

Ottoman Tax Registers (*Tahrir Defterleri*)

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Abstract. The Ottoman government obtained current information on the empire's sources of revenue through periodic registers called *tahrir defterleri*. These documents include detailed information on taxpaying subjects and taxable resources, making it possible to study the economic and social history of the Middle East and eastern Europe in the fifteenth and sixteenth centuries. Although the use of these documents has been typically limited to the construction of local histories, adopting a more optimistic attitude toward their potential and using appropriate sampling procedures can greatly increase their contribution to historical scholarship. They can be used in comprehensive quantitative studies and in addressing questions of broader historical significance or larger social scientific relevance.

Keywords: Ottoman Empire, sampling, *tahrir defterleri*, tax registers

There are few historical records that are as rich, extensive, well-preserved, and widely available as the tax registers of the Ottoman Empire. To obtain current information on the empire's sources of revenue, the Ottoman government conducted periodic surveys of the lands under its domination and recorded detailed information about taxpaying subjects and taxable resources in registers called *defter-i hākānī* (imperial registers), commonly known as the *tahrir defterleri* (plural of *defter*). Having survived from as early as the fifteenth century, many of these registers are available to researchers in various archives in Turkey and in other countries that were once under Ottoman domination. There now exist *defters* of regions ranging from Anatolia and the Balkans to Syria and Palestine in the south, Georgia in the east, and Hungary and Poland in the north, altogether forming an indispensable series of documents for studying the economic and social history of the Middle East and eastern Europe.

Although magnificent and fascinating as historical records, *tahrir defters* have been surprisingly underused in historical scholarship. Researchers have typically limited their use to the construction of local histories of specific regions, rarely addressing questions of broader historical

significance or larger social scientific relevance. Similarly, no comprehensive quantitative studies of the Middle East or eastern Europe have emerged to take full advantage of the wealth of information that these documents provide.

The reasons *tahrir defters* are underused in scholarship can be grouped into two general categories. First, an excessively cautious and sometimes even pessimistic attitude has recently emerged regarding the potential uses of these documents. Upon discovering their presence and magnitude in archives, historians of the Ottoman Empire were initially very optimistic about the value of these registers for research. Concerned about their possible misuse, however, some respected historians set out to outline their "pitfalls and limitations," the consequence of which was a significant shift in attitude (Lowry 1992). The period of initial optimism gave way to widespread pessimism, contributing to the underuse of *defters* in historical scholarship. Second, various archival, linguistic, and financial obstacles have limited the researcher's access to these documents and increased the cost of deciphering and processing the information therein. As a result, researchers were often forced to restrict the focus of their investigation topically, temporally, or geographically.

With the ultimate goal of improving the situation and promoting the use of *tahrir defters* in research, I have two objectives. The first is to respond to criticisms of *defters* as quantitative historical sources and to suggest some ways in which they can make research more productive. Once viewed properly, some perceived problems of these documents may turn out to be advantages. Although their use is certainly subject to various limitations, the documents' limitations are not qualitatively different from those applicable to other types of historical sources and thus should not be the sole basis for restricting their applicability in research. By being more optimistic and attempting to determine a document's usefulness not strictly by its own parameters but also by important questions of historical and socioeconomic inquiry, scholars can greatly improve the range of possible uses of *defters* in research.

The second objective is to propose a method for the efficient extraction of information from the *tahrir defters*: sampling. In dealing with massive amounts of information, using a representative sample rather than the whole dataset, one can facilitate comprehensive, large-scale studies at a fraction of the cost. Sampling has been a well-known and frequently employed tool at the historian's disposal in dealing with massive amounts of available data. Some studies with great impact on historical analyses have relied on sample data, as can be seen in the influential studies of slavery, geographic mobility, and population history (Fogel and Engerman 1974; Thernstrom 1973; Wrigley and Schofield 1981). By contrast, studies based on Ottoman *defters* have generally chosen to deal with the problem of massive data by restricting the focus of investigation to geographically small areas rather than by constructing representative samples of large areas.¹ Ottoman historians may have refrained from sampling these documents either because they considered sampling to be an unacceptable method of inquiry or simply because they were unfamiliar with the methods of sampling. Here, I discuss the methods and advantages of sampling the *tahrir defters*, using data from the published *defters* of Antep, Budin (Budapest), Kudüs (Jerusalem), and Malatya (Özdeğer 1988; Kaldy-Nagy 1971; Hütteroth and Abdalfattah 1977; Yinanç and Elibüyük 1983). Using conventional methods of sampling and elementary statistical analysis, I generate subsets of all the units in each of these registers and compare summary statistics between the subsets and entire populations to show how properly drawn samples can represent the characteristics of the population. I also discuss the limitations of sampling and the types of research in which sampling would be unlikely to produce reliable and representative results.

***Tahrir Defterleri* and Ottoman Historiography**

Beginning with a small principality on the Byzantine frontier around the year 1300, the Ottomans managed to build a vast empire by mid-sixteenth century that spanned the area between the Crimea in the north to Egypt and the Arabian Peninsula in the south, and between the Persian Gulf in the east to central Europe and North Africa in the west. The *tahrir defters* were vital to the financial administration of those lands and were used for a variety of purposes: they served as official registers to establish legal claims to land, to assess the empire's expected tax revenues, and to appropriate some of the revenues to the military and administrative officials as remuneration for their services (İnalçık 1954b; 1994, chap. 5). Because of their value to the administration of the empire, the Ottoman government took great care to preserve the *defters*, and over 1,500 of them have survived to the present.²

The detailed tax registers in the series, called *mufassal defters*, recorded for each fiscal unit the names, numbers, and legal status of adult males, approximate amounts of

land in use, and estimates of tax revenues from all productive resources and activities (see the appendix for a typical entry).³ Similar to the English Domesday Book but wider in spatial and temporal coverage, the *mufassal defters* contain such detailed information about taxpayers and economic activities in Ottoman towns and villages that it is difficult to imagine research on Ottoman history of the fifteenth and sixteenth centuries that does not in some way rely on this information.⁴

Although during the late nineteenth century some Hungarian researchers had brought attention to the value of, and published some excerpts from, the *tahrir defters*, it was not until World War II that studies based on those documents began in full force. Because they were not yet made available for scholars' use in Turkish archives, it was L. Fekete's (1943) publication of a *defter* (of the Hungarian district of Esztergom [Ostrogon]) preserved in Berlin that pioneered the genre of editing (with transcription and/or translation) whole registers.⁵ The next few decades witnessed numerous pioneering contributions to the field. Impressive results were achieved following the increasing openness of Turkish archives to researchers and the commitments by both Turkish authorities and an international group of scholars to undertake and promote *tahrir* studies.⁶ As Ö. L. Barkan (1970b, 163) proudly expressed, *tahrir defters* were viewed as "the most precious possession of the Turkish archives."

