PUBLIC PRIVATE PARTNERSHIPS IN EMERGING ARAB AGRICULTURE SECTORS—A CONCEPTUAL MARKET RISK MITIGATION SYSTEM

David G. Raboy,[1] Syed Abul Basher,[2] Ishrat Hossain,[3] and Simeon Kaitibie[4]

1. Background

Following the food crisis of 2007/2008 many countries in the Arab world recognized that reliance on external sources for food supplies was no longer a sustainable strategy. Whereas there were many prescribed components to food-security proposals, including strategic storage, forward contracts, enhanced import diversification and other measures, most policy makers stressed greater reliance on domestic production to insulate Arab countries from external price volatility and export prohibitions. (World Bank, 2009) The problems that must be overcome to enhance domestic production in Arab countries are daunting—water scarcity, rationalizing distribution, promoting policies that mitigate trade barriers, etc. Multilateral organizations and academicians have proposed a new development paradigm in which indigenous private sectors are empowered through the use of Public Private Partnerships (PPP). (UN, 2010) In some cases PPPs are used to take advantage of private sector expertise for assets ultimately transferred to the government (the BOOT model). In other cases PPPs are characterized by government provision of some type of assistance to facilitate private sector ownership of projects.

This paper considers the latter—the assistance of government to facilitate private ownership of agricultural projects. There are many functions that PPPs can address, including enhancing access to the supply chain for small-holder producers (Rich and Narrod, 2010), and

[1] Patton Boggs LLP.

[2] Qatar Central Bank and Qatar National Food Security Programme (QNFSP).

[3] Qatar University and QNFSP.

[4] Qatar University and QNFSP.

promoting food safety and quality control through collective action, involving government and private sector entities. (Narrod *et al*, 2009) This paper addresses another PPP function--mitigating market risk sufficiently to make private investment and project finance viable for agricultural projects. The government function in this PPP task is to financially absorb substantial market risk. An example of market risk mitigation in another area is the feed-in tariff system for industrial scale solar facilities in Spain and in the United States through loan guarantees, capital grants and tax benefits for renewable energy projects. In both cases the role of government in the PPP is to create a hospitable investment environment for private-sector-owned projects.

The PPP concept has special ramifications in the case of agriculture in Arab countries. Investments in agriculture in embryonic or developing agricultural sectors bear many of the characteristics of "idiosyncratic" assets (Williamson, 1975) where lock-in and contractual-opportunism issues reign, and mitigation of market risk is especially crucial to private-sector investment. In a PPP environment that attempts to mitigate market risk while minimizing public-sector produced perverse incentives, two important tools are long-term contracting and an efficient, non-distorting, market-risk mitigation system (MRMS). This paper provides a conceptual model of the latter, using the State of Qatar as an example.

Qatar imports about 90% of its food. Qatar suffers from endemic and extreme price volatility and high mean import prices for virtually all imported commodities—a direct result of import dependency. Qatar is a small country, with virtually no market power in international commodity trade. This lack of economies of scale in purchasing leads, especially in the case of commodities like grain, to very high concentration ratios regarding the origin of imports.[5]

[5] Some would argue that economies of purchasing scale could be achieved through regional cooperation, say within the GCC, but this has not happened, and all recent anecdotal political and commercial evidence is that such cooperation would be very hard to achieve.

Scale issues are at the heart of Qatar's food-security problems, and make logical strategies like import diversification very difficult. If food security cannot be assured, the economic consequences to Qatar could be substantial. Accordingly the State of Qatar has made the determination that food security is a national security interest. In November 2008 the Government established an inter-governmental Task Force to develop an overarching institutional solution to the food-security dilemma--the Qatar National Food Security Programme (QNFSP). The QNFSP Task Force (some 14 government entities) is supported by academic institutes, universities, and other research organizations, and has been conducting policy and technical research since late 2008. It is now entering its detail-design phase, which will lead directly to implementation. The three pillars of QNFSP are development of domestic agriculture[6] to mitigate reliance on external sources for food, enhanced strategic storage capacity, and rationalization of imports. The domestic component stresses the use of industrial scale solar generating facilities to power desalination plants dedicated to irrigation for agriculture, the use of best-practices for open-field agriculture in arid regions, substantial employment of protected agriculture in the fruits and vegetable sector, and the use of the most environmentally-favorable technologies. The final emphasis is on maximum private-sector participation in all sectors, requiring creative design of PPPs. All the technical and financial innovations associated with Qatar's program will be transferable to other food insecure countries in the MENA region.

The imports that will compete with the new domestic production will generally come from origins where agriculture is subsidized in some form. Major exporters to Qatar of agricultural products employ a range of subsidy systems that include trade-distorting payments such as those tied to production levels (Amber Box in WTO parlance), direct payments to

[6] Some dismiss the notion of domestic production as an essential component of food security in Gulf countries like Qatar. It is beyond the purview of this paper to argue the efficacy of domestic production in Qatar, although persuasive research-based evidence exists. That decision has already been made by the Government of the State of Qatar, and this paper is focused on the specific policy issue of market-risk mitigation.

farmers where production is limited (Blue Box), and subsidies that are not supposed to be trade distorting, such as area payments "decoupled" from production levels (Green Box). During accession, China was not required to make any subsidy reduction commitments, and therefore is in the same situation as Qatar, as discussed below. (WTO-China, 2001). The U.S. reported about $17 billion in Green-Box subsidies, including $5.2 billion in decoupled income payments to farmers, $8 billion in product-specific Amber-Box subsidies, and $3.4 billion in non-product-specific Amber Box subsidies. (WTO-U.S., 2009). Brazil and Australia make use great use of Green-Box subsidies including decoupled payments to farmers. Saudi Arabia employs Green-Box subsidies on the order of SR 674 million (about $180 million), and Amber-Box subsidies for barley, livestock, poultry and dates. Including non-product-specific Amber-Box subsidies, total trade-distorting subsidies applied to Saudi agricultural production are SR 1.3 billion (about $350 million). (WTO-Saudi Arabia, 2007) UAE was not required to make reduction commitments during the Uruguay Round (WTO-UAE, 1995), and lists all subsidies as exempt under the Special and Differential provisions of the WTO *Agreement on Agriculture*. (WTO-UAE, 2002). The EU has made use of a mix of Amber- and Green-Box subsidies. (WTO-EU, 2009)

Agricultural subsidies in major exporting countries produce substantial market risk, especially in small arid countries with embryonic agriculture sectors. Therefore Qatar must develop market-risk mitigation strategies that include a MRMS to create an environment conducive to private-sector investment in agriculture. Such a plan will be a key component of PPPs at the farm level, which will most likely contain primarily SMEs.

