Appendix

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December 27, 2024

This Appendix contains additional data, sources, estimations and methodological details referenced to in the article *Was it really so high? New estimates on income inequality in Finland, 1865–1959*. The Appendix has been structured as follows. Section 1 describes the consent and municipal tax records in detail and goes through the generalised Pareto curve interpolation process step-by-step. This section also features additional discussion on the replication of the results in Roikonen (2022) and the issues encountered with it. Section 2 describes the subsistence basked estimated for the article's maximum feasible Gini coefficient. Section 3 presents additional data on the development of income taxation in Finland from 1938 to 1959. Section 4 presents the average equity ratio and rates of return on equity and total capital in Finnish industries in 1837–1938. Section 5 compares the top 1 percent's income share to those of the bottom 50 percent and the top 25–2 percent, or the fractile called as the 'middle class' for short. The section includes additional description of the consent tax micro data. Finally, Section 6 provides a comparison of agricultural productivity in Finland and the U.S. in 1880.

1. Generalised Pareto curve interpolation

This appendix presents a detailed description of the methodology behind the income share estimates presented in the article, with a particular focus on consent and municipal tax records from 1865, 1871, 1876, 1880 and 1899–1900. Although these estimates are far from perfect, this appendix delves into some of the reasons why it may be reasonable to assume that the top 1 percent's taxed income share was not at an historical apex during the latter half of the 19th century, but only ascendant.

The first nation-wide income tax (*suostuntavero, bevillning*) was levied in the Grand Duchy of Finland between 1865 and 1885. I have translated it very directly as 'consent tax'. The name refers to the fact that it was levied on the estates' consent, enabled by the convocation of the estates by tsar Alexander II in 1863. It should be noted that the term is not unique. It applies to a number of taxes levied in Finland both under Swedish and Russian rule. It was only in the 1920s that a more modern terminology of income taxation began to supersede different forms of 'consent taxation'.[1] The tax was heavily influenced by a similar tax introduced in Sweden in 1861 (Nykänen, 2012, p. 55). It was somewhat progressive, with the statutory tax rates ranging from 0.8 percent for incomes above 500 FIM to 1.2 percent for incomes above 10,000 FIM. The tax rates and thresholds were retained throughout the period, which has subjected the taxpayers to at least some degree of 'bracket creep', that is, an increase in the tax rates in the absence of inflation checks.[2] This is visible in the growth in the number of tax units in the data, as their incomes have risen. The tax had to be renewed by the estates. Its abolition was thus a passive process once they declined to do so in 1885.[3] A state income

[1] The Diet (*säätyvaltiopäivät, Finlands ständer*) had been abolished already in 1906 and replaced by a single-chamber parliament. This speaks of the delay in the change of historically established terminology—after all, there was no longer any need for the 'consent' of the estates, which were *de facto* losing their status around the time.

[2] This phenomenon became much more prominent in the 20th century, in particularly during WWI and WWII in most warring countries, including Finland and Sweden (e.g. Henrekson and Stenkula, 2015, p. 13).

[3] According to Wikström (1985, pp. 29–39, 33), one issue with the tax was the relative evenness of income distribution which meant that the top tax rates did not bring in the anticipated revenue. In addition, although the vast majority of the Finnish population was rural, they accounted for less than a half of the revenue. Thus, the low yield was the primary reason for the abolishment of the tax.

tax has been levied in Finland annually since its introduction in 1920.

The tax unit in the consent tax of 1865–85 was primarily the household head. However, as mentioned in the article, the tax concerned also corporations (*osake- ja pankki-yhtiöt*) with regards to their dividends in 1865–79 and their 'pure' income in 1880–5. In addition, estates of the deceased were also among the units. Although few in number, the article has shown that the corporations' impact should not be neglected. Although the data analysed thus far covers only a small part of the taxed corporations, the estimations already show an impact on the top 1 percent's share. The tax concerned only a relatively small number of households. In 1865, this figure was approximately 18.8 percent. In 1880, the figure had risen to 31.2 percent of the estimated number of households (Roikonen and Heikkinen, 2020, p. 49). The exclusion of the vast majority of households has boiled down on the relatively high income threshold of 500 FIM per annum. The adjustment method developed by Atkinson (2007) has been used in order to account for these units in a 'top down' manner. The coefficient has been estimated for the top 10 percent using the `poweRlaw` package in **R**.

The tax was levied by local tax committees with between five to nine members. Rural municipalities had a single committee, whereas towns and cities could have several based on their population. The committees were supposed to represent the different social groups in their district. The committees' task was to assess the tax units' 'pure' income based on available information, be it the taxpayers' declarations or the quantity and value of production, sales opportunities, the scale and quality of enterprise, the value of parcels (i.e. wages in-kind), rates of interest, value of bequests, and so on (April 20, 1865/23, § 2). As will be shown later on, and as the article mentions, these information requirements made the task quite challenging.

The tax units were not obliged to file a tax return. Although they could voluntarily declare their income to the committee, few chose to do so. For example, in 1866, when the tax was levied for the first time on the previous year's incomes, around 26.0 percent of all units chose to declare their income. In 1876, the same figure was merely 2.9 percent. It seems that, at least in 1865–6, more than a third, or 35.6 percent, declared incomes which were deemed too low by the local tax committees (9.3 percent of the total). Although it is unclear to what degree this was motivated by tax evasion—after all, the tax ranged from merely 0.8 to 1.2 percent—it is clear at least that the decline in self-declaring means that the tax units' incomes were, for the better or for worse, increasingly dependent on the tax committees' assessments (Statistical Office of Finland, 1869, pp. 9–10; Statistical Office of Finland, 1875, p. 10).

The concept of income in these early years was 'pure' income. According to the original statute for the years 1865–7,

> Pure income is the saving which is created when some person's fixed or movable capital, office or business, and the increase in her wealth has otherwise through inheritance, testamentary or interstate succession, estate, discovery, pensions, year of grace [in Finnish, *armovuosi*, in Swedish, *nådår*] etc. received, are to be deducted not only annual expenses, wages, interests, pensions etc. but also all payments to the state or the municipality, irrespective of their name or quality. In addition, no deduction shall be made for the cost of living of the taxpayer and her family, the wage and maintenance of her various servants, or for any other charges relating thereto. Dividends received from companies which are subject to income tax under Article 3 [i.e. corporations] are, however, to be deducted when the shareholders' personal incomes are calculated (March 2, 1865/10, § 4, the author's translation).

As the statute did not include deductions, exemptions or imputations apart from the dividend deduction and a 500 FIM deduction for tax units whose income equalled or exceeded 550 FIM (the incomes were rounded to the nearest 100 FIM), the concept of 'pure' income was relatively close to more modern concepts of pre-tax or taxed income, including inheritances and capital gains, or profits from sales. Although the concept was modern, the income assessments, obviously, hinged on the accuracy of the local tax committees' assessments. Some authors, including Roikonen and Heikkinen (2020) and Voutilainen (2022) have emphasised the accuracy of these assessments, given the fact that the committees comprised of individuals supposedly well versed in the tax subjects' circumstances. This does not imply that there would not have been heterogeneity in the assessments. At this stage, it is hard to find evidence of any systematic biases in favour or to the detriment of certain tax units, although it is probable that the tax base was more complete for wages than, say, for rents (Statistical Office of Finland, 1875, p. 12). Regional differences may also have affected the assessments, and thus, effective tax rates to a degree.

