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Distributional National Accounts of Taiwan, 1981–2017

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We construct the pre-tax Distributional National Accounts (DINA) of Taiwan from 1981 to 2017 using survey data. Our DINA individual income series demonstrates a much larger inequality than previous results using tax tabulations and tax units. This difference is mainly due to a change in the unit of observation and the treatment of corporate retained earnings. We find that income inequality was stable in the 1980s and began to rise after the mid-1990s. After 2000, this trend further accelerated. We then estimate the distribution of economic growth. From 1981 to 2001, Taiwan experienced a period of rapid economic growth, with a growth rate of 7.32 percent annually and a fairly equal distribution of growth. From 2001 to 2017, the aggregate growth rate declined to 2.47 percent with a deteriorating distribution of growth. The increasing inequality in income and growth distribution is due to the combination of a worsening capital income distribution and rising retained earnings.

Keywords: distributional national accounts, income inequality, pre-tax national income
JEL classification: D31, E01, O15

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1 Introduction

One of the Four Asian Tigers, Taiwan demonstrated rapid economic growth while maintaining low levels of income inequality in the 1980s. After becoming a high-income economy, Taiwan's growth rate has slowed, but it remains a country with low inequality. Today, the official Gini coefficient is around 0.33. However, the official Gini coefficients calculated from the survey data have been criticized for two reasons: the survey data typically under-reports high income earners, and the Gini coefficient is insensitive to changes in the top income groups. As a result, the estimation of top income shares based on tax tabulations (Piketty, 2003) becomes popular in the literature.

However, the top income share method still faces two challenges. First, there is a large gap between aggregate microdata and macroeconomic data such as national accounts and gross domestic product. This is because tax data only account for the taxable income of households, missing income in other sectors. For example, in Taiwan, aggregate administrative income tax data amount to only about half of Taiwan's national income. This gap consists of non-taxable income, government income, and corporate retained earnings. This inconsistency makes it difficult to evaluate the entire income distribution and the distribution of economic growth. Second, the majority of missing income in the tax data consists of capital income, i.e., corporate retained earnings. If capital income is not taken into account correctly, the level of inequality would be underestimated. Starting in 2016, the World Inequality Database (WID) established a comprehensive methodology to help construct a homogenous income series that captures the entire population and income distribution, called Distributional National Accounts (DINA). This was first described in Alvaredo et al. (2016) and updated in 2020 as WID (2021). DINA aims to distribute national income to every individual adult in a country so that the aggregation of microdata leads to results consistent with macrodata. In this paper, we use this methodology to construct the Distributional National Accounts of Taiwan, with a focus on the long-term individual pre-tax income series from 1981 to 2017.

The DINA approach is as follows. National income can be divided into three sectors: households, corporations, and the government. We begin with microdata that provides individual income information in the household sector for the whole population. This could be the Family Income Survey (hereafter FIS) or administrative income tax data in Taiwan. The

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FIS started in 1981, and administrative income tax data was only available after 2001.[1] When the survey data is used, we have to first correct survey data with tax data (tax tabulation data has been available since 1956), such that top income shares calculated from the survey data match those from the tax data. The purpose of this correction is to address the issue of missing income and missing persons in the survey data.[2] When administrative income tax data is used, we have to account for income information for both tax filers and non-filers, which constitute the whole adult population. We then inflate or deflate each household income component to match the aggregate value reported in the national accounts for the households sector. Corporate retained earnings are redistributed proportionately to each individual's capital income or dividend income. Finally, the net primary income of the government sector is distributed according to each individual's factor income, such that the distribution of government income is neutral to inequality. In this way, DINA estimates the entire income distribution with consistency between microdata and macrodata.

A major challenge to constructing Taiwan's DINA series is the lack of sector data on national accounts before 1996. Taiwan's national accounts are compiled by the Directorate-General of Budget, Accounting, and Statistics (DGBAS, 行政院主計總處). The DGBAS began to publish sectoral decompositions of national income in 1996. Prior to 1996, only aggregate national income was available. In order to estimate the sectoral decomposition of national income for the period 1981 to 1995, we used data from the national budget (for the general government sector), the Yearbook of Tax Statistics (for the corporate sector), and the FIS (for the household sector).

Following the approach in Piketty, Saez, and Zucman (2019) and WID (2021), we use the FIS, tax tabulations, and our estimated sectoral national income data to construct the long-term DINA survey series from 1981 to 2017. The detailed DINA tax series using administrative income tax data is also constructed by our team and reported in Lee et al. (2022). In this paper, we provide both the DINA survey individual and household series. Our main series is the DINA survey individual series, and we compare it

[1] Although the FIS began in 1976, individual income information in the first five years is not credible. The income variables are not consistent and have many errors. So we begin with 1981.

[2] The very rich often decline to participate in the income survey. Even if the rich take part in the survey, they often underreport their income.

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with the DINA tax individual series in Lee et al. (2022) from 2001 to 2017. The household series is used to compare with the previous fiscal income shares reported in Chu, Chou, and Hu (2015) based on tax units because the household unit is closer to the tax unit. In light of the fact that tax microdata provides more accurate income information for the top income earners than survey microdata, we believe the top income shares reported in the DINA tax series are more accurate.

We have several findings. First, our results demonstrate a much higher level of income inequality than previous estimates. For example, our estimated Gini coefficient is around 0.6 in the 2010s. There are two reasons for this large difference. The first is due to the change in the unit of observation. For the previous estimations based on the survey, the unit of observation was a household. For the estimation of top income shares in Piketty (2003) and Chu, Chou, and Hu (2015), the unit of observation is the tax unit. In DINA, the unit is an individual adult, and the income is equally split between married couples, referred to as the equal-split individual income series. When the observation unit is changed from the tax unit or the household to the individual in Taiwan, the level of inequality increases significantly. Both the FIS and administrative income tax data demonstrate this pattern. For example, if we change the unit from the household to the equal-split individual in the FIS, the Gini coefficient of pre-tax income increases from 0.4 to 0.5; when the unit is switched from a tax unit to an equal-split individual in tax data, the Gini coefficient increases from 0.5 to 0.6. This is due to the structure of the underlying microdata, not DINA's imputations. This finding suggests a high level of within-household income inequality across household members in Taiwan. This sensitivity to the unit of observation is rarely seen in other countries using the same DINA approach and is novel to the WID.

The second reason is the treatment of corporate retained earnings in DINA. The top income shares reported in Chu, Chou, and Hu (2015) based upon tax tabulations and tax units are much lower than our estimates. As an example, in the 2010s, the top 1% income share of the DINA tax individual series represents approximately 19%; the top 1% of the DINA survey individual and household series represents approximately 16% and 14%, respectively; in contrast, the top 1% fiscal income share based on tax tabulations represents only approximately 10%. This is because the majority of missing income in tax data is in the form of capital income, i.e., corporate retained earnings. The previous estimates did not take this large amount of

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capital income into account and thus underestimated the level of inequality.

There is a common pattern across different DINA series. During the 1980s and into the mid-1990s, the level of inequality remained low and stable. However, inequality began to increase in 1993. This trend further intensified after 2000. As an example, the Gini coefficient of the DINA survey individual (household) series in 1981 was approximately 0.45 (0.32). It gradually increased to 0.48 (0.35) in 1993 and then rapidly increased to 0.6 (0.5) in 2017.

Further, we find that while the DINA survey series demonstrate a lower level of income inequality compared to the DINA tax series, the DINA survey series has a more rapidly increasing trend. The rapid rise in inequality in the DINA survey series is due to the combination of a worsening capital income distribution and rising retained earnings. For example, the fraction of aggregate capital income held by the top 10% (1%) income earners increased from 38% (15%) in 1981 to 66% (38%) in 2017 in the survey data. This is before the distribution of retained earnings. In addition, corporate retained earnings to national income share has risen from around 8% in 1981 to 19% in 2017. Since retained earnings are redistributed proportionately to capital income, this would further intensify the rising trend of inequality. Overall, we find that the rising income inequality after the middle 1990s in Taiwan is a capital income phenomenon.

We then compare the top income shares from the individual income series with the U.S., India, France, and China, which also employ the same DINA methodology. We found that pre-tax income inequality in Taiwan was similar to the levels in France in the 1980s. After the mid-1990s, inequality in Taiwan increased rapidly and reached the level of the U.S. in the 2010s. Globally speaking, if we categorize countries such as India and Brazil as having the highest level of pre-tax income inequality, then Taiwan and the U.S. belong to the group with the second-highest level of income inequality.

Last but not least, we calculate the distribution of economic growth from 1981 to 2017, including two subperiods, 1981 to 2001 and 2001 to 2017. We find that the growth distribution is more equal in the first period than in the second period. In both the DINA survey household and individual series, the first subperiod displays rapid economic growth and a relatively more equal growth distribution. From 1981 to 2001, the annualized real national income growth rate is 7.32%, and the top 10% income group accounts for about 34% to 39% of economic growth. However, in the period 2001 to 2017, the annualized growth rate declined to 2.47%, and

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the distribution of economic growth deteriorated, with the top 10% growth share reaching more than 50%. We conduct a counterfactual experiment and demonstrate that the worsening economic growth distribution is due to the interaction between rising retained earnings and a more unequal capital income distribution.

Hong and Cheng (2013) is the first study that uses the Pareto interpolation method with tax tabulations to estimate the top income shares in Taiwan from 1977 to 2010. Chu, Chou, and Hu (2015) then update their results to 2015 and also verify the estimated top income shares from tax tabulations with administrative income tax data. In addition, Lien et al. (2021) use the administrative data to estimate wealth inequality in Taiwan from 2004 to 2014. The methodology used in this paper follows from WID (2021). We first use the generalized Pareto interpolation method developed in Blanchet, Fournier, and Piketty (2022) to interpolate the Pareto distribution from tax tabulations. We then adjust the top tail from the survey microdata with tax tabulations according to Blanchet, Flores, and Morgan (2022). The methodology of DINA has been widely used in many countries and regions, such as the U.S. (Piketty, Saez, and Zucman, 2018), Latin America (De Rosa, Flores, and Morgan, 2020), Europe (Blanchet, Chancel, and Gethin, 2019), and Africa (Chancel et al., 2019). However, it has not been used widely in Asia. So far, the DINA series has only been constructed for India (Chancel and Piketty, 2019), China (Piketty, Yang, and Zucman, 2019), Hong Kong (Piketty and Yang, 2021), and Malaysia (Khalid and Yang, 2021). But none of these Asian countries provide microdata that has detailed individual income information as Taiwan. Most countries rely on survey data at the household level and equally split household income by the number of adults in each household. This paper then adds to our understanding of income inequality issues in Asia. Moreover, it reveals that the level of income inequality in Taiwan is much higher than previously believed.

The rest of the paper proceeds as follows. Section 2 discusses data resources, estimation, and imputation methods. Section 3 presents the main results. Section 4 concludes. The appendix provides data resources, additional results, and a unified DINA series, which is uploaded to the WID. All detailed numbers are in the online data appendix (an Excel file).

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2 Data and methodology

In this section, we first describe various datasets used by their availability at different time periods. We then show that the change in the observation unit from households to individuals results in a significant increase in inequality measures. Finally, we discuss the methodology.