Qatar must avoid the historically created complexities, distortions, perverse incentives and massive budgetary problems that have been associated with the EU's Common Agricultural Policy, or the U.S. Farm Program. It also must not rely on subsidized or free inputs that lead to resource inefficiency, overuse, and may result in environmental problems. Fortunately Qatar is in the unique position of starting fresh when designing a MRMS. Qatar is a small country, its farm sector is embryonic, and it does not face the political complexities that have produced inefficient and expensive systems in some developed agriculture-producing countries. Therefore Qatar should be able to structure a MRMS system in a simple, direct fashion. The MRMS will bear no relationship to tradition domestic support systems in developed countries with mature agricultural sectors.

The goals of a MRMS would be to make maximum use of market forces, minimize perverse incentives that encourage inefficiency while discouraging product differentiation and quality enhancement, mitigate fraud possibilities, and maximize fiscal efficiency. This analysis will describe, conceptually, a model for Qatar that attempts to fulfill the goals just stated. The paper will include a mathematical representation of the model, as well as provide a numerical example. The numerical example is for illustrative purposes only.

The remainder of the paper is organized as follows. Section 2. will provide the derivation of the conceptual MRMS model. Section 3. will present a numerical example of the model, including two of the options described in Section 2. Section 4. will consider future research. To demonstrate concepts throughout the paper, we employ corn as an illustrative commodity.

2. Derivation of the Conceptual MRMS Model

The system has two parts: 1) a "Full Cost Price" (*FCP*) which is defined as the true, all-inclusive economic cost of a unit of an agricultural commodity; and 2) a "Deficit Payment" which is a "truing up" to ensure that the farmer receives full economic cost remuneration in cases where the market price is insufficient. A crucial and differentiating aspect of the MRMS Deficit Payment is that it is calculated on a transaction-by-transaction basis. This is a key to maximization of market incentives, and avoids the problems associated with traditional domestic support systems where Amber-box subsidies are set at the same level per unit for all producers, regardless of their structures, efficiencies, and business models.

2.1 The *FCP* Model

The general structure for the MRMS will be the same for each crop, but there will be necessary nuances that differentiate the details of the procedure for different crops. The starting point for each crop will be the construction of a cost model which accounts for the economic cost of a unit of output--all variable and allocated fixed costs plus a cost of capital which reflects the minimum equity rate of return necessary to induce investors to make an investment in a farm (the "hurdle" rate, or opportunity cost of capital) and keep capital flowing to the enterprise. The output of each commodity model will be a *FCP* which reflects the total economic cost of producing a unit of a given crop.

The cost components that sum to the *FCP* can be divided into two broad categories: operating costs and "ownership" costs (otherwise known as the "cost of capital"). All costs are first calculated on a per-hectare basis (or equivalent basis based on standard size measurement), and then are converted to unit costs based on an analysis of yield. The general formula for a *FCP* of a specific commodity is:

$$FCP_m = \frac{\sum_{i(m)=1}^{V} v_{i(m)} + \sum_{j(m)=1}^{F} \left(f_{j(m)}/H\right) + \sum_{g(m)=1}^{C} \left(c_{g(m)}/H\right)}{Y} \qquad (1)$$

Where:

FCP_m = *FCP* for commodity *m*;

$v_{i(m)}$ = per-hectare variable cost of input *i* for commodity *m*;

$f_{j(m)}$ = total fixed costs of fixed-cost category *j* for commodity *m*;

H = total hectares; and

$c_{g(m)}$ = total capital costs (see below) for capital-type *g* associated with commodity *m*;

Dividing the numerator, reflecting all per-hectare costs, by the yield, *Y*, produces the full economic cost of commodity *m*, or FCP_m.

The methodology employed to calculate the cost of an agricultural commodity produced in Qatar in this study was designed to be consistent with revised costing methodologies as derived in 2000 by a Task Force of the Agricultural & Applied Economics Association (AAEA) and published in a study entitled *Commodity Costs and Returns Handbook*. (AAEA, 2000) The AAEA study is used by the United States Department of Agriculture (USDA) in the construction of all of its commodity-cost data bases. (USDA-ERS, 2009)

2.11 Operating Costs

Operating costs include variable costs such as seed, fertilizer, fuel, lubrication, electricity, water, maintenance, pesticides and other chemicals, labor expenses; and allocated fixed costs such as those associated with accounting, management functions and general farm overhead. These costs can be generally derived from accounting data on a per-hectare basis.

2.12 Capital Costs

Some prior cost models of agriculture in the MENA region have assigned simple mark-ups to operating costs, or assumed percentage *ad hoc* return rates, to reflect the ownership or capital costs of a farm, which are then incorporated in the unit cost of a commodity. (Mazid and Aw-Hassan, 2010) This may be appropriate in the case of small-holder agriculture, where family farms are passed from generation to generation (with property rights either formal or informal), and alternative economic opportunities for those associated with the farms are limited. In such cases both physical and human capital are subject to lock-in, in which case all returns over operating costs are essentially economic rents. These "rents," basically residuals, can be highly variable, and as residuals are not subject to modeling. For this type of fact pattern, rules-of-thumb involving ranges based on rough averages may be the best option for assigning ownership costs.

In the case of countries like Qatar, or other countries with embryonic agricultural sectors, agricultural investments are idiosyncratic, but there are many other investment opportunities. Therefore the cost of capital must be modeled to include the equity returns necessary for investors to forgo alternative investments in favor of investment in agricultural facilities. This is best done by incorporating finance theory, including risk analysis and portfolio theory. (AAEA, 2000).

There are many investment models that may pertain to Qatar's embryonic agricultural sector. These include owner/operator, owner/contractor, Qatar/foreign joint ventures, Direct Foreign Investment and regional investors treating minority or majority agricultural investments the same as any investment alternatives. To properly model the economics of farming in Qatar, models must reflect a true economic cost of capital and in particular the opportunity-cost of investment.

In this paper the starting point is the traditional user cost of capital approach. (Jorgenson, 1963; Hall and Jorgenson, 1967; Fullerton, 1987) Recent literature has used this concept to model investment behavior in the farm sector. (Lewis *et al*, 1988; Lagerkvist, 1999)

The concept behind the user cost of capital is the common finance one that an investor will only commit to an asset purchase if the associated cash-flow net-present-value (NPV) is non-negative when evaluated at an appropriate cost of capital. In Qatar, Qatari-owned businesses are not subject to tax. Many foreign enterprises investing in Qatar enjoy tax holidays. It is highly probable that new investments in agriculture conducted in a QNFSP world will not be subject to tax. Therefore it is reasonable to model the user cost of capital for investments in Qatari agriculture under the assumption that the income flows from the resulting enterprises will not be taxed. In the absence of taxes, and stated in continuous time, the simple cash flow expression to determine equilibrium NPV is:

$$q = \int_0^\infty ce^{-dt} e^{\pi t} e^{-\delta t} dt \qquad (2)$$

Where:

q = original asset cost*;*

c = rate of cash flow*;*

d = the nominal rate at which the investor discounts cash flows;

π = the inflation rate at which cash flows grow from the initial level; and

δ = the economic rate of depreciation, or an asset's loss of economic value as it ages.

