AUTOMATED VALUATION MODEL FOR LIVESTOCK APPRAISAL IN LOANING PRACTICE

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Abstract: Actualization of loan security (mortgage) value is of major importance in Hungarian loaning practice. Due to the recession in economics, the value of agricultural portfolio of banks has decreased a great deal, though not to such a great extent as other branches of the economy. Depreciation of estate stock is compensated with additional collateral security. Besides other stock, often temporarily and out of necessity, livestock is presented as additional collateral security. From the loaners' point of view, however, the registered inventory value does not guarantee security. The authors have set up an appraisal method giving professional guidance through automated valuation as to how dairy stock can be used as mortgage for loan security. Hereby we are to present the details of both the theory and the methodology of a model that is appropriate for the valuation of dairy livestock on an MS Excel basis. Thus, the process is fast and has more prospects for all parties in the loaning or leasing business. The method involves the features of livestock technology, the expected realized profit, and breed stock value. By the implementation of this method, the loaners can calculate the value of loan recovery (loan to value) with acceptable security.

Keywords: . automated valuation, livestock value, dairy economy, economic value, loan security

1. Introduction

The national valuation practice relies mainly on real estate assessment. The appliable methods are legally regulated. However, the chosen methods in the case of specific matters differ due to either the loaners or the appraisers. Automated valuation methods started to spread in the 1960s and 70s in the USA (*Márkus and Rábai*, 2005), mainly as a result of the mass marketing of residential properties. Although the method is up to the international standards (see *RICS*, 2013), it has not been applied in Hungary, except for some professional tests. One of the major problems in Hungarian loaning practice is that due to the depreciation of real estates, a significant lack of funds occurred, which is often compensated by additional loan recovery securities. However, in many cases, there are simply no chargeable real estates and thus other assets are involved.

If appropriately registered and identified, the livestock – registered in the category of fixed assets in the books may solve the above mentioned problems in the short run. However, the necessary methods are needed to be worked out. The aim of this paper is to summarise the methodological elements of the loan recovery valuation for livestock, which may be useful for financial institutions, creditors and farming organisations as well.

There are many applied methods in international practices (*Johns*, 2013; *Brown and Horne*, 1994; *Orr, Blawt and McCartney*, 2004), while in Hungary only methods calculating breed value are applied. Other method to set economic value serving as mortgage lending value (as credit security) is not known. The authors are presenting a professional method that is in harmony with all EU valuation principles and guidelines (see *Basel II. Agreement – Capital Requirements Directive, 2006/48/EC, in EVS 2012*) and may be applied to set the value of loan security.

The requirements of assessments made to set the value of loan security are registered in an integrated set of rules and regulations. The European Group of Valuer's Associations (*TEGoVA*) in Europe published *European Valuation Standards* (EVS) in 2003. Some other improved versions are EVS 2009 and 2012. Royal Institution of Chartered Surveyors (*RICS*) regularly publishes internationally accepted issues (Red Book 2012). These determine the professional and methodological basis of valuation. The Uniform Standards of Professional Appraisal Practice (*USPAP*, 2012) fixes the relevant rules and regulations in the USA. As for Hungarian practice, both EVS and RICS are generally accepted.

2. Methodological Basis of the Valuation Model

The livestock as tool of loan security (mortgage) needs to be regarded by the stock, for example its changes in quantity and quality should be followed and concerned at the time of the inspection and in the process of loaning. In order to do so, the most important factor is to register the identifying documents and the necessary inventories. After that, with the help

of the appropriate method, the appraisal of the circumstances conserving the condition of the livestock (farming, feeding, technology, reproduction) needs to be done. This is followed by the calculation of economic value, risk analysis and the calculation of the final mortgage value. Thus, automated appraisal is the logical system based calculation process connected with a special database. In the process of appraisal the different features affecting the final value (*CrV*) are included in modules.

The appraisal method consists of the following modules: database, technological appraisal module, economic appraisal module, final value calculation (loan to value and risk analysis) module.

