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Measurement of Labor Shares and Quality-adjusted Labor Inputs in Vietnam, 1970–2019

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Abstract

One of the largest obstacles to developing a productivity account in Vietnam is the lack of the estimate on compensations of employees in the System of National Accounts. This paper constructs the data for Vietnam on hours worked by type of workers, which are cross classified by gender, education attainment, age, and employment status, and on hourly wages in each type of labor for the period 1970–2019. The data constructed in this paper is used to estimate labor share at the aggregate level, which has a micro foundation, and to develop the measure of the quality-adjusted labor input. Our estimates show that the improvement in labor quality was modest at an annual rate of 0.5% from 1970 to 2000, but accelerated to an average of 2.0% per year from 2000 to 2019, accounting for 59.4% of the growth of quality-adjusted labor input of 3.4%.

Keywords: Labor compensation; labor quality; productivity

JEL classification: C82; D24; E24; J21; N35

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1 Introduction

The CLMV countries, i.e., Cambodia, Lao PDR, Myanmar, and Vietnam, who joined the ASEAN in the second half of 1990s, are recognized as the new frontier of regional growth of ASEAN.[1] Pomfret (2013) provides a brief explanation on the "development divide" between CLMV and the ASEAN5, which is the five founding members of ASEAN with signing of the Bangkok Declaration as of August 8, 1967, i.e., Indonesia, Malaysia, the Philippines, Singapore, and Thailand. He argues, while the ASEAN5 went through a decade-long process of development from import substitution to export-oriented policies, the CLMV countries "suffered from internal and external conflicts followed by interventionist inward-looking policies and came much later to market-based outward-oriented development strategies." The divide between the new and original members is emphasized in a gap in productivity. According to APO (2020), in terms of the per-worker labor productivity level, there is a factor of more than two disparity remains in 2018, between CLMV and ASEAN6, i.e., ASEAN5 plus Brunei who joined in 1984. Even in comparison with South Asia, the CLMV's labor productivity level is inferior by 34% to that in 2018.

The "productivity divide" should be examined in terms of the total factor productivity (TFP), for comparing the countries which confront different relative prices of factor inputs. The largest obstacle to measure TFP for CLMV countries is a lack of the estimates on compensations of employees (COE) in their System of National Accounts. The first purpose of this paper is to develop the time-series estimates of COE and total labor shares for the Vietnamese economy from 1970 to 2019, based on a bottom-up approach from the elementary-level estimates of labor compensations by type of workers.[2] For that purpose, the first task is to develop the employment matrix, which is defined by hours worked cross-classified by four categories, i.e., gender, education attainment, age, and employment status. Second, based on available fragmentary information on wages/incomes and the information on relative wages among different classes in each category of labor, the hourly wage matrix is constructed. Finally, the labor compensation matrix is developed.

The second purpose of this paper to develop the quality-adjusted labor inputs (QALI) for Vietnam as an appropriate measure of labor input in productivity account, following the approach set out by Jorgenson and Griliches (1995). The QALI aims to reflect the heterogeneity of each hour worked among different types of workers, which the traditional measures of aggregate labor inputs, i.e., number of workers/jobs, full-time equivalents, and hours worked, fail to account for. To construct QALI requires information on worker characteristics to distinguish the workforce into different types, which are then weighted by their marginal productivities, usually approximated by their respective hourly wages.[3] Based on the developed matrices on hours worked and labor

[1] The Vietnam joined the ASEAN as of July 28, 1995, followed by Lao PDR and Myanmar as of July 23, 1997, and Cambodia as of April 30, 1999.

[2] Compared to a bottom-up approach to estimate the time-series COE, a top-down approach has been used for Vietnam in our Asia QALI Database, based on the aggregated estimates of COE+MX (mixed income), which were fragmentary available in some years by General Statistics Office of Vietnam (GSO). However, our top-down estimates have resulted in fluctuations that are difficult to explain as discussed in Section 3.5. By newly using the comprehensive book, *Vietnam Statistical Data in the 20th century* (GSO 2004), a bottom-up approach can be applied in this paper.

[3] The 2008 System of National Accounts (2008 SNA) of the United Nations (2009) recommends developing QALI as an alternative measure of labor inputs to those assuming homogeneity. However, it also notes that measuring QALI is "very data intensive and only those countries that have highly developed statistical systems are likely to have the detailed data required"

compensation, the QALI measures for the Vietnamese economy are estimated.

This study is positioned as one of the Asia QALI Database developments, which has been conducted by the authors and some collaborators at Keio Economic Observatory (KEO), Keio University in Tokyo since 2013. The first report on the Asia QALI Database was provided in Nomura and Akashi (2017) for six South Asian countries. The latest version covers 25 Asian economies and is used to construct the productivity accounts for these economies as the APO Productivity Database, which has been developed by a joint research effort between the Asian Productivity Organization (APO) and KEO since 2007 (APO 2020). This paper is the second report of the Asia QALI Database.

The paper is structured as follows. Section 2 provides the definitions of the cross-classified data on number of employment, hours worked, and hourly wages. The data constraints, such as the cases of no survey results or some less-disaggregated data available, require a measurement framework to develop a fully cross-classified labor matrix. The framework to compensating a missing information is provided in Appendix A.1. Section 3 discusses data development and some issues in our observation period 1970–2019, with descriptions on the data sources and classifications. The estimated measures of COE and labor shares to GDP for Vietnam are examined with the results in other ASEAN countries as Indonesia, Malaysia, and Thailand and in the six South Asian countries, in which the official COE estimates in the national accounts and richer data on wage/income are available. Section 4 discusses the estimates of labor quality changes and QALI in Vietnam. Section 5 concludes.

2 Framework

The framework for measuring labor input and compensation is presented in this section. Our methodology follows the approach set out by Jorgenson and Griliches (1995), in which an index number of aggregate labor input was constructed, based on labor compensation data for male workers, classified by educational attainment. To account for the heterogeneity in hours worked, workers are distinguished by four categories with the following notation: $geas$ subscripts for gender (g), education (e), age (a), and employment status (s), in Vietnam. The following variables are defined at the elementary level in our measurement:

N_{geas} employment matrix, number of workers in category $geas$,
H_{geas} hours worked by all workers in category $geas$,
H_l abbreviation for H_{geas},
h_l hours worked per worker of category l ($H_l = N_l h_l$),
w_l hourly wage of category l,
L_l labor input of category l,
P_l^L price of labor input of category l, and
V_l^L nominal labor compensation of category l ($\mathrm{V}_l^L = \mathrm{P}_l^L L_l = H_l w_l$).

(para. 19.55, 2008 SNA).

These variables are defined in year (t) as $N_{geas,t}$. For simplification, we omit t, as long as it may not confuse the framework.

We aggregate the volume of labor input using a translog quantity index of the individual components:

(1) $\Delta \ln L = \sum_l \bar{v}_l^L \Delta \ln L_l$,

where the weights $\bar{v}_l^L$ are the two-period average share of each type of labor income in total labor income. To quantify the impact of substitution among different types of labor input, we assume that labor input for each category L_l is proportional to hours worked H_l:

(2) $L_l = \varphi_l H_l$,

where the constants of proportionality φ_l transform hours worked into flows of labor services. By the identity of nominal labor compensation as $P_l^L L_l = H_l w_l$, this infers that the price of labor input for each category is proportional to hourly wage w_l:

(3) $P_l^L = w_l/\varphi_l$.

We assume that labor services are the same at all points in time for each category of hours worked in each country. For example, an hour worked by a male employee, aged 40, with four years of college education represents the same labor input in 1970 as in 2019, regardless of the difference in cohorts.

Under assumption of Equation (2), the labor quantity index in Equation (1) is expressed in terms of hours worked:

(4) $\Delta \ln L = \sum_l \bar{v}_l^L \Delta \ln H_l$.

L measures the quality-adjusted labor input (QALI),[4] since L aggregates hours worked by different types of workers, which are weighted by their marginal productivities, approximated by their respective hourly wages.[5] The corresponding price of labor input P^L is implicitly defined as the ratio of the value of labor compensation V^L $(= \sum_l V_l^L)$ to the volume index as:

(5) $P^L = V^L/L$.

Compared to the quality-adjusted price index of labor input P^L, we define a simple average of hourly wage at the aggregate level as:

(6) $w = V^L/H$.

where

(7) $H = \sum_l H_l$

is the unweighted sum of each type of hours worked. Finally, the labor quality index Q is defined from both of the quantity and price sides as:

(8) $Q = L/H = w/P^L$.

Labor quality Q measures the part of labor input volume which is not explained by the number of hours worked observed. This also indicates the part of hourly wage which is not explained by the

[4] Observations of the constants φ_l are not required to define aggregate labor input.

[5] The 2008 SNA came to refer to the quality-adjusted labor input as a measure of labor inputs (United Nations 2009, Chapter 19), in addition to the conventional metrics of full-time equivalents and total actual hours worked. It is described that the volume index of QALI is "weighted together using average hourly wages for a worker falling into each category. The premise behind this approach is that workers are hired only until their marginal price (that is, their wages, including on-costs) is less than the marginal revenue expected to result from their production." (para 19.56).

quality-adjusted price of labor input. In our measurement, the aggregate measures of price, quantity, and quality defined in the equations (5)–(8) are measured for total employment (all s) and for employees only (s=1).

Following the methodology employed in Jorgenson, Gollop, and Fraumeni (1987) and Ho and Jorgenson (1999), the labor quality index is disaggregated into first- to fourth-order indices to facilitate the investigation of the sources of labor quality change. This JGF's disaggregation is formulated as

$$\begin{aligned}\Delta \ln Q = {} & \Delta \ln Q_G + \Delta \ln Q_E + \Delta \ln Q_A + \Delta \ln Q_S \\ & + \Delta \ln Q_{GE} + \Delta \ln Q_{GA} + \Delta \ln Q_{GS} + \cdots + \Delta \ln Q_{AS} \\ & + \Delta \ln Q_{GEA} + \Delta \ln Q_{GES} + \Delta \ln Q_{GAS} + \Delta \ln Q_{EAS} \\ & + \Delta \ln Q_{GEAS} \ ,\end{aligned} \tag{9}$$

where $\Delta \ln Q_G$ is an example of a first order index (for gender), $\Delta \ln Q_{GE}$ a second order index (for gender and education), and so on. Uppercase subscripts are used to signify that only one index exists for each dimension. For example, only one Q_G exists, whereas H_g, defined in equation (10), exists for each gender, male and female.

We now explicitly define the first order index and second order index. For the dimension of gender, we have

$$H_g = \sum_e \sum_a \sum_s H_l \tag{10}$$

and

$$\Delta \ln L_G = \sum_g \bar{v}_g^L \Delta \ln H_g \ , \tag{11}$$

where the weights $\bar{v}_g^L$ are the two-period average share of each type of labor income in total labor income. Then, the first order index for gender is defined as

$$\Delta \ln Q_G = \Delta \ln L_G - \Delta \ln H. \tag{12}$$

Similarly, the first order indices can be calculated for the other eas dimensions. The second order index is defined as

$$\Delta \ln Q_{GE} = \Delta \ln L_{GE} - \Delta \ln Q_G - \Delta \ln Q_E - \Delta \ln H, \tag{13}$$

where

$$\Delta \ln L_{GE} = \sum_{ge} \bar{v}_{ge}^L \Delta \ln H_{ge} \tag{14}$$

and

$$H_{ge} = \sum_a \sum_s H_l \ . \tag{15}$$

Similar second order indices can be calculated for each pair of the $geas$ dimensions, giving a total of six second order indices. There are four third order indices and one fourth order index. The sum of the growth rates of all orders' labor qualities provides the JGF decomposition formula presented in equation (9).

