Alexander Apostolides, LSE Cliometrics Group, 25 January 2008

The Good the Bad and the Ugly: Lessons learnt in estimating the value added of Cyprus's primary sector and results

Introduction

A greater emphasis in mathematical and statistical rigour is now expected in economics and economic history. Ad-Hoc procedures and guestimates are unpopular and considered unreliable. Yet a substantial amount of research relies on historical national accounts (HNAs) that would not satisfy criteria of robustness that the overall research itself entails. One could argue in order to have in order to have reliable results in one's research, the underlying dataset needs to be reliable.

Currently there is substantial harmonisation of national accounts creation within an UN framework (System of National Accounts or SNA), and an EU (European System of Accounts or ESA) framework. Both the SNA and the ESA attempt to instil a procedural consistency and methodological rigidity in calculating national accounts of a country. As national accounts data are increasingly being compared across time and space it is considered necessary to limit ad-hoc procedures within individual countries by providing a framework of what and how something should be measured. However even within such methodological frameworks there is great diversity in estimating the building blocks of the final series: the European commission and national statistical offices constantly create new directives and publications to make the process of calculating national accounts as transparent and as harmonised as possible.

This is not the case in historical national accounting. This is partly due to the difficulty of estimating output with historical sources; data might not be reliable, consistent of might not even exist. Thus each HNA essentially differs due to the different primary data available. However some differences arise from trying to estimate HNAs without a unified framework for researchers to base their estimates[1]. Although greater variation of procedures is to be expected due the varied quality and quantity of sources available for different countries, the lack of a unitary framework creates more incompatible procedures than they are possibly necessary. This has a negative impact in both the reliability of the estimate in question and its comparability with other estimates and with the present.

To be fair to researchers there comes a point when improving methodology and consistency comes at the expense of content. The estimation of current national accounts is one of the *raison d'être* of statistical offices; for researchers in HNA's their estimations are just a means to the end evaluating economic growth. This article argues that researchers should be forthright about ad-hoc procedures problems and weaknesses of the data, since historical

[1]Jan-Pieter Smits, "Measuring the 'Wealth and Poverty of Nations': Methodological Problems and Possible Solutions" *IEHC Helsinki, Session 103: New Experiences with Historical National Accounts,* (May 2006); Most researchers base their historical national accounts on a version of SNA or ESA; however basing one's research in a framework that seeks to better encapsulate the modern economy can create problems. In my experience basing my categorisation of products in the new Eurostat nomenclature (NACE rev.2) led to problems due to the complete elimination of ancillary activities to agriculture from the agricultural sector, necessitating in the creation of an additional category in the nomenclature.

national accounting can still provide relatively accurate assessments on broad issues of economic development. Creating HNAs is useful tool in evaluating economic history, as long as their limitations in relation to modern national accounts are understood.

The paper is in two parts: In part one the ad-hoc nature of estimations of the value added of the primary sector in Cyprus and Malta are made explicit (the Good, the Bad and the Ugly); however it is argued that despite such procedures and guestimates the results are reliable. In Part two the primary sector results are presented. Please feel free to provide suggestions on how to better capitalise the constructed results.

Part One: The Good the Bad and the Ugly

This paper will present the gross output and value added of Cyprus and Malta in the Agriculture, Forestry and Fishing sector and the Mining sector. Such an exercise is fraught with difficulty. The dataset was fragmented and unreliable. As a result methodologies were employed that would not be acceptable in current national accounting. Here such methods are made explicit as the good, the bad and the ugly.

The sectoral estimate of Agriculture, Forestry of Fishing of Cyprus is based on 85 products categorised in 19 Nace (4-digit) classes. The large number of crop and animal production series is due to the fact that Cypriot agriculture was very diverse; it was considered that unless the attempt to estimate gross output was as extensive as possible it would fail to capture the true outlook of the sector[2]. Malta's agricultural and fishing sector consisted of 42 products in 14 classes. Cypriot Mining and Quarrying constituted 18 products in 5 classes; in Malta's Quarrying constituted five products in 3 classes.