2.1. Database Module

Database involves the following features:

- *Farm identification data:* name of farm, topographical lot number, address, herds registration number, production control identification number, farm registration number, livestock keeping station registration number, name, address, other data of operating company/entrepreneur, data of contact person and people in charge, management operation system, breeding organization membership.
- *Livestock registration data:* inventory (based on unique registration ENAR), certificate of origin of animal, list of assets, milking control data (AT Ltd), control documents of breeding process by offices (Central Agricultural Office – Directorate of Food Chain-security and Animal Health).

period, ratio of reproduction, calving interval, etc. *(noted: A-L and O, P)* and 3 dependent variables as: culling age (*M*), culling rate (*N*), production lifetime (*R*). Regarding reproduction, compared to other professional standards, the rate of correction is between –2 and 2% per analysed factor *(Table 2***)**. Referring guidelines are based on Csáki (2005). In the last line of the calculation all corrections with + and – signs are summarised – in our example *(Table 2)* is -14%.

- *Appraisal based on animal health indicators (AHI)*: in accordance with correctional value based on mortality rate and disease-free periods (brucellosis, leucosis, TBC etc.) In the last line of the calculation all corrections with + and – signs are summarised *(Table 3)*.
- *Appraisal based on breeding and housing technology (BHI)*: Based on farm inspection, the appraiser can apply +/- 1% of correction (conformance of buildings, equipment, keeping conditions, quality assurance, etc.) *(Table 4)*. In the last line of the calculation all corrections with + and – signs are summarised.

Table 1. The Reproduction Features of a Given Livestock

A	Calving interval	day	443
B	Average service period	day	147
C	Reproduction (prolificity) rate	%	79,60%
D	Average time of first insemination	day	94
E	The rate of pregnant cows after I. insem.	%	24%
F	Interv. between I and II insemination	day	48
G	Fertility index	insemin./cow	3,2
H	Parturition rate of heifers	%	20%
I	Average age of heifers at I. parturition	month	25
J	Average number of lactation	lact./cow	2,3
K	Daily average of lactation on farm	day	354
L	Reproduction indices, inside of herd	%	52%
M	**Average age of culling**	month	***53***
N	**Culling rate (cows)**	%	***43%***
O	Average production of cows	kg/lactation	7391
P	Rate of cow mortality	%	1%
R	**Production life (average per cow)**	month	**28**

Source: Own data and calculation

3. Results and Discussions

3.1. Valuation Module of Technological Elements

In this module (*see Appendix*) direct end indirect technological elements are appraised that affect the value of livestock or reflect the result of the applied method.

- *Reproduction features (RBI):* As it presented in *Table 1*, appraised by applying 15 independent variables from service

The main modules of the appraising model:

Table 2. **Appraising Module of Reproduction Features**

Reproduction indices	U.M.	GOOD		ACCEPTABLE		WEAK		Valued stock	Correction
Parturition interval	day	< 400	2%	420	0%	> 450	-2%	443	-2%
Duration of aver. service period	day	< 110	2%	120	0%	> 140	-2%	147	-2%
Prolificity rates	%	> 80%	2%	75%	0%	< 70%	-2%	79,6%	0%
Data of first insemination	day	< 70	2%	80	0%	> 90	-2%	94	-2%
Gestation rate per I insemination	%	> 50%	2%	40%	0%	> 30%	-2%	24,4%	-2%
Interv. between I and II insemination	day	< 40	2%	45	0%	> 55	-2%	48	0%
Fertilization rate	ins./cow	< 2	2%	2,5	0%	> 3	-2%	3,2	-2%
Parturition rate of heifers (by av.cow nu	%	< 35%	2%	30%	0%	> 25%	-2%	20,4%	-2%
Aver. age of heifers at parturition	month	< 24	2%	26	0%	> 28	-2%	25	0%
Aver. number of lactations	lact./cow	> 4	2%	3,00	0%	< 2,50	-2%	2,3	0%
Aver. of farm lactation	day	< 160	2%	180	0%	> 200	-2%	354	0%
Reprod. index, inside of stock	%	> 75%	2%	60%	0%	< 50%	-2%	51,7%	-2%
TOTAL CORRECTION OF REPRODUCTION BIOLOGY *(RBI)*									-14%

Source: Own data and calculation based on data from Csáki (2005)

– *Appraisal based on livestock administration and inventory (IAI)*: +/- 1% of correction is applied regarding the following features: breeding organization membership, monitorability of administration, management operation system, its modernity, livestock insurance, personal/ professional competencies *(Table 5)*. This part of the module is the most subjective. However, since the rate of correction is low (1%), the objective appraisal is not significantly affected.

