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THE *TIMAR* SYSTEM: A QUESTION OF FINANCIAL VIABILITY, 1470-1670

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Öz

Bir Finansal Canlılık Sorunu: Tımar Sistemi, 1470-1670

Bu makalede, timar sisteminin 16. yüzyılın sonlarında başlayan zayıflama nedeniyle timarlı sipahilerin askeri görevlerini giderek azalan bir ölçekte yerine getirdikleri konusunda genel kabul gören iddianın doğruluk derecesini araştırdık. Süvarilerin ve atlarının enerji gereksinimlerinden hareketle, almaları gereken gıda miktarını, bunların güncel parasal değerini, "ortalama" bir timarlı sipahi ve cebelülerin 15-17. yüzyıllarda yapılan yedi seferde meydan savaşları ve kuşatmalar sırasında kullandıkları savaş araç ve gereçlerinin maliyetini hesapladık. Bu hesaplamalar sonucunda ortaya çıkan sefer maliyetlerini "ortalama" bir timarın geliri olarak kabul ettiğimiz parasal tutarla karşılaştırdık. Tüm bu seferlerde timar sisteminin askeri yükümlülüklerini büyük bir rahatlıkla yerine getirebilecek finansal güce sahip olduğu sonucuna vardık.

Anahtar Kelimeler: *Tımar, Osmanlı Seferleri, ekonomik tarih, askeri tarih, tımar geliri*.

Abstract

In this article we explore the validity of the argument that the timar system, starting with the last quarter of the sixteenth century, was crumbling financially and therefore was unable to perform its military obligations. Based on the energy requirements of an "average" timar contingent together with their horses we calculated the actual money cost of maintaining such a unit in seven different campaigns. We also calculated the depreciation cost of the weaponry in these campaigns. We compared these costs with the annual tax revenue of an "average" timar. We found no evidence of any such financial weakness with the conclusion that the *timar* system was perfectly viable in the two centuries under consideration.

Keywords: *Timar, Ottoman campaigns, economic history, military history, timar income*,

Note on Place Names

Contrary to the common usage we used the modern Turkish equivalent of place names outside the

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present borders of Turkey; instead of Baghdad we used Bağdat, for Mezökeresztes, Haçova, etc. We believe this usage is more in line with historical narrative.

Introduction

The *timar* system is probably the most recurring theme in writings on Ottoman history. Following Ö.L.Barkan's and H.İnalcık's ground-breaking works, M.T.Gökbilgin, F.M. Emecen, V. Mutafchieva, N.Beldiceanu[1], and many others made valuable contributions to our understanding of different aspects of *timar*s. In the late 1980's and throughout the 1990's we witnessed a torrent of books and articles, but mostly graduate theses, on the subject, using what has come to be affectionately known as the *tahrir* registers; the proper term being *defter-i hakani*. Some of these were of dubious academic value and, accordingly, they were criticised widely. Quite a few them, and the articles derived from them published in an abridged form in obscure all-purpose e-journals, came under heavy fire[2]. However tenuous they are it would be unfair to brush them away as being pieces of mere paleographic exercise with little or no worth. They added to our knowledge of the *timar*'s main characteristics. We now know how the *timar*s in particular and the *dirlik* system (land bestowals in return for administrative and military duties) in general functioned as an economic-administrative unit in the general framework of the Ottoman statecraft, and their unique aspects that differentiate them from their pre-Ottoman Anatolian and Rumelian precursors. We also know their military importance.

But, as we dig deeper into the *tahrir* studies we realise that however well-oiled a military and administrative machine it was, it had serious weaknesses. Starting from the granting of *timar*s, their registration, the taxes that the *reaya* had to pay and to whom they were paid, and the military obligations of the *sipahi*, we encounter a myriad of irregularities and exceptions to the rule, and a bewildering array of exceptions to exceptions which makes a meaningfully comprehensive taxonomy of the system a daunting task which has not been successfully achieved so far; all we have is detailed descriptions of the various categories and sub-categories together with how and when and where the exceptions occurred. Again, all these have been researched in depth and very well documented, hence they lie beyond the scope of this article except where they are relevant to the subject.

The gradual decline of the *timar* system, starting in the sixteenth century, is also another prevalent theme in the literature. It is generally argued that the factors contributing to this were mainly military and economic, in that, firstly, the battling capability of a sword-wielding cavalry and infantry found wanting when confronted with musket fire and, secondly, as a result of the increases in the general level of prices brought about by the influx of Spanish silver, the real income of the provincial *sipahi* class decreased throughout the century, rendering them incapable of performing the services required from them. Any such claim should demonstrate quantitatively that the *sipahi*'s tax income, in

[1] Barkan 1943; İnalcık 1948, pp.132-139; Gökbilgin 1952; İnalcık 1954; Emecen 1989; Beldiceanu 1985; Mutafchieva 1988. Uninitiated readers, interested in a more encapsulated account of *timar*s, can consult the relevant articles in *Encyclopedia of Islam*, 2nd ed., (*EI2*) and *Türkiye Diyanet Vakfı İslam Ansiklopedisi*, (*TDVİA*).

[2] See, for example, Afyoncu 2003.

the form of taxes he received in cash as well as in-kind, deteriorated to such levels that he was financially unable to meet his military obligations.

This article will attempt to determine the costs of equipping and maintaining a military unit of a *timar*-holder *sipahi* and his military entourage, *cebelüs,* with a view to quantify the hitherto generally accepted statement[3] that by the end of the sixteenth century the *timar* system was in economic and, therefore, military decline. As such, it is not concerned with the workings of the *timar* system, nor its evolution and eventual demise. Similarly, we are not concerned with how the wars the Ottomans waged were financed, whether with cash payments from the imperial treasury or the levying of a group of special taxes known as *avarız*, *nüzül*, or *sürsat* except when we discuss the pricing of the army purchases of foodstuffs. Our interest lies in the actual payments made by the *sipahi* to prepare and manage his military contingent in war and the nominal money value of his income (cash and in-kind) and compare them over a period of 200 years. This comparison will tell us if the *timar* system was, in fact, losing its financial viability in these two centuries. During our arguments we will make some assumptions and we will show how these assumptions affect our findings.

In order to calculate the amount of cash outlay required to feed and arm a group of soldiers three types of data is required: Firstly, we need to approximate the daily food requirements of a young and healthy soldier in the sixteenth century, engaged in exceptional physical activity during the long march to the battlefield and in the battle itself. This dietary requirement, valued at prices at which it was obtained, will give us the provisioning cost of a soldier per day during military campaigns. Secondly, we must calculate the cost of equipping the same soldier with appropriate weaponry. Thirdly, a reliable indication of the frequency of obtaining and repairing new weaponry is needed. These data do not exist in the form of ready-to-use statistical tables. They have to be culled from archival and secondary sources.

The year 1470, in the title of this article, has no special significance except that it is very near the base year of Ş.Pamuk's estimates of prices and indices[4] which we will use in our calculations. The year 1670 is not quite arbitrary for it enables us to see the *sipahi*'s financial condition well into the seventeenth century.

The Ottoman Army Goes to Battle

The Ottoman army consisted mainly of two different but equally mighty

[3] For a very succinct formulation of this assertion see, İnalcık, 2000, 506; also, 1965, 764. Aksan is of the same opinion, 2012, p.328. For two dissenting views on this point see, Ostapchuk 2019, pp.35-62; Kolçak 2013, pp.217-251, esp. p.236.

[4] Pamuk 2000b, appendix 2, and, Pamuk 1999. The price indices in both the Turkish and the English editions are given as charts, not tables. Fortunately, the author re-published these indices, and the actual prices, in 2000 adding data for Ankara, Bursa, Edirne, Şam, and Kahire in, Pamuk 2000a, pp.12-18, 48-50, appendix 1, pp.100-148. This table, with gaps, lists not only the calculated İstanbul consumer price index from 1469 to 1918 but also the silver content of the *akça* in grams. Although a great number of printing errors has creeped into these tables, they are of paramount importance for economists and historians.

components: the *kapukulu* soldiers and their auxiliary forces, and the provincial army of *sipahi*s and their retinue. The former was the standing army, paid wages for their services while the latter was called to arms only when the occasion arose, and they derived their income from the tax revenues they were assigned in the form of land-grants.

The procedure through which the Ottomans declared war and mobilized the army was quite well-defined: The *sultan*, after obtaining the religious blessing of the *şeyhülislam* in the form of a *fetva*, declared a state of war and sent edicts to the governors of the far-flung provinces of the empire, ordering them to muster their troops and join the *kapukulu* forces at Üsküdar if the enemy was in the east, or at Edirne if the campaign was going to be held in Europe.

The wording of the *sultan*'s command was almost the same in all cases, bar some variations and the degree of exhortations. The following passage occurs in the imperial edict of 4 December 1559, sent to the governor of the Anadolu province. Slightly different versions were also sent to the governor of Cezayir, *Bey* of Mora, *Sancakbeyi* of Koca-ili, and the *Bey* of Ağrıboz on 28 January 1560:

"*Vusûl buldukda, aslâ te'hîr ü terâhî itmeyüp bu hükm-i hümâyûnumun sûretin ihrâc idüp begler kullaruma gönderüp geregi gibi tenbîh ü te'kîd eyleyesin ki, her biri kanûn-nâme-i hümâyûnum mûcebince cebe vü cevşenleri ve cebelüleri ile ve sancaklarına müte'allık olan alay-begi ve zu'amâ vü erbâb-ı timarı dahı kanûn üzre cebe vü cevşenleri ve cebelüleri ve bi'l-cümle sâ'ir espâb-ı ceng ü cidâl ve âlât-ı harb ü kıtâlleri vechile tenbîh ü te'kîd eyleyesin ki kimesne bilmedük ve isitmedük dimeğe mecâli kalmayup sen dahı kanûn üzre sancağun alaybegisi ve zu'amâ vü erbâb-ı timarı ile ve cebe vü cebelün ile müretteb ü mükemmel hâzır ü âmâde olasın ki, her ne zamânda çıkmak emrüm olursa bilâ-tevakkuf çıkasın ve bu hükm-i şerîfüm sana ne gün varup ne vechile tedârük ve tenbîh itdüğün yazup bildüresin.*"[5]

Roughly translated, the *sultan* orders the governor to instruct, without any delay whatsoever, the *dirlik* owners of the province to make their troops battle-ready with full armour and weaponry and await further orders for marching to the muster zone. The governor is also ordered to confirm in writing the progress of preparations of the lesser officials under him. Even a cursory glance at the full text of the edict leaves no doubt about the extent of the wrath of the *sultan* that would immediately befall on the recipient should he waver carrying out the order.

After the circulation of the *sultan*'s orders, the full mobilization of the provincial forces took between 90-120 days. Therefore, a mobilization order issued in December-January meant full combat-readiness in March-April which coincided with the Ottoman war doctrine of "April-October campaign season". In any case, all the forces of the *sultan*'s army were always ready to march on the enemy on *ruz-ı Hızır* (5-6 May in the Gregorian calendar). If the muster zone was Edirne, the Anatolian provincial army

[5] *3 Numaralı Mühimme Defteri 966-968/1558-1560,* Ankara, 1993, pp.255, 323-324; similar edicts can be found in, *6 Numaralı Mühimme Defteri (972/1564-1565)*, Ankara, 1995, pp.100-101, 103-14, 256, 262-265.

crossed the Hellespont between Çardak (near Lapseki) and Gelibolu[6], thus, never coming near the imperial capital. If, however, the campaign was in Asia the Rumeli forces joined the main army between Bolvadin and Konya, crossing the Hellespont at the same point as their Anatolian counterparts. It appears that a conscious policy was in effect of keeping the provincial forces away from İstanbul.

The routes followed by the Ottoman forces going to battle both in Europe and Asia are very well documented in the literature: They map the network of warehouses where food and war material was stored, precisely[7]. The only exception to this common-sense rule, with disastrous results, was Süleyman I's 1533-1536 and 1547-1548 Safavid campaigns when the Ottoman army took the Erciş-Amid-Halep return route where there were probably very few supply points.

The Sipahi's First Experience with Decision-Making: What to Eat, How Much to Eat?

It is generally accepted that the Ottoman soldiers were well-fed, consuming daily not only freshly baked bread or biscuits but also some quantity of mutton or lamb, butter, and even honey and coffee[8]. However, it appears that this was not always the case; F.Emecen, quoting from the histories of Peçevi İbrahim and Hasan Beyzade, shows that sometimes even the most basic provisions, bread and biscuits, were in very short supply[9]. Also, during the Iran war of 1547-1548, the ruinous scorched-earth tactics of the Safavids forced the Ottoman army to desperate measures to obtain provisions[10]. A more tragic account of the hardships suffered by the troops when provisions were unavailable was offered by a former Croatian prisoner of war who was with the Ottoman army with his master[11].

In İstanbul in peace time, each *orta* of the *kapukulu* soldiers had their own cooks and kitchen[12] and they either bought the ingredients at reduced prices from the waqfs set

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[6] Ertaş 2008, pp.887-897.

[7] See, for example, the maps in, Sevinç 2010, pp.274-276; Sahillioğlu 1965a, pp.17-18. (The return route of Kara İbrahim Paşa from Sivas to İstanbul was exactly the same as the one followed by the Byzantine emperor Romanos IV's army on its way to Malazgirt in 1071, see, Haldon, *et.al.*, 2012, pp.209-235, and the route map in, Craenen, *et.al.*, 2012. (The MWGrid Project, run by Birmingham and Princeton Universities' Medieval Logistics Group, specifically explores the Battle of Malazgirt); Uyar and Erickson, 2009, p.84.

[8] Among many other sources see especially, Aksan 1995, pp.1-14; Murphey 2001, esp. Ch.5, pp.85-103; Murphey 2010, esp.pp.152-154; Agoston 1999, pp.118-144. The daily ration quantities cited by Aksan belong to the late 17th and early 18th centuries, when the Ottoman Empire was believed to be in the declining phase.

[9] Emecen 2010, p.186, 195.

[10] Balta 2017, pp.122-136 contains daily entries from Matrakçı Nasuh's *Beyan-ı Menazil-i Sefer-i Irakeyn.*

[11] Aksulu 1998, pp.19-20. Georgievic's account relates to the return voyage of the victorious Ottoman army after the capture of Tebriz in July 1548. The question of why the route of Selim I's Çaldıran campaign of 1514 was not followed remains unanswered.

[12] Uzunçarşılı 1988, pp.236-237.

up for the express purpose of subsidizing their purchases, or, if the ingredients were supplied centrally, a certain amount of money was deducted from their wages. The same principle applied during campaigns, too. In the Long War of the late sixteenth and early seventeenth centuries with the Habsburgs, the *mevacib* registers show that[13] deductions were made from garrison guards' three-monthly wages for the food they were provided[14].

The Ottoman army, like its European contemporaries[15], moved together with a large group of civilians the most important of which was the *orducu,* or *orducu esnafi*: a group of guild members who were tasked by the government to march with the army and supply the various needs of the combatants at prices pre-determined, again, by the government. They were mainly responsible for providing food, clothing, and battle equipment to the army and required to bring with them all the tools and materials necessary to perform their jobs[16]. However, the claim that the *orducu* were responsible for supplying combat equipment needs of the army[17] raises the question of standing army's auxiliary force of *cebeci'*s adequacy in performing their jobs, since it was the *cebeci* who were officially charged with supplying and repairing all armory and weaponry[18]. In the İstanbul *şeriye* court registers there exists quite a large number of references to sword makers and bowmakers (*şemşirgeran* and *kemangeran*) who were ordered to join the *orducu* but their number is neglibible compared to other crafts, never exceeding two tent-shops19. Most probably they were tasked with supplying and repairing swords and bows used by the *sultan*'s immediate circle as the suffix *-geran* refers to the craftsmen in the employ of the imperial palace[20] and they only appear in *orducu* lists after 1583 with none listed in 1545, 1552, 1578, and 1579[21].

The reason why we dwelt in length on the *orducu* is two-fold: Firstly, together with the regular auxiliary forces of the *kapukulu* soldiers they supplied the army with all the necessities and, secondly, they must have played a vital role in supplying provisions to the *sipahi* and his entourage of *cebelü*s. This point needs further elaboration because there is precious little in the literature on how the provincial army obtained its food

[13] Finkel, 1988, 85-86 (We are grateful to Dr. Finkel for lending us her personal copy of this book).

