DYNAMICS OF INCOME INEQUALITY IN THAILAND:
EVIDENCE FROM HOUSEHOLD PSEUDO-PANEL DATA

Hippolyte Fofack (AFTM3) and Albert Zeufack (DECRG)¹

The World Bank

December 1999

Abstract:
This paper analyzes six waves of the Thai Socio Economic Survey (SES) spanning from 1986 to 1996 to provide estimates of the scope, and trend of sectoral contribution to overall income inequality in Thailand. The paper first discusses the rationale for choosing a pertinent measure of income inequality, and the role of interaction terms in the decomposition of inequality indices in the case of Thailand. Analysis of the dynamics of income inequality not only confirms Kakwani and Kongkaew (1997) findings that the Thai inequality increasing trend depicted in the literature might have leveled-off after 1992, but also suggests that income inequality might have decreased between 1994 and 1996, as has growth of GDP. However, this slight decline of income inequality prior to the 1997 financial crisis might reflect the sole fact of diminishing profits and other revenues at the higher end of the income distribution. The decomposition of the Theil index and its dynamics over time suggest that industry and services account for a large share of total income inequality, and the recent decline did not alter the distribution of income inequality across socioeconomic classes. Finally, meso-economic determinants of the Thai income inequality are investigated using a pseudo-panel estimation approach. As many as 12 cohorts are formed in the 1986 base year, and the econometric investigation reveals that education, access to formal credit markets, intra-family transfers and spatial concentration of wealth are key determinants of income inequality in Thailand.

Key words: Income inequality, Inequality decomposition, Pseudo-Panel, Theil index.

JEL Classification: C23, D31, O15

¹ The authors would like to thank David Dollar, Martin Ravallion and Lyn Squire for their useful comments and suggestions on an earlier version of this paper.
I. INTRODUCTION

Recently, there has been a renewed interest in the growth-inequality relationship first explored by Kuznets (1955). This renewed interest is motivated not only by recent empirical evidence supporting the hypothesis that inequality is harmful for growth, see Persson and Tabellini (1994), Partridge (1997), Deininger and Squire, (1998); but also by the fact that, in some cases, extreme inequality in the distribution of income might be among the major causes behind political instability, see Chang (1994), Collier and Hoeffler (1998). Moreover, in some developing countries, economic growth was followed by a widening income gap between poor and non-poor, and between skilled and unskilled workers. The persistence of increased inequality has led policymakers to redefine growth strategy which accounts for redistribution.

This debate is particularly relevant for Thailand where the implementation of macroeconomic reforms following the economic crisis of the early 1980’s translated into sustained growth characterized by high growth rates and yet with persistence of large regional disparities, and more importantly increased income inequality. While the GDP grew at an average rate of 7.9% between 1981 and 1992, income inequality increased steadily during the same period. The July 1997 financial crisis that translated into large depreciation of household assets and reduction of personal income from massive layoff in the Thai manufacturing sector—see Dollar et al. (1998), could further widen income inequality, exacerbate urban poverty and threaten the benefits of medium-term economic growth accumulated during the period preceding the crisis.

The positive association between rising income inequality and high economic growth over time makes Thailand an ideal case study if one is interested in the nature of the association between variations in economic growth rates and rising income inequality and its implication on welfare, as well as the determinants of income inequality over

---

2 The renewed interest in the distributional aspects of growth and income inequality was heightened by the conference on income inequality organized by the International Monetary Fund in June 1997; the proceedings of the conference were published as special issues in the IMF Finance and Development Review. See also proceedings of another conference on income inequality organized the same year and published in Empirical Economics Review.

3 The most recent medium term growth strategy proposed by the Thai government recommends to distribute the benefits of growth across socioeconomic groups more equitably, see World Bank (1998).

4 Among the South East Asian countries, the persistence of income inequality has been particularly prominent in Thailand. In other countries where inequality has risen, such as Korea, income inequality did not persist.
time. In the past, attempts have been made to provide estimates of income inequality and its trends in Thailand, see World Bank (1996), Kakwani and Krongkaew (1996, 1997), Ahuja et al (1997). Although these studies provide estimates of the magnitude of aggregate income inequality and the sectoral and regional contribution to overall inequality, they fail to provide an analysis of the role of inter-action terms in the between decomposition of income inequality. More importantly, they fail to establish a clear connection between economic theory and the explanation of personal income, as emphasized by Atkinson (1997).

This paper suggests that the reasons for non-trickledown of income under high economic growth stem from the nature and causes of income inequality. Therefore it is crucial to analyze the economic determinants of income inequality at a more disaggregated level in order to assess its implications on welfare. The analysis is based on six consecutive waves of the Thai Socio-Economic Survey (SES) including the most recent one in 1996. The timeframe of the study covers the period 1986-1996, the “miracle” decade.

The paper is organized as follows: section two analyzes the shape of the empirical distribution of income in Thailand to provide a rationale for selecting a measure of income inequality. It shows that the marginal contribution of between-groups effect to overall income inequality converges to zero, and then establishes an upper bound for between-terms effects in the identification of determinants of income inequality. Section three applies this result to Socio-Economic Survey (SES) data to provide a most recent estimate of the scope of income inequality prior to the 1997 financial crisis in Thailand. The results of the Theil index decomposition not only confirm Kakwani and Krongkaew (1997) findings that the increasing trend in income inequality in Thailand depicted by Ahuja et al. (1997) might have leveled-off after 1992, but also suggest that income inequality might have decreased in 1996, as has the growth of GDP. Section four investigates the meso-economic determinants of income inequality in Thailand to understand the reasons for the positive association between economic growth and income inequality. A pseudo-panel estimation reveals that education, access to financial markets,

---

5 To our knowledge, this is the first time the 1994 and 1996 SES are both used in a study of income inequality determinants in Thailand. Kakwani and Krongkaew (1997) have used the 1994 SES.
intra-family transfers, and geographical concentration of income are powerful determinants of income inequality in Thailand. Finally, section five provides some concluding remarks and explores avenues for future research.

II Contribution of interaction terms to overall income inequality

Although income inequality is a reflection of the overall distribution of income, inferences on inequality are generally drawn from a host of single aggregate measures, which in some cases may well be influenced by outlying observations. Of all these measures, the most commonly used include: the generalized entropy family of inequality indices, the Gini coefficient, and the Atkinson family of inequality indices. While each of these measures provides an estimate of magnitude of income inequality, they do differ significantly, and the selection of a measure of inequality from this set for analytical purposes may affect both the scope as well as the distribution of income inequality within a given country, or in a cross-country comparison. For example a study of income inequality in rural Pakistan, the contribution of income sources to overall inequality varies widely depending on the measure of inequality used, see Adams and Alderman (1992). This section of the paper attempts to provide a rationale for selecting a measure of inequality in the context of income inequality studies. It investigates the impact of between-groups terms on overall income inequality by showing that the convergence of between-groups income inequality occurs beyond a certain threshold. The Thai SES has a good income data and inferences are drawn from the distribution of income rather than expenditure.

---

6 For a thorough review of different measures of income inequality, see Kakwani (1980), Osberg (1991), and Anand and Kanbur (1992).

7 Similarly, in a related study in developed countries Inference on income inequality from the Luxembourg Income Study suggests that the magnitude of inequality varies in the order of 1:3 depending on the measure of inequality that is used as basis for inference. Moreover, consistency in ranking is not even preserved across these measures—few countries which happen to rank high under one measure rank much lower when based on another measure.