The total correction index *(TCI)* means the summing up of the above mentioned corrections affecting the final market value, in our example on the basis of *Tables 2 to 5* that is:

$$RBI\% + AHI\% + BHI\% + IAI\% = TCI\%$$
$$-14\% + 3\% + 1\% + 4\% = \mathbf{-6\%}$$

3.2. The Module of Economic Valuation of the Breeding Stock

Concerning economic value, profitability and income generation capacity is of crucial importance, this module consists of more sub-modules, and each can be appreciated separately:

a) Sub-module: income generation capacity (yield value)

In this case, either national average or the given farm data can be applied. This module can be explained in two ways (in this case we used only national data):

i. Based on the annual lactation (*1iter/animal/year*) regarding the data of potential income generation of the main product issued by Agricultural Research Institute (*AKI, in: Béládi and Kertész*, 2011). In the module the potential income of the whole stock is calculated based on the subtraction of the average sale price and cost price (HUF/l) using the data of 3-5 years *(Table 6)*. The calculation formula for yield (income) value (YV_1) of the livestock is the following:

$$YV_1 = Q_{a\,lact} \times I_s \times L_a \times N_a$$

where:

$Q_{a\,lact}$ *– average milk production (l) /cow/ lactation period;*

I_s *– specific income (HUF/l);*

L_a *– average number of lactation in herd during production period / cow;*

N_a *– average number of cows;*

in our example for the whole livestock that is:

$$YV_1 = 7605 \times 8{,}89 \times 2{,}3 \times 690 = 107.344.000\ HUF$$

(rounded value)

Table 3. **Appraising Module of Animal Health Indicators**

Indicators	Good		Acceptable		Weak		*Correction*	
Cow mortality	< 1%	*2%*	2%	*0%*	> 3%	*-2%*	*1%*	*2%*
Free of Brucellosis		*1%*				*-1%*	*Y*	*1%*
Free of Leucosis		*1%*				*-1%*	*Y*	*1%*
Free of TBC		*1%*				*-1%*	*Y*	*1%*
Free of IBR		*1%*				*-1%*	*N*	*-1%*
Free of BVD		*1%*				*-1%*	*N*	*-1%*
Free of other disease		*1%*				*-1%*		
TOTAL CORRECTON OF ANIMAL HEALTH INDICATORS *(AHI)*								*3%*

Source: Own data and calculation

Table 4. **Appraising Module of Breeding and Housing Technology Indicators**

Indicators	GOOD	ACCEP-TABLE	WEAK	VALU-ATION	Cor-rection
Conformance of buildings	*1%*	*0%*	*-1%*	G	*1%*
Conformance of technical installation	*1%*	*0%*	*-1%*	G	*1%*
Hygenic conditions	*1%*	*0%*	*-1%*	A	*0%*
Conditions of animal health	*1%*	*0%*	*0%*	G	*1%*
Existence of HCCP	*1%*		*-1%*	P	*-1%*
Existence of quality guarantee system	*1%*		*-1%*	P	*-1%*
Other aspects	*1%*		*-1%*		
TOTAL CORRECTION OF BREEDING AND HOUSING TECHN. *(BHI)*					*1%*

Source: Own data and calculation

Table 5. **Appraising Module of Administration and Inventory Control Indicators**

Indicators	GOOD	ACCEPT ABLE	WEAK	VALU-ATION	Cor-rection
Membership of breeding assoc.	*1%*		*-1%*	G	*1%*
Controllability of inventory data	*1%*		*-1%*	G	*1%*
Farm management system	*1%*		*-1%*	G	*1%*
Unique identification system (ENAR)	*1%*		*-1%*	G	*1%*
Stock assurance	*1%*		*-1%*	P	*-1%*
Personal competencies	*1%*		*-1%*	G	*1%*
Other aspects					
TOTAL CORRECTION OF ADMINISTR. AND INVENTORY CONTROLL *(AII)*					*4%*

