Assessment of Relationship between Growth and Inequality: Micro Evidence from Thailand

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Abstract

This paper shows that growth and income distribution dynamics are closely linked through occupation, financial intermediation, and education. We use the micro data from Thailand for 1976-1996. The compositional changes across these characteristics account for half of the Thai inequality increase and forty percent of the Thai growth and poverty reduction. Financial deepening and educational expansion contributed to increasing inequality while occupational transformation contributed to poverty alleviation. The changes in income gaps across the income-status groups, that is, divergence and then convergence, give rise to inverted-U inequality dynamics. These two growth-related components of inequality dynamics, composition and income-gap dynamics, explain virtually all the change in overall inequality, except its initial rise. Thus, inequality dynamics can be viewed as integral part of wider process of growth as Kuznets speculated.

Key Words: Kuznets Dynamics, Growth, Inequality, Poverty

JEL Classification: D31, O41, I32

This paper examines the relationship between growth and inequality using the micro data from Thailand. Due to the scarcity of appropriate data, most empirical studies that attempt to establish the relationship between growth and inequality focus on cross-country regressions though the relationship is dynamic. The results of these studies are, unfortunately, robust neither to the specification of estimation nor to the selection of data.[1] At best, they have provided suggestive clues. A more natural alternative for studying the dynamic relationship between growth and inequality is an analysis of evolution of the income distribution for a given economy over time, using a series of micro data.[2]

Following Kuznets' (1955) original suggestion, the data are classified by average income levels for a long (two-decade) span, so that one can form long-term *income-status groups*. Then, the changes in the income distribution consist of (1) population shifts across income-status groups, (2) changes in income levels across these groups, and (3) distributional changes within these groups. The first component may be called "composition dynamics," the second component "income-gap (or convergence-divergence) dynamics," and the third one "intra-group inequality dynamics."

Kuznets (1955) viewed long term change in income inequality as part of a wider process of growth. Indeed, the first two components of inequality dynamics, (1) and (2) above, are indeed related to growth. As more people join higher-income groups transiting from the lower-income groups, the average income of the economy grows. But this also affects the shape of the aggregate income distribution. In fact, despite the monotone effect of composition dynamics on growth, this effect on inequality can be nonlinear and the well-known inverted-U shaped "Kuznets curve" was derived from this type of composition dynamics. Kuznets's leading example was the shift of labor force from agriculture to non-agriculture. However, compositional changes across *any* income-status groups, e.g. shift toward higher education, can be *common* sources of growth and income distribution dynamics. Further, different income-status groups may grow at differential rates. When higher-income groups grow faster than the lower-income groups, income levels across income-status groups diverge and income inequality tends to increase. To the contrary, when the catch-up growth by the lower-income groups takes place, we would observe convergence and hence declining inequality.

Since different components of inequality dynamics may move in different directions, possibly interactively, a priori relationship between growth and inequality may not be established, at best not at aggregate level. Certainly, the time series relationship between growth and inequality at aggregate level is not stable across countries as Fields (2001) emphasizes.[3] Thus, the evolution of income distribution needs to be decomposed into its components as above in order to properly relate it to growth.

Existing national level studies explore the effects of these dynamics either only on growth or only on inequality in isolation, focusing on a specific socioeconomic characteristics. For example, Knight and Sabot (1983) (for East Africa) and Park, Ross, and Sabot (1996) (for Brazil and Korea) focus on the effect of educational expansion on income inequality while Mookherjee and Shorrocks (1982) and Lindert (1986) focus on the effect of change in age-group composition on income inequality and wealth inequality for U.K., respectively. They find that the compositional changes in their selected characteristics do contribute to increasing inequality. However, the magnitudes and shapes of the effects of each component on their dynamics of growth and inequality differ depending on the chosen characteristics by which income-status groups are formed. In contrast, this paper studies economic growth, evolution of the income distribution, and socioeconomic changes, *comprehensively*, not in isolation, with respect to *a variety of* socioeconomic characteristics: age, gender, community type, production sector, occupation, participation in formal financial sector, and education. This will tell us which characteristics *from many possibilities* are crucial in linking growth with income distribution dynamics. We thus assess the empirical importance of the relationship between growth and inequality and at the same time document the channels through which they are linked.

The decomposition of growth using micro data sheds new light on growth accounting as well. Standard growth accounting exercises use macro data from national income accounts or factor prices to decompose the total output growth into factor accumulation and the residual, the so called "total factor productivity (TFP)" growth.[4] Thus, the TFP growth at aggregate level can be any sources of growth other than factor accumulation.

Population shifts across income-status groups might be one of the potential sources of this *aggregate* TFP growth and sorting this source of growth out of total growth is an alternative way of identifying the residual.[5]

We apply this method of assessing the relationship between growth and inequality to Thailand over the two decades between 1976 and 1996.[6] This country provides us with not only a rich set of nationally representative household survey data but is also a prototypical example of growing economy with increasing (and then decreasing) income inequality . We find that the income distribution dynamics are intimately related to the growth process in terms of both composition dynamics and income-gap dynamics via three characteristics: occupation, participation in formal financial sector, and education.

In terms of composition dynamics, expansion of financial intermediation and education played a major role in increasing inequality while occupational transformation contributed to poverty alleviation. The seemingly ironic adverse effect of educational expansion on distribution, which becomes obvious once considering the prevalent wealth constraints toward higher education, is also found by Knight and Sabot (1983) and Park, Ross, and Sabot (1996) for East Africa and Brazil, respectively. However, the empirical importance of financial deepening on *both* growth and inequality seems new, though the theoretical importance of this link on growth and inequality is fairly well appreciated, for example in Greenwood and Jovanovic (1990).

The differential income levels across income-status groups over a variety of characteristics were first widened but began to converge in a catch-up phase of growth. This is the main source of the inverted-U shaped Thai inequality dynamics. This divergence-convergence pattern of income-gap dynamics took place for every characteristic enumerated above but effect was the most salient through occupation. This indicates the importance of the rise and fall in occupational skill premia for inequality dynamics in the course of economic growth.[7] The down-turn of inequality came earlier and with a larger order of magnitude via income-gap dynamics while Kuznets (1955) postulated his own inverted-U curve via composition dynamics.

It is interesting to note that the crucial compositional changes linking growth and inequality are via *self-selective* characteristics (occupational transformation, increasing participation in formal financial intermediary, and shift toward higher education groups) ones rather than demographic (aging in population and increase in female-headed households) or structural (urbanization and indistrialization). This suggests that the features of self-selection at micro level may be substantial sources of both growth and inequality at macro level. The joint compositional change in these three self-selective characteristics accounts for nearly forty percent of the income growth and poverty alleviation in Thailand and more than half of the Thai inequality change over the two decades under study. Combining the effects of composition dynamics and income-gap dynamics together, fully seventy-two percent of the inequality change can be explained. In particular, intra-group inequality rises only at the very initial stage of development and then stays constant. The two growth-related components of inequality dynamics, composition and income-gap dynamics, explain virtually all the inequality dynamics after the Thai economy entered into its high-growth era.

The paper proceeds as follows. Section I introduces a benchmark model for the decomposition analysis. Section II describes main patterns of growth and income distribution dynamics in Thailand. We first explain the measurement of variables and then study the salient features. In Section III, these features are decomposed by constructing counterfactual distributions from nonparametric density estimation and index decomposition analysis. Combining the decomposition results, the relationship between growth and income distribution dynamics is assessed. Section VI concludes the paper.

I Model

Consider an economy populated by agents, indexed by i, who choose a category among K mutually exclusive alternatives of a socioeconomic characteristic, associated with income-generating attributes, at each discrete date t. Let d_{it}^k indicate an agent i's choice of the characteristic at date t so that $d_{it}^k = 1$ if agent i chooses category k at date t and $d_{it}^k = 0$ otherwise. Given choice of category k at date t, agent i gets an income

$$y_{it}^k = \mu_t^k + \varepsilon_{it}^k, \tag{1}$$

where μ_t^k indicates the average income within category k and ε_{it}^k the zero-mean idiosyncratic component of income within category k at date t. Agent i chooses a sequence of characteristic categories $((d_{is}^k)_{k=1}^K)_{s\geq t}$ at date t to maximize the expected value of the discounted life-time utility

$$E[\sum_{s=t}^{T} \beta^{s-t} u(y_{is}) \mid \Omega_{it}], \tag{2}$$

where T denotes the span of life time, β the discount factor, u the current-period indirect utility function defined on income, Ω_{it} the information set of the state variables, and y_{is} the income level that can be expressed such that

$$y_{is} = \sum_{k=1}^{K} d_{is}^k (\mu_s^k + \varepsilon_{is}^k). \tag{3}$$

There may exist an admissible set Γ_{it} that restricts agent i's characteristic choice at date t, reflecting possible impediments to trade.

Then, the sequence of characteristic choice $((d_{is}^k)_{k=1}^K)_{s\geq t}$ of agent i at date t is determined by

$$((d_{is}^k)_{k=1}^K)_{s\geq t} \in \arg\max\{E[\sum_{s=t}^{T} \beta^{s-t} u(\sum_{k=1}^{K} \widehat{d}_{is}^k (\mu_s^k + \varepsilon_{is}^k)) \mid \Omega_{it}] \ s.t. \ ((\widehat{d}_{is}^k)_{k=1}^K)_{s\geq t} \in \Gamma_{it}\}. \tag{4}$$

Given the profile of self-selection of all agents, population fraction of category k at date t is simply an average of individual characteristic choices such that

$$p_t^k = \sum\nolimits_{i=1}^{n_t} \frac{d_{it}^k}{n_t}, \tag{5}$$

where n_t denotes the population size at date t. Let f be the density function of the aggregate distribution of income and f^k be that of the category k distribution of income. The law of probability suggests that the aggregate distribution of income y_t at date t be decomposed into subgroup distributions such that

$$f(y_t, p_t, t) = \sum_{k=1}^{K} p_t^k f^k(y_t, t) \tag{6}$$

where $p_t = (p_t^k)_{k=1}^K$ denotes the distribution of the characteristic over K alternatives at date t, and the category k income distribution $f^k(y_t, t)$ is determined by the average income μ_t^k and the distribution of the idiosyncratic component of income ε_{it}^k for each category k.

In this economy, there are three factors that affect the aggregate shape of the income distribution: (1) composition of socioeconomic characteristics in population, $(p_t^k)_{k=1}^K$, (2) *inter-group* distances, measured by the differential average income levels across income-status groups, $(\mu_t^k)_{k=1}^K$, and (3) *intra-group* distributions, determined by the distributional shapes of the group-specific idiosyncratic income components $(\varepsilon_{it}^k)_{k=1}^K$. The evolution of income distribution can then be accounted for by the changes in these three factors, which we may call them "composition dynamics," "income-gap dynamics," and "intra-group inequality dynamics," respectively.

Various models of growth and inequality belong to this class of models though they put different emphasis on their own chosen income-status characteristics. For example, most dual-economy models, proposed by Lewis (1954) and Kuznets (1955), emphasize the role of dual production sectors in economic development and evolution of income inequality. Among modern ones, Banerjee and Newman (1993) and Lloyd-Ellis and Bernhardt (2000) consider similar models of growth and inequality but being more explicit about micro underpinnings on occupational transformation. In Greenwood and Jovanovic (1990), growth and inequality evolve together via participation in financial sector while via education in Galor and Zeira (1993). Sometimes migration between different community types is suggested as a potential link. Implicit in permanent-income type models, change in age-group composition may be another driving force of inequality dynamics as addressed by Deaton and Paxson (1994). Capital-skill complementarity model, postulated by Krusell, Ohanian, Ríos-Rull, and Violante (2000), can also be considered as a model belonging to this class, paying more attention to income-gap dynamics across different skill groups rather than to composition dynamics.

They all have different structures to emphasize their own built-in characteristics. However, they do share the common feature that evolution of income distribution are related to growth and the above three factors, namely, composition dynamics, income-gap dynamics, and intra-group inequality dynamics are the driving forces of income distribution dynamics along with growth. In this paper, rather than focusing our attention on a specific model, we decompose the data and compare the empirical importance of these three factors over various income-status characteristics that are suggested by the models to understand through which factors growth and inequality dynamics are in fact linked. With micro data being available, we can trace the component dynamics and assess their contributions to aggregate income distribution dynamics. In particular, the first two components of income distribution dynamics are related to growth process so that we can assess the relationship between growth and inequality.

II Growth and Income Distribution Dynamics in Thailand

A Data

We use the nationally representative household survey data from Thailand, the Socio-Economic Survey (SES), to study the evolution of income distribution over two decades between 1976 (when the compatible data collection began) and 1996 (prior to the 1997 Asian financial crisis which began in Thailand).[8] During this period, eight rounds of cross-section data were collected in 1976, 1981, 1986, 1988, 1990, 1992, 1994, and 1996 by the Thai National Statistical Office, adopting a sampling scheme of clustered random sample stratified by geographic regions over the whole country. The sample size of each round varies 10,897 to 25,208 depending on year with fairly high response rates of 80 to 97 percent.[9]

A.1 Measurement of Income

The original income figure from the SES is the monthly value of total annual receipt of resources received by all household members before tax in current value of Thai currency baht, which includes wages, net profits from farming and non-farm business, property income, transfer payments, and various types of income in kind. This SES household income figure is adjusted in two ways. First, it is deflated into real terms with the numeraire of 1990 baht applying *differential consumer price indices across regions* to reflect the regional variation in general price levels and changes. Second, it is scaled by *adult-male equivalent household size* to compare the income figures over households with different demographic structures in terms of equivalent welfare units.[10]

A.2 Household Characteristics

Among various socioeconomic characteristics, we consider seven household characteristics in categorizing income-status groups: age, gender, community type, production sector, occupation, participation in formal financial sector, and education. For person-specific characteristics like age, gender, production sector, occupation, and education, the characteristics of the household head are used. According to the SES, the average contribution shares of the head to the total household earnings are 83 to 90 percent, depending on year. Therefore, using head's characteristics seems a reasonable approximation to represent the household characteristics for the purpose of analyzing household income.