[14] Akgündüz, in his scathingly criticised 1992, 270, quoting from *Asafname*, shows that "it is law that the *padişah* give the *yeniçeri* and the *sipahi* grain [sufficient] for six days". Akgündüz accuses Hezarfen Hüseyin Efendi's *Telhisü'l-Beyan fi Kavanin-i Al-i Osman,* for misquoting *Asafname*. Also see, İşbilir 2002, pp.278-293 which is derived from the author's unpublished Ph.D. dissertation: İşbilir 1996.

[15] Tallett 1992, p.56, 141.

[16] The earliest reference to the *orducu esnafi* in the literature is: Aktepe 1954, pp.17-30. For a comprehensive account of how the *orducu* organisation worked see, Çelik, 2008. Also, Aksan, 1999, pp.145-176; Çelik 2018a. For a slightly different version of this article, see, Çelik 2018b.

[17] Çelik 2007, pp.370-373.

[18] Uzunçarşılı 1988, pp.3-31.

[19] There is no generally accepted form of citing *şeriye* registers. Here, we cite them by court district, register number, date, volume, and folio number preceded by *İKS*. Some examples are: *İKS*, Bab, no.3, 1666-1667, vol.17, f.878; *İKS*, İstanbul, no.22, 1695-1697, vol.57, f.638.

[20] Pakalın 1972, p.336.

[21] Çelik 2002, pp.168-169.

requirements during campaigns. C.Finkel discusses three sources on how the timariot army might have acquired its food and seems to have come to the conclusion that the timariots had no means of bringing their food with them to the campaign[22].

This importance of the *orducu* could be understood better if we consider G.Perje's hypothetical example that, a train of 11,000 carts, each carrying one ton of supplies (500 kg in the case of bread because of its bulkiness), and 50,000 to 70,000 draught animals were required in order to feed an army of 60,000 men with 40,000 horses for one month[23]. This train of carts would be 198 kilometers in length, with a marching distance of no less than eight days. For an extended campaign of 90 days, the numbers would be stupendously high. When we apply Perjes's line of reasoning to the provincial component of the Ottoman army the logistics requirements that we end up with are clearly unattainable.

Ö.L.Barkan and H.İnalcık put the number of *sipahi*s and *cebelü*s between 100,000 and 175,000 in the sixteenth century[24]. When we add to these already very large numbers the standing army of the *kapukulu* soldiers the inescapable conclusion is that the Ottoman army, nor any army of a similar size, could have brought all or any meaningful amount of the provisioning requirements along with itself during a campaign: Almost everything had to be procured locally and cooked as the army marched on; hence, the importance of the *orducu*. Therefore, when V.Aksan says, "*Sipahis were ... obliged to furnish their own horses, arms and sustenance, and soldiers from each sancak often collectively organised their own supplies*"[25] we take it to mean that the timariot army obtained its food requirements in the field. This fact presents the *sipahi* with the problem of what types of food he should provide to his soldiers and at what quantities.

The Sipahi's Approach to the Diet Problem

We can now calculate the amount of food an average timariot soldier needed to

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[22] Finkel 1988, pp.198-199.

[23] Perjes 1970, 5-11. Perjes's calculations assume that the army is accompanied by as many as 30,000 civilians. While calculating the number of carts required to carry one month's supply of rations and fodder for his hypothetical army Perjes uses an iterative process but stops at step 2; had he continued he would have found that the correct number of carts is 11,348 not 11,000. Alternatively, he could have used the following simple arithmetical formula twice (firstly for non-bread items and, secondly, for bread only) and add the results together: C=nr(t+dC)/c where C, the number of carts required, is the only unknown, while the parameters are n=campaign days, r=weight of rations per person, t=number of troops, d=number of cart drivers and helpers per cart, and c=carrying capacity of one cart, are all known quantities.

[24] The first estimate is from Barkan's "Timar" article in *İslam Ansiklopedisi*, Barkan bases this estimate on Ayn Ali Efendi's book *Kavânîn-i Âl-i Osmân der Hulâsa-i Mezâmîn-i Defter-i Dîvân*, originally written in 1608-1609. Ali Efendi was the "Keeper of *Tahrir* Registers" when he wrote the *Kavanin* (for a transcription see*:* Akgündüz, 1990-1996, vol. 9, pp.28-68). The second number is from İnalcık's "Timar" article in *TDVİA*, vol.41, where he quotes from a well-known treatise on Ottoman land regime written in 1653 which was later transcribed and edited by M.Sertoğlu, see, *Sofyalı Ali Çavuş Kanunnamesi*, İstanbul, 1992. For an analysis of the relationship between Ayn Ali's and Ali Çavuş's works, see, Howard 2008.

[25] Aksan 2007, p.54.

consume in a day. This will enable us later to estimate the cash expenditure the *sipahi* had to incur during a campaign. Clearly, the Ottomans, nor any other European country for that matter, had any idea of the calorie concept but they knew from experience that carbohydrate rich food, mainly bread and/or hardtack was good for soldiers exerting a high level of effort while marching and fighting. The daily calorie requirement of a soldier is determined mainly by four factors: height, weight, age, and level of activity. According to the Turkish Statistical Institute, the average height of a Turkish male between the ages of 15-34 is 173.7 cm in 2008 and 175.5 cm in 2019[26]. The average weight is 71 kg and 74.7 kg, respectively[27]. The tax and population surveys of the 1830's and 1840's furnish valuable information about the age and height distribution of peasants in Anatolia. Table 1 summarises the findings of some of the works on these surveys. Although it is not clear what was meant by the height descriptions, we can safely assume that, for example, "Medium" meant less than 170 cm.

Table 1: Average height and age in early mid-19th century Anatolia

Area	Date	Short	Medium	Rather tall	Tall	Average age
Amasya [(a)]	1840	11%	67%	10%	12%	-
Kütahya [(b)]	1834	16%	52%	18%	15%	25.8
Avunya [(c)]	1844-1845	-	-	-	-	24.7
Balya [(d)]	1840	-	-	-	-	23.5
Beyşehir [(e)]	1844	1%	84%	-	14%	-

[(a)] Özcan, 2016, pp.112-115; [(b)] Kolay 2014, pp.137-173; [(c)] Öztürk, 2010, p.21;
[(d)] Demirarslan, 2009, average age is calculated by us on the basis of the table in p.26;
[(e)] Muşmal, 2005, pp.363-364.

Considering the advances in nutrition levels and health care, these numbers must have been much lower in the sixteenth century. We will assume the average height to be 160 cms and average weight 57 kgs[28]. The age factor is equally difficult to determine due to lack of data[29]. J.C.Russell, basing his conclusions on anthropological studies of cemeteries, puts average life expectancy of 14-20 year old males at 30.1 years and 20-40 years olds at 28.4 years for the early Middle Ages[30]. A more recent study shows that

[26] http://www.tuik.gov.tr/PreIstatistikTablo.do?istab_id=2387.

[27] http://www.tuik.gov.tr/PreIstatistikTablo.do?istab_id=2388.

[28] The collaborative project of Our World in Data and the SDG-Tracker at Oxford University puts the average male height in Germany at 168 cm, Netherlands 166 cm, and France 164 cm in 1810 (https://ourworldindata.org/human-height#all-charts-preview). So, our estimate of 160 cm for the sixteenth century is quite generous. The weight factor is calculated by using the Devine formula: Ideal Weight=(50kg+(0.9kg*(height in cm-152))

[29] Very few authors have attempted to derive estimates of average life expectancy in the sixteenth century. Those who have, confined their findings to working papers and avoided academic journals; see, for example, Gador, Moav, 2005; Johansson, 2010; Cummins, 2014. These three papers use data relating to the upper classes probably because of the relatively easy accessibility of data.

[30] Russell 1972, p.42.

in rural England, between 1550-1599, life expectancy at birth was 38 years, and 33 years at age 20 while in rural China, between 1300-1880, it was 28 and 33 years, respectively[31]. There is no comparable study of life expectancy for Turkey in the sixteenth century except by D.A.Howard who, based on his study of *timar ruznamçe* registers, reaches the conclusion that *sipahi*s died at "*a very young age*" and that the career of a *sipahi* spanned a period of 18 years, "*from his late teens to his mid-thirties*."[32] The data in Table 1 suggest that the average age of an Anatolian peasant was about 25 years in the early nineteenth century. On the strength of these studies we will assume that average male life expectancy at birth in the sixteenth century Ottoman Empire was 35 years and anyone who had reached the mature age of 20 could have expected to live on for another 13 years, the average age at any time being 25 years.

The average daily energy expenditure of a healthy 25-year-old male is determined by a variety of factors, the most important of which are, the task being performed, weather conditions under which the task is performed, and the duration of the activity.

During a campaign a soldier is either marching, resting, or fighting. In our case, the amount of energy expenditure according to type of activity depended on how a 24-hour day of an Ottoman provincial soldier was divided among these activities which, again, depended on the length of time he had to spend to join the main army at either Edirne or Üsküdar, and the length of time he was moving with the army after joining it. Table 2 shows the number of estimated hours per day a *timar* soldier devoted to each type of activity:

Table 2: Hours spent per day on different activities

Activity Level	Sedentary	Light	Moderate	Active	Very active	Combat	Close combat
Activity							
Marching to muster point [(a)]	8	4	2	2	8 [(b)]	-	-
Moving with the army	8	5	4	4.5 [(c)]	2.5	-	-
Battlefield	5	3	3	4	4	3	2 [(d)]
Moving with the army	8	5	4	4.5 [(c)]	2.5 [(b)]	-	-
Marching home [(a)]	8	4	2	2	8 [(b)]	-	-

[(a)] The *timar* contingent did not have any heavy baggage with them as the main army did. Their rate of travel was determined by their own endurance; [(b)] An average war-horse could trot at 12-13 km/h for eight hours and canter at 22 km/h for four hours, with suitable breaks; [(c)] R.Murphey, 2001, p.65, where he estimates the army's rate of travel at 22 kms per day; at 4.4 hours a day (p.22) calculates a speed of 4.95 km/h. C.Finkel, on the other hand, puts it at 19-32 kms, based on the march from İstanbul to Belgrade, (1998, p.66); [(d)] Continuous hand-to-hand combat for more than a few minutes exists only in tales and motion-pictures. The copious release of epinephrine and the quick build-up lactic acid in the muscles, and the stress and anxiety of imminent death wears the combatants down in a matter of minutes. Real combat is actually slow and involves tactical moves to gain advantageous positions. The two-hour close combat activity in the table

[31] Clark 2007, p.114, table 5.2.

[32] Howard 1990, pp.55-56. (We are indebted to Professor D.A.Howard for providing us with a copy of this article). Howard's finding was echoed in, Acun's article (Acun 2002, p.1677).

was only possible with very frequent breaks lasting at least 2-3 minutes. All other numbers are our estimates of how the timariot soldier allocated his time between resting, doing chores, tending to his horse, etc.

Before proceeding to our last step of assigning numerical caloric values to tasks performed, we must consider the peculiar phenomenon of "negative energy balance." As early as 1963 it was known, but not scientifically demonstrated, that the high-stress environment of combat operations caused troops to lose weight almost continuously because of loss of appetite which resulted in less calorie intake than expended, thus resulting in a negative energy balance[33]. Almost half a century later, a study commissioned by the American Academy of Sciences conclusively showed that "individuals under stress often have diminished appetites. Soldiers usually burn about 4,500 kcal/day but consume only about 2,400 kcal/day"[34] A research review study carried out in 2005 on the personnel of six armies, performing a diversity of tasks (basic training, combat training, support and maintenance activities, etc.), at ambient temperatures ranging from -49 ^{0}C to 40 ^{0}C, lasting from 7.5 hours to 24 hours showed that energy expenditures ranged from 3,109 kcal to 7,131 kcal per day. What is more, the review concluded that soldiers "consume insufficient energy, whether they are provided an adequate amount or not" so much so that in one particular case total energy intake was only 16% of energy expended.[35]

Various tools are available online to estimate the equivalents of sedentary and other energy expenditure levels. We used the one that allowed us to incorporate an estimate of the negative energy balance in the calculations[36]. We assumed that light, moderate, and active activity levels resulted in an average weight loss of 0.25 kg/week, while the remaining activities resulted in 0.5 kg/week weight loss37. We also assumed that sedentary activity did not cause any weight loss. Table 3 shows the daily calorie requirements corresponding to the activity durations in Table 2.

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[33] Nottage 1963, 14-16. The author, a Lt.Colonel in the U.S. Army, noticed that an impressionistic study by the Combat Developments Command showed that negative effects of psychological stress resulted in smaller amounts of calorie intake.

[34] Institute of Medicine, 2006, p.1 but esp. appendix B, table b-19 on p.309 which summarizes the findings of 12 studies showing the effects of extreme conditions on energy balance.

[35] Tharion, 2005, 47-65, esp. p.51.

[36] https://www.calculator.net/bmr-calculator.html. This calculator has three options to compute the basic metabolic rate. We used the Mifflin St.Joer equation. The results of our calculations are presented in Appendix I for verification purposes.

[37] This assumption may underestimate the real weight loss of the *timar* soldier. A study on overweight Singaporean soldiers revealed that weekly weight loss reached an average of 1.15 kg during 20 week of basic military training without any extreme duress: *Institute of Medicine*, 2006*,* p.314.

Table 3: Daily calorie requirements of activities with (without) negative energy balance (kcal)

Activity level	Resting	Light campsite chores	Medium Campsite chores	Heavy campsite chores	Sustained horse riding	Siege tasks and siege combat	Close combat	Total
Activity								
Marching to muster point	580 (580)	291 (332)	156 (177)	166 (188)	667 (667)	- -	- -	1,860 (1,944)
Marching with army	580 (580)	364 (415)	312 (354)	375 (422)	208 (208)	- -	- -	1,839 (1,979)
Battlefield	363 (363)	218 (249)	234 (266)	333 (375)	334 (334)	282 (282)	532 [(a)] (532)	2,296 (2,401)
Marching with army	580 (580)	364 (415)	312 (354)	375 (422)	208 (208)	- -	- -	1,839 (1,979)
Marching home	580 (580)	291 (332)	156 (177)	166 (187)	667 (667)	- -	- -	1,860 (1,944)

[(a)]Although there are close approximations for activity levels from sedentary to combat in calorie calculators there is none that can even come close to a situation where two soldiers, clad in armour and carrying a heavy sword and a shield, are engaged in a deathly fight. The nearest estimate would be the average calorie expenditures in martial arts sports. For this purpose, we took the maximum calorie expenditures of Aikido, Capoeira, Jujutsu, Karate, Kyokushin, Kickboxing, and Taekwondo as reported in: Mynarski, *et.al.*, 2013, pp.127-133, and, Campos, *et.al.*, 2012, pp.1221-1228. The 266 kcal per day we have arrived is only 4.6% less than the average hourly calorie requirement of a Norwegian Rangers' food and sleep deprived training of 21-24 hours per day for seven days; see, Tharion, *et.al,* 2005, p.62.

Obviously, the daily calorie requirements calculated in the last column of Table 3 are sensitive to the values in Table 2. We have repeated the exercise by assigning different values to hours spent on different activities and, also, by reducing the number of activity levels from seven to a somehow unrealistic four (sedentary, very active, combat, close combat). The highest change was observed in the "marching with army" row from 1,839 kcal/day to 2,081 kcal/day, an increase of 13.2% with a negative energy balance. With no negative energy balance the upward change was only 5%. In the case of "battlefield" activities row, assigning 8, 10, 4, and 2 hours to sedentary, very active, combat, and close combat, respectively, the calorie requirement actually decreases by 4% in the case of negative energy balance and 8.3% for no negative energy balance. We do not think that these rather small changes warrant any modifications in our initial assumptions, so we keep Table 3 as is.

