THE TURKISH AGRICULTURAL POLICY ANALYSIS MODEL

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1. Brief overview

The Turkish Agricultural Policy Analysis Model (TAPAM) is a partial equilibrium full econometric model that determines the product level behavioral relationships in both crop and livestock sectors. TAPAM is designed to capture the effect of international exogenous variables and domestic agricultural policies on agricultural commodity markets and food security in Turkey. It can provide projections in the short to medium term.

In TAPAM the price transmission mechanism is used to reflect the effect of world prices in formation of domestic prices. Then, the supply and demand baseline is projected. TAPAM allows for the evaluation of consumption patterns with a demand system to formulate the food security impact. In particular, using food consumption data and the recommended daily allowance for each nutrient category, a given consumption pattern is translated into its nutritional impact. Since the food consumption data are unavailable for different socioeconomic and demographic groupings in Turkey, this impact is only evaluated for a segment of the population.

The data used in TAPAM were obtained from two main sources. Area, yield, production, prices, population, household consumption expenditure, price indices, GDP, and GDP deflator were taken from publications issued by the Turkish Statistics Institute (TSI), Turkish Republic. The consumption, export, import, and stock data were from the Ministry of Agriculture and Rural Affairs (MARA). Consumption data is disappearance consumption and it is derived as a residual in an accounting identity of the sources and uses of a commodity. Sources of a commodity include current production, imports, and beginning inventory. Input prices were obtained from The Union of Turkish Agricultural Chambers. Policy variables included, in particular the schedule of import tariffs, was obtained from OECD Country Reports.

TAPAM may be linked with CARD/FAPRI international trade model via a price transmission equation. Traded quantities from TAPAM can also be connected to the CARD/FAPRI model to obtain international price responses to changes in Turkish trade patterns. The linkage between CARD/FAPRI and TAPAM can be observed in Chart 1 in the Appendix[1].

[1] Further information regarding CARD/FAPRI cab be found in Koc et. al, (1998) and on http://www.fapri.org.

2. General characteristics

Table 1: General characteristics

Model	*TAPAM*
Modeling Approach	Partial equilibrium, price equilibrium
Temporal Properties	Sequential simulation, allows for dynamic simulation as well, short- to medium-run
Solution Type	Net trade; non-spatial when linked to FAPRI
Solution Algorithm	
Base Year	
Parameters	Econometric estimation
Commodity Coverage	9 crop products 5 livestock products
Country Coverage	Turkey
Behavioral Equations (per commodity, country)	-general form- Area Yield Domestic demand (separate food, feed, seed, processing)* Domestic price
Economic Identity	Net trade

*:Type of demand depends on the type of product.

3. Commodity coverage

Table 2: Country and commodity coverage

Commodities	
Wheat	Poultry
Barley	Beef
Sugar beet	Mutton
Rice	Eggs
Maize	Milk
Soybeans	
Sunflower oil	
Cottonseed oil	
Soya oil	

4. Econometric specifics

Two structural demand models were estimated separately using Iterative Three-Stage Least Squares. The first structural demand model consists of meat, and the second consists of vegetable oils, milk, and eggs. Structural demand models were specified as an Almost Ideal Demand System (AIDS). Actual estimation was accomplished through SAS and SHAZAM. The standard specification of an AIDS model expresses the expenditure share of each commodity as a function of its own-price, prices of related commodities (complements and substitutes), and real expenditures. The specification included the first and second difference of the expenditure share, and a trend to capture dynamic adjustments of consumers. The model allows direct estimation of the long-run parameters. The theoretical demand properties were imposed only on the long-run parameters.

Single supply and demand models were estimated using ordinary least squares (OLS). Where simultaneity exists, Two-Stage Least Squares was employed for estimation. When serial correlation is not corrected with the dynamic specification or functional form, a Cochrane-Orcutt iterative estimation procedure was used. Single supply equations included maize, soybean, sugar beet, rice, beef, mutton, chicken, milk, and egg. Single demand equations included sugar, wheat, rice, corn, barley, soybeans and cottonseed meal.

A system of supply equations for wheat, barley, cotton, sunflower, lentils, and chickpea was also estimated using Iterative Three-Stage Least Squares a system of supply equations expressed the area share of each commodity as a function of its own-lag, own gross-return, and gross-return of related commodities. In this specification, time trend and policy dummy were also included. Adding-up and symmetry restrictions were imposed on the supply system.

