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ECONOMIC ANALYSIS OF MILK PRODUCTION AND CONSUMPTION IN THE MIDDLE EAST AND NORTH AFRICA

M. Maitah, L. Smutka

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Abstract

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Milk products are considered as the essential food commodities for humans. Milk products contain essential elements for the human body such as protein, glucose, minerals and vitamins. Moreover, milk is considered the cheapest source of animal protein, an important resource for some related transformation industries and provides employment opportunities for a large number of small producers in both rural and urban areas. The aim of this paper is to analyze the factors which determine the supply and demand for liquid milk (henceforth milk) in the Middle East and North Africa in order to point out the main problems and constraints obstructing the milk production in this region. The research also attempts to understand the drivers for the development in milk production in the Middle East and North Africa.Total milk production in the Middle East and North Africa increased from about 12.57 million tons in 1990 to about 25.18 millions tons in 2008. This paper attempts to identify the factors which influence the effectiveness of production, consumption and foreign trade of milk in the Middle East and North Africa.
The most important factors affecting consumption is the population, per capita income and produced quantity where a 1% increase in all of them results in increasing the quantity consumed by 1.3%, 2.86% and 0.611%, respectively. Milk sector provides employment opportunities for more than 25% of the working force in some Middle East and North Africa countries.

milk, production, consumption, analysis, Middle East, North Africa

The growing demand for food increases the risks of food insecurity in the Middle East and North Africa – MENA[1] (Fig.1). The increasing population (3%) and increasing income (4.5%) strengthen the demand for food in this region (Omari A., 2008). On the other hand, supply-side constraints in this region could limit their ability to increase food production. Demand for food in the Middle East and North Africa is supposed to grow substantially to the year 2025 and beyond, but production is not expected to keep pace (Atman M., 2005). Unless corrective measures are undertaken, this would result in the increased dependence on milk imports by the Middle East and North Africa, exacerbating its food insecurity situation and increasing its exposure to food availability and price shocks. Limited rains and land resources represent the main barriers to increasing agricultural production especially in the Middle East region. With less than 2 percent of the world freshwater resources and rapid increases in its use, water has become increasingly scarce in the Middle East and North Africa (Othman

1 The MENA Region includes: Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Syria, Sudan, Somalia, Tunisia, United Arab Emirates, West Bank and Gaza, Yemen.

1: *Middle East and North Africa*

A., 2010). The region's per capita renewable water is projected to fall to below 500 cubic meters by 2030, compared with a world average of 4 800 cubic meters per capita and the situation could be aggravated by climate change (Abdel F., 2008).

The Middle East and North Africa have very little fertile agricultural land, which is rapidly degrading because of soil erosion and urban expansion. Estimations indicate that by 2050, per capita arable land will drop to 0.12 hectare, down 63 percent from its level in the 1990s compared with a world average of 0.21 ha per capita (Aden A., 2005). Milk products contain essential elements for the human body such as protein, glucose, minerals and vitamins. Moreover, milk is considered the cheapest source of animal protein, an important resource for some related transformation industries and provides employment opportunities for a large number of small producers in both rural and urban areas. The importance of milk products relative to the value of agricultural and animal products varies between the Middle East and North Africa countries. However, a large number of traditional producers depend on this sector for their livelihood. It is worth indicating that milk sector provides employment opportunities for more than 25% of the working force in some Middle East countries such as Syria (Atman M., 2005).

World milk production

Experts expect that milk production will be transferred from high-production cost countries to low-production-cost countries and regions experiencing a growing demand for milk products, where world milk production is expected to grow. The current share of developing countries accounts for 44% of the world total milk production (Sadi M., 2009). The world milk production is estimated to reach 665 million tons in 2010, from cattle (551 million tones; 84%), buffalo (12.5%, mainly from India and Pakistan), sheep and goats (3.2%) and other species (predominantly camels, 0.3%) (Dairy Australia, 2007). Almost all countries produce milk for local consumption. However, the cost of production varies greatly depending on factors including labor costs, animal genetics, on-farm technology, and fodder and water availability (Alqaisi O., 2009). In EU the breeders of dairy cattle struggle with a number of problems arising from the cost escalation, and from the dramatic fall of milk purchase prices (Mach J. *et al.*, 2009).

