Chapter 4: Micro Kuznets and Macro TFP Decompositions

This chapter provides a transition from measurement and the assemblage of facts to a documentation of key underlying drivers of the Thai economy. The decompositions here are atheoretic but standard. More to the point, they provide us with a consistent, micro and macro sense of the key variables behind movements in income, inequality, and poverty.

More specifically, macro TFP decompositions of GDP growth and micro Kuznets decompositions of household income, inequality, and poverty establish the consistent, macro/micro importance of education, financial sector, occupation/sector transitions, and again, geography. Much of the growth of GDP is attributable to factor accumulation, capital in particular. The residual – TFP growth – is highly correlated with income change. Still, there are anomalies. Within sector TFP growth is negative for manufacturing and services, for example, and positive for agriculture. Distinguishing time periods, TFP growth is negative except for the acceleration of income in the late 1980's. Decomposition by credit access in a model below will reconcile these anomalies.

Consistent with this, a micro decomposition of average income change into changes within sectors/groups and population shifts from low to high income groups shows the importance of financial access as well as education, occupation shifts, and urban to rural movements. Likewise, Kuznets decompositions using the Theil index show that inequality change is attributable to diverging average incomes across groups, especially for occupation and sector categories, and populations shifts across groups, especially for education and financial access. Poverty reduction can be attributed to the very same variables. Various models of household decision making in the chapters below will be estimated and/or calibrated and then compared to these Kuznets decompositions. The macro models used to explain TFP and the micro model used to explain inequality are exactly the same. That is, we use macro models built up from micro foundations.

4.1 A Macro TFP Decomposition

The standard macro decomposition of growth distinguishes growth of factors, that is, land, labor and capital, weighted by their respective factor shares, from the growth of productivity. The latter is the residual between weighted factor growth and actual growth. As in Young (QJE 1995), consider for example the translogarithmic value added production function:

$$Q = \exp\Big[\alpha_0 + \alpha_K \ln K + \alpha_L \ln L + \alpha_t t + \frac{1}{2} B_{KK} (\ln K)^2 + B_{KL} (\ln K)(\ln L) + B_{Kt} \ln K \cdot t + \frac{1}{2} B_{LL} (\ln L)^2 + B_{Lt} \ln L \cdot t + \frac{1}{2} B_{tt} t^2 \Big] \quad (4.1.1)$$

where K, L, and t denote capital input, labor input, and time, and where under the assumption of constant returns to scale, the parameters α_i and B_{jk} satisfy the restriction:

$$\alpha_K + \alpha_L = 1, \quad B_{KK} + B_{KL} = B_{LL} + B_{KL} = B_{Kt} + B_{Lt} = 0. \quad (4.1.2)$$

First differencing the logarithm of the production function provides a measure of the causes of growth across discrete time periods:

$$\ln\left(\frac{Q(T)}{Q(T-1)} \right) = \overline{\Theta}_K \ln\left(\frac{K(T)}{K(T-1)} \right) + \overline{\Theta}_L \ln\left(\frac{L(T)}{L(T-1)} \right) + TFP_{T-1,T}, \quad (4.1.3)$$

where

$$\overline{\Theta}_i = \left[\Theta_i(T) + \Theta_i(T-1) \right] / 2$$

and where the Θ_i's denote the elasticity of output with respect to each input i or, equivalently, assuming perfect competition, the share of each input in total factor payments. The translog index of TFP growth $\left(TFP_{T-1,T} \right)$ provides a measure of the increase in output attributable to the time-related shifts in the production function.

