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Abstract

Using Qatar as a case study, we exploit a novel micro dataset for 102 raw agricultural imported commodities on a shipment-by-shipment basis over the period January 1, 2005 to June 30, 2010. The data comprise over half a million individual observations, with a very rich set of characteristic specifications. Several interesting initial results emerge from the analysis. First, we find evidence of import-price volatility far in excess of world price volatility across a wide spectrum of commodities. Second, supply origins for virtually all commodities are highly concentrated. In many cases commodities are sole sourced. Third, although less so, concentration is evidenced among Qatari importing companies for certain commodities. Fourth, we notice anomalies that lead to inefficient shipping methodologies and associated increased costs. The paper concludes by providing an empirical illustration of hedonic price modeling for barley followed by guidance for future empirical research.

Keywords: Food security; Import data; Market concentration; Price volatility; Logistic inefficiency; Hedonic price modeling.

1. Introduction

Although food security is a world-wide problem, many observers considered the food crisis of 2007/2008 to be especially critical in Arab countries which tend to be arid and import dependent (World Bank, 2009). Whereas the literature associated with the 2007/2008 food crisis emphasized supply disruptions, much contemporary analysis considers the detrimental effects of price volatility (FAO, 2011; World Bank, 2011). Policy prescriptions for Arab countries to mitigate price volatility and other food security issues include greater diversification of imports, forward contracting, strategic storage, foreign investments in agricultural production, domestic production, and other measures (World Bank, 2009).

There is a subset of Arab import-dependent countries that deserve special attention—the so-called micro states that are found primarily in the region of the Persian Gulf. These include countries such as Kuwait, the United Arab Emirates (UAE), Qatar, Oman and Bahrain all having miniscule populations.[3] The special economic problems of small countries are well known (Streeten, 1993).[4] The general policy prescriptions just described may involve special difficulties not associated with larger states. As stated by Streeten (1993, p. 198): "[S]mall countries will tend to be more heavily concentrates on foreign sources of supply" and the smaller country size of micro states means that "a smaller volume of foreign trade is inevitably less diversified geographically than a larger volume."

Despite the relative success of some Arab micro states, especially Kuwait and Qatar, and the fact that these rich Gulf micro states have ample budgetary resources – thanks

[3] Streeten (1993) considered a country to be "small" if its population were less than 10 million people. Save for the UAE, the Arab States we consider have populations much smaller, in the 2 to 3 million range and therefore we refer to them as micro states.

[4] The collection of papers in Robinson (1960) remain a classic contribution to the theoretical analysis of micro states. The theory of micro states stresses the link between small size and suboptimality in terms of the minimum efficient scale of output, competition and efficiency. For recent empirical analyses on the economic performance of micro states, see, e.g., Armstrong and Read (1995) and Easterly and Kraay (2000).

to rising hydrocarbon export revenue – to absorb higher food prices, due to both country size, adverse climatic conditions as well as the supply inelasticities of cultivable land and water, food production for domestic consumption has remained largely neglected. Further, despite their strong fiscal balances to offset high price risk, the Arab microstates are highly vulnerable to quantity risk stemming from export bans by major producing countries.[5] These issues of food security is a major concern of the Arab micro states at the present time.

The unique population structure in some Arab micro states also pose a significant challenge to food security in these countries. For example, Qatar's diverse population comprising wealthy nationals and highly paid expatriate workers along with a considerable amount of low wage workers imply a diverse choice of food requirements with varying quality. This automatically imposes a constraint in achieving economies of scale in purchasing bulk food items at possibly lower prices. Furthermore, the varying demand elasticities of food across individual income groups is likely to distort perceived relative prices, hence resulting in changes in actual relative prices. For example, surging income and population of some oil-rich countries is likely to push up their consumption demand of animal products (e.g., milk, meat) over consumption of cereal, causing greater dependence on imports of meat products in the coming years (World Bank, 2009). Needless to say, the lack of a coordinated entry and exit of foreign workers (both skilled and unskilled) is itself a source of volatility of food prices in Qatar and similar countries.

Hitherto, there has been only one empirical analysis of the special food security issues facing micro states in the Arab world. Azzam and Rettab (2012) study UAE consumers' vulnerability to price increases of imported food products. They define vulnerability as

[5] For example, the global food crisis of 2007-2008 triggered a ban on rice exports by India, which traditionally supplies over one-half of the rice consumed in the GCC countries (Shah, 2010). As documented by Martin and Anderson (2010), export restrictions may have contributed as much as 35 percent to world rice prices and 25 percent to wheat prices during the 2007—2008 global food crisis.

the change in consumer welfare from multiple price changes relative to income, measured by the Hicksian compensating variation. The compensated own- and cross-elasticities were obtained by estimating an Almost Ideal Demand System (AIDS) model for UAE's food imports of seven commodity groups using monthly data over the 2005-2010 period. Results reveal that the welfare losses from price increases in cereals, meats, dairy and oils amount to 6.608 million USD, representing 5.54% of the value of imports of all seven commodities in December 2010. The magnitude of the welfare loss increases when a uniform price increase for the remaining three commodity groups (i.e., fish, fruits and vegetables) is added to the analysis. Furthermore, a decomposition of UAE's consumers by income groups show that households in the lowest income group are 3.5 times more vulnerable to rising prices of food imports than households in the highest income group. According to these findings, the low income groups should receive a transfer of 33.93 USD as compensation for mitigating the burden of rising food prices.

Further empirical analysis is necessary to determine whether these micro states face a different set of food security issues than larger states and, if so, how they are manifested. Investigation of such issues, however, requires an extremely rich and detailed micro data set. This paper describes a micro data set for the State of Qatar which is capable of feeding analysis to assess the special food security dilemmas of food-import-dependent micro states. Following a description of these data, some preliminary results on key issues in the form of descriptive statistics and anecdotal evidence are offered.

The remainder of this paper is organized as follows: Section 2 describes the micro-data set, its construction, and augmentation. Section 3 provides preliminary food-security results in the following areas: measures of import-price volatility, concentration levels among countries of origin exporting to Qatar, concentration calculations for importing companies in the State of Qatar, and anecdotal evidence on shipping constraints and anomalies. Section 4 presents an empirical application of hedonic modeling of barley

using the micro-data described in Section 2. Section 5 includes a summary discussion of the descriptive results and sets a detailed research agenda for the further analysis possible with the micro data, and the questions that such analysis must answer to obtain the detailed insights required to inform food security policy in arid, food-import-dependent micro Arab countries.

2. Description of the Data Set

This section discusses the data set that is the focus of this paper. The data set includes micro-data for all raw (and some semi-processed) agricultural commodities suitable for human or animal consumption that are imported into the State of Qatar in commercial quantities. The micro-data were augmented by data from external sources as will be discussed in Section 2.2. With the exception of dairy products, only non-processed commodities were included in the data collection.

2.1 The Micro-Data Set

Data for 102 raw agricultural commodities imported into the State of Qatar were collected on a shipment-by-shipment basis over the period January 1, 2005 to June 30, 2010. The data comprise over half a million individual observations, with a very rich set of characteristic specifications, as is discussed in Section 2.1.4.

2.1.1 Collection of Import Data in Qatar

Imports into the State of Qatar are regulated by the Customs & Ports General Authority (CPGA). Pursuant to the Gulf Cooperation Council (GCC) Agreement[6] goods are declared for customs purposes when they enter the first port of entry in any GCC country. The information gathered upon entry at the common point is transmitted to the customs authorities of the destination GCC Member State. A second verification

[6] The Economic Agreement Between GCC States, The Cooperation Council for the Arab States of the Gulf (GCC) Secretariat General, GCC Supreme Council, 22nd Session, 31 December, 2001, Muscat, Oman.

declaration is made when goods cross the customs frontier of the destination GCC Member State.[7]

There are three points of entry that are relevant to the data set described in this paper. Ocean shipments of agricultural commodities bound for Qatar arrive at the Port of Doha, which is the first GCC point of entry for imports transported by sea. The second point of entry is the Cargo Hall of the Doha International Airport where all airborne agricultural imports arrive. This is also a first-GCC point of entry. The third customs crossing is the Overland Customs Facility at the Salwa border crossing between Saudi Arabia and Qatar on Qatar's southern border in the far west of the country. All imports relevant to this paper that are shipped through the Salwa crossing are transported by truck. The Salwa crossing is the only border crossing for landborne agricultural imports, and is not the first GCC point of entry. Imports transported by road either originate in the GCC, Middle Eastern countries such as Jordan and Syria, in which case the initial customs declaration is made at a Saudi Arabian border crossing, or typically are transported by sea to the Dubai port of Jebel Ali, the first GCC port of entry where customs declaration is made, and then transshipped to Qatar through the Overland Customs Facility at the Salwa crossing where a second verification declaration is made.[8]

Customs Declaration information is entered electronically by the importer, and verified by officials of the CPGA. The electronic entry system contains a very large array of data fields, most of which receive entries, although some are omitted by the importer, and some fields are filled only irregularly. These electronic entries form the basis of the micro-data set.