2.1 Data

We use the Family Income Survey (FIS) and tax-tabulation statistics to construct microdata from 1981 to 2017. In addition, administrative individual income tax data became available in 2001, and tax-based microdata is constructed by our team, presented in Lee et al. (2022). Consequently, we were able to compare the DINA survey series with the DINA tax series for the period between 2001 and 2017.

Once the relevant microdata has been compiled, DINA imputes each national income component to its corresponding individual income item in the microdata. Unfortunately, Taiwan did not have detailed national income data by sector before 1996. Therefore, we must first estimate these components of national income for the period 1981 to 1995. The data resources used to estimate detailed national income components will be described in Section 2.3. Here, we introduce the main datasets used to construct the microdata.

Tax-tabulation statistics

Taiwan's income tax system began in 1956. The Ministry of Finance started annually to compile and publish tax-tabulation statistics in the *Yearbook of Tax Statistics* (賦稅統計年報) in 1974. The yearbook includes statistics for all forms of taxes levied in Taiwan. Individual income tax statistics group income (after deductions) into different brackets with corresponding populations. Further, it provides the following components of net income (in brackets): profits from businesses, income from professional practices, salaries, interest, rents, agricultural income, property transactions, lottery, and other sources. Please note that the net income reported in the yearbook is after tax deductions, and the units relate to tax units. Before any imputation, we add back the standard household deduction and the investment deduction each year (the amount varies by year).

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Family Income Survey

The FIS has been conducted and published by the Directorate-General of Budget, Accounting, and Statistics (DGBAS) annually since 1976. However, the raw data in the first five years (1976 to 1980) has some errors and cannot be used to construct the microdata. The FIS is a random sample, and the universal sampling rate is 0.2%, equal to about 20,000 households in Taiwan. For each household, the FIS asks for detailed information regarding income, assets, and consumption expenditures. The income components include compensation of employees, entrepreneurial income, property income, imputed rent, and transfers. The detailed income components vary across the period. As an example, Taiwan did not have a universal social insurance system until 1994; thereforem, the survey did not cover social insurance premiums and transfers prior to 1994. Although the primary unit of the FIS is a household, it also surveys each household member with the same questionnaire. As a result, the household unit in FIS can be decomposed into its individual units. In addition to income and expenditure information, the survey also includes demographic information, such as ages, marriage status, education, and job industry. As a result, we were able to identify married couples and split income equally between them for our equal-split individual income series.

Administrative Income Tax Data

Starting in 2001, detailed administrative individual income tax data is available from the Ministry of Finance. These files include 10 income categories and approximately 6 million tax units and 11 million individual tax-filers. The 10 income categories are wages, dividends, interests, rents, professional practice, pension, agricultural income, capital gains, lottery, and other. The files also include income information on 4 million individual non-filers. Lottery income and capital gains are excluded in the income series.

The following summarizes the available datasets we use at different periods.

1981–1995

We estimate sectoral components of national income and use the FIS and tax tabulations in this period. The tax-tabulation statistic is first interpolated and extrapolated by the generalized Pareto interpolation method developed by Blanchet, Fournier, and Piketty (2022). We use the FIS, corrected with

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tax-tabulation statistics according to the method proposed by Blanchet, Flores, and Morgan (2022), to prepare the survey microdata. We then use the simplified DINA approach to distribute national income.

1996–2017
In this period, national income by sector is available. We use FIS corrected with tax-tabulation and the simplified DINA approach to distribute national income in this period.

2001–2017
In this period, the detailed administrative individual tax data is available. Our team construct the tax microdata and distribute national income using the detailed DINA approach. The details are in Lee et al. (2022).

2.2 Income concepts and the unit of observation

Income Concept

The income used here is pre-tax national income. It is all pre-tax income accruing to the individual owners of the production factors, before the operation of the tax and transfer system, but after the operation of the social insurance system that includes the pension system. Note that capital gains from asset price changes, such as stocks and real estates, are not counted here. This is because these capital gains are not produced from factors and not considered as value-added.[3] As a result, the pre-tax national income is pre-tax factor income plus pensions and social insurance benefits and deducting pension contributions and social insurance premiums. This is the "broad" definition used in DINA. This definition is consistent with other countries and enables us to do cross-country comparisons.

However, when comparing pre-tax income inequality across countries, using the broad definition of pre-tax income means that the pension and social insurance system is also included in the comparison. This implies, ceteris paribus, that a county with a relatively weak pension and social insurance system would demonstrate higher inequality. In fact, this is exactly the case in Taiwan — especially when we change the unit of observation from the household to the individual.

[3] Since capital gains are a significant income source for the rich, neglecting them would underestimate the true level of income inequality. In the appendix of Chu, Chou, and Hu (2015), they report the result if these capital gains are counted in.

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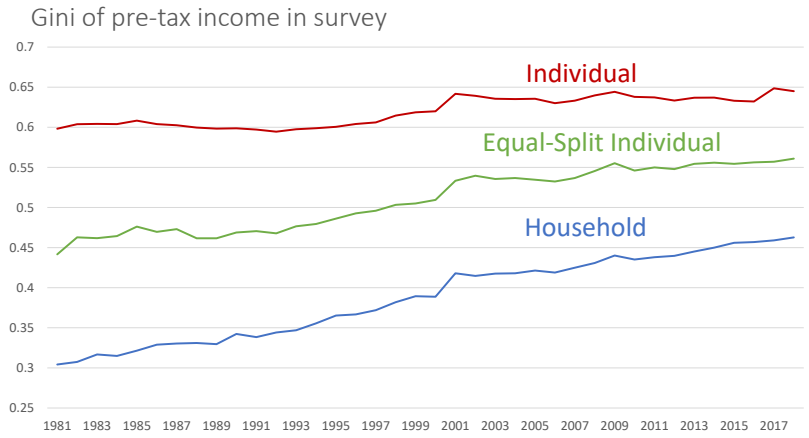


Figure 1: Gini coefficients with different units in the FIS

Unit of Observation

The unit of observation in DINA is "equal-split adults," which includes individuals 20 years old and up. Income is distributed to adults and split equally among married couples. We use equal-split adults as our benchmark income series. In addition, we also provide a household series that distributes income to each household when using the FIS. We do this because the household unit is typically used in survey data worldwide, and Taiwan's official statistics use the household unit as well.

We find that the Gini coefficient is highly sensitive to the choice of unit in Taiwan. Figure 1 plots the Gini coefficient of pre-tax income from raw data with three different units in the FIS, without any DINA imputation, from 1981 to 2018. The pre-tax income is the sum of salaries, entrepreneurial income, and property income in the survey. The Gini coefficient of the household is the lowest. It increases steadily from 0.3 in 1981 to 0.46 in 2018. The Gini coefficient of equal-split individuals is about 10 to 15 percentage points larger than that of the household series, rising from 0.44 in 1981 to 0.56 in 2018. The highest measure of the Gini coefficient is the individual series, with a more stable pattern that increases slightly from 0.60 in 1981 to 0.64 in 2018.

This sensitivity to unit appears in the tax data as well. Figure 2 plots the Gini coefficient of pre-tax income of tax filers with three different units —

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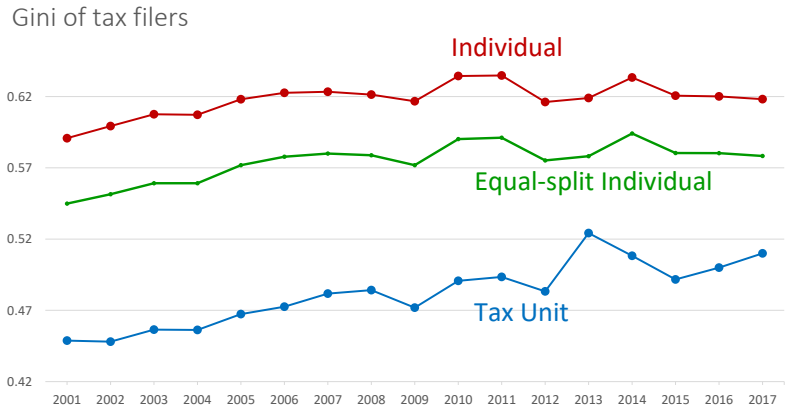


Figure 2: Gini coefficients with different units in tax microdata

individual, equal-split individual, and tax units — from 2001 to 2017. The magnitudes are slightly higher than their survey counterpart, but the pattern from 2001 to 2017 is similar.

The sensitivity to units is rarely seen in other countries and is novel to the WID. One reason is that most countries using DINA do not have microdata that provides detailed individual income information. Most countries rely on household surveys and divide household income among all adults within each household. This is the case for all Asian countries currently in the WID. This equal-split adult approach would then miss heterogeneous income information across household members and typically underestimate inequality levels.

Further, we do not observe this sensitivity to unit even in countries that have detailed microdata — the only exception is Mexico. In fact, most countries that use the DINA methodology have only slight variation in results across units of observation. Yet other countries exhibit the opposite pattern to what we see in Taiwan. In the U.S., for example, the tax unit data demonstrate a slightly larger inequality than the equal-split individual series. De Rosa, Flores, and Morgan (2020) report the DINA estimation for ten Latin American countries. Among them, only three countries — Mexico, Uruguay, Peru — demonstrate increases in the Gini coefficients from households to individuals. Mexico is the only country that provides

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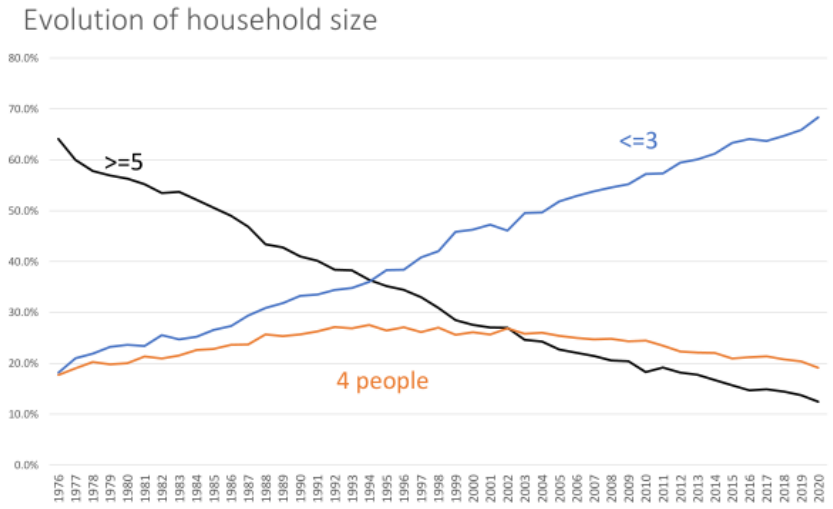


Figure 3: Trend in household size, 1976–2019

administrative income tax microdata. Currently, in the WID, countries that have rich microdata are mostly developed countries. Our hypothesis is that this sensitivity to the unit of observation may be related to the process of economic development and social norms relating to gender inequality. We discuss several possible reasons as follows.