Age groups are categorized into five: 30 or less, 31-40, 41-50, 51-60, 61 or more. Gender groups are dichotomous: male and female. Production sector has nine categories: agriculture, mining, manufacturing, electricity-gas-water, construction, trade-commerce, transport-communication, service, and economically inactive. There are four broad occupation categories: farmer, wageworker, non-farm entrepreneur, and the inactive. Each of these broad categories of occupation has sub-categories based on earnings capacity such as land size for farmers, skill level for wageworkers, and employment status for non-farm entrepreneurs.[11] Education has five categories based on the level of final attainment: no formal, primary, secondary, vocational, and university or higher. Community type and participation in formal financial sector are genuinely defined at household level. There are three community types: urban area, sanitary district, and rural area.[12] Financial participation has two categories: participant and non-participant. If any member of the household transacted with any of the formal financial institutions such as commercial banks, savings banks, Bank of Agriculture & Agricultural Cooperative (BAAC), government housing banks, financial companies, or credit financiers, the household is categorized as participant and otherwise as non-participant.[13]

B Salient Features

The Thai economy developed rapidly between 1976 and 1996. The average income grew by 5.0 percent each year.[14] This rapid growth alleviated poverty remarkably. In 1976, nearly half of the population, 48 percent, earned less than $2 a day in 1985 dollars. By 1996, this had fallen to 13 percent. Income inequality, however, increased sharply over this period. Already in 1976, the income Gini coefficient of Thailand (0.436) was much higher than the average of East Asia and Pacific Rim countries (0.362) and close to the average of Sub-Saharan African countries (0.441).[15] This high income inequality became even higher after two decades of growth. Indeed, by 1996, the income Gini coefficient of Thailand reached to 0.515, exceeding well the average of Latin American and Caribbean countries (0.502).

B.1 Aggregate Dynamics

Figure 1 compares the estimated density functions of income (in logarithmic scale) between two years, 1976 and 1996, which displays how the distributional shape of income has changed over the two decades. The density at log income level x is estimated by the nonparametric kernel method such that

$$\widehat{f}(x) = \frac{1}{h}\sum_{i=1}^{n} w_i K\left(\frac{x-y_i}{h}\right),$$

where $(y_1, \cdots, y_n)$ is the sampled income distribution, h the bandwidth, n the sample size, w_i the sampling probability weight for y_i such that $\sum_{i=1}^{n} w_i = 1$, and $K(\cdot)$ the kernel function that assigns the relative weight for the observed sample points near x over the chosen band.[16]

Two vertical lines in Figure 1 indicate the average income levels in both years; the left one for 1976 and right one for 1996. The distance between them represents the growth of average income. The support of the distribution was widened and shifted to the right. Comparison of the Lorenz curves for both years in Figure

2 shows that the 1996 Lorenz curve lies strictly below the 1976 Lorenz curve, which implies that inequality increased between 1976 and 1996 by any inequality indices obeying "Pigou-Dalton's principle of transfer," such as coefficient of variation, Gini coefficient, Atkinson indices, and generalized entropy indices. Figure 3 plots the cumulative distribution functions for both years, showing that the 1996 cumulative distribution function strictly lies below the 1976 one.[17] That is, the 1996 distribution stochastically dominates the 1976 distribution by the *first order*, which implies a poverty reduction, measured by *any* Foster-Greer-Thorbecke (FGT) poverty indices for *any* poverty line. Thus, the increase in inequality and poverty alleviation during growth are robust to the choice of numeric indices of inequality and poverty and also to the choice of poverty line.

Table A.1 in Appendix 1 reports various summary statistics of income, central tendency, inequality, and poverty indices during 1976-1996, which shows the trends of various distributional aspects. Taking Theil-L index as an inequality measure, Figure 4 compares the trend of income inequality with that of average income over the entire period, illustrating that there were two turning-point years for the Thai economy. For growth, we observe a noticeable acceleration after 1986 at the rate of 8.0 percent per annum. For inequality, 1992 is a turning-point year: except for a modest decrease between 1986 and 1988, the inequality increased until 1992, and then substantially dropped thereafter. Thus, we observe an inverted-U shaped inequality dynamics along with growth at aggregate level. Other inequality indices such as Theil-T index, Gini coefficient, Atkinson index, and Foster-Wolfson polarization index show the same pattern. In contrast to this nonlinear path of inequality, poverty decreased monotonically according to all three FGT poverty indices, except during the recession period between 1981 and 1986, which suggests that the poverty trend was driven by growth rather than by inequality.[18]

Based on the above turning points, we divide the overall two-decade period into three sub-periods: Stage 1 (1976-1986), the period of slow growth with increasing inequality; Stage 2 (1986-1992), the period of fast growth with increasing inequality; and Stage 3 (1992-1996), the period of fast growth with decreasing inequality.

B.2 Composition Dynamics

Over the two-decade period between 1976 and 1996, the Thai economy went through substantial changes in the composition of socioeconomic characteristics. Detailed patterns of compositional changes in age, gender, community type, production sector, occupation, participation in formal financial sector, and education are reported in Table A.2 in Appendix 1. Here, we recapitulate the salient features.

The demography changed substantially. The proportion of households with head more than 60 years old increased from 16 percent to 22 percent as the life expectancy at birth increased by nine years, from 65 to 74. The proportion of the female-headed households increased from 17 percent to 24 percent. As the aged and female-headed households increased, the proportion of economically inactive households, who live on either transfer income or property income, increased from 10 percent to 16 percent.

Agriculture has been a dominant sector of the Thai economy for a long time but the relative importance of agriculture has fallen from 61 percent to 42 percent with respect to employment share between 1976 and 1996 while service and manufacturing sectors expanded. In particular, it is construction and manufacturing sectors that expanded the fastest: their employment share more than doubled from 5.5 percent in 1976 to 12.9 percent in 1996.

Along with this rapid industrialization, urban ratio rose from 15 percent to 24 percent, and the major occupation was switched from farmer to wageworker. The proportion of farmers decreased from 53 percent to 27 percent while that of wageworkers increased from 28 percent to 44 percent. In particular, among wageworkers, the proportion of unskilled workers decreased while the skilled workers in industrial and service sectors increased. For example, the population fraction of general workers dropped from 5.3 percent to 3.1 percent while that of industrial production workers increased from 5.9 percent to 15.2 percent. However, along with this fast and continual industrialization, the proportion of non-farm entrepreneurs was stable around 14 percent until 1992, and then slightly increased to 16 percent by 1996. That is, the labor force released from the agricultural sector was absorbed into industrial sector as wageworkers rather than as entrepreneurs.

The proportion of no-formal education group fell from 24 percent to 9 percent and the proportion of secondary or higher education groups more than doubled from 8 percent to 20 percent, which increased the average years of schooling from four to six. However, a vast majority of Thai households, 92 percent in 1976 and still 80 percent in 1996, did not pursue education beyond the primary level and the general level of higher education remained very low for all the rapid income growth over the two decades. A bottleneck seems to exist in educational mobility between primary and secondary levels.[19]

The financial sector was deepened in the sense that the fraction of households using the formal financial institutions increased from 6 percent to 26 percent. Each year one additional percent of households used the formal financial institutions, which is of the largest order of magnitude among all above compositional changes.

B.3 Income-Gap Dynamics

Income-gap dynamics, measured by the change in average income levels across income-status groups, is another component of income distribution dynamics. The detailed trends of the subgroup average income levels are reported in Table A.3 in Appendix 1, showing that the subgroups categorized by each of the seven characteristics indeed form income-status groups. Every subgroup grew as the entire economy grew. There were no losing groups by absolute standard. However, overall, higher-income groups grew faster than the lower-income groups during the entire period, in particular, with respect to occupation. For example, the average income of professional workers grew at 5.8 percent per year while that of general worker grew at 3.0 percent during 1976-1996. These *divergent growth patterns* will tend to increase inequality.

During Stage 3 (1992-1996), however, we observe overtaking growth. The growth of higher-income groups slowed down while that of lower-income groups accelerated, except among age groups and gender groups. For example, the average income of professional worker grew only at 3.3 percent per year while that of general worker grew at 7.1 percent. This *catch-up growth* and hence *convergence* across income-status groups may explain the decrease in inequality during Stage 3.

B.4 Intra-group Dynamics

The remaining source of income distribution dynamics comes from *intra-group* distributional changes. Tables A.4 and A.5 in Appendix 1 report the levels of inequality and poverty, respectively, within each subgroup. Inequality increased and poverty was reduced for every subgroup as were for the whole economy. Table A.4 also suggests that there exists a rough inequality ordering across income-status groups: inequality levels are higher for higher-income groups than for lower-income groups, except among educational groups and community-type groups. Hence, the above population shifts from lower-income groups to higher-income groups may increase the overall inequality.

III Decomposition

In this section, we evaluate the quantitative contributions of the component dynamics to aggregate growth and income distribution dynamics from extensive decomposition analyses.

A Nonparametric Density Decomposition

Suppose that income distribution has changed between dates t and s, accompanied by a change in characteristics distribution from $p_t = (p_t^k)_{k=1}^K$ to $p_s = (p_s^k)_{k=1}^K$ and we would like to construct a counterfactual distribution that reflects only this compositional change. Recalling that the aggregate distribution of income y_t at date t can be decomposed into subgroup distributions such that

$$f(y_t, p_t, t) = \sum_{k=1}^{K} p_t^k f^k(y_t, t), \tag{7}$$

this can be done by replacing the p_t in (7) with p_s with maintaining the subgroup income distributions at date t such that

$$f(y_t, p_s, t) = \sum_{k=1}^{K} p_s^k f^k(y_t, t). \tag{8}$$

Only repeated cross-sectional data being available, we cannot switch the characteristic choice between dates maintaining income at individual level. However, we can rewrite the counterfactual density in (8) such that

$$f(y_t, p_s, t) = \sum_{k=1}^{K} p_t^k \left[\frac{p_s^k}{p_t^k}\right] f^k(y_t, t) \tag{9}$$

$$= \sum_{k=1}^{K} p_t^k [\rho_{s,t}^k f^k(y_t, t)] \tag{10}$$

$$= \sum_{k=1}^{K} \sum_{i=1}^{n_t} \frac{d_{it}^k}{n_t} [\rho_{s,t}^k f^k(y_t, t)], \tag{11}$$

where

$$\rho_{s,t}^k \equiv p_s^k / p_t^k, \ for\ k = 1, \cdots, K. \tag{12}$$

Note that the counterfactual density in (9) is now expressed with respect to the characteristic distribution and income distribution both at date t, with the income distribution at date t being *re-weighted* by $(\rho_{s,t}^k)_{k=1}^K$. Equation (11) suggests that this counterfactual density can be estimated applying the same nonparametric kernel method as we did for the actual distributions. Only difference here is that re-weighting factors need to be incorporated in the estimation. Let's denote the counterfactual density $f(y_t, p_s, t)$ by $f_{s,t}$. Then, the estimated density of $f_{s,t}$ at income level x is given by

$$\widehat{f}_{s,t}(x) = \sum_{k=1}^{K} \sum_{i=1}^{n_t} \frac{w_{it}}{h} d_{it}^k \rho_{s,t}^k K(\frac{x - y_{it}}{h}). \tag{13}$$

where $(y_{it})_{i=1}^{n_t}$ is the sampled income distribution, $(w_{it})_{i=1}^{n_t}$ the associated sampling weights, and $((d_{it}^k)_{k=1}^K)_{i=1}^{n_t}$ the characteristic choice vector at date t.[20] Comparison of the actual distribution with this counterfactual distribution allows us to infer the pure effect of compositional change in household characteristics on income distribution.

A.1 Numeric Decomposition

Having the counterfactual distribution in (13), we can numerically sort out the composition dynamics on income distribution using any distributional indices. Let $\vartheta\{f\}$ be *any* generic distributional index for distribution f, which can be mean, any inequality index, or any poverty index. Then, the total change of that distributional index $\vartheta\{f\}$ between dates t and s can be decomposed as follows:

$$\vartheta\{f_s\} - \vartheta\{f_t\} = [\vartheta\{f_s\} - \vartheta\{f_{s,t}\}] + [\vartheta\{f_{s,t}\} - \vartheta\{f_t\}], \tag{14}$$

where f_s and f_t denote the actual distributions at dates s and t, respectively, and $f_{s,t}$ the counterfactual distribution at date t with respect to date s characteristic distribution. The term $[\vartheta\{f_{s,t}\} - \vartheta\{f_t\}]$ in (14) represents the change in the distributional index solely due to compositional change in the concerning characteristic. Switching the reference date from t to s, decomposition formula would be

$$\vartheta\{f_s\} - \vartheta\{f_t\} = [\vartheta\{f_s\} - \vartheta\{f_{t,s}\}] + [\vartheta\{f_{t,s}\} - \vartheta\{f_t\}], \tag{15}$$

where now the term $[\vartheta\{f_s\} - \vartheta\{f_{t,s}\}]$ in (15) represents the composition effect.

Applying the decomposition formulae (14) and (15) to several distributional indices such as mean as a central tendency measure, Theil-L index, Theil-T index, and Gini coefficient as inequality measures, and the three FGT indices of head-count ratio P_0, poverty gap index P_1, and poverty severity index P_2 as poverty measures, Table 1 reports the percentage shares of the composition effects out of total change in these indices for each of the seven characteristics. We take the average of the two versions of composition effects in (14) and (15) as our composition effect.

Table 1 suggests that *occupation, financial participation, and education* are the three most important characteristics, which contributed to average income growth through compositional changes. Each of them accounts for 20 to 25 percent of average income growth. It turns out that they also have significant effects on distributional changes. Financial deepening and educational expansion account for 38 to 39 percent and 37 to 41 percent of total change in inequality, respectively, depending on indices. The occupational transformation does not contribute to change in inequality much but it does play the most important role in reducing poverty among other compositional changes, accounting for 20 to 23 percent of total poverty alleviation. The joint compositional change in all three characteristics accounts for 40 percent of average income growth, 53 to 57 percent of increase in inequality, and 29 to 33 percent of poverty reduction.