World milk trade

There is a growing global demand (an increase of 3% globally, but more than 10% in some developing countries, and 15% in China) for milk and other dairy products. Global competitiveness is also fuelling new uses for milk based ingredients, rising demand for cheese varieties, an increase in niche product markets and increased product shelf life (More S., 2009). Until fairly recently, the world milk trade was considered a secondary market for the disposal of surplus commodities. In recent years, however, the trade has been facilitated by improved refrigeration and transportation technologies, and is being increasingly influenced by increasing global demand for milk products (Alqaisi O., 2009). The international dairy trade has been dominated for many years by the European Union (with 30% of global dairy trade) and Australasia (New Zealand, 32%; Australia, 12%) (Dairy Australia, 2007). The milk sector is highly localized, as milk is a bulky and perishable product, and milk products are mostly consumed in the country or region where they are produced. Only a small fraction of global production is traded internationally. Trade in milk products is very volatile, as milk trade flows can be affected by (a) overall the economic situation in a country, (b) fluctuations in supply and demand, (c) changing exchange rates and (d) political measures (MOA, 2009). Additional volatility is introduced by the fact that the global milk market is extremely concentrated in terms of buyers and sellers; hence, supply or demand shocks are not easily absorbed (MOA, 2008). With demand for milk products most rapidly rising in regions that are not self-sufficient in milk production, volumes of milk trade are growing. Also the share of global milk production that is traded will increase as trade will grow at a faster pace than milk production (Haddadin J., 2005).

The developed countries continued to monopolize the bulk of milk products exports in 2010 to reach approximately 75% of trade exchange, which is slightly lower than it was in the early nineties when developed countries represented about 80% of the world dairy exports (Omari A., 2008). It is expected that New Zealand and Australia milk exports will increase, whilst European milk exports are expected to drop especially because of reforms and WTO obligations to reduce export subsidies. North American export is expected to remain stable. As for the world prices of milk products, over the next ten years they are not expected to increase in real terms (Othman A. *et al.*, 2010). Even if prices remain around their current levels, they will be sufficient to achieve growth in the incomes of developing countries and stimulate export oriented production in milk producing countries at low costs.

Milk production in the Middle East and North Africa

Cows are considered as the main source of milk production in most of the Middle East and North Africa countries. For instance, about 92.7% of the processed milk in Jordan is cow milk, while the rest is from sheep and goats (Alqaisi O., 2009). Milk production in most countries of this region is produced in both the traditional and modern sectors (Fig. 2). However, the traditional sector is the main source of production. This sector is usually divided into two types. The first type comprises nomadic cattle producers who are migratory by definition and dependent on natural pastures in raising their cattle and always move in pursuit of water and pastures. However, most of their milk production is not available for trade due to the remoteness of the production areas and the weak marketing facilities and services. In addition, they largely depend on milk for food and mainly raise cattle for meat production, i.e. milk production is considered a secondary activity for the majority of them. The second type comprises traditional producers who have settled around cities and agricultural projects. This type of producer mainly relies on crop residues to feed their animals. As regards the modern sector, it is always located around cities and dairy factories. This sector applies modern rearing techniques and intensified production in farms that are specialized in producing milk from imported, hybrid and domestic dairy cows. Producers in this sector rely on green fodder and feed concentrates for feeding their animals. In analyzed countries milk production has been constantly growing. It is a part of agriculture business activity which is growing very fast especially because of constantly growing demand (Aden A., 2005). Total milk production in the Middle East and North Africa increased from about 12.57 million tons in 1990 to about 25.10 million tons in 2008, which is a 99% increase (Abdel F., 2008). The estimated general regression equation for milk production in the Middle East and North Africa during the period (1990–2008) is presented as follows:

$$QP_t = 11\,245.12 + 754.78X_t$$

$$(31.46)^{**}$$

$R^2 = 0.982$
$F = 989.60$,
where:
QP_t ... is the estimated quantity of the Middle East milk production in thousand tons in year *t*.
X_t ..... is the time variable in year *t*, where $t = 1, 2, 3, \ldots, 19$.
*..... The figure between brackets is the calculated *t* value.
**..... Significant at 0.01 level of confidence.