8 The income record of the Thai SES is comprehensive and includes most components of household income, including transfers, interest and dividends, wages and salary, farm income, income-in-kind, rent, insurance, remittances; for more details, see annex.
2.1 **Rationale for selecting income inequality measure**

The scope of income inequality depends on the measure that is used, see Osberg (1991). In fact, from the conceptual point of view, the differences highlighted by these estimates are dependent upon the nature of the distribution, and also, more importantly, on the conceptual definition of the selected measures. The Atkinson family of inequality index is sensitive to inequality changes in the lowest part of the income distribution; the Gini coefficient is sensitive to inequality changes around the median; while the Theil index is more sensitive to changes in the top part of the distribution.\(^9\) Naturally, the rationale for selecting among these indicators should be determined by the shape of the empirical distribution of income—measures falling within the family of generalized entropy indices—the Theil for instance, should be preferred for heavy tailed distributions which are highly skewed, and the Gini coefficient for distributions clustered around the median, with much lower probability mass in the tails. Instead, the choice of these aggregate measures for income inequality analysis has essentially been arbitrary.

Although most of these measures satisfy the mean-independence property and the principle of transfer—mean-progressive transfers to the poor reduces overall income inequality—very few are transfer sensitive. The Gini coefficient is widely used for inequality, and is likely to be used even more as methods were recently proposed to extend decomposition of income inequality measure to this index, see Dagum (1997). However, although the Gini coefficient satisfies the principle of transfer, it is not transfer sensitive because of its dependence on ranks rather than income. Also the sensitivity of Atkinson depends on the functional form of the implied social welfare function and the choice of risk aversion measure. On the contrary, the Theil index is additively decomposable and transfer sensitive. In this paper, the choice of inequality measure is primarily dictated by the shape of underlined empirical distributions. More precisely, the concentration of probability mass in the tails of empirical distributions is compared with the concentration of probability in the tails of theoretical distributions which are known to have much heavier tails. The Theil index which falls within the family of generalized

---

\(^9\) The coefficient of variation \(C\) and the second entropy measure \(E_2 = C^2 / 2\) are also more sensitive to changes in the top part of the distribution, but are not transfer sensitive.
entropy indices may be a more appropriate measure of income inequality if the probability mass in the extreme tails of empirical distributions is relatively large, i.e.

\[ \lim_{\lambda_i \to m} P(x > \lambda_i) \geq \lim_{\lambda_i \to m} P(y > \lambda_i) \]  

(1)

where \( Y, X \) are random variables representing the theoretical and empirical distribution of income, respectively; \( \lambda_i \) and \( \lambda_e \) are specified cut-off points for theoretical and empirical distributions, respectively. The cut-off points are chosen to be multiple standard deviations away from the means of the distribution.\(^{10}\) If instead the concentration of probability mass around the central tendency measure for the empirical and theoretical distribution with heavy tails is almost equal, then the Gini coefficient which is more sensitive to changes around the median is used as measure of income inequality for the study. However, the choice of the inequality measure will be dictated by the question of interest. For instance, to analyze poverty one might choose to work with the Gini coefficient which has the advantage of capturing variability of income around the median where a large segment of poor population might fall.

An analysis using a set of Thai SES surveys compares the probability mass in the tail of these empirical distributions to the probability mass observed in the tails of known theoretical distributions: the Gamma and lognormal distributions. These theoretical distributions are chosen because they are positively skewed and are often used to model income data, see Kakwani (1980), Salem and Mount (1974).\(^{11}\) A matching of these estimated measures indicates that the magnitude of probability in the extreme tails of empirical distributions is relatively large. In fact the probability mass in the tail of empirical distributions of income is consistently much higher than that observed in the theoretical Gamma and lognormal distributions, despite the relatively long tails and skewness of these theoretical distributions. The results show a consistently higher

\(^{10}\) The theoretical distributions chosen have finite variance and the cut-off points are defined as \( \lambda_i = \bar{x} + mS \), where \( \bar{x} \) and \( S \) are mean and standard deviation respectively and \( m = 2,3 \).

\(^{11}\) Although the Gamma distribution does not satisfy the weak law of Pareto, it is widely used in modeling distribution of income because it is positively skewed and the parameter \( \alpha \) in the density function is directly related to the standard inequality measures. In a study by Sale and Mount (1974), this distribution provided a good approximation of the distribution of personal income in the United States for the years 1960 to 1969.
probability mass in the extreme tails of these empirical distributions, with much larger tail probability over time, see Figure 1. Moreover, a variation of these cut-off points does not even alter the size of the probability in the tails, and preeminence of large probability mass in the empirical tails—the probability mass in the tails remains consistently much higher at 2 and 3 standard deviations from the mean. Since income inequality is essentially driven by a large concentration of income at the upper end of the distribution. The steepest slope exhibited by the tail probability of empirical data in Figure 1 could suggest rapidly rising income inequality between 1986 and 1990.

![Figure 1: Probability mass in the extreme tails of theoretical and empirical distribution of income](image)

It is important to point out that the concentration of probability mass in the tails is even much higher when the empirical distribution of income is matched to the tails of lognormal distribution. While the ratio of Gamma tail probability to empirical distribution of income is about 98% in 1996, indicating that the probability mass in the tails of empirical distributions is slightly larger; the same ratio is about 67% when based on the lognormal distribution—the probability mass in the tails of lognormal distribution is over 30% smaller. Probably the difference between empirical and lognormal probability mass in the tails is exacerbated by the fact that the latter distribution tends to overreact to positive skewness portrayed by income distributions, see Kakwani (1980).
These empirical results suggest that the Theil index of income inequality which is one member of the family of generalized entropy indices could provide a good assessment of the scope and trends of income inequality in Thailand. Of course this choice is not dictated solely by the shape of the distribution—this will fail to take into account Atkinson’s (1970) main findings on the choice of inequality index, but also by the fact that the decline in poverty overtime was significant. This decline has shifted the focus away from poverty towards increasing attention to the distributional aspect of income in a rapidly growing economy.\footnote{The incidence of poverty based on $2 a day poverty line declined to 15.69\% in 1992, from 33.8 in 1986.}

This Theil index is estimated from the following equation:

\[
T = \left(1/n\right) \sum_{i=1}^{n} w_i \left(\frac{y_i}{\mu}\right) \log \left(\frac{y_i}{\mu}\right)
\]  

where \(n\) is the total number of households in the sample, \(\mu\) is estimate of the population mean, \(w_i\) is the household weighted coefficient, and \(y_i\) is the income of given household \(i\); for \(i = 1,2,\ldots,n\). This measure of inequality ranges from a maximum of one (perfect inequality) to zero (perfect equality).

### 2.2 Between-groups interaction effect

In the literature on income distribution, it is customary to decompose overall income inequality into within- and between-groups to isolate the contribution of each component, see Anand (1983), Anand and Kanbur (1992). This is essentially motivated by the following: while policies geared towards reducing earnings dispersions at the sectoral level may reduce intra-sectoral disparities, overall income inequality may persist as a result of large inter-sectoral income variance. Moreover, the contribution to overall income inequality may vary from one sector or group to another, and through this decomposition, one might be able to design easily redistributive growth policies.