Many in the succeeding generations of scholars have shared the excitement of the masters and pursued their agenda. The transcription and publication of the whole register(s) of a region in book form is one of the earliest and repeatedly practiced forms of scholarship. Transcriptions of dozens of *defters*, of diverse dates and regions, have so far been published in various languages for use in general scholarship. Although early publications in this genre generally had modest objectives, with mere transcriptions of the data and little or no analysis, some recent studies have also included more sophisticated analyses of taxation, population, and production trends in a region.⁷ Some historians have even pushed the agenda further by using the data from these documents in novel ways, for example, by examining taxation, urban life, population pressure, agricultural productivity, state-peasant relationships, and the continuity and change between Byzantine and Ottoman institutions. See M. Coşgel (2004a, 2004b), M. Coşgel and T. Micelli (2004), S. Faroqhi (1984), M. A. Cook (1972), M. L. Venzke (1997), H. İslamoğlu-Inan (1994), A. Singer (1994), and A. Bryer and H. Lowry (1986).⁸

The Limits and Possible Uses of *Tahrir Defters*

Despite the proliferation of studies based on *tahrir defters*, various criticisms have been expressed against their use in quantitative analysis. Whereas some criticisms objected to certain lines of research as being either too broad or too limited, others were directed against what were

deemed as inappropriate interpretations or applications of the data. Researchers were cautioned against unwarranted claims and urged to incorporate other methods of inquiry and sources of data. For example, the methods employed by the early work on demographic history pioneered by Barkan (1953, 1970b) have been heavily criticized, generating a literature on how to determine the value of the household multiplier and how best to use *tahrir defters* in conjunction with other sources to estimate population.⁹ Conventional approaches to *defters* were also criticized in an attempt to promote specific complementary sources and alternative methodologies.¹⁰

Although many such criticisms have undoubtedly made valuable contributions to the field, some may have been harmful, despite their authors' good intentions. Certain respected historians, some of whose own works have otherwise pioneered research based on the registers, have made negative critical comments. Consider, for example, the comments of H. W. Lowry.¹¹ Himself a respected scholar and well-known contributor to *tahrir* studies (who at some point seriously raised the issue of misuses of those documents), Lowry (1992, 8) set out to show the "pitfalls and limitations" of using them as sources for social and economic history. His first dictum begins with the statement: "The *tahrir defters* alone do not provide the basis for *any kind of quantitative study*, be it toponymy, topography, taxation, agricultural production, or population" (emphasis added). The only evidence Lowry provided to support that claim is his discovery of some villages found in other sources but missing in *defters*. All other surviving sources, according to him, must be examined for an overall perspective.

Even though no one would dispute the general premise of this dictum (that more sources are better), the sweeping prohibition issued against "any kind of quantitative study" seems excessively restrictive. For instance, what would be wrong with a quantitative study aimed at calculating the average amount of taxes paid by villages to fief holders? Although the *defters* may have omitted villages that paid taxes to other recipients (such as *vakıfs*), they most certainly included those that paid fief holders, so one need not consult any other sources for a satisfactory quantitative study of the taxes paid by the villages. Moreover, as I subsequently argue in more detail, unless one had good reason to suspect systematic differences between included and excluded villages, information from the included villages (or even from a smaller subset of them) can, for some types of inquiries, be used as representative of the overall population. Lowry (1992) can be said to be following exactly the same strategy, after all, when he used his knowledge of the "pitfalls and limitations" of *some defters* to make generalized comments on *all defters*. Despite the constructive dimension of his pronouncements and of similar comments by others, because they are issued by respected scholars they will undoubtedly be considered seriously and should be reassessed and qualified for a more balanced perspective.

Underlying most concerns about the use of *tahrir defters* in historical research is the recognition that in conducting the surveys the Ottoman government was not always interested in gathering the same information as today's historian might find useful. The surveys' purpose was to record only *taxable* resources and activities, not data on the population, resources, or economic activities as a whole. The quality of the information was determined by such constraints as the availability of enumerators and other resources allocated to this process, the willingness of individuals to cooperate with the enumerators, and various regional differences in language, customs, and units of measurement.

None of these concerns, however, are necessarily peculiar to *tahrir defters* but are fundamental difficulties faced in all areas of historical scholarship and should thus be properly viewed as issues that we need to understand and solve to be able to keep pushing the boundaries of knowledge. In all areas of historical inquiry, the usefulness and limitations of sources are determined not only by any inherent qualities of documents but also by the research interests of historians. With this methodological principle as a guide, let us now examine the extent of the limitations of *defters* identified in the literature and consider how to overcome them.

Upon closer inspection, some of the documents' commonly identified limitations actually turn out to be advantageous to the historian. For example, it is often alleged as a major weakness of the *defters* that the recorded figures reflect assessments rather than actual collected taxes, which could vary greatly from assessments (Singer 1990, 102). The enumerators were indeed instructed to record not the amounts of taxes actually collected during the year of the survey but the *expected* amounts based on the averages of the previous three years. Given that the surveys were not done annually, however, that procedure made the amounts even more useful indicators of taxation for most historical inquiries, precisely because the collected taxes (especially the tithes) could vary greatly from one year to the next. Had the recorded figures been the amounts of actual taxes, those historians who study issues such as tax burden and agricultural productivity would somehow have had to correct for the effect of temporal variations in weather and other conditions to be able to generalize the results. By averaging the amounts over three years, the *defters* intended to factor in these variations, which made the information more reliable and useful for both the Ottomans themselves as well as modern historians.

Another perceived limitation is that the *defters* did not record all resources and productive activities. Undoubtedly, certain items went unrecorded in the surveys, either because they were somehow hidden from the surveyors or because the surveyors chose not to record them. Although evidence exists of taxpayers' attempts to avoid registering some of their taxable activities or to avoid registration altogether by fleeing the site, such infractions were probably minor; the Ottomans implemented various mechanisms,

such as ensuring the presence of a team of experts and local leaders along with the taxpayers, during the registration process. Similarly, although the surveyors did not record some items intentionally, the tax revenue that was thus lost must have been deemed smaller than the benefit of recording and collecting those taxes. Given the interests of the state, one has to presume that the surveyors certainly would have recorded any resource or activity important enough to tax and feasible enough to assess and record. Because the resources used in the assessment, registry, collection, distribution, and other stages of the taxation process were occasionally insufficient, intentional omission of resources and activities were more likely to reflect an efficient allocation of scarce administrative resources than a systematic failure of surveyors.¹² Put differently, full information about taxable resources was not necessarily the optimal amount of information.

The absence of information on some resources and activities may be another instance of the documents' limitations actually being advantageous to the historian. Imagine the hypothetical scenario of *tahrir defters* that included literally all resources and activities in a region. Such comprehensiveness would have given both the Ottoman government and today's historian an overwhelming amount of information, possibly resulting in a prohibitively high cost of gathering, sorting out, and processing the data for use in taxation or research. Although one cannot deny the value of additional information when answering some research questions, for those interested in issues such as production and taxation, reducing the data to essential items may have been a mixed blessing. Given their local knowledge of the region and general knowledge of the cost of the taxation process, the surveyors were in the best position to determine which resources and activities were necessary to record. Lacking this knowledge, determination of the same by today's historian would have been accompanied by a much greater degree of difficulty and arbitrariness.