[7] This was confirmed in a 2010 meeting with Ahmad Ali Mohammad Al-Muhannadi, chairman of the Customs & Ports General Authority, Qatar.

[8] Ibid.

2.1.2 The Commodities

All raw agricultural commodities that were imported in non-trivial quantities and were destined for human or animal consumption were included in the data set. In Qatar imports are entered, at the greatest point of disaggregation, at the 8-digit Harmonized System (HS) level. Choice of included commodities began with observation of all shipments of every 8-digit commodity for HS Chapters 2 (Meat and Edible Offal), 4 (Dairy Produce; Birds Eggs, etc.), 7 (Edible Vegetables and Certain Roots and Tubers), 8 (Edible Fruits and Nuts), 10 (Cereals) and 12 (Oil Seeds, etc., Straw and Fodder).

All commodities that were not associated with products for human or animal consumption were eliminated from the data set. Eight-digit HS classifications that served as catch-all "others" categories were removed from the data set, due to lack of specificity. Where commodity descriptions were redundant, and information was unavailable as to the distinction, separate HS 8-digit classifications with the same name were treated as separate commodities. "Non-trivial" commodity quantities were defined *ad hoc* as those where trade exceeded 200 tonnes per year. This arbitrary cut-off was made primarily for empirical reasons, as commodities imported in quantities below this threshold lacked sufficient data points as to be statistically useful.

Upon completion of the selection process, the data set included 102 separate agricultural commodities. These included 22 commodities from HS Chapter 2 (meats), 25 from Chapter 4 (dairy), 24 from Chapter 7 (vegetables), 20 from Chapter 8 (fruits), 10 from Chapter 10 (cereals), and 1 from Chapter 12 (fodder). The list of commodities is available from the authors by request.

2.1.3 Data Cleaning

As is typically the case, customs entry information contains data entry errors including decimal inaccuracies, unit-of-measurement errors, simple typographical mistakes, and other faults. The researcher must "clean" the data of such errors while maintaining the integrity of the data—avoiding the elimination of legitimate data. This is especially crucial in the case of Qatar as import-price volatility is prevalent, and there is, as will be

seen, large dispersions in prices based on source and transportation mode. For example, special attention was paid when dealing with high priced items with only a few shipments (e.g. meat products), where seeming outlying prices might justifiably reflect consumers' choice in a fast growing and rich economy.

Initially attempts were made to use statistical algorithms to eliminate outliers[9], but further inspection found that these tools were overly mechanical for Qatari data **as** many legitimate data were being excluded by these techniques—robbing the data set of its robustness. As a result recourse had to be made to the tedious manual inspection of virally all sample observations.

The micro dataset was extensively cleaned to remove inconsistencies and to alter obvious incorrect data entries. For example changing a unit of weight, or adding a decimal often eliminated non-sensical values off by orders of magnitude. Data inconsistencies were evaluated using information from several angles including similar observations in previous and forward years; segregation by country of origin, type of transportation and importer identification. Emphasis was also given to improve the missing longitudinal linkages using all available information (e.g. country of origin, date of arrival) to match items/observations that exited the data in a given year with those that entered in the following year.

In order to make the samples as representative as possible, some truncation was necessary. Examples include elimination of all personal imports for non-commercial purpose, unusually small or large c.i.f. values that couldn't be accounted for by weight

[9] In particular, we employed two commonly used methods of detecting outliers in multivariate data. These are the (i) minimum covariance determinant (MCD) estimator of location and scatter introduced by Rousseeuw (1985) and updated by Rousseeuw and Driessen (1999) and (ii) the blocked adaptive computationally efficient outlier nominators (BACON) algorithm proposed by Billor et al. (2000). Both the estimators perform relatively fast and allow one to quickly identify outliers, even on large datasets of tens of thousands of observations. Both estimators are available to implement as STATA commands.

or decimal errors, and any imports with a total weight of less than 10 kilograms for a given shipment.

Following the manual inspection of all sample observations and attempts at resolution of suspect values, doubts regarding the accuracy of some data couldn't be eradicated. The default choice was to eliminate such observations from the micro-data set. This data purging, however, removed only 3,139 observations out of an original 516,656, leaving a data set with 513,426 observations. The eliminated observations accounted for only 6/10 of one percent of original observations—a level we deemed to be acceptable as regards the integrity of the data.

2.1.4 Micro-Data Characteristics

Each observation is an individual shipment of a specific commodity. There is a very rich set of characteristics that are recorded for each observation within the micro-data. These include:

1. Method of transport (air, sea, land) and port of entry, which are fully correlated as there is only one entry point for each mode of transportation.
2. HS 8-digit code.
3. Country of origin.
4. Cost, insurance and freight (c.i.f.) value.
5. Net weight, in various units, all converted to kilograms in the final data set.
6. Unit price calculated from (4) and (5) and expressed in Qatari Riyal (QR) per kilogram.
7. Customs duty rate.
8. Method of packaging—carton, container, bag, bulk, etc.
9. Number of packages.
10. Entry dates. Several dates were provided including the date of initial customs application creation, dates of amendments to customs applications, port arrival dates (incomplete) and customs forms finalization dates. Upon consultation with

officials of the CPGA it was determined that the arrival and finalization dates were typically identical, and therefore the former was used for date of customs clearance when available for an observation, and the latter employed when arrival date was missing.

11. Codes denoting the national registry of the carrier of the shipment.
12. Codes denoting the carrier company name.
13. Codes identifying the actual carrier—ships' names for ocean, airline names for air and truck brand for road.
14. A unique code identifying the importing company in Qatar. This code was used in lieu of company names to maintain confidentiality. The importer code was augmented by a business registration code, issued by the Ministry of Business and Trade for each importer but provided by the CPGA. This allowed verification of importer codes, and also made it possible to determine if individual importers were related parties.
15. A unique number identifying the customs clearing company.
16. A unique number identifying the specific customs clearing agent.

Not all of the information contained in the micro-data will be reported here in Section 3 which provides descriptive statistics and preliminary results. But all of the data will be relevant to the research plan described in Section 4.

2.2 Data Augmentation

The micro-data described in Section 2.1.4 has been augmented with data from external sources to round out the data set. Not all of the added data is relevant for the results provided in this paper's Section 3, but is crucial to the research plan outlined in Section 4.

Data augmentation included the matching of each observation's price with a world price, as represented by f.o.b. (free on board) export prices at the HS 10-digit level which are compiled by the United States International Trade Commission (USITC 2011).

For ocean-based shipments, the unique ship code allowed identification of specific ships for many commodities. Tracing these names through shipping information sources allowed detailed delineation of a ship's configuration, size, speed and other characteristics.[10] Finally preliminary "events" studies were performed on various commodities to identify events such as export curtailments, weather difficulties, political upheaval etc. in various major source countries. A more comprehensive set of events will be accumulated in the future and will be employed in the research described in Section 4.

3. Descriptive Statistics and Preliminary Results

In this section we present descriptive statistics and preliminary results for items of importance pertaining to food security in small, import-dependent countries. Section 3.1 considers the issue of agricultural-import price volatility for a subset of commodities. Section 3.2 analyzes concentration levels among *countries* of origin for the same commodities. Section 3.3 provides information on concentration intensities among importing *companies* in Qatar. For illustrative purposes, in Sections 3.1, 3.2 and 3.3, the commodity subset utilized consists of twenty-five commodities which span all the HS chapters in the data set, and represent substantial trade levels within those chapters. Further, results are presented, for comparison purposes, for the first six months of the years 2008 through 2010. Section 3.4 makes use of some of the supplemental data that augments the micro data to assess shipping anomalies in the cereals sector.

[10] Most of the information was obtained from World Shipping Register (www.e-ships.net), a leading company providing ships and shipping companies' data with an outstanding number of ships, and shipping companies and detailed per-ship characteristics. Information on all other ships not covered by the World Shipping Register was obtained from personal visits to Customs & Ports General Authority, Doha, Qatar.

3.1 Import Price Volatility

Import price volatility has increasingly become recognized as a serious manifestation of food insecurity (World Bank, 2011; FAO, 2011). Our micro-data set provides a unique look into the pattern of price volatility in small arid Arab countries.

The descriptive statistic employed to represent volatility in our paper is the coefficient of variation (CV). Since we have observations for every shipment entering Qatar over the relevant period, a population formulation of the CV is appropriate:

$$CV = \sigma/\mu \quad (1)$$

Where σ is the population standard deviation and μ is the population mean. Sokal and Rolf (1995) have shown that when the number of observations is small, equation (1), or its sample equivalent, can be biased. They suggest an unbiased sample estimator:

$$CV_s^* = CV_s[1 + 1/(4N)] \quad (2)$$

Where CV_s refers to sample CV and N is the sample size. The sample CV is defined as:

$$CV_s = s/\bar{x} \quad (3)$$

Where s is the sample standard deviation and $\bar{x}$ is the sample mean.