Crops included in the supply system account for 85 percent of total area sown. To avoid singularity in the system and to satisfy the adding-up restriction, the rest of the crops were excluded from the supply system. It is assumed that trend and policy dummy variables are proxy of the gross-return of the excluded equation.

The adequacy of the estimated complete demand system displays all the theoretical demand properties since these were imposed in the estimation (i.e. homogeneity). That is, own-price elasticity measures are negative and expenditure elasticity measures are all positive. Many of the long-run parameters have coefficient estimates that are significant. Also, lagged regressors and trend are significant, suggesting dynamic adjustment of consumers.

Elasticity measures and validation
Elasticity estimates provide a scale-free measure of supply and demand responsiveness to changes in its arguments (i.e., own-price, income, and input price). The sign of elasticity checks whether the minimum requirement of a downward sloping demand and upward sloping supply are met. Elasticity calculated from the estimated parameters satisfies all requirements of demand theory. It was calculated that all of the own-price elasticity is negative and all of the expenditure elasticity is positive. The price transmission elasticity shows a positive transmission from the world to producer and from producer to retail level. This means that producer prices respond positively to the devaluation of local currency.

Historical simulation of the model’s core equation was used to validate the estimated model using a selected set of validation statistics. Mean of the absolute value and root of the mean square error are used for validation tests.

5. Behavioral equations

For a small country (a price taker country) the world price, together with domestic price policies will drive the production, consumption, and trade pattern of the country. The foundation of a country commodity model is the demand and supply structure specific to the country. Therefore both price transmission and country's specific structure becomes important in this sort of a simulation model.

Price transmission equation

Price transmission equation provides the bridge between the world price and a country's internal price. Ideally, the border price in Turkey differs from the world price by the transportation cost. Since the world and border prices are highly correlated, it is adequate to generate the border price as a function of the world price. In case if the border price is not available, the producer or retail price is used. All domestic prices are expressed in the local currency and the world price is in U.S. dollars. In equation 1, *ER* is the price of one U.S. dollar in local currency (i.e., the exchange rate). Marketing cost is represented by the variable *C*. Commodity is denoted by *k* and P^p and P^w shows domestic and world price respectively. Whenever appropriate, the consumer price index is used as a proxy of marketing cost of the price transmission between different levels in the market chain (i.e., wholesale to retail). Also, possible lag and other variables in the regression equation will be determined empirically.

$$P_k^p = f\ (P_k^w, ER, C_k) \tag{1}$$

Domestic supply & demand: wheat

Turkey's traditional wheat import is mostly durum wheat and wheat for seed. It is difficult to discern durum wheat and soft wheat from the reported aggregate wheat production and trade data, therefore an aggregate description of wheat trade equilibrium is presented. Production shocks are the primary factors determining net trade, since domestic consumption is stable in the short run. Domestic wheat production is determined by area devoted to wheat and yield. Yield is dependent upon weather conditions, rainfall in particular. When the rainfall level is normal, especially in the central region, production is usually sufficient to meet domestic demand.

The domestic wheat price does not reflect domestic supply and demand conditions due to government intervention in the market. Government intervention includes price supports, and fertilizer and credit subsidies. In recent years, besides the traditional pressure group of farmers, a new pressure group has emerged as the Chambers of Industry and Commerce. This group is in favor of lowering producer support prices to the world price level. But it seems that the domestic producer and consumer price will continue to be higher than world price in the short-run. Due to the low yield, Turkey does not have a comparative advantage in wheat production. Hence, Turkey's wheat trade varies from one year to another, depending on production shocks and buffer stock levels. When Turkey has excess production, net trade is positive. However, since the domestic price is higher than the world price, exports are only possible with export subsidies. When the domestic production and buffer stock level do not meet domestic demand, Turkey's net wheat trade is negative. The Turkish Grain Board (TGB) is the dominant actor in the import and export of wheat. Some years the TGB gets import permission with lower import tax rates than private importers (OECD 1994). In this case, the TGB generates import rents.

Total domestic wheat use includes human consumption, feed use, seed use, and losses. Separate demands are estimated for human consumption and feed use. Seed use and losses are assumed to be stable at the average level. Total demand is obtained by summing these individual demands. Wheat demand for human consumption is specified in a single equation framework. Since data on human consumption are only available in aggregate, direct estimation of a single equation was preferred. The homogeneity condition is imposed by dividing all prices and income by a consumer price index (Alston et al. 1998). The per capita wheat demand is specified as a function of producer price, per capita income (GDP), time trend, and dummy variables.

