

## **Investigation of production opportunities and resource use efficiency in agricultural production of Armenia**

Nune Khachatryan, Armen Khachatryan and Matthias von Oppen

Nune Khachatryan, Email: [nune@Uni-Hohenheim.de](mailto:nune@Uni-Hohenheim.de),  
Armen Khachatryan, Email: [armen@Uni-Hohenheim.de](mailto:armen@Uni-Hohenheim.de)  
Prof. Dr. Matthias Von Oppen, Email: [i490b@Uni-Hohenheim.de](mailto:i490b@Uni-Hohenheim.de),  
Inst. of agricultural economics and social sciences in the tropics and subtropics;  
University of Hohenheim (490), D-70599 Stuttgart

### **Abstract**

Even though transition of Armenia from command economy to free market relations resulted in elimination of many subsidies on agricultural inputs, markets are still lacking to provide competitive prices. Hence, actual prices cannot serve as true economic indicators of production efficiency. Research on real costs of agricultural production is needed to determine the comparative advantage in various production alternatives. Production efficiencies of six agricultural commodities have been tested in this research using domestic resource cost methodology. The results of analysis revealed existence of comparative advantage in production of tomato, potato and wine grapes and its absence in production of table grapes, wheat and barley in Armenia.

*Keywords: comparative advantage, domestic resource cost.*

### **1. Introduction**

#### *1.1. Problem Statement*

The transition of Armenian economy from command type to free market started in 1990. Under the command economy the agricultural inputs were highly subsidized and could not serve as objective indicators of production efficiency. Also in the environment of emerging free market relations, where markets are still in the process of transition, actual market prices are likely to reflect market failures and imperfections. In the absence of adequate research on real costs of production to determine the comparative advantage in production of different agricultural commodities and because of the lack of competitive market prices reflecting scarcities, farmers require help to orient themselves to predict private profitability of enterprises for producing commodities

which in the future, once the markets are functioning well, may have comparative advantage also at the country level.

### *1.2. Objectives and Hypothesis*

The main objective of the paper is to study and analyze the production and market efficiency for different agricultural commodities in Armenia. Specific objectives are:

- to study the formation process of market prices for agricultural inputs, and outputs and to estimate their economic values; to calculate profit-cost ratios of different production alternatives.
- to investigate the comparative advantage of different production opportunities in Armenia's agriculture.

Hypothesis: Armenia has comparative advantage in vegetable production.

### *1.3. Methodology and Analysis*

Based upon the theory of comparative advantage the methodology of domestic resource cost (DRC) analysis is applied to investigate the domestic potential of producing six crops: tomato, potato, table grapes, wine grapes, wheat and barley, based on primary and secondary data gathered in three regions of Armenia. DRC ratios and benefit-cost ratios for six crops are calculated. Sensitivity analysis is carried out.

### *1.4. Results and Conclusions*

The DRC ratios for tomato, potato and wine grapes lie between 0 and 1 and for table grapes, wheat and barley are more than one. Such results allow to conclude: there is a comparative advantage in production of tomato, potato and wine grapes and no comparative advantage in production of table grapes, wheat and barley in Armenia.

## **2. DRC as Methodology of measuring the Comparative advantage**

### *2.1. Conceptual Framework of DRC Analysis*

Under the conditions of non-competitive markets the profitability of agricultural production should not be calculated on the bases of actual prices of inputs and outputs; instead their social values should be estimated and used. This approach circumvents the effects of market

failures and policy distortions on prices and, therefore, can serve as a reasonable indicator of comparative advantage.

The DRC approach as a measure of assessing comparative advantage or social profitability was formulated and further developed by Krueger (1966) and Bruno (1967). An empirical approximation of the effects of policies on economic efficiency expressed as the difference between efficiency based upon actual market (private) performance and efficiency based upon social valuations was first done in a study on rice in West Africa by Pearson (1981). The closest forerunner to the complete Policy Analysis Matrix (PAM) approach is the method used by Ingram and Pearson (1981). The PAM approach allows for a systematic comparison of different types of DRC computations.

To estimate the comparative advantage of the commodities in question this research implements the method of DRC estimation described by Monke and Pearson (1989), as a ratio of opportunity costs of domestic factors of production per unit of value added in world prices. The social value of additional domestic output is thus the foreign exchange saved by reducing imports or earned by expanding exports. For outputs and inputs traded internationally the social valuations are given by world prices, and, for domestic factors, by their alternative uses.