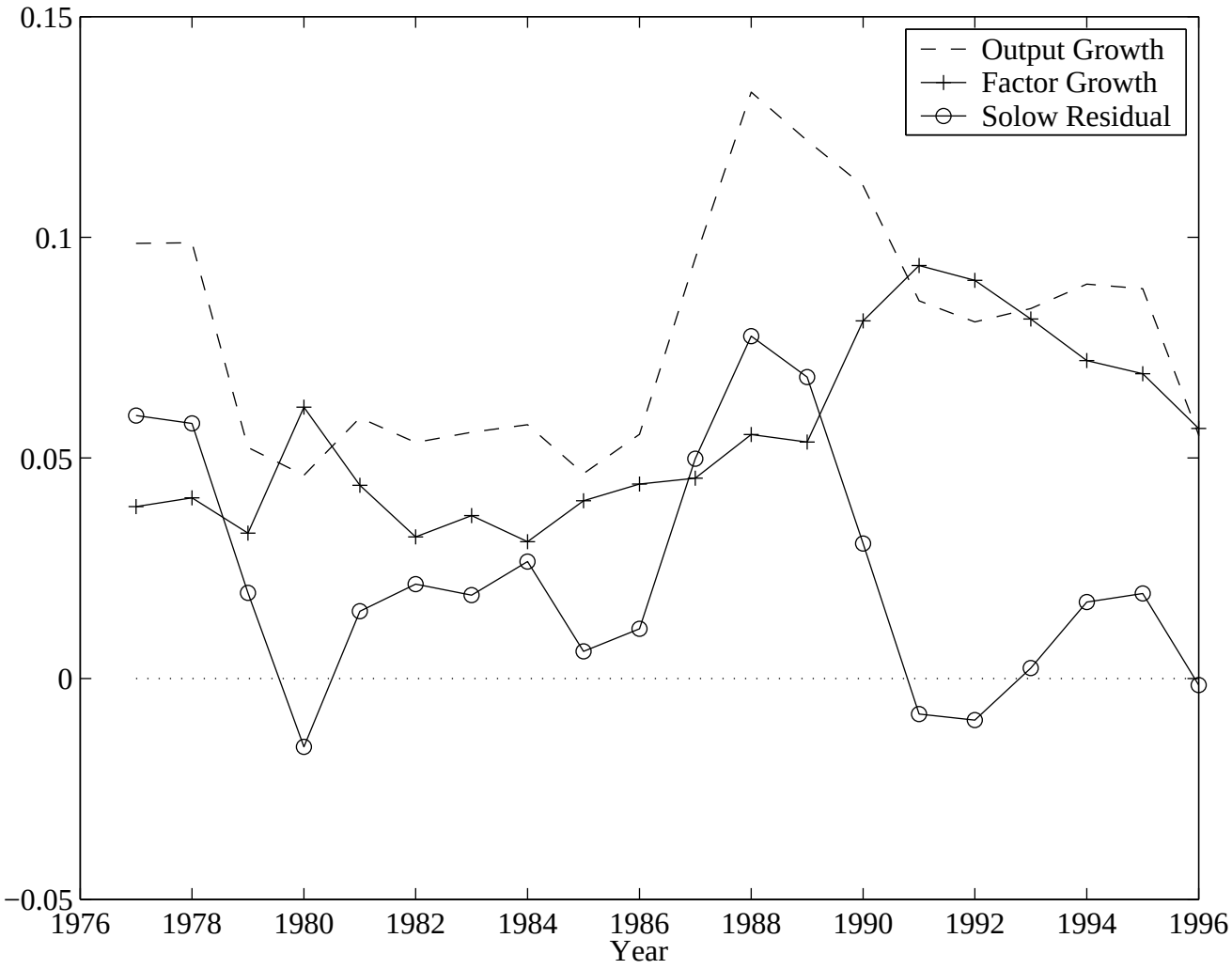

Figure 1. Standard Growth Accounting in Thailand

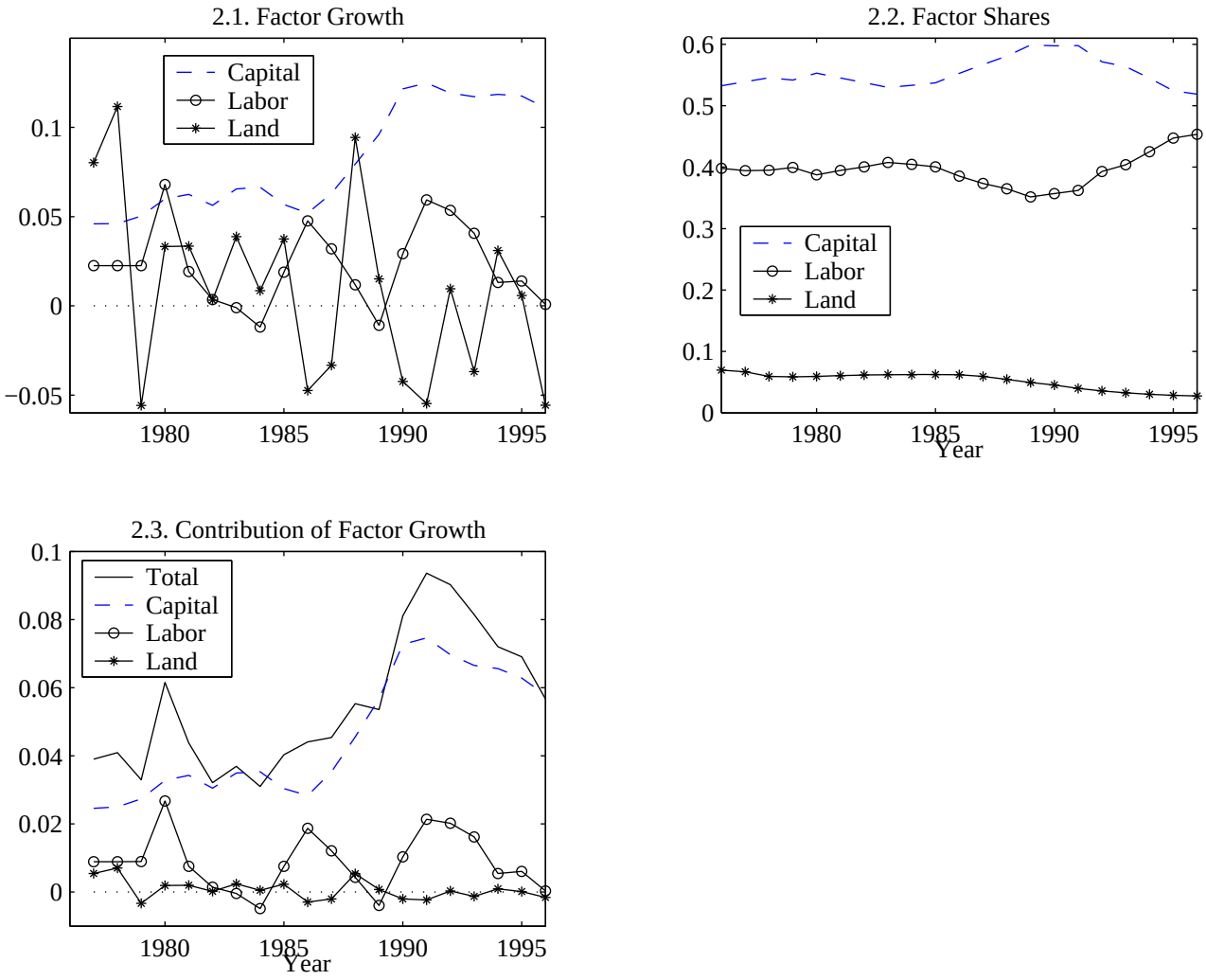

Figure 2. Decomposition of Factor Growth in Thailand

[Figure 4.1.1 Standard Growth Accounting in Thailand. Source: TDRI report, Tinakorn and Sussangkarn (1998)]

[Figure 4.1(panel 2.1-2.3) Decomposition of Factor Growth in Thailand. Source: TDRI report, Tinakorn and Sussangkarn (1998)]

In a widely used TDRI report from Sussangkarn (1998), the dominant factor for Thailand has been capital. As in Figure 4.1.1 and Figure 4.1 panel 2.1, it has the largest single share and the highest measured rate of growth. Note in panel 2.3 that its contribution to factor growth is only slightly below and moves closely with total factor growth. Total factor productivity growth (TFPG) is a non-trivial residual in panel 2.3, about half the size of total GDP growth on average and moves closely with it.