The wheat production function is calculated as the product of area planted (in share equation system framework) and yield. The share of the wheat in total area sown to field crops is a function of the one-period lag of gross wheat returns (yield multiplied by producer price), the one-period lag of gross returns for substitutes, the one-period lag of wheat's share of total area and a dummy variable. The dummy variable is a policy dummy that captures the impacts of the 1980 policy reform. The equation system cover six crops (wheat, barley, cotton, sunflower, lentils, and chickpea) and the share of these six crops is 85 percent of total area sown for field crops.

Wheat yield is specified as a function of time trend (technology) and dummy variable (rainfall or other weather conditions). First, the area sown for wheat is derived from estimated total field crops area then wheat production is calculated as the product of wheat area sown and yield. Total area sown to field crops is specified as a function of lagged total field crops area and fallow land. The fallow land is further specified as a function of its own lag and a trend.

The excess supply (demand) of wheat is the difference between domestic demand and supply. It is assumed that the stock level is constant with recent average. The supply of imported (demand for exported) wheat is perfectly elastic since Turkey is a small trading country. The price of imported (exported) wheat at the producer level is a function of border price, external duties, internal taxes, and marketing costs.

The equilibrium conditions are imposed by equating excess demand or supply with imported or exported wheat at the estimated price level.

$$Q^{w}_{pc(food)} = f(P^{w}_{t}, Y, T, \Theta, e) \tag{2}$$

$$Q^{w}_{feed} = f(Q^{w}_{feed,t-1}, T, e) \tag{3}$$

$$Q^{w}_{d} = [(Q^{w}_{pc(food)} * POP) + Q^{w}_{feed} + Q^{w}_{sd} + Q^{w}_{ls}] \tag{4}$$

$$S^{w}_{t} = f(S^{w}_{t-1}, GR^{w}_{t-1}, \sum_{i=1}^{n} GR^{s}_{t-1}, \Theta, e) \tag{5}$$

$$Y_{i} = f(T, \Theta, e) \tag{6}$$

$$FCA_t = f(FCA_{t-1}, FL_t, e) \quad (7)$$

$$FL_t = f(FL_{t-1}, T, e) \quad (8)$$

$$Q^{w}_{ed,es} = Q^{w}_{d} - Q^{w}_{s} \quad (9)$$

$$P^{w}_{p} = f(P^{w}_{b}, et^{w}, it^{w}, mc^{w}, e) \quad (10)$$

$$Q^{w}_{ed,es} = Q^{w}_{ims,exd} \quad (11)$$

Domestic supply & demand: rice

Turkey has imported significant quantities of rice since 1984. Presently, the import supply of rice represents approximately 50 percent of domestic consumption. Similar to that of wheat, rice demand is specified in a single-equation framework. It is specified as a function of per capita income and dummy variable. The price of rice was initially included in the model, but different estimation indicated that its own-price is not significant. This may be due to consumption habits, because rice is mostly consumed in urban Turkey. In rural areas, boiled and pounded wheat is commonly used rather than rice. Despite the fact that aggregate disappearance consumption doesn't respond to price, a support price was implemented by the GOT between 1967 and 1973, and 1991 and 1993 to encourage production of paddy. Moreover, paddy producers also benefited from other government support such as fertilizer subsidies, and low interest credits. To produce paddy, farmers have to have irrigated land and a permission certificate for planted area from the Ministry of Agriculture. The paddy area response model is specified as a function of area sown (t-1) and wholesale rice price (t-1).

The yield model is specified as a function of time trend. Paddy production is calculated as the product of area planted and yields. Using a conversion factor, domestic rice supply is derived from paddy production. Assuming stock level is constant and taking the difference between domestic demand and domestic supply of rice, an excess demand function (import supply function) is derived at every price level.

The supply of imported rice is perfectly elastic since Turkey is a small country. The price of imported rice at the retail level is a function of border price, external duties, internal taxes, and marketing cost.