A few commodities were associated with a small number of observations and CVs were calculated by both (1) and (2). There was no noticeable difference in the estimates; therefore the results for equation (1) are reported here. Table 1 displays mean, median, number of observations and CV for 25 representative commodities. Results for all shipments for the first six months of 2008, 2009 and 2010 respectively are reported.

[Place Table 1 approximately here]

There is no absolute interpretation of CV but most would agree that a CV greater than 1, standard deviation greater than mean, is evidence of a high level of variability. By this standard it can be seen that extreme price variability exists in many commodities. CVs, however, change from year to year for many products. Very large CVs are evidenced for virtually all Chapter 7 vegetables. The CVs are quite pronounced for

staples such as tomatoes and cucumbers. Price variability in meats is less evident, and shows fairly dramatic shifts from year to year. Beef prices are moderately volatile and the CVs are stable over the three years. Dairy CVs tend to be stable around unity. With respect to grains the CV for wheat was fairly low until 2010 when prices became quite variable. Barley-price variability has dropped over the three years, but was low only in 2010. Rice import-price volatility was high in 2008, very high in 2009, but dropped in 2010.

To assess the magnitudes of the micro-data CVs, they can be compared to those for the world prices described in Section 2.2. The latter data are monthly and CVs were calculated for each commodity for the first 10 months of 2010, which were then contrasted to the micro-data CVs for the first half of 2010. Because of the small sample size, the small-sample methodology of equation (2) was used, but the results did not differ in any material manner from those of equation (3). An important caveat to this exercise is that micro-data are being compared to small-sample monthly data. Furthermore, categorizing (high) CVs isn't straightforward since we do not know the degree of differentiation within the 8-digit commodities. The micro-data CV for cucumbers was 2.1659, fully 16 times the level for the "world-price" CV of .1393. The Qatari shipment CV for eggplant was 1.9304 as compared to the world-price CV of .1188. The micro-data CV for onions imported into Qatar was 1.7915, five times the world-price CV of .3656.

Price volatility does not only manifest over substantial time periods, it is also evident over very short periods of time. Figure 1 shows the prices of every shipment of tomatoes that arrived in Qatar in the second week of January 2010. Price differences are very pronounced across origins. The right hand Y axis relates to prices in the QR0.1 to QR1.8/kg range. The left hand Y axis is associated with prices between QR3 and QR27/kg. Although there are substantial source related price variations, price variability within one week for tomatoes of the same origin are also apparent. Needless

to say, differences in quality among products (e.g., Holland tomatoes versus Jordanian tomatoes) and transportation mode (i.e., seaborne, airborne, overland) also account for the observed variations in prices, irrespective of the locations of the market. **[Place Figure 1 approximately here]**

The descriptive statistics on volatility can be summarized as follows. Many commodities shipped into Qatar display extreme import-price volatility, especially as compared to world prices as represented by US export prices. Volatility appears to change from year to year for some Qatari imports. Large differences in price by source exist, but even over very short periods price volatility exists for imports from individual sources.[11] High and volatile international food prices are a major concern for importing Arab micro states like Qatar due to the impact it might have on consumer price inflation. This is because of the asymmetric effect of commodity price volatility on domestic prices, whereby "only price increases are transmitted, whereas consumers do not benefit from a decline in food prices" (Ianchovichina et al., 2012, p. 19). Further, given the perceived lower substitutability of food staples in Arab micro states, one would expect the food price volatility to be very harmful for consumers. Although direct estimates of the impact of food import price volatility on domestic prices are not available, in a recent study, Ianchovichina et al. (2012) found that, despite the widespread use of food price subsidies and other government interventions, a 1% increase in global food prices raises domestic price by some 0.25—0.40 percent in Arab micro states.[12]

[11] It is worth mentioning here that the incentive to under- or over-invoicing imports to reduce taxes or other duties is not relevant to the present context since most food items are exempted from import duties or are subject to low tariffs (maximum 5 percent) on certain products (meat, dairy) from specific locations (non Middle Eastern countries such as Brazil or the USA). Furthermore, hitherto no national general sales tax exists in Qatar.

[12] The country specific 12-month food price pass-through coefficients are Bahrain (0.349 percent), Kuwait (0.279 percent), Qatar (0.355 percent) and the UAE (0.413 percent).

3.2 Concentration Among Countries of Origin

A key element of a viable food security strategy is a country's ability to diversify import sources to provide buffers against political, health, weather and other disruptions. Diversification of source can also serve to dampen high prices and price volatility through competitive purchasing and greater parity relative to the market power of suppliers. In this section we provide descriptive statistics from the micro-data set to investigate concentration levels among countries of origin for the 25 representative commodities already listed in Table 1. Note that the stress is on concentration among supplying *countries* and not exporting *companies*.

The descriptive measure we employ to calculate country-of-origin concentration is the Herfindahl-Hirschman Index (HHI) which is used by the United States Justice Department (DOJ) to assess concentration levels (US Department of Justice, 2010). The HHI was employed by Orris Herfindahl, but was likely initially developed by Albert Hirchman (Hirschman, 1964).

The HHI is the sum of the squares of the market shares (fractional share × 100) of participants in a market. Squaring the shares magnifies the effects of dominant market-share holders. The DOJ has set intervals which define various concentration levels. Markets with HHIs less than 1,500 are considered to be unconcentrated. Those with HHIs between 1,500 and 2,500 are deemed to be moderately concentrated. Markets with HHIs in excess of 2,500 are considered to be highly concentrated (US Department of Justice, 2010). The upper bound is perfect monopoly where the HHI reaches 10,000. Although several companies may export from a given country, our interest here is disruptions and other food-security effects from regions, and therefore we apply the HHI concept to countries of origin for each commodity. Table 2 presents country-of-origin HHIs for the 25 representative commodities. (Table 2 also includes Qatari import company HHIs to be used in Section 3.3). **[Place Table 2 approximately here]**

As can be seen, with very few exceptions the country-of-origin HHIs suggest very high concentration levels as regards the sources of agricultural imports into Qatar. Most dairy products are at near-monopoly levels, suggesting sole sourcing of dairy imports and virtually no diversification. Similarly, with the exception of lentils in 2008 and 2009, vegetable sourcing is highly concentrated. This is also true of fruits with the exception of apples. Grains are also highly source concentrated with barley origins at sole-source monopoly levels.

Meat imports are also highly concentrated as to origin, although not at sole-source levels. What does it mean to have an origin HHI in the 3,500 range? Figure 2 provides market shares by origins for a culturally important meat import—HS 02042100, "carcasses and half carcasses of sheep, fresh or chilled."[13] The Figure shows that Qatar is almost completely dependent on India and Pakistan for imports of fresh sheep carcasses—two contiguous countries subject to similar weather and animal-health crises, and that have a history of severe political tensions. In reality there is no true diversification in this key import category, which leads to significant food-security exposure. **[Place Figure 2 Approximately here]**

This can be contrasted with a large developed country that is completely import-dependent in certain commodities. For example the United States imports all bananas consumed in the U.S. The U.S., however, is able to diversify import origin, with bananas shipped from at least 5 major sources, and an origin HHI calculated to be 2,100 based on USITC (2012) data. This is substantially below the DOJ "highly concentrated" threshold.

Finally, the upper panel of Figure 4 presents the distribution of origin concentration (measured by the HHI) for all 102 imported raw commodities over the 2008-2010 period. For each histogram, a Kernel density plot is also presented (represented by the solid black lines), which offers a complementary view on the distribution of market

[13] Such imports are subject to strict Halal requirements in addition to SPS rules.

concentration. As it shows, while the average level of supplier concentration has moderately increased over the 2008-2010 period, higher concentration is relatively widespread across countries of different origins (as evidenced by their low skewness values). Average HHI for all broad category of food items[14] show a high origin concentration, suggesting that import diversification has not been sufficient to offset the impact of high prices and price volatility. **[Place Figure 4 Approximately here]**

3.3 Concentration Among Agricultural Importing Companies in Qatar

Concentration among importers can also have food-security consequences, especially as regards high prices and price volatility. Table 2 provides the importing-company HHIs for the 25 representative commodities. For the most part importation is highly concentrated for meat and dairy, although the concentration levels do not rise to those of the country-of-origin HHIs. Import markets for fruits and vegetables are almost completely unconcentrated. This is likely due to the heterogeneous nature of these products whereby end-use variations (i.e., products imported for processing versus those imported for supermarkets to be sold fresh) primarily dictate the amounts to be imported.[15] This is not true of cereals. Importation is associated with monopoly power for wheat, and monopoly or near monopoly structure (depending on the year) for barley. Rice, however, is unconcentrated at the importer level.

What do concentration levels only moderately above the 2,500 threshold indicate? Although considered highly concentrated, they are still at the lower end of the highly-concentrated scale. Resorting, again, to HS 02042100, "carcasses and half carcasses of sheep, fresh or chilled," Figure 3 illustrates the structure. For this commodity, three importers dominate the market with approximately equal shares. So even for an HHI of about 2,700, competition could be substantially curtailed, with attendant effects on price and price-volatility. **[Place Figure 3 approximately here]**

[14] These include meat, dairy, fruits, vegetables and cereal commodities.