Although there are other limitations of *defters* without concurring advantages, it is nevertheless possible to overcome such limitations with further research. Perhaps the severest limitation is the incompleteness of the information about inhabitants. The Ottoman government was concerned primarily with taxation, so enumerators typically recorded only taxpaying adult males, omitting women, children, and tax-exempt groups.¹³ Studies of Ottoman population based on *defters* have therefore had to find ways of compensating for the missing information. Early studies commonly relied on simple measures such as the household multiplier in estimating total population from available information. Despite their basis in an acceptable, fundamental methodology, those early studies have been highly criticized for their speculative ways of determining the values of multipliers. Such criticisms, however, cannot be the basis for dismissing the whole project altogether. Although the pioneers may have unwisely used merely educated guesswork to estimate

the multipliers, we can now advance their contributions by more sophisticated, collaborative studies that employ recent demographic theories and a variety of sources complementary to *tahrir defters*, such as those proposed by B. K. Ataman (1992). Progress in scientific inquiry is achieved in this way, and studies of Ottoman population based on *defters* should be no exception.

Regional differences in units of measurement also present a set of limitations that can be similarly overcome by further research. Units for measuring weights and capacity varied significantly among regions.¹⁴ Because enumerators sometimes used regional, rather than standardized, units of measurement to record the amounts of tithes due in kind, it can be problematic to use these data for such inquiries as cross-regional comparisons of productivity. There are, however, ways of overcoming this problem: For example, one can use the monetary value, rather than the physical quantity, of output for comparison purposes.¹⁵ In the case of tithes, *defters* show both the physical quantity and the monetary value of the expected tax revenue, allowing the enumerator to use those values to aggregate taxes across products and taxpayers and the historian to make legitimate comparisons on the basis of standard currency.¹⁶

Another way of overcoming the problem is to discover the differences in units of measurement between regions by further research. Although monetary comparisons may be sufficient for most inquiries, some questions may require the researcher to determine the quantity of output, which in turn would require determining regional differences in units of measurement. Some differences have already been well documented (İnalçık 1983, 1994, 987–93); others require further research that uses similar methods and other sources.¹⁷

The foregoing is not meant to imply that *tahrir defters* are problem-free sources or that the problems should be neglected. Nevertheless, they are neither impossible to solve nor unique. All sources, including modern population censuses and opinion surveys, have to overcome hurdles, and researchers need to use available data with caution and methodological rigor. Although the nature and magnitude of the problem may differ among fields of inquiry, the differences do not set apart the historian of the Ottoman Empire as being distinctly disadvantaged because of inherent limitations of the registers as historical sources.

Just as various imperfections of sources have not prevented progress in other fields of historical scholarship, inevitable imperfections of *tahrir defters* can be overcome. The fact remains, however, that the critical attitude toward them contrasts sharply with some of the more appreciative and optimistic attitudes displayed toward the use of comparable sources in other literatures. Consider, for example, E. A. Kosminsky's (1956) pioneering study of English agrarian history based on the Hundred Rolls of 1279. Carefully reviewing various problems about the reliability of those records, he asked: "Do not their incompleteness and patchiness, the presence of gaps and mistakes, the vague and unreal nature of

many of the figures and terms of measurement, all render hopeless any attempt to obtain an accurate answer?" (40). Reminding us that similar problems invariably arise in all medieval sources, he dismissed the question by urging the historian to choose methods that generate not necessarily precise and certain but rather approximate and satisfactory answers, "which are unattainable by other methods of investigation." Despite acknowledging various significant limitations of using this source, he stated: "the risk involved in its use is no greater than that which always arises when we cease to be satisfied with limited answers to particular questions and seek to solve a general problem as a whole" (41–42). Given that *tahrir defters* as a whole are arguably more reliable records than the Hundred Rolls, Kosminsky's principles of historical methodology have clear implications for the historian of the Ottoman Empire.

Consider also similar issues raised about the reliability of another well-known set of sources widely available around the world as recorded throughout history by various states and private (religious or secular) organizations: tithe records. They have been the focus of attention in various fields of history and their reliability the subject of numerous heated debates. Despite familiar criticisms of using tithe records as sources, historians have successfully used them in various creative ways for historical research, including studies of legal and institutional history of the tithe and comparative studies of productivity. Reviewing the use of tithe records in studying production and productivity, Emmanuel Le Roy Ladurie and Joseph Goy (1982, 31) put it well: "To be cautious is one thing; but to take refuge in overqualification and hypercriticism can 'sterilize' certain subjects by concentrating on negative conclusions." To avoid such undesirable outcomes, historians of the Ottoman Empire would do well to adopt a more positive attitude toward their sources.

The groundwork for the ways in which *tahrir defters* can be used in quantitative analysis of the Ottoman economy and society has already been laid down by several path-breaking studies. Famous, if not uncontroversial, examples include Barkan's (1953) estimation of population, B. W. McGowan's (1969) study of food supply and taxation, and W. D. Hütteroth and K. Abdalfattah's (1977) study of historical geography. Much more needs to be done, however, for a mature and comprehensive understanding of Ottoman history during this period. In such a vast field, with coverage spanning multiple continents and centuries, possibilities for new and productive uses of *tahrir defters* are numerous. One possibility is to extend the coverage of previous studies to other periods and regions to determine regional and temporal variations in, for example, population, food supply and taxation, and historical geography. These studies can be done either by using data from already published *defters* or by retrieving new data directly from the archives, preferably making the data available to other researchers. Another possibility is to use the new tools, concepts, and

theories recently developed in the humanities and social sciences to improve upon previous approaches and to introduce entirely new approaches to the study of Ottoman history. An excellent example of a recent development whose fast-spreading areas of influence now include economic, social, and political history, is a discipline called New Institutional Economics (NIE).¹⁸ Quantitative analyses of Ottoman institutions such as law, state, taxation, and property rights that operationalize NIE ideas and use *defters* for data would certainly be welcome contributions to the field. By introducing new quantitative tools and methods to analyze the data, it is possible to achieve another set of contributions. Examples include the use of new statistical techniques, identification of regional variations in weights and measures, interpretation of data beyond their original bureaucratic definitions, generation of new variables by making reasonable assumptions, and efficient extraction of relevant data achieved by drawing representative samples.

Sampling in Historical Research

One problem that has burdened research based on *tahrir defters* is the enormity of the information. The sheer size of these documents, which may run over a thousand pages, might present an overwhelming task to the historian, testing the limits of available funds for gathering, storing, and processing the data. Compounded with other accessing, transcribing, and processing difficulties, the size and total number of the *defters* force the researcher to find a feasible strategy to extract the information.

A commonly used approach is sampling. Occasionally, it might be necessary and feasible for the researcher to gather information about every member of a population. For example, the only way to determine the youngest member of a group of students might be to find out the ages of every student, an easy task in a small group of, say, 30 students. Most research questions, however, do not necessarily require information about every member of a population and often require such an overwhelming amount of information that exhaustive data collection is simply not feasible. Suppose you wanted to determine the mean age (or height, income, literacy rate, etc.) of all Turkish citizens in the world. Only in an ideal world with unlimited resources and unrestricted access to information would it be possible to gather the required data and base analyses on *all* members of that population. In the real world, resources must be used efficiently and researchers must obtain the required information from a representative sample of the population. The theory of sampling shows that a properly drawn sample can radically reduce the amount of work required in collecting data, without a significant loss of accuracy. For example, to obtain a reliable estimate of the mean age of all Turkish citizens, it might be sufficient to gather the information from a small sample of individuals chosen randomly in a representative community in Turkey.