Gross output was calculated in 1938 producer prices; work is currently undertaken to produce and estimate also in current prices. In the case of Malta estimating agriculture was relatively straight forward as the estimates of gross output most products were given in volume and value terms and in producer prices[3]. In the case of Cyprus primary sources on producer prices were rare with the exception of producer prices reported in 1938 in the "Cyprus Agricultural Journal" and in Surridge's rural survey in 1930. What prices were not covered by the James and Koumides were estimated indirectly using an approximation used in Cypriot post-Second World War national accounting[4]. Based on a 1967 report that re-estimated the GDP of Cyprus from 1950 to 1967, the producer prices that were not known were assumed to be 0.75% of export (f.o.b) prices[5].

[2] D. A. Percival, Cyprus, Census of Population and Agriculture 1946: Report and Tables (Nicosia, GPO, 1947), p.56

[3] Source: Malta, *Annual Report of the Office of Agriculture*, 1921 – 1922 to 1937 – 1938; The reports introduce a timing issue as they were completed 6 to 2 months before the end of the calendar year.

[4] H. M. James, and C. Koumides, "An Analysis of Farming Costs in Cyprus", *The Cyprus Agricultural Journal* Vol. XXXIV (1939), Part. 2 and Part.3; Brewster Joseph Surridge, *A Survey of Rural Life in Cyprus*, (Nicosia: GPO, 1930)

[5] Source: National Archives, Cyprus Files V52 / V 53

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Below is a sample of the methodology used to estimate production divided in three categories: the good the bad and the ugly practises that were used to create the estimates.

The good practices: Some examples

This section describes the calculation of gross output in constant prices was relatively straightforward. The yearly volume of production was provided by the blue books of Cyprus or Malta and confirmed with the annual reports of the office / department of agriculture; the prices of the products were provided in the annual reports of the department or office of Agriculture. Care was necessary to establish that the 1938 price and 1921 -1938 referred to the same statistical unit. Table 1 provides the example of wheat output in Cyprus. Likewise the production of mining and quarrying products was provided in the Statistical Blue books for the colonies. The price of exported mining products in Cyprus contains elements of transport, and of the insurance sector; however it was neither possible nor desirable to differentiate due to the limited data available.

Table 1	Calculating Wheat Gross Output: Cyprus								
	1921	1922	1923	1924	1925	1926…	…1936	1937	1938
Volume of Wheat in Kiles	2380090	2495900	2567654	1820406	2071461	1623909	1782618	2139687	1951528
Price of Wheat per Kile in 1938	0.1369	0.1369	0.1369	0.1369	0.1369	0.1369	0.1369	0.1369	0.1369
Gross Output in 1938 prices	£325,851	£341,706	£351,529	£249,226	£283,597	£222,324	£244,053	£292,938	£267,178

If the volume of production was not available for some of the years in the period estimated using information available that year for other products. For example the known yearly data for cowpeas had a correlation of 0.828 in relation to the complete sesame production series. The average ratio of sesame to cowpeas (in volume) for the known period (1925 – 1938) was used to extrapolate the production of cowpeas for 1921 – 1924 based on the production of sesame in 1921 – 1924 and the average ratio to sesame seeds for 1925 – 1938. Despite using the average ratio of the period 1925 - 1938 to evaluate cowpeas it is still considered good practice since the relationship between cowpeas and sesame seems robust and relatively stable over 13 years; the estimate will capture the vagaries of the climate as affecting sesame.

Table 2	Calculating Cow Peas Output: Cyprus						
Correlation coefficient 1924 - 1938	0.828937		1921	1922	1923…	…1937	1938
Average Production Differential: Cow peas to Sesame 1924 - 1928	1.465766	Volume of Cow Peas in okes				279480	285487
		Volume of Sesame in Okes	270572	130522	234095	301638	215348
		Volume of Cow Peas in okes	396595	191315	343129		
		Price of Cow Peas per Oke in 1938	0.0116	0.0116	0.0116	0.0116	0.0116
		Gross Output in 1938 prices	4596	2217	3976	3239	3308

If no significant correlation relation was discerned with a product for which the complete information was known, the missing yearly output for the missing years was estimates to be constant at the 5 year average level. For example flax output in Cyprus 1921 – 1923 was assumed to equal the 5 year average for which the information is available 1924 – 1927. For some products such as sumach and cumin for which no more information was available only the exports of such products were enumerated. However the value of such products was not very significant if one assumes that the total production of cumin and sumach was three times the exported output they would constitute only 2% of the Gross output as estimated.