3 Measurement

3.1 Data Sources

The data used for constructing the labor matrix in Vietnam are listed in Table 1.[6] Two kinds of primary statistics are available in Vietnam: the *Population and Housing Census* (PHC) and the *Labour Force Survey* (LFS). The first PHC in Vietnam was conducted by General Statistics Office of Vietnam (GSO), the Ministry of Planning and Investment, in 1979 and has been implemented four times so far at intervals of 10 years[7]. The LFS was conducted for the first time in 1996 by Ministry of Labour, Invalids and Social Affairs (MOLISA) and had been published until 2007 on an annual basis. On the other hand, from 2007, GSO also started to conduct LFS (therefore Vietnam has two types of LFS in 2007 at one-month interval). According to Roubaud et al. (2008), the MOLISA-LFS mainly focuses on measuring unemployment and the GSO-LFS aims at measuring employment, although both surveys have quite similar purposes, sample design, and content of questionnaire and indicators[8].

For the periods before 1995, the estimates on number of workers are available in *Vietnam Statistical Data in the 20th Century* (GSO 2004) for 1976–1985, in Tran (1997) for 1976–1995, in the *Statistical Yearbook* 1976 by GSO in North Vietnam for 1970–1975, and in the *Statistical Yearbook* 1972 by National Institute of Statistics (NIS) in South Vietnam for 1971–1975 (projections by NIS). The comprehensive statistical book of GSO (2004) with nearly 5,000 pages is the most important data source for our long-term measurement.[9]

The data on monthly wages are available in GSO-LFS for 2012–2019, in the *Data on Vietnam's Female Labour* by Center for Study on Women Worker (CSWW) for 1996, and in *Vietnam Statistical Data in the 20th century* composed by GSO (2004) for 1970–1985. Only for employees in state sector, the monthly wage is available in GSO (2004) for 1976–1985 and 1991–1993 (only for managers), in the *Statistical Yearbook of Vietnam* (SYB) by GSO for 2000–2004, in Japan External Trade Organization (JETRO 1987, 1993) for 1975–1984 and 1985–1989. As a reference series, the wages information in Japanese companies in Vietnam were available in the *Survey on Business Conditions of Japanese Companies in Asia and Oceania* by JETRO for 1995–2000 and 2002–2018. In addition, the monthly average income per capita by sources of income are estimated in the *Living Standards Survey* (LSS) conducted by GSO for 1993[10], in the *Household*

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[7] On the latest PHC, GSO (2020) indicates that "the 2019 Census collected basic population and housing information from usual residents and designated household; in-depth information on population, demography, employment, household living conditions, etc., were only collected from the representative population identified in the sample survey of the Census." The size of the sample survey is 9% of the population. Only estimates of share are published.

[8] Section 3 in Roubaud et al. (2008) provides the detail comparison on the two types of LFS in 2007.

[9] GSO (2004) consists of three volumes, the first is "Vietnam statistical data, 1901–1975," the second is "Vietnam statistical data, 1976–2000," and the third is "21 statistical large-scale surveys and censuses in the 20th century." The second volume is divided to the first part on ten years operating under a subsidized centrally-planned economic system during 1976–1985 and the second part on the first fifteen years after the renovation policy (Doi Moi policy) in general and economic reform in particular were initiated by the Communist Party of Vietnam during 1986–2000.

[10] The two LSS were implemented in 1992/93 and 1997/98 based on the funds from the UNDP and SIDA (Swedish International Development Cooperation Agency) with technical assistance by the World Bank (Phung and Nguyen 2004). The LSS was taken over by HLSS (Household Living Standards Survey) in 2002 and the income data are available from the 2008 HLSS.

Living Standards Survey (HLSS) by GSO since 2008, in GSO (2004) for 1992–1996 and 1999, and in the SYB for 2002, 2004, and 2006. These income estimates may include non-wage income, but if possible, after making such adjustments, they will be used to compensate for missing wage trends.

Table 1: Data Sources

	seq	Sources		Categories	Periods
N	1	GSO	Population and Housing Census (PHC)	ge	1989, (2019)
				ga	1989, 1999
				gs	(2019)
				g	1989, 1999, 2009, (2019)
	2	MOLISA	Labour Force Survey (LFS)	ge	1996–2006
				ga	2004–2007
				gs	1996–2005, 2007
	3	GSO	Labour Force Survey (LFS)	ge	2007–2019
				ga	2007–2019
				gs	2007, 2009–2019
	4	GSO	Statistical Yearbook 1976 (SYB)	s_0 (in North Vietnam)	1970–1975
	5	NIS	Statistical Yearbook 1972 (SYB)	s_0 (in South Vietnam)	1971–1975 (projection)
	6	GSO (2004)	Vietnam Statistical Data in the 20th Century	s_0	1976–1985
	7	Tran (1997)	Vietnam's Long-term Economic Statistics: 1976–1995	s_0	1976–1995
	8	IISS	Military Balance	s_0	1970–2019
h^w	9	MOLISA	Labour Force Survey (LFS)	ga	2006
				gs	1996–2005
				g	1996–2005
	10	GSO	Labour Force Survey (LFS)	ge	2007–2008, 2010–2012
				ga	2007–2012
				gs	2007–2012
				g	2007–2019
w	11	GSO	Labour Force Survey (LFS)	ges_1, gas_1	2007, 2009–2012
h^mw	12	GSO	Labour Force Survey (LFS)	ges_1	2012–2019
	13	GSO	Living Standards Survey (LSS)	ges_1	1993
	14	CSWW (1996)	Data on Female Labour in Vietnam 1993	gs_1	1996
	15	GSO (2004)	Vietnam Statistical Data in the 20th Century	s_1 (in North Vietnam)	1970–1975
				s_1 (in state sector)	1976–1985
				s_1 (manager in state sector)	1991–1993
	16	GSO	Statistical Yearbook 2005 (SYB)	s_1 (in state sector)	2000–2004
	17	JETRO	Survey on Business Conditions of Japanese Companies in Asia and Oceania	s_1 (in Japanese company)	1995–2000, 2002–2018
	18	JETRO (1993, 1987)	Indochina Information	s_1 (in state sector)	1985–1989, 1975–1984
h^mw +α (monthly income)	19	GSO	Household Living Standards Survey (HLSS)	s_0, s_1	2008, 2010, 2012, 2014, 2016, 2018
	20	GSO	Living Standards Survey (LSS)	s_0, s_1	1993
	21	GSO	Statistical Yearbook 2003, 2006, 2008 (SYB)	s_0, s_1	2002, 2004, 2006
	22	GSO (2004)	Vietnam Statistical Data in the 20th Century	s_0	1992–1996, 1999
				s_1	1994–1996, 1999
(ref) COE+MX	23	GSO	Vietnam Input-Output Table (VIE-IOT)	s_0	1996, 2000, 2007, 2012
	24	GSO (1992)	Vietnam Economy 1986–1991	s_0	1989
	25	GSO (2004)	Vietnam Statistical Data in the 20th Century	s_0 (in South Vietnam)	1970–1972
(ref) COE	26	GSO (1992)	Vietnam Economy 1986–1991	s_1	1989

Note: h^mw is monthly wage per worker and $h^mw+\alpha$ is monthly income per capita. GSO, MOLISA, NIS, IISS, and CSWW represent General Statistical Office of Vietnam, Ministry of Labour, Invalids and Social Affairs (MOLISA), National Institute of Statistics (in South Vietnam), International Institute of Strategic Studies, and Center for Study on Women Worker. The number of employment (N) for South Vietnam in 1971–1975 is the projection estimates by NIS, based on the data in 1962–1969. In GSO (2004), the COE+MX for South Vietnam in 1962–1972 is published. Only estimates of share are available in the 2019 PHC.

At the aggregate level, COE is not available in the Vietnam's System of National Accounts, but the COE+MX have been estimated several times in the *Vietnam Input-Output Table* (VIE-IOT) for four periods 1996, 2000, 2007, and 2012 and in GSO (2004) only for South Vietnam in 1970–1972. In addition, the *Vietnam Economy 1986–1991* (GSO 1992) published by Statistical Publishing House, which is a unit of GSO, provides the COE estimate for the year of 1989. These estimates are used as a reference series in comparison with the estimates from this paper's bottom-up approach.[11] The employment and compensation matrices to be constructed in this paper are

[11] Only in 1989, the COE estimate is available in GSO (1992). However, the COE in private companies and cooperative organizations are not separately estimated from the COE+MX. Since it must be below the true COE, the 1989 estimate is not used as the benchmark in the bottom-up approach in this paper.

based on four categories defined in Table 2. Each labor input is classified to $2 \times 7 \times 11 \times 3 = 462$ groups.

Table 2: Labor Categories

Period (t)	1970-2019
Gender (g)	1) Male, 2) Female
Education attainment (e)	1) Never attended, 2) Not completed primary school, 3) Finish primary school, 4) Completed lower secondary school, 5) Completed secondary school, 6) Vocational training, Secondary vocational school, 7) College, university, and higher
Age (a)	1) 15-19, 2) 20-24, 3) 25-29, 4) 30-34, 5) 35-39, 6) 40-44, 7) 45-49, 8) 50-54, 9) 55-59, 10) 60-64, 11) 65 and over
Employment status (s)	1) Employee, Employer, 2) Own account workers, 3) Contributing family workers

3.2 Number of Workers

In Table 3, survey data on the number of workers from the PHC, MOLISA-LFS and GSO-LFS, and the SYB published by GSO and NIS and the estimates in Tran (1997) are compared with the ILO modelled estimates and our estimates. In the years before the MOLISA-LFS was conducted, GSO had published the estimates on the number of workers in SYB. The numbers of workers in SYB and MOLISA-LFS seem to be consistent in the connection period between 1995 and 1996. In addition, there is no considerable gap in the total number of workers between MOLISA-LFS and GSO-LFS in 2007.[12] The number of employment was investigated based on the usual economic activity in the past PHC in 1979, 1989, and 1999, compared to that the 2009 PHC and the LFS are based on the current economic activity[13]. In our measurement, the total number of workers is benchmarked by the 2009 PHC and the LFS and the estimates of the 1979, 1989, 1999, and 2019 PHC are used only to provide the information on worker composition. In 1970–1975, the sum of the SYB estimates in North and South Vietnam is used as the constraints of total number of workers[14]. Since the number of persons engaged in armed forces is not included in any labor data in Vietnam, the estimate based on the *Military Balance* published by the International Institute of Strategic Studies (IISS) is added in our estimates.[15]

[12] The total numbers of workers in the MOLISA- and GSO-LFS are 46.5 thousand and 46.2 thousand, respectively in 2007. However, the shares of unpaid family workers in total employment differ considerably as 42% and 13%, due to the difference in the definition of employment status as pointed in Roubaud et al. (2008).