The equilibrium condition requires equating excess rice demand with imported supply of rice at the estimated price level.

$$Q^{r}_{pc} = f(Y, \Theta, e) \quad (12)$$

$$A^{P}_{t} = f(A^{P}_{t-1}, P^{wpr}_{t-1}, e) \quad (13)$$

$$YD^{P}_{t} = f(T, e) \quad (14)$$

$$Q^{r}_{ed} = Q^{r} - Q^{r}_{ds} \qquad (15)$$

$$P^{r}_{r} = f(P^{r}_{b}, et^{r}, it^{r}, mc^{r}) \qquad (16)$$

$$Q^{r}_{ed} = Q^{r}_{is} \qquad (17)$$

Domestic supply & demand: sugar

Sugar beets are produced throughout Turkey. Almost all beets are grown under contract with state-owned or state-regulated refineries. As part of the contract the refineries prescribe the optimal crop rotation for the region (a three-year rotation). A common rotation includes cereals, pulses, fodder crops, and sunflower. Planting begins as early as February and continues through May. The harvest starts late in July and continues through November. Turkish Sugar Corporation (TSC) and the Central Union of Sugar Beet Producer Cooperatives (PANKOBIRLIK) guarantee they will buy all beets produced under contract. This policy ensures that farmers have a market, so they prefer to produce beets even though the price may not always be as high as they want. TSC provides seeds and fertilizers to farmers as part of the production contract. Farmers must use TSC-provided seeds but are free to purchase fertilizers from other sources. Farmers generally prefer to use TSC-provided fertilizers because payment for the fertilizers is deducted from the farmer's proceeds after harvest. This advantage, however, is countered by the fact that farmers generally do not receive their final payment until the following March or later. Since the final payment represents a significant portion of total return, the opportunity cost of the farmers' capital is significant because of high inflation. TSC also provides harvesting equipment or custom harvest services, as needed. Farmers are responsible for other inputs, including land and labor, irrigation, and transportation from farm to the factory or other central collection points.

For sugar net trade can be assumed to be residual because it depends on the domestic sugar beet production shock and stock level. Historical price data show that the domestic sugar price is well above the world price. Hence, sugar exports are only possible with an export support subsidy.

Consumer demand of refined sugar is specified as a function of per capita income, its own-price, and a dummy variable. The price of substitute and complementary goods were omitted from the demand equation to maintain a parsimonious specification. It is difficult to discern clear substitutes and complementary goods for sugar; nevertheless, given the food consumption habits and dietary habits in Turkey, we may consider tea, flour, and vegetable oil the principal complementary goods. Consequently, the influence of complementary goods on sugar consumption is approximated using a dummy variable to indicate when prices of complementary goods rise more rapidly than the sugar price. Historically, an inverse relationship has existed between Turkish sugar consumption and the change in the food price index relative to the sugar price. Sugar consumption declines when the food price index rises more rapidly than the sugar price; thus, a dummy variable may capture the negative impact of rising prices for complementary goods.

Area response for sugar beet is specified as a function of own-lag (t_3) producer price (t_1), wheat price (t_3), and a policy dummy. The yield model is specified as a function of producer price (t-1), time trend, and climate condition. Sugar beet production is calculated as the product of area planted and yields. Using the conversion factor, refined sugar production is derived from sugar beet production.

Taking the difference between domestic demand and domestic production of sugar, the stock level is derived at every price level. This excess production or demand primarily determines stock levels and net trade. So, net trade is estimated as a function of stock level (t-1) and a policy dummy variable.

The supply of imported sugar or demand of exported sugar is perfectly elastic since Turkey is a small country. The price of imported sugar or exported sugar at the retail level is a function of border price, external duties, internal taxes, and marketing costs. The equilibrium condition requires equating sugar demand with production and net trade of sugar at the estimated price level.

$$Q^s_{pc} = f(P^s_r, Y, \Theta, e) \tag{18}$$

$$A^{SB}_t = f(A^{SB}_{t-3}, P^{SB}_{t-1}, P^W_{t-3}, \Theta, e). \tag{19}$$

$$YD^{SB}_t = f(P^{SB}_{t-1}, T, \Theta, e) \tag{20}$$

$$Q^s_{stc} = Q^s_d - Q^S_P. \tag{21}$$

$$Q^s_{NT} = f(Q^s_{stc,t-1}, \Theta, e) \tag{22}$$

$$P^s_r = f(P^s_b, et^s, it^s, mc^s) \tag{23}$$

$$Q^s_d = Q^s_p - Q^s_{NT} \tag{24}$$

Domestic supply & demand: maize

Turkey's maize imports have grown steadily since the early 1980s, in conjunction with growth of the poultry sector, maize production in Turkey doubled between the early 1970s to early 1990s.