Source: Own data and calculation

Table 6. **Economic Valuation Module – Sub-module of Profitability 1.**

Specific income of dairy production by main product (milk)					AVERAGE
		2006	2007	2008	2006-2008
Milk price	HUF/l	63,85	70,13	83,66	***72,55***
Milk cost	HUF/l	56,21	63,47	71,27	***63,65***
Milk income	HUF/l	7,64	6,66	12,38	***8,89***

Source: Own calculation based on data from AKI (2011)

Table 7. **Economic Valuation Module – Sub-module of Profitability 2.**

Income of dairy production on the farm level					AVERAGE
		2006	2007	2008	2006-2008
Gross production	HUF/cow/year	567960	647394	741600	*652 318*
Production costs	HUF/cow/year	424838	503840	554855	*494 511*
Farm income	HUF/cow/year	143123	143554	186745	*157 807*

Source: Own calculation based on data from AKI (2011)

Table 8. **Economic Valuation Module – Sub-module Based on Inventory**

	*Gross**	*Depreciation**	*Net**	
Book value of cow stock*	**269 144 670**	82560618	186 584 052	HUF
Specific value (HUF/cow)	*390 065*	*119 653*	***270 412***	*HUF/cow*

The value of pregnant heifers	**111**	head*	**565 000**	HUF/head**	*62 715 000*	HUF

Note: * Farm data; ** data from breeding association

Table 9. Economic Valuation Module – Sub-module of Breeding and Slaughter Value

The structure of breed stock by production phase						
Stock on the beginning of prod.period	***230***	head	260 000	HUF/cow^{A}	*59 800 000*	HUF
Stock on the middle of prod.period	***230***	head	220 625	HUF/cow^{B}	*50 743 750*	HUF
Stock on the end of prod.period	***230***	head	181 250	HUF/cow^{C}	*41 687 500*	HUF
The total value of cow herd:	690	head			***152 231 250***	HUF

Note: ^{A} data from breeding association; ^{B} average of A and B; ^{C} market data from slaughterhouse

i.i. Also based on the data of test operation Farm Accountancy Data Network (*FADN*). Here the income of the whole farm is calculated, but other income sources (by-product, calf, culled cows) are also included in *Table 7)*.

The calculation formula for yield (income) value (YV_2) of the livestock in this case is:

$$YV_2 = I_f \times L_a \times N_a \qquad \textit{where:}$$

I_f – specific farm income (HUF/cow); L_a – average number of lactation in herd during production period / cow; N_a – average number of cows;

accordingly:

$$YV_2 = 157.807 \times 2{,}3 \times 690 = 250.440.000 \text{ HUF}$$
(rounded value)

It is very important to note that in the case of Holstein stock, due to the short production period (2-3 years), calculation of discounted value and deflation with consumer price index is not necessary. The value calculated from the farm income is close to the actual (cumulated, not calculated with capitalization) credit security (assessed) value (i.e. the rate of net income of the farm within a production period), but ignores market value and breeding value, so we advise its use only for control scope or concerning it with lower weight ratio in the final market value (as in the present case).

b) Sub-module: based on accountancy (book) value appraisal

We can get to know the gross purchase price, recorded depreciation and the actual net value of each animal. The module recognizes the average individual value as well *(Table 8).*

BV_{net}cow = Gross (purchase) value – Depreciation

In example the average of specific value for a cow (farm data) is*:*

390.065 HUF/cow – 119.653 HUF/cow = 270.412 HUF/cow

and for the whole herd:

$$BV_{net} = 270.412 \text{ HUF/cow} \times 690 \text{ cows} = 186.584.000 \text{ HUF}$$
(rounded)

Within a given period, based on inventory data and registered depreciation, the value in the books reflects the actual (net) value of the livestock (BV_{net}). However, note that when taking only the inventory into consideration to set the collateral value (*CrV*), the sum must be corrected by the technological correction index.