The first is related to the changing household structure in the past four decades in Taiwan. The typical Taiwanese family structure has evolved from big families with multigenerational cohabitation to small nuclear families. Figure 3 plots the proportion of household size in the FIS from 1976 to 2020. The proportion of big families (with a household size larger than 4) was above 60% in 1976. This number declines steadily to 12% in 2020. Meanwhile, the proportion of small families (with a household size smaller than 4) increased from less than 20% in 1976 to 68% in 2020.

This changing pattern of household structure is the result of many factors, such as economic development, technological progress, a decreasing fertility rate, the rising return to education, improving gender equality, a higher labor force participation rate for women, and increasing positive educational assortative mating. We briefly discuss the reasons behind unit sensitivity, but a more rigorous analysis is still needed.

There are several observations in Figure 1. First, the large difference be-

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tween the individual and household series suggests that within-household income inequality is much larger than between-household inequality. This is indeed the case that in a big family, members usually play distinct roles, such as homemaker or income-earner, thereby distributing risk across each other. With the development of economic development and technological advancement in the home, nuclear families became the majority and most family members assumed dual roles as income-earner and housekeeper. Along the development, we observe that between-household inequality is increasing. In addition, some high-income families may have a tax avoidance incentive to form separate tax units within their family members. This may also contribute to the large differences between individual inequality and household inequality.

Second, there is also a significant difference between the Gini coefficient of the individual and equal-split individual series, and this difference is declining. This implies a shrinking income difference between individuals in a marriage. Furthermore, note that the level of the individual Gini coefficient is stable, while the equal-split Gini coefficient increases rapidly. These two observations suggest that (1) the number of couples with a single income-earner and a single homemaker is decreasing, and (2) the extent of positive assortative mating is increasing. In the FIS, we do observe that the proportion of single-earner couples is declining. In addition, positive assortative mating could be a result of technological progress and higher return to education, and it, in turn, contributes to rising income inequality, as discussed in Greenwood et al. (2016). The detailed analysis is beyond the scope of this project, and we leave it for future work.

2.3 Estimation of National Income by Sectors

In the System of National Accounts (SNA), national income can be decomposed as the sum of the income of three sectors: households, corporations, and the general government. In 1996, the DGBAS began publishing Taiwan's sectoral decomposition of national income. The broad sectoral decomposition of national income by the DGBAS is shown in Table 1. The DGBAS does not report all the detailed components stated in SNA. For example, there are four components in the net primary income of households (S14) and NPISH (S15): compensation of employees (D1), net property income (D4), net operating surplus (B2n), and net mixed income (B3n). In Taiwan's national accounts, the DGBAS reports compensation of employ-

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Table 1: Sectoral decomposition of net national income

Sectors	Allocation of Primary Income by Sector	Data for Estimation
Net Primary Income of Households and NPISH (B5n, S14 + S15)	Compensation of employees (D1)	Residual
	Property Income(D4) + Net Operating Surplus (B2n) + Net Mixed Income (B3n)	Entrepreneurial income, property income, and imputed rent from the FIS
Net Primary Income of Corporations(B5n, S11 + S12)	Net Operating Surplus (B2n)	Yearbook of Tax Statistics
	Property Income (D4)	
Net Primary Income of the General Government (B5n, S13)	Taxes less subsidies on production and imports (D2 − D3)	Indirect tax and fiscal monopoly from the Yearbook
	Net Property Income (D4) + Net Operating Surplus (B2n)	Net operating surplus and interest income from the Yearbook

ees (D1) and the sum of other three components (D4 + B2n + B3n). In addition, there are three components in the primary income of the general government: taxes less subsidies on production and imports (D2 − D3), net operating surplus (B2n), and property income (D4). The DGBAS reports taxes less subsidies on production and imports (D2 − D3) and the sum of net operating surplus (B2n) and property income (D4) of the general government, as shown in Table 1.

Since the decomposition of national income is not available for the period from 1981 to 1995, we need to estimate it. We begin by estimating the net primary income for corporations, followed by the general government, and finally households. The data resources for the estimation are reported in the third column of Table 1.

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Estimation of the Net Primary Income of Corporations

The net primary income of corporations includes net operating surplus (B2n) and net property income (D4). In general, net property income is negative (capital depreciation). The net primary income of corporations is undistributed corporate profits that should be redistributed to their company owners. These undistributed corporate profits include both retained earnings and corporate income tax. Note that dividends have been accounted for as households' property income and do not appear in the corporate sector.

Our estimation of the net primary income of corporations is based on their accounting profits less dividends, before the deduction of corporate income tax and social insurance contributions. The data we use is the corporate income tax levied annually in the Yearbook of Tax Statistics (賦稅統計年報) by the Ministry of Finance. The Yearbook of Tax Statistics reports verified total national corporate taxable income and its tax amount. We treat this corporate taxable income as the corporation's accounting profits. In addition, we add back tax-exempt corporate profits since they are part of corporate income. These tax-exempt profits are the result of a series of statutes to encourage industry investment and economic development. These are the Statute for Investment Encouragement from 1960 to 1990 (獎勵投資條例), the Statute for Upgrading Industries from 1991 to 2010 (促進產業升級條例), and the Statute for Industrial Innovation after 2010 (產業創新條例). The Yearbook of Tax Statistics reports exempted tax and profits due to the Statutes. Finally, we deduct dividends to match the concept of net primary income of corporations. The total dividend received by households is listed in the income tax-tabulation statistics in the Yearbook as well.

Figure 4 compares our estimate of net primary income of corporations from 1981 to 2017 with the actual income reported in the national accounts. The blue-circled line is the actual net primary income of corporations in national accounts, from 1996 to 2017. Our estimation is the light-blue line with the cross mark.

Figure 4 illustrates that our estimation method matches the national accounts quite well. Our estimation is around 80% to 110% of the actual one.

The increase in the net primary income of corporations to the national income share is significant. It is stable at around 8% before 1992 and begins to increase from 8% in 1993 to a peak of 15% in 2004, drops to a trough

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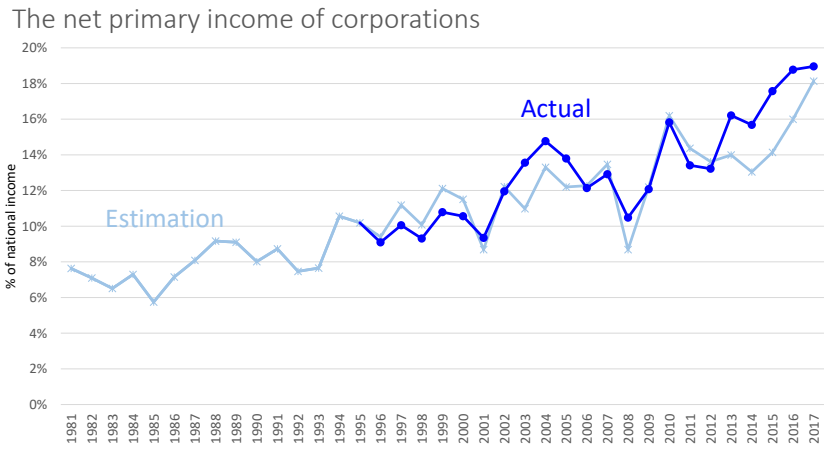


Figure 4: The estimated and the actual net primary income of corporations in national accounts

in 2008, and then rises to another peak of 19% in 2017. Overall, the net primary income of corporations to national income share increases two-fold from the 1990s to the 2010s. The net primary income of corporations is treated as retained earnings and will be imputed back proportionately according to the capital income of each individual. This step typically raises income inequality since the capital income distribution is more unequal than the total income distribution.

Estimation of the Net Primary Income of the General Government

The net primary income of the general government includes three components according to the SNA: taxes less subsidies on production and imports (D2 − D3), net operating surplus (B2n), and property income (D4). Since the net operating surplus is close to zero in convention, the DGBAS reports the sum of property income and net operating surplus together (B2n + D4, S13).

We calculate taxes on production and imports (D2 − D3) from the total amount of indirect taxes (minus subsidies) plus profits from fiscal monopolies reported in the Yearbook of Tax Statistics. According to the SNA (7.96 e.), fiscal monopolies are government-owned unincorporated enterprises granted a legal monopoly over the production and sales of certain

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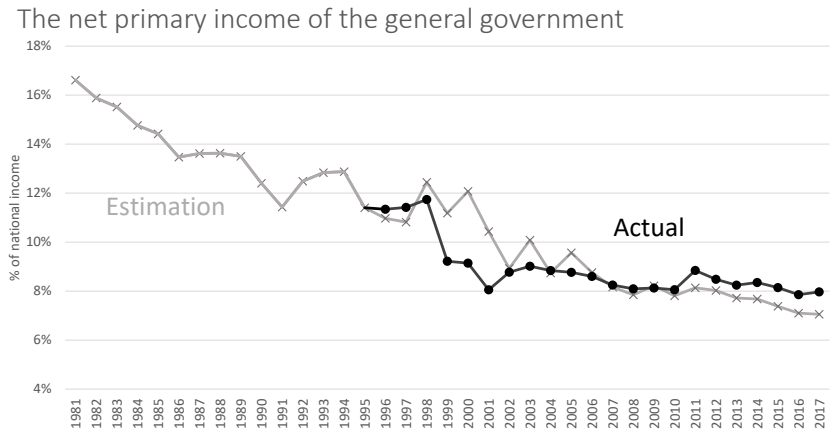


Figure 5: The ratio of estimated to actual net primary income of the general government

goods, such as alcoholic beverages, tobacco, sugar, salt, and some entertainment services. This is treated as an alternative way for the government to raise revenues and counts as a component of taxes on products.

We calculate the sum of the net operating surplus (B2n) and property income (D4) of the general government by the sum of the government's operating profits (minus costs) and interest income reported in the Government Revenue Report from the Ministry of Finance.

In Figure 5, we compare our estimation result with the net primary income of the general government reported in national accounts. Despite a spike from 1999 to 2001, our estimation is close to the one reported in national accounts. Additionally, the imputation of the primary income of the general government would not alter the level of income inequality in DINA. The redistribution is done in proportion to each individual's income, and in this way, measures of inequality, such as the Gini coefficient and income shares, are not affected.

The primary income of the general government to national income share has continuously decreased, declining from 17% in 1981 to 8% in 2001, and becoming stable at around 8% after 2001. The decline in the primary income of the general government is significant and worth some discussion. We further decompose taxes less subsidies on production and imports (D2 − D3) into three components: net taxes on imports (tariff), profits of fiscal

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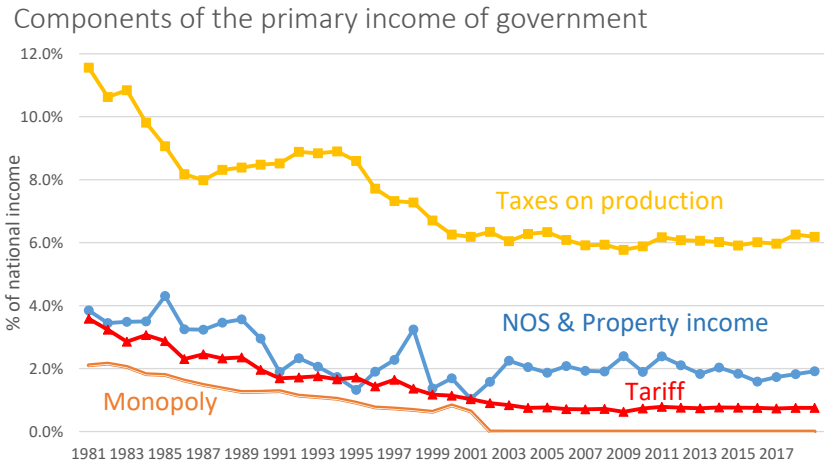


Figure 6: Components of the primary income of the general government as shares to national income

monopolies, and net taxes on production. In Figure 6, we depict these three components along with the sum of net operating surplus (NOS, B2n) and net property income (D4).