Maize is used by the livestock sector, food industry (to produce oil, gluten, flour, starch, etc.), and for human consumption (popcorn and bread). However, the share of direct human consumption has decreased in recent years. All maize users purchase it directly from producers, intermediates, or Turkish Grain Boards (TGB). Hence, the producer price is adequate for derived demand shifters. Per capita food demand of maize demand (food industry and direct consumption) is specified as a function of own-lag (t-1), maize producer price, per capita income, and dummy variables Dummy variables take impacts of unknown external shocks. The feed demand of maize is specified as a function of trend and egg-broiler feed requirement index. Total maize use is the sum of the demand for feed use and industry use (including direct human consumption), demand for seed uses, and losses.

Similar to sugar beets, maize production can be estimated from area sown and yields. Maize area sown is specified as a function of own-lag (t_1), cotton producer price (t_1), own producer price (t_1), and dummy for weather condition.

The yield model is specified as a function of own-lag (t-1), producer price (t-1), trend dummy for production technology such as seeds, irrigation practice, plant protection practice, etc., and a dummy for weather. Maize production is calculated as the product of area planted and yields.

Assuming the stock level is constant and taking the difference between domestic demand and domestic supply of maize, an import supply function is derived at every price level.

The supply of imported maize is perfectly elastic since Turkey is a small country. The price of imported maize at every price level is a function of border price, external duties, internal taxes, and marketing cost. The equilibrium condition requires equating excess maize demand with imported maize supply at the estimated price level.

$$Q_{pc}^{food} = f(Q_{pct-1}^{food}, P_p^m, Y, \Theta, e) \quad (25)$$

$$Q^{feed} = f(Trend, IN^{eb}, e) \quad (26)$$

$$Q_{tu}^m = [Q_{food}^m + Q_{feed}^m + Q_{seed}^m + Q_{loss}^m] \quad (27)$$

$$A_t^m = f(A_{t-1}^m, P_{t-1}^m, P_{t-1}^{ct}, \Theta, e) \quad (28)$$

$$YD_t^m = f(YD_{t-1}^m, P_{t-1}^m, T, \Theta, e) \quad (29)$$

$$Q_{is}^m = Q_p^m - Q_{md}^m \quad (30)$$

$$P_p^m = f(P_b^m, et^m, it^m, mc^m) \quad (31)$$

$$Q_{ed}^m = Q_{is}^m \quad (32)$$

Domestic supply & demand: soybeans

The model for soybeans resembles that of rice and maize. Turkey is a net soybean importer. The level of soybean import quantity has grown steadily since the early 1980s, in conjunction with the growth in livestock production, especially growth in poultry sector. The import supply of soybeans has been a big portion of domestic use since the early 1980s. Besides full-fat soybean imports, Turkey also imports soybean meal and soybean oil. Traditionally, Turkey is also a net importer of raw vegetable oils such as sunflower, cottonseed, palm, and soybean.

Soybean industry demand (including the direct use of full-fat soybeans) is specified as a function of own-lag (t-1), own-price, and egg-poultry requirement index. Total use of soybeans is the sum of the demand for industry consumption, demand for seed uses, and losses.

Similar to sugar beet, maize, and rice production, soybean production is derived from area sown and yields. Soybean area sown is specified as a function own-lag (t_1), soybean/maize producer price ratio (t_1), and a dummy for weather. The yield model is specified as a function of own lag (t-1) and producer price (t-1). Soybean production is calculated as the product of area planted and yields.

Assuming the stock level is constant and taking the difference between domestic demand and domestic supply of soybeans, an import supply function is derived at every price level.

The supply of imported soybeans is perfectly elastic since Turkey is a small country. The price of imported soybeans at every price level is a function of border price, external duties, internal taxes, and marketing cost.

The equilibrium condition requires equating excess soybean demand with imported soybean at the estimated price level.

$$Q^{sb}_{ind,t} = f(Q^{sb}_{ind,t-1}, P^{s}_{p}, IN^{eb}_{feed\ t}, e) \quad (33)$$

$$Q^{sb}_{tu} = [Q^{sb}_{ind} + Q^{sb}_{seed} + Q^{sb}_{loss}] \quad (34)$$

$$A^{sb}_{t} = f(A^{sb}_{t-1}, P^{sb/m}_{p,t-1}, \Theta, e) \quad (35)$$

$$YD^{sb}_{t} = f(YD^{sb}_{t-1}, P^{sb}_{p,t-1}, e) \quad (36)$$

$$Q^{sb}_{is} = Q^{sb}_{p} - Q^{sb}_{md} \quad (37)$$

$$P^{sb}_{p} = f(P^{sb}_{b}, et^{sb}, it^{sb}, mc^{sb}) \quad (38)$$

$$Q^{sb}_{ed} = Q^{sb}_{is}. \quad (39)$$

Domestic supply & demand: barley

The production shocks are primary factors that determine the level of barley trade. Consequently, Turkey's net barley trade is residual. It depends on production shocks and stock levels. Total barley use consists of feed use, industry use (beer, pasta, etc.), seed use, and losses. There are no available data for feed use and food industry use; hence, aggregate market demand is specified as a function of milk production, maize/barley producer prices ratio, weather dummy, and unknown external shock. Total barley use is the sum of the market demand, seed uses, and losses.