[15] We thank the anonymous referee to bring this interpretation to our attention.

Even with lower HHIs, there is the possibility of dominant import firms within commodities. For example, in the first half of 2010, as many as 42 import firms imported tomatoes into Qatar, with a resulting HHI of only 625. However, using the four- and eight-firm concentration ratio measures,[16] the extent of competition in the import of tomatoes in Qatar appears to be more concentrated. The four- and eight-firm concentration ratios reached 40 percent and 61 percent, respectively. Greater concentration was also associated with other imported fruits and vegetables commodities, which typically exhibited the least-concentrated markets. The most striking market concentration emerged in the import of rice. During the first half of 2010, of the 133 potential rice importers, the four- and eight-firm concentration ratios reached 46 percent and nearly 60 percent, respectively. These results indicate that the role of the biggest importing firms must be taken into account when assessing the competitive environment.

Finally, the lower panel of Figure 4 reports the distribution of importer concentration for all 102 imported raw commodities over the 2008-2010 period. Although the average level of market concentration at the importers' end is considerably lower than that of origin-specific concentration, HHI distributions for importers are more positively skewed, especially in the cereal and dairy products. In particular, average HHI during 2008 in the cereal category was significantly higher (around 6,000) than that of 2009-2010 (less than 5,000), suggesting that during the period of global food crisis of 2007-2008, the importers market was associated with a less fragmented market structure. On the contrary, the dairy segment became more concentrated over time, from a level of around 2,900 in 2008 to nearly 4,900 in 2010.

[16] The n-firm concentration ratio, $C_n = \sum_{i=1}^{n} s_i$, is a concentration indicator alternative to HHI, with n typically equal to 4 and 8. However, unlike the HHI, the C_n is not sensitive to the distribution of market shares among firms (Scherer and Ross, 1990).

3.4 Shipping Anomalies in the Cereals Sector

The micro-data set will also prove useful in identifying shipping patterns and anomalies unique to small-scale import-dependent countries that could have food security consequences. In this section we provide anecdotal evidence on shipments to Qatar in the cereals sector.

In the first half of 2010, 63,510 tonnes of barley were imported into Qatar. A complete origin monopoly existed with 99.9% of the barley volume shipped from Australia. Yet there was substantial asymmetry in shipment-methodology for this basic animal-feed commodity. There were 24 individual shipments from Australia that entered Qatar during that period. But there were four separate modes of transportation, two of which required off-loading and transshipment on either small freighters or in trucks. The other two modes appear to be direct shipment involving single-hold quantities in larger bulk (including tanker) vessels.

On January 11, 2010 two individual shipments of barley of Australian origin arrived in Doha harbor on the general cargo ship Aann, flagged in Comoros and built in 1978. The capacity of the Aann is a mere 2,431 tonnes and the two shipments accounted for almost all of the Aann's capacity. On January 17, 2010 the Aann returned to the Port of Doha with another full-capacity shipment of Australian barley. Since ships can't fly, a reasonable assumption is that the Aann was transshipping grain from a regional port where a large ship had off-loaded large quantities. Of the 24 shipments of Australian barley to Qatar in the first half of 2010, 7 were transshipped in this fashion, using two small general cargo ships to transit the Persian Gulf—the Aann and the Trustful, flagged in Togo, built in 2008 with a capacity of 3,187 tonnes.

Nine shipments appear to be single-hold shipments on larger general-cargo carriers such as the VTC Sky and the VTC Sun, both flagged in Vietnam. Some of these 9 shipments arrived in different holds on the same day.

The remainder of shipments were offloaded and transferred to trucks, where they entered Qatar through the Salwa border crossing. The shipments delivered by sea, whether direct or transshipped, were shipped in bulk, whereas those ultimately delivered by truck were packaged in 30 kg bags. These differences in shipping method and packaging appear to have a substantial effect on unit price, despite the fact that in all cases the subject shipments were of a basic feed commodity.

In the first half of 2010, 48,841 tonnes of normal wheat entered Qatar. Although still highly concentrated, source was more diversified for wheat than for barley, with three major origins—Australia, Canada and Germany—dominating the trade. There were 18 individual shipments of wheat from all suppliers combined. Four shipments were large quantities on larger, ocean going dry-bulk vessels such as the 21,520 tonne capacity Sea Lark, flagged in Malta. Six shipments arrived in small ships—the Adan N (Turkey), the Mataf Star (Panama), and the Tom Ship 2 (Barbados). These were transshipped from a regional port. Curiously 6 shipments arrived in individual containers in container ships such as the Al Rumeila, Al Yasra and Al Waab, all flagged in Qatar. This seems to be a very expensive way to transport wheat. Two transshipped shipments arrived by truck. The truck and container shipments were packaged in 25 kg bags, whereas the remainder of the shipments arrived in bulk.

In the first half of 2010, 8,235 tonnes of yellow corn were imported into Qatar, primarily for use as poultry feed. Seventy-nine percent of this volume originated in Argentina, and the only other major supplier was India with a 16% origin share. Three bulk shipments, all from Argentina and ranging from 2,000 to 2,400 tonnes a piece accounted for 6,539 tonnes, or 79% of total volume. The ships involved were the 2,431 tonne capacity Aann (Comoros), also used for barley, and the 4,250 tonne capacity Adnan N (Turkey), also employed for wheat. These three small-ship deliveries were all transshipments from a regional port. With the exception of one small shipment, all

Indian deliveries were individual containers of corn, carried on Qatari and Panamanian flagged container ships. Two shipments from Pakistan, some 250 tonnes of corn, were also shipped in Qatari-flag container ships. The remainder was transshipped via truck. The three larger Argentine shipments were in bulk while the container shipments were split between 40 kg bags and bulk shipping measured in square meters.

Typical grain shipments in the non-micro-state larger grain trade are delivered via large dry-bulk carriers, with capacities from 20,000 tonnes to hundreds of thousands of tonnes (UNCTAD, 2008; USDA-AMS, 2009). This is the efficient way to ship grain. That Qatar displays such asymmetry in shipment method—resorting to transshipment and container service for basic commodity grains often used for animal feed—is a symptom of the effects of small scale on logistics. Table 3 lists the ships employed in the import of cereals into Qatar in the first half of 2010, their configurations and capacities, and the grains they transported. **[Place Table 3 approximately here]**

4. An Empirical Illustration of Hedonic Price Modeling for Barley

To exploit the micro-data at hand, in this section we consider an empirical investigation to measure the shadow prices and costs of characteristics of a particular commodity (i.e., barley) using the hedonic price modeling. The time period considered is between January 2005 and June 2010, which covers the entire time span of the micro-data set detailed in Section 2. Summary statistics reveal that per unit prices of barley were not only higher in 2008, they were also very volatile compared to other years.[17] For example, compared to 2005, prices of barley were almost eight-fold higher and over six times more volatile in 2008. In terms of the mode of transportation, about 70% of imported barley arrived through ships, followed by road (20%) and air (10%). Bag and each (bulk) are the two primary method of packaging used to import barley into Qatar, covering over 90% of imported barley (with almost equal share to each method), followed by carton (3%) and square meter (2.65%). Finally, regarding country of origin

[17] All unreported summary statistics are available from the corresponding author on request.

of imports, about 30% of barley were sourced from the UAE (which is considered as re-exports for the UAE given its strategic location), followed by Australia (27%), Ukraine (17%), the USA (11%), India (8%) and the remaining from other destinations. These factors (i.e., shipment methods, packaging and sourcing) can be analyzed in an econometric pricing model to isolate their respective effects, while accounting for other factors (e.g., year fixed effects).

Following the arguments above, the basic hedonic pricing model is as follows:

$$P_{ijct} = \alpha + \sum_{i=1}^{3} \beta_i X_i + \sum_{j=1}^{4} \gamma_j Y_j + \sum_{c=1}^{6} \delta_c Z_c + \sum_{t=1}^{6} \varphi_t D_t + \epsilon_{ijct} \qquad (4)$$

where P_{ijct}= the unit price of imported barley (in logarithm) with modes of transportation *i*, method of packaging *j*, country of sourcing *c* in time *t*. X_i denote modes of transportation with i = 1 (sea), i = 2 (air) and i = 3 (road); Y_j denote method of packaging with j = 1 (bag), j = 2 (carton), j = 3 (each) and j = 4 (square meter); Z_c refer to country of source with c = 1 (UAE), c = 2 (Australia), c = 3 (India), c = 4 (Ukraine), c = 5 (USA) and c = 6 (rest of the world); and D_t are a set of year fixed effects with t = 1,2,…,6 denote years 2005, 2006,…,2010, respectively. The year fixed effects variables account for any systematic differences in prices across years, correcting for the net effect of supply or demand variation. The model specification is similar to Wiggins and Raboy (1996) who studied the potential effects of quality-related factors on prices of imported bananas in the US using the hedonic regression method.