The equation indicates a statistically significant annual rate of increase in milk production in the Middle East and North Africa at 0.01 level of confidence during the period (1990–2008). This increase has been estimated at 754.78 thousand tons per annum representing 4% of average annual milk production in the Middle East and North Africa that reached about 18 792.89 thousand tons during the same period. The coefficient of determination (R2) indicates that around 98% of the variations in the volume of milk production is linearly correlated with time. Sudan ranked the first in the milk production in the Middle East and North Africa region during the period (1995–2005), where its annual average milk production reached around 6 725 thousand tons representing approximately 34.2% of average milk production in the Middle East and North Africa during the analyzed time period. Egypt's milk production ranked the second place representing 19.5% of total milk production in the analyzed region, followed by Syria, Algeria and Saudi Arabia with share in total analyzed regions production monitored time period representing about 8.6%, 7% and 5.1%, respectively (Aden A., 2005).

Data indicates that milk consumption in the Middle East and North Africa increased from about 21 314 thousand tons in 1990 to about 35 929 thousand tons in 2008 (Fig. 2), which is an increase of 68.6% (approximately). The estimated general regression equation for milk consumption in the Middle East and North Africa during the period (1990–2008) is presented as follows:

$$QC_t = 18\,848.53 + 891.24X_t$$

$$(22.33)^{**}$$

$R^2 = 0.967$
$F = 494.29$,
where:
QP_t ... is the estimated quantity of the Middle East milk consumption in thousand tons in year *t*.
P_t ..... is the time variable in year *t*, where $t = 1, 2, 3, \ldots, 19$.
*..... The figure between brackets is the calculated t value.
**..... Significant at 0.01 level of confidence.

The equation shows that milk consumption in the Middle East and North Africa have been increasing at a statistically significantly annual rate of 891.24 thousand tons represents approximately 3.2% per annum of the average amount of consumption during the period (1990–2008) which is (27 760.94 thousand tons). The calculated coefficient of determination indicates that 96.7% of the variation in the quantity consumed of milk products in the Middle East and North Africa are linearly correlated with time. Moreover, the equation indicates that the self sufficiency rate increased from 59% in 1990 to about 70% in 2008. On the other hand it must be emphasized the physical value of consumption is growing. Growth of consumption volume is higher than physical growth of region's production volume. It means that high production of total milk consumption must be covered by intensive import activities.

Milk imports in the Middle East and North Africa

Milk imports belong to major imported food commodities in the Middle East and North Africa (Fig. 2). During the period (1998–2002), the average value of food imports amounted to US $ 8 799.3 million approximately, of which the average value of milk imports was about US $ 2 777.8 million representing approximately 31.6% of the total value of food imports. The volume of imports increased from about 8 939 thousand tons in 1990 to about 13 058 thousand tons in 2008, which is an increase of 46% approximately compared to 1990. As regards the value of milk imports, it increased from about US $ 2.08 billion 1990 to about US $ 5.44 billion in 2008, a 161.4% increase compared to 1990. In other words, the rate of increase in the value of imports during the studied period was greater than the rate of increase in the volume of imports, which reflects the growing increase in the prices of imported milk commodities and the consequent increase in trade balance burden. The estimated general regression equation for the volume of milk imports in the Middle East and North Africa during the period (1990–2008) is presented as follows:

$$QM_t = 7\,377.25 + 224.41X_t$$

$$(4.66)^{**}$$

$R^2 = 0.561$

$F = 21.74$,

where:

QM_t .is the estimated quantity of the Middle East milk imports in thousand tons in year t.

X_t .....is the time variable in year t, where $t = 1, 2, 3, \ldots, 19$.

*.....The figure between brackets is the calculated t value.

**.....Significant at 0.01 level of confidence.

This equation indicates that the Middle East and North Africa imports of milk products have been increasing at a statistically significant annual rate equivalent to 224.41 thousand tons representing about 2.33% of their annual average volume of milk imports estimated at 9 621.42 thousand tons during the period (1990–2008).