Sampling has played a significant role in historical research. Some sources of historical information include massive amounts of data, such as those contained in the enumeration schedules of population censuses, probate inventories, and certificates of birth, death, and marriage. Historians have dealt with data overload by restricting the focus of inquiry in time, space, or subject. An alternative strategy, encouraged in an influential article by Roger Schofield (1972) and frequently employed in a variety of contexts, is sampling. Sampling has made it possible for the historian to widen the scale and scope of inquiry by efficiently extracting information from large amounts of data. For example, influential studies of American history that relied on the enumeration schedules of the U.S. censuses were based on sample data.¹⁹ As an additional benefit of sampling, historians have often made their sample data available to other researchers in digital form, thereby allowing others to address issues that can be investigated using the same data. Well-known examples include the Parker-Gallman sample of southern farms in the United States (based on the agriculture and population censuses of 1860), the Bateman-Foust sample of northern farms, and the census data available from the IPUMS project of the Minnesota Population Center at the University of Minnesota.

Ottoman historians have also employed sampling in their research, though perhaps less explicitly and less systematically. Quantitative studies, such as the measurements of changes in prices, economic activity, and population levels, have often relied on sample data. For example, Barkan (1970a) and Pamuk (2001) studied the price revolution of the sixteenth century by calculating price indexes based on the prices of a representative set of leading consumption items. Rather than use the price information from each archival source about every commodity everywhere in the empire, they simply used the information from the account books and prices paid by hospices, pious foundations (*vakıf*), Topkapı Palace, and officially established price ceilings (*narh*). Some nonquantitative studies have also employed a sampling approach. The collection of regional law codes included in Barkan's well-known *Kanunlar* (1943), for example, is only a small subset of all the *kānūnnāmes* available in the archives, a subset deemed representative of the whole.²⁰

Similarly, studies of Ottoman consumption based on estate inventories, registers of the palace kitchen, and other written records have used sampling to collect evidence (Quataert 2000). Although some studies have not been explicit enough about their choices of evidence and methods of sampling, they clearly seek to benefit from the advantages of sampling by making general claims about their subject matter, based on the presumption that their sample represents the whole. Of course, the persuasiveness of the claims ultimately depends on the representativeness of the sample, an issue that can best be assessed with proper knowledge of sampling theory and methods.

Although studies based on *tahrir defters* have typically used whole registers as sources, some scholars have focused on limited geographic areas but have explicitly or implicitly treated them as representative of a larger population. For example, although H. Islamoğlu-Inan's (1994) study used data from the *defters* of part of the *vilāyet* of Rum (about 500 settlements), she derived conclusions about the state and peasant relations in Anatolia as a whole, on the basis of an implicit belief about Rum's being representative of Anatolia. Similarly, demographic studies have typically used the *defters* of specific regions to determine more general population trends. For example, Barkan's (1970b) pioneering estimates of the Ottoman population used data from only cities and towns, with the following justification: "with certain qualifications one can accept the hypothesis that in this period the growth of the urban population was closely related to the growth of the total population." Similarly, M. A. Cook's (1972) study of population pressure in rural Anatolia used evidence from three areas of Anatolia (about 700 villages). Keeping in mind Fernand Braudel's well-known hypothesis of increasing population pressure, Cook then broadened the domain of inquiry and asked: "supposing the hypothesis were true, not just of the three areas studied here, but of Anatolia as a whole, what exactly would it explain for us?" (29). Although the implicit, ad hoc nature of the sampling procedures used in some of these studies may raise questions about the completeness and reliability of their conclusions, their impact on Ottoman history nevertheless demonstrates how a well-chosen part can be representative of the whole.

The only case of explicit sampling of *defters* to date has been in McGowan's (1969) comparative study of food supply and taxation in four selected districts on the Middle Danube. Having studied the Sirem district in detail for his PhD dissertation, he added a comparative dimension to the analysis by selecting a (systematic) sample of 100 villages from each of the other three districts.²¹ Using these data and simple statistical techniques, he estimated quantitative measures of productivity and standard of living to answer various socioeconomic questions in a comparative setting.

One reason why researchers did not follow McGowan's lead in sampling the *defters* for quantitative analysis may have been the ad hoc nature of his sampling procedure and the lack of detailed discussions of alternative sampling procedures, the size and representativeness of the selected samples, and the cost and benefits of sampling in general. Defining sampling as being "one of the great labor saving benefits of modern statistical techniques," McGowan (1969, 152) merely asserted that "random samples of 100 are sufficiently large to warrant generalization." Similarly, although he used a page-oriented systematic sampling procedure, he expressed hope that "this method would result in a *random* spatial dispersion throughout each province" (emphasis added). He did not discuss in detail the source of the number 100 and whether his sampling procedure really

resulted in a random dispersion. In fact, because the probabilities of being drawn into the sample differ significantly between systematic and random methods of sampling, the properties of estimates were different under the two methods. This outcome does not mean, of course, that McGowan's sampling procedure was erroneous or that his arguments were unpersuasive. It only means that a more satisfactory discussion of these issues might have made McGowan's method of sampling more acceptable, his arguments even more persuasive, and sampling in general a more common practice among the historians of the Ottoman Empire.

Methods of Sampling

To discuss the procedures and relative advantages of different methods of sampling, let us focus on three widely used methods that are most applicable to sampling the *tahrir defters*: random, systematic, and cluster sampling.²² As discussed earlier, the essential point in sampling is that the chosen sample must be able to represent the variability of the population. When human beings choose deliberately they are likely to introduce bias, so an acceptable method must avoid deliberate choice and use an unbiased procedure for the sample to be representative. Although the three methods chosen for illustration are all acceptable and widely used in survey research, each has distinct advantages and disadvantages.

An ideal selection procedure gives each item an equal chance of being included in the sample. The method that best meets this criterion is simple random sampling, which leaves selection entirely to chance. If a numbered list of all the items in the population is available, choosing randomly means to use only a table of random digits or some other appropriate random mechanism for selection from the list. For example, if one can make a complete list of all the villages in a *tahrir defter* arranged in numerical order (e.g., in the order they are listed in the document), the random number generator of a computer can be used to determine the subset of the villages to be included in the sample.

Although random sampling has many desirable properties, investigators often prefer nonrandom methods of sampling because it is often very costly or impossible to make a complete list of every item in the population before sampling can begin. Even when a list is easily available, it might be too tedious and time consuming to access randomly chosen items in the data source. In sampling a *tahrir defter*, for example, villages may not be numbered consecutively throughout the document, or they may be mixed together with other types of administrative units (e.g., urban districts and uninhabited villages), in which case one would have to number the villages. Note also that under the current rules of Turkish archives, researchers are allowed to photocopy only one-third of a *defter*. One would thus have to work with the original document in drawing a list. Because

one would not be allowed to write on an original document, however, one would have to draw a separate list with the names and locations of villages included in the *defter* and then return to the original document once the sample was chosen in order to locate and record detailed data for the villages in the sample. Thus, such considerations may make the method of random sampling a tedious and difficult procedure.