These results suggest that substantial parts of growth and income distribution dynamics are closely linked by composition dynamics with respect to occupation, financial participation, and education. They also suggest that significant part of the aggregate TFP growth from macro growth accounting may well be related to compositional changes with respect to these three characteristics. Even dropping educational expansion, which is used to be incorporated in macro growth accounting as human capital accumulation, joint compositional change only in financial participation and occupation accounts for 32 percent of total growth and also 32 percent of total inequality change in terms of Theil-L index.

The composition effect of industrialization contributed significantly to growth (16 percent) and poverty reduction (15 to 16 percent) but only little to inequality change (-3 to 2 percent). Thus, though industrialization was indeed a significant engine of growth, it did not play an important role in linking growth and inequality, different from Kuznets's (1955) own leading example. Migration between rural areas and urban areas did not contribute much both to growth and distributional changes either. Negligible are the composition dynamics via demographic transformation, which contrasts the findings of Mookherjee and Shorrocks (1982) and Lindert

(1986) that report the importance of compositional changes in age-groups in U.K. in explaining the changes in income inequality and wealth inequality, respectively.

A.2 Distributional Ordering

We may compare the entire shapes of distributions between actual and counterfactual ones using distributional ordering such as Lorenz ordering or poverty ordering without relying on specific distributional indices. Figure 5 compares the counterfactual density of 1976 income distribution applying 1996 distribution of occupation, financial participation, and education, estimated by kernel method in (13), with the actual ones in 1976 and 1996. Three vertical lines in Figure 5 represent the average income levels for the 1976 actual distribution, the 1976 counterfactual distribution, and the 1996 actual distribution, respectively from left to right, where the distance between the left two lines represents the average income growth due to the compositional changes. Figure 5 also shows that the income distribution was moved toward the right by the compositional changes. Comparison of Lorenz curves of the counterfactual and actual distributions in Figure 6 suggests that the 1976 actual distribution Lorenz dominates the 1976 counterfactual distribution. Comparison of cumulative distribution functions of the counterfactual and actual distributions in Figure 7 indicates the first-order stochastic dominance of 1976 counterfactual distribution over the 1976 actual distribution. That is, the composition effects on increase in inequality and poverty alleviation are robust to the choice of distributional indices and poverty line.

B Index Decomposition of Growth and Inequality Change

The nonparametric density decomposition sorts composition dynamics out without relying particular choice of numeric indices, but it does not decompose the rest of distributional change into two other components, i.e., income-gap dynamics and intra-group inequality dynamics. To perform this further decomposition, we use a particular inequality measure, Theil-L entropy index, which is shown, by Bourguignon (1979) and Shorrocks (1980), to be the unique inequality index that is consistent with population weighting among the subgroup-decomposable inequality indices.

Aggregate mean income μ_t at date t is additively decomposable into subgroup means μ_t^k's weighted by subgroup population shares p_t^k's such that

$$\mu_t = \sum_{k=1}^{K} p_t^k \mu_t^k.$$

Due to this additive nature of mean, average income growth is decomposed into two parts such that

$$\Delta\mu = \sum_{k=1}^{K} \overline{p^k} \Delta\mu^k + \sum_{k=1}^{K} \overline{\mu^k} \Delta p^k, \tag{16}$$

where Δ denotes the time difference operator and upper bar the time average operator between dates. This is simply a discrete version of chain rule. The first term in (16) captures the intra-group growth and the second term the growth due to compositional change in population.

Theil-L entropy index has similar property of additivity. It measures inequality of distribution $y_t = (y_{1t}, \cdots, y_{n_t t})$ at date t according to the following formula

$$I_t = \frac{1}{n_t} \sum_{i=1}^{n_t} \ln \frac{\mu_t}{y_{it}},$$

which can be re-written such that

$$I_t = \sum_{k=1}^{K} p_t^k \{I_t^k + \ln \frac{\mu_t}{\mu_t^k}\}, \tag{17}$$

where I_t^k denotes the inequality within subgroup k, measured by the same formula. Note that the subgroup decomposition for Theil-L index in (17) is compatible with that of density function in (6) but it further decomposes the subgroup distributions into *intra-group* inequality part $(I_t^k)_{k=1}^K$ and *inter-group* inequality part $(\ln \frac{\mu_t}{\mu_t^k})_{k=1}^K$ that is measured by the relative income gaps in log scale.

Then, the total inequality I_t is additively decomposed into two components, the *within-group inequality* WI_t and the *across-group inequality* AI_t such that

$$I_t = WI_t + AI_t, \tag{18}$$

$$WI_t = \sum_{k=1}^{K} p_t^k I_t^k, \quad \text{and} \quad AI_t = \sum_{k=1}^{K} p_t^k \ln \frac{\mu_t}{\mu_t^k}. \tag{19}$$

The within-group inequality WI is the sum of intra-group inequality levels while the across-group inequality AI is the sum of inter-group income gaps, both being weighted by population fractions of subgroups. Due to the additive nature of the Theil-L index, we can similarly apply the discrete chain rule to decompose the total change in inequality such that[21]

$$\Delta I = \Delta WI + \Delta AI, \tag{20}$$

$$\Delta WI = \sum_k \overline{p^k} \Delta I^k + \sum_k \overline{I^k} \Delta p^k, \tag{21}$$

$$\Delta AI = \sum_k \left[\frac{\overline{p^k \mu^k}}{\mu} - \overline{p^k} \right] \Delta \ln \mu^k + \sum_k \left[\frac{\overline{\mu^k}}{\mu} - \overline{\ln \frac{\mu^k}{\mu}} \right] \Delta p^k. \tag{22}$$

Now the term $\sum_k \overline{p^k} \Delta I^k$ in (21) captures the intra-group inequality dynamics while the term $\sum_k \left[\frac{\overline{p^k \mu^k}}{\mu} - \overline{p^k} \right] \Delta \ln \mu^k$ in (22) captures income-gap dynamics. Interpreting the latter term as income-gap dynamics becomes clear noting that $\Delta \ln \mu^k$ approximates the income growth rate of subgroup k. Composition dynamics work through both routes of changes in WI and AI, i.e., through the term $\sum_k \overline{I^k} \Delta p^k$ in (21) and the term $\sum_k \left[\frac{\overline{\mu^k}}{\mu} - \overline{\ln \frac{\mu^k}{\mu}} \right] \Delta p^k$ in

(22) since both WI and AI are weighted by the population fractions of subgroups. The composition dynamics via AI are in fact the source of inequality dynamics through which Kuznets derived his own inverted-U curve from numerical experiments using hypothetical data.[22]

B.1 Average Income Growth

Table 2 reports the contribution shares of compositional growth out of total income growth for overall period as well as for three sub-periods, using the formula in (16). The growth rates are included at the bottom row. The three most important characteristics are occupation, financial participation, and education as were already identified. The joint compositional change in these characteristics accounts for 39 percent of total growth for overall period, 38 percent both for Stages 2 and 3, and remarkable 66 percent for Stage 1. In other words, the average income grew at the rate of approximately 2 percent each year purely due to the compositional changes in occupation, financial participation, and education for two decades. The single most important characteristic for compositional growth varies depending on period, education (45 percent) in Stage 1, financial participation (27 percent) in Stage 2, and occupation (30 percent) in Stage 3.

B.2 Income Inequality Change

Applying the decomposition formulae (21) and (22), Table 3 reports the contribution shares of components of inequality dynamics out of total inequality change. Each sub-table in Table 3, Table 3.1 to Table 3.4, reports the decomposition results for each different period.

Table 3 indicates that the composition dynamics work mainly via across-group inequality rather than via within-group inequality for every period. Thus, inequality changes due to compositional changes are mostly related to re-weighting the inter-group income-gaps. It also suggests that the three most important characteristics for compositional growth also played important roles in changing inequality, not only for the overall period but also for every sub-period. Again negligible are the composition effects on inequality through changes in demographic factors of age and gender. Compositional changes in structural factors such as industrialization and migration had non-negligible effects on inequality but the effects were much small compared with those of financial deepening and educational expansion. For overall period, joint compositional change of the three most important characteristics accounts for 53 percent of total inequality change. In particular, the expansion of financial intermediation or education alone accounts for 39 or 40 percent of total inequality change but occupational transformation alone accounts for only 9 percent. The single most important characteristic in terms of composition dynamics varies over sub-periods: education (22 percent) for Stage 1, financial participation (48 percent) for Stage 2, and occupation (11 percent) for Stage 3. Note that the compositional changes of all three characteristics contributed to increasing inequality before 1992. However, after 1992, the turning point of the

Thai inequality, occupational transformation, though small, *reduced* inequality while the expansion of financial intermediation and education continued to contribute to increasing inequality.

The effect of income-gap dynamics is the most salient through occupation, not only for the overall period (32 percent) but also *both* for the inequality-increasing periods (46 percent in Stage 1 and 54 percent in Stage 2) and the inequality-decreasing period (85 percent in Stage 3). The importance of occupational income-gap dynamics, which we may interpret as rise and fall in occupational skill premia, in explaining inequality change was also found by Juhn, Murphy, and Pierce (1993) for the United States though they consider wage inequality rather than income inequality. The effects of changes in income premia across financial-participation and education groups are tiny at 2 percent and 5 percent, respectively, out of total change in inequality for the overall period. In Stage 3, the inequality-decreasing period, the income-gap effects dominate the composition effects. In fact, *99 percent* of the decrease in inequality in Stage 3 is due to this *convergence* in income levels across income-status groups jointly categorized by occupation, financial participation, and education. Thus, the down-turn of the aggregate income inequality in Thailand is mostly due to the income-gap dynamics.

The intra-group inequality change accounts for only 28 percent of total inequality change for the overall period and negligible fractions for both high-growth periods, 2 percent for Stage 2 and -4 percent for Stage 3, with respect to the joint category by the three characteristics. Thus, major part of the inequality dynamics is accounted for by composition dynamics and income-gap dynamics via the above three self-selective characteristics.

C Index Decomposition of Poverty Change

Poverty is another distributional aspect, which is affected both by growth and inequality. Holding the inequality level constant, growth tends to alleviate poverty while holding the average income constant, increasing inequality worsens poverty. Thus, for a growing economy with increasing inequality, both effects counteract each other on poverty change. Here, we decompose the total poverty change into growth effect and inequality effect at aggregate level. Note that compositional change is the common factor that affects both growth and inequality. Thus, the effects of composition dynamics on poverty can be considered as being induced by the direct link between growth and inequality. We sort out these effects via two different channels, growth or inequality change, separately.

C.1 Aggregate Effects of Growth and Inequality

For the decomposition of poverty change into growth and inequality components at aggregate level, we adopt the method suggested by Datt and Ravallion (1992) who parameterized the FGT poverty indices with respect to average income and elliptical Lorenz curve such that

$$P = P(\frac{z}{\mu}, L),$$

where z denotes poverty line, μ average income, and L parameters of elliptical form of Lorenz curve suggested by Villasenor and Arnold (1989). Details of this parameterization are explained in Appendix 2. Then, total poverty change ΔP between dates t and s into growth component G, inequality component D, and residual term such that

$$\Delta P = G + D + residual, \tag{23}$$

$$G = \left[P(\frac{z}{\mu_s}, L_t) - P(\frac{z}{\mu_t}, L_t) \right], \tag{24}$$

$$D = \left[P(\frac{z}{\mu_t}, L_s) - P(\frac{z}{\mu_t}, L_t) \right], \tag{25}$$

where the growth component G is obtained by changing only the average income holding the Lorenz curve parameters constant while the inequality component D is obtained by changing only the Lorenz curve parameters holding average income constant.

Using head-count ratio as poverty measure and \$2 a day per person in 1985 dollar as poverty line, the total amount of poverty change per year is decomposed into growth and inequality effects in Table 4. The parameter estimates of the elliptical Lorenz curve for Thailand are reported in Appendix 2. The difference between the sum of growth and inequality effects and the total poverty change corresponds to the residual term. Table 4 suggests that growth reduced the fraction of poor Thai households by 2.28 percent each year, but the increase in inequality raised poverty by 0.36 percent each year. Thus, growth effect dominates the inequality effect in aggregate poverty change. Combining these two effects together with the residual term, overall poverty declined by 1.71 percent each year. The amount of poverty reduction increased from 0.37 percent in Stage 1 to 2.9 percent in Stage 2 and even larger to 3.27 percent in Stage 3, which are mainly due to the growth effects on poverty reduction, 1.28 percent, 3.82 percent, and 2.72 percent, respectively for each Stage. In particular in Stage 3, due to the decrease in inequality, even the inequality effect contributed to poverty alleviation by 0.89 percent.

C.2 Composition Effects

To separate the composition effect, common source of growth and inequality change, from the aggregate effects of G and D, we again need to construct counterfactual distributions as follows. Basic idea is the same as the construction of counterfactual distributions from nonparametric density estimation but now the counterfactual distributions are estimated in terms of parametric Lorenz curve by applying *weighted least square method* using the re-weighting factors in (12) as the *weights*.

Let L_t^* be the parameter estimates of counterfactual Lorenz curve and μ_t^* be the counterfactual mean income at date t using the income distribution at date t but applying the date s characteristic distribution. Then, G and D can be further decomposed such that

$$G = \left[P(\frac{z}{\mu_s}, L_t) - P(\frac{z}{\mu_t^*}, L_t)\right] + \left[P(\frac{z}{\mu_t^*}, L_t) - P(\frac{z}{\mu_t}, L_t)\right], \tag{26}$$

$$D = \left[P(\frac{z}{\mu_t}, L_s) - P(\frac{z}{\mu_t}, L_t^*)\right] + \left[P(\frac{z}{\mu_t}, L_t^*) - P(\frac{z}{\mu_t}, L_t)\right]. \tag{27}$$

The term $\left[P(\frac{z}{\mu_t^*}, L_t) - P(\frac{z}{\mu_t}, L_t)\right]$ in (26) represents the composition effect on poverty change via growth while the term $\left[P(\frac{z}{\mu_s}, L_t^*) - P(\frac{z}{\mu_t}, L_t)\right]$ in (27) represents the composition effect on poverty change via inequality change.