On the other hand, the estimated general regression equation for the value of milk imports at the level of the Middle East and North Africa during the period (1990–2008) is presented as follows:

$$VM_t = 1\,313\,373.28 + 134\,679.14X_t$$

$$(5.05)^{**}$$

$R^2 = 0.600$

$F = 25.46$,

where:

VM_t..is the estimated value of the Middle East milk imports in US $ million in time t.

X_t .....is the time variable in year t, where $t = 1, 2, 3, \ldots, 19$.

*.....The figure between brackets is the calculated t value.

**.....Significant at 0.01 level of confidence.

The equation indicates that the value of Middle East and North Africa milk imports has been increasing at a statistically significant annual rate estimated at US $ 0.134 billion, representing about 5% of the annual average value of their imports that amounted to US $ 2.66 billion during the period (1990–2008). Saudi Arabia and Algeria import value each represented 19.9% of the total value of milk imports by the Middle East and North Africa region as average of the period 2003–2005, followed by Egypt and UAE where import values accounted for 8.7% and 8.4%, respectively.

Milk exports in the Middle East and North Africa

Milk export has only minor position in total analyzed countries' export activities. The value of the Middle East and North Africa milk exports represented about 2.5% of the total value of the Middle East and North Africa food exports as an average of the period (1998–2004), which rose to about 9.2% as average of the period (2003–2005). This increase is attributed to the usage of more developed and sophisticated technology in milk production. Oman ranked the first place in milk exports that accounted for 33% of the total exported volume at the level of the Middle East and North Africa. The volume of Omani milk exports has been estimated at about 296 thousand tons as annual average for the period (2003–2005) worth US $107 million approximately. Saudi Arabia followed with exports that represented 23.2% of the total exported volume and 18.8% of the total exports value. The estimated general regression equation for the volume of the Middle East milk and North Africa exports products during the period (1990–2008) is presented as follows:

$$QE_t = 136.58 + 47.64X_t$$

(7.57)*

$R^2 = 0.771$
$F = 57.26$,
where:
QE_t... is the estimated quantity of Middle East milk exports in thousands tones in time t.
X_t..... is the time variable in year t, where $t = 1, 2, 3, \ldots, 19$.
*..... The figure between brackets is the calculated t value.
**..... Significant at 0.01 level of confidence.

This equation shows that the volume of the Middle East and North Africa milk exports has been increasing at a statistically significant annual rate of 47.64 thousand tones representing about 15.49% of the annual average volume of the Middle East and North Africa milk exports estimated at 307.63 thousand tones during the period (1990–2008). The estimated general regression equation for the value of milk exports indicates that milk exported value has been increasing at a statistically significant annual rate of US $ 24 089.21thousandas representing 12% of the average value of the Middle East and North Africa milk exports estimated at US $ 202 942.63 thousands during the period (1990–2008). The estimated equation is presented as follows:

$$VE_t = -37\,949.47 + 24\,089.21X_t$$

(11.23)*

$R^2 = 0.881$
$F = 126.07$,
where:
VE_t ... is the estimated value of the Middle East milk exports in US $ million in time t.
X_t..... is the time variable in year t, where $t = 1, 2, 3, \ldots, 19$.
*..... The figure between brackets is the calculated t value.
**..... Significant at 0.01 level of confidence.

OBJECTIVES AND METHODS

Due to the weak performance of the milk sector in the Middle East and North Africa which is reflected in low production, this sector fails to meet the growing consumption requirements in this region. This is the reason why we see that it is necessary to study those aspects related to milk production and consumption in the Middle East and North Africa.

The aim of this paper is to analyze the factors which determine the supply and demand for milk in the Middle East and North Africa in order to point out the main problems and constraints obstructing the milk production, processing and trade in this region. The research also attempts to understand the drivers for the development in milk production in the Middle East and North Africa.