The bad practices necessary: The estimation of Citrus Output in Cyprus

In some cases direct information on production was not always available, or the information available was contradictory and unreliable. In such cases extensive research on published mining or agricultural sources that were published by the government (annual reports of departments / offices, ad-hoc reports by expert on issues of rural poverty, irrigation and marketing) were consulted in order to construct a model to replicate the unknown direct estimates. It was not always possible to use period sources; missing information was supplemented by information for the 1940s.

An example of this is citrus production in Cyprus. Citrus production in Cyprus was the key to the post-Second World War dynamic growth of the agricultural sector. This it was important to have an estimate of citrus production to evaluate if the sector was as dynamic in the period 1921 -1938. No estimated of citrus production was included in any of the Blue Books of 1921 – 1938. Limited estimates of citrus production for 1927 and 1928 were provided in the annual reports of the agricultural department. It was decided to estimate citrus production based on irrigation since citrus plants outside irrigated areas do not produce fruit. In their totality the statistical blue book and the agricultural census of 1946 provide enough information to estimate yields per acre and per tree for oranges, valencia oranges, bitter oranges, lemons, sweet lemons and grapefruit. By estimating the yield of citrus trees per acre it was clear that all citrus plantations in 1946 were situated perennially irrigated areas[6].

[6] The estimation of output and number of trees are slightly different between the Blue Book and the 1946 Census (0.7%). The Blue Book results are based on a survey of an area under cultivation while the Census results are

An assumption was made that during the period 1921 – 1946 the product mix of the permanently irrigated area was constant as presented in the 1946 census. Thus it was assumed the same proportion (17%) of the irrigated area was producing citrus products in 1931 as in 1946. Further assumptions are necessary; it is assumed that the number of trees per acre and the fruit yields per tree in 1946 were representative of the yields of 1921 – 1946 in order for an estimate to be possible[7]. The perennially irrigated area in 1931 was 68749 donums; the assumed area under citrus cultivation (17%) is estimated at 11687 donums. Assuming that there were 194 trees per acre (as in 1946 census), the total number of citrus trees in 1931 is estimated at 749422. The estimated trees for 1931 trees can be separated into their type of citrus by using their 1946 weights of trees, and thus estimate volume and value of citrus production in 1931 as shown below. The growth of trees from 1931 to 1946 is annualized at 3.35% per annum, and assumed to represent the growth of citrus trees for the whole 1921 – 1938 period and annual estimated of production are created. Thus prior to 1921 volume of citrus fruit is declining by 3.35% and after 1931 the volume of citrus fruit is increasing by 3.35%

Table 3

Type of Citrus Tree	1931	1946	Citrus Production 1946	Yield of Citrus products in 1946 (no. per tree)	Estimated Production in 1931	Price of Citrus 1938 (£ per fruit)	Value of Citrus Production (constant 1938 prices)
Oranges	544209	892677	87945000	99	53614533	0.001121103	60107
Valencia Oranges	20155	33061	2258000	68	1376546	0.001121103	1543
Grapefruit	36327	59588	6116000	103	3728535	0.002776392	10352
Bitter Oranges	20634	33847	2045000	60	1246684	0.001121103	1398
Mandarins	23675	38835	2045000	53	1246694	0.000645761	805
Sour Lemons	100149	164277	34400000	209	20971442.14	0.000747652	15679
Sweet Limes	4273	7008	637000	91	388399	0.000747652	290
Total	**749422**	**1229293**	**135446000**	**683**	**82572834**	**0.008281**	**90175**

Such a method creates almost as many problems as it solves; it is very problematic and based on assumption rather than evidence, despite the estimates having as a basis actual Cypriot data from 1931 and 1946. Compared to the estimates on 1926 and 1927 within the 1928 annual report of agriculture my estimates are significantly inflated: even by removing the products not enumerated in 1927, the estimate is over inflated by 26.8%.. Some evidence

based on questionnaires given to agricultural producers. Source: Percival, D. A. *Census of Population and Agriculture 1946* (Nicosia: GPO, 1947?) and Cyprus *Blue Book for the year 1946* (Nicosia: GPO, 1947)