R.Murphey is probably the first Ottoman historian to realise that caloric values

were important for calculating the cost of moving large armies across vast areas. On the basis of a daily ration list given in the eighteenth century book by L.F.Marsigli, Murphey constructs a table showing the daily calorie intake of Ottoman soldiers at rest[38]. It must be noted that all the caloric values in the last column of Table 3 are significantly lower than the 2,982 kcal calculated by R.Murphey. Our calculations show that the timariot soldier would have required 1,740 kcal per day during the same rest period. One of the reasons of this sizeable discrepancy between the two calculations is the result of Murphey's uniform treatment of bread, rice and hardtack calorie values at 270 kcal per 100 grams[39]. More accurate numbers would be 275, 130, and 142 kcal/100 grams for bread, cooked long or short white rice, and hardtack, respectively. His calorie content for mutton is 356 kcal/100 grams, while the actual average calorie count is about 260 kcal/100 grams, uncooked. While it is true that during cooking the protein is gelatinized thereby raising the calorie content of meat, it is debatable that this increase is as much as 41%. On the other hand, Murphey underestimates the calorie content of clarified butter by about 21%. If we re-calculate Murphey's daily ration using the values, we have suggested we obtain 2,504 kcal which is still 44% higher than our calculation of 1,740 kcal. Therefore, the difference must have been caused by the composition of the daily diet suggested by L.F.Marsigli, which we will have occasion to discuss in detail later on.

The next step in calculating the daily provisioning cost of a *timar* soldier is to select the components of the daily ration. We assume the same ration composition as Marsigli but without hardtack[40], which has a much lower caloric value than bread, leaving us with bread, mutton, rice and clarified butter. How much each of these items should be included in the daily ration of the soldiers so as to provide them with their calorie requirements but keeping the cost as low as possible is the time-celebrated diet problem of linear optimization the solution of which requires intensive manual calculations or the use of a computer. The *sipahi* probably did know how to read and write but certainly could not carry out complex matrix operations nor did he have access to a computer. But he did have something very important on his side: the accumulated wisdom and experience of the past centuries handed over to him by his ancestors. He did know that his soldiers must feel their bellies full at all times and not complain about

[38] Murphey 2001, p.89, quoting the ration list given by L.F.Marsigli which is composed of 320 grams of bread, 160 grams of hardtack and rice each, 192 grams of mutton, and 80 grams of clarified butter. It is interesting to note that Marsigli's ration closely resembles the diet of the *acemi oğlanları* of the Topkapı Palace, see, K.F.Kiple, K.C.Ornelas (eds.), 1999, p.1148. Marsigli's book was translated into Turkish by Nazmi (a retired Lt.Colonel, Nazmi 1934).

[39] Murphey 2001, note 21, p.236.

[40] Hardtack was important for the navy, but it appears that the army did not consume much of it while marching or in the battlefield; see Genç, 2012, 72-73. According to S.Genç's calculations (pp.66-75) total hardtack consumption in the Tiflis and Tebriz campaigns was nearly 90 tons while the army consumed a staggering 5,763 tons of bread. The hardtack bakery in Bebek exclusively served the navy: Altı, Başkutlu 2020, pp.419-437. It seems that baking hardtack for the army was the preferred method of getting rid of mouldy flour in government warehouses. Another method of disposing mouldy flour was to sell it to the public; see the order dated 13 Feb., 1573 to the *defterdar* of Cyprus, DABOA (formerly BOA), *MD* 21-223.

being hungry. The best way to achieve this goal was to feed soldiers with as much bread as possible, which also had the economic rationale that bread had the lowest relative price of all ingredients in the rations. Bread not only provided carbohydrates but gave a very satisfactory sensation of being full. The *sipahi*, through the experience of the campaigns of previous centuries, was also aware of the fact that his soldiers needed protein as well as fat to give them energy and that a bread-only diet was not the ideal solution. We can say that he was acutely aware of what we today call "Acceptable Macronutrient Distribution Ranges" (AMDR) where there are limits to the substitutability of protein, fat, and carbohydrates for each other. It is recognized that a carbohydrate content of 45% to 65% is acceptable for a healthy adult when fat and protein contents are varied between 20-35% and 10-35%, respectively. So, from the point of nutritional value a diet of 65% carbohydrate, 20% fat, and 15% of protein is as good as a diet of 45% carbohydrate, 35% of fat, and 20% of protein (or any other similar combination) because they provide the same amount of macronutrients. To keep the bread ration at its highest but still within these ranges was the solution the *sipahi* inherited from his ancestors. Thus, he took the first step towards the solution of his linear optimization problem.

It seems that from this point on it was smooth-sailing for the *sipahi*. All he had to do was to review the prices of the ration components and try a few combinations, giving weight to bread and always keeping in mind the requirements of AMDR, and arrive at a daily ration that not only satisfied the calorie requirements in Table 3 but also gave him as low a total cost as possible. Again, the knowledge and experience he inherited would help him to reach this goal. But this was not to be for he would face different sets of prices on his journey to join the army and another set after joining it.

Price Formation in Towns and Rural Areas

The *narh* institution in the Ottoman Empire was one of the powerful instruments with which the bureaucracy controlled an important aspect of the economy. Commodity prices, especially those of necessities, were set by local authorities after consultation with the representatives of local guilds. These prices were registered with the *kadı*, announced, enforced by the *ihtisab ağası* and adjusted periodically, sometimes even daily. This process of price-fixing in towns is quite well documented in the literature, albeit with some serious confusion about its nature[41].

Being not self-sufficient, big cities required a steady supply of almost anything. The *narh* system ensured that this supply of goods was sustainable by recognizing a "fair" profit margin for both the wholesalers and the retailers and protecting the purchasing power of the city-dwellers. The mechanism was very simple: Any merchant (*getürücü*, literally meaning bringer) supplying goods to a town was given a profit margin of 5%-15%, and the retailers (*oturucu* or *oturakçı*, literally meaning sitter), were also recognised a profit rate of up to 25%[42]. The *getürücü* was not allowed to open his

[41] See Appendix II.

[42] The lowest profit margin of 1.4% is for clarified butter while the highest is for mutton in the

own shop to take advantage of both wholesaler and retailer profit margins[43]. This simple mechanism had one great drawback: The town officials, when calculating the rate of profit to be given to the *getürücü*, had to assume that all *getürücü*s bought their goods at the same price and transported it from the place of origin to towns at the same cost. This simply was not true, as the *kadı* and the *muhtesib* of the town became painfully aware when *getürücü*s with higher costs, who did not earn a sufficient profit or even made a loss, just stopped bringing goods.

Outside İstanbul, large towns such as Bursa, Konya, Edirne were also under the control of the *kadı-muhtesib-narh* system. But when we move away from large towns, we find ourselves in uncharted-territory as far as price formation is concerned. It is true that even smaller towns had some kind of *narh* mechanism but in countryside we do not have any evidence that *narh,* even in its simplest forms, ever existed. S.Faroqhi in her study of periodical markets in the six *sancak*s of Western and Southern Anatolia in the sixteenth century[44] found that there was an abundance of weekly or fortnightly rural markets outside towns where peasants brought their produce and bought goods which could not be produced in villages or obtained from *çerçici*s (itinerant hardware vendors) who periodically visited rural settlements and bartered their wares for agricultural produce. These rural markets were important for peasants because they were the most practical, if not the most profitable, way of converting surplus agricultural produce to money which was direly needed to pay the cash taxes due to the *sipahi*[45].

The *narh* mechanism required the simultaneous pre-existence of two important factors: The collaboration of the *kadı*, the *muhtesib*, and the local guilds to determine and periodically revise prices, and the possibility of levying and collecting taxes related to all kinds of marketplace activities, from bringing of goods to the market, to the calibration of scales, opening a stall or a shop, buying, selling, etc.. The *kadı* resided in the administrative center of the *sancak* and his deputies (*naib*) represented him in lesser towns. We have no evidence of *naib*s or guilds in the countryside. The *muhtesib*, who obtained his office by purchasing it from the central government at a fixed sum (*mukataa*) for a period of up to three years, financially depended on the collection of market taxes (*bac-ı pazar* and *resm-i ihtisab*) from exchange activities. In towns periodical street markets and the permanent location of shops at specific quarters made

eighteenth century; see, Çakmak 2012, p.24, 30; and, *İKS*, Üsküdar, no.22, 1590-1591, vol.10, f.649, f.657.

[43] For example, the *kadı* of İstanbul was ordered on 19 June 1560, to put an end to the illegal selling of rice, clarified butter, candle oil, olive oil, honey, cheese, almonds, chickpeas, and apricots by vendors other than retail grocers. Altınay 1987, 115-116. Similary, an imperial edict sent to the *kadı* of İstanbul on 26 January 1568, ordered him to prevent wholesalers of rice from stocking it in their warehouse and selling it to consumers at the retail price (*oturıcı narhına*): *7 Numaralı Mühimme Defteri, (975-976 / 1567-1569)*, vol.1, Ankara, 1988, p.380.

[44] Faroqhi 1978, pp.42-85.

[45] Peasants were under obligation, by law, to bring the *sipahi*'s share of wheat and barley as tax-in-kind to the nearest market which caused constant strife because the *sipahi* almost always insisted that it should be brought and sold in markets in town, where prices are higher, rather than in rural markets; see, Faroqhi 2000, p.69.

tax collection relatively easy and feasible. In the countryside this was not possible with a large number of periodical markets set up at locations between villages far from towns and from each other, and usually away from main roads. Also, a *kanunname* attributed to Selim I explicitly stated that *bac-ı bazar* was not applicable when sales took place in villages: "*Ve dahi köylerde her ne satılsa bac olmaz ve dahi altun ve gümüş ve kurşun satılsa yükle dahi olsa bac alınmaz*"[46]. Furthermore, the *kanunname* also stated that if outsiders (meaning peasants) coming to towns sold their goods directly to end-users no *narh* was applicable to that transaction. Most probably this was why İ.Ortaylı concluded that the *muhtesib* had no power outside towns[47]. It appears that periodical countryside markets were free from administrative controls where supply and demand conditions determined prices.

Accordingly, we have a hierarchy of prices where İstanbul sat at the top with prices inflated by transportation costs and successive *getürücü* and *oturucu* margins of profit as goods exchanged hands in their journey from producing districts to the imperial capital. At the bottom of this hierarchy was countryside markets where peasants sold their produce to each other or to merchants without any price controls in the form of fixed profit margins.

Therefore, if we use İstanbul prices to calculate the *sipahi*'s cost of feeding his soldiers, this will represent the absolute maximum cost to the *sipahi*. This is obviously not realistic but gives a good idea of the extent of food expenditure a *sipahi* could face when riding along the countryside to join the main army. More realistic estimates would be obtained if we use price sets that are 10% to 30% lower than İstanbul prices[48].

The Geographical Extent of Ottoman Campaigns

According to Q.Wright the Ottomans fought 36 battles between 1480 and 1670, including land and sea engagements where the casualty total exceeded 1,000 in land engagements and 500 in sea wars. The ten principal European powers (including Turkey) engaged in a total of 424 such wars[49]. The Center for Global Economic History database, however, lists an impressive total of 263 armed conflicts Ottomans fought during the same period[50]. R.Murphey, on the other hand, lists 20 principal wars between 1514 and 1670[51]. Lastly, S.A.Somel, shows a total of 178 armed conflicts (including internal uprisings) between 1470 and 1670[52]. For a graphical representation of military conflicts in which the Ottomans were involved between 1469 and 1610 see the chart in

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[46] Pulaha and Yücel 1988, p.34.

[47] Ortaylı 2008, p.300. Pamuk maintains that the publication of *narh* lists created the illusion that the *narh* was a permanent aspect of the economy while, in truth, it was only resorted to when there was a shortage of goods, extreme monetary fluctuations, and extraordinary unrest: 2005, pp.90-91 where he challenges the archive-based narrative of history.

[48] See Appendix III for details of price calculations.

[49] Wright 1942, appendix xix, pp.625-635.

[50] http://www.cgeh.nl/data. It should be noted that CGEH data include internal conflicts as well.

[51] Murphey 2001 appendix I, pp.195-196.

[52] Somel 2003, pp.xxiv-xli.

Appendix V which clearly shows that the Ottomans were almost continuously at war either abroad against the Austrians, Hungarians, Poles, Venetians, Mamluks, or Safavids, or at home fighting to quell internal uprisings. The outer limits of the geographical area in which these battles took place are given by the polygon defined by straight lines joining Uyvar (Nove Zamky, Slovakia), Estergon (Esztergom-Hungary), Eğri (Eger-Hungary), Haçova (Mezökeresztes-Hungary), Akkirman (Bilhorod Dnistrovs'ky-Ukraine) in the north; Tebriz (Iran) and Bağdat (Iraq) in the east, Ridaniye (Egypt) in the south, and Malta in the west. This polygon will later be used to to find a location for the "average" *timar* which will represent all the *timar*s.

Out of this area, we selected seven Ottoman campaigns between 1484 and 1663 in which timariots fought alongside with the regular army. They are:

1) Akkirman: 1484
2) Ridaniye: 1516-1518
3) Tebriz: 1533-1534
4) Estergon: 1543
5) Eğri (Eger-Hungary)-Haçova: 1596
6) İstolni-Belgrad (Szekesfehervar-Hungary): 1602
7) Uyvar: 1663

These are not random selections. Akkirman, Estergon, Eğri, İstolni-Belgrad, and Uyvar represent extended siege wars while Ridaniye and Haçova were fierce field battles. The Tebriz campaign of Süleyman I is a unique category in itself; there was no battle and the Ottoman army entered the city that had already been abandoned but the hardships suffered on the return route is testimony to the resilience of a victorious but exhausted army. Also, with the single exception of İstolni-Belgrad, they all correspond to the vertices of the irregular polygon discussed in Appendix VI below.

The İstanbul *narh* prices corresponding to these campaigns as calculated in Appendix III are presented in Table 4 (Our calculations in *italics*, Ş.Pamuk's numbers in **bold**) :

Table 4: İstanbul prices for dietary components (akçes per 100 grams)

Campaign	Date	Bread	Mutton	Clarified Butter	Rice
Akkirman	1484	*0.04*	*0.1*	*0.62*	*0.63*
Ridaniye	1516-1517	*0.05*	*0.13*	*0.85*	*0.72*
Tebriz	1533-1536	*0.06*	*0.18*	*0.54*	*0.56*
Estergon	1543	*0.06*	*0.17*	*0.53*	*0.55*
Eğri-Haçova	1596	*0.13*	**0.47**	**1.32**	**0.56**
İstolni-Belgrad	1602	*0.23*	*0.58*	**2.03**	**1.84**
Uyvar	1663	*0.20*	**0.94**	**1.79**	**2.06**

It must be noted that these are the highest prices that a *sipahi* would expect to

pay during a campaign. In reality, he probably paid less although we do not know how much less; so we calculated his total food costs at four different price sets ranging from 70% of the İstanbul prices at 10% intervals with quantities in Table IV-4 in Appendix IV. The following table shows these results:

*Table 5: Food costs of seven campaigns (akçe*s *per person per day)*

Campaign	At İstanbul prices	At 70%	At 80%	At 90%
Akkirman	0.686	0.480	0.549	0.617
Ridaniye	0.856	0.599	0.685	0.770
Tebriz	0.901	0.631	0.721	0.811
Estergon	0.881	0.617	0.705	0.793
Eğri-Haçova	1.783	1.331	1.426	1.605
İstolni-Belgrad	3.186	2.230	2.549	2.867
Uyvar	3.582	2.507	2.866	3.224

These cost figures multiplied by the number of soldiers and the days spent on campaigns will produce the total food cost of the *sipahi* at any given battle. This calculation requires us to specify the total number of soldiers supplied by each timar and its exact geographical location so that the length of the journey to the battlefield can be calculated.

The "Average" Timar

There were tens of thousands of *timar*s in existence at any given time during the period under consideration. Furthermore, new *timar*s were created as new territories came under Ottoman rule; some of the existing *timar*s were enlarged through the promotion system, some changed hands, and still some became vacant. The ideal solution would be to identify and follow each and every *timar* throughout its history using the *ruznamçe* registers, calculate its tax revenue and determine the number of soldiers provided[53] by that *timar*. Its geographical location would enable us to calculate how far this *timar* contingent traveled to join the main army and all its movements during the campaign. We very much hope and are confident that future historians with sufficient resources will tackle this Olympian task one day.