From Figure 6, we can see that all four components decreased significantly from the 1980s to the 2010s. The two most declining government income sources are the reduction of tariffs and taxes on production. In the 1960s and 1970s, Taiwan's government used high tariffs to protect the domestic manufacturing industry. In 1970, the Taiwan government conducted the first tax reform with the purpose of increasing income taxes, while reducing indirect taxes to help industry transformation and resource allocation. Additionally, the government implemented tax exemptions on certain products in order to encourage more investment (exemptions and reductions include indirect taxes, such as business taxes and commodity taxes, as well as direct taxes like corporate income tax). As shown in Figure 7, this tax reform was implemented gradually and contributed to the decline of production taxes in the early 1980s. Further, as part of its efforts to engage in more international trade, Taiwan began lowering its tariffs in 1984. As a result, the tariff to national income share declined from about 4% in the 1980s to 1% in the 2010s. A third declining component is government-owned fiscal monopolies, including the sale of tobacco, alcohol, sugar, salt, and others.

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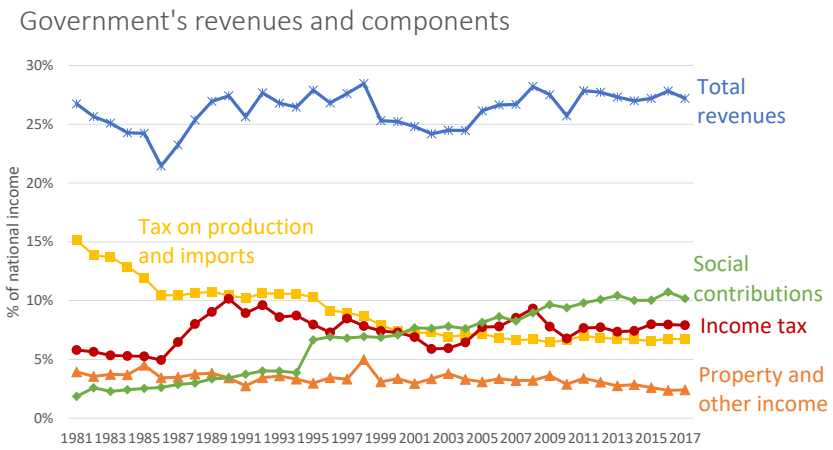


Figure 7: Components of government revenues as shares to national income

These fiscal monopolies date back to the Japanese colonial period. The Chinese National Party (Kuomintang) inherited these government-owned monopolies when it took over Taiwan in 1945. In the 1980s, the government-owned Taiwan sugar company even engaged in the business of pork and orchids. In the middle of the 1990s, as Taiwan underwent full democratization and prepared to join the World Trade Organization, the government began to privatize fiscal monopolies, allowing foreign imports to compete. Diluting fiscal monopoly profits results in a reduction in government revenues. After 2002, fiscal monopolies have finally been abolished.

However, it is important to emphasize that the primary income of the general government is not the same as government revenues, which include direct taxes (mostly income taxes) and social contributions. Using the government data provided by the DGBAS, we depict total government revenue and its components as shares of national income in Figure 7. Despite a significant decline in the primary income of the government shown in Figure 5, total government revenues have remained stable and have been about 25 to 27 percent of national income since 1981. During the 1980s, the decline in indirect taxes was offset by the increase in direct taxes, which was in line with the direction of the first tax reform. From the 1990s to the 2010s, indirect and direct taxes declined, while social contributions increased and contributed more to government revenues. The increase in social contribu-

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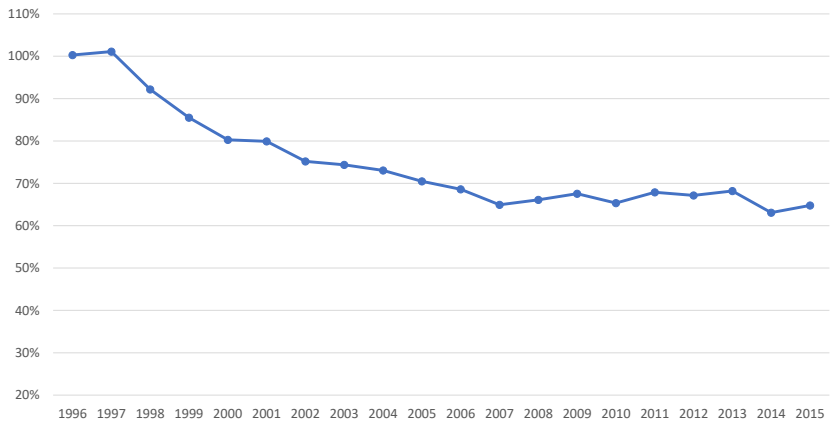


Figure 8: Ratio of estimated household property income to actual household property income in national accounts

tions is due to the democratization process in the 1990s. The first direct legislative election was in 1992, and the first direct presidential election was in 1996. Most of Taiwan's social insurance systems were developed during these years as a result of direct elections. For a more detailed analysis of the social insurance systems in Taiwan using the post-tax DINA, please refer to Lee et al. (2022).

Estimation of the Net Primary Income of Households

There are two components to the net primary income of households: compensation of employees (D1) and the sum of net property income (D4), net operating surplus (B2n), and net mixed income (B3n). We call the sum of D4, B2n, and B3n as the primary property income of households here. To estimate the primary property income of households, we use the weighted sum of entrepreneurial income (income from professional practice and self-employment), property income, and imputed rent reported in the FIS. Figure 8 plots the ratio of the survey-estimated primary property income to the actual one reported in national accounts after 1996. In comparison with data after 1996, this estimation method corresponds quite well with the data in 1996 and 1997, then declines to around 80 percent in 2000. Today, this estimation method is around 65 percent of actual primary property income

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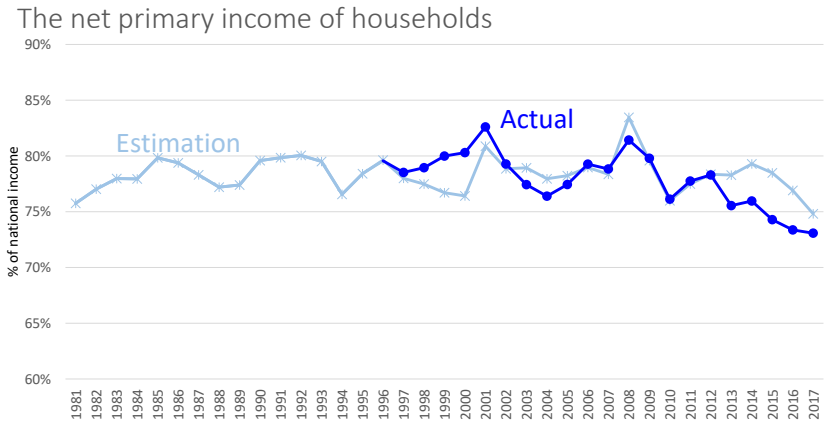


Figure 9: Share of household primary income to national income

of households. Overall, this estimation from the FIS tends to underestimate the true data. Since the majority of households' property income is capital income, inflating it would increase inequality. As a result, we conservatively choose not to inflate it. In this manner, this estimation method would not overestimate inequality. Note that all the above conservative estimations are applied from 1981 to 1995. After 1996, we use sectoral data in national accounts. may underestimate income inequality for the period 1981 to 1995.

With the above estimates of the primary income of corporations, the general government, and the primary property income of households, we are left with the compensation of employees (D1) in national accounts. Since aggregate national income is known, we treat the compensation of employees as residual income. Figure 9 depicts the estimated national income share of the household sector from 1981 to 2017 (the light-blue line with the cross mark) and the actual one reported in national accounts after 1996 (the blue circular markers). It turns out that our estimation matches national accounts well.

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2.4 Simplified DINA-Survey

For the period from 1981 to 2017, we construct the survey microdata and use the simplified DINA approach to distribute national income. In this subsection, we describe the imputation detail.

The first step is to interpolate tax tabulations using the generalized Pareto interpolation method developed by Blanchet, Fournier, and Piketty (2022). Before doing the generalized Pareto interpolation, we add back the standard household tax deductions for the average income of each bracket, as well as include the investment tax deduction for the bracket in which average investment income is larger than the tax deduction threshold. We exclude income from property transactions (capital gains) and lottery. The generalized Pareto interpolation then interpolates the tax tabulations into 127 brackets from 0 to the 99.999 percentile.

The second step is to correct the survey microdata with interpolated tax tabulations. We use the sum of compensation of employees (survey item 190), entrepreneurial income (survey item 240), and property income (survey item 330) as pre-tax income that matches the income concept in tax tabulations. We use the Stata code provided by Blanchet, Flores, and Morgan (2022) (hereafter BFM) to extend and inflate the top income tail of the survey to match that of tax tabulations. The merging point is around 99% in the 1980s and 1990s. After 2000, the merging point becomes 98%, and it further drops to 95% after 2008. Our data appendix reports the top 1% and 10% income shares in the survey microdata before and after corrections. The top 1% income share in the original survey data is less than that in the tax data by about 3% to 5%. The BFM correction increases the top 1% income share by about 1% to 4%, but the corrected income share is still slightly less than that in tax tabulations by about 2%.

The next step is to impute national income components into the corrected survey microdata. Table 2 summarizes our imputation procedure. First, the sum of compensation of employees in the FIS is inflated to match the aggregate value of compensation of employees (D1) in national income, while entrepreneurial income, property income, and imputed rent in the survey are not inflated.

The undistributed profits of corporations are distributed back in proportion to each household's or individual's capital income. In principle, retained earnings should be distributed according to each individual's dividend income (so they are distributed back to stock owners). However, the

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Table 2: Imputed distribution of national income

Sectors	Allocation of Primary Income by Sector	Imputed to
Net Primary Income of Household and NPISH (B5n, S14 + S15)	Compensation of employees (D1)	Inflate compensation of employees in the FIS
	Property Income(D4) + Net Operating Surplus (B2n) + Net Mixed Income (B3n)	Entrepreneurial income, property income, and imputed rent in the FIS
Net Primary Income of Corporations(B5n, S11 + S12)	Net Operating Surplus (B2n)	Capital income
	Property Income (D4)	(or dividend income)
Net Primary Income of the General Government (B5n, S13)	Taxes less subsidies on production and imports (D2 − D3)	Factor Income (neutral)
	Net Property Income (D4) + Net Operating Surplus (B2n)	

dividend income information in the FIS is not credible. For example, we find that about 60% to 80% of tax filers report positive dividend income in tax data, but less than 15% of households in the FIS report dividend income. Since dividend income is recorded and reported by corporations to the government agency, dividend income information in the tax data should be accurate. According to DINA guidelines, if dividend income information is not available, capital income may be substituted for dividend income.[4] In practice, we find this substitution works well (detailed in Section 3.3). Finally, the primary income of the general government is distributed in proportion to each household's or individual's factor income. This distribution

[4]The capital income used here for the distribution of corporate retained earnings is defined as follows. It is 30% of proprietors' income (item 240) plus property income (item 330). We do not include imputed rent (item 390) as part of capital income when we redistribute retained earnings. This approach follows Gollin (2002). When we calculate aggregate capital share, we include imputed rent.