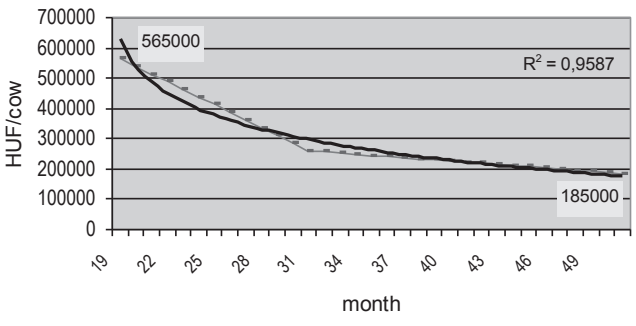
Thus the value of heifers can be calculate as the number of them multiplied with the value reported by Breeding Association *(detailed in Table 8):*

$$CrV = BV_{net} \times (100\% - TCI\%)$$

c) Sub-module: based on breeding value

The breeding organization (in this case Hungarian Holstein Association*) has data on the actual market value of breeding stock replacement and cows in the first year lactation. Both can be set in the database. Value of the breeding heifer stock

Figure 1. The change of breed value of an animal during the production lifetime



Source: own calculation, based on farm data

depends on lactation (higher lactation potential means higher value). In this method breeding value is somewhat similar to 'replacement cost' in the case of real estates *(Table 9)*.
According to the data of the organization, individual (specific) value decreases sharply by the end of the first lactation. However, in the following period (*illustrated in Figure 1*) the rate of decline is slower. By the end of the breeding period, individual value equals with the slaughter value.

The *Figure 1* also shows that even in the case of high breeding value, by the end of an average production period, the rate of depreciation may be as high as 70%. Thus, breeding value is admissible only in the early phase of the breeding period; otherwise, other factors should be taken into consideration, such as the registered value in the inventory.

Depreciation of specific breeding value (per head) can be represented graphically with trend function (R2 = 0,9587), which equation in our case is:

$$y = -130209Ln(x) + 631815$$

Breeding value of the whole stock can be calculated from the per head breeding value. Specific (per head) breeding value is the average of the monthly value during the period from calving (cca. 25 months) to disposal (52 months in present case).

$$\overline{SB_rV} = \frac{\sum_{i=1}^{n} sb_r v_i}{n}$$

where:

sb_rv_i – specific monthly breeding value, n – month's spent in the production period

Breeding value of the whole stock can be calculated from the average specific breeding value and the average stock size. I.e., based on the data of the presented farm:

$$\overline{SB_rV} \times N = 248.125\,HUF/cow \times 690\,cows = 171.206.000\,HUF$$

d) Sub-module: appraisal based on slaughter- and breeding value

Value of the stock at the time of culling is the same as the slaughter value calculated as the multiplication of individual weight and market purchase price. Since culling and replacement are necessary in continuous production, three categories are determined in livestock structure. In this module in the case of stagnant population 1/3 of the stock is at the beginning, 1/3 is at the medium stage and 1/3 is at the final stage of production. In the module, the value of the first category is the highest (marked as "cow in first lactation") the third category is at slaughter value, while the second is at the average value of the other two. The total value of the whole stock can be calculated by adding up the value of all the three categories.

Including both breeding and slaughter value in the first phase of production is necessary because in the case of these cows, production potency is higher, and it is crucial from the economic view. In the case of cows in the productive period, breeding value is the average of the two opposite categories, while during the disposal period, breeding value is irrelevant, only slaughter value is taken into consideration. This method gives way to represent a market view as well *(Table 9)*.

3.3. Module of Calculating Market Value

When calculating the market value, the *aim of the appraisal* or the expectations of the Client can be of crucial importance. Based on some foreign examples, it can be investment value, leasing and credit recovery value or other economic aims. In this module, either of them can be regarded by weighing the appropriate value. However, when the aim of appraisal is credit security, all sub-modules *a2, b, c* and *d* are recommended to use with adequate weights, except for *a1* which is recommended only for monitoring. In our example the market value of cow stock in production can set up by the following mode:

VALUE CATEGORIES	thousand HUF	**WEIGHT**
Yield (income based) value 2.	250 440	10%
Book value	186 584	20%
Breed value	171 206	30%
Slaughter- and breed value	152 231	40%
Weighted average (economic) value of the whole herd	**174 615**	100%

So as to set the final market value, it is necessary to add the value of heifer stock (bred within farm, for cow replacement) at market price or book value (*see Table 8.*), usually there is minor difference between the two. The sum of the two figures gives the value of the whole stock that now can be concerned as market value, and must be corrected with the module based on technological elements (*see part 2.2.2.*), and the result of this can give the final market value.