Similar to wheat, barley production is derived from area sown and yields. Barley area share in total area sown to field crops is a function of one period lag of own gross return (yield is multiplied by producer price), one period lag of gross-return for substitutes (wheat, cotton, sunflower, lentils, and chickpea) and lag of own share (t_1). Barley yield is specified as a function of time trend (technology) and dummy variable (rainfall or other weather condition). Barley production is calculated as the product of area planted and yields. Area sown to barley is derived from estimated sown area to field crops.

It is assumed that the stock level is constant and taking the difference between domestic market demand and domestic production derives an import supply (or export demand) at every price level. The import supply (or export demand) of barley is perfectly elastic since Turkey is a small trading country. The barley producer price is a function of border price, external duties, internal taxes, and marketing cost.

The equilibrium conditions are imposed by equating excess supply or demand with imported or exported barley at the estimated price level.

$$Q^{b}_{md} = f(Q^{milk}_{p}, PR^{(m/b)}_{p}, \Theta, ES, e) \quad (40)$$

$$Q^{b}_{tu} = [Q^{b}_{md} + Q^{b}_{seed} + Q^{b}_{loss}]. \quad (41)$$

$$S^{B}_{t} = f(S^{B}_{t-1}, GR^{B}_{t-1}, \sum_{i=1}^{n} GR^{s}_{t-1}, \Theta, e) \quad (42)$$

$$YD^{b}_{t} = f(T, \Theta, e) \quad (43)$$

$$Q^{B}_{exd,is} = Q^{B}_{d} - Q^{B}_{p} \quad (44)$$

$$P^{b}_{p} = f(P^{b}_{b}, et^{b}, it^{b}, mc^{b}) \quad (45)$$

$$Q^{m}_{exd,is} = Q^{b}_{ex,im} \quad (46)$$

Domestic supply & demand: vegetable oils (sunflower, cottonseed, and soybeans)
Traditionally, Turkey is a net importer of raw vegetable oil, but the level of net import mostly depends upon the production level of sunflower, cotton, and soybean. To calculate the contribution of domestic raw vegetable oil supply to total supply, it is also important to take into account oilseed imports. Turkish vegetable oil consumption consists of sunflower oil, cottonseed oil, soybean oil, olive oil, maize oil, palm oil (in recent years), and other sources. But the share of sunflower, cottonseed, and soybean is more than 75 percent of total consumption. The share of olive oil is approximately 0.5 percent. Turkey is a principal olive oil exporter in the world market. Turkish olive oil exports depend upon periodicity in production and yields. Turkey also exports margarine and refined liquid oil in consumer-ready packs to regional markets such as the Middle East countries. Margarine comprises approximately 40 percent of total domestic consumption. The Turkish consumer uses margarine both for cooking and breakfast. The margarine for breakfast is a substitute for butter, cheese, and other high-value dairy products in low income households. At the same time, margarine is also a substitute for butter in confectionery manufacturing such as sweets. Egg is also consumed mostly at breakfast and used in confectionery manufacturing such as sweets and pasta. It is reasonable to consider vegetable oil, milk, and eggs as a separate subgroup because there is at least a moderate substitute or complementary relationship among them.

Aggregate market demand for vegetable oil is specified as an AIDS. The estimated share equation can be expressed as a function of weighted retail price of vegetable oils, price of close substitute products (egg and milk), and expenditure. To capture dynamic adjustment, first difference of the own share, first difference of all prices, and expenditure is included as explanatory variables. A logarithmic trend and dummy variables are also included.

Similar to wheat and barley; sunflower and cotton production are derived from area sown and yields. The area share of sunflower and cotton are a function of a one-period lag of own gross-return of sunflower and cotton (yield multiplied by producer price), one period lag of gross-return for substitutes (i.e., for sunflower, cotton, wheat, barley, lentils, and chickpea) and the lag of own-share (t-1). In the cotton equation, a trend variable is included instead of own-share.