Sources of Growth By Sector

	Agriculture	Manufacturing	Industry (including manufacturing)	Service
1. Growth rate of output	3.71 (100)	10.35 (100)	10.50 (100)	7.83 (100)
2. Total Factor Input				
Without labor quality adjustment	2.42 (65.23)	9.26 (89.47)	10.08 (96.00)	7.39 (94.38)
With labor quality adjustment	2.78 (74.93)	10.47 (101.15)	11.17 (106.38)	8.23 (105.11)
2.1 Labor	0.05 (13.48)	4.18 (40.38)	3.97 (37.81)	2.93 (37.42)
Employment	0.14	2.97	2.88	2.09
Quality changes	0.36	1.21	1.09	0.84
2.2 Capital	2.24 (60.38)	6.29 (60.77)	7.20 (68.57)	5.30 (67.69)
2.3 Land	0.04 (1.08)			
3. Total Factor Productivity				
Without labor quality adjustment	1.29 (34.77)	1.09 (10.53)	0.42 (4.00)	0.44 (5.62)
With labor quality adjustment	0.93 (25.07)	-0.12 (-1.15)	-0.67 (-6.38)	-0.40 (-5.11)

Note: Numbers in parentheses indicate percentage contribution to growth
Source: Tables 13-16

[Table 4.1.2. Sources of Growth by Sector, 1981-1995 (based on 1988 prices). Source: Tinakorn and Sussangkarn (1998)]

Period	GDP Growth	Contribution from inputs			TFP	
		Capital (K Index)	Labor		Unadjusted	Adjusted
			Employment	Quality Adjusted		
1981- 1985	6.47	5.58	1.81	2.76	-0.92	-1.87
1986- 1990	14.42	7.07	3.5	3.83	3.85	3.52
1991- 1995	10.62	8.97	3.34	5.3	-1.69	-3.65
1981- 1995 (Percentage Contribution)	10.50 (100.00)	7.20 (68.57)	2.88 (27.43)	3.97 (37.81)	0.42 (4.00)	-0.67 (-6.38)

[Table 4.1.3. Contribution of input and TFP to growth: industry. Source: Tinakorn and Sussangkarn (1998)]

Period	GDP Growth	Contribution from Inputs			TFP	
		Capital (K Index)	Labor		Unadjusted	Adjusted
			Employment	Quality Adjusted		
1981-1985	5.33	3.99	1.81	2.79	-0.47	-1.45
1986-1990	10.01	5.22	1.89	3.26	2.90	1.53
1991-1995	8.15	6.71	2.58	2.73	-1.14	-1.29
1981-1995 (Percentage Contribution)	7.83 (100.00)	5.30 (67.69)	2.09 (26.69)	2.93 (37.42)	0.44 (5.62)	-0.40 (-5.11)

[Table 4.1.4. Contribution of input and TFP to growth: services. Source: Tinakorn and Sussangkarn (1998)]

Still, decompositions by sector beg questions. Total factor productivity from 1981-1985 separately for manufacturing, industry inclusive of manufacturing, and services ranges from only 4% to 10.5% of sector growth, and this goes negative when labor is adjusted for quality via the education/earnings numbers. See Table 4.1.2. Among all sectors, only agriculture has a relatively high TFP growth, at 25% and 35% of total agriculture output growth, with and without labor adjustment, respectively. Likewise, in Table 4.1.3 and 4.1.4, disaggregating into key time periods, TFP growth for sectors such as industry and services is negative for the 1981-1985 and 1991-1995 periods, positive only for the high growth spurt, 1986-1990 period.