[13] The current status approach in the 2009, 2019 PHC and the LFS related to the economic activity over a seven-day period before the investigation, the usual status approach in the 1979, 1989, and 1999 PHC relates to the main economic activity over the twelve-month period.

[14] Since the number of total workers in 1970 in South Vietnam was not available in SYB, it was extrapolated using the growth rate of that in North Vietnam from 1971 to 1970. In 1971, the total number of workers are estimated as 7.9 million in North Vietnam and 7.2 million in South Vietnam.

[15] All workers engaged in the armed forces are classified into employees. On gender composition, Nguyen (2016) indicates that there were 6,000 women in the Women's Armed Forces Corps of South Vietnam in 1975 and Quốc phòng toàn dân (*National Defense Journal*) presents female shares in the army as 2.2% in 2013 and 2014. In 1975, in which Vietnam was still divided into North and South, we assume that the same number of women engaged in the armed forces in North Vietnam (the estimated female share is 0.9%). In 1976–2012, they are linearly interpolated. The compositions in age and educational classes by gender are assumed to be identical with those in other employees aged under 29 (a=1–3 in in Table 2).

Table 3: Number of Total Employment

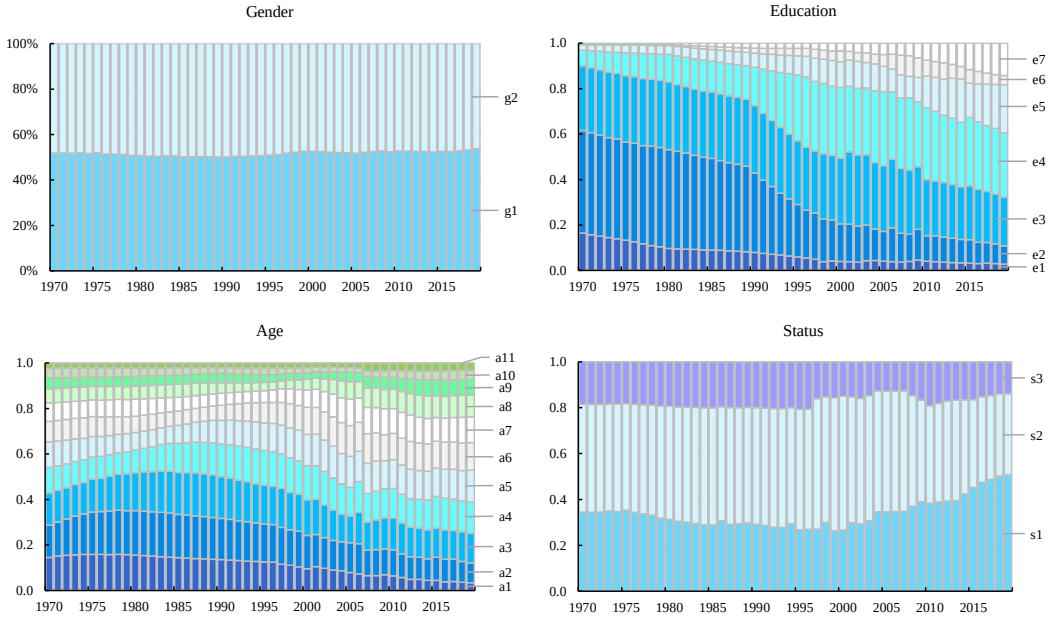
	Our estimates		a. PHC	b. MOLISA -LFS	c. GSO-LFS	d. GSO (2004)	e. Tran (1997)	f. ILO modelled estimates	g. GSO-SYB	h. NIS-SYB	i. IISS
									in North Vietnam	Projection in South Vietnam	Military
		sum	1	2	3	6	7		4	5	8
1970	15,003	g+h'+i							7,098		913
1971	16,076	g+h+i							7,924	7,160	992
1972	16,216	g+h+i							7,797	7,403	1,016
1973	16,920	g+h+i							8,043	7,727	1,150
1974	18,226	g+h+i							8,835	8,243	1,148
1975	19,514	g+h+i							9,114	9,022	1,378
1976	20,569	d+i				19,358	18,358				1,211
1977	21,046	d+i				19,835	19,056				1,211
1978	21,647	d+i				20,436	19,194				1,211
1979	22,092	d+i	21,808			21,069	19,377				1,023
1980	22,668	d+i				21,639	19,999				1,029
1981	23,556	d+i				22,527	20,363				1,029
1982	24,577	d+i				23,548	21,284				1,029
1983	25,562	d+i				24,362	22,075				1,200
1984	26,341	d+i				25,114	23,149				1,227
1985	27,052	d+i				26,025	26,025				1,027
1986	28,554	e+i					27,399				1,155
1987	29,228	e+i					27,968				1,260
1988	29,729	e+i					28,477				1,252
1989	30,190	e+i	28,051				28,940				1,250
1990	31,336	e+i					30,286				1,050
1991	32,014	e+i					30,974	32,985			1,040
1992	32,672	e+i					31,815	33,807			857
1993	33,575	e+i					32,718	34,627			857
1994	34,364	e+i					33,664	35,468			700
1995	35,302	e+i					34,680	36,327			622
1996	36,022	b'+i		35,384				37,154			622
1997	36,176	b'+i		35,603				37,698			557
1998	37,496	b'+i		36,954				38,899			524
1999	38,662	b'+i	35,847	38,120				39,864			524
2000	38,910	b'+i		38,368				40,811			524
2001	39,543	b'+i		39,000				41,648			524
2002	40,705	b'+i		40,162				42,858			524
2003	41,719	b'+i		41,176				43,670			524
2004	42,845	b'+i		42,316				44,600			510
2005	43,968	b'+i		43,452				45,534			495
2006	44,496	b'+i		43,980				46,403			495
2007	45,540	b'+i		45,208	46,018			47,329			495
2008	46,313	c'+i			46,461			48,394			495
2009	48,177	a+i	47,682		48,012			49,341			495
2010	49,679	c'+i			49,494			50,684			522
2011	51,058	c'+i			50,881			51,634			522
2012	51,592	c'+i			51,421			52,453			522
2013	52,370	c'+i			52,206			53,587			522
2014	52,913	c'+i			52,754			54,317			522
2015	53,000	c'+i			52,839			54,575			522
2016	53,460	c'+i			53,302			54,826			522
2017	53,861	c'+i			53,702			55,407			522
2018	54,413	c'+i			54,252			55,784			522
2019	54,824	c'+i			54,659			56,210			522

Unit: thousand persons. Sources: Data listed in Table 1 and our estimates. Note: The numbers under the data name indicate the sequence of the data in Table 1.The c' in the third column represents for the adjusted estimate of c (in this case, benchmarking with the 2009 PHC). The data in the 1979 PHC is estimated based on the number of the labor force assuming constant employment ratio in the 1989 PHC.

In the compositions of employment status, there are a considerable gap between the MOLISA- and GSO-LFS in 2007. In estimating the number of workers by employment status, the GSO-LFS is used as the baseline in the period 1996–2006, it is backwardly estimated using growth rates

derived from the MOLISA-LFS. Before 1995, the number of employees is estimated using the data on number of workers by industry in SYB, based on the assumption that the workers who belong to agriculture are mainly own account workers or unpaid family workers. In other labor categories, i.e., gender and education, the estimates in each composition in both LFS are used without any adjustment, since the gaps are minor.

The two-dimension number-of-worker data provided in the PHC and LFS (N_{ge} and N_{ga}) are used to estimate three-dimension data (N_{gea}) using the information of the corresponding labor force data (F_{gea}) as the initial values to provide the $e \times a$ matrix information (see Appendices A.1 and A.2). In addition, the estimated N_{gea} and N_{gs} are used to estimate the four-dimension data (N_{geas}). Since we could not find the $ea \times s$ matrix information in any data in Vietnam, the information in Thailand is used to provide the initial values in matrix balancing.[16]



Sources: Our estimates based on PHC and LFS in Table 1. Note: See Table 2 for the definition of labor categories and Table 12 (Appendix A.3) for the numbers.

Figure 1: Employment Composition in Each Category

The estimated employment-compositions in each category are presented in Figure 1.[17] A large share of female workers is one of the properties in Vietnam, as males have less than 50% of total non-military workers until the beginning of the 1990s. The Vietnam war during 1955–1975 has enlarged female roles as labor force due to mobilization of males[18]. Another reason is that a

[16] In our Asia QALI Database project, the four-dimensional cross-classified data (N_{geas}, h_{geas}, and w_{geas}) of LFS in Thailand is purchased by the Director of Statistical Information Dissemination and Service Group, National Statistical Office for the period 1980–2016 and it is estimated backwardly until 1970. Considering the gap in per-capita real GDP between Vietnam and Thailand, the lag of 27 years is assumed to provide the $ea \times s$ matrix information: i.e., the composition information in Thailand for the year 1991 is applied to provide the initial values to estimate the composition in Vietnam for the year 2018 (the information for the period 1970–1996 in Vietnam, the Thailand data as of the initial observation period, i.e., 1970, is applied).

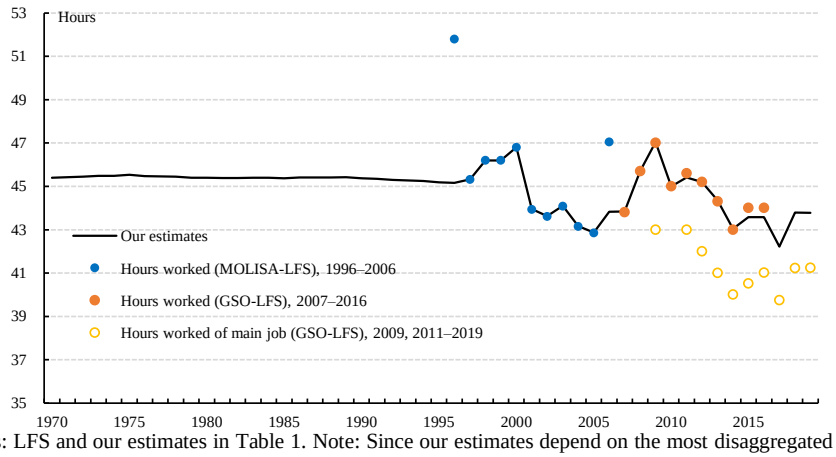
[17] In MOLISA-LFS, the female share in total employment fluctuates from 48.1% in 2005, 46.5% in 2006, and 48.8% in 2007. Since these trends are not found in our auxiliary employment data (Appendix A.1), the original data of N_{ga} in 2006 are adjusted.