Evaluation of the integral produces the classic formula for the user cost of capital:

$$c = q(d - \pi + \delta) \qquad (3)$$

The economic depreciation rate, δ, plays an important role. Its inclusion turns equation (2) into a "permanent reinvestment" model where the farm owner reinvests every year to maintain cash flows, rather than allowing the enterprise to decay to nothing. (Gravelle and Esenwein, 1983) d, the nominal discount rate, is the weighted-average cost of capital (WACC):

$$d = \omega i_D + (1 - \omega) i_E \qquad (4)$$

Where:

i_D = the nominal debt interest rate associated with the financing of the farm asset;

i_E = the required equity rate of return (opportunity cost); and

ω = the share of debt in the total financing of the asset in question.

The rate of return on equity required to induce an investor to purchase an asset and to keep capital flowing to the enterprise, i_E, is modeled in this paper through use of the Capital Asset Pricing Model (CAPM). (Sharpe, 1964, Lintner, 1965, Brealey *et al*, 2008) CAPM is predicated on the concept that what is essential for equity modeling is opportunity cost.

CAPM has seen much use lately in modeling agricultural investment. The AAEA *Handbook* devotes a substantial amount of space to the use of CAPM in agricultural settings. (AAEA, 2000, Chapter 2) A recent USDA-funded empirical study found CAPM very useful in modeling the returns received by agricultural cooperatives in the U.S. (Pederson, 1998)

The CAPM expression for an equity hurdle rate is:

$$i_E = i_F + \beta(i_M - i_F) \quad (5)$$

Where:

i_F = a risk free rate of return; and

i_M = the rate of return on a broad-based equity market index.

2.2 Deficit Payment Options and Associated Incentives

A Deficit Payment is a mechanism by which a farmer is remunerated for any difference between the *FCP* and actual price the farmer receives in the market for a given commodity. The structure of a Deficit Payment can be a very thorny exercise, because the possibilities of inadvertently producing perverse incentives are rampant. In this section several options for Deficit Payments will be considered. After two basic structures are described some simple analytics are offered to depict the associated incentives. As previously stated the Qatar-model deficit payments occur on a transaction-by-transaction basis, as opposed a system utilizing a flat, per-unit payment that is the same for all farmers and all transactions. This distinction substantially affects the incentives of any system, and is essential to make the most of market forces.

Before discussing various options, it is worth noting Qatar's WTO obligations with respect to agricultural subsidies. During the Uruguay Round Qatar was not required to make any commitments regarding agricultural subsidies, even potential Amber-Box subsidies. (WTO-Qatar, 1995) Regular notifications to the WTO Committee on Agriculture are still required, but Qatar's latest notifications indicate that Qatar has offered neither domestic support, nor export subsidies to its agricultural sector. (WTO-Qatar, 2005a, 2005b) Article 7(2)(b) of the WTO Agreement on Agriculture states that countries like Qatar that did not make reduction commitments cannot subsequently implement trade-distorting subsidies in excess of 10% of the value of agricultural production in the relevant year.

Should the Doha Round of WTO negotiations be concluded, Qatar's situation regarding agriculture subsidies will not change. Qatar will not be required to make any reduction commitments. The latest draft of the Doha Round's modalities for a new agriculture agreement was issued 6 December 2008. (WTO, 2008) Section I of that document sets proposed rules for domestic support, and introduces the concept of the "base level for reductions in Overall Trade-Distorting Domestic Support (Base OTDS)." Section I.A.6. states: "Developing country Members with no Final Bound AMS commitments [Uruguay Round subsidy commitments] shall not be required to undertake reduction commitments in their Base OTDS." (WTO, 2008, explanation added) Therefore Qatar will not be required to make any commitments in the Doha Round as well. Section I.D.32 states that for developing countries not required to make reduction commitments, the amount of trade-distorting domestic subsidies subsequently introduced will be limited to 10% of the value of agricultural production in the relevant year, as is the case under the existing Agricultural Agreement.

2.21 Traditional Deficiency Payment

A traditional deficiency payment (TDP) is an Amber-Box subsidy that simply remits to the farmer the monetary difference between the *FCP* and the actual price at which the farmer sold a relevant commodity to an unrelated party (recall that the model in this paper provides for transaction-by-transaction remuneration). The remittance would be issued by the Qatari government during some "truing-up" period.

TDPs would be inefficient in a small country like Qatar, and would produce serious perverse incentives. The scale issue is important for understanding potential agricultural market structure in Qatar. It is expected that each commodity would be produced by a relatively small number of producers due to the necessity of establishing economies of scale sufficient for best-practices. This means that strategic behavior would be possible, as compared to a model of atomistic, price-taking producers. Perverse incentives no consequences for inefficiency, and no motivation to follow best practices. In addition, there would be a lack of incentives to enhance quality or produce products differentiated by superior quality characteristics.

Although still debated, many economists subscribe to the belief that differentiated products entail enhanced quality characteristics, and that competition in the quality-characteristic space benefits consumers. (Klein and Leffler, 1981, Landes and Posner, 1987) Quite a bit of empirical research on product differentiation has been conducted regarding the agricultural sector, and the results imply that quality-related product-differentiation, with associated price premiums, exist even for basic commodities. (Rosenbaum and Wilson, 1991, Raboy and Simpson, 1992, Wiggins and Raboy, 1996).

Production of differentiated products in agriculture typically involves increased costs, but, absent distortions that interfere with market functioning, producers are compensated by price premiums in excess of these additional costs in the market (quasi-rents), which provide incentives to innovate. (Raboy and Wiggins, 1997) A TDP mechanism applied on a transaction-by-transaction basis, however, eliminates incentives to compete in the quality-differentiation space because the farmer's TDP is limited to the difference between the *FCP*, a fixed amount, and the price the farmer receives in the market. The perverse result is that when a farmer enjoys a price premium in the market, it is negated by the lower TDP he/she will receive.

2.22 Percentage Mark-up Deficit Payment Method

One way to avoid the perverse incentives associated with a TDP system would be to calculate a percentage mark-up which would define the Deficit Payment (Mark-Up Payment or MUP). The MUP would equal the product of the mark-up and the price actually received in the market. A pure mark-up system would also be an Amber-Box subsidy.