Value of the cow herd (see above)	174 615	th HUF
The (market) value of heifers (see part 2.2.3.)	62 715	th HUF
Total breed stock value with heifers	237 330	th HUF
Correction indices (see part 2.2.2.)	–6%	
The value of correction	–14 240	th HUF
Final market value of the whole livestock (MV_l)	**223 090**	th HUF

3.4. The Module of Risk Analysis and Credit Recovery (mortgage) Valuation:

The primary focus of this section is the risk of forced sale, which can be determined on the basis of earlier experience, list of professional publications, or appraisal. During risk analysis we have the chance to examine different scenarios, based on the guidelines of short-term sale, i.e. optimistic, pessimistic and realistic versions. In the case of real estates we usually calculate with 50-70% of the market price as allows fast selling during a short period of time. Without further research, we assume 35% as a realistic rate (r_R » 35%) and assumes actual sale within 1-3 months.

Based on the above mentioned calculation, assuming that we have the required data and the database is professionally acceptable, the mortgage (credit recovery or collateral) value (CrV) of a stock of 690 cows, according to the model is:

$$\boldsymbol{CrV = MV_l \times (100\% - r_R) =}$$

$$\boldsymbol{223.090 \times (100\% - 35\%) = 145.000\ thousand\ HUF}$$

(rounded value)

4. Conclusion, Proposal:

The above mentioned model can be applied in the case of a great number of appraisals. The basis of the model is Excel, which can give way to automated valuation, in case of having the required database.

The results may be most useful for loaning institutes, however, it may be profitable on the producers' side as well. For the loaners, it may be useful to introduce new financial patterns, as seen abroad.

Another important and basic condition of the assessment is that the appraisers should be professionally prepared to follow the given guidelines and monitor and check the acceptability of the given documents.

The third condition is that there should be continuous and balanced communication between loaners, producers and appraisers.

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References

Béládi K., Kertész R. (2011). A főbb mezőgazdasági ágazatok költség- és jövedelemhelyzete 2010. Agrárgazdasági Információk. AKI. Budapest. 1–141 p.

Brown P.W., Horne D. (1994). Two-Generation Dairy Cow Leasing. Iowa State University – University Extension. Ames. 1–7 p.

Csáki T. (2005). Tejtermelő állományok szaporodásbiológiai gondozása a gyakorlatban. VIII. Állatorvosi és II. MÁOK-HUNGAROVET Nemzetközi Állatorvosi Konferencia és Kongresszus – Budapest.

The European Group of Valuers' Associations © TEGoVA (2012): European Valuation Standards 2012, seventh edition. Part A.2 Valuation of Property for Financial Institutions. 130 p.

GVH (Gazdasági Versenyhivatal) (2005). Jelentés – A jelzáloghitelezés tárgyában folytatott ágazati vizsgálatról. Budapest. http://www.gvh.hu/domain2/files/modules/module25/pdf/print_4132_h.pdf

Johns B.L. (2013). Dairy Cow Leasing. University of Wisconsin – Extension Farm Management. Madison.

Márkus L., Rábai Gy. (2005). Vagyonértékelési módszerek és gyakorlatuk, in Sóós J. 2005. Ingatlangazdaságtan, KJK–KERSZÖV Jogi és Üzleti Kiadó Kft., Budapest

Orr. G.,Blawt P., McCartney I. (2004). Cow-Calf lease agreements. Fact Sheet. Saskatchewan Ministry of Agriculture. 1–11 p.

RICS (Royal Institution of Chartered Surveyors) (2012). Valuation – Professional Standards. Westwood Businnes Park. Coventry. 1–466 p.

RICS (2013). – Automated Valuation Models – Draft information paper. https://consultations.rics.org/consult.ti/_avm/viewCompoundDoc?docid=3764852&sessionid=&voteid=