The between-group contribution to overall income inequality is proportional to the number of distinct and non-homogeneous groups— it rises as the number of groups increases. In contrast, the within-group inequality is inversely proportional and decreases...
as the between-group increases. Mainly because the within-group variance reduces with the size of the group, and as more and more disjoint sets are formed, the income dispersion within each set becomes smaller in relation to that of the overall population. Although the grouping factor is key to estimating the relative contribution, studies have generally failed to provide meaningful explanation to justify such grouping. Either the grouping has been purely arbitrary, or else it has been increased, especially when the sample size is large enough to capture the relative contribution of between-groups to overall income inequality.

Establishing an upper bound is particularly relevant for Thailand, where the sample size is relatively large and could allow a decomposition based on as many groups as existing socioeconomic class. Such an upper bound for grouping depends on the rate of convergence of between-group variance. When the relative contribution of between-group income inequality rapidly hits a ceiling, the number of grouping factors is relatively small. Drawing on the Thai Socio-economic survey, this Section attempts to determine such a ceiling for Thailand. In particular, we show that beyond a certain threshold, the marginal increase of the relative contribution of the between-group to overall inequality becomes insignificant, and increasing the number of terms in the decomposition does not alter the relative between-group contribution of each component. The results are summarized by the proposition below and further illustrated by Figure 2.

**Proposition:** If \( I_{B(k)} \) is the between-group income inequality based on distinct groups \( G \), then there exists a positive integer \( g < G < \infty \), such that \( \Delta I_{B(k)} < \varepsilon \) for \( k > g \), where \( \Delta I_{B(k)} = I_{B(k+1)} - I_{B(k)} \) and \( \varepsilon \) is small.

This figure assesses the impact of different grouping on the contribution of between-groups to overall income inequality. The scope of the data allows further desegregation of the initial sample, starting with two socioeconomic classes: Farmers and non Farmers; then three groups: Farmers, Industry, Services and Economically inactive; four groups: Farmers owning land, Farmers renting land, Industry, Services and

---

13 The 1996 Thai SES survey collected data on over 25000 households; the previous survey in 1994 was based on an even larger sample, and the data is collected on seven socioeconomic classes: Farm operator owning land primarily, Farm operator renting land primarily, Entrepreneurs – trade and industry, Professional – technical and managerial, Labourers, Other employees, Economically inactive.
Economically inactive; five groups: Farmers owning land, Farmers renting land, Industry, Services, Economically inactive, up to eight groups. The classification of household into a given socioeconomic class is based on the main income source of the head.

The results show the relative increase of the between-groups contribution to overall income inequality, resulting from incremental variation of total number of groups. The convergence of incremental changes—marginal increase of between-groups contribution to overall income inequality is attained quite rapidly. In fact, beyond four groups, $\Delta I_{B(k)}$ is smaller than $\varepsilon = .002$, and remains uniformly smaller regardless of the number of groups in the decomposition.

These empirical results suggest that the dynamics of income inequality in Thailand could well be captured by restricting the decomposition analysis to four groups or less if one is only interested in tracking between-group income inequality across socioeconomic groups with such a highly desegregated data sets. Especially because beyond such threshold further increasing the number of groups does not affect the overall structure of income inequality. These results also suggest that the Thai income inequality dynamics might be driven by the large within-group variability, rather than the between-groups one. Drawing on these empirical findings, this study investigates the dynamics of income inequality on the basis of four socioeconomic classes: Agriculture, Industry,

---

$^{14}$ Several other combinations were tried at each stage of the decomposition, but did not alter the result.
Services and Economically Inactive. This grouping was dictated by our desire to highlight the main sources of income in Thailand. While income received from the first set of socioeconomic class is essentially in the form of wages, individuals in the latter class received their main income from public and private transfers: this includes pension, remittances, interest and dividends. Emphasizing socioeconomic classes is particularly important because income inequality might be largely driven by earnings disparities across the main socioeconomic classes.

III Dynamics of Income Inequality in Thailand

In the past, attempts have been made to provide estimates of income inequality and its trends in Thailand, see World Bank (1996), Kakwani and Krongkaew (1996), Ahuja et al (1997). Although these studies provide estimates of the magnitude of income inequality and the sectoral and regional contribution to overall inequality, they fail to account for the dynamics of sectoral interaction effects which may be critical to understanding changes in the pattern of inequality over time. Moreover, the analysis carried out in all these studies uses the 1992 SES as last year, missing the opportunity to provide some insights on the dynamics of income inequality prior to the crisis. This section of the paper applies the results derived in the previous section to the most recent SES data to provide a most recent update of the scope of income inequality prior to the 1997 financial crisis. It analyzes the long term trends of inequality in Thailand over the last decade and the dynamics of sectoral contribution to overall income inequality.

3.1. Long term trends in Thai income inequality

The dynamics of income inequality are analyzed for the period between 1986 and 1996 using post tax real per capita income from the last six SES surveys. Income data collected in the context of the Thai SES surveys is comprehensive and satisfies the requirements suggested by Ravallion (1996), and Deininger and Squire (1996) for welfare analysis. Empirical results show that income inequality increases dramatically between 1986 and 1990. During this period, the Theil index of income inequality

\[ \text{Theil index} \]

For further details on the data see annexes.
increases from 27% to over 70%. The rise in overall income inequality was even more
dramatic between 1986 and 1988, where the Theil index increased from 27% to 65%. It is
worth pointing out that the Thai GDP growth rate experienced its sharpest increase
during the 1986-1988 period where it reached 13% in 1988 from 3% in 1986. This
positive association between rising income inequality and economic growth might
suggest a Kuznets’ type relationship, to the extent that a reduction in GDP growth rate
after 1988 was paralleled by a reduction in the growth rate of income inequality—the
GDP growth rate declined from 13.3% to 6.4% while the Theil index declined from over
70% to 67% between 1990 and 1996 (see figure 1 in annex). However, these preliminary
results require further investigations.

These results appear to corroborate earlier studies on income inequality in
Thailand. While the study by Ahuja et al. (1997) suggests rising income inequality
between 1975 and 1992, a recent study based on the 1994 SES survey of Kakwani and
Krongkaev (1997) suggests that income inequality may have leveled off during the period
1992 and 1994. The present study confirms this result and suggests a slight decline in the
period preceding the crisis. However, despite this relative decline, income inequality
remains important in Thailand as indicated by the magnitude of the estimated Theil index
of income inequality. Despite the similarity in the pattern and trends one should not
overlook the difference in magnitude of income inequality provided by these studies.
While the study by Ahuja et al. (1997) uses per capita household expenditure, the present
study uses per capita household income which is subject to more variability. The use of
expenditure instead of income leads to a reduced underlying dispersion and variability
especially in the top part of the distribution.16

This increase in overall income inequality was characterized by a large
concentration of total revenues in Bangkok area. The regional concentration of total
revenues expressed as share of total aggregated household income increases steadily—
rising from about 20% to over 30% between 1986 and 1992. However, since 1992, the
bias towards large concentration of total household revenue in the Bangkok area has
declined significantly, and as of 1996, the Bangkok region accounts for less than 15% of

16 Indeed, the marginal propensity to consume tends to increase as revenues increase, but at a rate much lower than the
rate of increase of revenues in the upper income class.
total aggregated income. The graph in Figure 3 provides the trends of income inequality up to 1996.