This type of system would require some preliminary calculations, but they are transparent. For ease of explanation we will consider only the initial calculation, understanding that periodic adjustments will be necessary. The first step would be to calculate the *FCP* for each commodity. Each *FCP* would then be compared to the periodic weighted-average price of competing imports in order to calculate a systematic percentage difference between the *FCP* and the indicative competitive market price, as represented by the average import price. These percentage mark-ups would be adopted for MUP purposes and would be fixed for each commodity, over a set period of time. The MUP would be calculated for each farmer on a transaction-by-transaction basis by multiplying the price the farmer actually received in the market by the fixed percentage mark-up.

The perverse incentives associated with the traditional deficiency payment likely do not exist when the Deficit Payment is defined as a percentage mark-up on received market price, or are certainly mitigated.

Consider the effects of a mark-up system on efficiency, product differentiation and quality enhancement. As previously stated, an innovative farmer would incur additional costs to produce agricultural products that are of enhanced quality, or are differentiated by desired characteristics, but such costs are more than made up by the price premiums the market is willing to pay for higher-quality goods. In the mark-up system, if the farmer can earn a price premium over the standard price in the market, then he has also increased his base for Deficit Payment purposes. The market premium associated with higher quality is thus magnified by application of the fixed mark-up to the higher price received by the farmer in the market. The mark-up system therefore offers substantial incentives for product differentiation and quality innovation.

Although the normal market incentives for innovation are magnified by the mark-up system, there is little danger of fraudulent increases in market prices, as the market will only sustain a premium if differential quality characteristics are real and desired by the market. Therefore the quality-innovation incentives associated with a mark-up system are completely based on market signals.

2.23 Analytics

A simple mathematical representation of the incentives of these two options is as follows. Let $\hat{C}_{mi}$ represent total economic costs under best practices for commodity *m* at farm *i*. For the representative farm, note that $\hat{C}_{mi} = FCP_m$. P_{mi} is the price received by farm *i*, which may deviate from the equilibrium market price for standard goods produced under best practices, P_m—a discount for inferior products or a premium for quality enhanced or differentiated products. Define τ_{mi} to be a positive or negative deviation from $\hat{C}_{mi}$ for farm *i*. Finally define q_{mi} to be a measure of additional unit innovation costs required for quality or product differentiation for farm *i*. We assume that the following relationship holds--$P_{mi}=F(\tau_{mi}, q_{mi})$.

Other relationships generally applicable to all options are the following: If $\hat{C}_{mi}$ represents normal unit costs under best practices then if τ_{mi} >0, the market will not compensate the costs above best practices through price premiums, as the quality of the goods will not exceed the norm:

$$\frac{\partial P_{mi}}{\partial \tau_{mi}} = 0 \qquad \text{for all } \tau_{mi} > 0. \tag{6}$$

But cost expenditure less than $\hat{C}_m$ will result in an inferior product, or inefficiency that, among other things, sacrifices quality control. The market will reflect a sub-standard product through a discounted price:

$$\frac{\partial P_{mi}}{\partial |\tau_{mi}|} < 0 \qquad \text{for all } \tau_{mi} < 0. \tag{7}$$

Finally, if product differentiation has value and creates quasi-rents through associated price premiums:

$$\frac{\partial P_{mi}}{\partial q_{mi}} > 0 \tag{8}$$

Due to the scale issue, rent seeking is possible, and will be a viable strategy under certain incentive sets. Define Π_{mi} to be profit above the opportunity cost of capital, or economic rent, for commodity *m* and farm *i*.

First consider the rent formula facing an agricultural firm under a *TDP* system. Rent is defined as:

$$\Pi_{mi} = (FCP_m - P_{mi}) + P_{mi} - \widehat{C}_{mi} - \tau_{mi} - q_{mi} \tag{9}$$

The term in parentheses on the right hand side is the TDP. The farmer also receives the his/her individual price, as set in the market. FCP_m $\hat{C}_{mi}$ are fixed. Note that if $P_{Mi}= P_M$, FCP_m = $\hat{C}_{mi}$ and there is no deviation in costs relative to best-practices levels or quality-related expenditure, rents are zero.

The farm-specific price terms in (9) cancel and are removed from the rent equation:

$$\Pi_{mi} = FCP_m - \hat{C}_{mi} - \tau_{mi} - q_{mi} \tag{10}$$

This implies that with respect to normal cost deviations from best practices:

$$\frac{\partial \Pi_{mi}}{\partial \tau_{mi}} = -1 < 0 \text{ for all } \tau_m > 0\text{; and} \tag{11}$$

$$\frac{\partial \Pi_{mi}}{\partial |\tau_{mi}|} = 1 > 0 \qquad \text{for all } \tau_m < 0 \tag{12}$$

Whereas there are no incentives to allow costs to exceed the best practices level, as they will not be compensated for in the market and will result in returns lower than opportunity cost, rents can be gained by economizing on costs so that they are less than the best practices level. Skimping on quality control, handling, prompt delivery, etc. will result in profit above opportunity cost. This is because whatever discount occurs in the market due to inferior goods is made up by a higher *TDP*.

In terms of quality and product differentiation, under the TDP system:

$$\frac{\partial \Pi_{mi}}{\partial q_{mi}} = -1 < 0 \qquad \text{for all } q_{mi}. \tag{13}$$

There is no incentive to strive for enhanced quality or produce differentiated products. Any premium price is negated by a lower *TDP*.

Now consider the incentives associated with the MUP system. Defining M_m as the systematic mark-up for commodity *m*, the rent formula for the MUP system is:

$$\Pi_{mi} = (1 + M_m)P_{mi} - \widehat{C}_{mi} - \tau_{mi} - q_{mi} \tag{14}$$

As with the TDP system, if the *FCP* equals the firm-specific best-practices cost, and market and firm-specific prices are also equal, rents are zero absent cost deviations or quality-related expenditures.

Observe the effects of deviations from best-practices total costs. Referring to equations (6) and (7):

$$\frac{\partial \Pi_{mi}}{\partial \tau_{mi}} = -1 < 0 \quad \text{for all } \tau_{mi} > 0. \tag{15}$$

This is the same as with the TDP system. Rent can't be gained by incurring excess non-innovation costs above best-practices levels. But the incentives associated with cost structures below best practices are different:

$$\frac{\partial \Pi_{mi}}{\partial |\tau_{mi}|} = (1 + M_m)\frac{\partial P_{mi}}{\partial |\tau_{mi}|} + 1 \qquad \text{for all } \tau_{mi} < 0. \tag{15}$$

The partial derivative in the first right-hand-side term, from equation (7), is negative, but is multiplied by a number greater than 1, $(1+M_m)$. The rent seeking possibilities from cutting costs relative to best-practices levels are greatly diminished and, over a plausible range, would reduce profits below opportunity cost.