Here, we sort out the effects of compositional changes of the three most important characteristics linking growth with inequality, namely, occupation, financial participation, and education. Table 5 reports the shares of composition effects out of the total poverty change through growth or inequality change: each sub-table, Table 5.1 to Table 5.4, reports the shares of composition effects for overall and each of three sub-periods. The dominance of growth effect over inequality effect is also observed for the composition effects for every period. During the overall period, 62 percent of total poverty reduction was due to the growth from the compositional change in the three characteristics while poverty *increased* by 12 percent via inequality increase from the same compositional change. The net composition effect, including the effect on residual terms, accounts for 39 percent of total poverty reduction for overall period, 33 percent for both Stages 2 and 3, and remarkable 92 percent for Stage 1. Thus, composition dynamics played an important role in changing the Thai poverty as well.

Focusing on each single characteristic, we find that occupational transformation was the most significant composition dynamics in reducing poverty in all periods. In particular, occupational transformation alone accounts for the 73 percent of poverty reduction in Stage 1. In Stages 2 and 3, occupational transformation reduced poverty *even via inequality effect*, though small portion, while the inequality effects of financial deepening and educational expansion continued to contribute to increasing poverty. Over the entire two decades, 29 percent of poverty reduction came from occupational transformation alone while financial deepening and educational expansion contributed to poverty reduction by 14 and 18 percents, respectively.

D Shapes of Component Dynamics

Multiplying the total change in inequality by the contribution share of each component dynamics from the decomposition tables, the inequality change due to each component dynamics can be calculated for each sub-period. By connecting the due inequality levels over periods, we construct the path of inequality solely due to each component dynamics. This way the aggregate inequality dynamics are decomposed into three component dynamics, i.e., composition dynamics, income-gap dynamics, and intra-group inequality dynamics in Figure 8, which has four panels, Figure 8.1 to Figure 8.4, according to different categorization by occupation, financial participation, education, and joint three characteristics, respectively. Note that the paths are drawn on *average income level* not on time so that the shapes of component inequality dynamics *along growth* can be inferred.

The shapes of components of inequality dynamics look different over characteristics. Inequality due to composition dynamics from financial deepening or educational expansion is monotonically increasing while that from occupational transformation is moderately inverted-U shaped. The differential income levels across income-status groups were first widened as the Thai economy developed but they began to converge due to the catch-up growth of lower-income groups after some critical level of development, which generates the inverted-U shaped income-gap dynamics. This divergence-convergence income-gap dynamics took place for every characteristic. However, the effect is the most salient across occupation groups, which indicates an importance of the rise and fall in occupational skill premia for inequality dynamics. Inequality was increased by the overall occupational income-gap dynamics. However, the increase in inequality due to the initial divergence across financial-participation or education groups was virtually offset by the subsequent convergence effect and the overall change in income premia across financial-participation or education groups did not change the aggregate inequality much.

Categorizing the population by a single characteristic, intra-group inequality dynamics seem to play an important role in shaping the aggregate inequality. However, with the joint categorization by all three characteristics, we observe *flat intra-group inequality dynamics* except the initial increase, which suggests that, taking the heterogeneity in population into consideration well enough, the driving forces of the aggregate inequality change are the growth-related components of inequality dynamics, i.e., composition dynamics and income-gap dynamics, except at the very initial stage of development. In particular, composition dynamics were the main forces of increase in inequality while income-gap dynamics shaped the inequality dynamics as inverted-U. It is interesting to note that the down-turn of inequality came earlier and with larger order of magnitude via income-gap dynamics rather than via composition dynamics in Thailand, differently from what Kuznets (1955) postulated his own inverted-U curve via composition dynamics.

Similarly, the aggregate poverty trend is decomposed into two parts: a part due to compositional change and a part due to intra-group poverty change, which are displayed in Figure 9. In contrast to inequality dynamics, both components of poverty dynamics are monotonically decreasing along growth for every categorization. The poverty reduction was mostly driven by the compositional change at initial stage of development. In particular, with the joint category by the three characteristics, almost all the initial poverty reduction was due to the compositional change. However, as the economy further developed, intra-group poverty change became the major factor of poverty reduction though the composition effect was still significant for poverty alleviation.

IV Conclusion

Applying comprehensive decomposition analysis to the micro data from Thailand, this paper shows that crucial channels linking income distribution dynamics with growth are three self-selective characteristics: occupation, participation in formal financial sector, and education. The compositional change in these characteristics among the Thai population accounts for 39 percent of average income growth as well as of poverty alleviation, and remarkable 53 percent of increase in inequality in Thailand. Changes in demographic composition of age and gender or structural transformation of urbanization and industrialization turn out to be either negligible or less important. The orders of magnitudes of the compositional effects on growth are similar over the three characteristics but their effects on income distribution dynamics sharply contrast. It was the expansion of financial intermediation and education that mainly contributed to inequality increase while occupational transformation mainly contributed to poverty reduction. The major factor that shapes the inequality dynamics to be inverted-U was the income-gap dynamics, in particular the divergence-convergence in income levels across occupation groups, rather than the composition dynamics.

The central theme of Kuznets (1955) was to study the factors determining the secular level and trend of income inequality in the course of a country's economic growth. His initial puzzle was the down-turn or constancy of income inequality among then developed countries, given the apparent *growth-related inequality-increasing forces* such as cumulative effects of savings concentrated in the upper-income bracket. Various factors were discussed as potential counteracting forces, including population shift across income-status groups. He illustrated the well-known inverted-U shaped inequality path in the course of economic growth, the so called "Kuznets curve," via intersectoral population shift. The essential message of Kuznets is, however, that the "long swing in income inequality must be viewed as part of a wider process of economic growth," rather than the inverted-U curve itself. He concluded his seminal paper by saying "This paper is perhaps 5 per cent empirical information and 95 per cent speculation," calling for a more "adequate knowledge and a more cogent view of the whole field."

This paper attempted to provide a more adequate knowledge that he called for, clarifying his speculation by applying comprehensive decomposition analysis to the micro data from Thailand. Our results indicate that growth and income distribution dynamics are intimately related to each other. *Seventy-two percent* of total inequality change in Thailand is accounted for by the two growth-related dynamics, composition dynamics (53 percent) and income-gap dynamics (19 percent), when we categorize income-status groups by the above three characteristics. In particular, intra-group inequality rises only at the very initial stage of development and then stays constant and the two growth-related inequality dynamics explain virtually all the inequality change after the Thai economy entered into high-growth era. Thus, the long swing in income inequality can in fact be viewed as part of wider process of economic growth as Kuznets speculated. However, the relevant links seem different from what Kuznets had in mind. The composition dynamics were effective through *self-selective* characteristics such as occupation, participation in formal financial sector, and education rather than through structural characteristics such as dual production sector. Also it was the income-gap dynamics, in particular across occupation groups, rather than the composition dynamics that shaped the inequality dynamics to be inverted-U.

To obtain "a more cogent view of the whole field," we need further studies of the structural relationships guided by theories. In particular, for an economy where growth and inequality are interwound, we may well consider the models that are explicit in specifying the incentives and constraints so that we can better understand the interaction between composition dynamics and income-gap dynamics in some key characteristics.[23] This paper aimed to identify the "key characteristics" that the data suggest so that it may lay a cornerstone on the further studies attempting to provide the cogent view on growth and inequality.

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Notes

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[1]For example, the inverted-U relationship between levels of inequality and development in Ahluwalia (1976) becomes upright-U in Fields and Jakubson (1994) and the harmful effect of inequality on subsequent growth in Alesina and Rodrik (1994) turns into a beneficial one in Forbes (2000) when the country-specific fixed effects are explicitly taken into account. A fundamental assumption underlying these cross-sectional studies is that the relationship is homogeneous across countries in all respects other than control variables and random residuals. Thus, this non-robustness is related to the difficulty of controlling *country-specific fixed effects*. However, it is still not obvious that these linear-model treatments of fixed effects help in identifying the underlying relationship when the dynamics of growth and inequality are in fact *non-linear* as Banerjee and Duflo (2000) emphasize. Even if we had a complete solution for the fixed effect problem in nonlinear models, the international interdependency in development process, pointed out by Saith (1983), brings another problem of *spatial cum serial correlation* in random residuals of these regressions.

[2]Kuznets (1954) originally called for this alternative for studying the relationship between growth and inequality as necessary by saying that "for countries distinguished by their size, historical heritage, and the timing of their industrialization process—we obviously need a variety of national studies.··· The alternative shortcuts prevalent to date—of cross-country comparisons and of studies of population, economic, and social change, each in isolation—have been helpful as suggesting leads but are far from an adequate guide either to testable analytical conclusions or to formulation of long-term policy."

[3]For example, the time series relationship between growth and inequality at aggregate level is inverted-U for Columbia, upright-U for Taiwan, and of no particular pattern for a number of Asian countries. Fields (2001) provides a review of existing empirical evidence from both cross-country and time-series regressions at aggregate levels.

[4]The representative studies include Young (1995) who uses primal approach on quantity data and Hsieh (2000) who uses dual approach on factor market price data, both accounting for the East Asian growth.

[5]Indeed, Young (1995) mentions the importance of the sectoral shift of labor force from agriculture to non-agriculture for the East Asian growth though he did not further pursue the growth accounting in terms of the compositional changes in population. Caselli and Coleman (1999) discuss the importance of this sectoral shift not only for the growth but also for the regional convergence in U.S.

[6]Bourguignon, Ferreira, and Lustig (1998) provide an alternative way of studying the determinants of income distribution dynamics using micro data though they do not relate them to growth aspects. After running regressions with coefficients and residual distribution to vary over time, the effects of changes in income premia associated with the corresponding regressor or the effect of change in the distribution of unobservable characteristics are isolated by switching the regression coefficients or residual distributions between dates. This method can capture a more variety of income-gap dynamics than the direct decomposition method in this paper but it cannot address composition dynamics as explicit as in this paper. Thus, both

methods are complementary. Bidani and Jeong (2001) applies this regression-based method to Thailand.

[7] The importance of rise in occupational skill premia in explaining inequality change was also found by Juhn, Murphy, and Pierce (1993) for the United States though they consider wage inequality rather than income inequality.

[8] Household, is defined as a group of persons who make common provision for food and other living essentials with the general criteria for membership of common housekeeping arrangements, sharing of principal meals, common financial arrangements for supplying basic living essentials, and recognition of one member as head.

[9] Response rates are usually less than 80 percent in case of nationally representative household surveys. For example, the response rate of the 1994-1995 U.K. Family Expenditure Survey was 67 percent and the response rates of the U.S. General Social Survey vary betwen 75 to 80 percent.

[10] The adult-male equivalence scales are: 1 for male over age 18; 0.9 for female over 18; 0.94 for male between 13 and 18; 0.83 for female between 13 and 18; 0.67 for both sexes between 7 and 12; 0.52 for both sexes between 4 and 6; 0.32 for both sexes between 1 and 3; 0.05 for both sexes less than a year old. Though the *level* of inequality at a given date varies depending on the specific choice of scales, the features of *change* in inequality does not. It turns out that the following decomposition results are robust to various measurement of income.

[11] There are three sub-categories of farmer: small farmer, big farmer, and other farmer. Small farmers include the farm operators owning less than 40 rai of land (a rai corresponds to 0.4 acre) and all farmers renting land. Other farming activities include fishing, shrimp farming, forestry, and vegetable farming. There are three types of non-farm entrepreneur: non-farm self-employed, non-farm employer, and own-account professional. There are five types of wageworkers according to skill level and working sector: farm worker, general worker, production worker, service worker, and professional worker. Professional workers include technical workers and employed managers. The inactive group consists of rentiers living on property income and the assisted living on transfer income. In sum, there are thirteen occupation categories.

[12] Sanitary district is an area in planned transition from rural area to urban area.

[13] The SES data record the changes in household assets and liabilities with various formal financial institutions, from which we can identify whether a household made transactions with these financial institutions.

[14] The national income account data show a little higher growth rate of real GNP per capita at annual average rate of 5.7 percent. Applying the Purchasing Power Parity (PPP) of 8.2 baht in 1985 dollars from the Penn World Tables in Summers and Heston (1991), this implies that the annual per capita income increased by 2.7 times from \$1,210 to \$3,210 in 1985 dollars during two decades.

[15] The regional average income Gini coefficients are from Deininger and Squire (1996).

[16] For the kernel function, the Epanechinikov kernel is used such that

$$\begin{aligned} K(z) &= 0.75(1-z^2), \quad if \quad |z| \leq 1 \\ &= 0, \qquad\qquad\quad if \quad |z| > 1. \end{aligned}$$

For the bandwidth choice, we follow the suggestion of Silverman (1986), namely

$$h = 2.34 \min(\sigma, 0.75IQR)n^{-1/5},$$

where σ is the standard deviation and IQR the interquartile range of income distribution.

[17]The distribution functions are displayed up to the income level of 4000 baht to take a closer look at the lower ends, which is important for poverty ordering. They do not cross either at the whole range over 4000 baht.

[18]Here, we use $2 a day in 1985 dollar as a poverty line, which corresponds to 536 baht per month in 1990 baht value, after adjusting inflation, applying the Purchasing Power Parity (PPP) of 8.2 baht in 1985 dollars from the Penn World Tables in Summers and Heston (1991). Note that this poverty line is per capita, but we use equivalent income. Thus, different poverty lines apply to households with different demographic structures.

[19]Jeong (2000) shows that educational attainment of secondary or higher level is significantly related to household wealth, suggesting the possibility of wealth constraint as a source of this bottleneck.

[20]DiNardo, Fortin, and Lemieux (1996) applied similar decomposition method to study the compositional change in labor union participation for the U.S. wage inequality. They run probit model to get the re-weighting factors conditional on some covariates. Here, we simply take the ratios of unconditional population fractions of subgroups between dates in obtaining the re-weighting factors, which is sufficient for our decomposition purpose.