[7] Hart-Davis, C. H., *Report and General Abstracts of the Census of 1931* (Nicosia: F. S. Passingham, 1932) and Percival, D. A. *Census of Population and Agriculture 1946* (Nicosia: GPO, 1947?)

seems to indicate that the number of citrus trees estimated is plausible: a report of 1946 states that the number of all fruit trees (excluding olives and carobs) in 1931 was 1493300, while the estimate for 1931 estimated that just the orange trees were 749422 (50.1%). This enforces the view that the estimate of trees could be plausible since citrus was by far the most populous fruit tree in Cyprus.

The estimate is unsatisfactory but the best possible considering the lack of primary data. There are a number of reasons serious problems: irrigation might not have grown at a smooth annual rate; the share of citrus trees in the perennially irrigated area could have been less in 1931 than in 1946; the number of trees per acre might have been less prior to 1946; the yield per tree reported in 1946 could have been unrepresentative for 1921 – 1938; the product mix of citrus trees might have been very different in 1921; the majority of citrus expansion could have occurred in the period 1939 – 1946 thus overestimating the yearly growth of citrus production for the period 1921 - 1946.

The estimates for citrus production also impose a linear relation that is simply not representative. Further research is necessary especially in irrigation and the yearly yields of citrus trees[8]. Pitcairn in the Cyprus agricultural journal in 1936 estimated the irrigated area under citrus in 1935 as 11700, just 13 donums higher than the 1931 census estimate, possibly indicating a much slower growth of acreage under irrigation before 1935[9]. However it is possible that Pitcairn was quoting the 1931 census results of citrus products that were not published in 1931. This would reinforce the suitability of the citrus production estimate as estimated above as the estimated acres under citrus orchards is close to the 1931 reported acreage.

Most worryingly is that the estimate follows a yearly annual growth which is unrepresentative of the extremely variable situation of Cypriot agriculture at the time; the estimate fails to capture the real yearly growth trend. This would be particularly problematic for researchers who would use the results to judge business cycles: part of the agricultural statistics are based on constant growth models and would not be suitable for pinpointing ups and down for the economy.

The Ugly: Animal Production in Cyprus; Milk Production in Malta

The data sources used for the estimation of animal products are all circumstantial; except for the yearly enumeration of animals, there were no slaughterhouse statistics that were representative of the island as a whole. Cyprus data on animals slaughtered were limited for a short span of years to some urban areas of this very rural island. It was decided to construct a model of meat production, and relegate the limited evidence of actual slaughtering as a check for plausibility.

[8] Published sources on irrigation are not helpful in providing additional estimates on irrigation and the product mix of irrigated lands: Ellis, W. M., *Report on Improving irrigation works in Cyprus* (Nicosia: GPO, 1922); Raeburn, C. *water Supply in Cyprus: A general report (2nd ed.)* (Nicosia: GPO, 1945)
[9] Pitcairn, A., "Irrigation of Cyprus" *Cyprus Agricultural Journal*, p.43

Thus model was based on agricultural studies published during the period as well as detailed agricultural analysis presented in the quarterly journal of the department of Agriculture[10]. Where more information was needed post-Second World War sources were consulted and revised downwards in order to attempt to simulate the pre-War conditions. The model constructed for Cyprus meat production enabled the estimation for skin, milk and wool and was subsequently used to estimate milk and wool production of Malta.

Sheep and Goat products were based on the yearly enumeration of livestock, which enumerated every animal over one year old. The annual rate of change of animals was combined with the net exports of sheep and goats to estimate the yearly increase / decrease of the stock. Using evidence from historical and contemporary sources on the aggregate ratio of males to females in the population was estimated and a reproduction transformation coefficient was assigned to the females of the previous year (y_{t-1}), thus estimating the total number of young Lambs / Kids born in year t. Both the ratio of males to females and the reproduction coefficient were assumed to be constant.