The result for incurring costs associated with quality and product differentiation is as follows for the MUP system.

$$\frac{\partial \Pi_{mi}}{\partial q_{mi}} = (1 + M_m)\frac{\partial P_{mi}}{\partial q_{mi}} - 1 \qquad (16)$$

Normally, the increase in price associated with quality enhancement would have to exceed expenditure to produce quasi rents. The derivative on the right hand side would have to be greater than 1. But in the case of a MUP system the partial derivative in the first right-hand-side term no longer has to be greater than 1, because it is multiplied by $(1+M_m)$. Indeed, if the mark-up percentage is 25% (the mark-up derived in the numerical example), the change in a farm's price in the market only has to rise a bit more than .8% for every 1% increase in quality-related expenditure. The MUP reinforces investment in quality-enhancement and product-differentiation expenditures which, under plausible scenarios, can produce quasi rents.

2.23 Hybrid Mark-up/Decoupled-Payment Method

An option that would employ Green-Box subsidies and minimize the use of Amber-Box subsidies would be a hybrid system. Under such a system a per-hectare decoupled income payment would be paid to the farmer in a set amount for each commodity. This payment would not vary with production. The decoupled payment could be supplemented by an MUP. Note that only the latter would be considered Amber-Box, and the system could easily be structured so that trade-distorting subsidies do not exceed the WTO-mandated 10% of production value.

The economic incentives of the hybrid system would be very similar to those associated with the pure mark-up system. A farmer incurs fixed costs that don't vary with production and variable costs that do. A decoupled income payment is equivalent to a fixed-cost subsidy, while the positive incentives toward product differentiation and quality enhancement would derive from the MUP.

3. A Numerical Example of the MRMS—Corn

In this section a numerical example of the MRMS is provided. The example considers a hypothetical, representative 100 hectare farm that produces only corn, abstracting from crop rotation. The illustration first shows the calculation of the *FCP* for corn from the hypothetical farm and then calculates a MUP under a percentage mark-up and a hybrid mark-up/decoupled payment system.

This example is for illustrative purposes only, and the actual quantitative result should not be perceived literally. The data for the example are derived from representative farms in countries with climatic conditions similar to Qatar, and were chosen to be as realistic as possible for farms employing best practices. Actual costs for farms in Qatar could differ, however. Similarly, capital costs are derived from data in the region deemed representative. All costs are expressed in U.S. dollars.

3.1 The FCP

Data on operating costs for this hypothetical farm were primarily provided by the International Center for Agricultural Research in Dry Areas (ICARDA).[7] Table 1 displays assumed operating costs (variable and allocated fixed costs) on a per-hectare basis.

The user cost of capital calculation, based on the expression in equation (3), begins with a delineation of required physical assets and their original cost.[8] Other required inputs are the economic depreciation rate for each physical asset and the appropriate rate of inflation.

Data for the economic depreciation rate, δ, for each asset category are based on the work of Hulten and Wykoff (1981). Over the 2000-2009 period, the annual average inflation rate in Qatar was 6.18 percent. The WACC is calculated next, as it is used frequently in Middle East modeling. (Al Mutairi *et al*, 2009)

---

7 Operating cost data were transmitted by Aden Aw-Hassan and Ahmad Maziz, ICARDA, Aleppo, Syria.

8 These data were provided by Aden Aw-Hassan, ICARDA, Aleppo, Syria.

In Middle Eastern countries the most popular source of debt financing is bank borrowing, while debt financing through issuance of debt securities is rather limited. (IMF 2009) We assume that the investor receives debt financing in Qatar, and that a cost of debt of 5.25 %, which is the yield on a recent 10-year sovereign bond issued by the State of Qatar, is a plausible approximation of bank-borrowing interest rates.

CAPM is used to calculate the equity hurdle rate relevant to potential investors in the Qatari corn farm. Various studies considered evidence on CAPM betas in agriculture. (Erickson *et al*, 2001, Turvey and Driver, 1987, Hopkins and Morehart, 2002)

CAPM is estimated using realized excess returns, as follows:

$$i_E - i_F = \alpha + \beta(i_M - i_F) + \varepsilon \tag{17}$$

α, the intercept, should not be statistically different from zero (because the market premium should compensate for systemic risk) and β is interpreted in the standard fashion.

Equation (17) is estimated as follows, incorporating two caveats: Benjelloun and Squalli (2008) have demonstrated that in the emerging capital markets of the GCC, general stock indexes often poorly reflect individual-sector performance. As will be seen, however, robust results are obtained for Qatar. Market-returns data are obtained from the Qatar Exchange (QE) for month-end equity market index values of the Qatar Index. Benjelloun (2009) has shown that in certain GCC stock markets diversification can be achieved with only a few stocks in a portfolio, systemic risk is high and index and stock returns are highly correlated. With this caveat, our proxy asset-specific return is the rate of return on a relatively risky stock—Commercial Bank of Qatar (CBQK).

The risk-free return is derived from 10-year U.S. government bond yields with average annualized monthly yields obtained from *International Financial Statistics*, published by the

International Monetary Fund. Asset-specific excess returns are regressed on market excess returns using OLS and also alternative robust-estimation procedures. These include the Median estimator, least trimmed squares (LTS) (Rousseeuw, 1984), Huber's (1964) M-estimators, and the MM-estimators proposed by Yohai (1987).

OLS has problems when observations with very large residuals distort parameter estimation due to outliers. (Verardi and Croux, 2009) The basic measure of the robustness of an estimator is its "breakdown point," which is the fraction of "bad" data that can be tolerated without affecting the estimator to an arbitrarily large extent. The M-estimator and Rousseeuw's LTS estimator are highly inefficient in that high efficiency can only be achieved at the cost of lower breakdown points. MM-estimators combine a high breakdown point with high efficiency.

We consider two versions of this estimator: MM-estimators with 70% efficiency and with 95% efficiency. Simulation results by Verardi and Croux (2009) show that the MM-estimator with an efficiency of 70% is the least biased estimator, and results produced by this method are the ones reported in this paper.

The sample period is January 2000 to December 2009. The regression results are as follows:

Parameter	α	β
Coefficient	.186	1.226
Standard Error	.8550	.0549
Probability	.828	.000
	Breakdown Point	.5
	Robust R^2	.8942

β is estimated at 1.226 and is statistically significant at the .000 level. The coefficient of the intercept is not significantly different from zero.