The DRC is calculated using the formula, (MORRIS, 1990):

$$DRC = \frac{\sum W_p F_p}{P_c F_c - \sum P_i T_i} \quad (1)$$

where:

- $F_p$  = coefficients for domestic resources or intermediary inputs
- $T_i$  = coefficients for tradable inputs
- $F_c$  = quantity produced of output
- $W_p$  = shadow price (opportunity cost) for domestic resource or non tradable input
- $P_i$  = border price for tradable input
- $P_c$  = border price for tradable output

The calculation of DRC is done in the following steps 1) budget construction; 2) inputs and outputs classification; 3) social price calculations; 4) sensitivity analysis.

## 2.2. Interpretation of DRC Results

The DRC results conclude whether the production of a certain commodity has a comparative advantage for a certain country ,i.e. reveal the efficiency of the use of domestic resources to save one unit of foreign exchange. The interpretation of DRC results is presented in Table 1.

Table 1. Interpretation of DRC Ratios

DRC Ratios	Interpretation	Conclusion
DRC = 1	The economy neither gains nor saves foreign exchange through domestic production	Economy on balance
$0 < \text{DRC} < 1$	Value of domestic resources used in production is less than value of foreign exchange earned or saved	Comparative advantage
DRC > 1	Value of domestic resources used in production is greater than value of foreign exchange earned or saved	No comp. Advantage
DRC < 1	More foreign exchange is used in production of a commodity than the commodity is worth	No comp. advantage

Source: Author, based on Pearson 1989, Tsakok 1990, Morris 1990.

## 2.3. Required data

The data required for the DRC methodology come from primary and secondary sources. The primary data, obtained from interviews with farmers, included actual information on farm-level technical coefficients, such as quantities of agricultural production inputs and outputs, yield levels, prices paid and received by farmers, etc. Secondary data are obtained from annual reports of the Department of Statistics and State Register and the Ministry of Agriculture of Armenia.

## 3. DRC Calculations for Selected Products

### 3.1. Steps for calculating DRC

After selecting six production activities, the first step in the DRC analysis requires to assemble the **production budget**. The production costs of

one-year-production cycle are calculated for tomato, potato, wheat and barley; for permanent crops (wine and table grapes), the net present value of costs is derived.

In the next step, all inputs and outputs have been **classified** into tradable and non-tradable factors. The tradable factors are commodities or services which are imported or exported. Fertilizers, seeds and seedlings, pesticides, machinery and various containers, packaging materials and fuel are tradable inputs. Even though some of the tradable inputs are being produced within Armenia, they have to be considered as tradables. The tradable outputs are the six selected agricultural commodities. Factors which do not enter the international market, such as labor, land, capital and water are non-tradables or so called domestic factors. Several non-tradable inputs (hired machinery, transport requirements, etc.) consist of tradable and non-tradable components and are further disaggregated, so that ultimately all component costs are classified as tradable inputs or domestic factors. Machinery, maintenance spares, fuel and depreciation are considered as tradable inputs. Maintenance labor, rent for machinery and capital costs are non-tradable inputs.

Such a classification is necessary for **social value estimations** (also known in literature as shadow, efficiency, accounting, economic, opportunity cost prices or value of marginal physical product (Tsakok 1990)). Social prices are intended to reflect the true economic value of outputs and inputs in the absence of taxes, subsidies, tariffs and quotas, price control and other effects of government policies or market failures. The social prices are expressed in US Dollar using the official exchange rate. The social price for an agricultural commodity is a border price – the price at which foreign suppliers would deliver the commodity to the domestic market or the price that foreign consumers would pay domestic suppliers to deliver the commodity to their markets (Monke and Pearson 1989). In this report the Russian market is assumed as reference point, whereto Armenia does export most of its outputs and from where it imports fertilizers, fuel, bottles, boxes, labels and other tradable production inputs.

The appropriate **social values of tradable outputs** and inputs are given by world prices – c.i.f. import (c.i.f. Russia, adjusted for transportation and insurance cost to Armenia) prices for importable goods and services and f.o.b. prices (or c.i.f. Russia minus transportation and insurance cost from Armenia) for exportable goods.

The **social value of the non tradable** factors is found by estimating the net income forgone because the factor is not employed in its best alternative use.

**Labor** - The domestic factors are first grouped into mobile, which can move freely within different sectors of economy, and fixed categories. Labor and capital are mobile factors. There is a legislated minimum-wage regulation in Armenia, but the labor market ignores it and the market is completely unregulated. Despite the rather high rate of urban unemployment and some differences in wage levels between regions and sectors there are no interregional labor movements in Armenia, because of high costs of traveling and housing. The labor, therefore, is considered as fixed factor. Regional labor markets are competitive, and there is surplus of labor relative to available opportunities. The opportunity cost of labor is assumed to be reflected in the private wage.