[21]The first application of this decomposition is done by Mookherjee and Shorrocks (1982). The decomposition of the across-group inequality change involves an approximation due to the logarithm. The approximation error in our decomposition results turns out to be negligible, less than 1 percent of total change.

[22]The mechanics of this inverted-U shaped inequality dynamics from population shifts across income-status groups was noticed earlier by Robinson (1976) and later by Anand and Kanbur (1993). Derivation of the inverted-U shaped inequality dynamics in terms of Theil-L index is available from the author upon request.

[23]Jeong and Townsend (2002) attempt to provide an initiative to this line of research by evaluating the models of growth and inequality from structural estimation and simulation.

Appendix 1. Data Tables

Table A.1. SES Summary Statiscs for Equivalent Income in Thailand (1990 Baht)

Year	1976	1981	1986	1988	1990	1992	1994	1996	1976-1996 [1]
Total (In Billion)	43	63	66	78	96	120	134	160	6.7%
Central Tendency									
Mean	1009	1317	1227	1418	1693	2033	2225	2659	5.0%
Median	709	884	745	859	981	1113	1270	1584	4.1%
Inequality									
Interquartile Ratio	1.01	1.12	1.30	1.31	1.31	1.38	1.38	1.36	1.5%
Theil-L Index	0.292	0.330	0.408	0.402	0.451	0.496	0.470	0.437	2.0%
Theil-T Index	0.340	0.373	0.461	0.441	0.564	0.603	0.559	0.504	2.0%
Gini Coefficient	0.418	0.443	0.489	0.486	0.512	0.535	0.521	0.503	0.9%
Coefficient of Variation	1.191	1.195	1.339	1.266	1.906	1.960	1.757	1.588	1.5%
Atkinson Index (e=1)	0.253	0.281	0.335	0.331	0.363	0.391	0.375	0.354	1.7%
Polarization	0.374	0.413	0.480	0.487	0.485	0.518	0.512	0.499	1.4%
Poverty									
Head-count Ratio (P_0)	0.483	0.359	0.446	0.365	0.307	0.256	0.205	0.130	-6.4%
Poverty Gap (P_1)	0.175	0.119	0.170	0.127	0.100	0.079	0.061	0.034	-7.8%
Poverty Severity (P_2)	0.083	0.054	0.085	0.060	0.044	0.034	0.026	0.013	-8.7%
Sample Size	11356	11880	10895	11044	13174	13458	25208	25110	

Note 1. Annual average rate of change between 1976 and 1996 of each summary statistic

Table A.2. Composition of Income-Status Groups (%)

Year	1976	1981	1986	1988	1990	1992	1994	1996	76-96 [1]	76-86 [2]	86-92 [2]	92-96 [2]
Age												
30 or less	17.3	21.6	21.0	20.2	20.0	20.1	20.7	20.3	3.0	0.37	-0.14	0.04
31 - 40	27.9	27.2	29.3	30.6	30.3	30.0	30.8	31.1	3.1	0.13	0.13	0.26
41 - 50	30.3	27.0	25.0	24.1	23.5	24.0	23.4	23.9	-6.3	-0.53	-0.17	-0.01
51 - 60	16.5	16.4	17.1	16.8	17.4	16.6	15.9	15.3	-1.2	0.06	-0.07	-0.34
61 or more	8.0	7.8	7.7	8.4	8.7	9.3	9.2	9.4	1.4	-0.03	0.26	0.05
Gender												
Male	84.9	81.4	80.5	78.7	79.6	79.1	75.1	74.4	-10.5	-0.44	-0.23	-1.17
Female	15.1	18.6	19.5	21.3	20.4	20.9	24.9	25.6	10.5	0.44	0.23	1.17
Community Type												
Urban	14.8	18.0	17.5	18.8	19.9	18.8	19.4	20.6	5.8	0.27	0.21	0.46
Sanitary District	12.7	11.7	12.0	9.2	9.1	9.6	10.6	10.4	-2.4	-0.07	-0.41	0.19
Rural	72.5	70.3	70.5	72.0	71.0	71.6	70.0	69.0	-3.5	-0.20	0.20	-0.65
Production Sector												
Agriculture	65.3	61.0	60.1	58.4	56.9	53.5	48.2	46.1	-19.2	-0.52	-1.11	-1.83
Mining	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.00	-0.01	0.01
Manufacture	4.6	6.8	6.6	6.6	7.9	7.7	9.6	9.5	4.9	0.20	0.18	0.47
Electricity, Gas & Water	0.3	0.3	0.3	0.6	0.6	0.5	0.5	0.5	0.2	0.00	0.03	0.01
Construction	1.9	3.3	2.8	3.3	3.8	4.4	5.6	6.7	4.8	0.09	0.28	0.56
Trade & Commerce	9.9	10.6	11.2	11.1	10.7	11.6	12.6	13.2	3.3	0.13	0.06	0.40
Transport & Communication	2.5	3.0	2.9	3.0	3.4	3.0	3.4	3.4	0.9	0.04	0.01	0.11
Service	11.9	12.3	12.6	13.3	13.4	15.4	15.5	15.6	3.7	0.07	0.46	0.06
Inactive	1.3	2.5	3.3	3.7	3.2	3.9	4.5	4.7	3.4	0.20	0.10	0.21
Occupation												
Small Farmer	46.1	45.8	39.4	38.6	36.9	34.8	27.9	26.2	-19.9	-0.67	-0.77	-2.16
Fisher & Other Farmer	2.0	1.7	1.3	1.2	0.9	0.7	0.9	0.7	-1.3	-0.08	-0.10	0.01
Big Farmer	7.6	6.7	7.1	5.0	5.4	4.8	3.0	3.0	-4.6	-0.05	-0.40	-0.43
Non-farm Self-employed	13.2	11.3	11.4	11.4	11.3	11.4	12.5	13.3	0.1	-0.18	-0.01	0.48
Non-farm Employer	1.4	2.6	2.5	2.6	2.6	3.1	3.2	3.5	2.1	0.10	0.11	0.10
Own-account Professional	0.1	0.1	0.1	0.0	0.1	0.2	0.3	0.2	0.0	0.00	0.01	-0.01
Farm Worker	4.7	5.7	6.6	6.8	6.2	6.0	6.3	5.5	0.8	0.19	-0.10	-0.12
General Worker	5.0	1.6	3.9	3.8	3.8	3.9	3.7	3.0	-2.0	-0.11	0.00	-0.24
Production Worker	5.9	7.7	8.7	8.5	10.4	11.3	14.1	15.5	9.6	0.28	0.42	1.06
Service Worker	7.4	7.9	8.3	9.7	10.7	11.1	12.3	12.8	5.4	0.10	0.47	0.40
Professional Worker	3.7	4.4	4.6	5.3	5.0	5.2	5.8	6.2	2.5	0.09	0.10	0.25
Assisted	2.2	3.6	5.3	6.3	6.0	6.5	9.4	9.4	7.1	0.31	0.20	0.72
Rentier	0.5	1.0	0.7	0.8	0.8	0.9	0.7	0.7	0.2	0.02	0.05	-0.05
Financial Participation												
Non-participant	93.5	89.8	89.3	84.7	80.4	78.1	75.5	73.4	-20.1	-0.41	-1.86	-1.19
Participant	6.5	10.2	10.7	15.3	19.6	21.9	24.5	26.6	20.1	0.41	1.86	1.19
Education												
No Formal	18.3	12.5	8.6	7.6	7.1	6.9	6.2	5.6	-12.7	-0.97	-0.27	-0.34
Primary	73.1	76.1	78.6	77.4	76.4	74.9	73.2	71.8	-1.3	0.55	-0.63	-0.78
Secondary	5.4	6.3	6.1	6.9	8.3	8.9	10.3	11.4	6.0	0.07	0.47	0.63
Vocational	2.2	3.6	4.0	4.5	4.2	4.6	5.0	5.3	3.1	0.18	0.09	0.18
University or Higher	1.1	1.5	2.7	3.6	4.0	4.8	5.3	6.0	4.9	0.17	0.34	0.31

Note 1. Total change in population fraction between 1976 and 1996

Note 2. Annual average change in population fraction for corresponding periods

Table A.3. Average Income Profile (1990 Baht)

Year	1976	1981	1986	1988	1990	1992	1994	1996	76-96 [1]	76-86 [1]	86-92 [1]	92-96 [1]
Age												
30 or less	1136	1424	1295	1419	1665	1981	2165	2550	4.1	1.3	7.3	6.5
31 - 40	1023	1313	1279	1501	1726	2160	2277	2711	5.0	2.3	9.1	5.8
41 - 50	945	1183	1167	1337	1680	2117	2387	2767	5.5	2.1	10.4	6.9
51 - 60	994	1386	1179	1415	1736	1959	2216	2855	5.4	1.7	8.8	9.9
61 or more	958	1361	1148	1347	1593	1648	1780	2127	4.1	1.8	6.2	6.6
Gender												
Male	989	1258	1156	1360	1625	1936	2132	2505	4.8	1.6	9.0	6.7
Female	1124	1580	1519	1633	1958	2400	2503	3105	5.2	3.1	7.9	6.6
Community Type												
Urban	1900	2561	2682	2954	3492	4776	4629	5410	5.4	3.5	10.1	3.2
Sanitary District	1289	1388	1332	1580	1781	2339	2509	2888	4.1	0.3	9.8	5.4
Rural	778	987	848	996	1179	1273	1515	1803	4.3	0.9	7.0	9.1
Production Sector												
Agriculture	716	878	727	854	1022	1010	1157	1442	3.6	0.1	5.6	9.3
Mining	1438	1324	1476	2857	3354	2272	2475	4509	5.9	0.3	7.5	18.7
Manufacture	1513	1787	1827	2037	2249	2793	2892	3465	4.2	1.9	7.3	5.5
Electricity, Gas & Water	1858	3038	2165	4014	4236	5977	5655	5791	5.8	1.5	18.4	-0.8
Construction	1193	1356	1436	1339	2216	2293	1898	2425	3.6	1.9	8.1	1.4
Trade & Commerce	1749	2165	2050	2312	2748	3614	3515	3854	4.0	1.6	9.9	1.6
Transport & Communication	1452	1771	1839	1988	2405	3177	3028	3492	4.5	2.4	9.5	2.4
Service	1543	2152	2169	2422	2772	3414	3815	4471	5.5	3.5	7.9	7.0
Inactive	1220	2233	1933	2086	2273	2746	2585	2910	4.4	4.7	6.0	1.5
Occupation												
Small Farmer	637	799	649	749	844	911	1069	1309	3.7	0.2	5.8	9.5
Fisher & Other Farmer	875	1221	798	1305	1472	1982	2833	2370	5.1	-0.9	16.4	4.6
Big Farmer	1090	1361	1064	1425	2037	1546	1743	2379	4.0	-0.2	6.4	11.4
Non-farm Self-employed	1421	1645	1485	1654	1956	2244	2391	2961	3.7	0.4	7.1	7.2
Non-farm Employer	3422	3629	3525	3637	5647	6223	6607	6979	3.6	0.3	9.9	2.9
Own-account Professional	2536	2108	2455	7427	2843	13517	10851	7257	5.4	-0.3	32.9	-14.4
Farm Worker	715	748	616	676	753	833	942	1147	2.4	-1.5	5.2	8.3
General Worker	766	893	720	685	800	1056	1117	1391	3.0	-0.6	6.6	7.1
Production Worker	1217	1470	1388	1532	1674	1957	1787	2078	2.7	1.3	5.9	1.5
Service Worker	1521	2055	2122	2244	2498	3115	3231	3711	4.6	3.4	6.6	4.5
Professional Worker	2245	3082	3389	3837	4557	6127	6008	6964	5.8	4.2	10.4	3.3
Assisted	1233	1917	1645	1842	1796	2050	1942	2299	3.2	2.9	3.7	2.9
Rentier	1372	2238	2311	2125	4504	4301	4250	3774	5.2	5.3	10.9	-3.2
Financial Participation												
Non-participant	943	1189	1079	1209	1296	1490	1678	2043	3.9	1.4	5.5	8.2
Participant	1956	2446	2464	2575	3327	3973	3912	4357	4.1	2.3	8.3	2.3
Education												
No Formal	851	1111	890	994	1063	1153	1187	1420	2.6	0.4	4.4	5.3
Primary	908	1131	982	1116	1297	1445	1604	1945	3.9	0.8	6.6	7.7
Secondary	1861	2312	2253	2445	2970	3239	3369	3604	3.4	1.9	6.2	2.7
Vocational	2261	2825	3030	3268	3971	4614	4768	5209	4.3	3.0	7.3	3.1
University or Higher	3753	4802	4402	4525	5366	7816	7398	8299	4.0	1.6	10.0	1.5