Over the 2000-2009 sample period the average annualized market rate of return was 25.58%, while during the same period the average annualized risk-free return was 4.45%, indicating a market risk premium of 21.07%. The asset-specific (CBQK) risk premium, the product of CAPM β and the market risk premium, is 25.83%.

Debt/equity mixes in a nascent Qatari agricultural sector will be a function of contracting practices and potential governmental loan guarantees. We assume, for illustrative purposes, that agricultural investments enjoy long term take-and-pay contracts and loan guarantees—facilitating low-cost interest rates and high proportions of debt. The debt/equity ratio is set at 70/30. Therefore, the WACC is 11.42%. Table 2 displays, for each physical asset, total-farm original asset costs, the economic depreciation rate, and the calculated user cost of capital.

Yield estimates for corn cultivation in arid climates for good farms vary widely. For example De Pauw (2010) uses a range of 4 to 6 tonnes/hectare, but also refers to a research result of 9 tonnes/hectare. Data from functioning farms in UAE have shown yields of 12 tonnes/hectare, but this seems to be an anomaly. (UAE, 2006) For purposes of this illustration we assume a yield of 6 tonnes/hectare.

The result produced by summing per-hectare costs and dividing by yield is the *FCP* of producing a tonne of corn on the hypothetical 100 hectare Qatari farm. As depicted in Table 3, the calculated *FCP* per tonne for corn is $387.

3.2 The Deficit Payment--Two Options

Should the market price, determined by import prices of corn, be lower than the full economic cost of domestic production as depicted in Table 3 (and eliminating as a candidate the TDP), a MUP of some sort will be required to ensure that farming remains financially sustainable to private investors. This section will provide numerical examples for two options—a stand-alone MUP and an MUP/decoupled-payment system. The data required for the examples are displayed in Table 4. The economic cost of domestically produced corn from our hypothetical Qatari farm is compared to the weighted average price of imported corn over 2007 and 2008, which is employed to represent a single market transaction price. (Qatar Statistics Authority, 2009) As illustrated, the weighted-average import price is $311/tonne and the deficit is $76/tonne. Selected individual shipment prices are also displayed for comparison purposes.[9]

First consider a pure percentage mark-up system. Recent import data would be compared to the constructed cost in the *FCP* model for each commodity—to produce the percentage mark-up. When a farmer sold his goods he would be eligible for the amount he actually received in the market, plus an MUP equal to the product of the mark-up and his actual market price.

In our example, the calculated deficit is $76/tonne, 24.4% of the weighted-average import price for corn of $311/tonne. Under the MUP system the authorities could set the deficit mark-up at, say, 25%. If a farmer gained in the market a price exactly equal to $311/tonne, he would receive a MUP of $77.75/tonne. If the farmer produced an inferior product that sold at a discount in the market, say $290/tonne, his MUP would be $72.50/tonne for total remuneration of $362.50/tonne. If he sold a superior, differentiated product at a premium price on the market, say $350/tonne, his MUP would be $87.50/tonne for total remuneration of $437.5/tonne.

If a farmer's costs were higher than the FCP's best-practices model costs, he would suffer low returns. For example a farmer with total economic costs of $400/tonne, but producing corn of average quality would still receive $311/tonne in the market. With the MUP his total remuneration would be $388.75/tonne, $11.25/tonne less than total economic costs. This loss would come directly out of equity returns.

A pure MUP system has a lot to recommend it. Quality enhancement and differentiated products are rewarded. There is, however, a major draw-back. The MUP system is an Amber

[9] Based on micro-data produced by Customs Authority.

Box subsidy under WTO definitions. Although Qatar could probably justify such a system under the Special and Differential provisions of WTO agreements, a pure MUP system would nonetheless put Qatar in a position of implementing trade-distorting subsidies in excess of the 10% *de minimus* level. Using corn as an example, by definition the level of subsidy would be approximately 25% of the value of agricultural production, as represented by actual market prices.

There are alternatives that would ensure that farming is remunerative in Qatar, which would maintain the positive incentives of the percentage mark-up system, but would keep Amber-Box subsidies below the 10% threshold. A hybrid system including decoupled income payment and a MUP has potential to produce the desired incentives without running afoul of the spirit, as well as the letter of the law, of WTO agreements.

Consider the following possibility. From the data in Table 3 it can be calculated that variable costs are 30.51% of total economic cost/tonne of corn, or $118.17. Allocated fixed costs are $11.17/tonne, or 2.88% of unit cost. Capital costs are about 66.61% of unit cost; $258. A hybrid system could be designed to pay, say, a $270/hectare decoupled income-support payment. This payment is not linked to production, but is offered to only active corn farms as in the EU, and the total decoupled support is solely a function of the size of the farm. For a farm with a yield of 6 tonnes/hectare, the decoupled payment is equivalent to about a $45/tonne subsidy of fixed and capital costs. On top of this is added a percentage MUP of 10% of the price the farmer actually receives in the market. Assuming an average market price of $311/tonne, the MUP will be about $31/tonne. The sum of the market price, the pro-rated decoupled income payment and the Deficit Payment is $387/tonne, exactly equal *FCP* for the representative farm.

Under this hybrid system, the positive incentives of the mark-up system are maintained, but total Amber-Box support is approximately 10%, the threshold level for trade-distorting subsidies established in the *Agreement on Agriculture*. There is any number of combinations of systems that would achieve the same qualitative result. This illustration shows that it is possible to construct a MRMS for Qatar that is WTO-compliant, minimizes perverse incentives and enhances positive ones, and is capable of ensuring financial sustainability for investors of all sorts in the Qatari agricultural sector.

4. Future Research

This paper has derived a conceptual model for a market-oriented Market Risk Mitigation System, which would be a tool used by PPPs in an agricultural setting. Although designed for the State of Qatar, the model may be appropriate for other countries with emerging agricultural sectors, or for countries which desire to enhance their agricultural sectors by better aligning production and market incentives. Food-security concerns make both scenarios likely, and countries would be well-served by employing PPP structures and stressing efficiency-enhancing market-based incentives in their risk-mitigation systems, which are essential for eliminating perverse incentives.

Any domestic support system contains the seeds for fraudulently gaming the system. It is beyond the scope of this paper to address fraud and audit issues, but anti-fraud measures should rank high on the list of future research topics. Two potential sources of fraud initially come to mind: 1) origin fraud; and 2) collusion between buyer and seller to fraudulently overstate invoice price.

Additional research must be conducted on the incentive effects of various Deficit-Payment formats. This paper has just scratched the surface by discussing a few options.