Nonetheless, we can define an "average" or generic *timar* which would represent all *timar*s from the point of view of tax revenue and geographical location and use these data in our calculations. The definition of a *timar*, as given by *kanunname*s, is any land-grant with an annual tax revenue of up to 20,000 *akçe*s. There is no data on the statistical dispersion of *timar* revenues. *Sancak*s contained *timar*s with revenues as low

[53] It is interesting to note that the number of soldiers that each timar was supposed to provide almost completely disappears from *tahrir* registers after 1530.

as 1,000-2,000 *akçe*s (mostly allocated to fortress guards) and as high as almost 20,000 *akçe*s. In Ordu, for example, the fertile northern belt *timar*s bordered on the lower limit of a *zeamet* while the southern *timar*s rarely approached 4,000 *akçe*s[54]. Being fully aware of its shortcomings, we take the mid-point of this revenue range (10,000 *akçe*s) and consider it as representative of all *timar*s.

The number of *cebelü*s to be provided by the *sipahi* at this average revenue is, at best, ambiguous. H.İnalcık warned that it is difficult to determine this number with any precision[55]. On the one hand we have the *kanunname* of Bayezid II (*Kitab-ı Kavanin-i Örfiyye-i Osmani*, promulgated probably in the last decade of the fifteenth century but certainly before the sixteenth century) which states that any *timar* with a revenue of between 10,000-11,000 *akçe*s must provide three *cebelü*s, one *gulam* and one tent[56]. A.Akgündüz argues that the original text of the *kanunname* does not contain the "one *gulam*" requirement[57]. Then we have Ayn Ali's *Kavanin-i Al-i Osman*[58] which unequivocally states that "t*imarı onbinden ziyade olanlar zeamete varınca üç cebelü verür*" thus limiting the number of *cebelü*s to two if the timar income was up to and including 10,000 *akçes*. P. Ricaut, in Book III of his *History*[59], calculates (sometimes wrongly) the number of *cebelü*s provided by the *timar*s based on "Imperial Rolls and Registers of the Grand Signior", using a fixed coefficient of two per *timar* throughout. For Marsigli, timars with incomes of up to 14,500 akçes provide two cebelüs[60]. According to Sofyalı Ali Çavuş "*Erbab-ı timara üç binde bir cebelü ferman olunmuştur. Timarı on bin olanlar on binden zeamete varınca üç cebelü verür*". M.Sertoğlu hastens to add that the 3,000 *akçe* increments come into force after the first 3,000 *akçe* (known as the *kılıç*) which limits the number of *cebelü*s of a 10,000 *akçe* timar to two[61]. In the fifteenth century a *sipahi* with a *dirlik* of as low as 370 *akçe*s was required to participate in the campaigns and bring a *cebelü* with him[62]. As new territories were captured fortresses and *palanka*s were built to protect the frontiers in Europe and in the east as well as to keep the peace in Anatolia. These garrisons were populated with guards under a variety of names[63]. One of these groups, called *müstahfiz,* was granted *timars* with incomes of less than 2,000 *akçe*s. Accordingly, the last quarter of the fifteenth and the

[54] Kılıç 2012, pp.256-304.

[55] İnalcık 2000, p.503.

[56] Akgündüz 1990-1996, p.45. These numbers are repeated in Beldiceanu 1985, p.84.

[57] Akgündüz 1990-1996, p.46.

[58] Ayn Ali Efendi 1863, p.21.

[59] Ricaut 1686, pp.332-339.

[60] Marsigli 1934, p.107.

[61] Sertoğlu 1992, pp.21-22. H. İnalcık calculated the number of *timar*s and *cebelü*s from Sofyalı Ali Çavuş's work and found that in the 24 provinces of the Empire there were 56,445 *timar*s providing 118,135 *cebelü*s; 2.1 *cebelü*s per *timar*: İnalcık 2000, p. 170.

[62] Emecen 1993, p.188.

[63] Between 1479 and 1540 there were 200 fortresses and *palanka*s in Hungary alone and the 11 garrisons in the east had 14,590 guards: see, Akto, 2019, pp.33-82. According to İnalcık, in 1527-1528, 37, 521 *timar*s supplied a total of 9,563 fortress guards, "Timar", *TDVİA*, p.169.

first quarter of the sixteenth century probably marks the beginning of the disappearance of small *sipahi* timars as well as the appearance of the initial *kılıç* size of 3,000 *akçe*s. In the following centuries the *sipahi*s supplied only two *cebelü*s for their incomes up to and including 10,000 *akçe*s.

The second characteristic of our "average" *timar* is that it should, as far as possible, approximate the geographical location of all *timar*s. Appendix VI shows how we derived the representative spatial position of this generic *timar*. It is at N 38.624 and E 29.271, marked with X, with a straightline distance of 187.9 kms to and slightly northeast of İzmir, 160.6 kms due east of Manisa, and 12.7 kms from Uşak. Its straightline distances (in kms) to the vertices of the polygon are as follows: Uyvar: 1,342; Estergon: 1,332; Eğri 1,260; Haçova 1,239; Akkirman 847; Tebriz 1,481; Bağdat 1,484; Ridaniye 970; Malta 1,345.

Its road-distance to the European muster point of Edirne is 653 kms, while it is 320 kms to the Anatolian muster point of Konya.

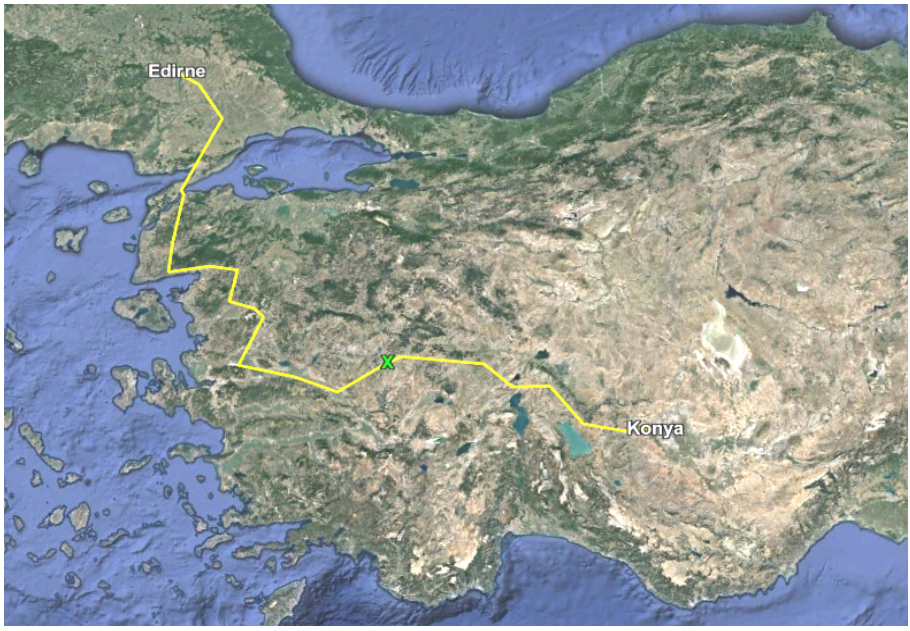


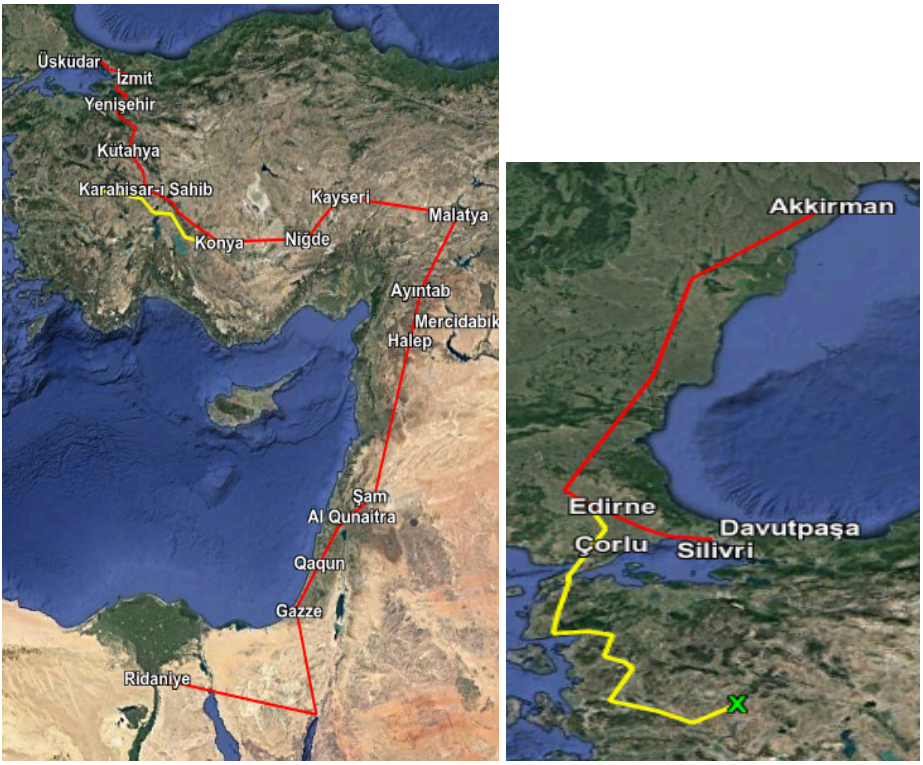
Figure 1: Generic *timar* to Konya and Edirne roads.

X-Edirne road exactly follows the ancient Roman road of Magnesia-Hadrianapolis up to the crossing-point at Çardak. The Roman road, after the crossing, takes an inexplicable detour to Tekirdağ instead of crossing the plain and proceeding directly up north to Edirne. The Orbis database of Stanford University (The Stanford

Geospatial Network of the Roman World)[64] gives the total distance from X to Edirne as 772 kms and estimates a journey of 14.7 days on horseback at 56 kms a day, including the long detour. When the detour is removed the distance is reduced to 653 kms and the journey to 11.67 days. This road, again up to the Hellespont crossing, corresponds very closely to Luther's description[65] of Anatolian road system.

According to Orbis, the Magnesium-Iconium road is 525 kms long and takes 9.4 days. When we consider only the X to Konya portion of this road the distance is reduced to 320 kms and the journey to 5.7 days. This route is almost exactly the same as described by U.M.Luther[66] and the Şuhut-Konya portion conforms to F.Taeschner's findings[67].

Before we calculate the distances between the "average" *timar* and the battlefields we must show the campaign routes of the Ottoman armies[68].



[64] http://orbis.stanford.edu/

[65] Luther 1989, pp.xix-xxvii.

[66] Luther 1989, p.xxiii

[67] Taeschner 2010.

[68] These routes are mentioned in almost all studies on Ottoman campaigns. We mainly used (with some corrections) Sağlam, 2016.

Figure 2: Üsküdar-Ridaniye route Figure 3: Davutpaşa-Akkirman route

(The route taken by the Ottoman army is marked in red and the *timar* contingent's is in yellow.)

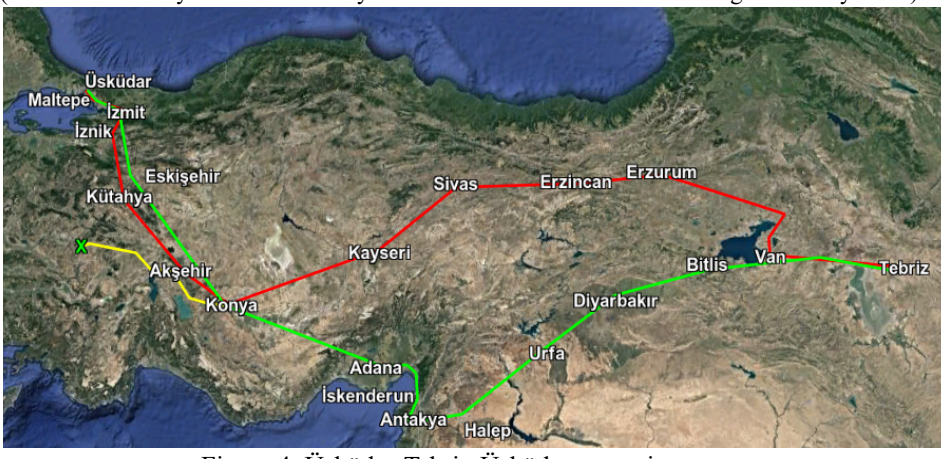


Figure 4: Üsküdar-Tebriz-Üsküdar campaign route

(The red line shows the route from Üsküdar to Tebriz while the green line shows the return route. The yellow line shows the route followed by the "average" *timar* contingent to join the main army at Konya.)

Figure 5: Estergon, Haçova, İstolni-Belgrad, Uyvar routes

(The campaign route is in red while the assumed routes from Budapest to İstolni-Belgrad and

Haçova are in cyan.)

The following table shows the distances and the assumed length of the journey between the "average" *timar* and battlefields:

Table 6: Distances and length of journey from X to battlefields (kms)

Battlefield	Distance	To and from muster point in days (56 kms per day)	To and from battlefield in days (24 kms per day)	Total number of days
Akkirman	1,252	11.66 x 2 = 23.32	24.96 x 2 = 49.92	73.24
Ridaniye	2,299	5.71 x 2 = 11.43	82.46 x 2 = 164.92	176.35
Tebriz	1,610	5.71 x 2 = 11.43	53.75 x 2 = 107.5	118.93
Tebriz (return)	1,603	5.71 x 2 = 11.43	53.46 x 2 = 106.92	118.35
Estergon	1,690	11.66 x 2 = 23.32	43.21 x 2 = 86.42	109.74
Eğri-Haçova	1,779	11.66 x 2 = 23.32	46.92 x 2 = 93.83	117.15
İstolni-Belgrad	1,707	11.66 x 2 = 23.32	43.92 x 2 = 87.83	111.15
Uyvar	1,739	11.66 x 2 = 23.32	45.25 x 2 = 90.50	113.82

The average *timar* contingent's speed of 56 kms a day is taken from the Orbis database on non-paved Roman roads. It corresponds to one hour of cantering plus two hours and 50 minutes of trotting for an average war horse. The 24 kms per day army-moving-speed is the average of R.Murphey's an C.Finkel's estimates (see note [(c)] to Table 2 above).

The number of days spent during a campaign in the last column of Table 6 does not include rest periods. The total length of the march can only be calculated from campaign journals which are unavailable for Akkirman, Ridaniye, Estergon, Eğri-Haçova, and İstolni-Belgrad. Besides, even the journal-entry method is marred with difficulties. The detailed chronology of Selim I's Mamluk campaign (from and to Üsküdar) shows a total length of two years, one month and 20 days[69]. This duration includes an inordinate number of "rest" days: 72 days in Halep, 232 days in Şam, and 230 days in Cairo; a total of 534 "rest" days out of a total of 780 days. To calculate the duration of the *timar* contingent's journey to and from Ridaniyye we have to subtract the Üsküdar-Konya-Üsküdar march and add the X-Konya-X portion which gives us 2,299 kms or 176.35 days to which we have to add the 534 "rest" days which results in 710.35 days of campaign time.

The Tebriz (*Irakeyn*) campaign started with İbrahim Paşa's departure from İstanbul on 21 October, 1533 and ended with Süleyman I's (who joined the army later in the campaign) return to İstanbul on 8 January, 1536: a total of 809 days. Although the

[69] Danişmend 1971, pp.24-48.

campaign itself was short, the extended stays at Halep, the conquest of Bağdat and the four months spent there, and the re-capture of Tebriz made it the longest campaign in Ottoman annals[70]. From these 809 days we subtract the Üsküdar-Konya-Üsküdar distance and add X-Konya-X which gives us a total campaign duration of 770 days for the *timar* troops.

For the Estergon and Baghdat (1638) campaigns R.Murphey calculated the journey length as 119 and 197 days out of which 67 and 76 days were spent marching while 52 and 121 days resting, respectively[71]. But M.İpçioğlu shows that the Estergon campaign (Edirne-Estergon-Belgrade) lasted a total of 169 days including rests[72] and that Süleyman I demobilised the entire army after reaching Belgrade on 9 October, 1543[73] thereby enabling the "average" *timar* contingent to trot and canter home at 56 kms a day. Therefore, the total campaign duration for the "average" *timar* soldiers was 202.4 days.

Although there is no journal for the Eğri-Haçova campaign of Mehmed III in 1596, fortunately, we have a very detailed account of the army's daily movements thanks to G.Börekçi who discovered an anonymous manuscript in a Konya library and eventually published it in its entirety[74]. This manuscript (attributed to Katip Ga'ibi by G.Börekçi) is a depressing narrative of the complete collapse of the Ottoman logistic system especially on the return route. According to this account the Edirne-Haçova-Edirne route was travelled in 162 days to which we add the 23.32 days of X-Edirne-X route of the *timar* contingent resulting in 185.32 days of campaign duration.