Sunflower and cotton yields are specified as a function of time trend (technology) and dummy variable (rainfall or other weather conditions). Both sunflower seed and cottonseed are calculated as the product of area planted and yield. Area sown to sunflower and cotton are derived from estimated area sown to field crops. Cottonseed is calculated from cotton production by using conversion factors. Summing of oil extraction from domestic production of sunflower seed, cottonseed, and soybean derives total domestic supply of vegetable oils. Olive oil and others are omitted due to their small share in total production.

At every price level, taking the difference between domestic vegetable oil demand and supply of vegetable oils from domestic oil seeds production derives the excess demand (or import supply).

The supply of particular imported raw vegetable oils is perfectly elastic since Turkey is a small trading country. The vegetable oil retail price is a function of border price, external duties, internal taxes and marketing cost. Equating excess demand with imported supply at the estimated price level imposes the equilibrium conditions.

$$S_{pc}^{vo} = f(\Delta S, P_r^{vo}, \Delta P_r^{vo}, P_r^s, \Delta P_r^s, M, \Delta M, LT, \Theta, e) \quad (47)$$

$$S_t^{SF} = f(S_{t-1}^{SF}, GR_{t-1}^{SF}, \sum_{i=1}^{n} GR_{t-1}^{s}, \Theta, e) \quad (48)$$

$$S_t^{CT} = f(GR_{t-1}^{CT}, \sum_{i=1}^{n} GR_{t-1}^{s}, T, e) \quad (49)$$

$$YD_t^{SF} = f(T, \Theta, e) \quad (50)$$

$$YD_t^{CT} = f(T, e) \quad (51)$$

$$Q_{is}^{vo} = Q_d^{vo} - Q_{sfds}^{vo} \quad (52)$$

$$P_r^{vo} = f(P_b^{vo}, et^{vo}, it^{vo}, mc^{vo}) \quad (53)$$

$$Q_{ed}^{vo} = Q_{is}^{vo} \quad (54)$$

Domestic supply & demand: livestock
The livestock sector model includes poultry, beef, mutton, eggs, and milk. A standard trade model similar to that of crops is used to model these commodities. The only peculiarity is in the lag structure that captures the biological process involved in production.

Turkey has been importing meat and dairy products since the mid-1980s. Beef imports have increased considerably due to the shortage of domestic supply relative to the domestic demand in recent years. Turkey traditionally has been a net exporter of live sheep and mutton, but the shortage of sheep stock numbers and increasing domestic meat prices in recent years have considerably reduced exports. Since 1987 Turkey has also been importing breeding cows to improve the cattle carcass and milk yield. To keep consumer prices stable, the domestic market has also been opened for beef cattle in recent years.

Excess beef demand is derived from domestic supply and market demand. Then a perfectly elastic import supply is imposed and adjusted for external duties and internal taxes in the excess demand space to determine to equilibrium quantity imported. The same price is fed back to the domestic supply and demand to determine the equilibrium quantity supplied and demanded.

The market demand for chicken, beef, and mutton are specified as AIDS. The estimated equation can be expressed as a function of own-price, price of substitute product (for beef demand there is chicken and mutton), and expenditure. To capture the dynamic adjustment, first differences of all prices and expenditures are included as explanatory variables. Dummy variables are also included.

The domestic beef supply is specified as a function of own-producer price (t) and (t-1), producer price of cow milk (t), and time trend. The domestic supply of chicken is specified as a function of broiler feed price index/producer price (live hens) (t-1), time trend, and dummy variables. Domestic supply of eggs is specified as a function of egg production (t-1), composed feed price/producer price ratio (t) and (t_1) and time trend. The domestic supply of milk is specified as a function of producer price (t_2) and time trend.

Milk net trade is specified as a function of domestic retail white cheese price and North European Cheese Export Price ratio (t-1) and lag of the net trade (own lag). Since Turkey imports only a negligible portion of its domestic milk consumption, the equilibrium price is determined by equating the domestic supply plus net trade to domestic demand.