Before presenting the estimation results, a note on the use of categorical regressors included in the regression model (4) using a set of 0/1 dummies differentiating the effects of the separate categories of the variable. A coefficient associated with the conventional dummy variable reflects the expected outcome difference between the represented category and some reference category. Since one of the categories serves as the reference category, only *k-1* dummy variables are estimated for a *k*-category variable. However, the coefficients effect attributed to dummy variables is not invariant

to the choice of the omitted group(s), a problem well-known as invariance or identification problem in the literature (see e.g., Yun, 2005). To overcome this problem, we follow the remedy set out by Yun (2005) which employs a normalized regression through an averaging approach. As a result, the estimated coefficients of the $0/1$ dummy variables of the normalized regression reflect deviations from the "grand mean" (in other words, the modified coefficients will sum up to zero over all categories) rather than deviations from the reference category. The transformed coefficients are equivalent to those obtained by using the so called "effects coding" for the dummy variables – see Bech and Gyrd-Hansen (2005) for an illustration.[18] A final note on the dependent variable is necessary. The import prices of barley (P_{ijct}) follow a discrete pattern of shipments, whereby we may have multiple shipments on a given day and no shipments at all in certain months. The data contains 189 observations. **[Place Table 4 approximately here]**

Table 4 presents regression results of Equation (4) containing the three-set of characteristics variables, namely transportation, packaging and country of origin. Furthermore, it also includes year fixed effects to account for systematic differences in prices across years. Results show that, relative to the average of the estimates, transportation via sea exerts a negative effect on import prices, while the impact is positive for air and road transportations. However, only the impact of ocean-based shipments are statistically significant at the 1% level. Regarding the effects of method of packaging on prices of imported barley, results reveal that both carton and bulk raise import prices, whereas packaging via bag and square meter lowers them. However, the estimated coefficient of bag is statistically significant at the 10% level only. Concerning

[18] An alternative method for coding categorical variable is "orthogonal coding". Pedhazur (1997, pp. 340-409) demonstrates that the end results of multiple regression analyses of the same data coded by simple dummy coding, effect coding and orthogonal coding are identical. However, orthogonal coding permits the researchers more flexibility to examine more than simple omnibus tests, such as the complex coding type of contrast coding when a researcher wants to explore specific theory driven hypotheses about group differences among categories of a predictor variable (see Davis, 2010). We thank the anonymous referee to bring this issue to our attention.

the effects of country of origin on import prices, imports from the USA are much costlier than the average cost of imports from Australia or Ukraine. This is to be expected as US imports are primarily shipped via air, whereas imports are transported via ocean-borne cargo from Australia or Ukraine. The coefficient estimates of the year fixed effects are positive for 2007 and 2008, consistently with the observed trend in world prices observed during these periods. Furthermore, the negative and significant coefficient of 2010 is also in line with the drop in world cereal prices documented following the aftermath of 2008-2009 global financial and economic crises. The F-test confirms that the explanatory variables are jointly significant and the model has reasonably good explanatory power (R^2 value of 0.65). All in all, the results show that transport through sea, packaging in bags, and country of sourcing such as Australia, Ukraine and the US stand as the most significant characteristics determinants of import prices of barley into Qatar.

We have performed several additional regression estimations controlling for world (export) price of barley and HHI indices for importers and country of origin. In most cases, the elasticity of world price appears small and statistically insignificant. Whereas, the estimated coefficients of HHI indices appeared noisy, due to large standard errors. Furthermore, their inclusion in the regression didn't lead to an improvement in the overall explanatory power of the model. One likely reason is that since HHI indices are measured on a half yearly interval, the rate of change in the response (dependent) variable is disproportionate over the entire time period of observation.

The example laid above is only an illustration of the type of analyses that could be conducted using this rich micro data set. More care is needed in disentangling the true effect of quality characteristics to explain the bulk of price variation in import prices. Nonetheless, the analysis presented here for barley may provide a glimpse of a price-characteristic relationship in other cereal markets.

5. Discussion and Research Agenda

This paper has described a rich micro-data set of agricultural imports into the State of Qatar. One preliminary observation is the appearance of substantial import-price volatility across a wide spectrum of commodities. Why does this occur, and what is its relationship to the small scale of Qatar's import market?

A second initial observation is that origins for virtually all commodities are highly concentrated. In many cases commodities are sole sourced. Although less so, concentration is evidenced among Qatari importing companies for certain commodities. The final early impression has to do with the logistics of importation in a small country like Qatar, especially with respect to products such as cereals. It appears that anomalies exist that lead to inefficient shipping methodologies and associated increased costs. These preliminary observations beg for further investigation and the rich micro-data set, as augmented, provides fertile ground for new and expanded research. A summary of a proposed research agenda follows:

1. *Hedonic Price Modeling*. The specific hedonic modeling presented in Section 4 is only an illustration of the wide possibilities of hedonic regressions that can be investigated using the micro-data. The augmented micro-data set can be used in commodity specific, sectoral, or general panel data settings to measure the shadow prices and costs of characteristics that enhance or detract from consumer well-being. Such effects as quality-source-related premiums can be estimated, as well as logistics-anomaly-costs that affect prices and food security (Rosen, 1974; Wiggins and Raboy, 1996). Similarly, the effects on prices at the import level of concentration among origin countries or importing companies can be assessed for various commodities. Market concentration among importing companies is not inherently evil, because it may lead to economies of scale in purchasing and buying. Small numbers of buyers or sellers operating in the absence of opportunistic behavior do not pose a problem for market efficiency, but small numbers in conjunction with opportunism make it possible for powerful buyers

and sellers to control the market (Sashi, 2004). With respect to Qatar and other small-scale Arab countries, however, current research has provided no guidance on what benefits and costs may derive from the highly concentrated nature of, for example, concentrated cereals import markets at the importer level. These results in turn can inform planning modeling as to import rationalization, strategic storage, and domestic production.

2. *Demand and Substitution Modeling*. Using advanced demand modeling techniques, food security policy may be enhanced by informed use of import substitution. Qatar imports many of the same commodities from different countries. For example Qatar imports meats from Brazil, Australia, India, New Zealand, Syria, India, Pakistan and Saudi Arabia; dairy products from Saudi Arabia, Netherlands, Germany, New Zealand and Jordan; and cereals from Pakistan, Ukraine, India and Australia. Within these specified food groups, price and expenditure effects can be analyzed in order to investigate the possibility of import substitution (Yang and Koo, 1994; Richards, van Ispelen and Kagan, 1997). If Qatar can effectively substitute imports from one country for those from another country, it can avoid excessively high costs associated with importing small amounts of certain commodities from far afield distances. In addition, such an analysis will present opportunities for potential access to the Qatar food market by food exporting countries. An appropriate analytical method is the Source Almost Ideal Demand System (SAIDS) which would allow assessment of import substitution for various commodities.

3. *General Analysis of Price Volatility*. High and increasing price volatility can be caused by both demand side and supply side factors. On the demand side, increasing population and incomes in Qatar can put upward pressure on market demand, while on the supply side supply disruptions due to export bans and natural disasters, taking farmland out of agricultural production, and high oil prices may be responsible. But one of the most important considerations must be the impact of scale on import-price

volatility that is far in excess of that seen in world prices. Further research to determine the major causal factors affecting price volatility is necessary. Similarly, inefficient import decisions may incur significant rent from time to time. This also needs to be investigated.

Beyond the hedonic modeling just discussed, logistical issues need to be studied in great detail, entailing a separate, specific modeling format. Especially as relates to scale, logistical issues are prime suspects pertaining to high and volatile prices.
These are just some of the research issues that can be served by the micro-data set, as augmented, described in this paper. Use of these rich data can help inform on microeconomic questions relating to micro Arab countries and appropriate policies to enhance food security.