For İstolni-Belgrad, the chronicler Abdülkadir Efendi gives a detailed account of the siege and the eventual surrender of the fortress on 29 August 1602 but does not specify any dates for the campaign movements of the army[75]. Taking into account İstolni-Belgrad's geographical proximity to Budapest (which lies almost half-way between Eğri and İstolni-Belgrad) we estimate a campaign duration 182 days.

A.Şimşirgil, analyzing contemporary chronicles, estimates that the Ottoman army's Edirne-Uyvar march took 127 days, including extended stays in Filibe (Plovdiv-Bulgaria), Niş (Serbia), and Ösek (Osijek-Croatia). The army also spent almost 16 days in building three different bridges on the Danube[76]. Assuming the same extended stays but excluding the time spent in building bridges the return journey is 111 days resulting in X-Uyvar-X duration of 260.72 days.

The total campaign durations that we have calculated are, on the average, three times as long as the total number of days in the last column of Table 6. This means that

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[70] Danişmend 1971, pp.158-181; Balta 2017, pp.57-67; Emecen 1999, pp.116-117. In contrast, in the second Iran campaign the Ottoman army reached Tebriz in 121 days including 33 rest days.

[71] Murphey 2001, p.22.

[72] İpçioğlu 1990, pp.137-161 which is based on İpçioğlu 1989.

[73] İpçioğlu 1990, p.150.

[74] Börekçi 2013, pp.200-216

[75] Abdülkadir Efendi 2003, pp.305-321.

[76] These numbers are taken from A.Şimşirgil's unpublished orientation thesis for associate professorship (1997). Its full text is available at: https://turuz.com. Şimşirgil's time-line between Davutpaşa-Budapest is repeated, with slight changes, in Çalışır 2009, pp.92-93.

the Ottoman army rested two days for every day of marching. Based on this average, we estimate the total duration of the Akkirman campaign as 220 days.

We now have all the necessary data to calculate the food cost of a three-strong timar contingent in these seven campaigns. Table 7 below shows these results:

Table 7: Food cost of campaigns for two cebelüs and a sipahi (at İstanbul prices in akçes)

Campaign	Total duration (days)	Cost per day	Total cost
Akkirman	220.00	2.058	452.76
Ridaniye	710.35	2.568	1,824.18
Tebriz	770.00	2.703	2,081.31
Estergon	202.40	2.643	534,94
Eğri-Haçova	185.32	5.349	991.28
İstolni-Belgrad	182.00	9.558	1,739.56
Uyvar	260.72	10.746	2,801.70

These prolonged absences of the *sipahi* away from home strained his financial resources to such an extent that he often faced the danger of not being able to buy food for his soldiers. Two methods were used to alleviate this serious problem: Firstly, there was the state loans whereby the local officials were ordered to lend cash to timariots[77]. The local *kadi*s were entrusted with the task of recollecting the loan when the campaign ended[78]. The second and apparently more-widely practiced method was the designation by the *sipahi*s of a *sancak* of one of their number as proxy (*harçlıkçı)* and send him home to collect the taxes due to them from the *reaya*. The *mühimme* registers show that for larger areas the number of these proxies could be as high as 124[79]. The success of this method depended on the efficiency and the honesty of the *harçlıkçı*. Some of them collected the taxes due to their comrades but instead of going back they simply vanished with the money[80]. The more zealous of them forced the *reaya* to pay their *öşür* not in kind but in cash, or valued the produce not at *narh-ı cari* (see Appendix II) but at *narh-ı ruzi* and therefore increasing the amount of wheat and barley that the *reaya* were supposed to provide[81]. Apart from these somehow minor issues it appears that the *harçlıkçı* system worked pretty well.

[77] Tekgül 2016, pp.590-617.

[78] Tatar 2019, p.62.

[79] *3 Numaralı Mühimme Defteri*, pp.246-248.

[80] For example, the *harçlıkçı*s sent to Aksaray, Daday, and Develi in 1572-73 did not return with the tax revenues and, accordingly, their *timar*s were revoked: DABOA, *MD*, 13-537, 696, 721, 992.

[81] See the orders sent to the *kadı* of Yaya and the *bey* of Vulçitrin: DABOA, *MD*, 48-804, 881; Tatar 2019, p.106.

The Fine Art of *Sürsat* Pricing

The Ottomans had two very effective tax tools in their disposal to finance their campaigns: the *nüzul* and the *sürsat*. Leaving aside the lengthy literature on how and when the *nüzul* tax came into being, its transformation and re-transformation between cash and in-kind forms we will concentrate on the *sürsat*. Unlike the *nüzul*, which covered only wheat and barley, and sometimes flour, the *sürsat*'s subject was wheat, barley, bread, honey, mutton, hay, and firewood. The *sürsat* levy was first mentioned in an imperial order of 8 December, 1581[82] which shows that it was a late sixteenth century invention. It was levied on the *reaya* living on or near the campaign routes and generally assessed and collected in kind, but the prospective taxpayer could petition for and was usually granted permission to pay it in cash. The usual reason for this commutation was the high cost of transporting the taxable items to the nearest point on the campaign route.

The novelty of the *sürsat* tax was that the taxpayer had to sell, whatever commodity he was supposed to supply, at prices fixed by the government without regard to actual market conditions. As such, when the fixed government price was below a certain level of the actual market price, it created an uneven incidence in favour of those taxpayers whose liability was commuted to cash payment and against those who brought the commodities to the campaign route; but the Ottomans did not seem to be very much concerned with equity in tax matters, especially in times of war.

Although it was levied on other commodities as well, the *sürsat* was the main instrument to obtain cheap wheat for the soldiers and barley for the cavalry horses. The following table shows the sürsat prices for barley in different localities at different times:

Table 8: Sürsat prices for barley (akçes per kg)

Location	Date	Price
-	1616	0.52[(a)]
Ayıntab	1634	1.73[(b)]
Karahisar-ı Şarki	1634-35	1.62[(c)]
Kayseri	1656	1.52[(d)]
Kayseri	1658	1.52[(d)]
İstanbul	1661-62	0.91[(e)]
İstanbul	1670-71	0.46[(f)]
Bolu	1671-72	1.73[(g)]
Bolu	1673	0.87[(h)]
-	1676	1.73[(i)]
Konya	1676	1.73[(j)]
Kayseri	1678	1.73[(d)]

82 DABOA, *MD*, 45-4164. For an incisive analysis of various kinds of extraordinary war-time taxes (*nuzül, sürsat*, and *iştira*) see Finkel 1988, pp.130-144.

Konya	1685	1.73[(j)]
Kayseri	1687	2.17[(d)]
Konya	1687	1.73[(j)]

[(a)] İşbilir, 2002, p.17. (We have converted the *kile* volume given by the authors to kg dividing by 23.093 instead of the usual 26.656 because barley has a larger volume than wheat; see, Taşkın, 2005, p.63; İnalcık gives a similar weight (23.76 kg) for the Buda barley *kile* for 1665: İnalcık 1983, p.331; [(b)] Koçak, 2010, p.236; [(c)] Polat, 2011, p.167; [(d)] Selçuk, 2008, p.180; [(e)] *İKS*, Eyüb, no.74, 1661-62, vol.28, f.75; [(f)] *İKS*, Eyüb, no.224, 1670-71, vol.29, f.186; [(g)] Sahillioğlu, 1964, p.17; Sahillioğlu, 1965b, p.26; [(i)] Gülcan, 1989, p.329; [(j)] Öztürk, 2017, p.220-222.

The glaring disparity between the government-fixed *sürsat* prices and actual market prices for barley is noteworthy. In 1616, for example, while the market price of barley was 1.95 *akçe*s per kg the *sürsat* price was fixed at 0.52 akçes, almost one-fourth of the market price. Similarly, in Bolu in 1671-72 the sürsat price was exactly 25% of the market price. Another remarkable feature of the *sürsat* price was its stability through time. From 1616 to 1687, out of 15 different *sürsat* prices, we note that the lowest was 0.46 *akçe* per kg in İstanbul in 1670-71, closely followed by 0.52 in 1616, 0.87 in 1673 in Bolu, and 0.91 in 1661-62 again in İstanbul. The remaining 12 prices range from 1.52 to 2.17 (in Kayseri in 1687), six of them being 1.73 (in 1634, 1671-72, 1676, 1678, 1685, and 1687) and two 1.52 (1656 and 1658). The average *sürsat* price for the whole period is 1.45 *akçe* per kg, while it is 1.18 for 1616-1670. We will use these prices to calculate the cost of feeding horses in campaigns.

The reason why we are so interested in these price trends is that barley, together with forage, was the main source of food for the horses.

The Horse

A horse, unlike the bovine family, eats small quantities but frequently. Its nutritional needs are mainly determined by its weight and the activities it performs. It is an interesting fact that a horse grazing on green grass is able to get all the sustenance it needs without requiring anything else. But grass is not always available; winter months and geographical land patterns sometimes makes it impossible to find. In such cases, the horse is either fed dried grass or grain, or a mixture of both.

In Anatolia, the most widespread horse breeds were and still are the Anatolian pony, the Rahvan horse, and the Canik horse[83]. The Anatolian pony, the most common of all three, believed to have descended from the legendary *Akhal-Teke* breed of Turkoman horses, is a small horse with extraordinary stamina[84]. An average Anatolian pony has a

[83] The FAO Domestic Animal Database is, inexplicably, silent on these breeds except noting that the Anatolian pony is on the verge of extinction and the Canik horse is really bad-tempered: http://www.fao.org/dad-is/browse-by-country-and-species/en/ .

[84] The Anatolian pony probably could not compete with, but came close to the famous Tatar ponies “which managed to complete 59 hours of march … over a three day period”: Murphey 2001, pp.218-219.

heart girth of 138.7 cm and length of 138.1 cm[85]. This gives a total weight of 224 kgs[86]. This pony's calorie requirements for different activity levels are shown in Table 9.

Table 9: Calorie requirements of the Anatolian pony per day-per hour (kcal)

Activity Level	Calorie requirement per 100 kgs of weight[(a)]	Daily calorie requirement	Hourly calorie requirement
Maintenance	3,308	7.410	308.75
Moderate	5,513	12,350	514,58
Heavy	7,278	16,302	679.25

[(a)] http://www.dayvillesupply.com/hay-and-horse-feed/calorie-needs.html

These calorie requirements can be satisfied in a variety of ways: grazing only, grazing and barley, barley only. A horse eating from 5.1 kgs (in 7 hours) to 9.8 (in 17 hours) kgs of grass per day receives between 2,593-2,785 kcal, with an average of 2,623 kcal[87]. One kg of barley, on the other hand, provides 3,540 kcal[88]. It contains 730.5 grs of carbohydrates (by difference), 90 grs of water, 121 grs of protein, and small amounts of fat, ash, and sugar. The following table shows alternative ways of providing the Anatolian pony with its calorie requirements:

Table 10: Meeting the Anatolian pony's calorie requirements (kgs)

Calorie requirement (kcal)	Grass only	50% grass + 50% barley	Barley only
7,410	2.83	1.41 + 1.05	2.09
12,350	4.71	2.35 + 1.74	3.49
16,302	6.22	3.11 + 2.30	4.61

During the European campaigns the Ottoman army traversed through the lush pastures of Bulgaria, Romania, Serbia, and Hungary[89]. With the exception of the disastrous Eğri-Haçova campaign, when fodder was unavailable even for the *sultan*'s own horses[90] it is reasonable to assume that the *timar* contingent's horses had ample opportunity to graze. In the case of eastern campaigns, the situation was somewhat different. On the Üsküdar-Tebriz route, pastures to the east and southeast of Erzurum,

[85] Yılmaz 2012, p.120. Their small size is evidenced by various illustrations in Ricaut 1686, p.74, 308; Marsigli, (illustrations at the end of the book); Güleç 2005, pp.45-47.

[86] Similar to calorie calculators for humans there is an abundance of horse-weight calculators online. We used: https://thehorse.com/tools/adult-horse-weight-calculator/ .

87 Asai, 1999, pp.490-492.

[88] https://ndb.nal.usda.gov/fdc-app.html#/food-details/170283/nutrients.

[89] Finkel 1998, p.195 gives examples of where foraging was amply available.

[90] "*... sa'adetlü padişahumun atları yemsiz yatmıştır*", Börekçi, 2016, p.56. This disgraceful event happened on the 38th day of the campaign, immediately after the army left Sofia for Belgrade.

when the terrain became mountainous, were available but only in limited areas. On the return route the arid zone between Diyarbakır and Halep meant almost no pastures at all. The Üsküdar-Ridaniye route also had its difficulties with very limited grazing opportunities to the south of Halep. The "average" timar to Edirne and Konya routes had plenty of pastures.

Table 9 above shares activity levels with Table 2, with the difference that the former has only three levels of activity while the latter has seven. But we note that the sedentary and light activity levels in Table 2 are similar to the maintenance level in Table 9; moderate and active to moderate, and very active, combat, and close combat levels to heavy activity levels. Therefore, if we convert Table 2 levels to Table 9 levels we obtain the following table:

Table 11: Anatolian pony's activity levels (hours per day)

Activity level	Marching to muster point	Moving with the army	Battlefield	Moving with the army	Marching home
Maintenance	12	13	8	13	12
Moderate	4	8.5	7	8.5	4
Heavy	8	2.5	9	2.5	8

Combining the hourly calorie requirements in column 4 of Table 9 with Table 11 we obtain the daily color requirement of the Anatolian by type of activity level:

Table 12: Anatolian pony's calorie requirements by type of activity (kcal)

Activity level	Marching to muster point	Moving with the army	Battlefield	Moving with the army	Marching home
Maintenance	3,705	4,014	2,470	4,014	3,705
Moderate	2,058	4,374	3,602	4,374	2,058
Heavy	5,434	1,698	6,113	1,698	5,434
Total	11,197	10,086	12,185	10,086	11,197

The *timar* contingent's horses must be provided with fodder that will produce the calories shown in the last row of Table 12. Despite the generous availability of pastures on the western front (with the exception of the Eğri-Haçova campaign), we will make another assumption that will result in still higher fodder costs: only 28% of the calorie requirements will be supplied by free grass grazing and the remaining 72% by feeding the horses with barley which results in Table 13:

Table 13: Feeding the Anatolian pony during a campaign (kgs/day)

Activity level	Marching to muster point	Moving with the army	Batllefield	Moving with the army	Marching home

Calories required (kcal)	11,197	10,086	12,185	10,086	11,197
Provided by grass (kgs)	1.28 (3,359 kcal)	1.15 (3,026 kcal)	1.39 (3,655 kcal)	1.15 (3,026kcal)	1.28 (3,359 kcal)
Provided by barley (kgs)	2.27 (7,838 kcal)	2.05 (7,060 kcal)	2.47 (8,530 kcal)	2.05 (7,060 kcal)	2.27 (7,838 kcal)

The last row of this table shows how much barley each horse must be fed per day to achieve the required energy intake, assuming the rest will be supplied by grazing. Since the *timar* contingent has three horses these quantities must be multiplied by three to get the daily barley requirement. Multiplying by the number of days in each campaign we will obtain the amount of barley that the Anatolian ponies will consume in these campaigns. While calculating the food requirements of the soldiers (see Appendix IV) we made the cost-increasing assumption that each soldier needed 2,267 kcal per day irrespective of his level of activity. We know that he did not need that much (for example, he needed only 1,860 kcal while marching to the muster point) but, nevertheless, we made the assumption which resulted in increasing the total cost to the *sipahi*. Similarly, here we make yet another cost-increasing assumption and assign 2.47 kgs of barley per day to the *timar* contingent's horses, being fully aware that they needed that much of barley *only* in the battlefield while exerting their maximum effort.