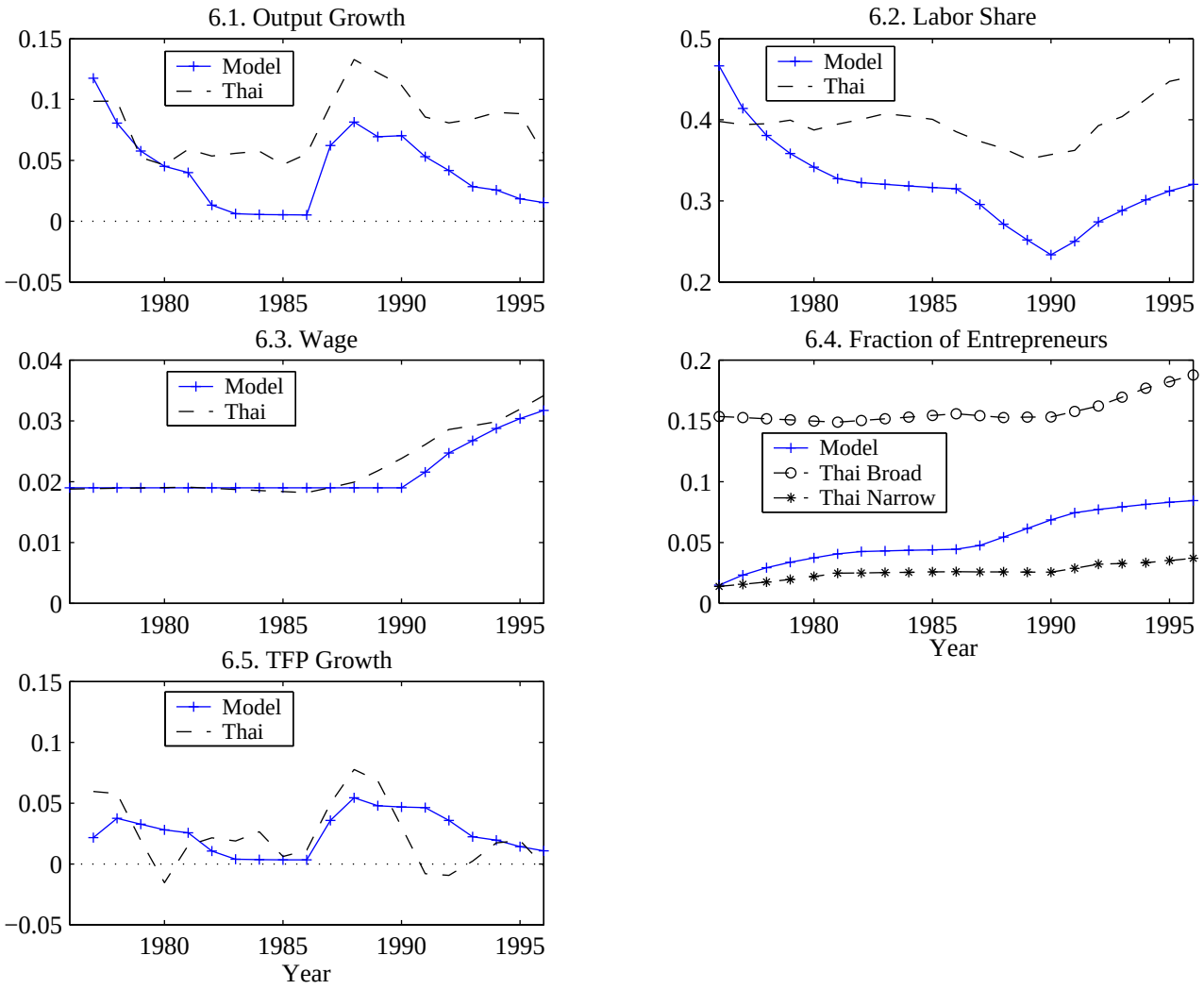

Figure 6. Aggregate Dynamics

[Fig 4.3 (a)-(e). Total-factor productivity aggregate growth dynamics. Source: Jeong and Townsend (2007).]