[18] The number of armed forces peaked to 1.38 million (7.1% of total workers) in 1975, in which the female worker share is 51.6% of non-military workers, as shown in Table 12 (Appendix A.3).

socialist regime tends to encourage women to get in the labor market "through high investment in female education and generous provision of state-provided child care and other family support measures," as described in Kreibaum and Klasen (2015). They also indicate that the war has a positive effect on the female labor participation and especially in Northern Vietnam, due to "a combination of economic dire straits and political ideology pulled and kept women in the workforce." In our estimates, the share of workers who have never attended school (N_{e_1}) in female employment is only 20% as of the initial period of our observation in 1970. This level is close to the level in the early 1980s in Sri Lanka, which has the highest average schooling years among South Asian countries (Nomura and Akashi 2017).

3.3 Average Hours Worked

Figure 2 compares the MOLISA-LFS and GSO-LFS estimates on the weekly average hours worked per worker (h^w). In GSO-LFS, the two kinds of estimates of h^w for main job and total jobs are published until 2016. Our estimates follow the estimate of h^w for total jobs (since 2017, in which h^w for total job is not available, it is estimated using the changes in h^w for main job). In MOLISA-LFS, the h^w data is available in 1996–2006. However, since we could not justify longer h^w in 1996 and 2006, we use the MOLISA-LFS estimates only for the period 1997–2005. To convert from the weekly average hours worked per worker (h^w) to the annual hours worked per worker (h), we apply 49.8–51.1 weeks per year, which is counted by considering the number of national holidays in Vietnam.

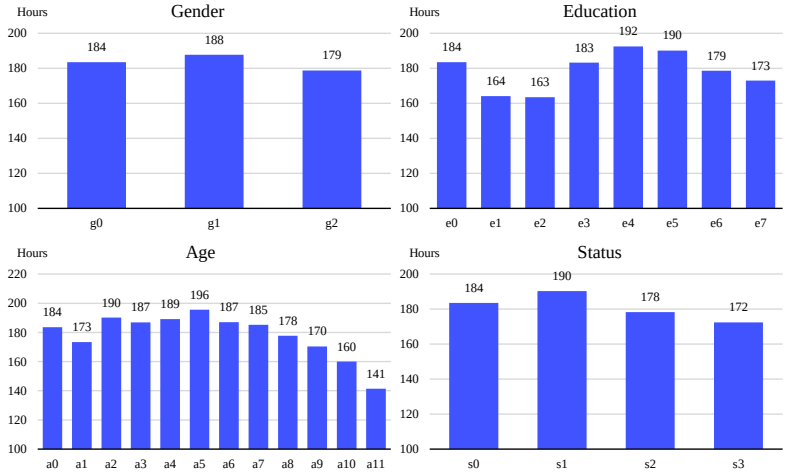


Sources: LFS and our estimates in Table 1. Note: Since our estimates depend on the most disaggregated LFS data available, when compared as aggregated values in this chart, the estimate published in LFS is somewhat different because of the use of the different weights in aggregation.

Figure 2: Weekly Average Hours Worked per Worker

The published LFS data provides three two-dimensional data: h_{ge}, h_{ga}, and h_{gs}, as shown in Table 1. Since the matrix information is not in public as long as we know, the information of h_{geas} observed in Thailand is applied to estimate the tentative value of h'_{geas}. Using this h'_{geas} and our estimate of N_{geas} developed in Section 3.2, the tentative matrix of total hours worked (H'_{geas}) are estimated and used to provide the initial values in matrix balancing process to obtain

the best estimate of H_{geas} (see Appendix A.1). Before 1996, the estimated h_{geas} in 1997 is assumed to be constant at the elementary level of our measurement, due to lack of the information on average hours worked in the past estimates. Figure 3 compares the estimated average hours per worker in each category in 2019. As a gender gap, the female hours worked is 5% lower than that of male, which is considerably smaller than those in most South Asian countries.[19]



Sources: Our estimates based on LFS in Table 1. Note: See Table 2 for labor categories.

Figure 3: Average Monthly Hours Worked per Worker in Each Category in 2019

3.4 Hourly Wages of Employees

The COE estimates are not available in the current SNA in CLMV countries. But the availability the data on Vietnam's wage/income is more abundant than those in other CLMV countries, even if they are fragmented. This allows a more detailed look at Vietnam's wage/income trends throughout the observation period. The process to develop the time-series labor compensation matrix in Vietnam is divided into three phases. The first phase is the development of a fully cross-classified matrix on relative hourly wage for employee. The second phase is the development of time-series estimates of average monthly income per employee. Third, the time-series hourly wage matrix for employee are estimated so that the sum of the products of the relative hourly wage (in the phase 1) and the hours worked per employee (in Section 3.3) at the elementary level is reconciled with the estimated average monthly income (in the phase 2).

In the phase 1, for constructing fully cross-classified hourly wage matrix for employees (s_1), one or two types of two-dimensional data in GSO-LFS (w_{ges_1} and w_{gas_1}) are available in 2007 and 2009–2012 in GSO-LFS. Using these data as constrains, three-dimensional wages (w_{geas_1}) are estimated.[20] Two-dimensional data on monthly wage per worker for employee (w_{ges_1}) is available in the LSS for 1993 and in GSO-LFS for 2012–2019 and one-dimensional data (w_{gs_1}) is available

[19] In South Asian countries, the gender gap of average hours worked in 2019 is –27% in Bangladesh, –4% in Bhutan, –14% in India, –18% in Nepal, –27% in Pakistan, and –11% in Sri Lanka, based on our updated estimates of Nomura and Akashi (2017).
[20] The missing information (i.e., the e×a information) is supplemented using the information in Thailand. This method is described as $B_{0,3}$ in Table 10 in Appendix A.1.

in CSWW (1996) for 1996, as presented in Table 1[21]. In developing three-dimensional wages, the missing information (i.e., the information on age in 1993 and 2012–2019 and the $e \times a$ information in 1996) is supplemented using the information on the estimated relative hourly wage matrix in 2007 and 2009–2012.[22]

It is important for our measurement to determine the backward trend in nominal wages for the years, in which the fully cross-classified hourly wage matrices have not been developed in the phase 1. The phase 2 develops time-series estimates of average monthly wage per employee from several data sources, such as GSO (2004), SYB by GSO, and JETRO (1987, 1993). Table 4 presents the estimates of annual growth rates of monthly wage/income per employee (including our adjustments to original data) in each data (columns a-i) and the assumptions (third column) used to develop our estimate on the monthly wage index. In 1994–2006, the data on monthly income per capita, for which the head of household is an employee, is published in GSO (2004) for 1994–1996 and 1999 and in SYB for 2002, 2004, and 2006. This data is divided to three types of income sources: salary/wage, self-employment income, and other income.[23] Using the total of the salary/wage and self-employment income per capita and the ratio of employees to population, the monthly wages per employee are estimated. For the 1994–2006 interim year, in which data is not available, it is interpolated using the GDP price index (column-j). The annual growth rates of this adjusted data are shown in column-b of Table 4.

The income data shown in column-c is similar to the estimates in column-b, but the impact by the changes in other income as one of the income sources could not be removed. Considering the character as an approximation, the Jevons index (simple geometric average) of the monthly income index (column-c) and the GDP price index (column-j) is used from 1992 to 1994. In 1991–1993, the monthly income data for employees (only for managers) in state-owned enterprises are available in the *State-owned Enterprises Survey* in GSO (2004). The Jevons index of this monthly income index (column-g) and the GDP price index (column-j) is also used as an approximation of monthly wage index.

In 1975–1988, the data on monthly wage per employee in state sector is available in GSO (2004) and JETRO (1987, 1993), as presented in column-e and column-f, respectively. In this period, the Jevons index of the state-employee wage index and the GDP price is used. In 1970–1975, monthly income per capita of workers and civil service by income sources in North Vietnam is available in GSO (2004). The monthly income index excluding the impact by the changes in other income is used to extrapolate to monthly wage per employee, as the Jevons index of this adjusted wage index (column-h) and the GDP price index. In column-i, monthly wage per employee of Japanese companies, which is defined by the Jevons index of the wage indices by occupation in Hanoi, Ho Chi Minh, Danang, is presented for a reference. The GDP price index is

[21] In the 2019 GSO-LFS, the growth of monthly income per employee (column-a) is 17.9%, much higher than 1.8% of the GDP price growth (column-j) and 2.8% of the CPI growth (column-k). Our current decision is to use the average growth rate between the column-a and the column-j.

[22] This method is described as $D_{11,2}$ for 1996 or $C_{1,2}$ for 1993 and 2013–2019 in Table 10 in Appendix A.1.

[23] Monthly income data published in GSO (2004) and SYB in 1994–2006 may be investigated based on the same statistical concept in the household survey of the 1993 LSS, in which "other income" is defined as "income from leasing houses, workshops machines and equipment, income from leasing durable goods, interest from savings, stock, and lending."

applied in the years when no wage/income data is found.

Table 4: Annual Growths of Monthly Wages per Employee

	Our estimates		a. GSO-LFS	b. SYB& GSO(2004)	c. GSO (2004)	d. SYB	e. GSO (2004)	f. JETRO (1987,1993)	g. GSO (2004)	h. GSO (2004)	i. JETRO	j. GDP price	k. CPI
			Monthly wage per employee	Based on monthly income per capita (excluding other incomes)	Based on monthly income per capita (including other incomes)	Monthly wage per employee in state sector			Monthly wage per employee (manager) in state sector	Based on monthly income per capita in North Vietnam (excluding other incomes)	Monthly wage per employee of Japanese company		
		ave.	12	21,22	22	16	15	18	15	15	17		
1970													
1971	1.56	(h,j)								1.86		1.25	4.85
1972	-0.48	(h,j)								0.28		-1.25	4.86
1973	-0.15	(h,j)								-1.66		1.37	4.87
1974	6.75	(h,j)								6.31		7.19	4.87
1975	1.65	(h,j)								1.38		1.92	4.84
1976	7.64	(f,j)						1.09				14.18	4.87
1977	3.00	(f,j)					-0.16	2.64				3.37	4.86
1978	10.10	(f,j)					-0.33	3.22				16.97	17.03
1979	6.40	(f,j)					-0.49	-0.56				13.36	2.41
1980	25.32	((e,f),j)					6.84	32.68				17.95	13.65
1981	61.78	((e,f),j)					54.77	35.32				78.52	28.29
1982	64.40	((e,f),j)					49.18	69.34				69.54	69.34
1983	29.98	((e,f),j)					31.16	46.13				21.31	40.14
1984	35.03	((e,f),j)					27.67	37.29				37.59	50.05
1985	145.58	(e,j)					172.26					118.91	65.14
1986	164.45	(f,j)						168.38				160.51	176.66
1987	156.26	(f,j)						159.42				153.11	153.11
1988	157.33	(f,j)						152.36				162.29	162.29
1989	55.41	j										55.41	55.41
1990	35.14	j										35.14	35.14
1991	54.69	j										54.69	59.78
1992	33.75	(g,j)							39.32			28.19	31.99
1993	20.34	(c,j)			24.63				36.49			16.05	8.01
1994	24.78	(c,j)			33.90							15.66	9.06
1995	23.65	b		23.65	19.33							15.73	15.64
1996	8.77	b		8.77	9.11						7.71	8.34	5.52
1997	11.62	b		11.62							34.34	6.39	3.16
1998	13.44	b		13.44							5.98	8.47	7.01
1999	10.31	b		10.31							9.60	5.58	4.03
2000	16.24	b		16.24							1.59	3.35	-1.73
2001	13.35	b		13.35		11.62						1.93	-0.43
2002	14.13	b		14.13		11.33						3.88	3.76
2003	5.19	b		5.19		15.40					10.50	6.46	3.17
2004	6.58	b		6.58		12.28					0.87	7.86	7.47
2005	15.13	b		15.13							9.05	7.87	7.96
2006	14.99	b		14.99							7.87	8.22	7.13
2007	7.98	j									23.70	9.19	7.98
2008	35.01	a	(35.01)									20.44	20.80
2009	18.75	a	(18.75)									6.03	6.82
2010	5.05	a	5.05									11.40	8.81
2011	20.92	a	20.92								10.04	19.28	17.12
2012	19.06	a	19.06								19.47	10.37	8.70
2013	9.22	a	9.22								0.71	4.65	6.38
2014	8.22	a	8.22								10.33	3.60	4.00
2015	5.29	a	5.29								6.88	-0.19	0.63
2016	4.50	a	4.50								-5.28	1.10	2.63
2017	8.38	a	8.38								25.09	4.00	3.46
2018	4.23	a	4.98								7.21	3.34	3.48
2019	9.81	(a,j)	17.85									1.77	2.76