The domestic mutton supply is specified as a function of mutton price (t-1) and dummy variables. Since Turkey is a small country in international beef import, the price of imported beef at the producer level is a function of the border price of beef, external duties, internal tax, and marketing cost. Price is fed back to domestic supply and demand to determine the quantity demanded (Qd) and supplied (Qs), and fed back to the excess demand to determine the quantity imported (Qm). The equilibrium condition is expressed as excess demand equality to import supply.

$$S_{pc}^{beef} = f(P_r^{beef}, \Delta P_r^{beef}, P_r^s, \Delta P_r^s, M, \Delta M, \Theta, e) \quad (55)$$

$$Q_{ds}^{beef} = f(P_p^{beef}, P_{p,t-1}^{beef}, P_p^{cwm}, T, e) \quad (56)$$

$$Q_{ds}^{Chicken} = f(P_{t-1}^{FPI/P_{lh}}, T, \Theta, e) \quad (57)$$

$$Q_{ds,t}^{E} = f(Q_{ds,t-1}^{E}, P_t^{FP/P}, T, e) \quad (58)$$

$$Q_{ds}^{Milk} = f(P_{p,t-2}^{cwm}, T, e) \quad (59)$$

$$Q_{NT}^{Milk} = f(P_{t-1}^{DRC/NEUC}, Q_{NT[t-1]}^{Milk}, e) \quad (60)$$

$$P^e = Q_{Dm}^s + Q^{NT} - Q^D \quad (61)$$

$$Q_{ds}^{Mutton} = f(P_{p,t-1}^{M}, \Theta_t, e) \quad (62)$$

$$P_p^{beef} = f(P_b^{beef}, et^{beef}, it^{beef}, mc^{beef}) \quad (63)$$

$$Q_{ed}^{beef} = Q_{is}^{beef} \quad (64)$$

6. Policy instruments

References

Koc, A.Ali, Darnell B. Smith, Frank Fuller, and Jacinto Fabiosa, (1998). The Turkish Agricultural Policy Analysis Model, Technical Report 98-TR 42, Center for Agricultural and Rural Development, Iowa State University.

http://www.fapri.org.

Appendix

Chart 1. The linkage between CARD/FAPRI and TAPAM

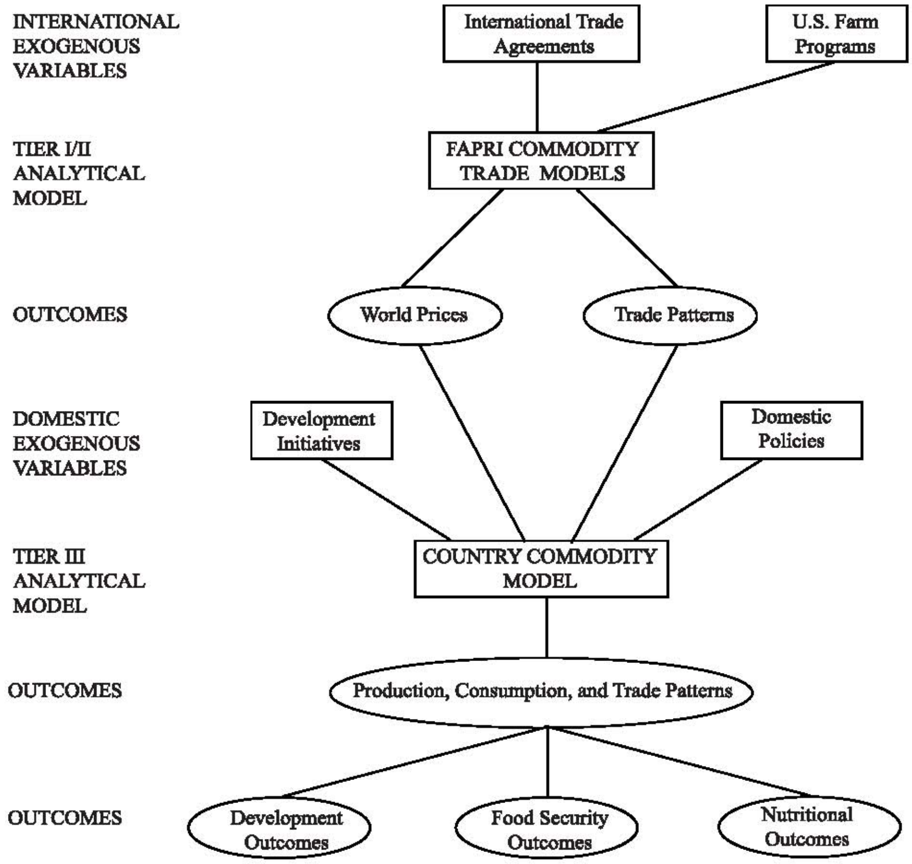

FIGURE 2.1. The Link between TAPAM and CARD/FAPRI World Trade Model