This paper provided a simple numerical example of the functioning of a potential Market Risk Mitigation System for agriculture in Qatar. If the system is to become operational, substantial research must be devoted to optimizing data sources for each commodity, in order to produce *FC*Ps that are precise representations of full economic costs.

Finally this paper did not address the administration of a MRMS. All of the institutional details, and day-to-day administrative functions, must be delineated in future research.

Table 1: Corn Farm Operating Costs (100 hectare farm)

		Total Farm	Per hectare
Variable Costs	Tillage and Leveling		$98
	Seed		$18
	Fertilizer and other chemicals		$97
	Water		$76
	Maintenance		$57
	Labor		$235
	Harvesting and Transport		$95
	Packing materials		$33
Allocated Fixed Costs	Marketing Costs	$300	$3
	Computer Services	$100	$1
	Accounting Costs	$900	$9
	Management Overhead	$2,600	$26
	General Farm Overhead	$1,700	$17
	Other Farm Overhead	$1,100	$11

Source: Data from ICARDA, provided by Aden Aw-Hassan and Ahmad Maziz.

Table 2: Machinery Requirements, Unit Prices, Economic Depreciation and User Cost of Capital for a Representative Arid-Climate 100 Hectare Corn Farm

Machinery	Number	Unit price (US$)	Economic Depreciation	User cost of capital
Tractor FEL (Small)	1	$60,000	0.1633	$12,942.00
Tractor (Medium)	1	$90,000	0.1633	$19,413.00
Planter 4 m	1	$65,000	0.0971	$9,717.50
Irrigation boom & sprinkler	1	$85,000	0.0971	$12,707.50
Irrigation pipe network & pump	10km	$45,000	0.0971	$6,727.50
Plough (Moouldboard)	1	$25,000	0.0971	$3,737.50
Cultivator 15 tyne (Duck foot)	1	$25,000	0.0971	$3,737.50
Boomsprayer 12m 2000l	1	$40,000	0.0971	$5,980.00
Fertilizer spreader 20m	1	$40,000	0.0971	$5,980.00
Combine harvestor (4m)	1	$250,000	0.0971	$37,375.00
Grain handling equipment	1	$8,000	0.0971	$1,196.00
Grain storage (40 tonne)	1	$10,000	0.1225	$1,749.00
Machinery shed (30m ´ 10m)	1	$20,000	0.1225	$3,498.00
Machinery workshop/store	1	$25,000	0.1225	$4,372.50
Truck (5 tonne)	1	$55,000	0.2537	$16,835.50
Pickup vehicle	1	$22,000	0.3333	$8,485.40
Computers	1	$1,500	0.2729	$487.95
TOTALS for 100 hectares		**$866,500**		**$154,942**
Per hectare costs		$8,665		$1,549

Source: Original cost data from ICARDA, provided by Aden Aw-Hassan. Economic depreciation rates from Hulten and Wykoff (1981)

Table 3: Economic Cost of Corn Per Tonne

		Total Farm	Per hectare
Variable Costs	Tillage and Leveling		$98
	Seed		$18
	Fertilizer and other chemicals		$97
	Water		$76
	Maintenance		$57
	Labor		$235
	Harvesting and Transport		$95
	Packing materials		$33
Allocated Overheads	Marketing Costs	$300	$3
	Computer Services	$100	$1
	Accounting Costs	$900	$9
	Management Overhead	$2,600	$26
	General Farm Overhead	$1,700	$17
	Other Farm Overhead	$1,100	$11
User Cost of Capital	Tractor FEL (Small)	$12,942.00	$129
	Tractor (Medium)	$19,413.00	$194
	Planter 4 m	$9,717.50	$97
	Irrigation boom & sprinkler	$12,707.50	$127
	Irrigation pipe network & pump	$6,727.50	$67
	Plough (Moouldboard)	$3,737.50	$37
	Cultivator 15 tyne (Duck foot)	$3,737.50	$37
	Boomsprayer 12m 2000l	$5,980.00	$60
	Fertilizer spreader 20m	$5,980.00	$60
	Combine harvestor (4m)	$37,375.00	$374
	Grain handling equipment	$1,196.00	$12
	Grain storage (40 tonne)	$1,749.00	$17
	Machinery shed (30m ´ 10m)	$3,498.00	$35
	Machinery workshop/store (30m ´ 10m)	$4,372.50	$44
	Truck (5 tonne)	$16,835.50	$168
	Pickup vehicle	$8,485.40	$85
	Computers	$487.95	$5
		TOTAL Per HECTARE=	$2,324
		YIELD Per HECTARE (tonnes)=	6
		Economic Cost Per Tonne=	**$387**

Source: calculations from Tables 1 and 2. Yield data from DePauw (2010)

Table 4: Calculation of Deficit Payment

Economic Cost/Tonne of Corn From Hypothetical Qatari Farm		$387
2007/2008 Weighted Average Import Price in Qatar		$311
Excess Domestic Cost Over Import-Price Determined Market Price		$76

Sample Shipment Prices-Doha Port Arrivals

DATE	ORIGIN	C.I.F. PRICE/TONNE
10-Feb-07	Argentina	$293
19-May-07	Argentina	$293
1-Jul-07	Argentina	$293
29-Jul-07	Argentina	$293
17-Sep-07	Argentina	$292
1-Nov-07	US	$339
17-Dec-07	US	$351

Source: Data from Qatar Statistics Authority (2009) and micro-data from the Customs and Ports Authority of the State of Qatar.

References

Agricultural & Applied Economics Association (AAEA), 2000. *Commodity Costs and Returns Estimation Handbook*, Ames, Iowa.

Al Mutairi, M. E., Tian, G., Tan, A., 2009. Corporate finance practice in Kuwait: a survey to confront theory with practice. Paper presented to the 22nd Australasian Finance and Banking Conference 2009. Available at http://ssrn.com/abstract=1456750.

Benjelloun, H., 2009. Portfolio diversification: evidence from Qatar and the UAE. *Int. J.Econ. Iss.*, **2**, 9-15.

Benjelloun, H., Squalli, J., 2008. Do general indexes mask sectoral inefficiencies? A multiple variance ratio assessment of Middle Eastern equity markets. *Int. J. Man. Fin.*, **4**, 136-151.

Bjornson, B., Innes, R., 1992. Another look at returns to agriculture and nonagricultural assets, *Am. J. Agric. Econ.*, **74**, 109-119.

Brealy, R. A., Myers, S. C., Allen, F., 2008, *Principles of Corporate Finance.* McGraw-Hill/Irwin, New York, NY.

De Pauw, E., 2010. Land survey for suitability and availability for food and feed production in Qatar. *The Agricultural Sector in Qatar: Challenges and Opportunities*, International Center for Agricultural Research in Dry Areas (ICARDA), Aleppo, Syria.