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is neutral to many inequality measures.

2.5 Detailed DINA-Tax

From 2001 to 2017, both detailed national income by sector and administrative income tax data are available. Lee et al. (2022) use the individual income tax data to construct tax microdata, which includes both tax filers and nonfilers. Since taxable income is only a part of national income, the detailed DINA imputes and distributes tax-exempt labor income (contributions of pension, labor insurance, and health insurance) and tax-exempt capital income (mostly imputed housing rent) to each individual such that the income concept matches with national income. Undistributed corporate profits are distributed proportionately to each individual's dividend income. The primary income of the general government is distributed proportionately to each individual's factor income.

The pre-tax national income is broadly defined in DINA. It includes received pension benefits and social insurance benefits (mainly from labor insurance and unemployment insurance) and deducts all social and pension contributions. The surplus/deficit of the social insurance system is then distributed in proportion to the distribution of factor income. For further detail, please refer to Lee et al. (2022).

3 Results

This section presents three DINA series and various measures of inequality. By using the survey microdata, we provide equal-split individual and household series for 1981 to 2017, and compare them with the detailed DINA tax individual series from Lee et al. (2022) for the period 2001 to 2017. This allows us to compare the DINA results between the survey microdata and tax microdata.

First, we present the Gini coefficients and income shares of various income groups. We then demonstrate that the rise in income inequality is due to the interaction between the deterioration of the capital income distribution and an increase in retained earnings over the sample period. Additionally, we compare our equal-split individual series with those of other countries that use the same DINA methodology. Finally, we discuss how economic growth is distributed over different periods. Detailed statistics are provided in the Data Appendix.

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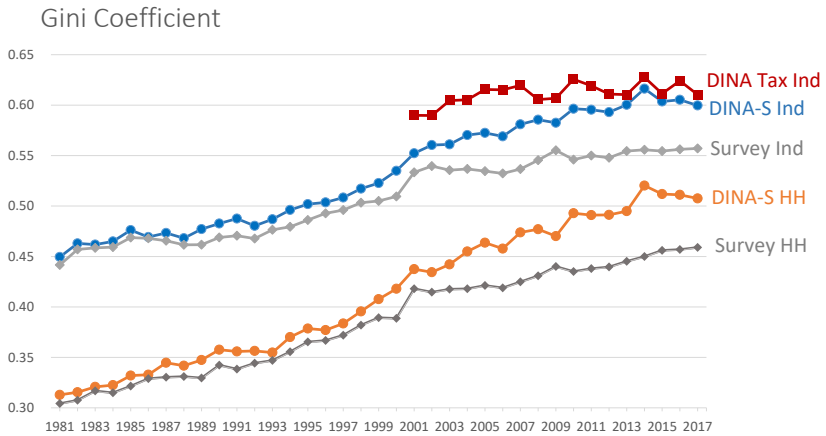


Figure 10: Gini coefficients of DINA individual and household series

3.1 Gini Coefficient

Figure 10 illustrates the Gini coefficients of our pre-tax income series for the DINA survey individual (DINA-S Ind, blue circular line), DINA survey household (DINA-S HH, orange circular line), and DINA tax individual (red squared line). The two gray lines illustrate the results calculated from the FIS without DINA imputation. All individual series are equally split between couples.

There are several takeaways from Figure 10. To begin with, all five series show a stable upward trend — the survey series demonstrates a lower level of inequality but a rapid increase, while the tax series demonstrates a higher level of inequality with a gradual increase. For example, the Gini coefficient for the DINA survey household series increases from 0.31 in 1981 to 0.52 in 2017. The Gini coefficient for the DINA survey individual series increases from 0.44 in 1981 to 0.60 in 2017. Among all five series, the DINA tax individual series exhibits the highest level of inequality but with a gradual increase, from 0.58 in 2001 to 0.62 in 2017. In addition, the increasing trends for the four survey series became steeper after 1993.

Further, both the household and individual series show significant differences from their survey counterparts (the gray lines) after the year 2000. From 1981 to 1999, the Gini coefficients of DINA are about one to three percentage points higher than those calculated from the FIS. These differ-

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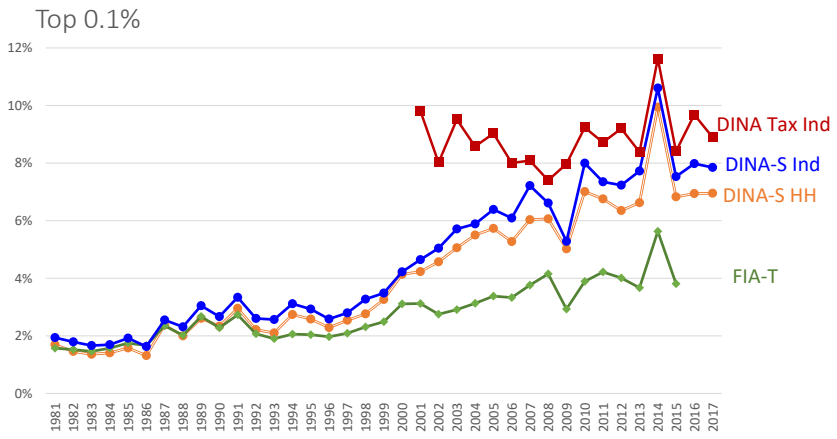


Figure 11: The top 0.1% income shares

ences increase to approximately three to five percentage points after 2000. Later, we will demonstrate that these increasing differences can be attributed to the surge in top capital income shares after 2000 and the increase in retained earnings.

3.2 Income Shares

This subsection presents income shares of various income groups that help depict the entire income distribution.

Figures 11, 12, and 13 depict the top 0.1%, 1%, and 10% income shares, respectively. In these figures, the blue circled line is the DINA survey individual income series (denoted as DINA-S Ind), the orange circled line is the DINA survey household series (denoted as DINA-S HH), the red squared line is the DINA tax individual series, and the green diamond line is the fiscal income series denoted as FIA-T and used in Chu, Chou, and Hu, 2015. FIA-T represents the top fiscal income shares that are derived from the tabulated tax statistics using only the Pareto interpolation method. The unit of observation in FIA-T is the tax unit.

Figures 11, 12, and 13 demonstrate several common patterns. First, both the DINA survey individual and household series exhibit a similar pattern: top income shares are stable throughout the 1980s and begin to rise after the middle 1990s. This corresponds to the same period that the net pri-

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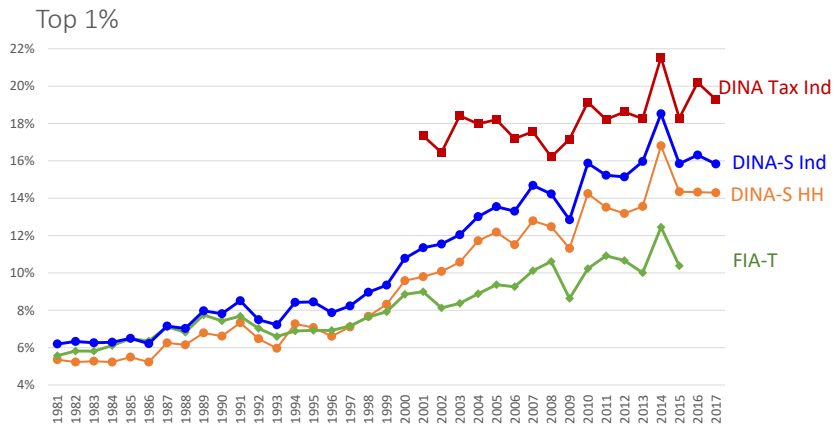


Figure 12: The top 1% income shares

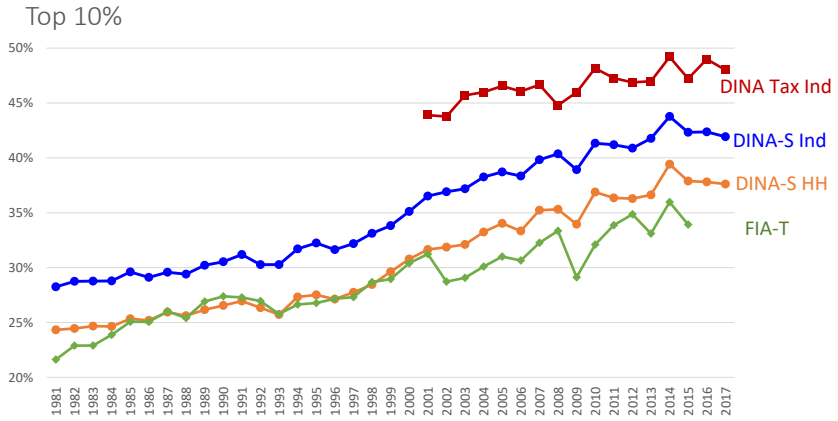


Figure 13: The top 10% income shares

mary income of corporations to national income share begins to rise (Figure 4). This changing pattern is also consistent with the FIA-T series in the 1980s and 1990s.

The top income shares of the DINA tax individual series increase gradually, except the top 0.1% income share. The top 1% and the top 10% income shares increase from 17% and 44% in 2001 to 19% and 48% in 2017, respectively, while the top 0.1% income share remains stable around

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8% to 10% in this period.

As with Gini coefficients, the DINA survey series shows lower top income shares but with a rapidly increasing trend over time. In contrast, the DINA tax series demonstrates a higher level of top income shares with a gradual increase. The survey data, even after the BFM correction, still underestimate inequality levels. The merging point is typically around 95% to 98% from 2000 to 2017. However, the DINA survey series has more rapid increases than the DINA tax series. These differences — especially in the year 2001 to 2003 — are due to the different distributing targets of the underlying microdata.

Retained earnings are distributed proportionately to individuals' dividend income in the tax microdata and capital income in the survey microdata. Later, in Section 3.3, we will show that the dividend income distribution remains stable — although with a spike in dividend income shares in the year 2001 to 2013 — in the tax data, yet the capital income distribution keeps worsening from 1981 to 2017 in the survey microdata (Figure 19 and 20). The combination of the worsening capital income distribution and increasing retained earnings explains the differences in levels and trends between the DINA survey and DINA tax series.