The reduction of bias in the level of revenue concentration which resulted into a more balanced overall income distribution across regions might have translated in reduction of income inequality. In fact since 1992, the trends in income inequality have been relatively constant and the slight increase recorded between 1992 and 1994 was followed by a proportional decline in the pre-crisis period, i.e. between 1994 and 1996.

The estimate of over time probability mass in the extreme tails of empirical real per capita income derived in Section 2 suggests a sharp increase between 1986 and 1990, as a result of steep positive slope. However, just like the trends observed by the Theil index, the slope of the curve depicting the long term trend of tail probability measure leveled off between 1992 and 1994 and became negative in the pre-crisis era. The similarity between the estimate of probability mass in the tails of empirical distribution of real per capita income over time, and the corresponding trends of income inequality depicted by Theil measure appear to support the choice of this latter as a measure of income inequality. This is strengthened by further empirical results in the following sub-sections which suggest that the Thai income inequality might be exacerbated by a large concentration of wealth in the uppermost decile of the distribution.

The leveling of income inequality between 1992 and 1994, and the downward trend during the pre-crisis period in 1996 were characterized by important volatility in the
dispersion of income across all socioeconomic classes, reaching a peak in 1994. Revenue concentration which is generally viewed as an important source of income inequality—see Deininger and Squire (1996), Atkinson (1997)—is even more important in Thailand and increases significantly between 1992 and 1994. The ratio of income share of the top decile over the bottom decile which was almost constant across all sectors up to 1992 increases steadily between 1992 and 1994, and irrespective of the socioeconomic class.

These results suggest that the exceptional growth performance of the Thai economy over the last decade did not trickle down, and the reduction of income inequality after 1992 might reflect the sole fact of diminishing profits and other revenues at the higher end of the income distribution rather than a closing gap due to an increase at the lower end of the distribution. In fact a comparison of average real per capita income rate of growth in the uppermost and lowest decile shows a different pattern between these two income groups. Despite the phenomenal growth rate recorded between 1986 and 1988, the growth rate of average real per capita income in the bottom decile increased by over 34%, while that of the uppermost decile was over ten times much higher. Moreover, in subsequent years, where growth rates were much slower, the average real per capita income growth rate in the top decile continued to increase, while at the same time it declined in the bottom decile.

This shift in the concentration of income as well as its distribution across income recipients within each socioeconomic class was even more apparent in the services, and less so in agriculture. Figure 4 provides over time changes in the relative concentration of income across income recipients and sectors. It is important to point out that this distribution of income across the different income recipients and socioeconomic classes is consistent with changes in the trends in income inequality between 1994 and 1996 at the national level, where a rise in income inequality was immediately followed by a decline in 1996. The impact of differences in the relative concentration of wealth across

---

17 In the classification used in this paper primary sector essentially refers to farmers. The secondary sector refers to entrepreneurs, paid and unpaid workers in industry. The tertiary sector refers to service workers.

18 For instance, while the average real per capita income grew by 3% in the top decile between 1988 and 1990, it declined by over 13% in the bottom decile. The same pattern was observed up to 1992—period of persistent rising income inequality.

19 The causes of these changes are numerous and could include among other things rising wages differentials across
income recipients and sectors on overall aggregate income inequality is discussed in a later section.

3.2 Characteristics of Thai income inequality dynamics: Decomposition analysis

As mentioned earlier, the Theil index of income inequality is additively decomposable— the overall aggregate measure can be decomposed easily as the weighted sum of between- and within-group components. The expression in equation 2 above can then be rewritten as:

\[
T = \sum_i w_i \frac{Y_i}{Y} \left[ \sum_j y_{ij} \log \left( \frac{y_{ij}/Y_i}{n_{ij}/n_i} \right) \right] + \sum_i w_i \frac{Y_i}{Y} \log \left( \frac{Y_i}{Y} \right)
\]

where the leftmost expression in the formula,

\[
T_w = \sum_i w_i \frac{Y_i}{Y} \left[ \sum_j y_{ij} \log \left( \frac{y_{ij}/Y_i}{n_{ij}/n_i} \right) \right]
\]

is the within-group component and the rightmost expression,

\[
T_B = \sum_i w_i \frac{Y_i}{Y} \log \left( \frac{Y_i}{Y} \right)
\]
is the between-group component.\footnote{For further details on the decomposition of the Theil entropy index of income inequality, see Bourguignon (1979), Mookherjee and Shorrocks (1982), and Dagum (1997)}

Drawing on this decomposition, the dynamics of Thai income inequality are assessed through over time changes in the between- and within-groups contribution to overall income inequality. Following results obtained in section 2 of this paper, socioeconomic class was decomposed into four distinct sub-groups: Farmers, Industry, Services and Economically inactive.\footnote{Income received by the latter group in this socioeconomic classification is in the form of capital income ( dividends, interest, rent income, imputed rent from residing in own dwelling), pensions, public transfers, remittances.}

The decomposition results indicate that the Thai dynamics of income inequality are largely attributed to the within-group contribution which explains over 95% of total variation. In contrast, the contribution of the between-group component is much smaller, and beyond four groups, the marginal increase of this term is almost negligible, (see empirical results in previous section). The magnitude of the within-group contribution is essentially attributed to large intra-group variation leading to greater overall income inequality as shown in Table 1 below.

\begin{table}[!h]
\centering
\caption{Between- and Within-group decomposition of overall income inequality}
\begin{tabular}{lcccccc}
\hline
\hline
Within & 0.2625 & 0.6485 & 0.7087 & 0.6942 & 0.7185 & 0.6721 \\
Between & 0.0056 & 0.0134 & 0.1093 & 0.0133 & 0.0128 & 0.0099 \\
Total & 0.2640 & 0.6574 & 0.7165 & 0.7035 & 0.7278 & 0.6788 \\
\hline
\end{tabular}
\end{table}

In fact, the within-group income is significant as witnessed by the large concentration of wealth in the top decile which accounts for 10% of the population, and yet owns over 40% of total aggregated national household income.\footnote{Compared to other countries and regions, this share is extremely high. Indeed, in Deininger and Squire (1996), the income share of the top quintile is about 52% in Sub-Saharan Africa, and 40% in South Asia. The East Asia and}
1996, the income share of the bottom decile was less than 1% of total aggregated national income across all socioeconomic classes (see Table 1 in Annex 2). Redmond and Sutherland (1995), analyzing the implications of UK redistributive taxation which reduces the tax burden on all income decile, but the uppermost conclude such policy lowered the Gini coefficient by 5%. However unequal distribution of income could well be caused by unequal distribution of real assets at the upstream. Section four will investigate further the role of land and home ownership as determinant of income inequality in a pseudo panel setting.

The relatively low level of $T_B$ contribution to overall income inequality is further explained by the fact that the between-group means differentials are small. In fact, since the between-groups contribution assumes uniform distribution of income among individuals within each group—everyone receives the mean income of the group, see Theil (1972) and Cardoso (1997) and estimates the differences at the means levels, the small mean difference across groups could only produce low between-groups effects. And to the extent that the scope of within-group dispersion is important, the within-group contribution to overall income inequality will dominate the between-groups. Increased dispersion within each occupational group and the relative contribution of each sector to overall income inequality over time is further investigated in the following sub-section.