The reproduction coefficient was based on sources on animal births, animal infant mortality and miscarriages[11]. The aggregate flock of animals was assigned a constant death / culling ratio. By adding the number of animals that died to the difference between the animals in year t in relation to year t-1 and the net exports of animals of the species, the number of Lambs / Kids maintained to make up the flock in year t was estimated. It was assumed that the remaining births were fed only until they reached a certain weight and where killed for their meat and skin before the next enumeration of livestock took place. Constant volume transformation coefficients were assigned to slaughtered adults and young to estimate the production of sheep and goat meat and skin. Milk production was estimated based on a constant transformation coefficient based on the female animals over 1 years old.

This method of estimation can only provide very rough approximation of meat, skin and milk output. A serious weakness of the model is that it assumes that births, deaths and the ratio of females of the flock are constant over the time period. This leads to an overestimation of animal products during a periods of draught / scarcity of fodder, while it underestimates production as animal hygiene and vaccination became widespread. The constant transformation coefficients for milk, meat and skin do not take into account the wastage of the animals during periods of drought; thus some of the animals slaughtered / milked during the drought period of 1931 – 1932 would have been emaciated and thus produced less meat and milk[12]. The estimates for animal production for Cyprus (and milk production for Malta) essentially vary with the amount of livestock enumerated, and not due to demand for animal

[10] The Cyprus Agricultural Journal (which was also known before 1918 as the Cyprus Journal) was published quarterly by the department of agriculture, and contains useful information on Cyprus agriculture

[11] The author is using contemporary sources from the period 1938 – 1921 on reproduction of sheep and goats and reduced downwards using modern resources on miscarriages, failed births and infant mortality, augmented upwards to take into account the reduced health and hygiene during the 1938 – 1921 period: Maule, J P, "The Breeding and Management of Sheep in Cyprus", *The Cyprus Agricultural Journal*, December, Part 4, Vol. XXX (1935) p.88; "The Milk Yield of the Maltese and Native Goats", *The Cyprus Agricultural Journal*, December, Part 4, Vol. XXXIII (1938); Constantinou, A, *Ruminant Livestock Genetic Resources in Cyprus*, (unpublished, 1981)

[12] "Introduction", *The Cyprus Agricultural Journal*, volume XXVII, Part.1 (1932); "Introduction", *The Cyprus Agricultural Journal*, volume XXVII, Part.2 (1932);

products, weather, animal husbandry, nutrition, animal hygiene or change of tastes of the consumer.

Table 4: Model for Estimating Meat, Skin, Wool and Milk Production of Sheep and Goats