Note 1. Annual average growth rate of mean income for corresponding periods

Table A.4. Inequality Profile by Theil-L Index

Year	1976	1981	1986	1988	1990	1992	1994	1996	76-96 [1]	76-86 [2]	86-92 [2]	92-96 [2]
Age												
30 or less	0.262	0.314	0.354	0.332	0.378	0.392	0.368	0.361	9.9	0.91	0.64	-0.77
31 - 40	0.303	0.344	0.414	0.438	0.451	0.521	0.476	0.451	14.8	1.11	1.79	-1.75
41 - 50	0.295	0.312	0.421	0.414	0.466	0.539	0.535	0.451	15.5	1.26	1.97	-2.22
51 - 60	0.299	0.344	0.446	0.402	0.511	0.500	0.518	0.496	19.7	1.47	0.90	-0.10
61 or more	0.262	0.331	0.390	0.391	0.458	0.490	0.398	0.390	12.8	1.28	1.67	-2.50
Gender												
Male	0.291	0.318	0.398	0.400	0.451	0.498	0.482	0.431	14.0	1.07	1.67	-1.69
Female	0.292	0.362	0.417	0.395	0.437	0.469	0.425	0.438	14.6	1.25	0.88	-0.79
Community Type												
Urban	0.244	0.256	0.276	0.284	0.357	0.387	0.321	0.307	6.4	0.32	1.86	-2.00
Sanitary District	0.259	0.266	0.356	0.319	0.360	0.388	0.408	0.387	12.7	0.97	0.53	-0.04
Rural	0.220	0.250	0.288	0.295	0.336	0.314	0.358	0.319	10.0	0.68	0.43	0.14
Production Sector												
Agriculture	0.196	0.220	0.246	0.262	0.316	0.259	0.291	0.300	10.4	0.50	0.21	1.02
Mining	0.251	0.220	0.163	0.714	0.364	0.161	0.393	0.544	29.4	-0.88	-0.02	9.57
Manufacture	0.273	0.282	0.300	0.323	0.333	0.353	0.354	0.327	5.3	0.27	0.88	-0.66
Electricity, Gas & Water	0.212	0.168	0.218	0.237	0.190	0.247	0.254	0.289	7.8	0.07	0.48	1.06
Construction	0.206	0.219	0.293	0.252	0.583	0.434	0.340	0.382	17.6	0.87	2.35	-1.29
Trade & Commerce	0.278	0.290	0.334	0.320	0.358	0.461	0.386	0.322	4.5	0.57	2.12	-3.47
Transport & Communication	0.195	0.221	0.272	0.227	0.291	0.401	0.370	0.280	8.4	0.77	2.14	-3.03
Service	0.237	0.272	0.348	0.318	0.359	0.372	0.381	0.351	11.3	1.10	0.41	-0.54
Inactive	0.242	0.386	0.467	0.401	0.519	0.509	0.421	0.383	14.1	2.25	0.70	-3.15
Occupation												
Small Farmer	0.180	0.179	0.217	0.216	0.230	0.229	0.275	0.288	10.8	0.37	0.20	1.48
Fisher & Other Farmer	0.216	0.395	0.253	0.377	0.381	0.514	0.887	0.467	25.1	0.37	4.34	-1.15
Big Farmer	0.236	0.239	0.296	0.285	0.504	0.326	0.334	0.400	16.4	0.60	0.51	1.84
Non-farm Self-employed	0.251	0.258	0.265	0.262	0.294	0.297	0.290	0.285	3.4	0.14	0.54	-0.32
Non-farm Employer	0.325	0.366	0.392	0.398	0.584	0.512	0.513	0.465	14.0	0.68	1.98	-1.17
Own-account Professional	0.183	0.344	0.379	0.728	0.294	1.372	0.932	0.349	16.6	1.95	16.56	-25.58
Farm Worker	0.133	0.161	0.207	0.163	0.160	0.201	0.191	0.189	5.6	0.74	-0.10	-0.30
General Worker	0.120	0.156	0.179	0.164	0.143	0.166	0.195	0.169	4.9	0.59	-0.21	0.06
Production Worker	0.173	0.219	0.243	0.247	0.247	0.272	0.247	0.250	7.6	0.69	0.50	-0.56
Service Worker	0.172	0.213	0.229	0.231	0.254	0.263	0.274	0.250	7.8	0.57	0.57	-0.33
Professional Worker	0.166	0.200	0.208	0.202	0.221	0.316	0.277	0.287	12.2	0.42	1.80	-0.71
Assisted	0.313	0.325	0.405	0.408	0.382	0.451	0.374	0.330	1.7	0.92	0.77	-3.03
Rentier	0.415	0.530	0.607	0.423	1.007	0.700	0.602	0.510	9.4	1.91	1.55	-4.75
Financial Participation												
Non-participant	0.266	0.298	0.362	0.346	0.341	0.366	0.361	0.353	8.8	0.96	0.07	-0.32
Participant	0.358	0.327	0.415	0.423	0.480	0.521	0.498	0.434	7.6	0.58	1.75	-2.16
Education												
No Formal	0.270	0.310	0.355	0.330	0.331	0.408	0.365	0.356	8.59	0.85	0.88	-1.28
Primary	0.249	0.276	0.318	0.312	0.344	0.340	0.336	0.320	7.0	0.69	0.37	-0.52
Secondary	0.201	0.256	0.300	0.328	0.419	0.356	0.381	0.338	13.7	0.99	0.93	-0.45
Vocational	0.191	0.161	0.240	0.210	0.294	0.319	0.298	0.255	6.4	0.49	1.32	-1.61
University or Higher	0.187	0.209	0.180	0.204	0.243	0.320	0.248	0.253	6.6	-0.08	2.34	-1.67

Note 1. Total change in Theil-L index between 1976 and 1996 (multiplied by 100)

Note 2. Annual average change in Theil-L index for corresponding periods (multiplied by 100)

Table A.5. Poverty Profile by Head-Count Ratio (%)

Year	1976	1981	1986	1988	1990	1992	1994	1996	76-96 [1]	76-86 [2]	86-92 [2]	92-96 [2]
Age												
30 or less	41.6	34.7	40.6	34.0	28.3	23.2	18.2	12.1	-29.5	-0.11	-2.90	-2.77
31 - 40	51.4	39.6	46.2	38.1	32.5	26.6	21.6	14.1	-37.3	-0.52	-3.27	-3.12
41 - 50	51.9	38.8	46.2	39.9	30.3	26.0	20.0	11.8	-40.2	-0.58	-3.36	-3.56
51 - 60	46.1	30.1	45.6	34.0	31.5	24.7	21.7	13.4	-32.7	-0.05	-3.48	-2.81
61 or more	44.9	29.9	43.9	34.0	31.1	29.6	23.0	14.8	-30.1	-0.10	-2.37	-3.71
Gender												
Male	50.0	37.6	47.3	38.5	32.5	27.4	22.1	14.1	-35.9	-0.28	-3.30	-3.33
Female	39.8	29.0	34.2	29.9	24.6	19.2	16.2	10.1	-29.7	-0.56	-2.50	-2.27
Community Type												
Urban	9.7	5.2	5.5	4.9	3.9	2.1	1.9	0.9	-8.8	-0.42	-0.56	-0.31
Sanitary District	30.1	26.8	34.6	25.0	23.5	15.2	13.0	7.4	-22.7	0.45	-3.23	-1.96
Rural	59.4	45.3	56.1	46.3	39.2	33.2	26.9	17.5	-41.9	-0.33	-3.82	-3.93
Sector												
Agriculture	63.1	50.2	62.8	53.0	45.4	40.6	35.0	24.3	-38.8	-0.03	-3.70	-4.07
Mining	24.6	29.5	14.2	27.1	0.0	0.0	0.0	7.3	-17.3	-1.04	-2.37	1.82
Manufacture	22.6	18.6	17.2	14.2	10.8	8.6	5.6	3.6	-19.0	-0.54	-1.43	-1.25
Electricity, Gas & Water	9.5	1.6	7.1	3.5	2.7	0.0	0.0	0.7	-8.8	-0.24	-1.18	0.17
Construction	29.4	22.2	23.4	24.4	20.0	12.9	13.4	5.2	-24.2	-0.61	-1.74	-1.92
Trade & Commerce	15.3	10.0	15.1	8.8	8.2	6.2	4.5	1.9	-13.4	-0.02	-1.49	-1.07
Transport & Communication	18.4	15.5	15.8	10.5	7.4	4.7	5.9	2.0	-16.4	-0.26	-1.85	-0.66
Service	21.2	10.8	16.5	13.0	11.1	7.8	6.8	2.6	-18.6	-0.47	-1.45	-1.30
Inactive	35.6	15.5	25.9	22.1	23.0	17.2	13.4	8.4	-27.2	-0.96	-1.46	-2.18
Occupation												
Small Farmer	70.2	52.6	68.2	58.1	50.6	44.9	38.0	28.5	-41.7	-0.20	-3.89	-4.09
Fisher & Other Farmer	50.9	38.4	60.6	33.7	33.3	11.1	28.0	15.8	-35.2	0.97	-8.25	1.16
Big Farmer	38.2	25.7	41.1	21.0	18.6	21.0	20.0	8.4	-29.8	0.29	-3.35	-3.14
Non-farm Self-employed	25.2	18.3	21.9	16.1	14.4	9.6	8.5	3.9	-21.3	-0.33	-2.04	-1.43
Non-farm Employer	2.6	4.0	6.2	5.2	4.6	2.9	1.5	1.4	-1.2	0.36	-0.55	-0.38
Own-account Professional	0.0	10.4	8.3	17.3	0.0	13.3	10.7	3.7	3.7	0.83	0.84	-2.41
Farm Worker	56.5	59.0	69.2	61.4	54.2	49.6	38.5	28.3	-28.2	1.26	-3.26	-5.32
General Worker	52.4	40.8	55.0	58.2	46.0	32.2	31.7	14.4	-37.9	0.27	-3.80	-4.45
Production Worker	24.9	21.7	24.6	19.8	16.2	12.3	13.7	8.3	-16.6	-0.03	-2.06	-0.99
Service Worker	13.0	8.6	8.9	8.0	5.7	3.9	4.0	1.8	-11.2	-0.41	-0.82	-0.55
Professional Worker	2.6	3.2	1.9	0.8	1.2	2.2	2.1	1.7	-0.9	-0.07	0.04	-0.13
Assisted	32.4	15.4	29.1	26.8	24.7	22.2	19.2	10.3	-22.2	-0.33	-1.16	-2.97
Rentier	27.7	24.0	25.4	23.0	21.6	13.9	10.7	9.6	-18.1	-0.23	-1.92	-1.06
Financial Participation												
Non-participant	50.6	38.7	48.1	40.2	35.7	30.1	24.4	16.2	-34.4	-0.25	-3.00	-3.46
Participant	18.0	12.7	16.7	16.7	11.1	10.2	9.0	4.6	-13.5	-0.13	-1.08	-1.42
Education												
No Formal	54.5	42.8	55.7	49.8	43.4	44.8	41.3	30.6	-23.9	0.12	-1.81	-3.56
Primary	51.9	39.5	49.6	41.1	35.2	29.0	23.6	15.0	-36.9	-0.23	-3.45	-3.49
Secondary	9.2	8.7	13.0	12.6	9.3	7.7	6.8	4.7	-4.5	0.38	-0.89	-0.76
Vocational	2.6	0.7	2.9	3.1	2.3	4.1	2.1	1.7	-0.8	0.03	0.21	-0.59
University or Higher	0.0	0.0	0.1	0.2	0.1	0.9	0.2	0.0	0.0	0.01	0.13	-0.23

Note 1. Total change in head-count ratio between 1976 and 1996 in percentage terms

Note 2. Annual average change in head-count ratio for corresponding periods in percentage terms

Appendix 2. Estimation of Lorenz Curves for Poverty Decomposition

The poverty decomposition methodology depends on the parametric formulation of Lorenz curve. Villasenor and Arnold (1989) suggest an elliptical form as a way of this formulation, which is a special version of the general quadratic form

$$ap^2 + bpL + cL^2 + dp + eL + f = 0,$$

where L is the ordered income share and p is the ordered population share. Since the Lorenz curve must pass through $(0, 0)$ and $(1, 1)$, we need to impose the following restrictions on the parameters: $f = 0$, and $e = -(a + b + c + d)$. The elliptical Lorenz curve is a special case with $b^2 - 4ac < 0$, $c = 1$, $a + b + d + 1 > 0$, $d \geq 0$, and $a + d - 1 \leq 0$. With this specification, three parameters a, b, and d characterize the Lorenz curve such that

$$L\,(1 - L) = a(p^2 - L) + bL(p - 1) + d(p - L).$$

The FGT poverty indices are defined as

$$P_\alpha = \frac{1}{n} \sum_{y_i < z} [(z - y_i)/z]^\alpha,$$

where $(y_1, \cdots, y_n)$ denotes the income distribution profile, z the poverty line, and α non-negative integer value. Given the parameters a, b, and d, the poverty indices of head-count ratio P_0, poverty gap index P_1, and poverty severity index P_2 can be characterized as follows:

$$\text{(1)} \qquad \begin{aligned} P_0 &= -\left[\beta + r(b + 2z/\mu)\left\{(b + 2z/\mu)^2 - \alpha\right\}^{-1/2}\right]/2\alpha \\ P_1 &= P_0 - (\mu/z)L(P_0) \\ P_2 &= 2P_1 - P_0 - (\mu/z)^2\left[aP_0 + bL(P_0) - (r/16)\ln\{(1 - P_0/s_1)/(1 - P_0/s_2)\}\right] \end{aligned}$$

where $e = -(a+b+d+1)$, $\alpha = b^2 - 4ad$, $\beta = 2be - 4d$, $r = (\beta^2 - 4\alpha e^2)^{1/2}$, $s_1 = (r - \beta)/2\alpha$, $s_2 = -(r + \beta)/2\alpha$, μ the mean income, z the poverty line, $L(x)$ the value of Lorenz curve at x.

The parameters a, b, and d of the elliptical Lorenz curve can be estimated by standard least-square methods. The fitting performance of the elliptical Lorenz curve to the Thai Lorenz curve is remarkable: R^2 is around 0.99 in each given year. Table A.6 reports the estimates of the parameters of the elliptical Lorenz curve and the ratio of poverty line to mean income for the actual income distributions at benchmark years while Tables A.7 to A.10 for the counterfactual income distributions switching the compositions of occupation, financial participation, education, and joint three characteristics, respectively. In Tables A.7 to A.10, the year in parenthesis indicates the year when the composition of characteristics is used. For example, the estimates at the row 1976 (1996) are obtained from the income profile in 1976 using 1996 composition of characteristics.