### 3.3 Dynamics of relative contribution to overall income inequality

In a previous study on the dynamics of income inequality in Thailand, the geographical location, level of education and socioeconomic class were listed as important explanatory variables for income inequality between 1975 and 1992, see Ahuja et al. (1997). Hence, the variable socioeconomic class which explains nearly 25% of overall income inequality dynamics in 1975 rose to nearly 35% in 1992. Similarly, the geographical location variable which explains over 13% of total income inequality in 1975 increased to 25% in 1992. In this sub-section, socioeconomic class is disaggregated into several components to assess the relative contribution of each component to overall income inequality, as well its dynamics over time.

---

Pacific region average is about 44% in 1990.
The distribution of total income inequality among the four groups defined earlier suggests that income inequality is largely driven by large disparities in services and industry which together account for more than 62% of total income inequality in 1996. The relative contribution of these two sectors was much higher in the previous years. However, the contribution of the industrial sector to total income inequality over time has been consistently much higher, despite its relative decline since 1990, and rapid increase in the contribution of services between 1988 and 1994. In 1996, income from services accounted for nearly 28% of total income inequality, whereas income from industry explained over 36% of total income. Table 2 below provides the share of each socioeconomic class to overall income inequality.

Table 2: Sectoral contribution to overall income inequality

<table>
<thead>
<tr>
<th>Year</th>
<th>Farmers</th>
<th>Industry</th>
<th>Services</th>
<th>Economically Inactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>0.19706</td>
<td>0.20895</td>
<td>0.17262</td>
<td>0.06868</td>
</tr>
<tr>
<td>1990</td>
<td>0.1952</td>
<td>0.25939</td>
<td>0.18712</td>
<td>0.06585</td>
</tr>
<tr>
<td>1992</td>
<td>0.15591</td>
<td>0.26239</td>
<td>0.19624</td>
<td>0.07217</td>
</tr>
<tr>
<td>1994</td>
<td>0.15761</td>
<td>0.25435</td>
<td>0.20845</td>
<td>0.0965</td>
</tr>
<tr>
<td>1996</td>
<td>0.14328</td>
<td>0.23902</td>
<td>0.18672</td>
<td>0.09465</td>
</tr>
</tbody>
</table>

The contribution of the remaining two socioeconomic classes to overall income inequality is much smaller, with certain differences: the share of income from agriculture in total income inequality has been declining, whereas the contribution from the latter socioeconomic class has been rising. Income dispersion from agriculture which accounted for nearly 20% of total variation in aggregated income in 1988 declined to 15% in 1994 and much less in 1996. On the other hand, income dispersion from the latter socioeconomic class which accounted for less than 6% of total variation increased to nearly 10% in 1994. The differences in trends in the contribution to overall income inequality are prominent up to 1994. Strangely enough however, in the year preceding the 1997 financial crisis, a downward trend is observed across all these socioeconomic classes. The negative slope across all socioeconomic classes could point to a reduction in overall aggregate income inequality, but more importantly to a depreciation of assets.
owned by individuals in the top decile on the eve of the crisis, to the extent that this was followed by sharp decline in the concentration of income in this group.

IV. Determinants of income inequality in Thailand: A pseudo-panel analysis

The emphasis of income inequality literature on the decomposition approach, which focuses on the magnitude of aggregate income inequality and the sectoral and regional contribution to overall inequality, has made it difficult to establish clear connections between economic theory and the explanation of personal income. As emphasized by Atkinson (1997), studies in this field have generally neglected these links despite their obvious nature - the shift in the demand for skilled labor and earnings dispersion, for example- and their relevance for economic policy. In this section, we attempt to fill the gap by assessing the meso-economic determinants of real per capita income inequality in a pseudo-panel of Thai households during the period 1988-1996, focusing on the level of education, access to formal financial services, remittances, and geographical concentration of wealth. Indeed, as mentioned in Deaton (1997), the semi-aggregated structure of cohort data helps bridge the gap between the microeconomic household-level data and the macroeconomic data from national accounts. Moreover, analyzing the economic determinants of income inequality at a more desegregated level as suggested by Kanbur (1998) could help explain the non-trickle down of income observed in the previous section.

4.1. Data and Estimation

4.1.1. The Data:

In this section we use data from six waves of the Thai Socio Economic Surveys (SES). The SES is a nationally representative survey covering between 11,000 and 30,000 households (see appendix for details). The large size of the Thai SES allows the construction of twelve representative age cohorts. Table 2 in annex 2 gives the number of households per cohort. Although cohort data do not help in tracking the dynamics of

---

household and individual income, they are particularly suitable in the study of income inequality given the strong age-component of the income distribution. It is therefore possible to track the same group of individual over time and apply panel data econometric techniques. Moreover, as done with panel data, cohorts can be used to control for unobservable fixed effects and better control for attrition bias.

Figure 5 presents average per capita income dynamics for selected cohorts. Besides highlighting the younger cohorts premium, younger generation being better off than older ones, this graph indicates that the extraordinary increase in per capita income culminated in 1988, and all the age groups benefited from this increase between 1986 and 1988. However, those who were in their forty’s in 1986 benefited the least from the economic boom. Between 1988 and 1996, there was a decline in the real mean income, especially in the youngest cohorts, which is consistent with the overall income distribution. Also, it’s worth noticing that there was clearly a decline in the between cohort inequality. Although such convergence is not surprising, it might suggest that the surge in cross-cohort income differentials was due to new entrants in the labor market with higher returns to education. This result merits further investigation.

![Figure 5: Dynamics of average real per capita income in selected Thai age cohorts](image)

4.1.2. Estimation Methodology

Given the panel settings of our data (panel of successive cross-sections), the estimation technique should rely on the error component model (ECM) which is modeled as follows:
\[ TH_{it} = \alpha + \beta(X_{it}) + \epsilon_{it} \]  

(6)

Where \( TH_{it} \) is the Theil index for the \( ith \) cohort at time \( t \). \( X_{it} \) is the vector of explanatory variables, and \( \epsilon_{it} = u_i + v_{it} \) the error term which is composed of cohort specific effects \( (u_i) \) and a standard (independent and identically distributed) perturbation term \( (v_{it}) \). The econometric issue with the error component model is a potential correlation between \( (u_i) \) and \( X_{it} \). In the specific case of pseudo-panels, if the cohort specific effects are correlated with the explanatory variables which is very likely— the level of education for example might be cohort specific— the Between estimator is biased. The appropriate estimator of this “fixed effect model” is the Within estimator also called Least Squares Dummy Variables (LSDV) estimator, see Mundlak (1978).

The fixed effect model can be written as follows:

\[ TH_{it} = u_i + \beta(X_{it}) + v_{it} \]  

(7)

\( (u_i) \) being the fixed effects.

Following Deaton (1985), the LSDV can be used in estimating pseudo-panels since the within operator will eliminate the cohort specific effects. Moreover, given the large size of our cohorts\(^{24} \), we can ignore the measurement error problem, which is crucial in panel and macro-econometric regressions.