The top income share and Gini coefficient estimates have been obtained using a so-called generalised Pareto curve interpolation developed by Blanchet et al. (2017). This method is known for its suitability for the assessment of top incomes. By definition, a generalised Pareto curve comprises of inverted Pareto coefficients $b(p)$ following the rank $0 \leq p \leq 1$, where $b(p)$ is ratio between the average income above p and the p-th quantile $Q(p)$ so that $b(p) = \mathrm{E}(X|X > Q(p))/Q(p)$. For example, in 1880, the average taxed income in the 10,000 to 50,000 FIM bracket was 19,462 FIM, so that the inverted Pareto coefficient between these quantiles, 10,000 and 50,000 FIM, was 1.9 at a two-digit level. Blanchet et al. (2017) note the usefulness of this method for historical tax records because the interpolation requires only relatively little information in order to produce supposedly accurate estimates. They also laud the accuracy of the method, noting that its precision 'is such that it is often preferable to use tabulations based on exhaustive data sets rather than individual data from a non-exhaustive subsample of the population, even for subsamples considered very large by statistical standards.' For example, in the case of a 100,000-observation subsample, the mean relative error for the top 5 percent's share can be in the range of three percent, whereas the same for the tabulated data using the generalised Pareto curve interpolation can be as low as 0.5 percent with the difference increasing rapidly as one moves up the distribution. For the top 0.1 percent, the mean relative error can be as high as 20 percent in a 100,000-observation subsample, but as low as four percent in tabulated data using the given method (Blanchet et al., 2017, pp. 2, 3). Paretian interpolation methods have become the staple in historical income inequality research across the globe (e.g. Atkinson and Piketty, 2007; Atkinson and Piketty, 2010; Piketty and Saez, 2003). Although other tail-heavy distributions, such as the log-normal or Weibull distributions can also be used for similar interpolation purposes, the generalised Pareto curve interpolation seems to suit the purpose quite well.

The Statistical (Main) Office of Finland produced annual consent tax statistics for the taxed incomes in 1865, 1871, 1876 and 1880. The tabulations contain data on bracket thresholds (e.g. 10,000 to 50,000 FIM), the number of tax units within these thresholds (for example, 905 in the given bracket in 1865) by social group (among others, state officials, merchants, industrialists and peasants) by their primary occupation and their tax sums. As the income brackets follow the thresholds in the income tax statute (His Imperial Majesty's Benignant Declaration on the consent tax that the Finnish Estates have taken upon themselves to pay in the years 1865, 1866 and 1867 (March 2, 1865/10)), it is possible to weight these rates with the number of tax units in each bracket in order to arrive at an estimate on the weighted average tax rate. The total sum of taxes can then be divided by this weighted average in order to obtain an estimate of the total sum of taxed income in the given year. Because this method captures only the taxed incomes above the 500 FIM exemption limit, each tax unit above the bottom threshold of 500 FIM have been assigned an additional 500 FIM in order arrive at the level of total 'pure' income.[4] This can then be divided with the number of tax units (80,517 in 1865) in order to estimate the average 'pure' income (taxed income plus the 500 FIM deduction). More formally, this can be expressed as

$$\bar{y}_t = \left(\frac{\sum_{i=1}^{N} \tau_{it}}{\phi_t} + [500\,\mathrm{FIM} \times \sum_{i=1}^{N} u_{it}]\right) / \sum_{i=1}^{N} u_{it}, \tag{1}$$

where $\bar{y}$ is the average 'pure' income, u is the tax unit, t is the year of observation, τ stands for the consent tax and ϕ is the weighted average tax rate using the number of tax units in each bracket as weights. For the year 1880, the data include sums of taxes paid by the tax units in each income bracket. This allows one to estimate the average taxed income slightly more reliably. Still, the differences are minor—in 1880, the estimated total taxed income is 162.2 million FIM when the bracket sums are aggregated, the 1880 data allowing for such a calculation. If one uses the weighted average tax rate of 1.0 percent as in Equation 1, the total taxed income is 156.9 million FIM. In per capita terms, the figures are 1,144 and 1,107 FIM, respectively, a 3.4-percent difference, which can be considered modest. Because there were no other exemptions than the one for incomes below 500 FIM and the ensuing

[4] Dividing the total sum of taxes (e.g. 668,828 FIM in 1865) with the average weighted tax rate (1.0 percent from 1865 to 1880) yields only the sum of income above the 500 FIM exemption threshold. For example, if a household head, i.e. the intended unit of taxation alongside corporations, had an assessed income of 700 FIM, the first 500 FIM would have been exempted and the tax levied only on the remaining 200 FIM. The tax rate below 5,000 FIM being 0.8 percent, the tax would have in this case been 1.6 FIM (0.008 × 200 FIM). In total, the taxed income above the 500 FIM threshold would have been around 82.9 million FIM in 1865. When each tax unit has been assigned an 'extra' 500 FIM, the total taxed income, or the 'pure' income is 123.1 million FIM.

500 FIM exemption from the 'pure' income of tax units with incomes above this level, the total tax yield allows for a fairly reliable estimation of the taxed income, as well as the 'pure' income, when each tax unit are assigned an 'extra' 500 FIM.

In practice, the share estimates presented in this article have been produced using the `gpinter` package written by Thomas Blanchet for **R**. In particular, the function `thresholds_fit` has been used. This function requires data on percentiles, bracket thresholds, the average income within the distribution (obtained using the method described previously in this appendix) and, preferably, data on the bottom threshold (in this case, 500 FIM) and the top bracket average or income share (100,000 FIM or above). As this data cannot be obtained straight away for 1865, 1871 and 1876, it has been estimated using the ratio of the top bracket average to the total distribution average in 1880 (i.e. 0.005) by dividing the average income with this ratio.

Table 1 shows the data needed for the generalised Pareto curve interpolation for the year 1865.

Thresholds (FIM)		Tax units	Percentile	Tax rate (%)	Tax yield (FIM)	'Pure' income (FIM)
500	1,000	60,941	75.69	0.80	668,828	123,151,948
1,000	5,000	17,512	97.44	0.80		
5,000	10,000	1,369	99.14	1.00		
10,000	50,000	662	99.96	1.20		
50,000	100,000	28	99.99	1.20		
100,000		5	100.00	1.20		
		80,517		**1.00**	**8**	**1,530**

Table 1: An example of tabulated tax data in 1865. Source: Statistical Office of Finland, 1869, table 1 (pp. L–LI). Note: the bottom row of the fifth column gives the weighted average tax rate using the number of tax units in each bracket as weights. The bottom rows of the sixth column gives the average tax and 'pure' income per capita. These data include corporations and their dividends. Note also that the data have not been adjusted for the tax units below the 500 FIM threshold as, for example, in Roikonen (2022), where an additional bracket is added below the 500–1,000 FIM bracket and assigned an average income of 40, 60 or 80 percent of the 500 FIM threshold.