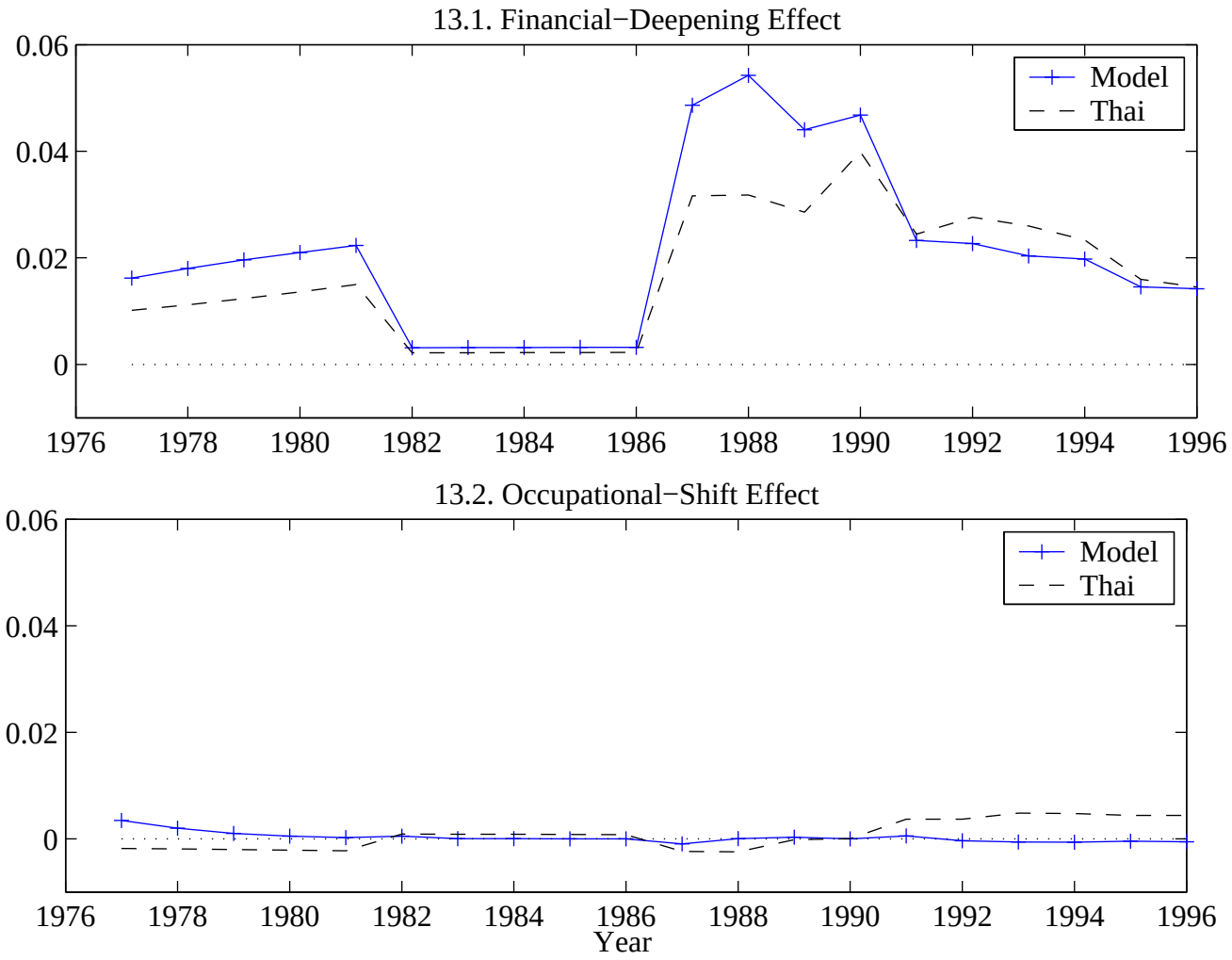

Figure 13. Sources of TFP Growth

Notes: Financial−deepening effect and occupational−shift effect are measured as in equations (38) and (39), respectively.