Unit: annual growth rate (%). Sources: Wage/income data from LFS and SYB by GSO, GSO (2004), JETRO (1987, 1993), and GDP price and CPI from APO (2020). Note: The numbers under the data name indicate the sequences of the data in Table 1**.** The (c,j) in third column represents the Jevons index (geometric average) of two indices in column-c and column-j. These estimates in some data include our adjustments to original data as described in the text of Section 3.4.

In phase 3, the time-series hourly wage matrices for employee are estimated so that the sum of the products of the relative hourly wage (in the phase 1) and the hours worked per employee (in Section 3.3) at the elementary level is reconciled with the estimated average monthly income (in the phase 2).

Table 5 shows our estimates of the COE share to GDP and the estimates of the COE+MX share published in several years in GSO (1992) and VIE-IOT. As the ratio of COE to COE+MX in row-c in Table 5, it is of note that our estimates based on a bottom-up approach are almost consistent with the estimates before revision (based on a top-down approach) in 2000, 2007, and 2012. However, the impact of our revision is more pronounced in 1989 and 1996.

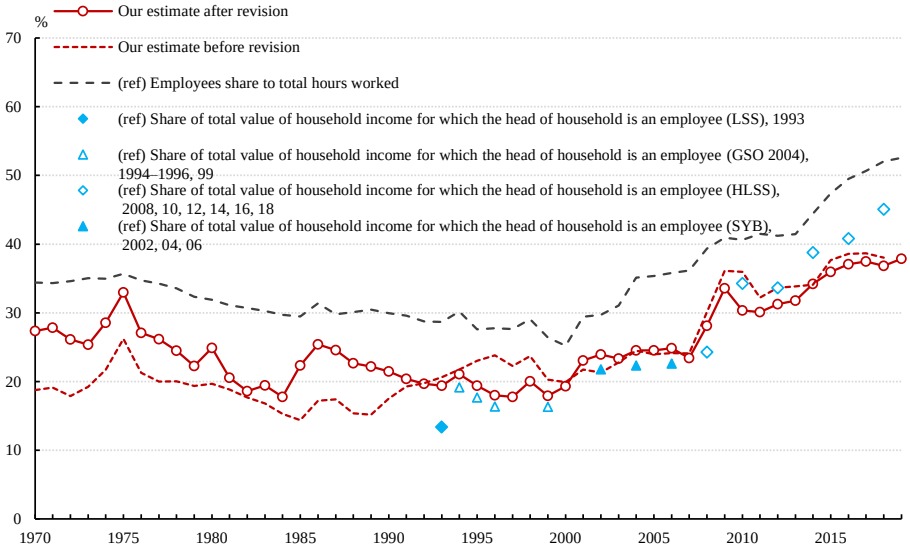
Table 5: Ratio of COE in COE+MX

	1989	1996	2000	2007	2012
a) COE share	22.2	18.0	19.3	23.4	31.3
b) COE+MX share	57.6	70.1	58.1	49.0	65.0
c) Ratio of COE/(COE+MX)					
estimate after revision (based on a bottom-up approach: a/b)	0.38	0.26	0.33	0.48	0.48
(ref) estimate before revision (based on a top-down approach)	0.26	0.34	0.35	0.42	0.45

Unit: % (share to GDP) in row-a and -b and index (COE+MX=1.0) in row-c Sources: Our estimate for row-a and -c and GSO (1992) and the VIE-IOT for row-b. GDP at current basic prices used to compute shares in row-a and -b is from APO (2020).

Figure 4 compares the long-term trends in COE shares to GDP before and after the revision with two reference indicators. The first reference indicator is the employees share to total hours worked (our estimates in Section 3.3). The second reference indicator is the share of the total value of household income to GDP, for which the head of household is an employee, based on the data on monthly household income per capita (excluding the impact of other incomes) in LSS/HLSS, SYB, and GSO (2004).[24] The estimate before revision based on a top-down approach shows an increasing trend in the 1990s, which cannot be supported by two reference indicators. This trend in the 1990s may have been generated using double benchmarking to 1989 (GSO 1992) and 1996 (VIE-IOT), with the crude assumptions on the ratio of COE/(COE+MX) to separate the COE+MX. Our revised estimates based on a bottom-up approach do not have the similar upward trend in the 1990s and appear to be in good agreement with the two reference indicators, except in 1993 and the 2010s.

[24] In the total household income, for which the head of household is an employee, the income for non-household heads who are non-employees is included (in the 2009 PHC, average number of workers per household is 2.1 person). On the other hand, the income for non-household heads who are employees are not included in this household income. Thus, this rough indicator based on LSS/HLSS in Figure 4 is used as a reference to confirm the trend of our estimates.



Unit: % (share of COE to GDP at current basic prices). Sources: Our estimates.

Figure 4: COE Share to GDP

3.5 Labor Share

Having constructed the COE matrix in Section 3.4, the next procedure is to estimate the compensation matrix of non-employees (own-account workers (s_2) and contributing family workers (s_3)). The different methodologies, i.e., the capital income approach labor income approach, are applied for agriculture and non-agriculture industries, respectively.

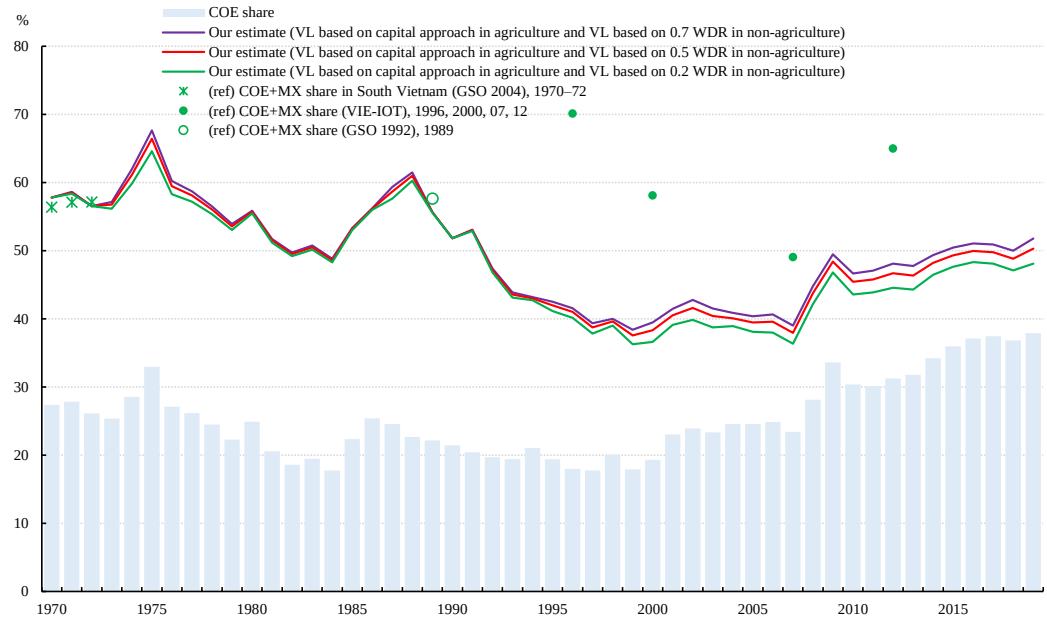
In the capital income approach for agricultural industry, first, capital income is estimated by the sum of the returns to capital of land for agricultural use and other fixed assets owned in agriculture, based on the capital stock estimates for Vietnam in APO (2020). Second, by comparing our estimates of capital income and the COE+MX in VIE-IOT for several benchmark years (Table 1), we obtain 15% as a crude estimate of the average share of capital income to the COE+MX. Finally, the time-series estimates of the COE+MX are developed,[25] and 85% of the COE+MX is applied for estimating total labor income in agriculture industry.

In the labor income approach for non-agriculture industries, the wage differential ratio (WDR) in hourly wages of non-employees to employees is assumed in each elementary group of labor inputs. Figure 5 compares the estimated labor shares in the whole economy, based on three cases that the time invariant WDR are 0.2, 0.5, and 0.7 in non-agriculture industry. The differences among three cases are not large, reflecting smaller share of labor income in non-agriculture industries. We apply 0.5 as the WDR as an approximation.

Our estimate of labor share can be compared with a reference indicator of the COE+MX share to GDP in several years in VIE-IOT, GSO (1992), and GSO (2004) for South Vietnam. Except in 1996, our estimate on labor share seems to be reasonable.[26]

[25] For the years, in which the estimates of COE+MX in VIE-IOT are not available, they are interpolated/extrapolated based on the tentative estimates of labor income of non-employees in agriculture (using the hourly wages of employees). The number of non-employees in agriculture is assumed to be the same as the number of employment in agriculture in APO (2020).

[26] As shown in Table 5, the COE+MX estimate in VIE-IOT for 1996 seems to be too high compared to other years as a GDP share.