Another widely used method is systematic sampling, where every k^{th} item is drawn sequentially from the population. Systematic sampling is likely to be much easier and cheaper to administer than random sampling because it requires counting only as the sample is drawn. When numerical ordering of the population is difficult or impossible before sampling (e.g., when working with original documents), it would thus be more convenient to use systematic sampling. As discussed above, McGowan (1969) applied the systematic (rather than random) method in sampling the *tahrir defters* by using a page-oriented selection procedure.

In systematic sampling, once the first item has been selected, the rest of the sample is determined, so all items do not have an equal chance of being drawn in the sample. The only possible place of random selection in systematic sampling is in the choice of the first entry, which is frequently chosen by generating a random number between 1 and k . Systematic and random sampling procedures thus have comparable properties only if the items in the population were listed in a random order. If, however, there is an unknown periodicity, a relationship between every k^{th} item in the arrangement of the items in the population, then systematic sampling will be biased and its results unreliable. For instance, if villages are listed by regions, some regions are more densely populated than others, and the sampling method includes every tenth village, so more populous villages will be undersampled, and the sample will not be representative of the population as a whole.

An alternative approach is cluster sampling, which consists of grouping sampling units into clusters on a spatial or geographical basis, sampling these clusters at random, and either selecting all the units in the cluster or sampling them at higher than usual rates (sometimes further subsampling the chosen cluster in multiple stages of cluster sampling). This method has been frequently employed, for example, in sampling the U.S. census manuscript schedules. Because the villages in *tahrir defters* were already clustered into larger divisions called *nāhiyes*, cluster sampling these villages would require randomly selecting one (or more) of the *nāhiyes* and either selecting all the villages in the *nāhiye* or (randomly, systematically, or by another method) selecting a smaller subset of them, depending on the desired size of the sample. Cluster sampling thus does not have the desirable properties of random sampling and is likely to be problematic if variations within clusters are much less than between clusters. Although other sampling methods might produce better estimators of population characteristics,

cluster sampling is nonetheless widely employed in survey research primarily because it offers greater administrative convenience, lower sampling costs, and easier access to source data.

How large a sample is needed? Determining the required sample size is one of the most important decisions a researcher must make to obtain reliable estimates of population characteristics. Although a larger sample would clearly increase the accuracy of the estimates of population parameters, it would also be costlier to gather. In general, the choice of a sampling size may involve a complex set of considerations including the preferred sampling method, cost of sampling, the desired level of the reliability of estimators, and information about the (usually unknown) population parameters. It also depends on the population characteristics of interest: whether one is interested in estimating a total, median, proportion, or mean value.

Suppose, for example, that our objective is to use a simple random sample to estimate the mean value of a single population characteristic, such as the mean age or income level of individuals in a city. Assuming sampling costs to be directly proportional to sample size, the minimum desired sample size can be approximated by the formula:

$$n_o \geq (z^2 s^2) / d^2, \quad (1)$$

where z is the reliability coefficient corresponding to the specified confidence level (based on a normality assumption for sampling distribution of the estimate), s is the variance, and d is the value set by the investigator for the maximum acceptable difference between the sample estimate and true population parameter. We see from formula (1) that the smaller we choose d , the greater will be the sample size. Similarly, the optimal sample size will rise with higher values of z and s .

If n_o turns out to be a high fraction of the whole population, it can be reduced by the finite population correction through the following formula:

$$n = n_o / [1 + (n_o / N)], \quad (2)$$

where N is the total number of items in the population.²³ When the researcher is sampling from a finite population without replacement, as is typically the case in historical studies, the sampling fraction can be large and should be corrected by formula (2).

Population Characteristics and Their Estimates

To illustrate these procedures with simple examples and to show the advantages of sampling, I use data from the published *defters* of Antep, Budapest, Jerusalem, and Malatya (Özdeğer 1988; Kaldy-Nagy 1971; Hütteroth and Abdalfattah 1977; Yinanç and Elibüyük 1983).²⁴ These regions represent the geographic diversity of the Ottoman Empire: Budapest is in central Europe, Jerusalem is in southwestern Asia, and Antep and Malatya are in Asia

Minor. Moreover, because some of these publications cover either multiple districts or one district on multiple dates, they include populations of different sizes and provide information about these regions at different periods of time. The dates (CE) of these *defters* are 1536, 1543, and 1574 for Antep; 1546 and 1562 for Budapest; 1596 for Jerusalem; and 1560 for Malatya. I use these data first to calculate summary statistics for all villages (whole population) recorded in a *defter*, separately for each region and time period. I then use the three sampling methods described above to draw samples from each *defter*, use these samples to estimate the characteristics of populations, and compare the results of different estimation methods with each other and with population values.

Suppose that our objective is to estimate two characteristics of the villages recorded in these documents, two mean values chosen to represent different levels of variability among villages.²⁵ The first is the mean value of taxes due from cereal grains (the sum of all taxes due from wheat, barley, millet, etc.). Because most villages grew cereals, the variability of taxes from cereals was low among villages, as can be seen in the low standard deviation of cereals (relative to the mean) in most regions listed in table A1.²⁶ The second characteristic of interest is the mean value of taxes due from fruits and vegetables (the sum of all—variously termed—taxes due from the products of gardens, orchards, and vineyards). A comparison of the standard deviations (relative to means) of taxes reported in table A1 shows that villages must have grown much more variable amounts of fruits and vegetables than cereal grains. Different levels of variability between the two types of taxes will show the way benefits of sampling can vary with the characteristic of interest.

As discussed above, the optimal sample size depends on the method of sampling, population characteristics of interest, the desired level of the reliability of estimators, and population variance. For simple random samples, I used formulas (1) and (2) to determine the sample size. I determined the minimum acceptable sample size by choosing z corresponding to the confidence level of 10 percent and setting d such that the sample estimate is within (a fairly wide margin of) 20 percent of the population mean.²⁷

I used the optimal size calculated for simple random samples to approximate the size of systematic samples. I can assume that villages were listed in *defters* in a random (nonperiodic) order, so the situation is practically the same as simple random sampling. Because the size of a systematic sample also depends on the sampling interval, it can only approximate the desired size. For example, if the formula happens to generate 42 as the desired sample size from a region of 200 villages, this size can be approximated by a 1-in-5 systematic sample that yields 40 villages.²⁸

The first of the cluster samples I generated is based on random selections of subprovinces, called *nāhiye*, within each region. I began by randomly choosing one of the *nāhiyes*. If the total number of villages in this *nāhiye* was

large enough (that is, greater than n), I included all the villages in this *nāhiye* in the sample. If the number was not large enough, I chose another *nāhiye* until a sufficiently large sample was drawn.²⁹ The sizes of this type of cluster sample were thus determined primarily by the number of villages in the chosen clusters.

For the second type of cluster samples, I chose one-third of the villages (in consecutive order) in the population. This type of sampling was motivated by the rule currently practiced by Turkish archives of providing researchers a photocopy of only one-third of a *defter*. The administrative simplicity of cluster sampling might prompt a researcher to seek the benefits of sampling within the bounds of this rule simply by drawing a sample that consists of all villages in a “randomly” chosen one-third of a *defter*. To draw such a sample, I first chose a random number between 1 and N (population size) and selected the next $(1/3)N$ villages for the sample, continuing from the beginning of the order if the sample was not completed when N was reached. By including such samples in the analysis, one can compare the results and assess the appropriateness of this type of sampling procedure.

