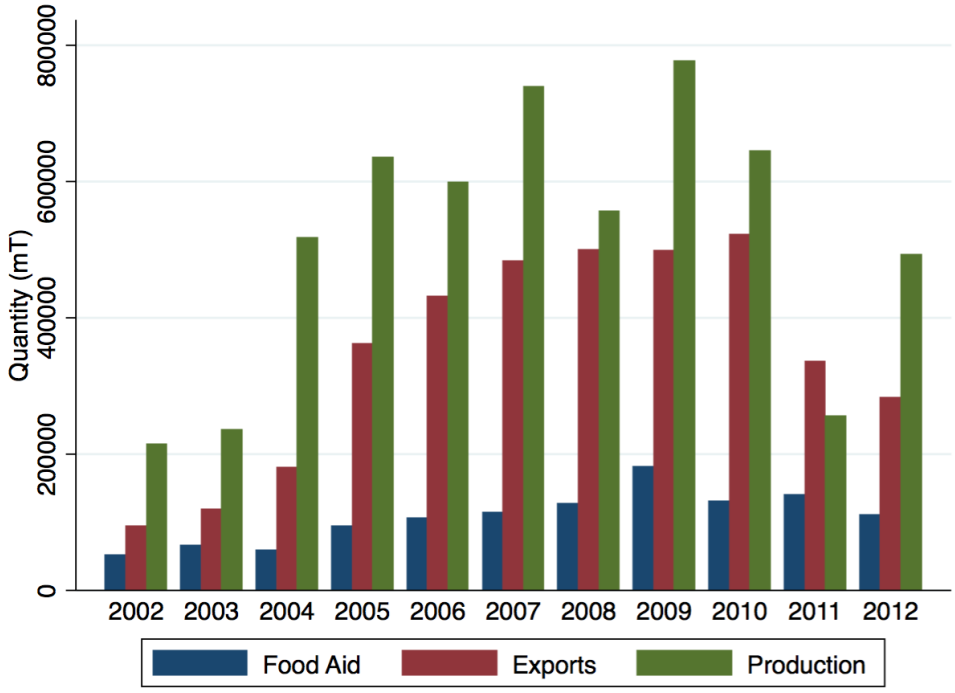


Source: World Food Program - Food Aid Information System (2014)