In addition, prior to 2000, the DINA survey household series has similar top income shares as the FIA-T. However, after 2000, the DINA survey household series increases more rapidly than the FIA-T. The rising top income shares in DINA are primarily due to the surge in retained earnings combined with the deteriorating capital income distribution. In contrast, FIA-T uses the Pareto interpolation method, which does not use the information of retained earnings or capital income. As a result, the FIA-T series does not capture rising inequality caused by increases in retained earnings and capital income.

In short, the top income shares (0.1%, 1%, and 10%) demonstrate an increasing trend from 1981 to 2017, and the levels are all much higher than previously estimated results based on tax tabulations and tax units. For the DINA survey individual series, the top 0.1% income share increases from 2% in 1981 to 8% in 2017, the top 1% income share increases from 6% to 16%, and the top 10% income share increases from 24% to 37%.

These increase in top income shares are at the expense of the remaining 90% population. Figures 14 and 15 depict the middle 40% (P50–P90) and the bottom 50% income shares for three DINA series. Between 1981 and 2017, the DINA survey series indicates that the bottom 50% group suf-

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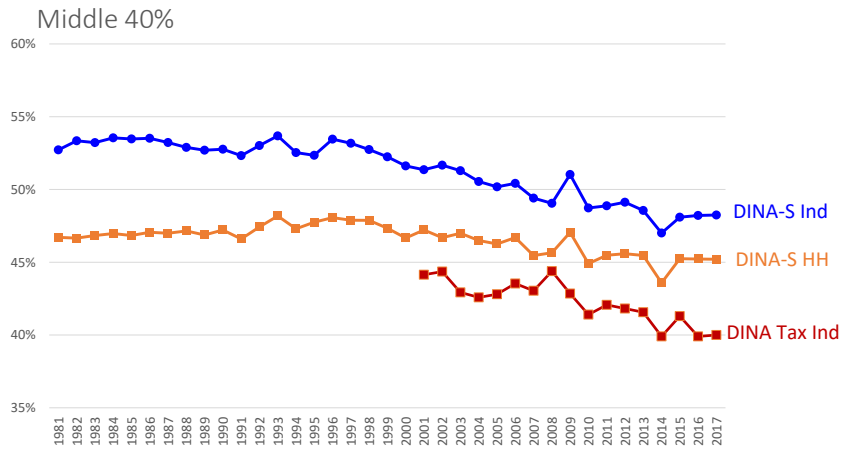


Figure 14: The middle 40% income shares

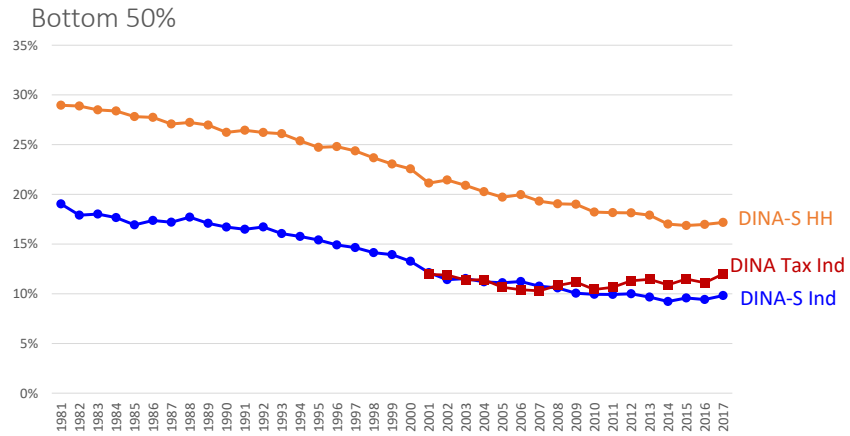


Figure 15: The bottom 50% income shares

fers more than the middle 40% income group. Consider the DINA survey individual series. The middle 40% income share declines by about 4.5 percentage points, from 52.7% to 48.2%. Meanwhile, the bottom 50% income share decreases by 9.2 percentage points, from 19% to 9.8%.

Comparing the DINA survey with the DINA tax individual series, the DINA survey series has a similar bottom 50% income share. However, the

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DINA survey has a higher middle 40% share than the DINA tax series. Suppose tax microdata represents a more accurate income distribution. Then across Figures 11 to 15, we see that the survey microdata underestimates the top income groups, overestimates the middle 40% income group, and is accurate for the bottom 50% income group.

3.3 Rising inequality due to capital income

In the previous subsection, we showed that income inequality rose rapidly after the mid-1990s, and the increasing trend in the DINA survey series is larger than in the DINA tax series. In this subsection, we show that the rapid increase in income inequality after the mid-1990s in the DINA survey series is due to the combination of an upsurge in corporate retained earnings and a worsening capital income distribution. In contrast, the DINA tax series demonstrates a gradually increasing — even flat in the top 0.1% income share — trend because the dividend income distribution becomes more equal, counteracting the rising retained earnings.

First, we depict the aggregate capital share from the DINA survey series in Figure 16.[5] Aggregate capital share has risen from around 28% in the 1980s to 38% in 2017. This rising capital share (and the declined labor share) contributes to rising income inequality because capital income is more unequally distributed than labor income.

Figures 17 and 18 depict the top income shares with and without the distribution of retained earnings. They show clearly that the rising trends in top income shares would be less rapid if there was no distribution of retained earnings (although they still increased gradually between 2001 and 2017). Similar graphs for the DINA tax series have been shown in Lee et al. (2022).

To understand how the distribution of retained earnings affects inequality differently in the DINA tax and DINA survey series, we depict the shares of retained earnings redistributed to different income groups in Figure 19 and 20. In the survey data, we first rank individuals by their pre-tax income

[5]Aggregate capital share is defined as the share of aggregate capital income in national income. So does the labor share. Nevertheless, many media stories, and even some academic reports, in Taiwan mistakenly consider labor income as compensation for employees. Labor income should also include part of the income from self-employment and proprietorships. For more details, please refer to Gollin (2002). The aggregate capital income used in Figure 16 is the sum of 30% of proprietors' income, property income, imputed rent, and retained earnings.

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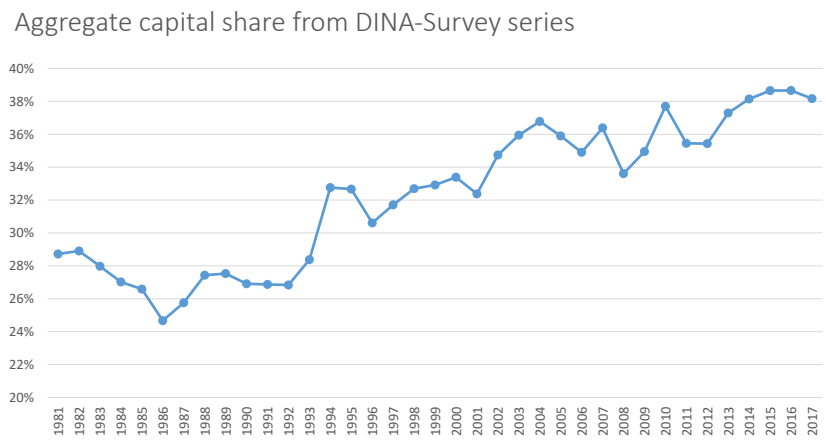


Figure 16: Aggregate capital share, 1981–2017

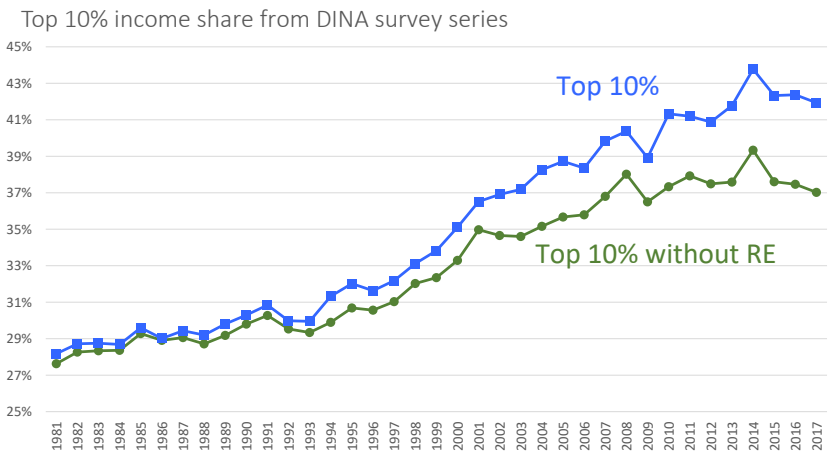


Figure 17: The top 10% income shares with and without distributed retained earnings

and then ask how much fraction of aggregate capital income is held by each income group. Since retained earnings are redistributed proportionately to capital income, this capital income share also reflects the fraction of retained

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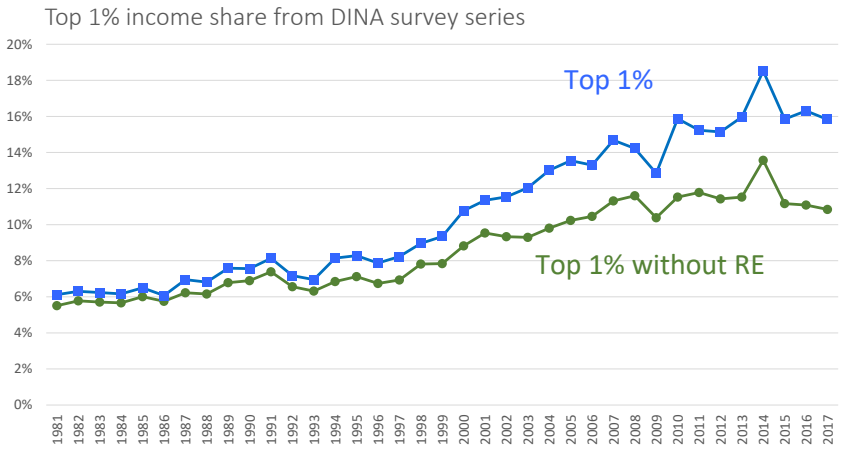


Figure 18: The top 1% income shares with and without distributed retained earnings

earnings distributed to each income group.[6] The same approach is used in the tax data; however, we estimate the fraction of dividend income held by the top income groups out of aggregate dividend income.

Most importantly, the survey data demonstrate a worsening capital income distribution from 1981 to 2017 — the top income earners are holding more and more fractions of aggregate capital income. Figure 19 shows that the top 10% (1%) income earners held about 40% (14%) of aggregate capital income in 1981, and this share rose to 68% (38%) in 2017. Similarly, in Figure 20, the capital shares of the top 0.1% and 0.01% income groups increased from around 6% and 3% in 1981 to 23% and 11% in 2017, respectively. This worsening capital income distribution combined with the increasing retained earnings explains the rapidly increasing trends of the Gini coefficients and top income shares in the DINA survey series (Figure 10 to 13).

In contrast, the tax data show a stable, even improved, dividend income distribution. Dividend income shares held by the top 1%, 0.1%, and 0.01% decreased significantly from the peak in 2001 and then became less volatile after 2004. The dividend income share held by the top 10 percent of in-

[6]The capital income here is the one used in Section 2.4. It is 30% of proprietors' income plus property income. The imputed rent is not included here.