Table 8 shows that the average *sürsat* price for barley for the whole period was 1.45 *akçe*/kg. This was the price the *reaya* was supposed to sell his produce when he brought it to the campaign route. To whom it was sold is a matter of controversy. H.İnalcık maintains that it was sold to a "government agent"[91]. C.Finkel, on the other hand, quoting from the Vienna manuscript of Abdülkadir Efendi's chronicle, shows that it was "indisputably … sold to the troops"[92]. Indeed, Abdülkadir Efendi is adamant in saying that sürsat provisions were a subject of trade for the reaya[93]. We will assume that the selling price to the provincial soldiers was 1.73 akçe/kg, the most frequent number in Table 8 Table 14 shows the barley cost of feeding the horses and the food costs of the contingent in all the campaigns. Attentive readers will realize that the duration of the Eğri-Haçova campaign in this table is given as 92.7 days while the campaign lasted 185.32 days. The reason for this is self-explanatory: during the return route there was no barley to be had and, judging by the campaign journal of Katib Ga'ibi, the army lost a huge number of its horses, camels, and draught animals. Some of the horses were killed during the battle, some drowned in rivers and swamps, and some were stolen. Given the level of hunger reached in the army ranks, it is reasonable to assume that quite a few of

[91] İnalcık and Quataert 1994, p.97

[92] Finkel 1988, p.136.

[93] Abdülkadir Efendi 2003, vol.1, p.108; vol.2, p.707, 715.

them were slaughtered and eaten by their riders[94]. We assume that the timar contingent lost all their horses on the return route to Edirne, the cost aspect of which will be dealt with later when we calculate the weaponry and war material costs.

Table 14: Total food and fodder cost in campaigns (kgs and akçes)

Campaign	Duration in days	Barley consumption (kgs)	Barley cost (akçes)	Food cost (akçes)	Total cost (akçes)
Akkirman	220.00	1,628	2,816	453	3,269
Ridaniye	710.35	5,256	9,092	1,824	10,916
Tebriz	770.00	5,697	9,855	2,081	11,936
Estergon	202.40	1,498	2,590	535	3,125
Eğri-Haçova	92.7	686	1,186	991	2,177
İstolni-Belgrad	182.00	1,347	2,329	1,740	4,069
Uyvar	260.72	1,929	3,337	2,802	6,139

The Ridaniye and Tebriz campaigns lasted two taxation periods but even then, the *sipahi* was able to meet his food and fodder costs. The timing differences between the collection of taxes and expenditure dates must have been bridged by the loan advances made by the central treasury and the funds collected through the *harçlıkçı* system.

Weaponry as Investment

We can now proceed to calculate the last cost item: procurement and maintenance of the major pieces of weaponry and equipment. When the *sipahi* received the call-to-arms he joined the main army clad in a chainmail shirt or tunic (except when he was at the very low level rung of the ladder when he was allowed to wear a *cebe*[95]) with metal plate leg and sometimes arm guards, on a horse, carrying a sword and a shield, a dagger, possibly a lance, and sometimes a mace. He usually wore an iron helmet with a spiked top. His retinue consisted of troops riding horses, wearing a simple defensive armor called *cebe*, carrying a sword and a shield, a dagger, a bow and a quiver of arrows, and sometimes a lance. The whole contingent was required to bring one or more tents with them to the campaign.

The important point about the weaponry was that unlike food and fodder they did not disappear as they were used. With proper care and maintenance, they lasted a long time and they could be used in successive campaigns. Therefore, the money spent on them should be treated not as expense but as investment and their cost must be depreciated over their useful economic life.

[94] Finkel (1988, p.156) shows that during the sieges of Varad in 1598 and Pest in 1602, when hunger among the soldiers reached high levels, horses were butchered and eaten.

[95] Akgündüz 1990-1996, vol.2, pp.45-46.

The only exception to this rule was the arrow: when the bow was released the arrow could have been regarded as lost forever unless it was replaced by arrows thrown by the enemy. In 1502 in Edirne arrows made from pine tree with goose fletching was sold at 0.2 *akçe*. If the fletching was eagle feather the price jumped to one *akçe*. When bought in quantity (batches of eight arrows) the price was 0.5 *akçe* and the maximum price for a bow was set at 40 akçes[96]. In 1658 an arrow cost three *akçe*s while in 1664 it was cheaper at two *akçe*s; the average throughout the seventeenth century was 2.25 *akçe*s[97]. Assuming that half of the 30 arrows that the Ottoman soldiers released was later recovered, this gives us a total arrow-cost of 101.3 *akçe*s/day for the last three campaigns; for Akkirman and Ridaniye and Estergon it works out at 22.5 *akçe*s/day. The same source, this time quoting from İ.Bostan, gives a bow price of 120 *akçe*s throughout the seventeenth century. Assuming a five-year average usable life this works out at 8 *akçe*s for Akkirman, Ridaniye, Tebriz, and Estergon bow price of 40 *akçe*s) while it was 72 for the remaining three campaigns. The depreciation cost of the bow must be multiplied by two for Ridaniye and Tebriz because these campaigns lasted longer than one year.

Leaving aside the ceremonial shields of the higher ranking officials which cost up to 2,000 *akçes*[98] the shields used by the sipahi contingent were simple affairs, mainly made from fig trees, and reinforced with hide and metal studs[99] which was resistant to lance and sword blows. Their prices varied between 25 and 170 *akçe*s between 1591 and 1736[100] with an average price of 49 akçes, yielding a depreciation cost of 29 akçes for the contingent for each campaign and 58 *akçes* for Ridaniye and Tebriz.

The most quoted weapon in probate records is the *karakılıç*, the traditional sword of the Ottoman cavalry with a curved blade. The average price for the *karakılıç* for the 26 entries in these records is 177 *akçe*s[101] with a depreciation cost of 106 *akçe*s for the shorter campaigns and 212 akçes for the longer.

If the *timar* contingent consisted of only one soldier, the *sipahi* himself, he brought with him a *tenktür* to sleep in and protection against weather. The *tenktü*r was essentially a glorified sleeping bag. For a larger group a tent was required. The price of a tent depended on the material it was made of and its sleeping capacity. For example, in 1567 in Edirne a waterproof (*muşamma*) çadır was valued at 600 *akçe*s while an ordinary tent was 200 *akçe*s and in 1572 four different tents were valued at 498, 555, 645, and 1,000 *akçes*[102]. From 1521 to 1698 we have five different valuations for tents ranging from 265 to 700

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[96] Barkan 1942, p.175.

[97] Kolçak 2012, p.327.

[98] *İKS*, İstanbul, no.191, 1591-1617, vol.44, f.110.

[99] Marsigli 1934*,* p.159.

[100] *İKS*, İstanbul, no.191, 1591-1617, vol.44, f.110; *İKS*, Galata, no.37, 1613-1615, vol.37, f.81; *İKS*, Galata, vol.54, 1672-1674, f.850; *İKS*, Eyüb, vol.163, 1734-1736, vol.67, f.289.

[101] Barkan 1966, pp.147-423; *İKS*, Eyüb, no.138, 1717-1718, vol.90, ff.84-128; *İKS*, Galata, no.132, 1606-1607, vol.36, f.53; *İKS*, Galata, no.137, 1613-1615, vol.37, f.81, 100, 173, 181; *İKS*, Galata, no.46, 1615-1620, vol.38, f.35, 108; *İKS*, Galata, no.65, 1641-1644, vol.39, f.62; İ*KS*, Kısmet-i Askeriye, no.19, 1698-1699, vol.58, f.104, 427.

[102] Barkan,1966, p.86, 138, 147, 150, 236.

*akçe*s[103]. Furthermore, we have two interesting probate entries that valued tents according to the partitions they had: one with 14 partitions valued at 2,800 and another one with 10 partitions at 1,860 akçes[104]. If the number of partitions was any indication of how many people could sleep in that tent, then this works at about 200 *akçe*s per person; a number which is in conformity with the average of the prices we quoted. The depreciation cost for Ridaniye and Tebriz becomes 160 *akçe*s and for the rest 80 *akçe*s.

The chainmail armor (the *bürüme*) was an intricate piece of equipment. It was made of thousands of iron or low-steel rings (up to 21,000) riveted together with iron pins and sometimes with wire[105]. It required metallurgical knowledge, extrusion technology, high skills, and a lot of labour time. The number of *timar*s at the height of the system numbered around 50,000 with at least 4/5 of the *sipahi*s wearing chainmail in the battle. The inevitable question that arises within this context is: who manufactured these armours? According to T.Çoruhlu[106] the great majority were supplied by workshops on the western shores of the Caspian Sea, and from Bitlis, Erzurum, and Kars. Evliya Çelebi, on the other hand, maintains that there were more than 1,000 armour-makers in İstanbul all of whom were in the employ of the *cebehane*, manufacturing armour for the *kapukulu* soldiers; independent armour-makers had only four workshops employing a total of 40 workers[107]. The wires used in making the rings of the *bürüme* were extruded from Caspian and Indian iron by *demir çekenler esnafı* who numbered 40 in 15 workshops[108]. Obviously, this many craftsman could not satisfy the armour needs of the *kapukulu* and timariot soldiers. An answer to this mystery is offered by G.Busbecq that the armour worn by the Ottomans almost entirely consisted of booty from previous campaigns. He also makes fun of how undignified the soldiers looked wearing these ill-fitting hand-me-downs[109]. We also have quantitative proof that these armours were mostly of non-Ottoman origin: out of 4,111 chainmail armours worn by the Ottomans in the battle of Mohaç 3,286 were described as *Frengi* and *Ungurusi*[110]. The "Ottoman" chainmails exhibited in various museums around the world are most probably ceremonial and none of them bear any resemblance to the actual armour illustrated by L.F.Marsigli[111].

Whatever its source of manufacture was the chainmail commanded a market price and was actively traded. The first chainmail price that can be found is 480 akçes in

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[103] *İKS*, Üsküdar, no.1, 1521, vol.1, f.279; *İKS*, Galata, no.46, 1615-1620, vol.38, f.60; İ*KS*, Galata, no.65, 1641-1644, vol.39, f.279; *İKS*, Kısmet-i Askeriye, no.19, 1698-1699, vol.58, f.104.

[104] *İKS*, İstanbul, no.191, 1591-1617, vol.44, f.218, and, *İKS*, Rumeli, no.80, 1647-1649, vol.15, f.105.

[105] Williams 1996, pp.363-398; Demmin 1894, pp.165-174; Ffoulkes 1909, pp.15-29; Çoruhlu 1995, pp.17-19; Bilge 2017, p.51.

[106] Çoruhlu 2013, p.395.

[107] Kahraman and Dağlı 2003, p.560.

[108] Kahraman and Dağlı 2003, p.571.

[109] Busbecq 2005, p.123.

[110] Emecen 2010, p.213.

[111] Marsigli 1934, illustration no.6 at the end of the book. Bikkul 1957, pp.35-52 describes most of the exhibits as of non-Ottoman origin.

1553[112]. An İstanbul probate record, on the other hand, valued 13 different chainmails between 100 and 700 *akçe*s[113]. Sticking to our cost-increasing assumption we accept the higher price and assign a depreciable value of 700 *akçe*s to the *sipahi*'s chainmail.

The *cebe* worn by the *sipahi*'s soldiers was made from padded fabric, sometimes boiled leather, reinforced with metal plates. Topçular Katibi repeatedly mentions a type of *cebe* with pieces of wood planks[114]. No cebe survived the passage of time and we do not have any examples in museums or in private collections. The only piece of price information about the *cebe* belongs to the same probate record above with three items valued between 170 and 200 *akçe*s. We again take the higher price and because it was much less durable than the chainmail we assume its economic life was as short as two years.

Probate records abound with horse prices from 200 to 22,400 *akçe*s, the latter probably commanded by a rare thoroughbred. In Barkan's study of Edirne probate records we found 83 instances of horse price, excluding *tay*s (colts), *bargir-i seyishane* (pack horse), *hergele* (unbroken) and *yund* (mustang) between the years 1533-1659[115]. A cursory look at the *şeriye* registers revealed another seven prices for 1573-1644[116]. The series of these 90 prices has a wide dispersion, with a standard deviation of almost 1.5 times the mean but the mode and the median are both 1,500 *akçe*s. From this series we eliminated three horses with a price of 16,000 and higher: clearly, they are thoroughbreeds and quite beyond the reach of the *timar* contingent. We also eliminated seven horses with prices between 200 and 351 *akçe*s that are described as used by household servants, and a blind stallion valued at 655 *akçe*s. This gave us a much narrower dispersion and the standard deviation to the mean ratio decreased to 0.91 with the mode and the median remaining the same at 1,500 *akçe*s. What we are considering is the Anatolian pony, an animal not much bigger than a full-grown donkey and we assign the mode value of 1,500 *akçe*s to its price. In the case of the Eğri-Haçova campaign where the *timar* contingent lost all its horses on the return route, and assuming that all the weaponry (including the horses) had already completed half of their useful economic lives before the return journey began, the write-off value of all the three horses of the timar contingent becomes 2,250 *akçe*s. Putting together all the calculations for weaponry we obtain Table 15:

Table 15: Depreciation Cost of Weaponry (Akçes)

Campaign	Arrow	Bow	Shield	Sword	Tent	Chainmail	*Cebe*	Horse	Total
Akkirman	225	8	29	106	120	140	100	900	1,628
Ridaniye	23	16	58	212	240	280	200	1,800	2,829
Tebriz	-	16	58	212	240	280	200	1,800	2,806
Estergon	293	16	29	106	120	140	100	900	1,704

[112] Barkan 1966, p.118.

[113] *İKS*, İstanbul, no.191, 1591-1617, vol.44, f.110.

[114] Abdülkadir Efendi 2003, *passim*.

[115] Barkan 1966, pp.85-433.

[116] *İKS*, Galata, no.15, 1573-1591, v.34, f.195; no.65, 1641-1644, vol.65, f.336; *İKS*, İstanbul, vol.191, 1591-1617, vol.44, f.63, 90, 100, 234.

Eğri-Haçova	2,126	72	29	106	120	140	100	2,250	4,943
İstolni-Belgrad	3,442	72	29	106	120	140	100	900	4,909
Uyvar	3,949	72	29	106	120	140	100	900	5,416

From the point of view of depreciation cost the Uyvar campaign was the most expensive closely followed by the Eğri-Haçova and the İstolni-Belgrad campaigns. The reasons are obvious: the siege of Uyvar lasted 39 days during which the *sipahi* contingent's cost of arrows released amounted to a staggering 3,949 *akçe*s. The İstolni-Belgrad campaign is a close second with an arrow cost of 3,442 *akçe*s spent during a siege of 34 days. Compared to Uyvar the siege of Eğri was shorter by 18 days but the complete write off the all the three horses on the return route inflated the total depreciation cost of the campaign to nearly that of Uyvar. During the Tebriz campaign there was no battle and no arrows were expended. It might be argued that since there was no siege or field battle the depreciation costs in columns 3-5 must be excluded from the table but these are already insignificant sums.

Before combining all the costs into a summary table and showing the total cost of each campaign as compared to the average timar value of 10,000 *akçe*s two important reminders are in order. As we explained in Appendix II in detail, the total tax revenue of any *dirlik* reflected the true value of the sum of its cash taxes and the valuation of its taxes-in-kind *only and only* when that dirlik was bestowed on any given date. This value was entered in the *defter-i hakani* and remained the same until a new tahrir was undertaken. Therefore, the actual money income that a *sipahi* derived from his *dirlik* was a direct function of the price level of both wheat and barley *and* the proportion of these taxes-in-kind to taxes payable only in cash. The higher this proportion and prices of wheat and barley, the higher was the *sipahi*s actual money income because while cash taxes remained stable (except for some minor modifications) the money value of taxes-in-kind increased. H.İnalcık states quite categorically that this ratio was at least 50%[117]. Although this is a quite debatable statement[118] the one-to-one ratio between the two types of taxes as claimed by H.İnalcık means a continuous increase in the *sipahi*s money income as prices increase through time. This means that any comparison of the total cost of the campaigns in the following table with the average *timar* income of 10,000 *akçe*s that we assumed is only relevant at the date of the campaign provided that the most recent *tahrir* was not too far away in the past. As we show in Appendix II, there were considerable gaps between *tahrir* dates with the result that, on the average, the assumed 10,000 *akçe*s *timar* value in money terms was much higher at campaign dates.

Secondly, the values in Table 15 are sensitive to the number of arrows thrown

[117] İnalcık and Quatert 1994, p.71 and again in p.90.