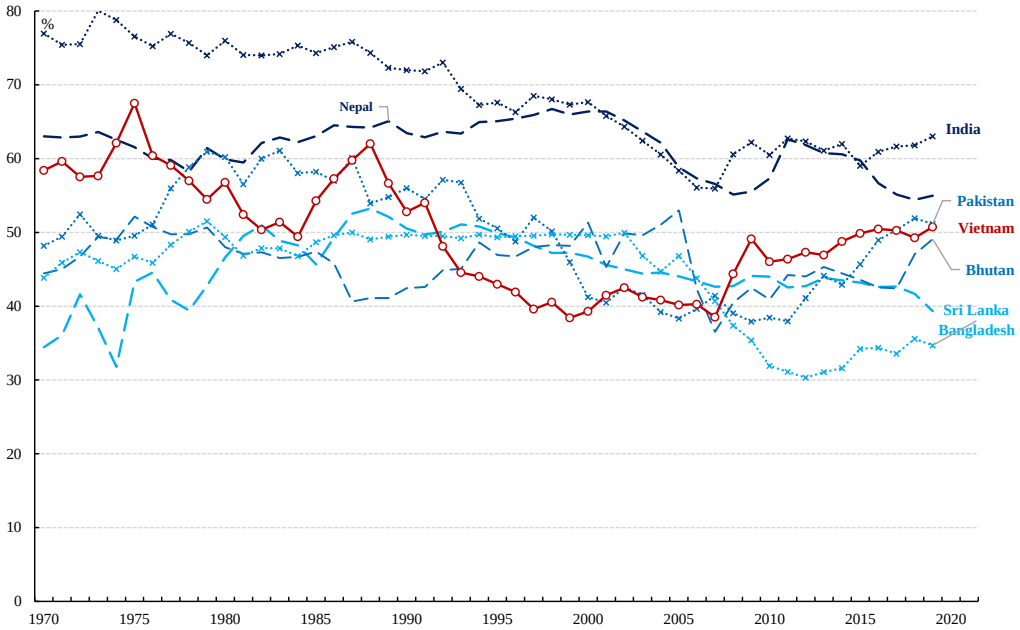
Note: Our estimates and the estimates of COE+MX in Table 1.

Figure 5: Labor Share to GDP

Vietnam's labor share estimate is compared to those for the six South Asian countries in Figure 6 and for the three ASEAN countries in Figure 7, in which the official COE estimate in their national accounts and more data on wage/income is available over time. Vietnam's labor share estimate is lower than those in South Asian countries in the late 1970s (after the reunification in 1975) and the early 1980s, but compared to ASEAN countries, it is considerably higher than other ASEAN countries as seen in Figure 7. The first turning point for increasing labor share in Vietnam, which is a unique trend among the compared countries, is in 1985, one year before the launch of a political and economic renewal campaign (Doi Moi policy) to promote the transition from centralized economy to socialist-oriented market economy in 1986.

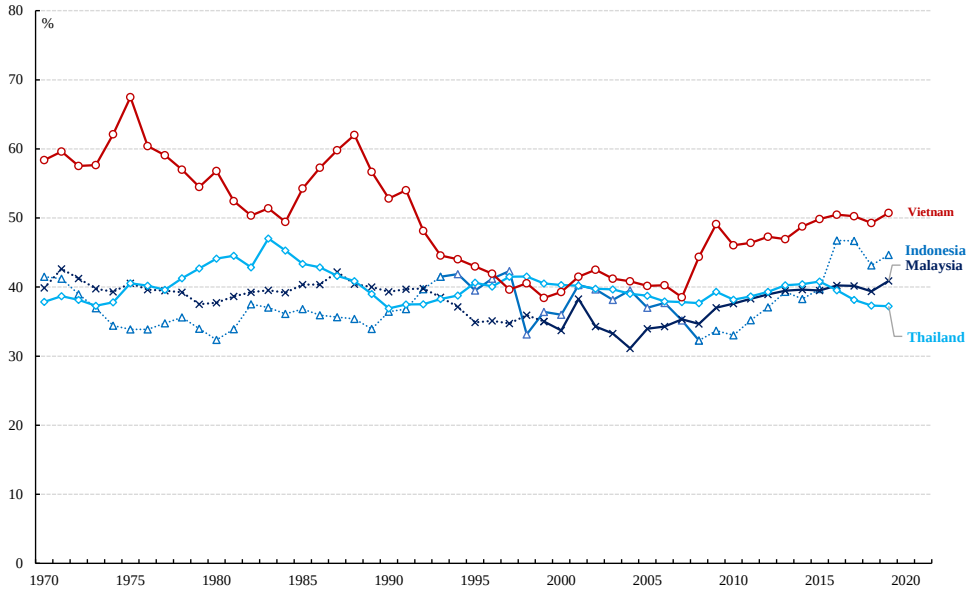
From the late 1980s to the mid-1990s, in the countries compared in Figure 6 and Figure 7, the labor share is generally on a gradual downtrend in many countries compared.[27] Vietnam has a second, but moderate, turning point in the transition to a more market-oriented economy in the late 1990s and early 2000s after the Asian currency crisis. Similar labor share recovery is seen in Indonesia and Malaysia in Figure 7, but in South Asia, almost all countries have continued to decline during the same period. The third turning point to increase is 2008–2009. Similar, but more modest, recovery is seen in Malaysia and Thailand in the same period. Beyond the decline of the next few years, it has continued to slowly increase in ASEAN countries throughout the 2010s. In 2019, Vietnam is at the highest level among other ASEAN countries and at the middle level among six countries in South Asia. Vietnam's estimate is highly uncertain in the data and can be sensitive to the underlying assumptions, but our revision based on a bottom-up approach may be evaluated as appropriate from an international comparison perspective.

[27] As shown in Figure 4, our estimate before revision based on a top-down approach using the double benchmarking of 1989 and 1996 provided an opposite trend.



Unit: Share of total labor compensation in GDP at current basic prices (%). Sources: Our estimates and the updated estimates of Nomura and Akashi (2017) for South Asia.

Figure 6: Labor Share Comparison with South Asian Countries



Unit: Share of total labor compensation in GDP at current basic prices (%). Sources: National accounts for Indonesia (1993–2008), Thailand (1970–2019), and Malaysia (1999–2019) and our backward estimates in the Asia QALI Database (shown as a dot line).

Figure 7: Labor Share Comparison with ASEAN Countries

4 Labor Quality

Table 6 summarizes the estimation results of Vietnam's labor input and labor quality growths, and Figure 8 shows the long-term index on labor input. Supplementary time series data on the aggregate measures of labor inputs and wages, and components of the labor matrix are presented

in Appendix A.3. In the labor input growth in Vietnam, the role of labor quality change was modest until 2000, at an annual rate of 0.49% from 1970 to 2000. However, from 2000 to 2019, the improvement in labor quality accelerated to an average of 2.00% per year, accounting 59.4% of the growth of quality-adjusted labor input (L) of 3.36%, slightly decreased from 3.77% in 1970–2000. In other words, the labor quality improvement has fully compensated for the rapid decline in the growth of total hours worked (H) in Vietnam from 3.29% in 1970–2000 to 1.37% in 2000–2019.

Table 6: Aggregate Labor Input of Vietnam Economy

	1970 –75	1975 –80	1980 –85	1985 –90	1990 –95	95 –2000	2000 –05	2005 –10	2010 –15	2015 –19	70 –2000	2000 –19	70 –2019
L: Labor input	6.21	4.07	4.26	2.72	2.37	3.01	3.67	5.55	0.93	3.30	3.77	3.36	3.61
Q: Labor quality	0.83	1.07	0.71	-0.18	0.14	0.35	2.99	2.13	0.60	2.34	0.49	2.00	1.07
	(13.3)	(26.4)	(16.6)	(-6.8)	(5.9)	(11.6)	(81.5)	(38.4)	(64.9)	(70.9)	(12.9)	(59.4)	(29.7)
H: Total Hours worked	5.39	2.99	3.55	2.91	2.23	2.66	0.68	3.42	0.32	0.96	3.29	1.37	2.54
	(86.7)	(73.6)	(83.4)	(106.8)	(94.1)	(88.4)	(18.5)	(61.6)	(35.1)	(29.1)	(87.1)	(40.6)	(70.3)
N: Number of employment	5.26	3.00	3.54	2.94	2.38	1.95	2.44	2.44	1.29	0.85	3.18	1.80	2.64
	(84.6)	(73.7)	(83.1)	(107.9)	(100.4)	(64.8)	(66.6)	(44.0)	(139.7)	(25.7)	(84.2)	(53.6)	(73.2)
h: Average hours worked	0.13	0.00	0.01	-0.03	-0.15	0.71	-1.77	0.98	-0.97	0.11	0.11	-0.44	-0.10
	(2.1)	(-0.1)	(0.3)	(-1.2)	(-6.4)	(23.7)	(-48.2)	(17.6)	(-104.7)	(3.5)	(3.0)	(-13.1)	(-2.8)
P^L: Quality-adjusted price of labor input	0.54	9.16	66.23	114.41	27.68	9.20	10.53	13.77	14.44	6.26	37.87	11.51	27.65
Q: Labor quality	0.83	1.07	0.71	-0.18	0.14	0.35	2.99	2.13	0.60	2.34	0.49	2.00	1.07
	(151.6)	(11.7)	(1.1)	(-0.2)	(0.5)	(3.8)	(28.4)	(15.5)	(4.2)	(37.3)	(1.3)	(17.4)	(3.9)
w: Hourly wage	1.37	10.24	66.93	114.23	27.82	9.55	13.52	15.90	15.04	8.60	38.36	13.51	28.72
	(251.6)	(111.7)	(101.1)	(99.8)	(100.5)	(103.8)	(128.4)	(115.5)	(104.2)	(137.3)	(101.3)	(117.4)	(103.9)
Labor compensation	6.76	13.23	70.49	117.14	30.05	12.20	14.19	19.32	15.36	9.56	41.64	14.87	31.26

Unit: % (average annual growth rates), except for those in parentheses, which are contribution shares. Source: Our estimates.

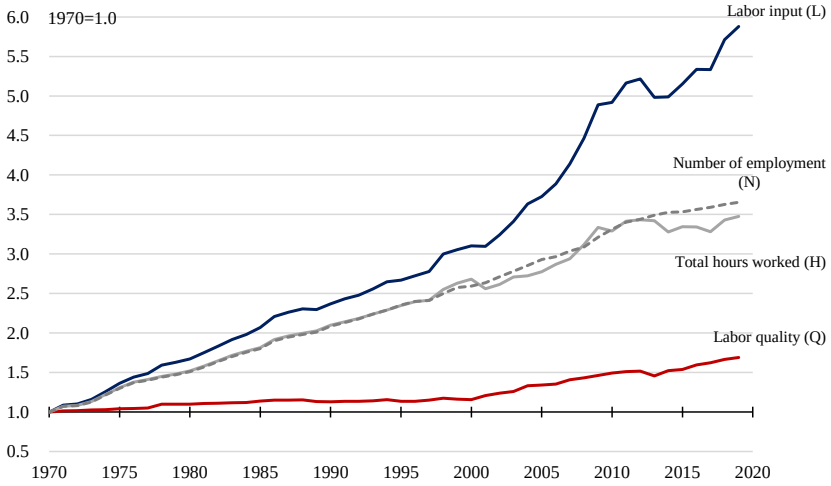


Figure 8: Labor Input and Labor Quality Indices

Table 7 presents the decomposition of labor quality growths in the JGF formula presented in equation (9) in Section 2. Based on these estimates, the labor quality factors, which has the large impact on labor quality growth from 2000, are the first order indices for employment status (Q_S) and education (Q_E). The impact of the first order index for employment status (Q_S) is outstanding

in the early 2000s, reflecting the expansion of employee share of 8.0 percentage point from 26.6% in 2000 to 34.6% in 2005 (Table 12 in Appendix A.3). As the employee share reaches 50.7% in 2019, the shift of workers from informal sector to formal sector is measured in the growth of Q_S, although this estimate is sensitive to the assumption of WDR discussed in Section 3.5.