**Capital** - The shadow price of capital (mechanization services, rental of farm implements, use of transportation) is estimated using the demand approach. There is a free, competitive market for capital use. The opportunity cost of mechanization services, for example, is approximated by the rental fee, which in fact indicates the marginal product of these services. This is what the farmers assess against marginal productivity and this determines their willingness to pay.

**Water** - The water is subsidized in Armenia. The shadow price of water is calculated using the actual purchase price and the subsidy rate.

**Land** - The best quality fertile agricultural land of Armenia is located in Ararat valley, where the only alternative to agricultural use is no use at all. There is no competitive market in renting or leasing land in Armenia yet and the rental value cannot be considered as economic value of land. Therefore, the opportunity cost of land is estimated as an approximation of the land value. The social profitability per ha (excluding land rent) are calculated for possible alternative uses of land and the social profitability

earned by the best alternative use (tomato, social profit = 273\$ ) is taken as the social value of land.

### 3.2. Sensitivity Analysis

The DRC framework lends itself readily to sensitivity analysis, and it is a convenient tool for revealing the changes in comparative advantage rankings, as individual parameters are changed. This is helpful also to assess effects of possible errors in evaluation of technical coefficients used in assembling the enterprise budgets or in estimating social values. Sensitivity analysis is carried out to examine the effects of the changes of parameters like yield levels, wages and land rates. The DRC ratios are calculated changing the values of the basic model parameters at 20% into both directions, to assess the impact of possible changes.

### 3.3. Interpretation of Results of Analysis

The results of calculations of DRC ratios for the six above mentioned crops are presented in Table 2.

Table 2. DRC Ratios (Base Run and Sensitivity Analysis Results)

Scenario	Parameter	D R C R A T I O S					
		Tomato	Potato	Wine Grapes	Table Grapes	Wheat	Barley
Base	100%	0.78	0.79	0.89	1.22	1.67	2.57
Yield	0.8*base	1.54	1.15	1.20	1.68	2.46	4.22
	1.2*base	0.54	0.61	0.71	0.97	1.27	1.85
Labor	0.8*base	0.74	0.76	0.84	1.15	1.66	2.57
	1.2*base	0.82	0.82	0.93	1.30	1.69	2.57
Land rent	actual rent	0.61	0.36	0.57	0.84	0.68	0.54
	no rent	0.59	0.34	0.56	0.83	0.64	0.45

The DRC ratios of 0.78 for tomato, 0.79 for potato and 0.89 for wine grapes prove that Armenia has a comparative advantage in producing these products. But there is no comparative advantage in producing table grapes (DRC ratio = 1.22), wheat (1.67) and barley (2.57). Their

DRC ratios are more than one, indicating that the value of domestic resources used in production is greater than the value of foreign exchange earned or saved.

The sensitivity analysis is facilitated by the DRC framework; it was conducted to test the robustness of DRC results under changing conditions. The DRC ratios have been calculated for all six products in various scenarios to find out how comparative advantage rankings vary in response to changes in individual parameters.

The results of analysis prove that yield fluctuations influence the DRC ratios dramatically. The DRC ratios in Table 2 show that a 20 % lower yield level makes the production of all six produces inefficient. Assuming the yield is 20% higher, the ratios are also influenced greatly; table grape production turns to be quite efficient with DRC ratio equal to 0.97, but wheat and barley remain inefficient.

Differing the costs of labor force is not influencing the results essentially and there are no tangible changes in production efficiency. A 20% change of labor force price in both directions influences the production efficiency by less than 3%.

The land factor is of crucial matter. The calculation results considering both private and social values of land rent show that the estimated social profitability of every kind of activity is almost two times lower (DRC ratios equal 0.78-2.57) than private (i.e. land evaluated with its actual rent) profitability (DRC ratios equal 0.36-0.84). Under such conditions all the six activities show high profitability. DRC ratios of 0.34 – 0.83 (no land rate) also claim to have comparative advantage for farmers. The input “land” is a decisive factor because of the imperfections of the land market of Armenia. The production of table grapes, wheat and barley, though privately profitable, does not utilize the domestic resources efficiently on the global (country) level, and these ratios would be misleading when accurate general-equilibrium effects are anticipated.

#### **4. Conclusions and Recommendations**

Based on the results of the DRC ratios for six agricultural commodities, calculated under different scenarios and reflecting plausibly the varying conditions we can conclude that the value of domestic resources used in



the production of tomato, potato and table grapes is less than the foreign exchange earned or saved and, therefore, there is a comparative advantage for producing these three commodities in Armenia. Efforts should be done to improve the productivity of tomato, potato and table grapes production and maintain it on more stable levels.

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