[118] Our first impression from a study of *timar* incomes is that the Anatolian *timar*s had a very high ratio of taxes-in-kind to cash taxes (sometimes as much as up to three or four times) while İnalcık's claim was closer to the truth in the European provinces.

and recovered. We assumed that the *timar* soldiers released 30 arrows every day and recovered 15 of them later on. If more arrows were released than the daily 30 and less than 50% of the arrows thrown were recovered then the depreciation cost of arrows rises and can become quite high, in proportion to the error in our assumption. Similarly, considering the long duration of all the campaigns and our assumption of a 4.35 *akçe*/kg of purchase price for barley by the *timar* soldiers, the feeding cost of horses rises if the purchase price was higher than what we assumed.

With these reminders in mind we reach our final table:

Table 16: Total Cost of Campaigns (Akçes)

Campaign	Food	Barley	Depreciation	Total cost
Akkirman	453	2,816	1,628	4,897
Ridaniye	1,824	9,092	2,749	13,745
Tebriz	2.081	9,855	2,726	14,742
Estergon	535	2,590	1,664	4,829
Eğri-Haçova	991	1,186	4,904	7,121
İstolni Belgrad	1,740	2,329	4,871	8,980
Uyvar	2,802	3,337	5,378	11,557

It must be noted that, with the exception of Uyvar, the costs of all the campaigns was well below the assumed *tahrir* value of *timar* incomes. The Uyvar campaign, that took place in the late seventeenth century, overshot the *tahrir* value by only 11.6% which could have been easily financed by previous savings. More to the point, in 1663 when the Uyvar campaign was undertaken, no *tahrir*s had been undertaken for almost 70 years and the increase in the money incomes of the *sipahi*s because of the upward movement of wheat and barley prices since the last *tahrir* could have easily bridged the gap.

The Timar System as a Financially Working Organisation

This article attempted to test the validity of the argument that the Ottoman *timar* system was in financial decline in the late sixteenth century and that it was unable to carry out the military obligations it was supposed to perform. We found this not to be true.

Based on the energy requirements of the *timar* soldiers and their horses we calculated the actual money cost of maintaining such a unit in seven different campaigns. We also calculated the depreciation cost of the weaponry in these campaigns. While making these calculations we made several assumptions when confronted with conflicting information, ambiguities in sources, and the sheer absence of data. All these assumptions, however, were in the direction of increasing the cost of campaigns rather than decreasing it. Their cumulative effect must have been to inflate the cost figures in our calculations beyond what they truly were. The last three of the seven campaigns took place between 1596 and 1663, a period in which the timar system

was supposedly not functioning properly. We found no evidence of this generally accepted proposition.

It appears that the reasons for the gradual decline and dissolution of the *timar* system must be sought somewhere else, not in its financial strength.

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Appendix I: Calculation of Calorie Requirements

Basic Parameters:

Age = 25 years	Weight loss 1 = 0.25 kg/week
Height = 160 cms	Weight loss 2 = 0.50 kg/week
Weight = 57.2 kgs	Basic Metabolic Rate = 1,450 kcal/day

Table I-1: Daily calorie requirements of different types of activity per day

Activity	Sedentary	Light exercise	Moderate exercise	Active	Very active	Extra active
No weight loss	1,740	1,994	2,124	2,248	2,501	2,755
Weight loss 1	-	1,744	1,874	1,998	-	-
Weight loss 2	-	-	-	-	2,001	2,255

Definitions of activities: (Campaign equivalents)
Sedentary: Little or no exercise (Resting)
Light exercise: 1-3 times/week (Light campsite chores: Cooking, cleaning)
Moderate exercise: 4-5 times/week (Medium campsite chores: Collecting and chopping firewood, carrying water)
Active: Daily exercise or intense exercise 3-4 times/week (Heavy campsite chores: Setting up and dismantling tents, grooming and feeding horses)
Very active: Intense exercise 6-7 times/week (Sustained horse-riding)
Extra active: Very intense exercise daily, or physical job (Digging trenches, siege combat, close combat)
Exercise: 15-30 minutes of elevated heart rate activity
Intense exercise: 45-120 minutes of elevated heart rate activity
Very intense exercise: More than two hours of elevated heart rate activity

Appendix II: A Necessary Digression on *Narh* and *Narh-ı Cari*

It seems that there is some confusion among historians of the Ottoman Empire, both contemporary and modern, about the true nature of the price setting process. We are given to understand that *narh* prices were price ceilings and any attempt by the seller to offer his goods above this ceiling was punishable by law[119]. This was not always true: There were occasions when prices were fixed not as a ceiling but as a minimum[120] and selling below that minimum was an offense. This was certainly a tool used to prevent unfair competition between guild members. But

[119] See, for example, the two classical works by Kütükoğlu, 1978, pp.1-85, and, 1983; Kallek, 2006, pp.390-391; İlgürel, 2003, pp.11-21.

[120] Mantran, 1969, p.315, citing the *kanunname* of Mehmed IV, dated 1680; Sahillioğlu, 1967, pp.36-40.

the confusion does not end here. Different historians have attributed different meanings to the *narh* price, which, undoubtedly, was caused by the liberal use of the term in its various forms in historical documents. Even a cursory search of of İstanbul *şeriye* registers returns hundreds of examples, qualified by almost as many adjectives. We have *narh*, *narh-ı cari*, *narh-ı ruzi*, *narh-ı padişahi*[121], *narh-ı sultani*[122], *narh-ı kadim*[123], *narh-ı ruzi-i kadim*[124] , and even a *narh-ı devri*[125]. The most glaring example of this confusion is to treat the *narh* price as the freely established competitive market price. It is even argued that the *narh* system created a competitive equlibrium where there was no monopolistic interference, and that the *narh* prices were not imposed by the authorities but were "current" prices, implying free interaction of market forces[126].

The provisioning of big cities required strict administrative measures and a peculiar method of pricing. In the case of wheat, the most essential of all grains, we witness a torrent of imperial edicts to *kadı*s almost everywhere to buy *tereke* (grain) at their local *narh-ı cari* and expedite shipment to İstanbul, at government's cost, because there was a serious shortage in the capital[127]. The language of these edicts requires close examination: They invariably and consistently use the term *narh-ı cari* instead of, for example, *narh-ı ruzi*, that is, current *narh* price instead of daily *narh* price. It appears that, although they seem to refer to the same thing, they are actually two very different prices.

In order to understand the very important difference between them we have to go back to the time when a *dirlik* was first granted. While evaluating the value of a *dirlik* one of the most important tasks was the assignment of quantity values to annual grain production, this quantity was then converted to monetary terms by multiplying it with an average price. The product of this operation, sometimes as high as 60%-70% of the total tax value of the *dirlik*, was added to the estimated money value of taxes to be paid in cash. The resulting sum was the estimated money value of the *dirlik* which determined the extent of the military obligations (number of fully equipped soldiers, tents, etc.) of the person who was going to be granted that specific *dirlik*. This average price of grain was referred to as *narh-ı cari* and it remained the same until a new *tahrir* was undertaken and a new average price was calculated. The grain *narh-ı cari* was, therefore, nothing but an accounting convention the Ottomans used to obtain cheap wheat and barley for the provisioning of İstanbul and also for areas where there was a shortage of grain.

The correct determination of the tax value of a *dirlik* was very important to the Ottomans because it had a direct bearing on the number of soldiers that the *dirlik* would send to a campaign. Apart from a whole team of highly skilled assessors and scribes all interested parties were to be present in the valuation process, which, sometimes spanned a number of years. The *il yazıcı* (or

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[121] *İKS*, Eyüb, no.61, 1655, vol.27, f.97; *İKS*, Galata, no.90, 1663, vol.40, f.357

[122] *İKS*, Eyüb, no.74, 1661-1662, vol.28, f.76.

[123] *İKS*, İstanbul, no.25, 1765-1767, vol.76, f.362.

[124] *İKS*, İstanbul, no.25, 1765-1767, vol.76, f.442.

[125] Kuran (ed.), 2010, p.292.

[126] Tabakoğlu, 2002, p.1225; Öztürk, 2002, p.1569. This confusion is not confined to Turkish scholars only, see, Monsalve, 2012, pp.1-17

[127] The *mühimme* registers are full of such edicts; see, for example, DABOA, *MD* 31-339, 2 Aug, 1577; *MD* 40-339, 12 Oct., 1579; *MD* 51–268, 12 Sep., 1583; *MD* 71-413, 9 Sept., 1593. For a sample of similar orders, see, Aydın 2014. But it was not only İstanbul that experienced such grain shortages; edicts sent to the *kadı*s and governors of various localities instructed them to purchase grain at *narh-ı cari* and send it to Gazze (DABOA, *MD* 103-12); Gule (DABOA, *MD* 19-37); Rhodes (DABOA, *MD* 21-223; *MD* 43-220).

tahrir emini) who was the leader of the assessment team took pains to make sure that the process included everyone and everything that was even remotely taxable[128]. There was even a detailed "manual", dated back to the reign of Süleyman I, which could have been an updated version of an earlier manual[129]. Article 3[130] of the manual instructed the *il yazıcı* to calculate average grain output of the last three years (.. *mahsulatın her nev'inin üçer yıllığın bir yere cem idüb dahi üçe bölüb ...kaydedeler*), and Article 4[131] specified that the output tables thus obtained should not be valued by the *il yazıcı* but sent to İstanbul where the *sultan* himself would assign money values to grain quantities (*narhları hususu .. anın üzerine nice baha tayin idersem ... kaydolunub ... cümlesi bağlanıla*). The *sultan* had no way of knowing the local price of grain at the time of the *tahrir* but Article 13[132] required the *il yazıcı* to append to output tables a list of current prices certified by the local *kadı* (*her birinin narhı nenün üzerine ise kadılardan hüccet getüreler*).

We do not know if the sultan applied the same certified prices to the output tables but we see no apparent reason why he should not have done so simply because if the prices the *sultan* chose to apply were higher than the certified prices (a useful tool to increase the military obligations of the dirlik holder) this would have created a situation where the *dirlik* holder, after collecting the taxes-in-kind due to him, would have wanted to sell the grain he had in his possession at the price the *sultan* deemed appropriate and would be unsuccesful. Therefore, it is safe to assume that the prices used to convert grain quantities to money sums reflected the certified prices[133].

After this final step the *dirlik* valuation process was complete and the certified price became *narh-ı cari*. As long as grain prices remained stable over time this accounting convention served its purpose well. But in times of rising prices it became self-defeating in the sense that while the provisioning of big cities could still be managed at prices fixed some time previously, the tax and therefore the military value of the *dirlik* was understated in proportion to the increase in prices. From the military point of view the success of the *dirlik* valuation process was very much dependent on how frequent was the *tahrir* renewals.

*Tahrir*s were made as soon as a new territory came under Ottoman rule. Theoretically, they were renewed every 25-30 years. *Dirlik* certificates were renewed, in return for a fee, as a new *sultan* ascended to the throne, but this most probably did not warrant a new *tahrir,* except for Süleyman I who ordered the renewal of all *tahrir*s when he succeeded his father in 1520. The following table shows the renewal dates of *tahrir*s for some *sancak*s:

[128] Darling summarises the whole procedure in Darling, 1996, pp.29-35 but does not expand on the important subject of how the estimated grain output was valued.

[129] Barkan, 1940, pp.20-59.

[130] Barkan, 1940, p.40.

[131] Barkan, 1940, p.p.40-41.

[132] Barkan, 1940, p.43. It appears that the certified prices were obtained by taking into account the last year's price and the price at the time of the *tahrir*.

[133] Eighty years ago Ö.L.Barkan warned economic historians and especially students of price history about the importance of studying the effects of the divergence of *narh-ı cari* from locally effective grain prices; see, Barkan, 1941, p.217.

Table II-1: Tahrir dates for some selected sancaks: 15th - 17th centuries

Kaza/Sancak	Years									Maximum duration without renewal (years)
Akseki [a]	-	1500	-	-	1530	-	1575	-	-	45
Karahisar-ı Sahib [b]	1481 (?)	-	1528	-	-	-	1572	-	-	47
Ruha [c]	-	-	1518	-	-	1540	1566	-	-	26
Adıyaman [d]	-	1519	1524	1530	1540	1547	1560	-	-	13
Sivrihisar [e]	1486	-	1521	-	1539	-	-	-	-	35
Çemişgezek [f]	-	1518	1523	-	-	1541	1566	-	-	25
Karahisar-ı Şarki [g]	1485	-	1520-23	-	-	1547	1569	-	1613	44
Trabzon [h]	1486	1515	-	-	-	1554	1574	1583	1634	51
Canik [i]	1420-30(?)	1455-56	1485	1520	-	1554	1576	-	-	35
Aydın [j]	pre-1467	1478	-	-	1529	-	1573	-	-	51
Lazıkıyye [k]	pre-1500	-	1520	-	-	-	1570-71	-	-	50
Bursa[l]	1486-87	-	1521-22	-	1530-31	1539-40	1573-74	1590	-	35

[a] Kıvrım, 2015, pp.36-62; [b] Bulduk, 2013, pp.xxii-xxiii; [c] Turan, 2012, pp.xiv-xviii; [d] Taştemir, 1999, pp.7-9; [e] Doğru, 1997, pp.4-5; [f] Ünal, 1999. pp.1-4; [g] Acun, 2006, pp.20-25; [h] Bostan, 2002, pp.9-13; [I] Öz, 1999., pp.8-15; [j] Kütükoğlu, 2010, pp.5-8; [k] Gökçe, 2000, pp.4-6; [l] Ergenç, 2014, pp.202-203.

Out of the 12 sancaks, six are lagging almost half-a-century behind the last *tahrir* date. This delay in not writing a new *tahrir* has important consequences. For example, if the *kadı* of Aydın was ordered to buy grain at *narh-ı cari* in 1529 he would be in the market offering a price that was only relevant in 1478. Similarly, in 1634, a *sipahi* of Trabzon would join the army with a contingent of *cebelü*s whose number was, to a very large extent, determined according to the price level of grain in 1583. Admittedly, the table only shows the situation of some *sancak*s chosen arbitrarily and may not reflect the true picture but, nevertheless, it gives a good idea about the pitfalls of using *narh-ı cari* as an accounting measure. used to obtain cheap wheat and barley for the provisioning of İstanbul and also for areas where there was a shortage of grain.