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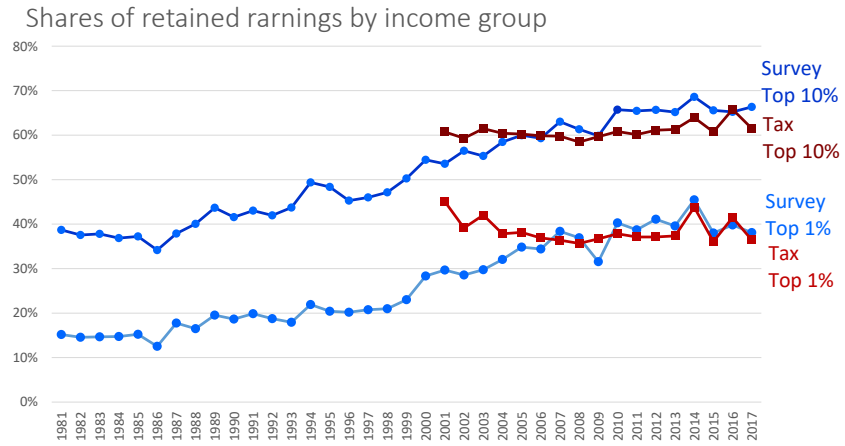


Figure 19: Shares of retained earnings held by the top 10% and 1% income groups

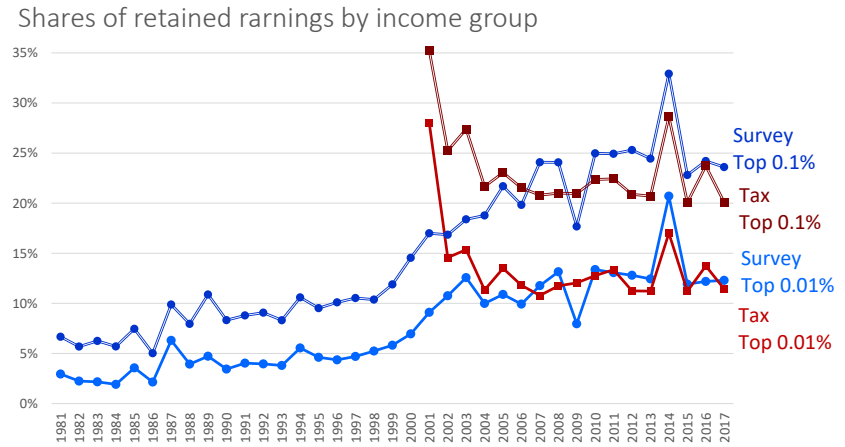


Figure 20: Shares of retained earnings held by the top 0.1% and 0.01% income groups

come earners is stable at around 60% for the sample period. The relatively stable and flat dividend income shares, coupled with rising retained earnings, explain the gradual increases in inequality measures in the DINA tax series from 2001 to 2017 (Figure 10 to 13).

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Further, in Figure 11 and 12, there is a significant difference between the DINA tax and survey individual series in the year 2001, and the top 1% and 0.1% income shares of the DINA survey series "catch up" with the DINA tax series thereafter. This is because the capital income distribution deteriorates in the survey data, while the dividend income distribution improves in the tax data.

In spite of the differences for the years 2001 to 2003, we find that shares of capital income in the survey data coincide with shares of dividend income in the tax data. As we explain in Section 2.4, the substitution of capital income for dividend income works well in practice. In addition, Figure 19 and 20 show that in 2014, there is a spike of underlying capital (dividend) income share in the survey (tax) data for the top 1%, 0.1%, and 0.01%. This explains the spike in top income shares in Figure 11 and 12.

3.4 Cross-country comparison

To understand Taiwan's position within the global inequality landscape, we compare Taiwan's results with those of other countries that have used a similar DINA methodology. Figures 21 and 22 depict the top 1% and 10% income shares for five countries: China, France, India, the U.S., and Taiwan. In these countries, the unit is an equal-split individual. Note that the DINA series of China and India rely on survey household data, not individual microdata. Household income is then divided equally among all adult members of a household. This equal-split adult series would have lower measures of inequality compared to the equal-split between married couples series. In contrast, the DINA series of the U.S. and France use administrative individual income tax microdata, which is more comparable to Taiwan data. Here, we provide both the DINA series from the survey microdata (Taiwan-S) and tax microdata (Taiwan-T).

The two Taiwan DINA series demonstrate different inequality levels and cross-country rankings. In the period when tax data is available, we believe that the tax series offers a more accurate picture of inequality in Taiwan. In Figures 21 and 22, the inequality level represented by Taiwan-S is at a similar level to that in France and China in the 1980s. This low level of inequality continued until the mid-1990s. Since then, Taiwan's inequality has increased rapidly and is now higher than both France and China.

However, the Taiwan-S series still underestimates the level of inequality. Indeed, the Taiwan-T series after 2001 indicates that Taiwan's inequality is

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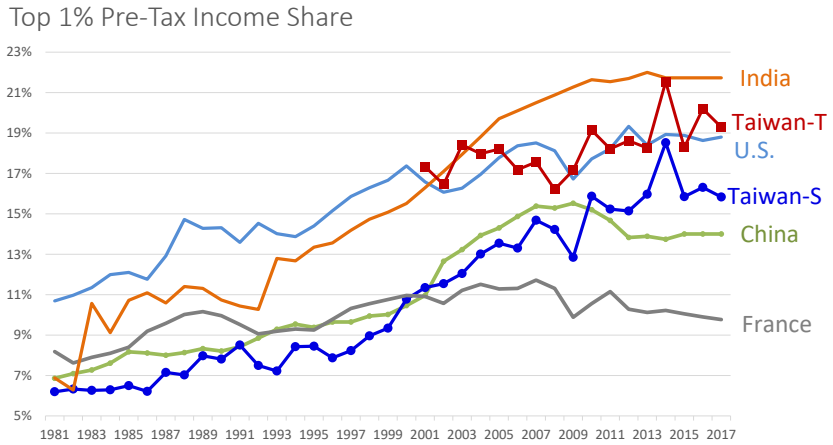


Figure 21: The top 1% national income shares (DINA) across five countries. Taiwan uses the unified DINA series

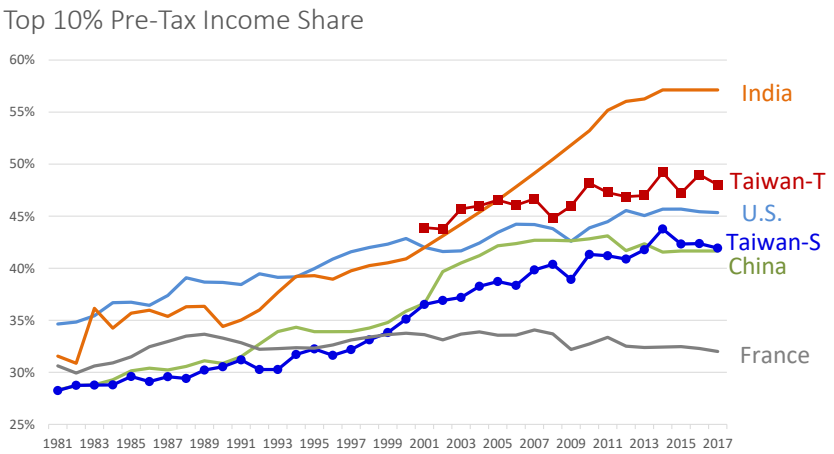


Figure 22: The top 10% national income shares (DINA) across five countries. Taiwan uses the unified DINA series

similar to that of the U.S.. The top 10% income share is around 45% to 50%, and the top 1% income share is around 20%.

In Appendix B, we provide a unified series for cross-country comparison. The unified series uses the tax DINA series for the period from 2001 to

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2017. From 1981 to 2000, we shift up the survey DINA series by adding the average difference between the tax and survey DINA from 2001 to 2017. The unified series is uploaded to the World Inequality Database.

According to today's global inequality ranking, countries in Africa, Latin America, and India are experiencing the highest income inequality rates, with the top 10 percent sharing 55 percent of income and the top one percent sharing more than 20 percent of income. Following these countries, the U.S. and Taiwan rank as the countries with the second-highest income inequality. It is striking how the inequality level in Taiwan rose so rapidly after the mid-1990s.

3.5 Distribution of economic growth

This subsection presents and analyzes the distribution of real economic growth from 1981 to 2017. From 1981 to 2001, Taiwan experienced rapid economic growth — the annualized growth rate of real national income was 7.32%, which Robert Lucas described as a growth miracle. The real annualized growth rate subsequently slowed down to 2.47% from 2001 to 2017. We are wondering how the fruits of economic growth were distributed in these two periods. Overall, we find that the growth distribution is more equal in the first period and becomes worse in the second period. We conduct a counterfactual experiment and find that it is the interaction between the rising retained earnings and a more unequal capital income distribution of the survey microdata that makes the distribution of economic growth more unequal in the period 2001 to 2017.

Table 3 lists the shares of economic growth by income group using the DINA survey household series. Table 4 lists the growth shares using the DINA survey individual series, as well as the DINA tax series.

While the household series exhibits a more equal distribution of growth than the individual series, they share the same pattern. That is, the distribution of economic growth was more equal during the rapid growth period from 1981 to 2001. After 2001, as the economic growth rate slowed, the distribution of growth also deteriorated. For the past 37 years, the bottom 90% of income earners have accounted for about 55% (individual series) to 59% (household series) of economic growth. From 1981 to 2001, the growth share of the bottom 90% group was about 60% to 65%. However, from 2001 to 2017, it declined to less than 50%.

Comparing the DINA survey individual series and the DINA tax series

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Table 3: Shares of economic growth by income group from the DINA survey household series

Household	1981–2017	1981–2001	2001–2017
Bottom 50%	14.58%	18.27%	8.97%
Middle 40%	44.87%	47.41%	41.03%
Top 10%	40.55%	34.32%	50.00%
Top 1%	16.27%	11.42%	23.62%
Top 0.1%	8.11%	5.16%	12.60%
Top 0.01%	4.18%	2.63%	6.54%

Table 4: Shares of economic growth by income group from the DINA individual series

	Survey			Tax
Individual	1981–2017	1981–2001	2001–2017	2001–2017
Bottom 50%	7.79%	9.59%	5.08%	12.07%
Middle 40%	47.26%	50.86%	41.84%	31.28%
Top 10%	44.94%	39.55%	53.08%	56.65%
Top 1%	17.95%	13.23%	25.07%	23.38%
Top 0.1%	9.15%	5.64%	14.44%	6.95%
Top 0.01%	4.74%	2.88%	7.55%	−0.41%

in the period 2001 to 2017, we find that the DINA survey series underestimates the growth share of the bottom 50% and overestimates the middle 40% growth share, but it correctly estimates the top 10% and 1% growth shares. The difference is largest in the top 0.1% and 0.01% groups. Both groups have a lower growth share in the tax data than in the survey data. This is because the dividend income shares of both groups decreased from the peak in 2001 to 2004, as shown in Figure 20.