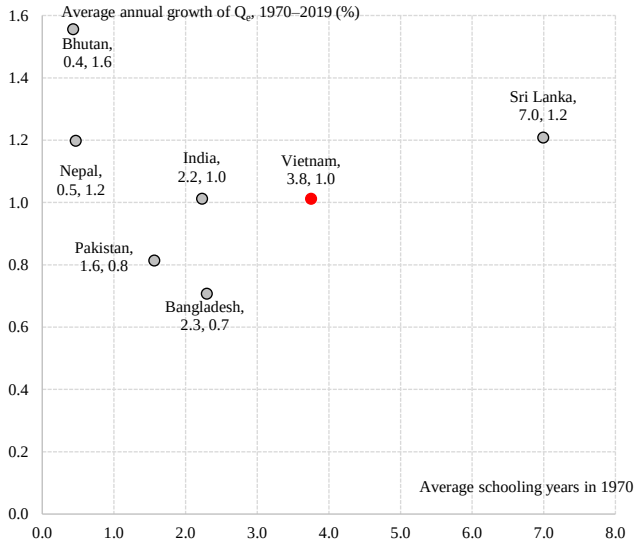
Table 7: Decompositions of Labor Quality Improvement

	1970 –75	1975 –80	1980 –85	1985 –90	1990 –95	95 –2000	2000 –05	2005 –10	2010 –15	2015 –19	70 –2000	2000 –19	70 –2019
Total	0.83	1.07	0.71	-0.18	0.14	0.35	2.99	2.13	0.60	2.34	0.49	2.00	1.07
g	0.01	-0.10	-0.06	-0.01	0.02	0.05	-0.01	0.05	0.02	0.02	-0.02	0.02	0.00
e	0.67	0.47	0.35	0.54	1.34	1.16	1.01	1.85	1.06	1.82	0.76	1.41	1.01
a	0.34	0.26	0.24	0.09	-0.02	0.32	0.21	-0.17	0.11	0.30	0.21	0.10	0.17
s	0.12	-0.34	-0.19	0.04	-0.33	-0.45	2.47	1.01	1.42	1.24	-0.19	1.55	0.48
ge	-0.03	-0.03	-0.04	-0.03	-0.01	-0.03	0.00	0.01	-0.02	-0.02	-0.03	-0.01	-0.02
ga	-0.02	-0.03	-0.01	0.00	0.01	-0.01	0.00	-0.01	0.05	0.03	-0.01	0.01	0.00
gs	0.01	0.00	0.01	-0.01	-0.04	0.00	-0.01	0.13	-0.04	-0.04	0.00	0.01	0.00
ea	-0.34	-0.07	-0.05	-0.05	-0.31	-0.24	0.20	0.56	0.06	0.37	-0.18	0.29	0.01
es	-0.25	-0.07	-0.11	-0.29	-0.73	-0.48	-1.01	-1.04	-0.74	-0.99	-0.32	-0.95	-0.56
as	-0.14	-0.04	0.07	0.05	0.14	-0.03	0.34	0.48	-0.02	-0.16	0.01	0.18	0.07
gea	0.23	-0.09	0.36	-0.54	-0.11	0.02	0.15	-0.16	-0.04	-0.03	-0.02	-0.02	-0.02
ges	-0.04	0.06	0.06	0.01	0.05	-0.01	-0.03	0.00	0.03	-0.01	0.02	0.00	0.01
gas	0.02	0.09	0.01	-0.03	0.01	0.01	0.01	-0.11	-0.01	-0.03	0.02	-0.03	0.00
eas	0.25	0.14	-0.03	-0.01	-0.01	-0.01	-0.19	-0.66	-0.60	-0.36	0.05	-0.46	-0.14
geas	-0.01	0.82	0.10	0.06	0.14	0.03	-0.15	0.20	-0.67	0.20	0.19	-0.12	0.07

Unit: % (average annual growth rates). Source: Our estimates.

Another significant factor is the first order index for education (Q_E). A sound improvement in Q_E is observed over the entire period, accelerating from 0.76 percentage point in 1970–2000 to 1.41 in 2000–2019. The pace of improving education of workers in Vietnam is somewhat faster than the experience of South Asian countries. Figure 9 plots countries' initial levels of average schooling years of workers in 1970 as the initial period of our observation, against their respective average growth rates of Q_E between 1970 and 2019. Workers in Vietnam are more educated (3.8 years of schooling on average) in 1970 than South Asian countries, except Sri Lanka (7.0 years). Among South Asian countries (except Sri Lanka), these two variables tend to have a negative correlation, i.e., higher growths of Q_E are explained by the lower initial levels of education on average. Under this rough correlation, Vietnam has shown good performance in educating workers at a higher pace.

The second order index for education and status (Q_{ES}) tends to be negative as presented in Table 7. In 1970–2019, the contribution of Q_{ES} is –0.56 percentage point per year on average, with some significant drops in the early 1990s (–0.73 percentage point) and in the late 2000s (–1.04 percentage point). This implies the less educated workers have entered the labor markets more as employees.



Sources: Our estimates and the updated estimates of Nomura and Akashi (2017) for South Asia.

Figure 9: Growth in First Order Index for Education and Initial Schooling Years

5 Conclusion

One of the largest obstacles to developing a productivity account in Vietnam is the lack of COE estimates in the System of National Accounts. As far as we know, this paper seems to be the first attempt to estimate the labor share for Vietnamese economic growth over the long term based on a bottom-up approach using the labor data at a detailed level. The employment and hourly wage matrices developed in this paper is cross classified by four categories, i.e., gender, education attainment, age, and employment status. The estimated data is used to develop the long-term estimate of labor income for non-agriculture industries, and to estimate the measure of the quality-adjusted labor input.

Our measurement is based on the survey data available as much as possible in Vietnam. But it has to be constrained by availability of data on labor input and wage/income in Vietnam and essentially must rely on some crude assumptions. There may be room for correction and improvement, depending on the data and administrative records that will be available but not recognized in this paper and on further examination on better assumptions (including the time variant WDR) in data development processes. In addition, investigating the details of labor data in other CLMV countries, for which the estimate of COE is not available in their national accounts as in Vietnam, is our next challenge. Comparative studies in this region may help improve the economic measurements of each other's countries.

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Appendix

A.1 Data Development

The data constraints, such as the use of less-disaggregated data and the frequent changes in available data over periods, require a country-common measurement framework to develop a fully cross-classified (four dimensional) labor dataset, which consists of the number of workers (N_{geas}), hours worked (H_{geas}), and labor compensation (V^{L}_{geas}). In the case of no survey results available, auxiliary data (see Appendix A.2) are used for interpolation or extrapolation.

(1) Number of Workers (N)

Depending on the availability of the most detailed data, the methods to construct the four-dimensional (4D) employment matrix N_{geas} vary in response to five scenarios, denoted as cases A to E. In case A, the full set of 4D data is directly observed. In case B, three kinds of 3D data are available. For example, if N_{ges}, N_{gea}, and N_{gas} are available, $\widehat{N}_{geas}$ is estimated based on two kinds of 3D data held as the restrictions (i.e., $\sum_a \widehat{N}_{geas}=N_{ges}$ and $\sum_s \widehat{N}_{geas}=N_{gea}$) and the remaining kind of 3D data (i.e., N_{gas}) as the initial values for the $a \times s$ matrix information in each g category of $\widehat{N}_{geas}$. For matrix balancing, we apply the KEO-RAS approach, which is one of the applications of the Lagrange multiplier method (see Kuroda et al., 1997). This procedure is described as:

$$\text{(16)} \quad \min \sum_{as}\left(\widehat{N}_{geas} - N_{gas}\right)^2, \text{ subject to } \; N_{ges} = \sum_a \widehat{N}_{geas} \text{ and } \; N_{gea} = \sum_s \widehat{N}_{geas},$$

where N_{gas} is the initial values and N_{ges} and N_{gea} are the restrictions.

In case C, only two kinds of 3D data are available (e.g., N_{ges} and N_{gas}). Contrast to case B, the missing information (i.e., the $e \times a$ matrix information) is supplemented by the use of auxiliary data. The first row of Table 8 summarizes case C. The auxiliary data to provide the initial values of $N_{gea,tk}$ is classified into four types: 1. estimates based on 2D data (e.g., the estimates based on available three kinds of 2D data: $N_{ge,tk}$, $N_{ga,tk}$, and $N_{ea,tk}$),[28] 2. estimates based on data in the near periods (e.g., $N_{gea,t'k}$ where $t-2 \le t' \le t+2$), 3. estimates based on the labor

[28] As Equation (16) presents the method to estimate 4D data based on three kinds of 3D data, similar method can be applied to estimate 3D data based on three kinds of 2D data.

force matrix,[29] and 4. data in other countries (k') as the last resort in the case that no relevant auxiliary data or estimates are available. If the data in the near period (the 2nd type of auxiliary data) is used as the initial values, this method is named as case $C_{0,2}$ in Table 8.

Table 8: Auxiliary Data to Estimate 4D Employment Matrix

	Auxiliary data (restriction, initial value)			
	1: Estimates based on 2D data	2: Estimates based on data in near periods	3: Estimates based on labor force	4: Data in other countries
	e.g. $\hat{N}_{aea,tk}$ or $\hat{N}_{aeas,t}$	e.g. $N_{gea,t'k}$ or $N_{geas,t'k}$	e.g. $\hat{\beta}_{aea,tk}F_{aea,t}$	e.g. $N_{geas,tk'}$
C: Two 3D data e.g. $N_{ges,tk}$ & $N_{gas,tk}$	$C_{0,1}$	$C_{0,2}$	$C_{0,3}$	$C_{0,4}$
D: One 3D data e.g. $N_{aes,tk}$	$D_{1,1}$	$D_{1,2}$	$D_{1,3}$, $D_{2,3}$	$D_{1,4}$, $D_{3,4}$
E: No 3D data	$E_{11,1}$	$E_{11,2}$, $E_{12,2}$, $E_{13,2}$, $E_{22,2}$	$E_{11,3}$, $E_{12,3}$	$E_{11,4}$, $E_{13,4}$, $E_{23,4}$

Note: The C, D, and E in the rows of this table correspond to the cases that two kinds of, one kind of, and no 3D data are available, respectively. As the use of auxiliary data, for example in case $D_{a,b}$, "a" indicates the type of auxiliary data used to provide the additional restriction(s) for missing information and "b" indicates the type of auxiliary data used as the initial values.

In case D, only one kind of 3D data is available (e.g., N_{ges}). Then two kinds of auxiliary data have to be prepared. One kind is employed to provide the information on age (a) as an additional restriction and the other one is used as the initial values. The second row of Table 8 summarizes case D. If the estimate based on 2D data (the 1st type of auxiliary data) has to be used as the additional restriction and the estimate based on labor force matrix (the 3rd type of auxiliary data) is used as the initial values, this estimation procedure is described as case $D_{1,3}$ in Table 8. Case $D_{1,1}$ is preferred to case $D_{1,3}$ and case $D_{1,3}$ is preferred to case $D_{2,3}$ in our measurement.