The total tax yield in 1865 was 668,828 FIM. Using the 1.0 percent weighted tax rate average, this produces a total income of 82,893,448 FIM as these figures' quotient. Given the 500 FIM exemption, adding this amount of income to the taxed income of each unit, the 'pure' income is 123,151,948 FIM, or by 48.6 higher than the sum of taxed income. Given the number of tax units (80,517 in the given year), this results in an average income of 1,530 FIM per tax unit, which is 500 FIM or 48.5 percent more than the average for taxed income, 1,030 FIM.[5] Thus, moving from the taxed income to 'pure' income increases the total and per capita incomes quite significantly. Not only this, but it also results in lower inequality, as the addition of the deducted 500 FIM to each tax units' income is relatively a greater increase at the bottom than at the top of the distribution.[6] The ratio of the total average income to the average in the top bracket in 1880 was 228,584 FIM to 1,144 FIM, or 0.005. This figure has been used to divide the 1,530 FIM average in 1865, thus obtaining a top bracket average of 305,903 FIM.

The corporations' dividends and, in 1880, their 'pure' income, has been subtracted by assigning each recorded corporation and its dividend to its 'respective' income bracket, after which their dividends have been summed up and they have been subtracted from the number of tax units per bracket and their sum of dividends has been subtracted from the sum of 'pure' income. Given the available data from the financial statements, the number of tax units decreases to 80,513. The total 'pure' income declines to 122,380,848 FIM, or by 0.6 percent. The average 'pure' income per capita declines to 1,520 FIM. Although this may not seem much, the relevant changes happen at the very top, or within the top income bracket. Note that there were five tax units in this

[5] Note that thresholds have been adjusted upwards accordingly. For example, the 1,000 FIM threshold has become 1,500 FIM, and so on. This is necessary for the generalised Pareto curve interpolation to function properly, as the average income of 1,530 FIM would not otherwise match these bracket thresholds.

[6] This can be illustrated accordingly. If we take a vector of seven incomes (100, 200, 500, 1000, 2000, 5000 and 10,000 FIM), their Gini coefficient is 0.620. If we add 500 FIM to each of these incomes, the Gini coefficient is 0.523, or 0.097 points lower than the initial value.

bracket in 1865. Given the data on corporations' dividends available at this stage, at least three of should have been corporations—if the local tax committees have identified them and taxed them accordingly. Their total dividend was 768,000 FIM. When this sum is removed from the total 'pure' income in the bracket, the average income actually increases to 379,207 FIM. This is because dividing the remaining income with the other two tax units results in a higher average. Nevertheless, subtracting the corporations brings about a lower level of inequality, as there are fewer tax units and less income at the top of the distribution. In 1865, accounting for the tax units below the 500 FIM threshold (Atkinson, 2007, pp. 27–28), the top 1 percent's share was 12.7 percent. Without the corporations' dividends, the same figure goes down to 10.8 percent, or by 1.8 percentage points.

Subtracting the corporations and their incomes from the tabulations becomes much more straightforward in the case of the 1899–1900 municipal tax data (A. Hjelt and Broms, 1904, 1905), as the tabulations themselves indicate their numbers, incomes and taxes. When the new income and wealth tax was introduced in 1920, the corporations were reported separately, which homogenises the data even further in terms of tax units, although the unit itself would continue to change between individuals and jointly taxed married or jointly self-employed couples (Jäntti et al., 2010, table 8A.9, p. 432). These issues aside, most of the estimation issues discussed in the article as well as in this appendix concern the initial four years of this study.

As has been mentioned in the article and in this Appendix, dividends were not subjected to double taxation under the consent tax. Instead, they were taxed at the level of the corporation. In 1865–79, corporations were taxed only for their distributed dividends. From 1880 to 1885, corporations, as other tax units, were taxed for their 'pure' income. This makes their subtraction from the tax unit population all the more important. If one chooses to follow the concept of 'pure' income at the level of household heads—i.e. the 'ideal' homogeneous tax unit population in the sense that the tax was, in principle, and alongside the aforementioned corporations, supposed to be levied on their income—then the corporations' dividends and 'pure' incomes are supposed to vanish in thin air. However, it one wishes to broaden the concept and see how the dividends (and, at this stage, only dividends, for the undistributed profits have not directly formed a part of the shareholders' personal incomes, although using a broader concept of income, e.g. that in contemporary distributed national account, or DINA, studies, (for example, Garbinti et al., 2018) would see these undistributed profits measured as part of their income) have affected the distribution of income at household level, one needs to estimate their distribution.

As I discuss in the article, the corporations' dividends and 'pure' have been subtracted from the data in an indirect manner by means of their financial statements. As such, the study captures only a part of the said incomes. Micro data, that is, the consent tax accounts, are of little use here, because they only show the tax units' total 'pure' or taxed income depending on the tax committee. In other words, the accounts do not break the incomes down to separate items, such as wages and salaries, entrepreneurial and capital income. The situation is no better in the case of the municipal tax data in 1899–1900, although in this case the corporations' incomes can be subtracted from the tabulated data directly, which means, in principle, that their subtraction offers a truer picture of income inequality among household heads. An issue in this latter case, however, is that the data does not break the corporations' 'pure' income down to dividends and undistributed profits (e.g. deposits to profit, pension, insurance and auxiliary accounts). I have tried to estimate the share of dividends in their net profits with the financial statements data I have for industrial corporations and banks. I have calculated a weighted average pay-out share, which in the case of a the i-th corporation translates to

$$\kappa'_{it} = (\frac{d_{it}}{(d_{it} + \theta_{it})})(\frac{d_{it}}{\sum_{i=1}^{n} d_{it}}), \tag{2}$$

where $i = 1, ..., n$ are the corporations, d is the dividend and θ is the undistributed profit, and the factor in the second round brackets is the weight of this given corporation. In 1899, this weighted average pay-out share was 0.748 and in 1900 it was 0.840. Thus, I have estimated that 74.8 percent of the corporations 'pure' income was paid out in dividends in 1899 and 84.0 percent in 1900. One issue with this method are outliers: extremely high pay-out shares due to losses. In 1899, the data comprises of 13 corporations, five of which turned a loss. In 1900, six out of the 14 corporations did the same. In the case where the said corporations both turned a loss and paid out an even more substantial dividend—an example of this being Finlayson in 1900—the pay-out share can appear extremely high (in this case, 41.250). I have omitted such cases when estimating the weighted average, which lowers its level somewhat.