Estimation results for the taxes on cereal grains (table 1) are shown separately from those on fruits and vegetables

(table 2). In the first column of both tables are the population means, standard deviations, and the total numbers of villages in the provinces on the specified dates of the registers. Other columns show the estimates of the population means, along with the standard errors and sample sizes of the estimates, based on simple random, systematic, and cluster samples.

The means of simple random and systematic samples are generally very close to population values. Although, in some cases, the sample means may appear to differ substantially from population values, this difference needs to be considered in light of the standard deviations of the population and the sample means. Statistically speaking, what matters is not the absolute difference between the population and sample means but its statistical significance. To test for the significance of these differences, I calculated t statistics for each sample mean. These statistics show that, at current levels of significance, the differences between population means and estimates obtained by simple random and systematic methods are generally statistically insignificant. One can also see that seemingly substantial differences between the population mean and its estimates typically correspond to cases where the population variance is high. Such a variance indicates a wide dispersion of

TABLE 1. Taxes Due from Cereal Grains: Population Values and Estimates

Region (Date)		Whole population	Simple random sample	Systematic sample	Cluster sample (by <i>nāhiye</i>)	Cluster sample (1/3)
Antep (1536)	Mean value	1,298	1,154	1,321	1,120	1,353
	<i>SD</i>	1,026	521	731	890	1,112
	No. of villages	102	30	25	44	34
Antep (1543)	Mean value	3,821	3,668	4,005	4,865	2,142
	<i>SD</i>	3,540	2,716	3,473	4,016	1,399
	No. of villages	220	46	44	98	73
Antep (1574)	Mean value	4,185	4,622	3,939	5,275	4,926
	<i>SD</i>	3,159	3,993	2,957	3,672	4,066
	No. of villages	212	33	30	95	71
Budapest (1546)	Mean value	1,820	1,601	1,698	1,585	2,104
	<i>SD</i>	1,580	1,039	1,121	1,460	1,827
	No. of villages	297	44	42	73	99
Budapest (1562)	Mean value	3,164	3,351	2,801	3,550	2,905
	<i>SD</i>	2,983	3,176	2,703	3,875	1,878
	No. of villages	297	50	50	78	99
Jerusalem (1596)	Mean value	3,491	3,789	3,810	2,963	2,886
	<i>SD</i>	3,595	4,235	3,881	2,364	2,284
	No. of villages	187	52	47	52	62
Malatya (1560)	Mean value	2,252	2,183	2,533	1,968	2,637
	<i>SD</i>	2,371	1,814	3,083	1,630	2,489
	No. of villages	640	67	64	84	213

Source. Özdeğer (1988), Kaldy-Nagy (1971), Hütteroth and Abdalfattah (1977), and Yinanç and Elibüyük (1983).

Note. All monetary values are expressed in the Ottoman currency of *Akçe*. The population and samples include only inhabited villages; large towns and uninhabited lands are omitted. See text for description of sample sizes and determination of sampling procedures. The significant increase in the population of Antep between 1536 and 1543 is caused by changing district boundaries. *SD* = standard deviation.

TABLE 2. Taxes Due from Fruits and Vegetables: Population Values and Estimates

Region (Date)		Whole population	Simple random sample	Systematic sample	Cluster sample (by <i>nāhiye</i>)	Cluster sample (1/3)
Antep (1536)	Mean value	1,653	1,299	1,462	1,789	1,489
	<i>SD</i>	2,520	1,353	1,711	2,148	2,129
	No. of villages	102	62	51	44	34
Antep (1543)	Mean value	2,097	1,932	2,172	1,595	1,673
	<i>SD</i>	3,071	2,276	3,264	1,761	2,497
	No. of villages	220	87	55	98	73
Antep (1574)	Mean value	2,361	2,441	2,415	1,903	2,342
	<i>SD</i>	2,926	2,444	2,263	2,134	3,228
	No. of villages	212	70	53	94	71
Budapest (1546)	Mean value	682	688	887	1,123	394
	<i>SD</i>	2,001	1,156	1,848	3,050	758
	No. of villages	297	197	149	73	99
Budapest (1562)	Mean value	1,708	1,951	1,835	2,545	759
	<i>SD</i>	6,060	3,518	4,981	6,538	1,520
	No. of villages	297	220	149	78	99
Jerusalem (1596)	Mean value	2,547	2,567	2,701	4,124	3,699
	<i>SD</i>	4,124	3,796	4,127	6,307	5,868
	No. of villages	187	93	136	52	62
Malatya (1560)	Mean value	498	542	453	706	658
	<i>SD</i>	960	1,105	819	1,055	1,295
	No. of villages	640	181	180	125	213

Source. Özdeğer (1988), Kaldy-Nagy (1971), Hütteroth and Abdalfattah (1977), and Yinanç and Elibüyük (1983).

Note. All monetary values are expressed in the Ottoman currency of *Akçe*. The population and samples include only inhabited villages; large towns and uninhabited lands are omitted. See text for description of sample sizes and determination of sampling procedures. The significant increase in the population of Antep between 1536 and 1543 is caused by changing district boundaries. *SD* = standard deviation.

values in the population, so a subsample of the population is also likely to reflect this dispersion through a high standard error of the sample. The existence of substantial differences between sample and population means is not necessarily a problem of sampling but a problem of distribution.

The estimates obtained by cluster sampling, however, sometimes vary significantly from the population means. The two methods of cluster sampling can also yield very different estimates, as can be seen from the estimates obtained from the Antep (1543) population in table 1 and the Budapest (1546, 1562) populations in table 2. These differences are clearly indicative of substantial systematic variations among the subprovinces of a region, possibly caused by the climate, topography, and other natural and socioeconomic considerations. In such cases, because cluster samples as a rule include villages from some subprovinces but not others, they do not accurately represent the population. Therefore, when one suspects such systematic differences within a region of interest, it would not be appropriate to choose cluster sampling.

A comparison of optimal sample sizes for the simple random method (n) in table 1 with the total number of villages (N) in each region shows the benefits of sampling and the

way sampling can cut the cost of collecting data by a significant fraction. The average optimal sample size in table 1 is about 46 villages, sizes ranging from 30 in Antep in 1536 to 67 in Malatya in 1560. The proportion of optimal sample sizes to the total number of villages in the population (n/N) range from being 10 percent of the population in Malatya to 29 percent in Antep in 1536, averaging about 16 percent in all regions. These figures indicate that an investigator need not have data on all villages or on a substantial proportion of villages in a region to be able to examine that region's history.