Figure 2: US Food Aid Use, Exports, and Production of Pulse Crops, 2002-2012



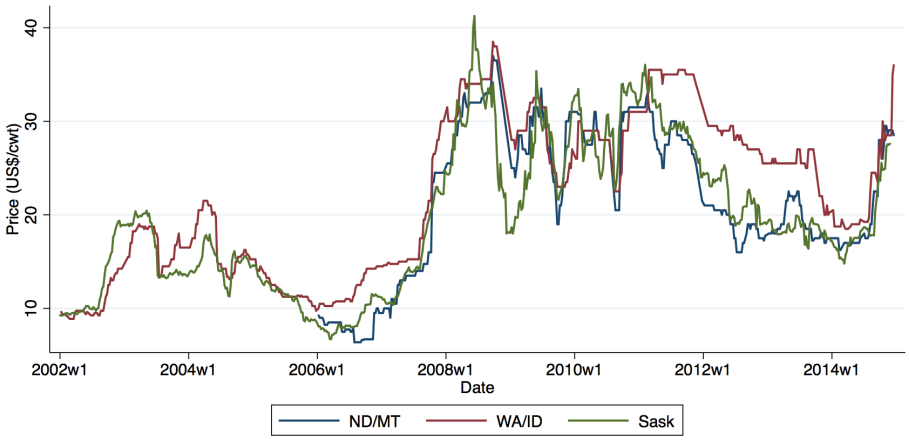
(a) Lentils



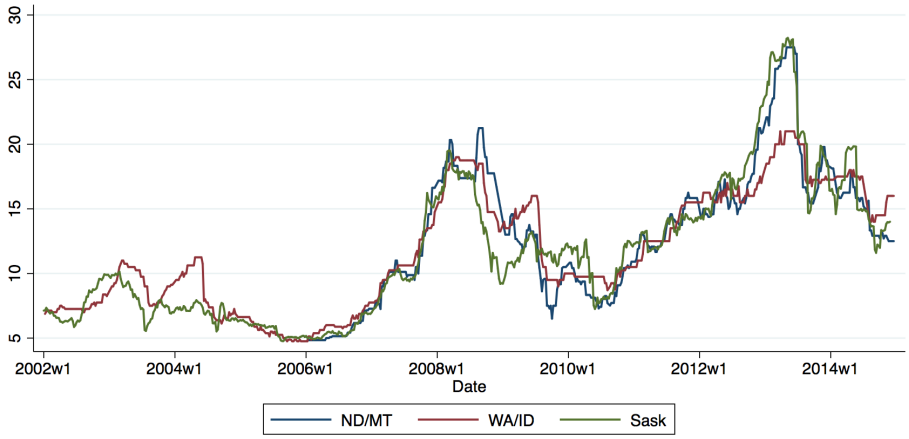
(b) Dry Peas

Source: World Food Program - Food Aid Information System (2014); Food and Agriculture Organization (2014)

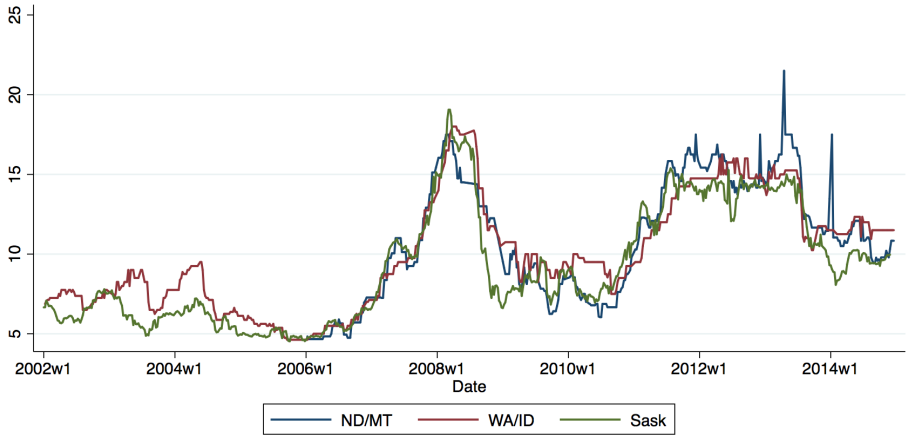
Figure 3: Weekly pulse crop prices at various locations, 2002-2014