As mentioned in the previous paragraphs, neither the published consent tax tabulations nor the micro data tell us anything about the distribution of different income items. Therefore, one needs to rely on external sources. I have estimated the distribution of the dividends among household heads by using the closest available data, which in this case means the tabulations on complete tax returns (n = 470,431) in the 1921 income and wealth tax statistics (OSF IV B:1, table 6, pp. 30–31). This data is admittedly quite distant from the turn of the century, not to mention 1865. Still, it is the nearest disaggregated data available. I proxy the distribution of dividends using that of capital income (rents, interest and dividends). Fortunately for the municipal tax records in 1899 and 1900, this 1921 data distinguishes between rural and urban municipalities. I have therefore been able to produce separate estimations for each sub-group of data. I have then used the share of tax units in rural and urban municipalities as weights for arriving at a weighted average income share of the top 1 percent, as well as the total income and average.

From here on, the method is simple. I assume that the distribution of dividends in 1865–1900 has been identical to that of capital income in 1921 and allocate the corporations' dividends accordingly to the top 1 percent. In 1921, the top 1 percent's capital income share was 23.8 percent. I thus assume that this share of the dividends I have managed to find in the archives has gone to the said income group. For example, in 1865, 183,525 of the total of 771,100 FIM has been allocated to the top 1 percent. This method is of course rather coarse. For example, it does not account for dividends between non-household owners or foreign owners. Hence, even though I have only managed to obtain an unknown share of the dividends (at least those of the biggest industrial corporations and two major banks), the method presumably exaggerates the share of dividends received by the top 1 percent of household heads. Furthermore, because the 1921 data does not break down the capital income into its sub-components, it is difficult to say if dividends were more or less unevenly distributed than capital income in total.

A critical question with the 1921 data is timing. Did WWI, and, in the Finnish case, the civil war of 1918, alongside with the tumultuous aftermath of these epochal events, still impact the level and distribution of income three years later? In other words, can these data be reasonably compared to the observations from 1865, 1871, 1876, 1880 and 1899–1900? According to Heikkinen (2017, p. 68), the Finnish exports were by 1921 following a relatively strong path to recovery. In addition, prices, profits and the GDP did not contract in the newly-independent Finland after the war—on the contrary, the wholesale price index increased almost twelvefold in 1914–21 , while the GDP, in nominal terms, grew from 1,192 million FIM in 1914 to 12,095 million in 1921 (Vattula, 1983, table 10.2.a., pp. 375–377 and table 14.5.b., p. 459). At the same time, the studied corporations' nominal net profits grew from 14.5 million in 1914 to 125.8 million in 1921 (BOF Teollisuuden; NHA Suomen). In relative terms, however, these corporations' profits-to-GDP ratio actually fell from 1.2 to 1.0 percent. In 1865–1900, based on the six years available, the ratio was 0.8 percent. Therefore, although the ratio was higher in 1921 than in, say, 1865, when it was a more modest 0.4 percent (probably the result of low incorporation rate), it seems to be so that the level of profits in 1921 was no longer affected either by the war-time peak demand (the ratio increased from 1.2 percent in 1914 to 2.7 percent in 1916) nor its collapse to 0.5–0.6 percent in 1917–8. Hence, the 1921 data can be seen as 'normal' in the sense that the profits-to-GDP ratio was closer to its level at the start of the war.

The income share and Gini coefficient estimations by Roikonen (2022) are replicated in the article by applying his methodology. I have produced two replications. The first one tries to reproduce the figures presented in the said article. The second tries to follow his methodology as closely as possibly. The fact that these figures differ from the ones published in Roikonen's article boils down most likely to a number of intricacies. A peculiar fact, however, is that when the replication was attempted by following his methodology as closely as possible, the obtained estimates differed from those published in Roikonen's article quite significantly. Although the said differences may again have been caused by some errors in the replication, there are a few things that are worth mentioning.

First, Roikonen (2022), as Roikonen and Heikkinen (2020) before him, create a 'synthetic' sample of tax units below the 500 FIM threshold.[7] In so doing, he opts for a 'bottom up' type of approach to the issue of missing tax units. Using anecdotal data on the average income of these missing units, Roikonen produces a number of estimations in which he assumes that the average

[7] These two articles share almost the same methodology, which means that they are cited here side by side.

was either 40, 60 or 80 percent of the said threshold (Roikonen, 2022, p. 237). In this replication, the first has been used, for it serves as a sort of an upper bound estimate in comparison to my 'lower bound' estimates. In other words, in this version of his estimation, the average income below the 500 FIM threshold has been 200 FIM.

Second, as the published consent tax tabulations do not allow for the estimation of bracket-specific average incomes before 1880, Roikonen (2022) uses the said year's averages for 1865, 1871 and 1876, as well. Although it is not completely clear whether these have been produced by dividing the tax sums per bracket with the tax rates (0.8 to 1.2 percent depending on the level of income), this is likely the case. It seems, however, unlikely that either Roikonen (2022) or Roikonen and Heikkinen (2020) have added 500 FIM to the tax units' incomes above the 500 FIM threshold in order to account for this exemption as in Equation (1). This creates a problem in the 500 to 1,000 FIM bracket, for the average taxed income (without the 500 FIM exemption) is 171 FIM, which is below the 200 FIM average in the 'synthetic' bracket, as well as obviously below the 500 FIM bottom threshold in the bracket itself. However, one can omit this bracket from the imputation.

The first replication uses the `thresholds_fit` command in the `gpinter` package written for **R** by Thomas Blanchet. The figures close to those in Roikonen (2022) have been obtained by using quantiles, or bracket thresholds, their respective percentiles and by setting the bottom threshold at 40 percent of its value of 500 FIM, that is, at 200 FIM. The second replication uses the `tabulation_fit` command, which utilises again bracket thresholds (including the 'synthetic' bracket's lower threshold of 0 FIM), percentiles and within-bracket averages from the 1880 consent tax tabulations (Statistical Main Office of Finland, 1885, Table 2, pp. 36–37 and Table 3, p. 72), including the top bracket average of 228,084 FIM, and the total average, which is a weighted average of the bracket average incomes with the number of tax units per bracket as weights. Table 2 presents the data used in the interpolations for the year 1880. Note that the second bracket average (171 FIM) has been omitted in the interpolation because its level is below the lower threshold of 500 FIM. The last column provides averages with the 500 FIM exemption included for comparison.

Thresholds (FIM)		Tax units	Percentile	Average (taxed)	Average ('pure')
0	500	312,590	68.80	200	200
500	1,000	114,417	93.98	171	671
1,000	5,000	24,543	99.39	1,325	1,825
5,000	10,000	1,818	99.79	7,437	7,937
10,000	50,000	905	99.99	18,962	19,462
50,000	100,000	41	>99.99	69,689	70,189
100,000		25	100.00	228,084	228,584
		454,339		**339**	**495**

Table 2: An example of the data used in the replication of Roikonen's (2022) results for the year 1880. Source: Roikonen, 2022; Roikonen and Heikkinen, 2020; Statistical Main Office of Finland, 1885. Note: the 'pure' income column includes the 500 FIM exemption for the tax units from the second income bracket upwards. The first bracket is the 'synthetic' sample created by Roikonen and Heikkinen (2020) and re-used in Roikonen (2022).