No	Explanation	Notation	Source
(1)	Number of animals Y_t	(1) = Y_t	Blue Book Y_t
(2)	Number of animals Y_{t-1}	(2) = $Y_{(t-1)}$	Blue Book Y_{t-1}
(3)	Gross increase / decrease	(3) = $Y_t - Y_{(t-1)}$	(3) = (1) – (2)
(4)	Ratio of males to flock	(4) = R_m	Cyprus Agricultural Census (1977); Bevan (1918); Kostellenos *et al* (2007)
(5)	Number of Males Y_{t-1}	(5) = $Y_{(t-1)}$*R_m	(5) = (2) * (4)
(6)	Number of Females Y_{t-1}	(6) = $Y_{(t-1)}$*(1 – R_m)	(6) = (2) * (1 – (4)
(7)	Reproduction Transformation Coefficient	(7) = B	Maule Sheuki, Cyprus Agricultural Journal (1935); J P Maule, Cyprus Agricultural Journal (1938) Constantinou (1981)
(8)	Total Lamb / Kids born	(8) = B * ($Y_{(t-1)}$*(1 –R_m)	(8) = (7) * (6)
(9)	Survivors from Natural Deaths / Disease / Culling of Y_{t-1} population	(9) = S	Maule Sheuki, Cyprus Agricultural Journal (1935); Moylan Gambles, Cyprus Agricultural Journal (1936)
(10)	Number of Lost Animals during Yt	(10) = $Y_{(t-1)}$*S	(10) = (2) * (8)
(11)	Net exports Y_t	(11) = X_t	Cyprus Blue Book 1938
(12)	Number of Lambs / Kids to make the Y_t population and Net Exports X_t	(12) = ($Y_t - Y_{(t-1)}$) + ($Y_{(t-1)}$*S) + X_t	(12) = (3) + (9) + (11)
(13)	Number of Lambs / Kids for born to be used for meat / skin	(13) = [B * [$Y_{(t-1)}$*(1 –R_m)]] – [($Y_t - Y_{(t-1)}$) + ($Y_{(t-1)}$*S) + X_t]	(13) = (8) – (12)
(14)	Number of Adult Animals culled for meat	(14) = ($Y_{(t-1)}$*S)/2	Maule Sheuki, Cyprus Agricultural Journal (1935)
(15)	Net number of animals killed for meat and skin	(15) = [[B * [$Y_{(t-1)}$*(1 –R_m)]] – [($Y_t - Y_{(t-1)}$) + ($Y_{(t-1)}$*S) + X_t]] + [($Y_{(t-1)}$*S)/2]	(15) = (13) + (14)
(16)	Adult Meat per Carcass in kg	(16) = M_a	Γεώργιος Κωστελένος, *et al*, (2007); pp.50 - 51 (1914 - 1940)
(17)	Lamb / Kid Meat per Carcass in kg	(17) = M_y	Γεώργιος Κωστελένος, *et al*, (2007); pp.50 - 51 (1914 - 1940)
(18)	**Total meat produced in kg**	**(18) = [**[B * [$Y_{(t-1)}$*(1 –R_m)]] – [($Y_t - Y_{(t-1)}$) + ($Y_{(t-1)}$*S) + X_t]* M_y] + [[($Y_{(t-1)}$*S)/2]* M_a]	**(18) = [[(13) * (17)] + [(14) * (16)]**
(19)	Av. Wool per surviving adult male (Kg.)	(19) = W_m	Maule Sheuki, Cyprus Agricultural Journal (1935); Cypriot Goats are of a short hair variety - adjusted downwards based on Greek data
(20)	Av. Wool per Surviving adult female (Kg.)	(20) = W_f	Maule Sheuki, Cyprus Agricultural Journal (1935); Cypriot Goats are of a short hair variety - adjusted downwards based on Greek data
(21)	**Total Estimated Wool (Kg.)**	**(21) = [[[**Y_t –[($Y_t - Y_{(t-1)}$) + ($Y_{(t-1)}$*S) + X_t]]*(1 - R_m)]* W_f] + **[[[**Y_t –[($Y_t - Y_{(t-1)}$) + ($Y_{(t-1)}$*S) + X_t]]*R_m]* W_m]	**(21) = [[(1) – (12)] * [1 – (4)]] *(20) + [[(1) – (12)] *(4)] * (19)]**

(22)	Adult hide weight per Slaughtered Animal (kg.)	(22) = H_a	Γεώργιος Κωστελένος, *et al*, (2007); pp.50 - 51 (1914 - 1940)
(23)	Lamb / Kid hide weight per Slaughtered Animal (kg.)	(23) = H_y	Γεώργιος Κωστελένος, *et al*, (2007); pp.50 - 51 (1914 - 1940)
(24)	**Total Skin Produced kg**	**(24) = [[**$(Y_{(t-1)}*S)/2]* H_a]$ + $[[[B * [Y_{(t-1)}*(1 - R_m)]] - [(Y_t - Y_{(t-1)}) + (Y_{(t-1)}*S) + X_t]] * H_y]$	**(24) = [(14)* (22)] + [(13)*(23)]**
(25)	Milk per Surviving Adult (Kg.)	(25) = M_f	Cyprus Agricultural Journal (1932 - 1938); adjusted downwards based on Greek data
(26)	**Total Estimated Milk**	**(26) = [[[**$Y_t - [(Y_t - Y_{(t-1)}) + (Y_{(t-1)}*S) + X_t]]*(1 - R_m)]* M_f]$	**(26) = [[(1) * (12) * (1 – 4)] *(25)]**