In order to link effectively analyses of income inequality to economic implications for personal distribution, the choice of variables included in the \( (X_{it}) \) vector draws on recent theoretical developments on the determinants of income inequality, including financial market imperfections, see Galor and Zeira (1993), and the Political Economy school of inequality that has emphasized the role of political participation, see Persson and Tabellini (1994). One of the main underpinnings of the political economy analysis is the role of education in the distribution of income. The more educated a population, the more poor can participate in the making of political decisions, and therefore preclude the rich minority from confiscating all the fruits of growth. The level

---

\(^{24}\) See table 3 in annex 2.
of education—which is likely to change over time as it includes vocational training, is therefore supposed to have a negative effect on income inequality in Thailand. Also, financial market imperfections, and precisely asymmetric information, prevents poor to access formal credit markets. As a consequence, poor are crowded out of investment opportunities, thus widening the income gap between households. Under these conditions, the ownership of collateral assets can ease the access to formal credit markets and reduce income inequality, see Galor and Zeira (1993). Therefore, Land and Home ownership is included among the regressors as proxy for access to formal credit market.

Results presented in section three of this paper suggest that one of the characteristics of Thai income inequality is high geographical concentration around Bangkok. As a consequence, there are large regional disparities in the spatial income distribution map—the gap between Bangkok the wealthiest region and the poorest North East is considerable. Following Knight and Song (1993), we test for these spatial differentials contribution to income inequality in Thailand. A corollary of geographical concentration is the massive migration from rural areas to Bangkok. Although the impact of migration on income inequality has been extensively analyzed, there is no clear consensus about the net effect of remittances, see Taylor (1992), and Barham and Boucher (1998). Depending on the stage of the immigration process, remittances might either exacerbate or reduce income inequality. Indeed, at the early stage of this process, very few households in the rural community have established contacts at the urban area. Information is limited, and migration is a risky and costly investment that only the wealthiest households can afford to undertake. Remittances, —depending on their magnitude in relation to income from other sources would therefore aggravate inequality, see Stark and al. (1986). However, as the migration process generalizes, the cost of migrating is reduced as information is available and diffused in the rural community and remittances will have a negative impact on inequality. In this paper, our conjecture is that migration being a widespread practice in Thai rural areas, remittances should be inequality reducing. Based on the above, equation (7) can be rewritten as:

\[
TH_{it} = u_i + \beta_1 (EDUSC_{it}) + \beta_2 (LANDHOW_{it}) + \beta_3 (TRANSFAJ_{it}) + \beta_4 (CONCNT_{it}) + v_{it}
\] (8)
Where:

EDUC, LANDHOW, TRANSFAJ, CONCNT are the level of education, land and home ownership, the sum of remittances at the household level, spatial concentration of income. The regressors are cohort-specific as well as year specific. While the first three variables are expected to be inequality reducing, spatial concentration is expected to be positively related to income inequality.

In equation (8), the error term \( v_{it} \) is assumed to be independent and identically distributed (iid). As a consequence, the only correlation over time is due to the presence of the same group of individuals over time. However, analyzing income inequality on age groups over time might require more attention. Indeed, a shock on factors determining the distribution of income, —those considered (education for example) or omitted in equation (8) will tend to affect inequality at least for the next few years. If this serial correlation is ignored, the estimates of regression coefficients, although consistent, are inefficient and standard errors are biased. Equation (9) below presents the model we estimate, introducing within group serial correlation in the residual term as a Markov first order autoregressive process.

\[
TH_{it} = u_i + \beta_1(EDUC_{it}) + \beta_2(LANDHOW_{it}) + \beta_3(TRANSFAJ_{it}) + \beta_4(CONCNT_{it}) + \rho v_{i,t-1} + \xi_{it}
\]

Where \( \rho \) is the autocorrelation coefficient \((-1 \leq \rho \leq 0\)), and \( \xi_{it} \) is the iid disturbance term.

4.2. Estimation results and Policy implications

Unconditional analysis of variance (ANOVA) reveals that within cohort variance explains a predominant share of the total variance (around 80%). This result is consistent with the findings of the previous section of the paper. While the results of the Lagrange Multiplier test reject the use of the OLS, the Hausman test establishes the superiority of the LSDV over the Generalized Least Squares estimator (GLS), confirming the correlation of cohort specific effects with explanatory variables. The specification tests and the comparison of results from OLS, GLS and LSDV do not reveal any specification error, see table 5 in annex 2.
Table 3 below presents the results of the Within estimations. All variables appear with the right sign and, are statistically significant. Regressions suggest that higher average education in Thailand lowers inequality, as does a higher incidence of home ownership, and a higher incidence of remittances. Higher spatial concentration of income is inequality increasing.

<table>
<thead>
<tr>
<th></th>
<th>Coeff.</th>
<th>Std.Err.</th>
<th>t-ratio</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC</td>
<td>-1.01798</td>
<td>0.613605</td>
<td>-1.65902</td>
<td>0.101717</td>
</tr>
<tr>
<td>LANDHOW</td>
<td>-0.927836</td>
<td>0.0835427</td>
<td>-11.1061</td>
<td>4.44089e-016</td>
</tr>
<tr>
<td>TRANSFAJ</td>
<td>-3.84141e-006</td>
<td>1.65797e-006</td>
<td>-2.31693</td>
<td>0.0235265</td>
</tr>
<tr>
<td>CONCNT</td>
<td>2.28051</td>
<td>0.979687</td>
<td>2.3278</td>
<td>0.022906</td>
</tr>
</tbody>
</table>

Number of Observations: 72; F-Test: 11.5; R-Squared: 0.80

The negative and significant relationship between education and income inequality established by this study suggest that a rising level of education in Thailand could result in the better sharing of national income. These results—consistent with findings by Li, Squire, and Zou (1998) on a cross-country analysis—are of particular relevance for Thailand, a country that lags far behind other Newly Industrialized Countries in terms of performance in educational achievements. By 1990, 83% of workers had only primary education or less and by 1994, only 20% of the workforce had completed secondary school. The Thai gross enrollment rate in secondary level education was only 57 percent in 1996, well behind its neighbors. Moreover, rising level of education could help lessen the tensions on the Thai labor market, characterized by a severe shortage of skilled labor, see Zeufack (1999).

The significance of the variable Land and Home ownership suggests that a greater access to formal credit market might reduce income inequality in Thailand. The possession of collaterable assets especially in poorest regions of Thailand such as the Northeast region could therefore be encouraged or facilitated. Besides serving as proxy for greater access to formal credit markets, land ownership per se has been identified as a

---

25 In 1996, this rate was 69 percent for China, 58 percent for Malaysia, 72 percent for Singapore, 79 percent for The Philippines, 102 percent for Korea, and 92 percent for Japan (Sources: UNESCO and World Bank, EdStats).
key determinant of income inequality see Ravallion (1989), Ravallion and Chen (1998). While a higher spatial concentration of income is found to be positively correlated with income inequality, a higher incidence of remittances can help tempering inequality. These results reinforce the need to promote a more regionally balanced financial infrastructure and growth sources in Thailand.

V. CONCLUSION

This paper has analyzed the shape of empirical distribution of income in Thailand to provide a rationale for selecting a measure of income inequality. The comparison of the probability mass in the tail of these empirical distributions to the probability mass observed in the tails of two positively skewed theoretical distributions— the Gamma and Lognormal distributions— suggests the appropriateness of the Theil index. This index is more sensitive to changes in the top part of the distribution, which is of critical importance as the concentration of wealth in the uppermost decile of these distributions appears particularly important in Thailand— the income share of this group is over 40% of total national income.