Sample sizes in table 2, however, show sampling's limitations. The primary difference between the two tables is that the population variances (relative to means) are significantly greater in table 2 than in table 1. As a result, the optimal sample sizes in table 2 (with the same levels of reliability as in table 1) are significantly higher. The average optimal sample size in table 2 is about 130 villages, and the average proportion of optimal sample sizes to the total number of villages in the population is about 45 percent. A comparison of the two tables thus shows when sampling is most likely to be useful. Clearly, the less variability in the population items, the lower the optimal size of a representative sample, and the greater the benefits of sampling. If, howev-

er, an investigator is focused on a characteristic with widely dispersed values and a consequently high variability, a representative sample will have to be larger and the benefits of sampling will be reduced.

Because a sample may not reliably show the peculiarities of the data that are sometimes the historian's primary interest, some projects are thus less likely to benefit from sampling. Some items of interest might be observed too infrequently in the *defters* to be reliably represented by sampled data. For example, if one wishes to study cases of villages that received tax exemptions for special services performed for the state, such as maintaining a bridge, then a sample of villages is unlikely to represent these instances reliably, simply because such instances happened (or were recorded in the *defters*) too infrequently. If attention is focused on the usual and typical rather than the unusual and extraordinary, then sampling will provide the information at a fraction of the cost of obtaining the data for the whole population.

Conclusion

Tahrir defters are the gold mines of research for the historian of the Middle East and eastern Europe, providing rich, detailed information about the names, numbers, and composition of taxpaying inhabitants and the amounts of taxes due from productive resources and economic activities. Despite the great potential of these documents, however, they have been surprisingly underused in historical research, and their full potential has not yet been achieved in comprehensive quantitative studies.

Two courses of action may change this outcome. The first is to relinquish the excessive caution and unnecessary criticism and instead adopt a more optimistic attitude toward the potential of these documents. Their perceived limitations are not significantly different from those of comparable documents used productively in other fields of historical scholarship. The *defters* can be used in numerous ways to push the boundaries of our knowledge, including the extension of the coverage of previous pathbreaking studies to other periods and regions, the use of new tools, concepts, and theories recently developed in the humanities and social sciences, and the introduction of new quantitative tools and methods to analyze the data.

The second strategy that can promote the use of *defters* in historical research is sampling. Although using whole *defters* may in some circumstances be a reasonable way of studying the history of a small region in great detail, it is unlikely that any region in its entirety can be studied through total processing of all the *tahrir defters*. Sampling can radically reduce the cost of data collection without sacrificing reliability. Although large projects are likely to benefit the most, cost considerations apply to projects of all sizes, and smaller projects with limited spatial or temporal focus can also benefit from sampling.

NOTES

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1. B. W. McGowan (1969) is an exception. Having worked on the whole *defter* of Sirem for his PhD dissertation, McGowan sampled from three more areas for a comparative study of food supply and taxation on the Middle Danube River.

2. The oldest available *defter* in Turkish archives is that of Albania, dated 1431–32, which has been edited by İnalçık (1954a). Although carrying out new surveys of the tax revenues of previously conquered lands was no longer common practice after the sixteenth century, the Ottomans continued to prepare new *defters* of newly conquered or reconquered lands in the seventeenth century. For an example of such late *defters*, see the description of the *defter* of Kamanice, dated 1681, by D. Kolodziejczyk (1993).

3. At the beginning of each province's register was a document called *kānūnnāme*, which laid down the basic tax regulations of the province and specified the rates at which each resource was to be taxed in different circumstances. For example, the *kānūnnāmes* specified, often in great detail, the tax rates that depended on the marital and economic status of peasants and the rates at which different types of grains, trees, animals, mills, and so on were to be taxed. See H. İnalçık (1960) for the history and types of *kānūnnāmes*. For collections of Ottoman *kānūnnāmes*, see Ö. L. Barkan (1943), A. Akgündüz (1990), and the bibliography in the appendix of D. A. Howard (1995/96).

4. The importance of these *defters* for historical scholarship has even led to the creation of a methodological subdiscipline called Deferology and *Tahrir* studies. See, for example, Barkan (1970b), Cvetkova (1983), Halasi-Kun (1986), Lowry (1992), Singer (1990), and the 1993 issue of *The Journal of Ottoman Studies*. There have also been three international congresses—*Defter Congresses*: the first two in Konya, Turkey, and the third in Erlangen, Germany—dedicated solely to the discussion of how best to proceed in the publication and use of *defters*.

5. For the *defters* of Hungarian provinces and the history of early scholarship in the field, see Fekete (1947).

6. For a history of scholarship during this period, see Halasi-Kun (1986, 163–64) and C. Heywood (1988, 322–25). Historians' excitement about the *defters* was in some ways greater for the history of the territories controlled by the Ottomans outside Turkey proper. See Cvetkova (1983), Feneşan (1996), Kaldy-Nagy (1968), and Lewis (1951) for examples.

7. See, for example, Göyünç and Hütteroth (1997) and Taştemir (1999). A more comprehensive list of published *defters* is available from the author: cosgel@uconn.edu.

8. See also M. Öz (2002) for a review of the pertinent literature and a discussion of the value of *defters* as quantitative sources.

9. For a review of these issues and the pertinent literature, see B. K. Ataman (1992) and Faroqhi (1999, 86–95).

10. For example, C. Heywood (1988) proposed to view *defters* essentially as "texts" (rather than as mere sources of quantitative data) and suggested a textual reading of them; R. Murphey (1990) examined the records of the Imperial council (*mühimme defterleri*) to highlight the importance of understanding the process of drafting the *tahrir defters*; and A. Singer (1990) suggested ways in which the court records (*kadı sicilleri*) can be used together with the *defters* of a region to study rural administration.

11. Published as a chapter in his (1992) book, this was originally a paper read by Lowry at the Fourth International Congress on Turkish Economic and Social History in Munich in 1986.

12. It is also possible, of course, that some of this omission results from rent seeking, negotiation, and compromise between state and taxpayers (see Murphey 1995/96).

13. Although some *defters* recorded tax-exempt groups, this practice was not consistently followed in all regions.

14. There could even be significant variations in the standards used within the same unit. See Venzke (1997, 45–59) for a detailed discussion of the variety of measures used in the Aleppo region. See also İnalçık (1983, 1994, 987–93) for Ottoman weights and measures in general.

15. Note also that, in cases of production involving multiple products, one has no choice but to use values (instead of output) for aggregation purposes, independent of how standardized the unit of measuring output may be.

16. Values are calculated by using prices determined by the government. Although one could question the reliability of government-determined prices in reflecting market values, Pamuk (2000a) found that they exhibited similar trends.

17. Research is already under way aimed at identifying regional differences in prices and units of measurement in the Ottoman Empire, in collaboration with the Global Price and Income project led by the Agricultural History Center of the University of California-Davis (Lindert 2002; Coşgel 2004b). For previous research on prices in the Ottoman Empire, see Pamuk (2000a, 2000b) and Özmucur and Pamuk (2002).

18. Ronald Coase and Douglass North, leading proponents of this approach, have been awarded the Nobel Prize in Economics. For a brief review of New Institutional Economics, see Oliver E. Williamson (2000). See also Coşgel (2002, 2003) for examples of the economic analyses of Ottoman taxation based on this approach.

19. See, for example, Stephan Thernstrom (1973) and Robert Fogel and Stanley Engerman (1974). See also R. C. Johnson (1978) for a critique of the sampling methods of these works.