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Figure 1: Tomato Import Prices by Source: Shipment-by-Shipment

2nd Week, January 2010

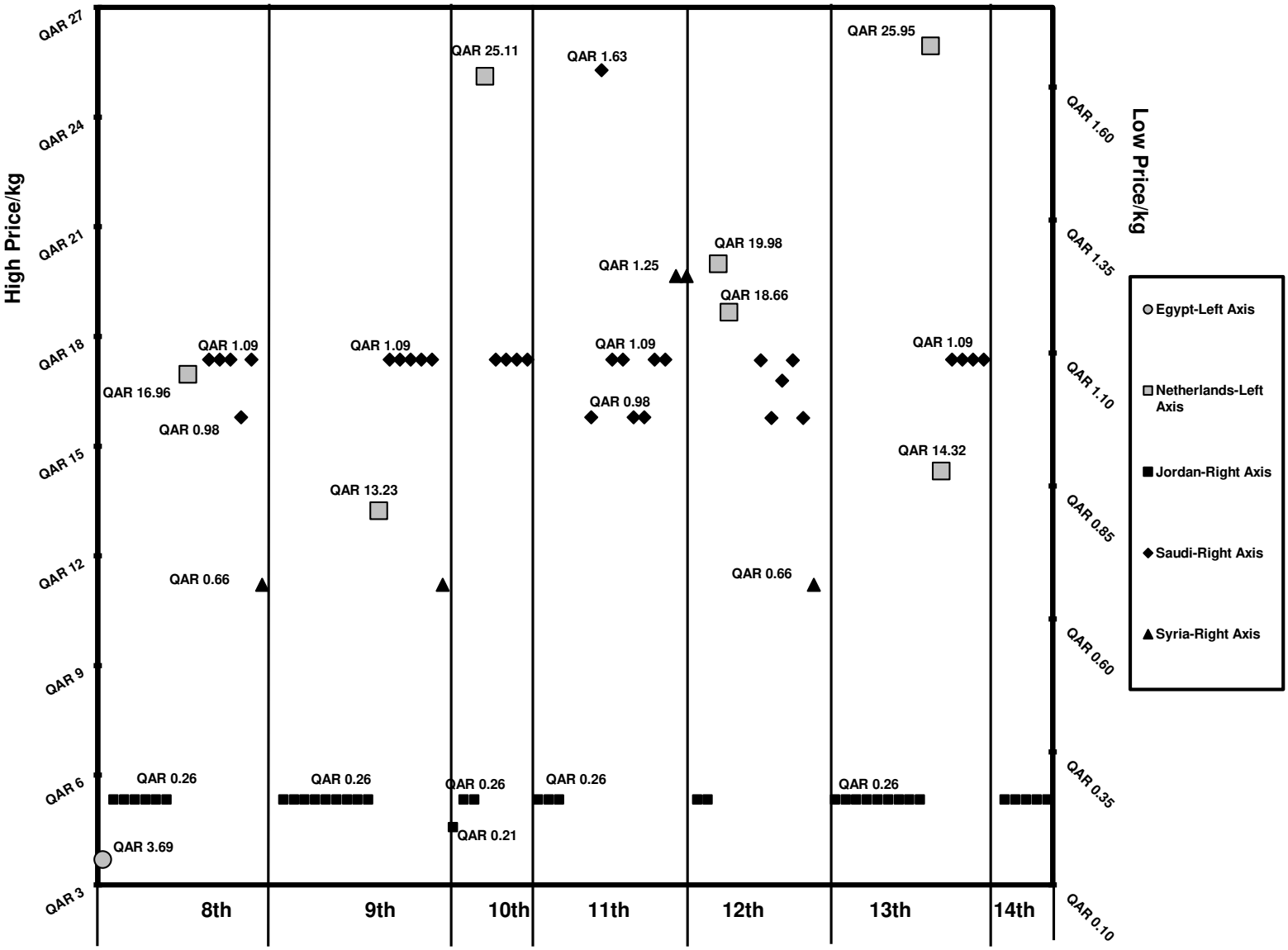

Figure 2: Origin Country Shares: HS 02042100, Carcasses and Half Carcasses of Sheep (fresh or chilled)--1st Half 2010

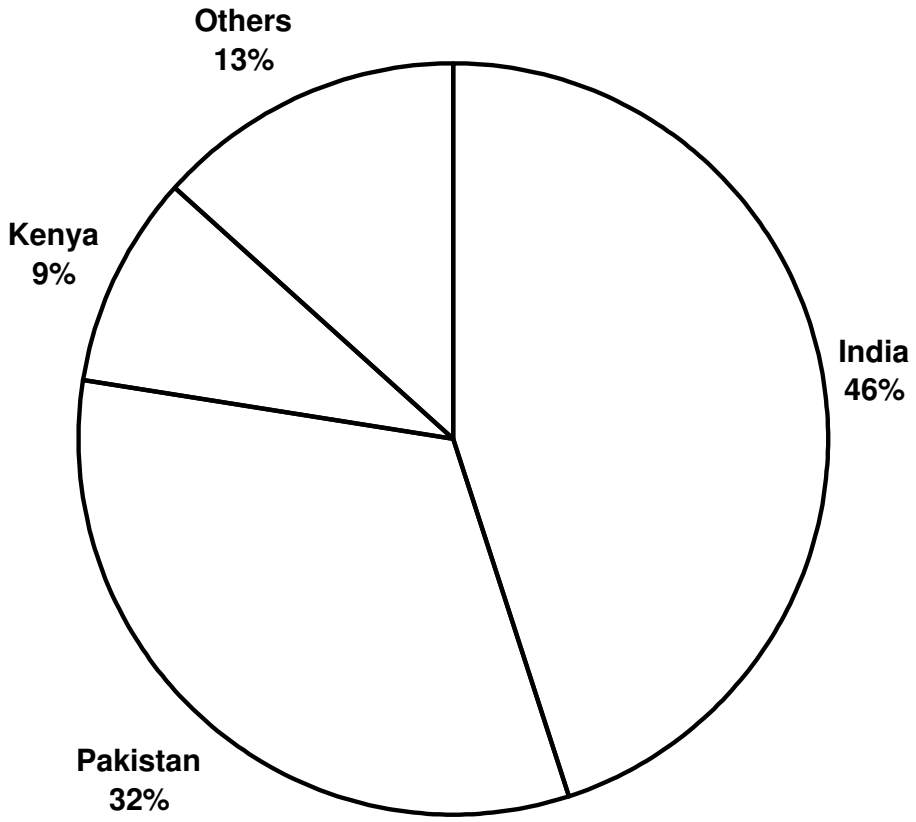

Figure 3: Importer Company Shares: HS 02042100, Carcasses and Half Carasses of Sheep (fresh or chilled)--1st Half 2010

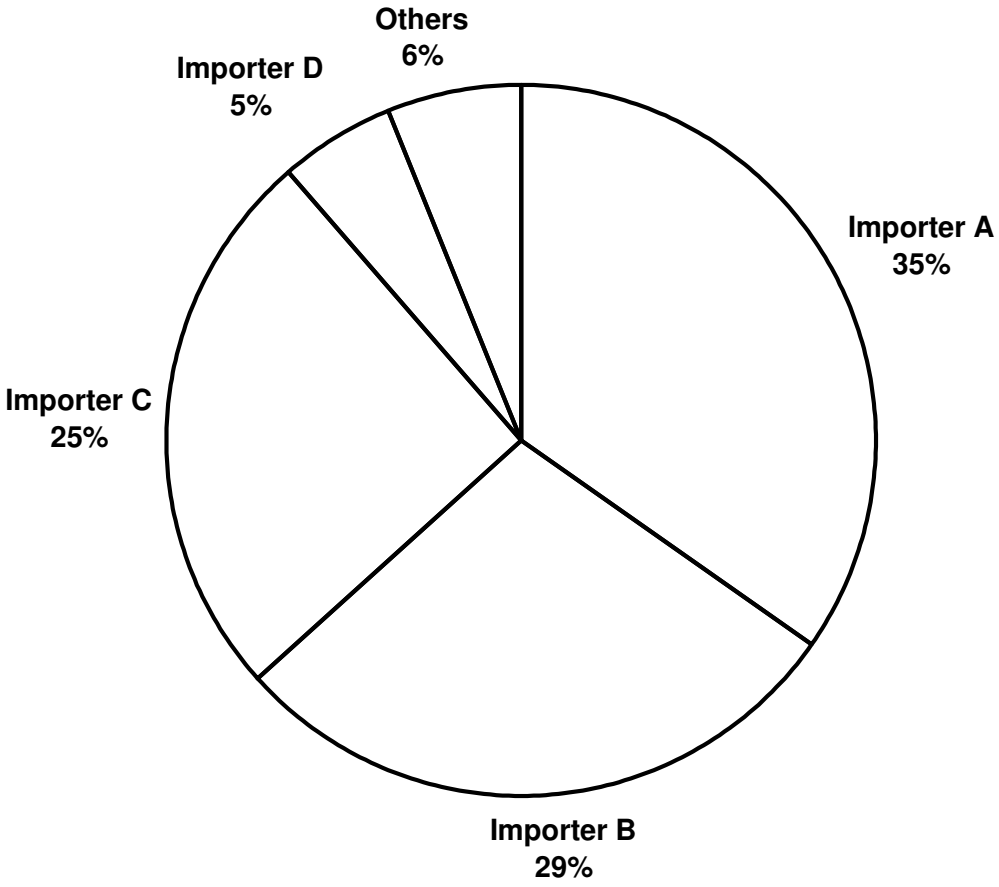

Figure 4: HHI by origin and import firms for all 102 imported commodities during 2008-2010