Table 3 compares the results from these two replications with those presented in the article. The figures have been chosen to be as comparable as possible in terms of methodology (i.e. income units below the 500 FIM threshold have been accounted for, but corporations remain in the data).[8]

[8] As before, the Gini coefficient has been adjusted for the income units below the 500 FIM threshold using the equation $G_t = s^*_t + (1 - s^*_t)G_t$, where G is the Gini, t stands for year and s^* is the income share of the top bracket (Atkinson, 2007, pp. 19–20).

	1865	1871	1876	1880
Top 1% share[(a)]	30.7%	27.3%	25.9%	16.8%
Top 1% share[(b)]	7.6%	7.3%	7.2%	8.8%
Top 1% share[(c)]	12.7%	11.7%	11.8%	14.3%
Top 1% average (FIM)[(a)]	5,818	4,596	5,270	5,945
Top 1% average (FIM)[(b)]	2,260	1,968	1,921	2,978
Top 1 % average (FIM)[(c)]	4,323	3,685	5,450	5,721
Total average (FIM)[(a)]	467	417	300	754
Total average (FIM)[(b)]	298	270	303	339
Total average (FIM)[(c)]	341	315	462	400
Total (mil. FIM)[(a)]	37.6	37.4	37.8	106.9
Total (mil. FIM)[(b)]	128.0	112.9	134.0	153.8
Total (mil. FIM)[(c)]	146.4	131.7	145.4	114.9
Gini[(a)]	0.712	0.672	0.692	0.711
Gini[(b)]	0.647	0.606	0.517	0.557
Gini[(c)]	0.182	0.223	0.202	0.273
Income units[(a),(b)]	428,782	418,372	442,731	454,339
Units below	81.2%	78.6%	71.5%	68.8%

Table 3: A comparison of the replications of Roikonen (2022) for the years 1865–80. Source: Roikonen, 2022; Roikonen and Heikkinen, 2020; Statistical Main Office of Finland, 1885; Statistical Office of Finland, 1869, 1875, 1880. Note: (a) figures from the first replication; (b) figures from the second replication; (c) the author's own estimation which, for the sake of comparison, adjusts the data for the tax units below the 500 FIM threshold using Atkinson's (2007) method, but does not account for the corporations. 'Units below' refer to the share of tax units below the 500 FIM threshold. The total number of households is from Roikonen and Heikkinen (2020).

As is readily visible, the two replications produce widely differing results both *vis-à-vis* one another and in comparison to my own estimations. Interestingly, the top 1 percent's shares from the second replication are actually below mine. They are, in addition, between 15.7 and 21.4 percentage points lower than the figures in the first replication, which have striven to match those in Roikonen (2022). Similar differences apply to the top 1 percent's and the total average incomes. In terms of the estimated total incomes, the differences between the second replication and my own estimations are much smaller, especially in 1865, 1871 and 1876. The Gini coefficients, on the other hand, are quite different between the two replications and my own estimations.

A peculiar feature of the second replication is the fact that the top 1 percent's share—an inequality metric on its own—appears to have been quite low whereas the Gini coefficient shows a high level of inequality. This stands in contrast to my own estimations, which show both a historically modest share of the top 1 percent as well as a low value of the Gini coefficient. This peculiarity probably boils down to a number of things. First, by using the same bracket averages for each and every year between 1865 and 1880, Roikonen (2022) probably makes the relative changes in inequality more modest than they otherwise appear to have been. These changes are, as Roikonen and Heikkinen (2020, p. 54) mention, now only due to fact that income units are moving between brackets. Second, by creating the 'synthetic' sample of the income units (i.e. households and corporations) below the 500 FIM threshold, Roikonen and Heikkinen (2020) and Roikonen (2022) create a long, 'flat' left-hand tail to the share distribution, which decreases the top income shares, but also, visually speaking, increases the area between the diagonal and the Lorenz curve, which is, in turn, one definition of the Gini coefficient. As Figure 1 shows, the lowest data point in the second replication is actually to the left of the diagonal.

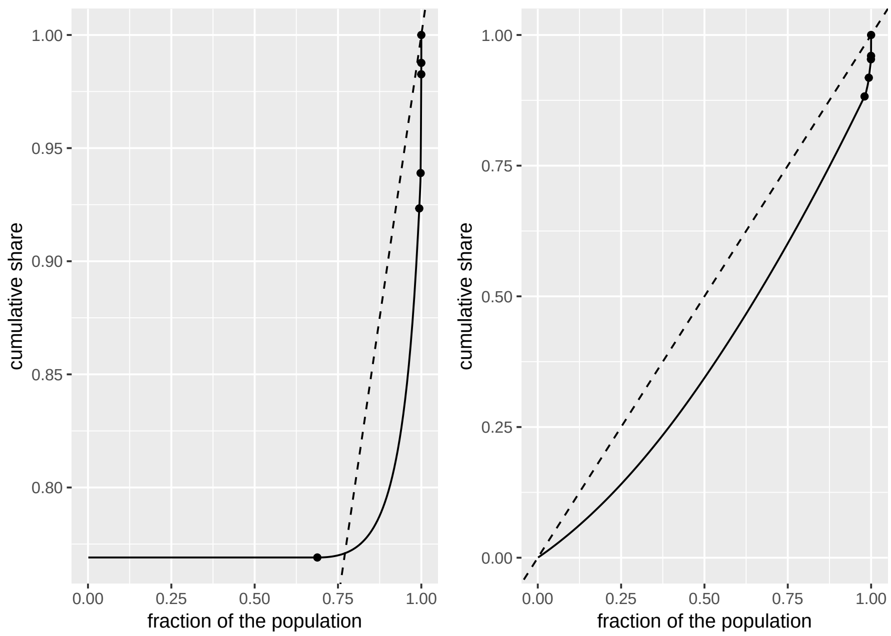

Figure 1: Lorenz curves in 1880: second replication of Roikonen (2022) on the left and this study on the right. Source: see Table 3.

Why do the estimations obtained from the second replication differ so strikingly from the first? This question is difficult to answer at this stage. First, I have attempted to replicate figures which are as close as possible to those in Roikonen (2022) within the broad confinement of the methodology of the generalised Pareto curve interpolation. This time, by setting the bottom threshold at 200 FIM, the level of income at the left-hand tail of the distribution is pushed downward, which increases the value of the Gini coefficient, albeit not dramatically, but which results in much higher top income shares. It may well be that the differences between the replications and Roikonen's original figures stem from a misunderstanding on my behalf. However, they also tell about the sensitivity of the estimations to relatively small differences in the interpolations.