In order to establish a threshold for decomposition analysis, empirical investigations based on Thai SES and allowing incremental change in the size of groupings was carried out. The results suggest that the dynamics of income inequality in Thailand are essentially driven by the large within-groups component, and the marginal increase of the between-groups effects to overall income inequality converges rapidly to zero as the number of groups increases. In fact beyond four groups, the marginal increase of the between-groups component is uniformly smaller than .002, i.e. $\Delta I_{B(k)} = I_{B(k+1)} - I_{B(k)} < .002$. This suggests that the number of terms in the decomposition analysis could well be restricted to four socioeconomic classes because, beyond such a threshold, further increasing the number of groups does not affect the distribution of total income inequality between the within- and the between component.

The paper has then applied this result to six waves of the (SES) covering the period 1986-1996, to provide a most recent update of the scope of income inequality prior to the 1997 financial crisis in Thailand. The results of the Theil index estimate not
only confirm Kakwani’s (1997) findings that the increasing trend in income inequality in Thailand depicted by Ahuja and al. (1997) might have leveled-off after 1992. Results also suggest that income inequality might have decreased in 1996, as has the growth of GDP. Moreover, the decomposition of the Theil index and its dynamics over time suggest that non-trickledown of income resulting from large concentration of wealth in industry and services could be the main causes of high income inequality in Thailand; as these two sectors account for a large share of total income inequality. Even the slight decline of income inequality prior to the 1997 financial crisis did not alter the distribution of income inequality across socioeconomic classes. Persistence of large within-group contribution and large concentration of wealth at the upper end of the distribution are preserved.

Additional causes and meso-economic determinants of the Thai income inequality were investigated using a pseudo-panel estimation approach. As many as 12 cohorts were formed in the 1986 base year, and the dynamics of income inequality were investigated by tracking the variations observed in these groups over time during the period 1986-1996. The results reveal that while education, access to formal credit markets, and remittances appear to be strong reducing factors of income inequality, the geographical concentration of income in Bangkok reinforces income inequality.

Future research will investigate the role played by Thai labor markets in the dynamics of income inequality, focussing particularly on wage differentials. As well, the positive association observed between economic growth and income inequality in Thailand is worth investigating. It might also be of interest to explore the role played by financial assets of which the appreciation over the last decade might have been critical in explaining the rising income inequality.
References:


International Monetary Fund. 1998 “Should Equity be a Goal of Economic Policy?”


Annex 1:
Data and Variables

Our data came from the 1988, 1990 and 1992, 1994, and 1996 Socioeconomic Surveys (SES). Different waves of the SES were conducted in 1975; 1981; 1986; 1988, 1990, 1992, 1994 and 1996. Besides being representative survey covering between 11,000 and 30,000 households, the SES offers the tremendous convenience of keeping the same survey design and same sampling scope over time. Given the large size of the Thai SES we were able to define twelve representative cohorts. Households are assigned to cohorts on the basis of the head’s age and, as is standard, we assume that income is shared equally within the household. So, one can assign an income to each individual and form person cohorts. Table 1 in annex 2 gives components of household income, and Table 2 gives the number of households per cohort.

The variables

Our left hand side variable, income inequality, captures the dispersion in per capita real income in each cohort and is measured by the Theil index. The education level variable is constructed in affecting the coefficient one to households whose heads have primary education or less, two to those with secondary education and three to those with higher education, technical and advanced vocational training. The Land and Home ownership variable, used to proxy access to formal credit market, was constructed following the same principle in affecting the coefficient zero to households renting land and house, one to those owning a house on a rented land, two to those receiving a rent and three to those owning land and a house. Income transfers is defined as aggregate sum of remittances received at the household level adjusted for inflation over the period of analysis. Finally, concentration is defined as the weighted income share of the region expressed as percentage of total aggregated revenue at the national level. All variables in current Baht are expressed in 1987 constant prices.
## Annex 2

### Table 1: Thai Socio Economic Survey: Components of household income Module

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>301</td>
<td>Wage and salaries</td>
</tr>
<tr>
<td>311</td>
<td>Entrepreneurial income</td>
</tr>
<tr>
<td>312</td>
<td>Farm income</td>
</tr>
<tr>
<td>313</td>
<td>Roomers and boarders</td>
</tr>
<tr>
<td>321</td>
<td>Land Rent</td>
</tr>
<tr>
<td>322</td>
<td>Other rent</td>
</tr>
<tr>
<td>323</td>
<td>Interest and dividends</td>
</tr>
<tr>
<td>331</td>
<td>Assistance and remittances</td>
</tr>
<tr>
<td>332</td>
<td>Pensions and annuities</td>
</tr>
<tr>
<td>333</td>
<td>Scholarships and grants</td>
</tr>
<tr>
<td>334</td>
<td>Terminal pay</td>
</tr>
<tr>
<td>401</td>
<td>Food as part of pay</td>
</tr>
<tr>
<td>402</td>
<td>Rent received as pay</td>
</tr>
<tr>
<td>403</td>
<td>Other goods received as pay</td>
</tr>
<tr>
<td>411</td>
<td>Home produced food</td>
</tr>
<tr>
<td>412</td>
<td>Owner occupied home</td>
</tr>
<tr>
<td>413</td>
<td>Other home produced goods</td>
</tr>
<tr>
<td>421</td>
<td>Crops received as rents</td>
</tr>
<tr>
<td>431</td>
<td>Food received free</td>
</tr>
<tr>
<td>432</td>
<td>Rent received free</td>
</tr>
<tr>
<td>433</td>
<td>Other goods received free</td>
</tr>
<tr>
<td>501</td>
<td>Money income</td>
</tr>
<tr>
<td>502</td>
<td>Income-in-kind</td>
</tr>
<tr>
<td>511</td>
<td>Proceeds from casualty insurance</td>
</tr>
<tr>
<td>512</td>
<td>Proceeds from life insurance</td>
</tr>
<tr>
<td>513</td>
<td>Lottery winnings</td>
</tr>
<tr>
<td>514</td>
<td>Remittances, bequests</td>
</tr>
<tr>
<td>515</td>
<td>Other money receipts</td>
</tr>
<tr>
<td>911</td>
<td>Total current income</td>
</tr>
<tr>
<td>912</td>
<td>Total other money income</td>
</tr>
</tbody>
</table>
**Table 2: Over time distribution of wealth in the top and bottom income decile by socioeconomic classes (in %)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Agriculture Bottom decile</th>
<th>Agriculture Top decile</th>
<th>Industry Bottom decile</th>
<th>Industry Top decile</th>
<th>Services Bottom decile</th>
<th>Services Top decile</th>
<th>Economically Inactive Bottom decile</th>
<th>Economically Inactive Top decile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>0.8</td>
<td>39.9</td>
<td>0.7</td>
<td>43.7</td>
<td>0.5</td>
<td>47.1</td>
<td>0.2</td>
<td>44.0</td>
</tr>
<tr>
<td>1990</td>
<td>0.7</td>
<td>41.9</td>
<td>0.5</td>
<td>44.8</td>
<td>0.5</td>
<td>48.5</td>
<td>0.3</td>
<td>45.9</td>
</tr>
<tr>
<td>1992</td>
<td>0.7</td>
<td>40.1</td>
<td>0.5</td>
<td>43.4</td>
<td>0.4</td>
<td>43.8</td>
<td>0.2</td>
<td>40.4</td>
</tr>
<tr>
<td>1994</td>
<td>0.2</td>
<td>45.3</td>
<td>0.2</td>
<td>48.8</td>
<td>0.1</td>
<td>53.5</td>
<td>0.1</td>
<td>44.4</td>
</tr>
<tr>
<td>1996</td>
<td>0.6</td>
<td>40.3</td>
<td>0.5</td>
<td>41.3</td>
<td>0.4</td>
<td>43.7</td>
<td>0.2</td>
<td>38.2</td>
</tr>
</tbody>
</table>