Table A.6. Estimates for Actual Lorenz Curves

Year	a	b	d	$\frac{z}{\mu}$
1976 (1976)	0.755	-0.523	0.354	0.684
1986 (1986)	0.725	0.449	0.443	0.542
1992 (1992)	0.620	0.974	0.462	0.320
1996 (1996)	0.772	0.414	0.373	0.243

Table A.7. Estimates for Lorenz Curves with Counterfactual Composition of Occupation

Year	a	b	d	$\frac{z}{\mu}$
1976 (1996)	0.858	-0.709	0.245	0.558
1976 (1986)	0.781	-0.517	0.328	0.639
1986 (1992)	0.801	0.445	0.404	0.500
1992 (1996)	0.713	0.745	0.389	0.293

Table A.8. Estimates for Lorenz Curves with Counterfactual Composition of Financial Participation

Year	a	b	d	$\frac{z}{\mu}$
1976 (1996)	0.733	-0.199	0.369	0.566
1976 (1986)	0.742	-0.443	0.359	0.656
1986 (1992)	0.749	0.780	0.458	0.480
1992 (1996)	0.639	1.133	0.461	0.302

Table A.9. Estimates for Lorenz Curves with Counterfactual Composition of Education

Year	a	b	d	$\frac{z}{\mu}$
1976 (1996)	0.771	-0.022	0.403	0.549
1976 (1986)	0.735	-0.320	0.384	0.633
1986 (1992)	0.757	0.807	0.473	0.494
1992 (1996)	0.651	1.163	0.461	0.298

Table A.10. Estimates for Lorenz Curves with Counterfactual Joint Composition of Three Characteristics

Year	a	b	d	$\frac{z}{\mu}$
1976 (1996)	0.771	-0.269	0.290	0.459
1976 (1986)	0.742	-0.319	0.365	0.604
1986 (1992)	0.778	0.746	0.419	0.451
1992 (1996)	0.724	0.688	0.371	0.286

Tables and Figures

Table 1. Composition Effects from Counterfactual Decomposition

Characteristics	Mean	Theil-L	Theil-T	Gini	P_0	P_1	P_2
Age	0	-2	-2	-2	0	0	0
Gender	2	1	0	1	2	2	2
Community Type	7	10	8	9	4	4	3
Production Sector	16	2	-3	-1	16	16	15
Occupation	21	8	-2	4	23	21	20
Financial Participation	20	39	38	39	13	11	11
Education	25	41	37	41	15	14	13
Joint Three	40	54	57	53	33	30	29

Notes: The numbers indicate percentage shares of changes due to compositional changes out of total change in distributional indices.

Table 2. Composition Effects on Average Income Growth

Characteristics	Overall	Stage 1	Stage 2	Stage 3
Age	0	3	0	0
Gender	2	5	1	4
Community Type	7	17	2	12
Production Sector	18	33	13	21
Occupation	21	39	17	30
Financial Participation	20	23	27	18
Education	25	45	20	24
Joint Three	39	66	38	38
Total Growth	4.96	1.98	8.78	6.94

Notes: The numbers indicate percentage shares of income growth due to compositional changes out of total income growth

Table 3. Decomposition of Inequality Change

Table 3.1. Overall (Total Change per Annum = 0.725)

Characteristics	Within-group Inequality		Across-group Inequality	
	Intra-group	Composition	Income-Gap	Composition
Age	101	-2	1	0
Gender	97	0	2	1
Community Type	67	-1	24	10
Production Sector	58	9	25	8
Occupation	59	2	32	7
Financial Participation	59	12	2	27
Education	54	-7	5	47
Joint Three	28	2	19	51

Table 3.2. Stage 1 (Total Change per Annum = 1.160)

Characteristics	Within-group Inequality		Across-group Inequality	
	Intra-group	Composition	Income-Gap	Composition
Age	102	-1	-1	0
Gender	95	0	4	1
Community Type	57	-1	37	7
Production Sector	43	7	35	15
Occupation	40	5	46	9
Financial Participation	80	3	7	10
Education	61	-5	17	27
Joint Three	48	4	28	20

Table 3.3. Stage 2 (Total Change per Annum = 1.472)

Characteristics	Within-group Inequality		Across-group Inequality	
	Intra-group	Composition	Income-Gap	Composition
Age	98	0	2	0
Gender	103	0	-3	0
Community Type	48	-2	47	7
Production Sector	44	9	50	-3
Occupation	35	5	54	6
Financial Participation	24	13	28	35
Education	38	-3	27	38
Joint Three	2	6	34	58

Table 3.4. Stage 3 (Total Change per Annum = -1.481)

Characteristics	Within-group Inequality		Across-group Inequality	
	Intra-group	Composition	Income-Gap	Composition
Age	99	1	0	0
Gender	100	1	0	-1
Community Type	20	-2	91	-9
Production Sector	24	-13	75	14
Occupation	4	-7	85	18
Financial Participation	52	-10	72	-14
Education	46	2	80	-28
Joint Three	-4	-2	99	7

Notes: The numbers indicate percentage shares of Theil-L index changes due to each component dynamics out of total change in Theil-L index: "Intra-group" for intra-group inequality change, "Income-Gap" for divergence or convergence in income levels across income-status groups, "Composition" under "Within-group Inequality" for composition effect via within-group inequality, and "Composition" under "Across-group Inequality" for composition effect via across-group inequality. Negative number for Stage 3 indicates increase in inequality while positive number indicates decrease in inequality since the total inequality decreased for this period.

Table 4. Decomposition of Poverty Change into Growth and Inequality Change

	Overall	Stage 1	Stage 2	Stage 3
Growth Effect	-2.28	-1.28	-3.82	-2.72
Inequality Effect	0.36	0.68	0.86	-0.89
Total Change	-1.71	-0.37	-2.90	-3.27

Notes: The numbers indicate the changes in head-count ratio in percentage terms due to income growth effect (first row), effect of change in inequality (second row), and total change (third row). Negative number suggests reduction of poverty while positive number suggests increase in poverty since the base of the decomposition is a negative number, the poverty reduction. The difference between the sum of growth effect and inequality effect and total change is due to the residual term.

Table 5. Composition Effects on Poverty Change

Table 5.1. Overall

Characteristics	Growth	Inequality	Total
Occupation	33	3	29
Financial Participation	30	-10	14
Education	36	-11	18
Joint Three	62	-12	39

Table 5.2. Stage 1

Characteristics	Growth	Inequality	Total
Occupation	103	-8	73
Financial Participation	62	-27	24
Education	116	-49	46
Joint Three	186	-59	92

Table 5.3. Stage 2

Characteristics	Growth	Inequality	Total
Occupation	21	1	21
Financial Participation	32	-10	20
Education	24	-9	14
Joint Three	48	-12	33

Table 5.4. Stage 3

Characteristics	Growth	Inequality	Total
Occupation	28	3	28
Financial Participation	18	-10	6
Education	22	-11	9
Joint Three	35	3	33

Notes: The numbers indicate the percentage shares of change in head-count ratio due to compositional changes in given characteristics via income growth (first column), income inequality change (second column), and combined effect (third column). Here, positive number suggests reduction of poverty while negative number suggests increase in poverty since this table reports the shares, not amount, of corresponding effects to the total poverty reduction. The difference between the sum of "Growth" and "Inequality" columns and the "Total" column is due to the residual term.