2. Subsistence basket for the maximum feasible Gini coefficient

The level and trend of the maximum feasible Gini coefficient developed by Milanovic, Lindert and Williamson (e.g. Milanovic, 2009, 2013; Milanovic et al., 2011) depends greatly on the level of subsistence. Although this level can be defined mechanically—for example, by assuming that the level is a certain percentage of the median income in a society—it can also follow the value of a so-called subsistence basket (for example, Allen and Weisdorf, 2011). This basket should, ideally, comprise of goods which have been deemed socially and physiologically necessary for the reproduction or survival of individuals and households in a given period of time. These goods should also be in realistic quantities and prices. One can also make a separation between a 'bare-bones' and a 'respectability' basket, the latter containing goods and quantities deemed fitting for a somewhat better off person or household. Although the literature and discussion on these kinds of consumption baskets is rich, to my knowledge there are no recent studies on the topic in Finland. I have thus chosen to rely on the classic, albeit problematic study by Hjelt (1912), which offers the nearest relevant point of departure for constructing such a basket. Hjelt studies industrial workers in Finland during the early 1900s. The study comprises of household accounts kept by worker households which were deemed 'normal' or typical (V. Hjelt, 1912, p. 22). The averages drawn from this accounts, therefore, cannot be deemed representative of the consumption of the population as a whole, but they do presumably capture as least many typical consumption goods and their quantitative relations to one another (e.g. bread and butter, meat and coffee). However, one needs to be quite careful when it comes to using these quantities, which the study acknowledges (V. Hjelt, 1912, pp. 76–77). Upon estimating the energy content (in kcal) of the items in an aggregate table of foodstuffs consumed by 210 'normal families' (V. Hjelt, 1912, p. 79) using modern data (U.S. Department of Agriculture, 2024), it became obvious that they could not have supported such a family, which, on average, comprises of 5.3 individuals or 2.6 adult male equivalent consumption units. Using more modern energy requirement figures (World Health Organization, 1985) for adult men and women engaged in manual agricultural labour as a reference point, it seems that the number and quantity of foodstuffs in the said table could only provide around 56.0 and 69.7 percent of the said men's and women's energy requirements per year, or 1,558 and 1,252 kcal per day versus the 2,780 and 2,235 kcal mentioned in the World Health Organization's study.[9] I have thus multiplied by the quantities in the aforementioned table by the ratio of these referential energy requirements to the ones obtained from the table, 1.78, to arrive at what can be deemed a subsistence level of food consumption. This increases the per capita energy content of the basket from 218,674 to 390,269 kcal a year.

My aim has been to construct a basket for the benchmark year 1875. The reason for this are partially related to the availability of price, harvest and trade data, although, in part, it has been a matter of choice. The basket has been constructed using data from the province of Uusimaa (in Swedish, Nyland), primarily due to data availability. I have adjusted the basket for the consumption of a rural household. This has necessitated a number of changes to the goods consumed by the 210 'normal' households in Hjelt (1912). For example, instead of more processed goods, such as bread, cheese, sausages and cold cuts, I have used grain and raw meat, for their processing has more likely taken place at the household or by using the household members' labour (e.g. grinding), or the produce has been mainly sold instead of being consumed at the household (for example, cheese and butter). In addition, I have omitted coffee from the basket, because its consumption became more widespread only from the 1880s and 1890s onward (Heikkinen, 1986, p. 127). Furthermore, it cannot be considered as a subsistence item relative to many other goods in the basket. I have, however, included sugar, for it was already imported and consumed around the time in reasonable quantities (Statistical Office of Finland, 1878, table 18, p. 21). Whether it can be considered as a subsistence good at the time, is more debatable, although it was quickly being established as a common consumption item (Ikonen, 1991, pp. 32–33). Ideally, one would change the composition of the subsistence basket over time following changes in consumption and the standard of living. Indeed, this can be considered as a necessary step in future research. At this stage, and for the simple purpose of giving the maximum feasible Gini coefficient and the inequality extraction ratio a more solid footing, I have simply extrapolated the per capita price of the basket backward and forward using the GDP price index (1926=100) in the historical national accounts (Statistics Finland, 2024).

[9] Lundh (2013) uses this same study for comparing the standard of living between urban and rural households in southern Sweden in 1914 and 1920.

Good	Unit	Amount	Price (FIM)	Kcal
Grain[(a)]	kg	49.83	7.46	127,554
Milk and cream[(b)]	litre	122.08	29.89	77,658
Butter	kg	11.99	6.64	85,982
Eggs	dozen	0.88	0.47	389
Meat and fat[(c)]	kg	18.59	4.75	48,646
Fish[(d)]	kg	2.99	0.38	4,723
Potatoes	kg	39.47	2.32	30,395
Peas	kg	0.75	0.33	609
Sugar	kg	3.57	8.10	14,313
Rent[(e)]		4.6%		
Firewood	fathom	2.25	1.66	
Salt	litre	0.25	0.19	
Tallow[(f)]	kg	2.45	1.81	
Total			**66.93**	**390,269**

Table 4: Per capita annual subsistence basket, 1875. Source: Allen and Weisdorf, 2011; Björkqvist, 1958; V. Hjelt, 1912; Lilius, 1888; Rabb, 1975; Statistical Office of Finland, 1878; Tilastollinen toimisto, 1879; U.S. Department of Agriculture, 2024; World Health Organization, 1985; National Archives (NA), Kamarikonttorin arkisto. E SAAPUNEET ASIAKIRJAT Eq Verohinnastot Eq:23; *Uusi Suometar* (January 24, 1879). Note: using price data from the province of Uusimaa in 1875; (a) a weighted average of the price and kcal content of barley, corn, rye and wheat based on their percentage shares of the arable in Sipoo, 1875, and their tax prices in the same year; (b) assuming that 95 percent of the amount has been milk and five percent cream; (c) assuming that 50 percent has been meat (beef) and 50 percent fat; (d) salted herring; (e) imputed per capita share of rent based on the household size in Hjelt (1912); (f) Allen and Weisdorf (2011, table 1, p. 718) assume a consumption of 2.6 kg of candles per basket.

3. Tax rates

The Gini coefficient(s) estimated for this study show a relative stable level of inequality in Finland from 1899–1900 or 1920 to 1959. This result seems to contradict recent views on WWI and WWII, in particular, as 'great levellers' due to war-time destruction of capital, loss of life and, especially, the increase in tax rates (e.g. Scheidel, 2017, p. 153). This does not mean that the main driving cause according to this explanation, taxation, had not increased in Finland during and after WWII. Indeed, as Figure 2 shows, both the top statutory marginal tax rate (MTR) and the effective tax rates in the top 0.1 and top 1 percent, the 'middle class', that is, the top 25–2 percent, and the bottom 50 percent did increase, albeit unevenly, from 1938 to 1948. Likewise, although state income taxation seems to have become less progressive from 1938 to 1945 according to the Kakwani index[10] (admittedly, there are only three observations), the increase in tax rates in 1946 seem to have made more progressive in turn.[11] The gist here is, however, that the changes in the effective tax rates and the progressivity of the tax system were relatively modest until the very end of the 1959, when we observe a significant increase in the former and a decline in the latter. At the same time, the top MTR was cut in 1947, 1951 and 1953, thus pushing it closer to its war-time level.