20. But see also Lowry's (1992, chap. 2) critical comments.

21. See McGowan (1969, 152) for a description of the sampling procedure.

22. See Paul Levy and Stanley Lemeshow (2000) or other textbooks on sampling for details on these and other sampling methods available to researchers. Because the population structure in *tahrir defters* does not fall into natural, easily identifiable, and relevant stratifications, stratified sampling methods are omitted in this discussion.

23. The procedure for finite population correction is based on the calculation of variance in formula (1) by the "nonbiased" or " $n-1$ " method. Population variance is typically unknown and needs to be estimated from pilot studies or previous surveys. The acceptable sample size is different for other statistics of interest and methods of sampling. See, for example, Schofield (1972) and Levy and Lemeshow (2000) for details and illustrations of how to determine the optimal sample sizes.

24. These publications are the transliterations of the original *defters* kept in the Prime Ministry Archives in Istanbul (numbers 186, 373, and 161 for Antep; numbers 388, 410, 449, and 345 for Budin) and in the Cadastral Office Archives in Ankara (number 112 for Kudüs and number 142 for Malatya).

25. In general, as can be seen in the appendix and table A1, the *defters* include information about the number of adult male taxpayers, personal (or household) taxes, and taxes on cereals, legumes, rice, fruits and vegetables, beehives, animals, mills, occasional fees, and other miscellaneous taxes.

26. Variability is formally measured by the coefficient of variation (or its square: relative variance), which is equal to the ratio of standard deviation to mean.

27. The historian should determine the values of z and d on the basis of the study's objectives. Because we have data for the whole population, I was able to calculate the population mean and variance and substitute for d and s in these formulas. Of course, the population parameters are typically unknown, in which case the investigator has to estimate them with pilot samples or make educated guesses about them on the basis of previous studies. See Schofield (1972, 163–65) and Levy and Lemeshow (2000, 70–75) for examples. See also table A1 for the population means and standard deviations of various characteristics of villages in the *tahrir defters* of the regions examined here, which future researchers can combine with other available information to use for estimating population parameters in other regions.

28. Once I determined the required sample sizes for random and systematic methods, I also generated samples of sizes $1.5n$ and $2n$ to test for the sensitivity of results to variations in sample size beyond n . A comparison of the estimates derived from samples of sizes n , $1.5n$, and $2n$ show that increasing the sample size beyond the optimal level does not necessarily increase the precision of estimates significantly.

29. Although I could have used two-stage cluster sampling to select a sample of size n (the optimal size for random sampling) by further sampling the cluster through random or systematic methods, I did not want the choice of a secondary sampling procedure to affect the results. The *defter* of Antep (1536) contained only one *nâhiye*, and Jerusalem also had only one *nâhiye* with a sufficiently large number of villages, so in those cases I randomly picked 30 and 52 (corresponding to the optimal sizes for simple random samples) consecutive villages as clusters.

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APPENDIX

Examples of Entries in Ottoman *Tahrir Defters* (Names of taxpayers omitted)

Village of Eyücek in Ayıntab [Antep] (1574)

Wheat: 120 *kile*, at 9 *akçe* per *kile*, 1,080 *akçe*; barley: 82, 9, 492; vetch: 10, 9, 90; chickpeas: 11, 9, 99; summer crops and vegetable garden: 350; vineyard: 141; *çift* [holder of a yoke of land] tax: 10 *çift*, at 40 per *çift*, 400 *akçe*; tax on small landholders: 10, 12, 120; tax on bachelors: 4, 6, 24; beehive tax: 30; title deed tax: 40; *âdet-i deştibânî* [village watchman tax]: 80; *bâd-i hevâ* [windfall, occasional] fees (half): 60; total tax revenue: 3,006 to the fiefholder, 60 [the other half of occasional fees] to the governor of the district

Village of Magyaröd in Budin [Budapest] (1562)

Gate tax: 25 gates, 1,250 *akçe*; wheat: 300 *keyl*, 3,600 *akçe*; mixed grains: 300 *keyl*, 3,600 *akçe*; grape juice: 1,200 *pinte*, 3,000 *akçe*; beehives: 160; occasional fees: 150; swine: 525; hemp and cabbage: 100; quality meadow: 400; church tax: 50; total tax revenue: 9,875

Village of Şübâ in Kudüs [Jerusalem] (1596)

Muslim heads of household: 60; Christian heads of household: 7; total adult males: 67; tax rate [for products subject to the tithe]: 1/3; wheat: 1,000; barley: 840; olive trees: 120; grape syrup: 1,040; occasional fees: 200; goats and beehives: 200; total tax revenue: 3,800

Note. *Akçe* is the Ottoman currency; *kile*(*keyl*) and *pinte* are units of measurement. When the literal translation of terms in the original Ottoman text was not sufficiently clear, I used more recent, self-explanatory terms. For transliterations of original texts, see Özdeğer (1988, 335), Kaldy-Nagy (1971, 164), and Hütteroth and Abdalfattah (1977, 115).

TABLE A1. Villages, Taxpayers, and Taxes in Ottoman *Tahrir Defters*

	Antep			Budapest		Jerusalem	Malatya
	(1536)	(1543)	(1574)	(1546)	(1562)	(1596)	(1560)
No. of villages	102	220	212	297	297	187	640
No. of adult taxpayers (households)	20 (20)	30 (38)	41 (56)	12 (11)	26 (20)	35 (37)	38 (41)
Taxes							
Personal (household)	608 (662)	813 (920)	908 (936)	606 (557)	1,547 (1,155)		659 (687)
Cereal grains	1,298 (1,026)	3,821 (3,540)	4,185 (3,159)	1,820 (1,580)	3,164 (2,983)	3,491 (3,595)	2,252 (2,371)
Legumes	46 (151)	37 (171)	27 (98)		42 (71)		1 (15)
Fibers		62 (293)		2 (18)	77 (117)		251 (470)
Fruits and vegetables	1,653 (2,520)	2,097 (3,071)	2,361 (2,926)	682 (2,001)	1,708 (6,060)	2,547 (4,124)	498 (960)
Beehives	30 (72)	69 (99)	82 (255)	23 (42)	122 (123)	346 (484)	45 (128)
Animals	69 (96)		1 (11)	124 (214)	608 (751)	5 (49)	153 (381)
Mills	16 (30)	29 (50)	32 (57)	13 (37)	29 (116)	6 (73)	16 (35)
Occasional fees	94 (114)	201 (271)	282 (256)	31 (52)	374 (874)	175 (179)	238 (248)
Miscellaneous other		7 (75)	28 (181)	130 (311)	427 (1,561)	80 (577)	212 (1,386)
Total taxes	3,814 (4,066)	7143 (6,942)	7,910 (6,039)	3,430 (3,394)	8,097 (10,281)	6,650 (6,753)	4,324 (3,933)

Source. Özdeğer (1988), Kaldy-Nagy (1971), Hütteroth and Abdalfattah (1977), and Yinanç and Elibüyük (1983).

Note. The populations include only inhabited villages; large towns and uninhabited lands are excluded. The numbers of taxpayers and amounts of taxes are mean values per village. Standard deviations are given in parentheses. All monetary values are expressed in the Ottoman currency of *Akçe*.

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