Appendix III: Linear Interpolation of Ş.Pamuk's İstanbul Consumer Price Index and Foodstuff Price Index

Ş.Pamuk's colossal work on consumer prices (CPI) in İstanbul between 1469 and 1914 (Pamuk, 2000a) has gaps resulting from lack of data. These gaps are more pronounced in the first half of the sixteenth century while we have an almost continuous series for the second half and the entire seventeenth century. Accordingly, his calculation of the foodstuff index (FI) has corresponding gaps. This index is based on a basket of flour, rice, clarified butter, olive oil, honey, and mutton. These gaps also afflict his calculation of average prices of bread, mutton, clarified butter, and rice which we use for calculating the dietary requirements of the *sipahi*'s contingent of troops. The simplest method to estimate the gap values is to treat the change in his CPI as the result of a linear change between the starting and the ending values. The following table shows the results of this linear interpolation in CPI and FI (original values in **bold**, gap years in *italics*):

Year	CPI	FI	Year	CPI	FI	Year	CPI	FI	Year	CPI	FI
1469	**1.00**	**1.00**	1501	*1.31*	*1.28*	1533	*1.82*	*1.84*	1565	*1.84*	*1.87*
1470	*1.08*	*1.08*	1502	*1.33*	*1.31*	1534	*1.80*	*1.84*	1566	*1.84*	*1.89*
1471	**1.16**	**1.16**	1503	*1.35*	*1.33*	1535	*1.79*	*1.84*	1567	*1.85*	*1.90*
1472	*1.32*	*1.45*	1504	*1.37*	*1.35*	1536	*1.77*	*1.83*	1568	*1.85*	*1.92*
1473	**1.48**	**1.73**	1505	*1.39*	*1.37*	1537	*1.76*	*1.83*	1569	**1.86**	**1.94**
1474	**1.16**	**1.17**	1506	*1.39*	*1.39*	1538	*1.75*	*1.82*	1570	**1.94**	**1.94**
1475	*1.17*	*1.18*	1507	*1.43*	*1.41*	1539	*1.73*	*1.82*	1571	*1.98*	*2.00*
1476	*1.18*	*1.19*	1508	*1.45*	*1.43*	1540	*1.72*	*1.82*	1572	*2.04*	*2.05*
1477	*1.19*	*1.19*	1509	*1.48*	*1.45*	1541	*1.70*	*1.81*	1573	**2.06**	**2.11**
1478	*1.20*	*1.20*	1510	*1.50*	*1.48*	1542	*1.69*	*1.81*	1574	**1.98**	**2.07**
1479	*1.21*	*1.21*	1511	*1.52*	*1.50*	1543	*1.67*	*1.81*	1575	**1.99**	**2.00**
1480	*1.22*	*1.22*	1512	*1.54*	*1.52*	1544	*1.66*	*1.80*	1576	*2.03*	*2.03*
1481	*1.23*	*1.23*	1513	*1.56*	*1.54*	1545	*1.64*	*1.80*	1577	*2.06*	*2.05*
1482	*1.23*	*1.23*	1514	*1.58*	*1.56*	1546	*1.63*	*1.79*	1578	*2.10*	*2.08*
1483	*1.24*	*1.24*	1515	*1.60*	*1.58*	1547	*1.62*	**1.79**	1579	*2.14*	**2.10**
1484	*1.25*	*1.25*	1516	*1.62*	*1.60*	1548	*1.60*	*1.75*	1580	*2.18*	*2.14*
1485	*1.26*	*1.26*	1517	*1.64*	*1.62*	1549	*1.59*	*1.71*	1581	*2.21*	*2.19*
1486	*1.27*	*1.27*	1518	*1.66*	*1.65*	1550	*1.57*	*1.67*	1582	*2.25*	*2.23*
1487	*1.28*	*1.27*	1519	*1.68*	*1.67*	1551	*1.56*	*1.63*	1583	*2.29*	*2.27*
1488	*1.29*	*1.28*	1520	*1.70*	*1.69*	1552	*1.54*	*1.58*	1584	*2.32*	*2.32*
1489	**1.30**	**1.29**	1521	*1.72*	*1.71*	1553	*1.53*	*1.54*	1585	**2.36**	**2.36**
1490	**1.09**	**1.05**	1522	*1.74*	**1.73**	1554	*1.51*	*1.50*	1586	**3.34**	**3.36**
1491	*1.11*	*1.07*	1523	*1.76*	*1.76*	1555	**1.50**	**1.46**	1587	**3.53**	**3.63**
1492	*1.13*	*1.09*	1524	*1.78*	*1.79*	1556	**1.78**	**1.78**	1588	**4.45**	**4.46**
1493	*1.15*	*1.11*	1525	*1.80*	*1.82*	1557	*1.79*	*1.79*	1589	**3.09**	**3.09**
1494	*1.17*	*1.14*	1526	*1.82*	*1.85*	1558	*1.79*	*1.80*	1590	**4.32**	**4.33**
1495	*1.19*	*1.16*	1527	**1.84**	**1.85**	1559	*1.80*	*1.81*	1591	**3.31**	**3.31**
1496	*1.21*	*1.18*	1528	**1.89**	**1.89**	1560	*1.80*	*1.82*	1592	**3.08**	**3.09**
1497	*1.23*	*1.20*	1529	*1.88*	*1.88*	1561	*1.81*	*1.82*	1593	**3.39**	**3.39**

1498	*1.25*	*1.22*	1530	*1.86*	*1.86*	1562	*1.82*	*1.83*	1594	**3.88**	**3.89**
1499	*1.27*	*1.24*	1531	*1.85*	*1.85*	1563	*1.82*	*1.84*	1595	**4.14**	**4.15**
1500	*1.29*	*1.26*	1532	*1.83*	**1.85**	1564	*1.83*	**1.85**	1596	**5.23**	**5.24**
Year	CPI	FI	Year	CPI	FI	Year	CPI	FI	Year	CPI	FI
1597	**6.24**	**6.25**	1621	**7.10**	**7.11**	1645	**3.95**	**4.00**	1669	**6.42**	**6.33**
1598	**6.09**	**6.11**	1622	**7.34**	**7.32**	1646	**4.19**	**4.20**	1670	**6.25**	**6.18**
1599	**4.85**	**4.86**	1623	**7.11**	*7.11*	1647	**4.21**	**4.22**			
1600	**4.79**	**4.78**	1624	**6.88**	**6.89**	1648	**4.78**	**4.93**			
1601	**4.45**	**4.46**	1625	**6.33**	**6.70**	1649	**4.80**	**4.81**			
1602	**4.44**	**4.45**	1626	**4.20**	**4.28**	1650	**4.31**	**4.32**			
1603	**4.69**	**4.70**	1627	**4.71**	**4.72**	1651	**4.36**	*4.37*			
1604	**6.98**	**6.76**	1628	**4.49**	**4.49**	1652	**4.41**	**4.42**			
1605	**6.35**	**6.36**	1629	**4.40**	**4.41**	1653	**4.58**	**4.58**			
1606	**6.28**	**6.30**	1630	**4.47**	**4.48**	1654	**4.51**	**4.52**			
1607	**5.82**	5.86	1631	**5.18**	**5.19**	1655	**4.54**	**4.55**			
1608	**5.36**	5.42	1632	**5.51**	**5.59**	1656	**4.82**	**4.83**			
1609	**4.90**	4.98	1633	**5.32**	**5.35**	1657	**6.25**	**6.26**			
1610	**4.44**	**4.54**	1634	**5.36**	**5.25**	1658	**5.69**	**5.70**			
1611	**4.10**	**4.11**	1635	**5.05**	**4.90**	1659	**5.14**	**5.15**			
1612	**4.12**	**3.40**	1636	**5.31**	**5.38**	1660	**6.01**	**6.02**			
1613	**4.05**	**3.33**	1637	**6.31**	**6.32**	1661	**7.23**	**7.25**			
1614	**4.16**	**4.16**	1638	**6.36**	**6.37**	1662	**5.83**	**5.84**			
1615	**4.82**	**4.83**	1639	**6.05**	**6.06**	1663	**5.15**	**5.16**			
1616	**5.26**	**5.29**	1640	**5.19**	**5.20**	1664	**5.05**	**5.06**			
1617	**5.06**	**5.10**	1641	**4.45**	**4.46**	1665	**4.93**	**4.93**			
1618	**3.99**	**4.00**	1642	**4.29**	**4.30**	1666	**5.28**	**5.03**			
1619	**4.44**	**4.45**	1643	**3.79**	**3.80**	1667	**5.94**	**5.96**			
1620	**4.63**	**4.63**	1644	**4.04**	**4.05**	1668	**6.34**	**6.10**			

Appendix IV: Calculation of the *Sipahi*'s Food Costs

Given the prices of foodstuffs, it is a matter of complex calculations to find out which set of ingredients gives the least cost of satisfying a required calorie level. The results are almost trivial when we consider that bread has the lowest relative price and provides acceptable levels of carbohydrates and protein but no fat. The calculating algorithm that comes with almost any spreadsheet software assigns a huge chunk of the budget to bread and miniscule amounts to the other ingredients. Obviously, this solution is not quite desirable as it does not satisfy AMDR.

The *sipahi*, following a rudimentary but sound understanding of AMDR, specifies that his soldiers should receive some clarified butter and rice so that they would get fat and an indispensable component of the Turkish kitchen: *pilav*. We assume that he includes at least 15 grams of clarified butter and 30 grams of rice in the daily ration. The following table shows the calorie and nutrient contents of bread, mutton, clarified butter, and rice for 100 grams of each:

Table IV-1: Calorie and macronutrient content of diet components

Ingredient (x_i)	Calorie (c_i)	Protein in gr (pr_i)	Fat in gr (f_i)	Carbohydrates in gram(ch_i)
Bread	266	8.97	0.00	48.28
Mutton	294	17.00	21.00	0.00
Fat	862	0.00	100.00	0.00
Rice	130	2.72	0.25	28.48

Given these data the problem is reduced to:

Minimise

$\sum_{i=1}^{4} x_i p_i$ where x_i is the quantity of the ingredient and p_i is the price of that ingredient subject to constraints

$\sum_{i=1}^{4} x_i c_i$ = required calories for each activity level (either 1,839; 1,860, or 2296)

$\sum_{i=1}^{4} x_i pr_i \geq 0$ (total amount of protein the diet should be greater than zero)

$\sum_{i=1}^{4} x_i f_i \geq 0$ (total amount of fat in the diet should be greater than zero)

$\sum_{i=1}^{4} x_i ch_i \geq 0$ (total amount of carbohydrates in the diet should be greater than zero)

$Bread \leq 650$ (total amount of bread in the diet should be less than 650 grams per day)

$Mutton \geq 0$ (total amount of mutton in the diet should be greater than zero)

$Butter = 15$ (total amount of clarified butter in the diet should be equal to 15 grams per day)

$Rice = 30$ (total amount of rice in the diet should be equal to 30 grams per day)

There is a total of 336 scenarios to be solved: 7 campaigns x 4 ingredients x 4 price levels x 3 calorie levels; which can be done in a few seconds on a mid-range computer. The solution of these scenarios gives us the minimum cost of providing a soldier with either 1,839, or 1,860 or 2,296 calories per day subject to AMDR and the requirements that the total daily bread intake should not be greater than 650 grams, there must be at least some mutton in the diet, and clarified butter and rice should be 15 and 30 grams, respectively. However, the *sipahi* cannot be expected to hit on these minimum-cost solutions except by sheer luck. If he did, he would have found that, for the Akkirman campaign for example, the following diet was required:

Table IV-2: Akkirman campaign diet composition (grams) and cost

Ingredients	Cost for 1,860 kcal	Cost for 2,296 kcal
Bread	500	635
Mutton	123	149.2
Clarified butter	15	15
Rice	30	30
Total cost per day (Akçe)	0.605	0.685

We now turn our attention to the actual daily amounts that the Turkish army provides to soldiers today[134]. The calorie calculations of the laws of 2007 and 2018 are quite consistent with table IV-1 above, except for some small understatement of the calorie contents of bread and rice, and a 16% overstatement of that of butter. Also, they overstate the protein and fat content of bread and rice by 39.4% and 110%, respectively, which are clearly printing errors. Instead of mutton they both specify 300 grams of beef (with bones) which is approximately equal to 225 grams of mutton. These rations, with the addition of other ingredients, are designed to provide soldiers with a daily energy intake of 3,986 kcal. With these caveats in mind, the table below shows the comparison of quantities and calories of the 2018 ration and the optimised solution in Table IV-2:

[134] "Türk Silahlı Kuvvetleri Besleme Kanunu", law no. 5668, *Resmi Gazete*, no.26538, 31 May, 2007; later amended by law no. 7078, *Resmi Gazete*, no.30354 (mükerrer), 8 Mar., 2018. In both laws the ration quantities were kept intact, and the ration tables are full of typographical errors; for example, the fat content of 20 grams of butter is given as 0.02 grams while its carbohydrate content is 14.12 grams. Clearly, these quantities should be interchanged. The earliest law on soldier rations ("Askeri Tayinat ve Yem Kanunu", *Düstur*, tertip 2, vol.6, p.1286, 1 Oct., 1914) contains similar errors. All three of these laws fix daily butter amount at 20 grams (equivalent of 15 grams of clarified butter) and the 2007 and 2018 laws allow 30 grams of rice per day. The law of 1914 does not specify any rice for the rations but 200 grams of *bulgur* (crushed wheat), a poor-man's substitute for *pilav*.

Table IV-3: Daily ration quantities as implemented by the Turkish army in 2018 (grams) compared with optimized quantities for 2,296 kcal solution

Ingredient	2018 quantities	Optimised solution quantities	Difference
Bread	600	635	-35
Mutton [(a)]	225	149.2	+75.8
Clarified butter [(b)]	15	15	-
Rice	30	30	-
Total kcal	2,426	2,296	+130

[(a)] Corresponds to 300 grams of beef with bones; [(b)] Corresponds to 20 grams of butter

The 2018 ration achieves a 130 kcal increase in energy intake by decreasing the quantity of bread by 35 grams and increasing mutton by almost 76 grams, overshooting the maximum calorie intake of 2,296 kcal for battlefield activities of the *timar* soldiers by nearly 6% which clearly is not what we are looking for.

The most feasible solution for determining a daily ration for the *timar* soldier seems to be the reasonable assumption that the *sipahi* overestimates his soldiers' bread and mutton needs while calculating ingredient quantities. The question of how much the *sipahi* overestimates ration quantities is open to speculation. We assume he overshoots by as much as 25% over the 1,860 kcal solution above in Table IV-2. This gives us the following results:

Table IV-4: Ration quantities with 25% overestimation of the 1,860 kcal solution

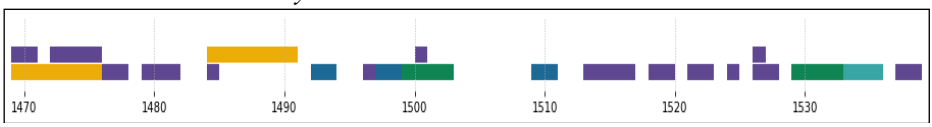
Ingredients	1,860 kcal solution	Overestimated quantities	cal
Bread	500	625	1,663
Mutton	123	153.75	452
Clarified butter	15	15	129
Rice	30	30	23
Total			2,267

This diet provides 22.9% more calories than needed during the ride to join the main army, and returning back home; 23.3% more while marching with the army, and only 1.3% less at the battlefield. Therefore, by making this diet applicable for all activities during the campaign we will be introducing yet another upward bias in food costs. However, this upward bias will be somehow compensated by the weight of the war material that the *sipahi* contingent had to carry.

Appendix V: The Time-Line of Ottoman Military Actions

We have combined the entries in the Center for Global Economic History database and S.A.Somel's chronology to visualize the frequency of military actions undertaken by the Ottomans. The following chart shows these actions in a continuous time-line spanning from 1469 to 1610:

Chart V-1: Ottoman military actions 1469-1610[(a)]



(a) We are grateful to A.Kurmuş, Fellow at the Harvard-Smithsonian Center for Astrophysics, who provided the Python code to generate this chart.

The two lines of the chart gives a clear idea of how busy the Ottomans were waging war, sometimes simultaneously, with very short spells of peace lasting less than four years.

Appendix VI: **The Centroid**

All regular polygons (square, triangle, rectangle, etc,) have a center which is defined as the geometrical location of the point equidistant to the vertices of the polygon. The polygon in Figure VI-1 is not a regular polygon. The center of such a polygon may or may not exist; if it exists it may or may not be within the polygon. But the centroid, or barycenter, exists and lies within the polygon area. (The term centroid, borrowed from physics, is the geometrical location of the point where the irregular polygon can be balanced on a tip. This point corresponds to the center of mass of the polygon. In regular polygons the center and the centroid coincide).

There are two main methods of calculating the location of the centroid. The first one is mathematical and produces the same result as the second one. In any convex polygon with vertices (x_0,y_0), (x_1,y_1), …, (x_{n-1},y_{n-1}) the centroid's geometrical location (C_x,C_y) is given by:

$$Cx = \frac{1}{6A}\sum_{i=0}^{n-1}(x_i + x_{(i+1)})(x_i\, y_{(i+1)} - x_{(i+1)}\, y_i)$$

$$Cy = \frac{1}{6A}\sum_{i=1}^{n-1}(y_i + y_{(i+1)})(x_i\, y_{(i+1)} - x_{(i+1)}\, y_i)$$

where A is:

$$A = \frac{1}{2}\sum_{i=0}^{n-1}(x_i\, y_{(i+1)} - x_{(i+1)}\, y_i)$$

The second method requires the defining and saving the polygon area as a .kmz or .kml file; after opening it in any GIS software the latitude and longitude of the centroid can then be read off directly from the layer. We have used Google Earth to draw the polygon and qGIS to find the

location of the centroid.

Figure VI-1: The Uyvar-Estergon-Eğri-Haçova-Akkirman-Tebriz-Bağdat-Ridaniye-Malta-Uyvar polygon

Figure VI-2: Centroid of the polygon **X**

The map above shows the exact location of the centroid. It is at N 38.624 and E 29.271, marked with X, almost half-way between present-day Karaağaç and İlyaslı.

There is also a third method, rather pedestrian and not so elegant, but which very closely approximates the results of the mathematical and GIS methods. It involves the joining of Uyvar and Tebriz, and Uyvar and Ridaniye by straight lines, finding the mid-points of these lines and drawing perpendicular lines at these mid-points. The intersection point of these perpendicular lines is again at very near Uşak.