[10] The Kakwani index measures tax progressivity as the difference of the concentration index of taxes and the Gini coefficient of pre-tax income, $P = C - G$. The higher the level, the more progressive the tax system. If P equals zero, the tax system is proportional and when it receives negative values, the system is regressive (Kakwani, 1977, p. 73).

[11] In addition to the state income tax, individuals, jointly taxed couples and corporations have paid a municipal income tax, which adds to these rates. However, because this tax has been proportional with some deductions for low-income taxpayers, its inclusion would probably lower the level of progressivity.

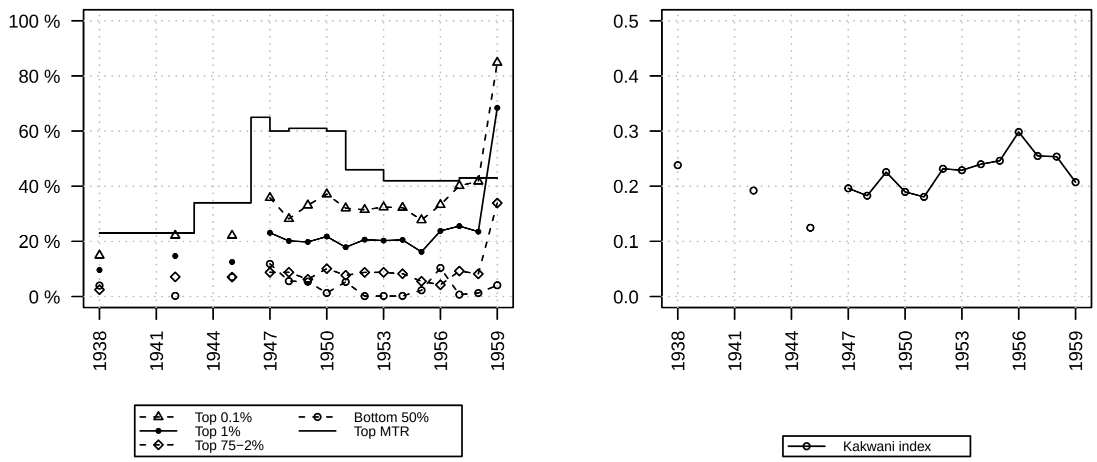

Figure 2: Effective tax rates the top statutory marginal tax rate and the Kakwani index, 1938–59. Source: Statistical Main Office of Finland, 1926–1963; AsK 1935 III–AsK 1958 III.

Although the changes the Gini coefficients or income inequality as a whole cannot be reduced to changes in taxation, the fact that the effective tax rates remained relatively stable between 1947 and the beginning of the 1950s may have been a contributing factor to the 'uneventful' development of the said coefficients, in addition to the opposite changes in the shares of the top 1 and bottom 50 percent, on the one hand, and the 'middle class' or the top 25–2 percent, on the other.

4. Equity ratio and rates of return in Finnish industries, 1837–1938

A possible explanatory variable for top income shares, such as that of the top 1 percent, is the rate of return on capital. Although it is difficult at this stage to say much about this or these rates, an indirect piece of evidence of it is the equity ratio, or the ratio of equity to total capital. Figure 3 presents this ratio for the industrial corporations used in this study in 1837–1938. The figure shows quite clearly, that the ratio remained quite stable with short-term fluctuations until the very end of the 19th century. The ratio declined from 1898 to 1917. After the Civil War of 1918 and a tumultuous adjustment period, the ratio recovered somewhat before declining in the 1930s. This implies that the corporations were increasingly unable to meet their investment requirements by means of undistributed profits and were becoming gradually more indebted. Whether this had repercussions on dividends and top incomes is uncertain at this stage. The rates of return on equity and total capital (equity and debt) remained relatively stationary with only short-term fluctuations from c. 1861 to 1908. In the 1910s, the rates appear, on average, higher than during the previous decades. There are two prominent peaks in these series in 1915–6 and 1919–20. These coincide, first, with the war-time demand during WWI and the period of high inflation after the war.

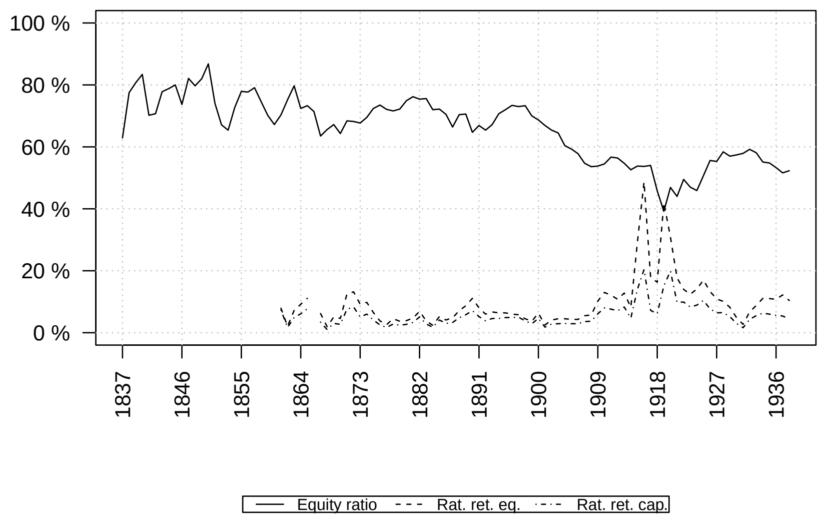

Figure 3: Weighted average equity ratio in Finnish industries, 1837–1939. Source: BOF Teollisuuden. Note: the figure uses the corporations' capital shares as weights.

5. Micro data

In the article, the estimated income shares, averages, Gini coefficients and other figures were compared to those obtained from the consent tax accounts of 1876, using data from Iisalmi, Sipoo and Tampere. Table 5 complements those comparisons with additional shares and averages. These include, alongside the already presented figures for the top 1 percent, the 'middle class', i.e. the tax units between the 75th and 99th percentile and the bottom 50 percent. As before, the 'n/a's' refer to the fact that there have been no taxed corporations in Iisalmi and Sipoo in 1876, while in Tampere there was nine.

Item	Tabulated	Tabulated (w/o corp.)	Micro data	Micro data (w/o corp.)
		Iisalmi (n = 695)		
Top 1% share	6.1%	n/a	8.4%	n/a
Top 25–2% share	29.3%	n/a	36.3%	n/a
Bottom 50% share	40.3%	n/a	43.3%	n/a
Top 1% average	6,020	n/a	11,000	n/a
Top 25–2% average	1,196	n/a	1,461	n/a
Bottom 50% average	791	n/a	600	n/a
Total average	980	n/a	949	n/a
		Sipoo (n = 364)		
Top 1% share	7.9%	n/a	8.0%	n/a
Top 25–2% share	26.2%	n/a	38.9%	n/a
Bottom 50% share	42.5%	n/a	38.5%	n/a
Top 1% average	8,174	n/a	9,333	n/a
Top 25–2% average	1,138	n/a	1,568	n/a
Bottom 50% average	886	n/a	600	n/a
Total average	1,041	n/a	963	n/a
		Tampere (n = 873 & 864)[(a)]		
Top 1% share	49.6%	55.2%	38.8%	18.1%
Top 25–2% share	19.0%	18.1%	37.8%	71.3 %
Bottom 50% share	18.8%	15.9%	9.2%	13.7%
Top 1% average	142,724	115,316	105,500	33,000
Top 25–2% average	2,283	1,578	4,131	3,824
Bottom 50% average	786	663	600	600
Total average	1,082	2,090	2,494	1,692

Table 5: Additional income share and average data, Iisalmi, Sipoo and Tampere, 1876 (FIM). Source: Statistical Office of Finland, 1880, National Archives (NA), Kuopion läänintilit (Ga:310), Suostuntaverojen tilit 1877 (I Gac:13), Suostuntaverotilitykset 1877 (Glc 17). Note: (a) with and without corporations.