The study adopted descriptive analysis to introduce the study problem, in addition to applying some quantitative analysis methods, such as linear regression analysis (the basic linear regression):

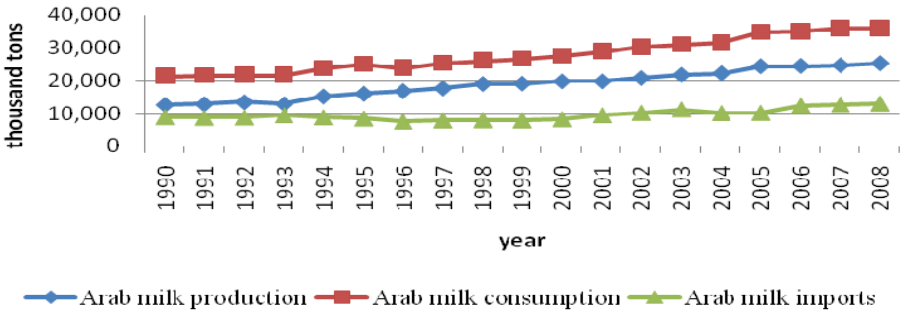
(Y = a + bx) as to estimate the general regression equations for the variables related to the study. The least square method is used to identify the main factors affecting the studied variables. The study depended on data published by various sources for the period (1990–2008) such as annual reports and bulletins issued by the League of Arab States, the Arab Organization for Agricultural Development (AOAD), Food and Agriculture Organization of the United Nations (FAO), in addition to some online data from the internet, as well as some studies related to the researched topic. The process of data values are analyzed in current USD prices and volume data values are analyzed in metric tons. The final result of this paper is a model which explains the Middle East and North Africa milk market developments. The model consists of three equations all at the level of the Middle East and North Africa. The first equation is for the volume of milk consumption; the second is for the volume of milk imports and the third is for the volume of milk supply in the Middle East and North Africa. Due to the limited role of milk export in the analyzed region, the export as an independent variable is excluded from the model construction.

The Consumption Equation:

$$[\text{Log}(QC]_t) = \beta_0 + \beta_1[\text{Log}(PU]_t) + \beta_2[\text{Log}(DI]_t) + + \beta_3[\text{Log}(PM]_t) + \beta_4[\text{Log}(QP]_t)$$

The Import Equation:

$$[\text{Log}(QM]_t) = \beta_5 + \beta_6[\text{Log}(QC]_t) + \beta_7[\text{Log}(PM]_t) + + \beta_8[\text{Log}(QP]_t)$$



2: *Middle East and North Africa production, consumption and import*

The Supply Equation:

$[\text{Log}(QS]_t) = \beta_9 + \beta_{10}[\text{Log}(QP]_t) + \beta_{11}[\text{Log}(PM]_t)$

Jointly Dependent Variables:

QC_t .. the quantity of the Middle East and North Africa milk consumption in year *t*, in thousand tons (data source: AOAD, 2009).

QM_t.. the quantity of the Middle East and North Africa milk imports in thousand tons in year *t*, in thousand tons (data source: AOAD, 2009).

QS_t.... the quantity of the Middle East and North Africa milk supply in thousand tons in year *t*, in thousand tons (data source: AOAD, 2009).

Predetermined Variables:

PU_t ... the Middle East and North Africa population in year *t*, in millions. (data source: AOAD, 2009).

DI_t.... average per capita income in the Middle East and North Africa in year *t*, in US $.(data source: AOAD, 2009).

PM_t .. average import price per ton of milk in year *t*, in US $. (data source: AOAD, 2009).

QP_t ... the quantity of the Middle East and North Africa milk production in thousand tons in year *t*, in thousand tons (data source: AOAD, 2009).

With regards to the consumption equation, it was assumed that the quantity of milk consumption in the Middle East and North Africa is a function of population, import price, per capita income, quantity of production and the quantity of imports at the level of the Middle East and North Africa. Economic theory presumes that increases in population, the volume of production, per capita income and the volume of imports result in an increase of the volume of consumption, while economic theory presumes an inverse relationship between the import price and consumed quantity, where the increase in import price results in lower imports and hence less available quantity for consumption. With respect to the milk imports equation, the economic theory assumes that an increase in consumed quantity leads to an increase of the quantity imported, while increases in import price and produced quantity lead to decrease in the quantity of imported milk products in the Middle East and North Africa. Finally, in the milk supply function, it was assumed that the quantity supplied of milk is a function of the quantity of milk production, the quantity of milk imports and milk import price. According to the logic of economic theory, the relationship between supply and the volumes of production and imports is a positive relationship, i.e. the quantity of milk supply in the Middle East and North Africa increases as the volume of milk production and the quantity of imports increase, while declines when the import price increases. The identity equation indicates that the quantity supplied equals the quantity produced plus the quantity imported, which equals the quantity available for consumption. Studying the previously specified model and the identification problem show that the model equations are identified and therefore the least squares method was the most appropriate method of estimation and for solving the system of simultaneous equations. This method gives more accurate estimation for the overall impact of independent variables. It also allows the total impacts of the changes insignificant variables on the rest of the variables included in the model to be estimated. In addition, the elasticity estimated using method is usually more efficient. The model parameters have been estimated using E-views statistical software. Several trials were made by including and excluding different variables until reaching the most efficient estimates in order to estimate the reduced form equation of the model. The estimates of the model with two stage least square used actual data for the time period (1990–2008). Because of the "Arab Spring" – a string of political uprisings that took place in the Middle East and North Africa, we were unable to collect the needed data for the recent years.