[Figure 4.4 (a)-(b). TFP Aggregate Growth Dynamics (top) and TFP Growth from Financial Deepening (bottom). Total-factor productivity growth from financial deepening and occupational shift effect. Source: Jeong and Townsend (2005)]

On the other hand, a decomposition which takes into account access/use of financial services yields a TFPG number which more closely tracks the aggregate. See Figure 4.1.5. This is a preview of coming attractions. The model which generated the graph will be featured below.

4.2 A Micro, Kuznets Decomposition

A more micro, Kuznets decomposition keeps track of group incomes, typically groups with low income, l, and high income, h, and population shifts Δp^h from low to high across the groups, where Δ

is a time-difference operator. Thus average per capita income, $\mu_t = p_t^h \mu_t^h + p_t^l \mu_t^l$, or simply a population-weighted average, using population proportions p_t^l and p_t^h, of groups average incomes, μ_t^l and μ_t^h. Thus the growth or change of income is approximately

$$\Delta\mu = \left\{\overline{p^h}\Delta\mu^h + \left(1-\overline{p^h}\right)\Delta\mu^l\right\} + \left(\overline{\mu^h} - \overline{\mu^l}\right)\Delta p^h . \qquad (4.2.1)$$

or more generally with categories k = 1,2,…K,

$$\Delta\mu = \sum_k \overline{p}^k \Delta\mu^k + \sum_k \overline{\mu}^k \Delta p^k \qquad (4.2.2)$$

The first terms in the above two equations are the components of growth within subgroups, and the final term the growth due to population shifts. Likewise the Theil L inequality index I is defined as

$$I \equiv \frac{1}{n}\sum_{i=1}^{n} \log\left(\frac{\mu}{y_i}\right) \qquad (4.2.3)$$

as the sum over households i of the log difference between average income μ and household i income y_i. Distinguishing again groups $k = 1,...K$, the index I consists of a within component WI and an across component AI, $I = WI + AI$, where

$$WI = \sum_{k=1}^{K} p^k I^k \quad \text{and} \quad AI = \sum_{k=1}^{K} p^k \log\left(\frac{\mu}{\mu^k}\right) \qquad (4.2.4)$$

Here, within category WI is simply the p^k population-weighted sum of inequality indexes I^k within groups k, and the across component AI is simply the population-weighted log difference between average per capita income μ and the group k average μ^k.

Taking first differences over time, $\Delta I = \Delta WI + \Delta AI$, where both the within and across measures of inequality change have an easy interpretation. The change in the within measure is much as in the earlier per-capita income growth equation 4.2.2, that is, here

$$\Delta WI = \sum_k \overline{p^k}\Delta I^k + \sum_k \overline{I^k}\Delta p^k \qquad (4.2.5)$$

the sum of $\overline{p^k}$ population-weighted change in inequality indices ΔI^k and a composition effect, intuitively, the shift Δp^k, from low to high inequality groups. The change in the across measure

$$\Delta AI = \underbrace{\sum_k \overline{p^k}\left[\frac{\overline{\mu^k}}{\mu} - 1\right]\Delta \ln \mu^k}_{\text{Divergence}} + \underbrace{\sum_k \left[\frac{\overline{\mu^k}}{\mu} - \ln\frac{\overline{\mu^k}}{\mu}\right]\Delta p^k}_{\text{Kuznets}} \qquad (4.2.6)$$

consists of a divergence term capturing the change in income differences within groups $\Delta \ln \mu^k$ at fixed population proportions $\overline{p^k}$, and another, famous Kuznets composition effect, the change in inequality due to shifting population Δp^k across groups k with incomes different from the average. Note that a given population shift may either increase or decrease inequality, depending on the number of households in a group and how far group income is from the population average. The Kuznets curve refers to a tendency for this term to be positive at first, contributing to an increase in inequality as only a "lucky" few have high incomes, then negative, as many people are in the high income group and the economy is moving toward equality at the higher income level.