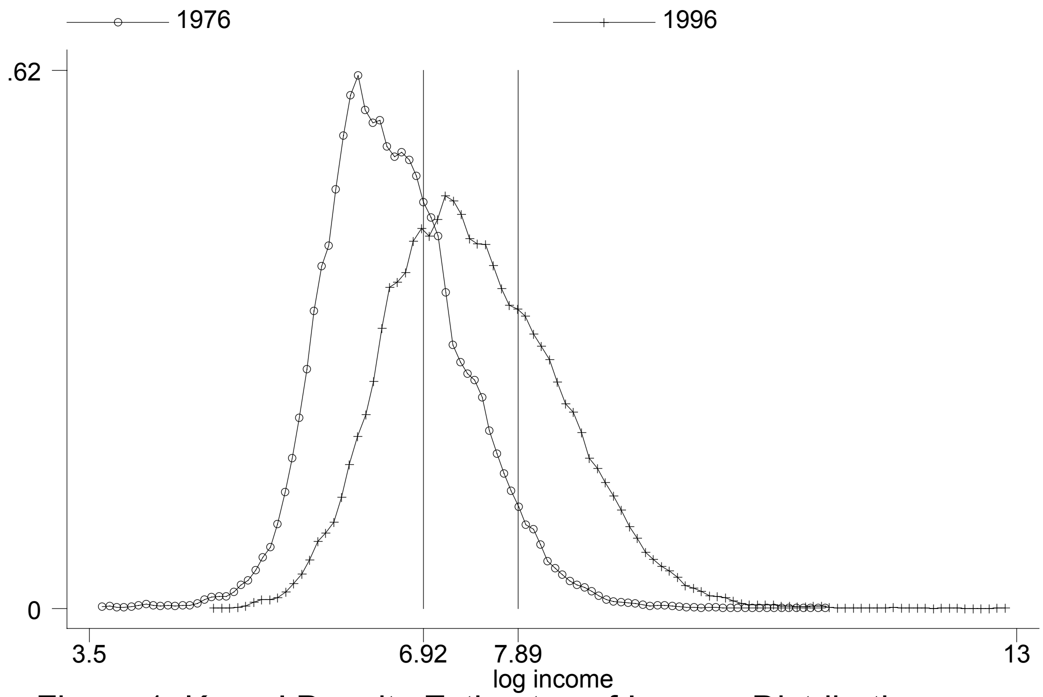

Figure 1. Kernel Density Estimates of Income Distributions

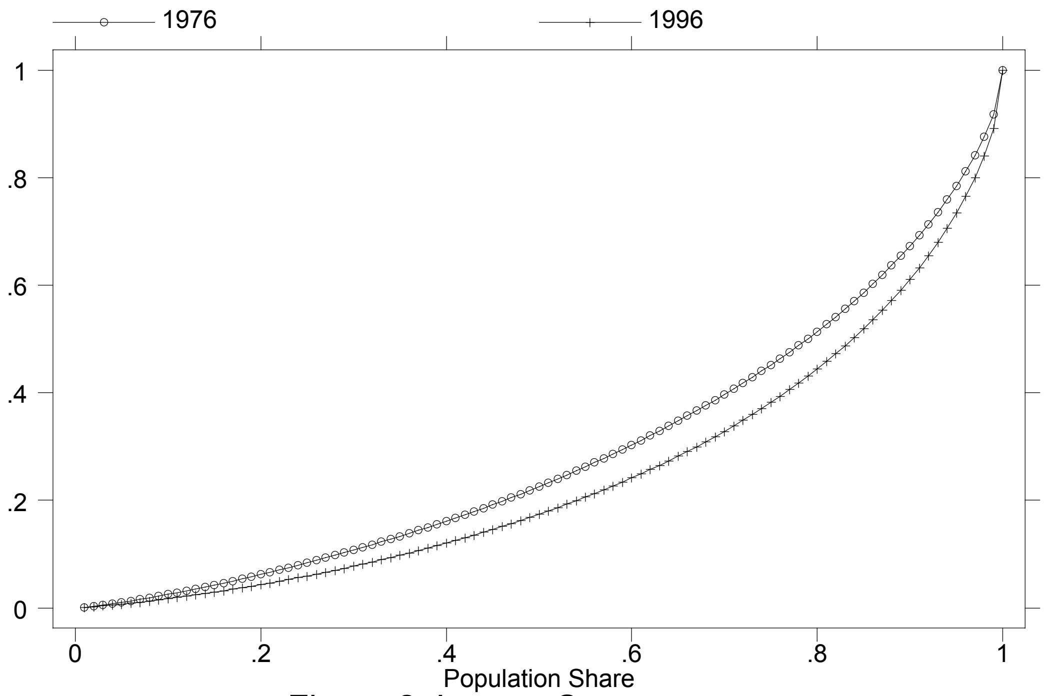

Figure 2. Lorenz Curves

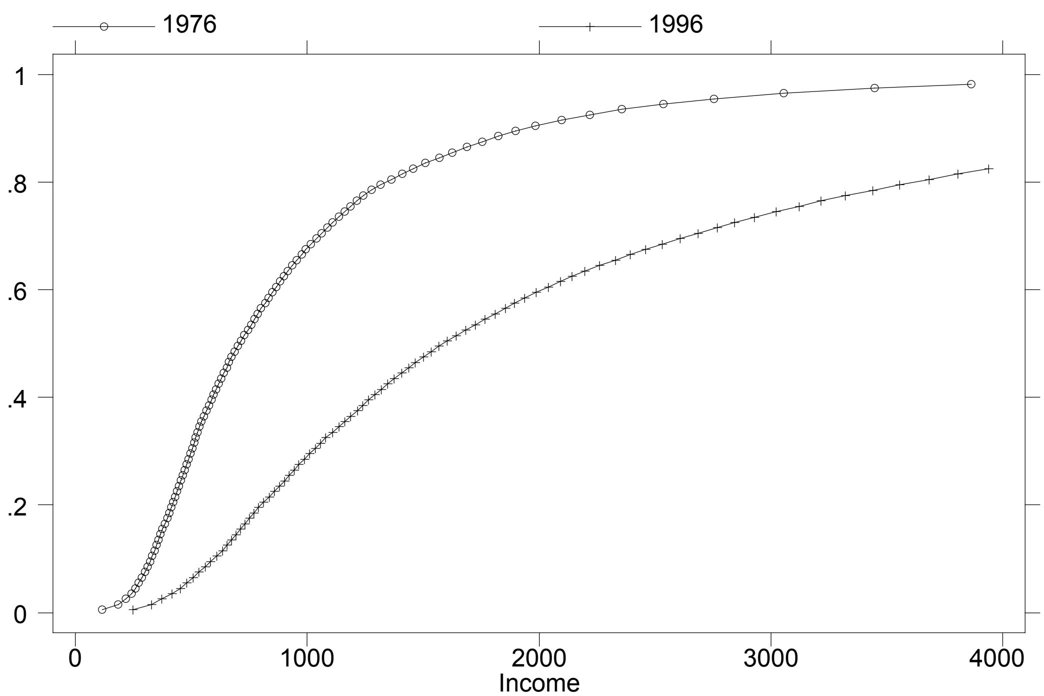

Figure 3. Cumulative Distribution Functions

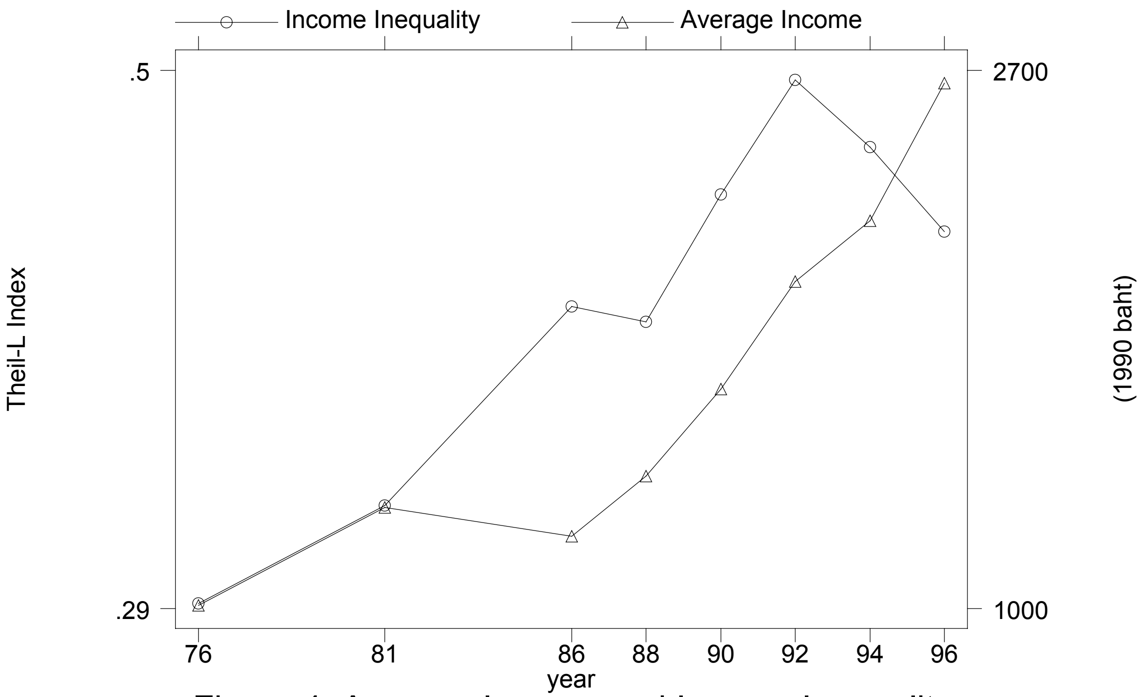

Figure 4. Average Income and Income Inequality

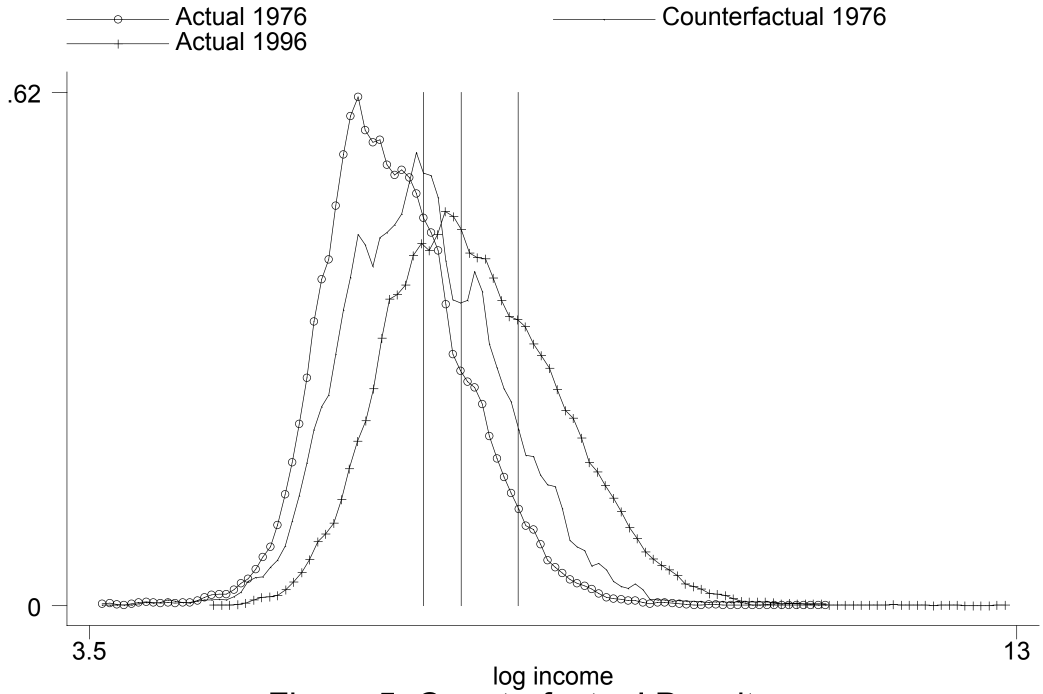

Figure 5. Counterfactual Density

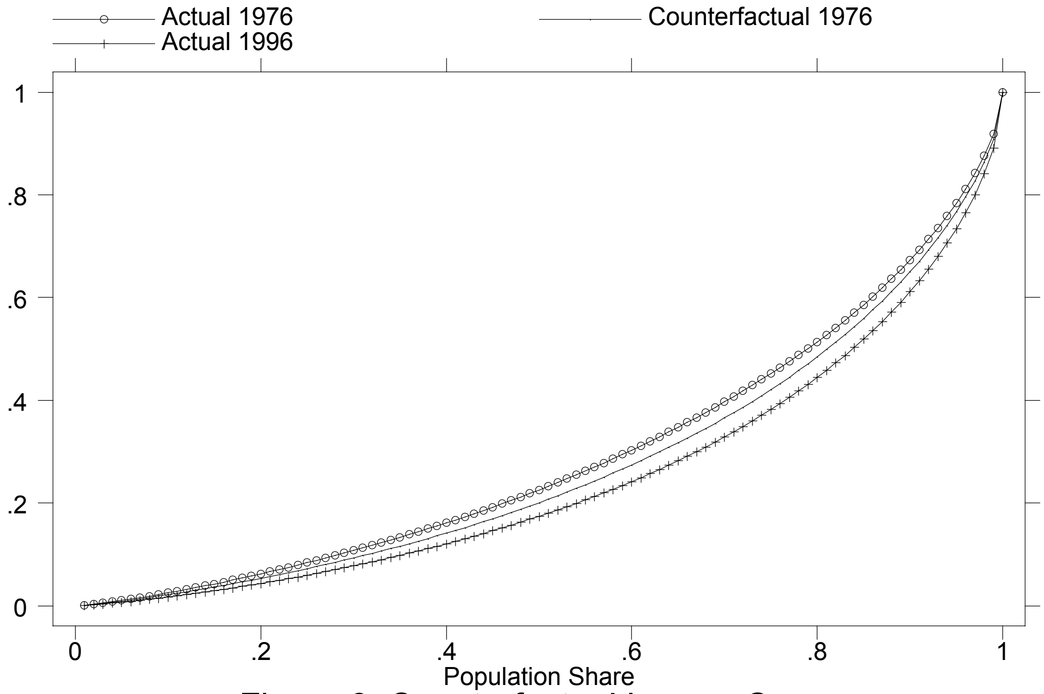

Figure 6. Counterfactual Lorenz Curve

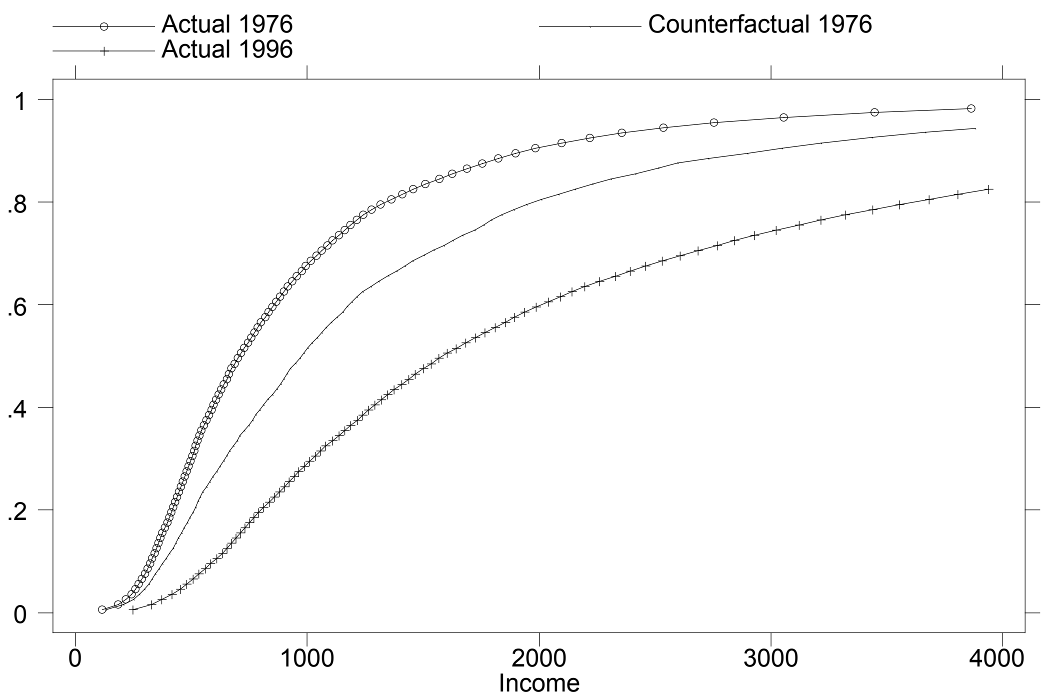

Figure 7. Counterfactual CDF

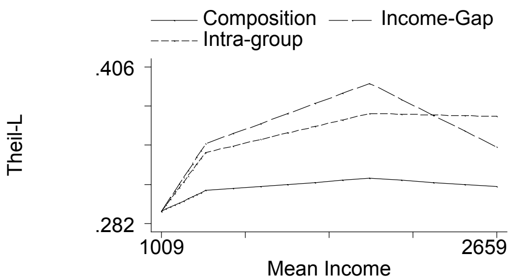

Figure 8.1. Occupation

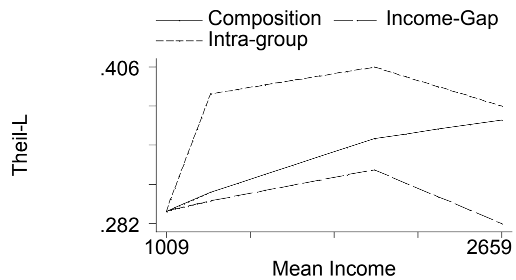

Figure 8.2. Financial Participation

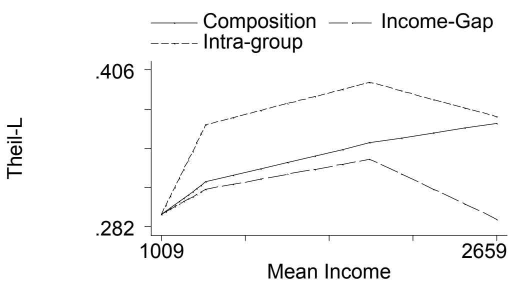

Figure 8.3. Education

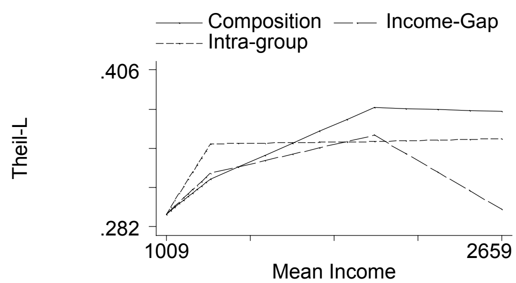

Figure 8.4. Joint Three

Figure 8. Decomposed Inequality Dynamics

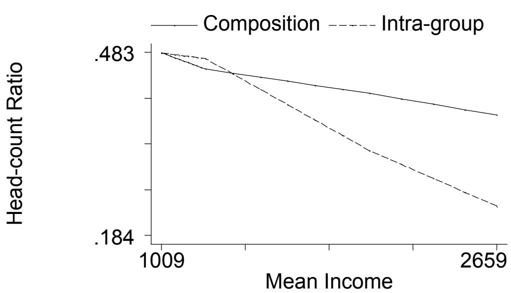

Figure 9.1. Occupation

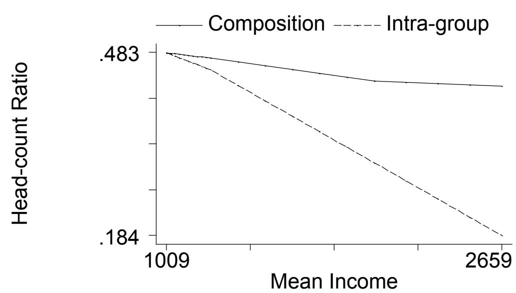

Figure 9.2. Financial Participation

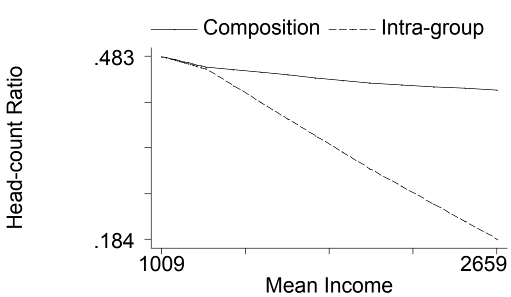

Figure 9.3. Education

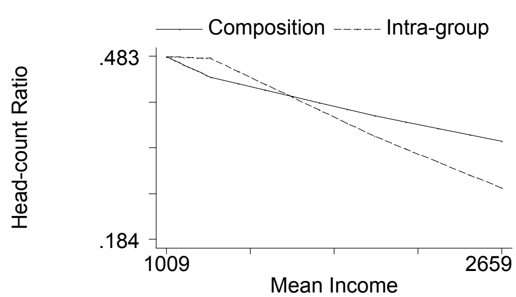

Figure 9.4. Joint Three

Figure 9. Decomposed Poverty Dynamics