RESULTS

Estimated results have been arranged in tables. Table I illustrates the structural estimates. Table II

I: *Estimates*

The Consumption Equation:					
$[\text{Log}(QC]_t) = 0.721 + 1.30[\text{Log}(PU]_t) + 2.86[\text{Log}(DI]_t) - 0.649[\text{Log}(PM]_t) + 0.611[\text{Log}(QP]_t)$					
	(3.5)*	(5.82)**	(6.17)**	(4.89)**	(2.35)*
$R = 0.87$	$R^2 = 0.81$	$DW = 1.46$	$F = 143.58$		
The Import Equation:					
$[\text{Log}(QM]_t) = 0.413 + 0.372[\text{Log}(QC]_t) - 1.49[\text{Log}(PM]_t) - 2.05[\text{Log}(QP]_t)$					
		(5.33)**	(4.96)**	(2.59)*	(2.15)*
$R = 0.79$	$R^2 = 0.67$	$DW = 1.59$	$F = 64.32$		
The Supply Equation:					
$[\text{Log}(QS]_t) = 0.942 + 0.761[\text{Log}(QP]_t) - 0.618[\text{Log}(PM]_t)$					
			(2.58)**	(3.61)*	(2.3)*
$R = 0.68$	$R^2 = 0.59$	$DW = 1.35$	$F = 85.31$		

II: *Correlation matrix*

	QCt	PUt	DIt	QPt	QMt	PMt	QSt
QCt	1						
PUt	0.86	1					
DIt	0.81	0.12	1				
QPt	0.93	0.35	0.14	1			
QMt	0.89	0.49	0.54	–0.83	1		
PMt	–0.85	0.10	0.11	–0.87	–0.91	1	
QSt	0.99	0.45	0.40	0.96	0.95	–0.84	1

III: *Elasticities*

Elasticities	PU_t	DI_t	PM_t	QP	QC_t
QC_t	1.30	2.86	–0.649	0.611	
QM_t			–1.49	–2.05	0.372
QS_t			–0.618	0.761	

represents the *correlation matrix*. Table III lists the estimated elasticity for the basic variables in the model.

As regards the consumption equation, estimated results indicate that the signs of the estimated parameters comply with the economic theory, where a 1% increase in the Middle East and North Africa population results in a statistically significant 1.30% increase in consumption, whilst a 1% increase in per capita income and production results in increasing consumption by 2.86% and 0.611%, respectively. Therefore, the equation verified the inverse relationship between the consumed quantity and import price, where a 1% increase in import price resulted in reducing the quantity of milk consumption in the Middle East and North Africa by 0.649%. The calculated t value indicates that such estimates are statistically significant. Parameters estimated using the reduced form of the imports function indicates that the Middle East and North Africa milk imports are significantly affected by the import price according to the logic of economic theory, where a 1% increase in the import price results in 0.372% decline in the imported quantity. Estimates verified the inverse relationship between the produced quantity, the import price on one hand and total imports on the other hand, where increasing each of them by 1% results in reducing the Middle East and North Africa milk imports by 2.05 and 1.49. The results are statistically significant at 0.05 level of confidence. As for milk supply in the Middle East and North Africa, estimated results proved the significant impact of the produced quantity and the import price, where a 1% increase in the produced quantity resulted in increasing the quantity supplied by 0.761%, whereas a 1% increase in import price resulted in reducing the quantity supplied by 0.618%, which complies with the assumption of the economic theory.