Characteristics	Overall	Stage 1	Stage 2	Stage3
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

[Table 4.2.1. Composition Effects on Average Income Growth. Note: the numbers indicate percentage shares of income growth due to compositional changes out of total income growth. Source: Jeong (2008)]

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 4.2.2. Decomposition of Inequality Change. Source: Jeong (2008)]

For Thailand, we learn much from Jeong's (2001) thesis. The growth of average income in the SES, 1976-1996, as seen in column 1 of Table 4.2.1, can be attributed to population shifts across occupations or production sectors, changes in financial participation, and increasing education, with contributions ranging from 18% to 25%. All three factors jointly account for 39% of the total income change. Rural to urban shifts account for 7%.

By time period, or stages of growth described earlier, production sector/occupation is large in the first and last sub-periods, 1976-86, and 1992-1996. In contrast, financial participation is high at 27% in the high growth, financial liberalization period. Education is high at 45% in the first sub-period. Rural to urban population shifts are high in the first sub-period at 17%, and nontrivial in the last sub-period also. Note that demographic effects (age, gender) are not accounting for much here.

As for inequality, in Table 4.2.2 column 2, the change in inequality within groups is the part that is not well explained. This is the intra-group effect. This remainder ranges from 41% to 46% for the same three factors: production sector/occupation, financial participation, and education – community type also matters. Interestingly, the Kuznets composition effect in column 4 is large at 27% and 47% for financial participation and education, respectively (a second within composition effect is contained in financial deepening, at 12%), less so for sector and occupation. In contrast, income divergence effects are large at 25-32% for sector/occupation. Income divergence effects are nontrivial at 24% for urban/rural community groups, though there is a 10% population shift, composition effect, in addition.

Stage 1

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

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

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

Note: 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. Source: Jeong 2005.

[Table 4.2.3. Source: Jeong (2005)]

Focusing on inequality and these sub-periods in Table 4.2.3, the occupation effect is coming primarily from an income divergence effects in all three sub periods, with divergence in the first two sub periods and convergence in the last. (The sign is positive if it is consistent with the overall change n inequality.) The financial access/use composition effect is particularly large in the second high growth, liberalization period, as anticipated, at 35%. There are divergent income effects as well, as those with access have faster growing incomes, contributing to inequality. The income convergence effect lowering inequality is obvious for financial participation in the last sub period, but this appears for virtually all types of sub groups. In contrast, a negative sign in the table indicates a tendency to increase inequality while the overall inequality index goes down, as in the bottom table, with the composition effect in education, financial participation and community type.

The income effect in education appears more prominent now in Table 4.2.3 in each sub period than in the earlier overall decomposition in Table 4.2.2. The income effect for geography, urban/rural status is also now high, one of the largest numbers in all tables, but it moves consistent with the overall national trend, contributing to increasing inequality up at first, and then decreasing inequality.

	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

[Table 4.2.4. Decomposition of Poverty Reduction into Growth and Inequality Change. Source: Jeong (2008)]

Poverty changes can be similarly decomposed into growth and inequality effects, as reported in Table 4.2.4. As could have been anticipated from the figure of shifting histograms, growth tends to shift income distributions to the right, reducing poverty, as there is less mass on the left tail. But an increase in inequality can fatten the left tail, raising poverty. Jeong (2000) shows that the growth effect dominates the inequality effect in the first two sub periods. In the third sub period inequality goes down so the growth and inequality effect work in the same direction. This is the reason why some of the earlier change maps were so dramatic. Jeong decomposes growth and inequality effects on poverty reduction into the familiar factors: occupation, financial participation, and education - with orders of magnitude that can be

anticipated form the earlier discussion. Here, however, the occupation effect stands out more as the main driver of the reduction in equality. See Table 4.2.5.

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

Note; 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 numbers suggest reduction of poverty while negative numbers suggest 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 “Total” column is due to the residual term.

[Table 4.2.5. Composition Effects on Poverty Reduction. Source: Jeong (2008)]