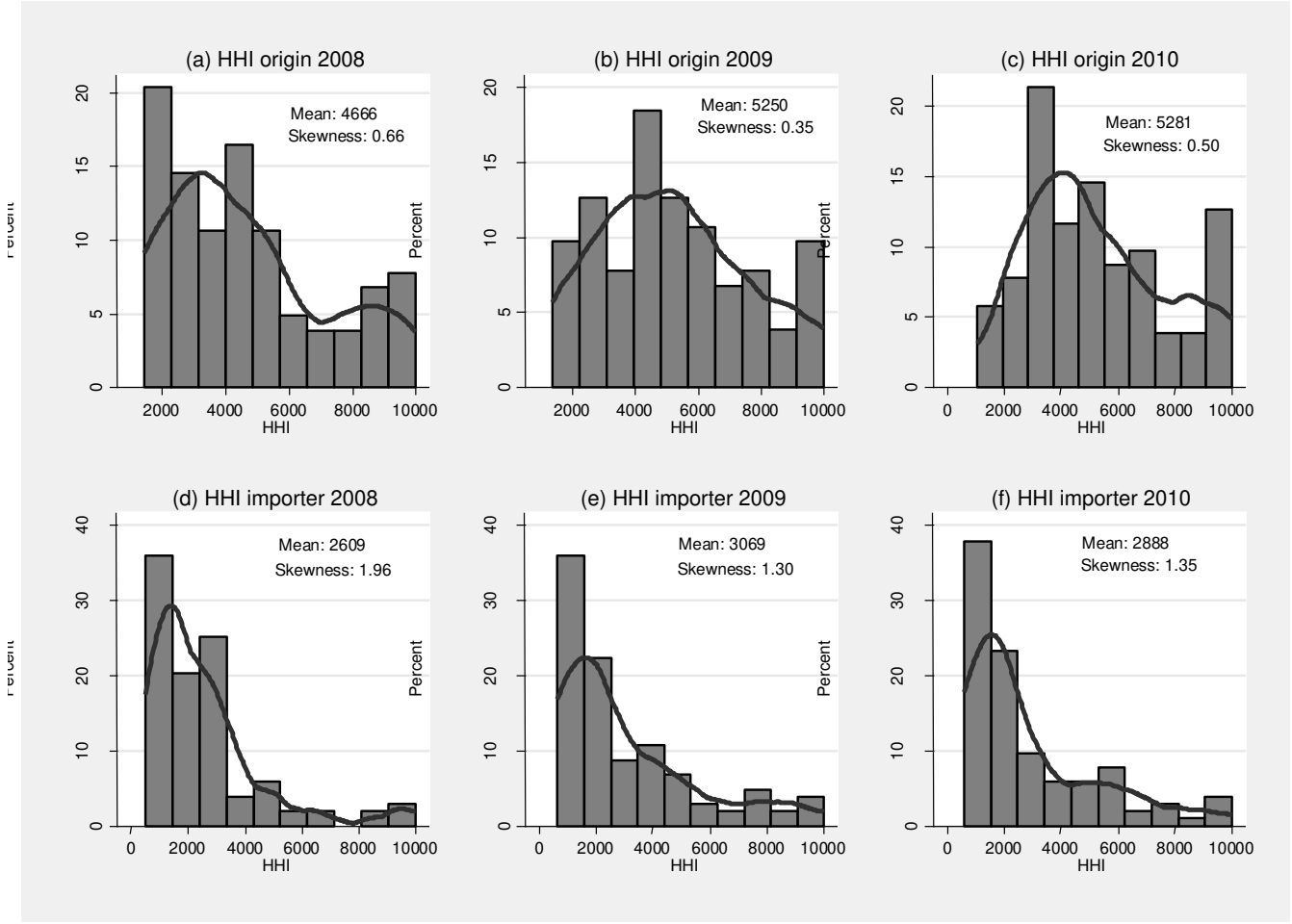

Table 1: 2008-2010 Comparisons of Coefficients of Variation

		Mean			Median			Observations			CV		
HS Code	HS Description	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
02013000	meat of bovine animals, boneless, fresh or chilled	52.07	51.42	34.75	28.03	33.88	18.81	62	77	159	0.9283	1.0438	1.0002
02042100	carcasses and half carcasses of sheep, fresh or chilled	12.90	13.31	14.46	9.38	14.27	14.60	820	1,055	945	1.0137	0.5871	0.5976
02071200	poultry, not cut in pieces, frozen	7.48	6.77	7.17	7.02	6.10	5.81	453	413	329	0.8059	0.4490	1.0318
04011030	long life milk(of a fat not exceeding 1% by weight) , in	5.53	3.25	3.89	3.30	2.48	3.25	367	432	553	1.2128	0.9408	0.8900
04029110	concentrated, milk	5.02	4.67	3.77	3.10	3.23	3.09	658	1,156	1,206	1.8407	0.8281	0.9523
04031000	yogurt	4.09	4.93	6.96	2.84	4.42	6.55	938	501	633	1.3046	1.0580	0.7106
04070090	birds eggs, other	6.46	6.36	6.04	5.18	6.29	5.63	89	300	423	1.0061	0.5711	0.6704
07019000	potatoes, fresh or chilled	1.15	2.96	1.71	1.09	1.09	1.09	1,508	2,365	2,334	0.6905	4.0225	2.0214
07020000	tomatoes, fresh or chilled	1.28	2.26	1.21	0.26	0.26	0.26	2,195	2,084	2,262	3.8523	2.8618	2.7925
07031011	onions for food(green or dry rind)	1.37	1.88	1.69	1.09	1.09	1.09	1,143	1,473	2,067	1.1799	4.0891	1.7915
07041000	cauliflower and headed broccoli, fresh or chilled	0.77	1.30	0.94	0.78	0.97	0.98	2,420	2,382	2,672	1.2375	4.8859	1.8043
07051100	cabbage lettuce (head lettuce)	0.60	4.33	2.19	0.26	0.26	0.26	1,539	1,571	2,147	1.9275	4.1900	2.8105
07061000	carrots and turnips, fresh or chilled	1.36	1.37	1.58	1.09	1.09	1.09	1,878	1,405	1,675	2.4000	1.3146	1.4885
07070000	cucumbers & gherkins, fresh or chilled	0.96	0.76	1.38	1.09	1.09	1.09	2,600	2,147	2,622	2.5039	0.7202	2.1659
07082000	beans, shelled or unshelled, fresh or chilled	1.37	0.85	2.40	0.30	1.09	1.09	884	1,160	2,085	1.9650	0.8694	1.9455
07093000	aubergines (egg plants), fresh or chilled	0.72	0.70	1.39	0.26	0.26	1.08	1,489	1,786	2,494	2.3213	1.3775	1.9304
07096000	fruits of the genus capsicum or of the genus pimenta	0.89	0.94	1.58	0.26	0.26	0.26	2,338	2,192	2,890	3.5859	4.2604	2.0811
07134000	dried lentils, shelled, whether or not skinned or split	4.14	4.55	3.08	2.33	2.36	2.80	369	364	378	1.6295	2.8904	0.7634
08051000	oranges, fresh or dried	1.32	1.43	1.74	1.00	1.33	1.25	1,109	1,074	1,030	1.4388	0.6965	1.7966
08052000	mandarins (incl tangerines and satsumas) clementine, wilkings	1.31	1.40	1.44	1.00	1.25	1.32	701	604	716	0.9705	0.7864	1.3200
08071100	watermelons	1.73	1.21	1.01	0.98	0.98	0.98	629	743	786	2.7707	2.6365	0.7490
08081000	apples, fresh	2.10	2.04	2.20	1.67	1.67	1.62	1,944	1,537	1,958	1.0892	0.8047	1.5651
10019010	normal wheat	1.84	1.53	2.31	1.78	0.99	1.05	10	7	19	0.3873	0.4544	1.5802
10030000	barley	13.20	11.31	0.92	2.00	3.30	0.77	35	7	28	2.0292	1.0495	0.4648
10063000	semi milled or wholly milled rice, whether or not polished or	4.11	4.41	3.28	2.80	2.61	2.83	1,050	933	897	1.6846	3.2277	0.6315

Table 2: 2008-2010 Comparisons of HHIs							
		Importer Company HHI			Origin Country HHI		
HS Code	HS Description	2008	2009	2010	2008	2009	2010
02013000	meat of bovine animals, boneless, fresh or chilled	2,907	4,754	2,446	2,733	6,413	3,909
02042100	carcasses and half carcasses of sheep, fresh or chilled	2,922	2,546	2,693	3,322	3,767	3,218
02071200	poultry, not cut in pieces, frozen	2,950	2,859	2,274	4,785	5,574	4,055
04011030	long life milk(of a fat not exceeding 1% by weight) , in packing exceeding 1L	2,623	4,960	3,896	9,116	9,303	9,547
04029110	concentrated, milk	2,739	4,232	5,539	7,126	7,670	6,772
04031000	yogurt	4,455	3,458	3,901	9,788	9,969	9,946
04070090	birds eggs, other	1,280	1,598	1,398	1,668	8,558	7,837
07019000	potatoes, fresh or chilled	1,573	1,791	1,719	3,573	6,255	8,583
07020000	tomatoes, fresh or chilled	665	713	626	6,455	7,509	7,069
07031011	onions for food(green or dry rind)	2,141	1,863	1,204	6,901	5,921	3,448
07041000	cauliflower and headed broccoli, fresh or chilled	933	956	1,110	4,298	4,515	4,651
07051100	cabbage lettuce (head lettuce)	779	766	745	3,950	4,711	3,604
07061000	carrots and turnips, fresh or chilled	1,057	1,150	1,288	3,016	3,150	3,491
07070000	cucumbers & gherkins, fresh or chilled	1,493	1,242	1,672	5,417	5,018	6,238
07082000	beans, shelled or unshelled, fresh or chilled	940	966	971	2,696	3,987	4,006
07093000	aubergines (egg plants), fresh or chilled	942	782	1,022	5,268	4,859	4,713
07096000	fruits of the genus capsicum or of the genus pimenta	634	687	594	4,914	4,975	4,594
07134000	dried lentils, shelled, whether or not skinned or split	837	693	1,241	1,790	2,100	3,481
08051000	oranges, fresh or dried	817	647	660	3,714	4,110	4,297
08052000	mandarins (incl tangerines and satsumas) clementine, wilkings, fresh or dried	866	871	861	4,296	3,315	3,150
08071100	watermelons	3,286	1,835	1,122	7,800	9,120	9,234
08081000	apples, fresh	1,300	886	737	2,321	2,283	1,768
10019010	normal wheat	9,953	9,965	8,137	4,665	4,112	3,427
10030000	barley	9,974	8,803	6,993	9,974	8,803	9,971
10063000	semi milled or wholly milled rice, whether or not polished or glazed	507	1,032	707	4,136	5,677	5,757