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A Counterfactual Experiment

In the previous section, we showed that the rise in inequality is a capital income phenomenon, in which the rise in retained earnings plays a critical role. To understand how the increase in retained earnings affects growth inequality, we conduct the following counterfactual experiment. That is, we hypothetically maintain the level of retained earnings between 2001 and 2017 at 1981: 7.6% of national income. We then move the extra income into the general government, whose distribution is proportionate to individuals' factor income and neutral to the inequality measures presented here. We do not change the primary income of households for each year. We then redo the DINA imputation and estimate the growth distribution. The counterfactual results are in Table 5 (household series) and 6 (individual series). To make it easier to compare with the actual data, we list the growth shares in Table 3 and 4, respectively, in parentheses with grey-blue color. In short, the reduction of retained earnings decreases the growth shares of the top 10% (and above) income groups and raises the shares of the middle 40% and the bottom 50% group in all periods and both series. This is distinct from the dashed lines in the two tables.

There are two main findings from the counterfactual experiment. First, the change in retained earnings affects the growth distribution significantly. The higher the reduction in retained earnings, the more equal the growth distribution is. This can be seen from the changes in the two subperiods in Table 5 and 6. In both the household and individual series, the counterfactual series demonstrate small changes in the subperiod 1981 to 2001 but large changes in the subperiod 2001 to 2017. In 2001, the share of retained earnings in national income is reduced from 9.34% to 7.6%, while in 2017, it is reduced from 19% to 7.6%. By moving a large fraction of retained earnings, which is distributed according to capital income, to the general government, whose distribution is neutral, we have a more equal economic growth distribution.

Second, the capital income distribution of the underlying survey microdata becomes more unequal in the second subperiod 2001–2017, making the growth distribution more unequal. This is inferred by comparing the counterfactual results between the subperiods 1981–2001 and 2001–2017 in both series. Since in both subperiods, the primary income of corporations is hypothetically controlled at 7.6% of national income, the change in inequality should come from changes in the underlying microdata. This is

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Table 5: The counterfactual experiment: shares of economic growth by income group from the DINA survey household series. The numbers in the parentheses are actual distribution from Table 3

Household	1981–2017	1981–2001	2001–2017	
Bottom 50%	15.45% (14.58%)	18.29% (18.27%)	11.57% (8.97%)	
Middle 40%	47.55% (44.87%)	47.55% (47.41%)	47.54% (41.03%)	↑
Top 10%	37.01% (40.55%)	34.15% (34.32%)	40.89% (50.00%)	↓
Top 1%	12.69% (16.27%)	11.22% (11.42%)	14.68% (23.62%)	
Top 0.1%	5.69% (8.11%)	5.00% (5.16%)	6.64% (12.60%)	
Top 0.01%	2.93% (4.18%)	2.54% (2.63%)	3.46% (6.54%)	

Table 6: The counterfactual experiment: shares of economic growth by income group from the DINA survey individual series. The numbers in the parentheses are actual distribution from Table 4

Individual	1981–2017	1981–2001	2001–2017	
Bottom 50%	8.12% (7.79%)	9.58% (9.59%)	6.15% (5.08%)	
Middle 40%	50.98% (47.26%)	51.08% (50.86%)	50.85% (41.84%)	↑
Top 10%	40.90% (44.94%)	39.34% (39.55%)	43.00% (53.08%)	↓
Top 1%	14.08% (17.95%)	13.02% (13.23%)	15.51% (25.07%)	
Top 0.1%	6.36% (9.15%)	5.47% (5.64%)	7.56% (14.44%)	
Top 0.01%	3.27% (4.74%)	2.78% (2.88%)	3.93% (7.55%)	

also evidenced by Figure 19 and 20 in Section 3.3. It means that the top income groups (ranked by total pre-tax income) hold more capital income in the second subperiod 2001–2017.

Overall, we find that the interaction between the rising retained earnings and a more unequal capital income distribution of the survey microdata makes the economic growth distribution more unequal in the period 2001 to 2017.

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4 Concluding Remarks

We have shown that the income inequality measures in the DINA series are substantially higher than previous estimates. It means the level of income inequality in Taiwan is much higher than previously believed. The difference between our results and prior estimates is due to the change in units and the treatment of retained earnings.

The DINA survey series demonstrates a lower level but a rapid increase in inequality than the DINA tax series. Taiwan's rising inequality from the mid-1990s until now is primarily caused by rising capital income — the combination of a worsening capital income distribution and increasing retained earnings. Following 2001, the distribution of economic growth became more unequal, while the growth rate declined.

Inequality measures are rarely sensitive to different units of observation to the extent that we see in Taiwan. According to this sensitivity, there is a significant degree of income inequality within the family and within the couple. This suggests an underlying issue of gender inequality in marriage and household work that deserves further investigation.

Appendix

A. Data Resources

Here we provide publicly available database. The data used in the DINA survey series are all publicly available. Administrative income tax data must be use on site in the data center of the Ministry of Finance. All the websites listed here are in Chinese. Although some data resources have English websites, we found that the Chinese website typically provides more data than its English website.

- National Accounts 國民所得及經濟成長資料庫
  https://nstatdb.dgbas.gov.tw/dgbasAll/webMain.aspx?sys=100&funid=dgmaind&mp=4
  Sectoral National Accounts are in 所得收支 → 所得收支按部門別之分配.
- The Yearbook of Tax Statistics:
  - 1974–2007, 賦稅統計年報
    https://stat.ncl.edu.tw/browse.jsp?p=97244238

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  - After 2007, 財政統計年報
    https://www.mof.gov.tw/singlehtml/285?cntId=64525

  Note that the tax tabulations, corporate taxable profits, corporate tax exempt profits, government indirect taxes, fiscal monopoly revenues, etc., are all in the Yearbook.

- The Survey of Family Income and Expenditure database, 家庭收支調查 (one has to apply for from the Survey Research Data Archive in Academia Sinica)
  https://srda.sinica.edu.tw/index.php

B. The Unified Series

In the main article, we have compared the survey and tax DINA series. Both have some advantages and shortcomings. The tax data is more accurate, while the survey data has a longer horizon. Here we construct a unified DINA series to present Taiwan's income inequality. Based on the property that individual income tax data is more accurate and survey data typically underestimate top income shares, we use tax DINA series for the period from 2001 to 2017. From 1981 to 2000, we shift up the survey DINA series by adding the average difference between the tax and survey DINA from 2001 to 2017. The procedure applies to the Gini coefficients and income shares of the top 0.1%, 1%, and 10%. Consequently, the Gini coefficients increased by 0.03, the top 0.1% income shares increased by 2 percentage points, the top 1% shares increased by 3.8 percentage points, and the top 10% shares increased by 6.6 percentage points between 1981 and 2000.

Regarding the other part of the distribution, we know that the survey DINA series overestimates the 40% share but has a similar magnitude to the bottom 50% share (Figure 14 and 15). Therefore, we subtract the added difference in the top 10% income shares from the middle 40% income shares, leaving the bottom 50% shares unchanged for the period from 1980 to 2000. The graphs and number of these unified DINA series are in the online Data appendix.

Figures A1 and A2 depict the top 1% and 10% income shares for five countries: China, France, India, the U.S., and Taiwan. In these countries, the unit is an equal-split individual. Note that the DINA series of China and India rely on survey microdata with an equal-split adult (adults within a household), and the DINA series of the U.S. and France use administra-

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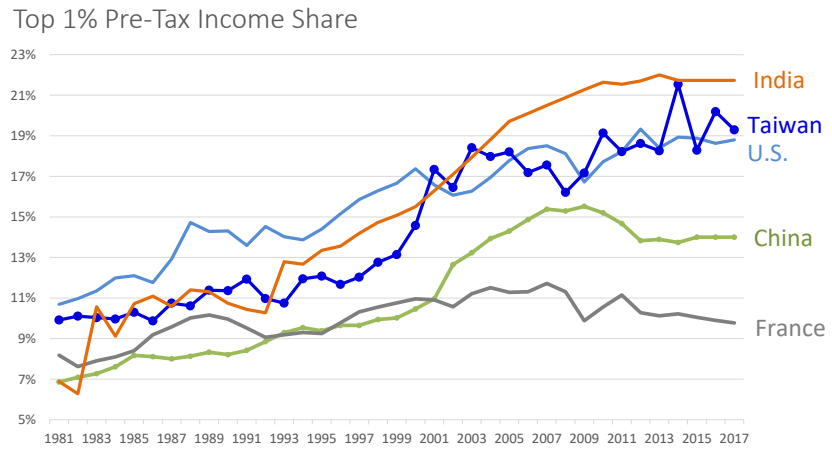


Figure A1: The top 1% national income shares (DINA) across five countries. Taiwan uses the unified DINA series

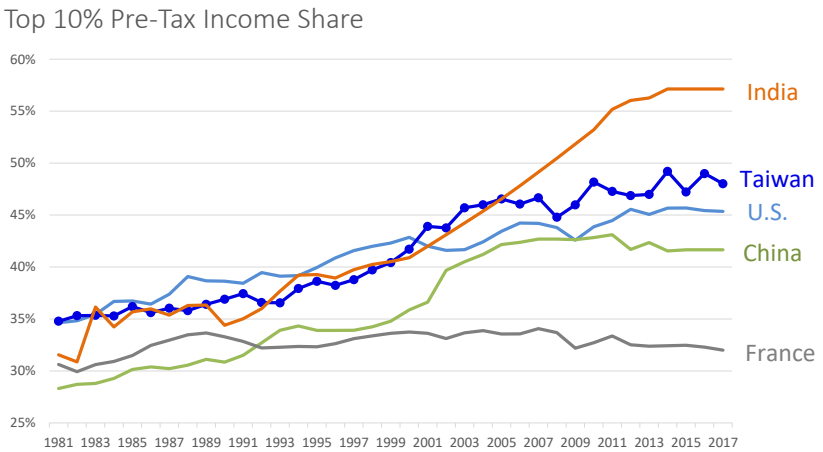


Figure A2: The top 10% national income shares (DINA) across five countries. Taiwan uses the unified DINA series

tive individual income tax microdata with an equal-split between married couples.

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台灣之國民所得分配帳, 1981–2017

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本文使用調查資料建構了台灣 1981–2017的稅前國民所得分配帳 (Distributional National Accounts, DINA)。研究結果發現, 以此方法計算出的所得不均度, 遠高於之前使用稅務統計資料的研究, 造成此一現象原因有二。首先, 由於家戶內個人所得不均度極高, 以個人而非納稅單位作爲觀察層級自然會估計出較高不均度。再者, 多考慮了企業保留盈餘的分配也會增加不均度。整體來說, 台灣的所得不均度在1980年代相對平穩, 到了1990年代中期後開始增加, 2000年之後則進一步加速。本文也估計了經濟成長的分配。1981–2001, 台灣有著高達7.32%的年均成長率和相對平等的成長分配。2001–2017, 經濟成長年均率下滑至2.47%並伴隨著成長分配的惡化。在2001年之後所得及成長分配的惡化, 主要來自日益不均的資本所得分配以及企業保留盈餘的增加。

關鍵詞: 國民所得分配帳, 所得不均, 稅前國民所得
JEL 分類代號: D31, E01, O15

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