Erickson, K.W., Mishra, A.M., Moss, C.B., 2001. Rates of return in the farm and non-farm sectors: a time series comparison. Paper presented to the 2001 Annual Meeting of Western Agricultural Economics Association, July 8-11, Utah.

Fullerton, D., 1987. The indexation of interest, depreciation and tax reform in the United States. *J. Pub. Econ.*, **32**, 25-51.

Gravelle, J, Esenweing, G. A. 1983. The measurement and interpretation of effective corporate tax rates: a comment. *Tax Notes*, June 6.

Hall, R., Jorgenson, D., 1967. Tax policy and investment behavior. *Am. Econ. Rev.*, **57**, 391-414.

Hopkins, J.W., Morehart M., 2002. An empirical analysis of the farm problem: comparability in rates of return, in Luther Tweeten and Stanley R. Thompson-eds. *Agricultural Policy for 21st Century* Iowa State Press, Iowa, 70-90.

Huber, P.J., 1964. Robust estimation of a location parameter, *Annals of Mathematical Statistics*, **35**, 73–101.

Hulten, C.R., Wykoff, F.C., 1981. The measurement of economic depreciation, in C.R. Hulten-ed., *Depreciation, Inflation, and the Taxation of Income from Capital*, Urban Institute Press, Washington DC, 81-125.

IMF, 2009. *Global Financial Stability Report*, International Monetary Fund, October, Washington DC.

Jorgenson, D., 1963. Capital theory and investment behavior, *Am. Econ. Rev.*, **53**, 247-259.

Klein, B., Leffler, K., 1981. The role of market forces in assuring contractual performance, *J. Pol. Econ.*, **89**, 615-641.

Lagerkvist, C., 1999. The user cost of capital in Danish and Swedish agriculture, *Eur. Rev. Ag. Econ.*, **26**, 79-100.

Landes, W.M., Posner, R.A., 1987. Trademark law: an economic perspective, *J. Law Econ.*, **30**, 265-309.

Lewis, P.E.T., Hall, N.H., Savage, C.R., Kingston, A.G., 1988. Taxation, cost of capital and investment in Australian agriculture, *Aust. J. Agric. Econ.*, **32**, 15-21.

Lintner, J., 1964. The valuation of risky assets and the selection of risky investments in stock portfolios and capital budgets, *Rev. Econ. Stat.*, **47**, 13-37.

Mazid, A. Aw-Hassan, A., 2010. Report on cost production costs in Qatar, *The Agricultural Sector in Qatar: Challenges and Opportunities*, International Center for Agricultural Research in Dry Areas (ICARDA), Aleppo, Syria, 413-424.

Narrod, C., Roy, D., Okello, J., Avendãno, B., Rich, K., Thorat, A., 2009. Public-private partnerships and collective action in high value fruit and vegetable supply chains, *Food Policy*, **34**, 8-15.

Qatar Statistics Authority (2009): Monthly HS 8-digit data for 2004-2006 provided electronically.

Raboy, D.G., Simpson, T., 1992. A methodology for tariffication of commodity trade in the presence of quality differences—the case of peanuts, *World Econ.*, **15**, 271-281.

Raboy, D.G., Wiggins S.N., 1997. Intangible capital, hedonic pricing and international transfer prices, *Pub. Fin. Rev.*, **25**, 347-365.

Rich, K.M., Narrod, C.A., 2010. The role of public-private partnerships in promoting smallholder access to livestock markets in developing countries, Discussion Paper 01001, International Food Policy Research Institute, Washington DC.

Rosenbaum, R.E., Wilson W.W., 1991. Quality differentials and prices: are cherries lemons?, *J. Ind. Econ.*, **34**, 649-658.

Rousseeuw, P.J., 1984. Least median of squares regression, *J. Am. Stat. Assoc.*, **79**, 871–880.

Sharpe, W.F., 1964. Capital asset prices: a theory of market equilibrium under conditions of risk, *J. Fin.*, **19**, 425-442.

Turvey, C.G., Driver, H.C., 1987. Systematic and nonsystematic risks in agriculture," *Can. J. Agric. Econ.*, **35**, 387-401.

United Arab Emirates, Ministry of Economy, 2006. *Statistical Abstract*, Accessed in February 2010. http://www.economy.ae/English/EconomicAndStatisticReports/StatisticReports/StatisticAbstract/Pages/sa2006.aspx .

United Nations, 2010. Accessed in January 2011. http://www.undp.org.cn/modules.php?op=modload&name=News&file=article&catid=31&sid=12 .

USDA-Economic Research Service, 2009: "Commodity Costs and Returns," at http://www.ers.usda.gov/Data/CostsAndReturns/, Washington DC.

Verardi, V., Croux C., 2009. Robust regression in stata, *Stata J.*, **9**, 439-453.

Wiggins, S., Raboy, D.G., 1996. Price premia to name brands: an empirical analysis, *J. Ind. Econ.*, **44**, 377-388.

Williamson, O., 1975. *Markets and Hierarchies,* Free Press, New York, NY.

World Trade Organization, 1995. *Agreement on Agriculture*, Geneva, CH.

World Trade Organization, Committee on Agriculture, 2008. *Revised Draft Modalities for Agriculture*, TN/AG/W/4/Rev. 4, December, Geneva, CH.

World Trade Organization-China, 2001. Schedule CLII – People's Republic of China, part IV – agricultural products: commitments limiting subsidization, Geneva, CH.

World Trade Organization-EU, 2009. G/AG/EEC/58, Geneva, CH.

World Trade Organization-Qatar, 1995. Schedule CXXXI-Qatar, Part IV – agricultural products: commitments limiting subsidization, Geneva, CH.

World Trade Organization, 2005a. G/AG/N/QAT/5, Geneva, CH.

World Trade Organization-Qatar, 2005b. G/AG/N/QAT/4, Geneva, CH.

World Trade Organization-UAE, 1995. United Arab Emirates, Schedule CXXXII, Part IV – agricultural products: commitments limiting subsidization," Geneva, CH.

World Trade Organization-UAE, 2002. G/AG/N/ARE/5, Geneva, CH.

World Trade Organization-U.S., 2009. G/AG/N/USA/66, Geneva, CH.

World Trade Organization-Saudi Arabia, 2007. G/AG/N/SAU/2, Geneva, CH.

World Bank, 2009. *Improving Food Security in Arab Countries*, World Bank, Washington DC.

Yohai, V.J., 1987. High breakdown-point and high efficiency robust estimates for regression, *An. Stat.*, **15**, 642–656.