In Iisalmi, the bracket share appear consistently lower in the tabulated data than in the micro data. The same applies to the average incomes in these brackets, with the exception of the bottom 50 percent. In the case of Sipoo, the difference in the top 1 percent's share is only 0.1 percentage points, whereas the share of the 'middle class' is 12.7 percentage points below that in the micro data. The bottom 50 percent's share, on the other hand, is four percentage points higher in the interpolation. In the case of Tampere, the situation is again quite different. Here, the top 1 percent's share appears much higher based on the interpolation than in the micro data. The difference actually grows when one compares the interpolation to the micro data without corporations. In the micro data, without corporations, the share of the 'middle class' grows almost 1.9 times in relation to the data where corporations are present. The share of this bracket does not respond as strongly to the way the corporations have been removed from the tabulated data. These differences suggest that the article's method may not adjust the top income shares sufficiently, even if all corporations could be accounted for, as in this case, where the corporations in the micro data have been joined to the tabulation for better comparability. An interesting peculiarity in the case of Tampere is the fact that the removal of the corporations actually seems to *increase* inequality instead of decreasing it. This cannot obviously be generalised upon, but it shows that the their removal may also have an opposite effect on estimated income inequality, as well.

One further issue with the micro data is the fact that the tax committees have, for a number of reasons, assigned many tax units the same income (e.g. 600, 800 or 1,000 FIM). The assessed incomes become more distinct only towards the very top of the distribution. This makes the distribution very 'flat' at the bottom. Table 6 shows the distribution of tax units within income brackets in Iisalmi, Sipoo and Tampere, 1876.

Income (FIM)	*n*	Share
600	736	38.1%
700	437	22.6%
800	205	10.6%
900–1,500	263	13.6%
1,500–2,000	84	4.4%
2,000–5,000	129	6.7%
5,000–10,000	42	2.2%
10,000–50,000	29	1.5%
50,000–100,000	4	0.2%
>100,000	1	0.005%
total	**1,930**	

Table 6: The distribution of tax units within income brackets (FIM), including corporations, in Iisalmi, Sipoo and Tampere, 1876. Source: NA Ga:310, I Gac:13, Glc 17.

The income share and inequality estimates presented in this study can, at best, be only as good as the data allows. For example, one may wonder whether 60.7 percent of the tax units really had an income which rounded up to 600 or 700 FIM, respectively. While we may appreciate the almost insurmountable difficulties that the local tax committees have faced when assessing people's and corporations' incomes, it may well be that the 'true' level of inequality was, in 1876 as in the other years during the late 19th and early 20th centuries, at least somewhat higher than the micro data suggests. Whether the generalised Pareto curve interpolation manages to produce estimates which are closer to this 'true' level of inequality remains an open question. I may well be that the consent tax records, at least, need to be supplemented with additional data not only for the income units below the 500 FIM threshold—i.e. the majority of the population between 1865 and 1885—but also for the units in the micro data itself.

6. Agricultural productivity in Finland and the U.S., 1880

Table 7 shows a comparison of agricultural productivity in Finland and the United States in 1880. The amount of arable and the total harvest per capita seem to have been around seven and five times higher in the U.S. Still, it is worth noting that the differences in grain yields are not as significant, apart from potatoes, where the difference is around fourfold. In the case of rye and wheat, the Finnish harvest figures actually show a higher yield than in the U.S. To what degree these differences are due to annual fluctuations has not been studied at this stage. Nevertheless, the table shows clearly that the average U.S. person occupied in agriculture worked on around seven times as much arable as in Finland at the time. The small scale of Finnish agriculture was one of the prime causes for its low productivity. Obviously, there are several complicating factors bringing uncertainty to these kinds of comparisons. First, the U.S. at the time, as it does now, spans and entire continent with multiple climate areas, significant differences in precipitation, humidity and temperature, soil quality, and so on. The U.S. as a whole, apart from Alaska, is located at a more southerly latitude than Finland. Secondly, the statistics themselves add another layer of complexity. In the Finnish case, for example, the cultivation and harvest data in the *Statistical Yearbooks* give only the most prominent crops, not all cultivated or harvested crops as a whole. Be that as it may, the differences in the average productivity of these countries' agriculture are significant enough to mitigate such issues insofar as one wishes to make broad inferences about the said differences.

		Finland	U.S.
Population in agriculture	1,000s	502	7,670
Share in agriculture[(a)]	percentage	73.5	44.1
Arable	hectares per capita	1.7	11.8
Harvest[(b)]	barrels per capita	15.5	84.6
Barley	barrels per hectare	8.5	13.5
Oats	barrels per hectare	8.4	15.1
Potato	barrels per hectare	7.3	29.7
Rye	barrels per hectare	11.5	6.5
Wheat	barrels per hectare	11.3	7.8

Table 7: Agricultural productivity comparison between Finland and the U.S., 1880. Source: Census Office, 1882, 1883; Statistical Office of Finland, 1882; U.S. Department of Agriculture, 2019; Vattula, 1983. Note: 1 bushel = 35.2 litres, 1 barrel = 4.2 bushels, 1 acre = 0.4 hectares. (a) Share of the occupied population; (b) all crops cultivated by acre or barrel (excluding flax and hemp in Finland).

Archives

Bank of Finland archives (Suomen Pankin arkisto)
National Archives (Kansallisarkisto)
Nordea history archives (Nordean historia-arkisto)

Others

His Imperial Majesty's Benignant Declaration on the consent tax that the Finnish Estates have taken upon themselves to pay in the years 1865, 1866 and 1867 (March 2, 1865/10)

His Imperial Majesty's Benignant Statute on certain guidelines when using the Benignant declaration on the consent tax that the Finnish estates have taken upon themselves to pay (April 20, 1865/23)

The Parliament's response N:o 48/1935 (AsK 1935 III)
The Parliament's response N:o 77/1943 (AsK 1943 I–II)
The Parliament's response N:o 16/1946 (AsK 1946 I–II)
The Parliament's response N:o 59/1947 (AsK 1947 I–II)
The Parliament's response N:o 4/1948 (AsK 1948 I–III)
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