The Cypriot meat production as estimated by the model provides similar results to the information given in the 1946 agricultural census, which was not used to build up the model. The census states that the annual slaughter of 80000 adult Sheep and Goats and 250000 Lambs / Kids for meat. Results for 1938 estimate 76507 adult beasts and 232825 Lambs / Kids slaughtered for meat[13]. The fact the 1938 estimate is similar while using different sources of information than the 1946 census ads validity to the estimates. The 1938 estimate and the 1946 census also produce similar results in terms of flock composition. Flock composition is important to represent the flock composition of the time as the estimate rely on constant ratios of male and females within the aggregate flock; if the ratio of male to females in the flock, or the ratio of retained young is not correct the model then will produce spurious rather than plausible results. The constant ratios of males to total adult population are 0.04 for sheep, 0.065 for goats[14]. The 1946 census ratio for rams is 0.032 and 0.071 for male goats. Although there is a difference between the models constant ratio and the 1946 census the difference is not large; using 1946 ratios the total sheep and goat meat production increased by 9092 kg or £817 pounds, which is less than 1% of the combined gross output value of sheep and goat meat. The proportion of young animals as a proportion of the flock, which provide the replacement ratio of the flock are also very similar: in 1946 young animals represented 20% of sheep and goats while the 1938 estimate was 21.6%.

The estimates of animal production were also checked with the limited data on municipal slaughter houses[15]. In order to calculate meat production for the whole 1921 – 1938 period the average per capita production of meat for 1938 was assumed to be constant, and then was combined with the intercencal yearly estimates of population.

[13] Percival, D. A. *Census of Population and Agriculture 1946* (Nicosia: GPO, 1947?) p.82
[14] The constant ratio for cattle is not included as it was calculated based on the 1946 census.
[15] Cyprus, *Annual report of the director of agriculture for the year 1938* (Nicosia, GPO. 1939) p.24; Based on the population projection estimated, the 1938 population of the four cities was estimated at 17.37% of the total population

Table 5

Title	Estimated Animals Slaughtered 1938 (1)	Enumerated Animals Slaughtered in urban area (17.37% of total Population) (2)	Estimated Animals based in expanding results of urban area (100% of population) (3)	Difference of estimated and urban area extrapolation (1) – (3)
Sheep and Lambs Slaughtered	166738	67676	389614	-222876
Goat and Kids Slaughtered	142595	19222	110662	31933
Total Number of Animals Slaughtered	371529	92409	532003	-160474
Total Volume of meat (kg.)	4629548	1552977	8940571	-4311023
Volume of meat per capita	11.65	22.5	22.5	-10.65
Value of Meat (£)	293181	102096	587772	-294591

The slaughterhouse extrapolation for the whole population can be considered as estimate maximums; since the slaughter houses served urban areas that were on average wealthier that rural areas, the consumption of meat is probably less in the rural area of Cyprus than the estimate entails. The returns from the slaughterhouses argue that my estimate is too conservative: both animals being killed and the meat that is extracted out of each animal was underestimated. The estimate also seems to underestimate the wholesale price. As a result the animal slaughter value is double my own 1938 estimate. However the slaughter estimate has problems of its own. The municipal slaughter houses might have been catering for a much wider section of the demand for meat than just the urban population. Thus the share of the population of the cities with municipal slaughterhouses is not representative to the amount of livestock slaughtered there.

Conclusion

Rather surprisingly the conclusion is optimistic; despite the crude way of estimating citrus and animal production in Cyprus the estimate is still relatively reliable on the aggregate. In 1938 the weight of citrus production in the total Agriculture, Forestry and Fishing sector is just 4%; the weight of animal production is 25.6%. Thus in order to miss estimate the total gross output of the sector by 5% one needs to misestimate animal production by 20%. Even if the estimate for grapes is 100% higher or lower the total effect on the gross output of agriculture is only 4%. Considering that Agriculture is just 50% of the Gross Domestic Output then the possibilities of large errors do not translate to gross errors in terms of GDP output. Thus the researcher, being aware of the limitation of his data sources, can guestimate so long as the error band of any poorly substantiated estimate does not jeopardize the reliability of his final results. However the necessity of using ad-hoc procedures should lead to caution by to researchers using the data. Historical GDP calculations should not be broken down on a too disaggregate a level, or used to try and pinpoint levels or cycles too precisely.