(a) Lentils



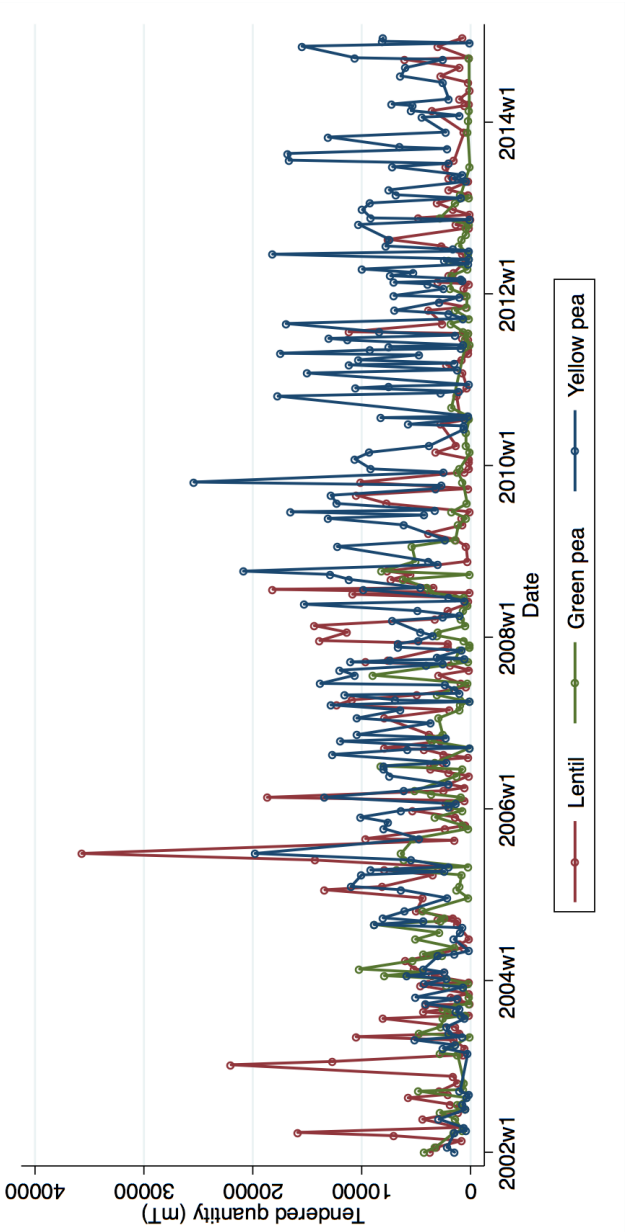
(b) Green Peas



(c) Yellow Peas

Source: USDA-AMS, Saskatchewan Ministry of Agriculture.

Figure 4: Weekly food aid tender quantities, 2002-2014



Source: USDA-AMS; Note weeks without tender announcements are omitted for clarity.

Figure 5: Logarithmic difference between North Dakota and Montana pulse prices and Saskatchewan pulse prices, 2006-2014

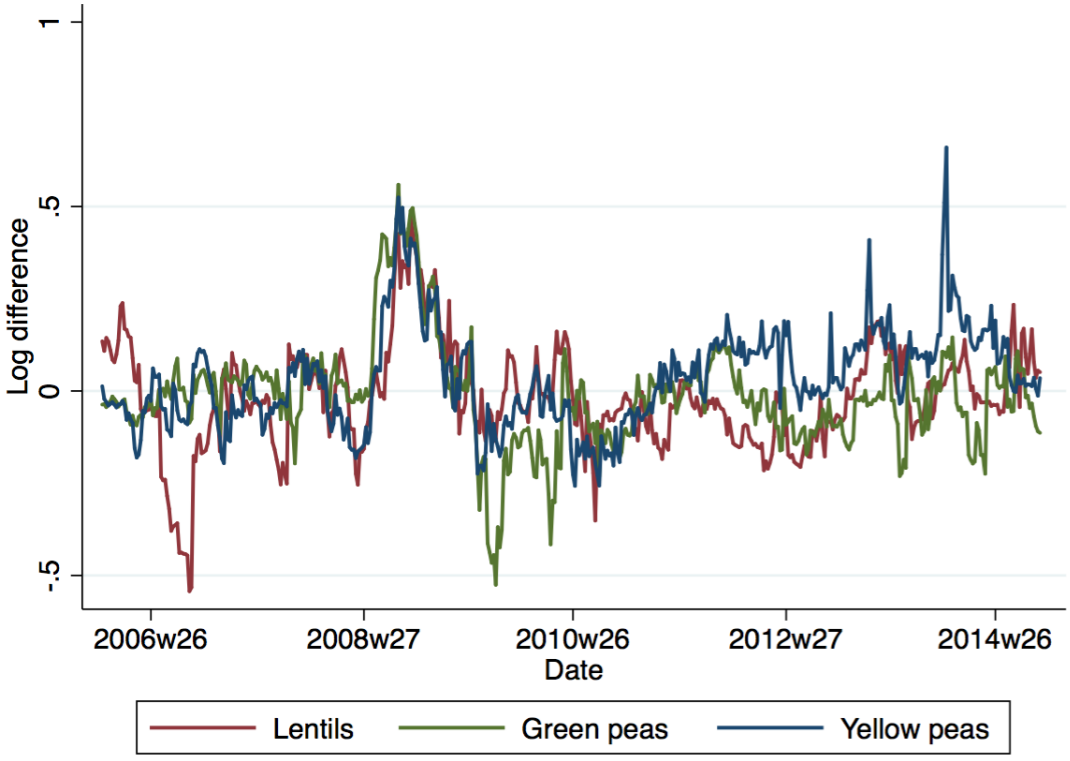


Figure 6: Impulse response functions