The correlation matrix was calculated in order to find out if there is a multicollinearity between the predetermined variables which could negatively influence the whole model. As it can be seen, no strong dependence (coefficient higher than 0.8) between the predetermined variables was proved. On the other hand, strong dependence between dependent and predetermined variables is shown which is favourable.

DISCUSSION

The milk sector in the Middle East and North Africa has been facing several problems. The problems resulted in (not being achieved) the optimum use of natural resources, livestock, wealth and the potentials available for developing the milk sector in the Middle East and North Africa.

- The problems and constraints are presented briefly as follows (Othman A. *et al.*, 2010), (Aden A., 2005), (Abdel F., 2008):
  - The fact that farmers pay more attention to the size of their herd more than to the breed, which was caused the depletion of natural resources and contributed to desertification and low productivity as the case in Sudan and Algeria.
  - The milk sector is totally dependent on traditional producers and natural pastures. The drought conditions that have occurred in some countries such as Sudan has resulted in the deterioration of pasture and animal feed.
  - The lack of animal extension services compared to agricultural extension, especially in the field of processing and marketing in several Middle East and North Africa countries.
  - The lack of control over the activation and imposition of health conditions and standards of milk production and processing.
  - The increase of diseases associated with high temperatures has led to the deaths of many animals as in Sudan.
  - The absence of milk collection centers and sometimes the inappropriateness of such centers in some countries such as Sudan is a key determinant for milk production, processing and trade.
  - The lack of the necessary infrastructure such as roads, means of transportation, communications and refrigeration warehouses.
- The region has adopted certain policies that have had a positive impact on the milk sector development. These policies can be summarized

as follows (Othman A., 210), (Alqaisi O., 2009), (Abdel F., 2008):

- Attracting of foreign investment in the milk sector, as in the case of Egypt and elsewhere.
- Supporting of milk collection centers, this has helped in the marketing operations and the flow of milk to factories and consumers.
- Supporting of small producers by providing them with soft loans, as in Syria and other countries.
- Supporting the import of foreign breeds of high-yielding cows, as in the case of Syria.
- Supporting of animal production, especially in newly reclaimed land, as in the case of Egypt where the Government has paid great attention to the buffalo as the main milk-producing animal.

Milk production cost in the Middle East and North Africa is highly affected by feed prices and milk pricing should be associated with feed prices. The milk sector in the Middle East and North Africa should have clear strategies in milk pricing. Shifting part of milk farming to areas where at least part of the feed could be grown would be helpful to improve feeding systems which are currently used. In addition, establishing modern milk factories by the dairy breeders associations would succeed to find a new market for milk producers and reduce the monopoly dominated by big dairy factories.

Milk import tariff levels in the Middle East and North Africa vary greatly among countries. In addition to tariffs, countries implement regulations aimed at protecting milk consumers from fraud. Such regulations impose technical requirements related to product composition and associated customs procedures such as sanitary certifications. For instance, relatively high tariffs on milk powder tend to increase milk supply, while low tariffs on milk handicap local production. Reducing imports of powdered milk will greatly help farmers in marketing their milk. Subsidies are not the main incentive tool used to encourage milk supply in the Middle East and North Africa. Where subsidies exist, they support production or transportation, but their level is not always effective. The practice of integrated crop-milk production system might be essential at this time to improve the management of farms and reduce the feed cost. Finally, an improvement on feed rations and the use of high quality roughages and silage should be encouraged.

It is obvious that the most important factors affecting consumption of milk in the Middle East and North Africa is the population, per capita income, produced quantity and imported quantity. The milk industry of the Middle East and North Africa is growing and there is evidence that it will continue to grow in spite the lack of fodder and water resources. Maintaining the growth in milk production in the Middle East and North Africa can be accomplished by finding better production systems and alternative feeding programs which could reduce the cost of milk production.

CONCLUSION

Milk products are considered as the essential food commodities for humans. The aim of this paper is to analyze the factors which determine the supply and demand for milk in the Middle East and North Africa in order to point out the main problems and constraints obstructing the milk production, processing and trade in this region. The research also attempts to understand the drivers for the development in milk production in the Middle East and North Africa.