Table 3: Cereals Imports in Qatar--Ship Information, 1st 1/2 2010

Ship Name	Type	Flag	Capacity (in tonnes)	Year Built	Barley	Wheat	Corn
Aann	GEN. CARGO	COMOROS	2,431	1978	**X**		**X**
Adnan n	GEN. CARGO	TURKEY	4,250	2006		**X**	**X**
Al Bidda	CONTAINER	QATAR	12,542	2000			**X**
Al Rumeila	CONTAINER	QATAR	12,524	2009		**X**	**X**
Al Yasra	CONTAINER	QATAR	12,512	2009		**X**	**X**
Al Khor	CONTAINER	QATAR	?	?			**X**
ALWaab	CONTAINER	QATAR	9,131	2003		**X**	
Caribbean ID	TANKER	HONG KONG	27,940	1996	**X**	**X**	
India Express	GEN. CARGO	PANAMA	17,373	1986			**X**
Mataf Star	GEN. CARGO	PANAMA	3,340	?		**X**	
MSC Normandle	CONTAINER	PANAMA	28,413	1983			**X**
Sea Lark	BULK SHIP	MALTA	21,520	1985		**X**	
Tom ship 2	GEN. CARGO	BARBADOS	4,210	1990		**X**	
Trustful	GEN. CARGO	TOGO	3,187	2008	**X**		
Vtc Sky	BULK SHIP	VIETNAM	23,581	1997	**X**		
Vtc Sun	BULK SHIP	VIETNAM	23,581	1996	**X**		

Table 4. Regression estimates of hedonic modeling of barley

Dependent variable: Import prices of barley (per kg) in US$		
Sea	-0.61***	(0.22)
Air	0.59	(0.42)
Road	0.01	(0.25)
Bag	-0.30*	(0.16)
Carton	0.48	(0.34)
Bulk	0.04	(0.16)
Square meter	-0.22	(0.16)
Australia	-0.45***	(0.14)
India	0.08	(0.40)
UAE	-0.28	(0.19)
Ukraine	-0.49**	(0.20)
USA	1.35***	(0.46)
Rest of the world	-0.20	(0.37)
2005	-0.17	(0.15)
2006	-0.07	(0.14)
2007	0.25**	(0.12)
2008	0.33	(0.20)
2009	0.04	(0.23)
2010	-0.38***	(0.14)
Constant	-0.24	(0.18)
F-statistic (k, df)	45.15***	
R^2	0.65	

Note: Standard errors are in parentheses. *k=15* and *df=173* refers to the number of estimated parameters and degrees of freedom, respectively. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Annex 1: List of Commodities in the Qatar Import Micro-Data Set

HS Code	Description
Chapter 2	***Meat and edible meat offal***
02011000	meat of bovine animals, carcasses and half carcasses, fresh or chilled
02013000	meat of bovine animals, boneless, fresh or chilled
02021000	meat of bovine animals, in carcasses or half carcasses, frozen
02022000	meat of bovine animals, cuts with bone in, frozen
02023010	meat of bovine animals, mince
02041000	carcasses and half carcasses of lamb, fresh or chilled
02042100	carcasses and half carcasses of sheep, fresh or chilled
02043000	carcasses and half carcasses of lamb, frozen
02044100	meat of sheep, in carcasses and half carcasses, frozen
02044200	meat of sheep, cuts with bone in, frozen
02044310	meat of sheep, mince, frozen
02045012	meat of goat, frozen
02045022	meat of goat, frozen
02045032	meat of goat, frozen
02071100	poultry, not cut in pieces, fresh or chilled
02071200	poultry, not cut in pieces, frozen
02071300	poultry, cuts and offal, fresh or chilled
02071400	poultry, cuts and offal, frozen
02072500	fowls not cut in pieces, frozen
02072600	fowls cuts and offal, fresh or chilled
02072700	fowls, cuts and offal, frozen
02073300	poultry, not cut in pieces, frozen
02011000	meat of bovine animals, carcasses and half carcasses, fresh or chilled
02013000	meat of bovine animals, boneless, fresh or chilled
02021000	meat of bovine animals, in carcasses or half carcasses, frozen
02022000	meat of bovine animals, cuts with bone in, frozen
02023010	meat of bovine animals, mince
02041000	carcasses and half carcasses of lamb, fresh or chilled
02042100	carcasses and half carcasses of sheep, fresh or chilled
02043000	carcasses and half carcasses of lamb, frozen
Chapter 4	***Dairy produce; birds eggs; honey; edible products of animal origin***
04011030	long life milk(of a fat not exceeding 1% by weight) , in packing exceeding 1L
04011090	milk, other
04012030	long life milk , in packing exceeding 1 l
04012090	milk, other
04013030	long life milk , in packing exceeding 1 l
04013090	milk, other
04021010	milk & cream for industrial purposes
04021090	milk & cream, other
04022110	milk & cream, for industrial purposes
04022190	milk & cream, other
04022910	milk & cream, for industrial purposes
04022990	milk & cream, other
04029110	concentrated, milk
04029120	concentrated, cream
04029910	concentrated, milk
04029920	concentrated, cream
04031000	yogurt
04039010	butter milk (labnah)
04051000	other butter
04061000	fresh cheese (including whey cheese), not fermented, and curd
04064000	blue veined cheese
04069020	cheese, solid or semi-solid cheese
04070090	birds eggs, other
04081900	birds eggs, other
04089900	birds eggs, other

04011030	long life milk(of a fat not exceeding 1% by weight) , in packing exceeding 1L
04011090	milk, other
04012030	long life milk , in packing exceeding 1 l

Chapter 7 Edible vegetables and certain roots and tubers

07019000	potatoes, fresh or chilled
07020000	tomatoes, fresh or chilled
07031011	onions for food(green or dry rind)
07032000	garlic, fresh or chilled
07039000	leeks & other alliaceous vegetables, fresh or chilled
07041000	cauliflower and headed broccoli, fresh or chilled
07042000	brussels sprouts, fresh or chilled
07049000	cabbages and other similar edible brassicas, fresh or chilled
07051100	cabbage lettuce (head lettuce)
07061000	carrots and turnips, fresh or chilled
07070000	cucumbers & gherkins, fresh or chilled
07082000	beans, shelled or unshelled, fresh or chilled
07089010	beans
07093000	aubergines (egg plants), fresh or chilled
07096000	fruits of the genus capsicum or of the genus pimenta
07099010	pumpkins, fresh or chilled
07099020	marrows and sqush, fresh or chilled
07099050	parsley
07099060	coriander
07131000	dried peas (pisum sativum), shelled, whether or not skinned or split
07132000	dried chickpeas (garbanzos), shelled, whether or not skinned or split
07134000	dried lentils, shelled, whether or not skinned or split
07135000	dried broad beans, shelled, whether or not skinned or split

Chapter 8 Edible fruit and nuts; citrus fruit or melons

08041010	wet dates
08041020	dried dates
08044000	avocados, fresh or dried
08045020	mangoes fresh
08051000	oranges, fresh or dried
08052000	mandarins (incl tangerines and satsumas) clementine, wilkings, fresh or dried
08054000	grapefruit, fresh or dried
08055010	grapefruit fresh
08061000	grapes, fresh
08062000	grapes, dried (raisins)
08071100	watermelons
08071910	melon (muskmelon)
08081000	apples, fresh
08082010	pears, fresh

Chapter 10 Cereals

10011000	durum wheat
10019010	normal wheat
10030000	barley
10059010	golden corn
10059020	white corn
10059090	other corns
10063000	semi milled or wholly milled rice, whether or not polished or glazed
10064000	broken rice

Chapter 12 Oil seeds; miscellaneous grains, seeds and fruits; and fodder

12141000	lucerne alfalfa meal and pellets