**Table 3: Number of households per cohort (Age group of the cohort in 1986)**

<table>
<thead>
<tr>
<th>Year</th>
<th>17-21</th>
<th>22-26</th>
<th>27-31</th>
<th>32-36</th>
<th>37-41</th>
<th>42-46</th>
<th>47-51</th>
<th>52-56</th>
<th>57-61</th>
<th>62-66</th>
<th>67-71</th>
<th>Over71</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>251</td>
<td>3139</td>
<td>240</td>
<td>725</td>
<td>46</td>
<td>733</td>
<td>68</td>
<td>731</td>
<td>74</td>
<td>376</td>
<td>33</td>
<td>136</td>
</tr>
<tr>
<td>1988</td>
<td>442</td>
<td>989</td>
<td>1370</td>
<td>1437</td>
<td>1198</td>
<td>1085</td>
<td>1062</td>
<td>947</td>
<td>781</td>
<td>563</td>
<td>390</td>
<td>407</td>
</tr>
<tr>
<td>1990</td>
<td>668</td>
<td>1265</td>
<td>1587</td>
<td>1701</td>
<td>1433</td>
<td>1308</td>
<td>1275</td>
<td>1199</td>
<td>872</td>
<td>579</td>
<td>388</td>
<td>419</td>
</tr>
<tr>
<td>1992</td>
<td>978</td>
<td>1451</td>
<td>1737</td>
<td>1693</td>
<td>1367</td>
<td>1276</td>
<td>1164</td>
<td>994</td>
<td>828</td>
<td>512</td>
<td>329</td>
<td>309</td>
</tr>
<tr>
<td>1994</td>
<td>1742</td>
<td>2974</td>
<td>3062</td>
<td>3478</td>
<td>2645</td>
<td>2848</td>
<td>2211</td>
<td>2457</td>
<td>1420</td>
<td>1437</td>
<td>488</td>
<td>1701</td>
</tr>
<tr>
<td>1996</td>
<td>2025</td>
<td>2710</td>
<td>3012</td>
<td>2796</td>
<td>2394</td>
<td>2239</td>
<td>2011</td>
<td>1889</td>
<td>1249</td>
<td>932</td>
<td>428</td>
<td>352</td>
</tr>
<tr>
<td>Year</td>
<td>TH1721</td>
<td>TH2226</td>
<td>TH2731</td>
<td>TH3236</td>
<td>TH3741</td>
<td>TH4246</td>
<td>TH4751</td>
<td>TH5256</td>
<td>TH5761</td>
<td>TH6266</td>
<td>TH6771</td>
<td>TH71+</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>1986</td>
<td>0.157</td>
<td>0.258</td>
<td>0.176</td>
<td>0.333</td>
<td>0.255</td>
<td>0.330</td>
<td>0.183</td>
<td>0.343</td>
<td>0.238</td>
<td>0.297</td>
<td>0.171</td>
<td>0.266</td>
</tr>
<tr>
<td>1988</td>
<td>0.190</td>
<td>0.195</td>
<td>0.211</td>
<td>0.232</td>
<td>0.230</td>
<td>0.197</td>
<td>0.176</td>
<td>0.167</td>
<td>0.159</td>
<td>0.177</td>
<td>0.126</td>
<td>0.112</td>
</tr>
<tr>
<td>1990</td>
<td>0.159</td>
<td>0.205</td>
<td>0.253</td>
<td>0.258</td>
<td>0.251</td>
<td>0.253</td>
<td>0.207</td>
<td>0.198</td>
<td>0.200</td>
<td>0.192</td>
<td>0.139</td>
<td>0.167</td>
</tr>
<tr>
<td>1992</td>
<td>0.142</td>
<td>0.174</td>
<td>0.212</td>
<td>0.218</td>
<td>0.183</td>
<td>0.173</td>
<td>0.174</td>
<td>0.175</td>
<td>0.159</td>
<td>0.156</td>
<td>0.113</td>
<td>0.130</td>
</tr>
<tr>
<td>1994</td>
<td>0.167</td>
<td>0.336</td>
<td>0.212</td>
<td>0.355</td>
<td>0.172</td>
<td>0.330</td>
<td>0.157</td>
<td>0.340</td>
<td>0.124</td>
<td>0.418</td>
<td>0.094</td>
<td>1.470</td>
</tr>
<tr>
<td>1996</td>
<td>0.167</td>
<td>0.212</td>
<td>0.209</td>
<td>0.189</td>
<td>0.178</td>
<td>0.174</td>
<td>0.180</td>
<td>0.159</td>
<td>0.152</td>
<td>0.141</td>
<td>0.126</td>
<td>0.113</td>
</tr>
</tbody>
</table>

*TH* is the Intra-Cohort Theil Index. For example, *TH1721* is the Theil index in the age group that was between 17 and 22 years old in 1986.
Table 5: Regression Results (A comparison of OLS, LSDV and GLS estimations)

Dependent Variable is the Theil index (Ztheil)

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>Within (LSDV)</th>
<th>GLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>T-Ratio</td>
<td>Coefficient</td>
</tr>
<tr>
<td>Constant</td>
<td>2.92</td>
<td>7.03</td>
<td></td>
</tr>
<tr>
<td>EDUC</td>
<td>-0.78</td>
<td>-4.37</td>
<td>-1.02</td>
</tr>
<tr>
<td>LANDHOW</td>
<td>-0.68</td>
<td>-7.74</td>
<td>-0.93</td>
</tr>
<tr>
<td>TRANSFAJ</td>
<td>-0.005</td>
<td>-2.79</td>
<td>-0.003</td>
</tr>
<tr>
<td>CONCNT</td>
<td>1.58</td>
<td>1.35</td>
<td>2.28</td>
</tr>
<tr>
<td>LM Test</td>
<td></td>
<td></td>
<td>7.52*</td>
</tr>
<tr>
<td>Hausman Test</td>
<td></td>
<td></td>
<td>9.49**</td>
</tr>
<tr>
<td>LR Test (Chi-Squared)</td>
<td></td>
<td></td>
<td>41.96***</td>
</tr>
<tr>
<td>N. obs.</td>
<td>72</td>
<td></td>
<td>72</td>
</tr>
<tr>
<td>F-Test</td>
<td>19.87***</td>
<td></td>
<td>11.5***</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.59</td>
<td></td>
<td>0.79</td>
</tr>
</tbody>
</table>

Lagrange Multiplier test (LM) against OLS
Log Likelihood test (LR) LSDV vs. OLS
Hausman Test: Random vs. Fixed Effects
***: Significant at 1% confidence level.
**: Significant at 5% confidence level.
Annex Figure 1: GDP growth and Income inequality in Thailand (1986-96)

Theil Index (%)

GDP Growth (%)

Theil index
GDP annual growth rate