Total milk production in the Middle East and North Africa increased from about 12.57 million tons in 1990 to about 25.18 millions tons in 2008. On the other hand the milk consumption in the Middle East and North Africa increased from about 21 314 thousand tons in 1990 to about 35 929 thousand tons in 2008, approximately an increase of 68%. The most important factors affecting consumption is the population, per capita income and produced quantity where a 1% increase in all of them results in increasing the quantity consumed by 1.3%, 2.86% and 0.611%, respectively. On the other hand an increase in import price by 1% results in a 0.649% decrease in consumption. Parameters estimated using the reduced form of the imports function indicates that the Middle East and North Africa milk imports are significantly affected by import price and produced quantity where increasing each of them by 1% results in reducing the Middle East and North Africa milk import by 1.49% and 2.05%, respectively. On the other hand an increase in consumption by 1% resulted in an increase of imports by 0.372%. In the supply equation a 1% increase in the produced quantity resulted in increasing the quantity supplied by 0.761%, whereas a 1% increase in import price resulted in reducing the quantity supplied by 0.618% which complies with the assumption of economic theory. The milk industry of the Middle East and North Africa is growing and there is evidence that it will continue to grow in spite the lack of fodder and water resources. It is obvious that the Middle East and North Africa countries need to cooperate with each other. This cooperation will lead to an improvement in milk products production. Maintaining the growth in milk production in the Middle East and North Africa can be accomplished by finding better production systems and alternative feeding programs which could reduce the cost of milk production. These efforts are aimed to reduce the risks of food insecurity in the Middle East and North Africa.

SUMMARY

The development of the milk industry plays an important role in the economy of the Middle East and North Africa countries. The Middle East and North Africa have very little fertile agricultural land, which is rapidly degrading because of soil erosion and urban expansion. According to the growth rate, the milk industry is viewed as one of the most progressive food industries in the Middle East and North Africa. Demand for food in the Middle East and North Africa is supposed to grow substantially to the year 2025 and beyond, but production is not expected to keep pace.

The aim of this paper is to analyze the factors which determine the supply and demand for milk in the Middle East and North Africa in order to point out the main problems and constraints obstructing the milk production in this region. The research also attempts to understand the drivers for the development in milk production in the Middle East and North Africa.

The study adopted descriptive analysis to introduce the study problem. In addition it is applying some quantitative analysis methods, such as linear regression analysis. The least square method is used to identify the main factors affecting the studied variables. This method gives more accurate estimation for the overall impact of independent variables. The study depended on data published by various sources for the period (1990–2008). The process of data values are analyzed in current USD prices and volume data values are analyzed in metric tons. The final result of this paper is a model which explains the Middle East and North Africa milk market developments.

Estimated results indicate that the signs of the estimated parameters comply with the economic theory, and it shows that a 1% increase in the Middle East and North Africa population results in a statistically significant 1.30% increase in consumption, whilst a 1% increase in per capita income and production results in increasing consumption by 2.86% and 0.611%, respectively. Results also show that a 1% increase in import price resulted in reducing the quantity of milk consumption in the Middle East and North Africa by 0.649%. The calculated t value indicates that such estimates are statistically significant.

From the results, it is obvious that the Middle East and North Africa countries should cooperate with each other. This mutual cooperation will lead to an improvement in their milk products production. The Middle East and North Africa countries need to establish executive programs to promote milk farming to attain self-sufficiency in milk production. The countries in this region should attract foreign investment, support milk collection centers, support small producers with soft loans, support the import of foreign breeds of high-yielding cows and introduce the latest technology in processing, packaging, and distributing. These policies can help to reduce the risks of food insecurity in the Middle East and North Africa.

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Address

doc. Ing. Mansoor Maitah, Ph.D. et Ph.D., doc. Ing. Luboš Smutka, Ph.D., Katedra ekonomiky, Provozně ekonomická fakulta, Česká zemědělská univerzita v Praze, Kamýcká 129, Praha - 6 Suchdol, Česká republika, e-mail: maitah@pef.czu.cz, smutka@pef.czu.cz