When 3D data is not available, which is case E as summarized in the final row in Table 8, two types of 3D auxiliary data have to be used to provide the additional restrictions and one type of 3D data is used as the initial values. There are many combinations of auxiliary data when three kinds are used in the estimation procedure, e.g., $E_{11,3}$ or $E_{13,2}$ as presented in Table 8. In our measurement, the procedures described on the left side are preferred in each case. The second column in Table 9 provides the procedures to develop the 4D employment matrix in Vietnam in each year of the whole observation period. The most frequent procedures applied are $E_{22,2}$ and $E_{11,4}$ reflecting the difficulty in obtaining the 3D data.

[29] In addition to the 4D employment matrix, 3D data on population ($P_{gea,tk}$) and labor force ($F_{gea,tk}$) are developed for the whole period of our observation in all countries. Appendix A.1 presents the details. The labor force matrix times the employment rate ($\beta_{gea,tk}$), which is observed in the near periods, provides the initial values of the information of $N_{gea,tk}$. Thus, in the case that the data or estimates of the $e \times a$ matrix information are not available, the use of the estimates based on labor force matrix provides the last resort in our measurement.

Table 9: Data Development Procedures in Employment and Wage Matrices in Vietnam

	N	w		N	w		N	w		N	w		N	w
1970	$E_{22,2}$	$D_{22,2}$	1980	$E_{22,2}$	$D_{22,2}$	1990	$E_{22,2}$	$D_{22,2}$	2000	$E_{11,4}$	$D_{22,2}$	2010	$E_{11,4}$	$B_{0,3}$
1971	$E_{22.2}$	$D_{22.2}$	1981	$E_{22.2}$	$D_{22.2}$	1991	$E_{22.2}$	$D_{22.2}$	2001	$E_{11.4}$	$D_{22.2}$	2011	$E_{11.4}$	$B_{0.3}$
1972	$E_{22.2}$	$D_{22.2}$	1982	$E_{22.2}$	$D_{22.2}$	1992	$E_{22.2}$	$D_{22.2}$	2002	$E_{11.4}$	$D_{22.2}$	2012	$E_{11.4}$	$B_{0.3}$
1973	$E_{22,2}$	$D_{22,2}$	1983	$E_{22,2}$	$D_{22,2}$	1993	$E_{22,2}$	$C_{1,2}$	2003	$E_{11,4}$	$D_{22,2}$	2013	$E_{11,4}$	$C_{1,2}$
1974	$E_{22,2}$	$D_{22,2}$	1984	$E_{22,2}$	$D_{22,2}$	1994	$E_{22,2}$	$D_{22,2}$	2004	$E_{11,4}$	$D_{22,2}$	2014	$E_{11,4}$	$C_{1,2}$
1975	$E_{22,2}$	$D_{22,2}$	1985	$E_{22,2}$	$D_{22,2}$	1995	$E_{22,2}$	$D_{22,2}$	2005	$E_{11,4}$	$D_{22,2}$	2015	$E_{11,4}$	$C_{1,2}$
1976	$E_{22,2}$	$D_{22,2}$	1986	$E_{22,2}$	$D_{22,2}$	1996	$E_{11,4}$	$D_{11,2}$	2006	$E_{12,2}$	$D_{22,2}$	2016	$E_{11,4}$	$C_{1,2}$
1977	$E_{22,2}$	$D_{22,2}$	1987	$E_{22,2}$	$D_{22,2}$	1997	$E_{11,4}$	$D_{22,2}$	2007	$E_{11,4}$	$B_{0,3}$	2017	$E_{11,4}$	$C_{1,2}$
1978	$E_{22,2}$	$D_{22,2}$	1988	$E_{22,2}$	$D_{22,2}$	1998	$E_{13,4}$	$D_{22,2}$	2008	$E_{12,2}$	$D_{22,2}$	2018	$E_{11,4}$	$C_{1,2}$
1979	$E_{22,2}$	$D_{22,2}$	1989	$E_{12,2}$	$D_{22,2}$	1999	$E_{11,4}$	$D_{22,2}$	2009	$E_{11,4}$	$B_{0,3}$	2019	$E_{11,4}$	$C_{1,2}$

Note: See Table 8 and Table 10 for the definitions of procedures to develop an employment matrix (N) and a wage matrix (w), respectively.

(2) Hours per Worker (h)

The estimated matrices in the number of workers are converted into those based on hours worked. Since the matrix information is not in public as long as we know, the information of h_{geas} observed in Thailand is applied to estimate the tentative value of h'_{geas}. Using this h'_{geas} and our estimate of N_{geas}, the tentative matrix of total hours worked (H'_{geas}) are estimated and used to provide the initial values in matrix balancing process to obtain the best estimate of H_{geas}.

For example, when only one kind of two-dimensional data (by gender and age) on average hours worked per worker (h_{ga}) is available, we allocate the two-dimensional data of H_{ga}(=h_{ga}*N_{ga}) to four-dimensional data of H_{geas} by the (H'_{geas}). When several kinds of data on hours worked per worker are available (e.g., h_{ge} and h_{ga}), a higher dimensional matrix of total hours worked (i.e., H_{gea}) is estimated (with two constraints of H_{ge} and H_{ga}), and then the balanced hours worked per worker (i.e., h_{gea}) are developed. The KEO-RAS method is used to estimate the employment matrix of hours worked, using the employment matrix of number of workers as the initial matrix as described in the following equation:

$$(17) \quad \min \sum_{ea}\left(\widehat{H}_{gea} - H'_{gea}\right)^2, \text{ subject to } \; H_{ge} = \sum_a \widehat{H}_{gea} \text{ and } \; H_{ga} = \sum_e \widehat{H}_{gea}.$$

(3) Hourly Wages (w)

The procedures to construct the wage matrix are separated into two steps, involving the development of compensation matrices, first, of employees (COE) and, then, of self-employed and contributing family workers. In the first procedure, the COE matrices (Nhw_{geas_1}) are estimated and then the hourly wage matrix (w_{geas_1}) are defined. The wage matrix for employees has three dimensions, (i.e., $g \times e \times a$), giving rise to four possible data scenarios and in turn the corresponding methods to measure the 3D wage matrix. In case A, full 3D wage matrix is directly observable. Cases B and C are defined as the cases that two and one kind of 2D wage matrix are available, respectively. Finally, in case D, there is no wage data available. In Table 10, these estimation cases and the kinds of auxiliary data used are listed in the rows and the columns, respectively. The auxiliary data in the third column indicates the estimated data on relative wages among different classes in each labor category in other countries are used. In our measurement for

Vietnam, the missing information is supplemented using the information in Thailand. Applied methods to estimate 3D wage matrix in Vietnam are presented in the third column in Table 9.

Table 10: Auxiliary Data to Estimate 3D Wage Matrix of Employees

	Auxiliary data (restriction, initial value)		
	1: Estimates based on 1D data	2: Estimates based on data in near periods	3: Data in other countries
	e.g. $\hat{w}_{ge,tk}$ or $\hat{w}_{ga,t}$	e.g. $w_{gea,t'k}$	e.g. $w_{gea,tk'}$
B: Two 2D data e.g. $w_{ae,tk}$ & $w_{ae,tk}$	$B_{0,1}$	$B_{0,2}$	$B_{0,3}$
C: One 2D data e.g. $w_{ae.tk}$	$C_{1,1}$	$C_{1,2}$	$C_{1,3}$
D: No 2D data	$D_{11,1}$	$D_{11,2}$, $D_{22,2}$	$D_{11,3}$, $D_{22,3}$

Note: The B, C, and D in the rows correspond to the cases that two kinds of, one kind of, and no 2D wage data are available. As to the use of auxiliary data, for example in the case $D_{a,b}$, "a" indicates the data type used as the additional restriction(s) for missing information and "b" indicates the data type used as the initial values.

A.2 Auxiliary Data

In the case that data on the number of workers are not available, the number of labor forces is used as an auxiliary data to interpolate or extrapolate the available data on the number of workers. We define the numbers of population and labor force, cross-classified by three categories (gea), as P_{gea} and F_{gea}, respectively. The ratio of the number of labor forces to the corresponding population is defined in each category as

(18) $F_{gea} = \alpha_{gea} P_{gea}$,

where α_{gea} is the labor force participation rate ($0 \leq \alpha_{gea} \leq 1$). Similarly, the ratio of the number of employment to the corresponding labor force is also defined,

(19) $N_{gea} = \beta_{gea} F_{gea}$,

where β_{gea} is the employment rate ($0 \leq \beta_{gea} \leq 1$).

United Nations (2017) provides the population matrix by gender and age P_{ga} annually and Barro and Lee (2010) provides the population matrix by gender, age, and education P_{gea} on a quinquennial basis. Using these international data and country-specific data, P_{gea} is prepared for each period of our observation. For the case that population data by education is not available in national data, the Barro-Lee Database (BLD) is used to provide the information on educational compositions. For the interval periods when the BLD is not available, the information on educational compositions is linearly interpolated. In the case that the two kinds of population-by-education data are available in national data, three-dimensional population data (P_{gea}) is estimated every year using the KEO-RAS method as follows:

(20) $\min \sum_{ea} \left(\hat{P}_{gea} - P_{gea}\right)^2$, subject to $P_{ge} = \sum_a \hat{P}_{gea}$ and $P_{ga} = \sum_e \hat{P}_{gea}$,

where P_{gea} is the initial values and P_{ge} and P_{ga} are the restrictions.

In the years when the labor force data is available in national data, F_{gea} is constructed based on a similar method. In the case that two types of two-dimensional labor force data (i.e., F_{ge} and F_{ga}) are available, the three-dimensional matrix is estimated using P_{gea} as the initial values in the KEO-RAS framework. Using the estimated P_{gea} and F_{gea}, the labor force participation rate α_{gea} is measured. For the years when the labor force data is not available, α_{gea} are estimated by a linear interpolation.

A.3 Supplementary Tables

Table 11: Aggregate Labor Input in Vietnam

Year	Price[1)]	Price/CPI	Quantity[2)]	Outlay	Quality	Employment	Hours per month	Hourly wage	Hours worked	GDP at basic pricess	Labor share
	(index)	(index)	(bil. Dong)	(bil. Dong)	(index)	(1000s)	(hours)	(Dong/hour)	(mils.)	(bil. Dong)	(%)
	P^L	P^L/CPI	L	V^L	Q	N	h	w	H	GDP	V^L/GDP
1970	0.00001164	0.403	52,647	0.613	0.865	15,003	192.9	0.0176	2,894	1.049	0.584
1971	0.00001161	0.383	57,320	0.666	0.878	16,076	193.0	0.0179	3,103	1.117	0.596
1972	0.00001191	0.374	58,025	0.691	0.880	16,216	193.3	0.0184	3,135	1.201	0.575
1973	0.00001227	0.367	61,132	0.750	0.887	16,920	193.6	0.0191	3,276	1.301	0.577
1974	0.00001244	0.354	66,249	0.824	0.892	18,226	193.8	0.0194	3,532	1.327	0.621
1975	0.00001196	0.325	71,832	0.859	0.901	19,514	194.2	0.0189	3,789	1.273	0.675
1976	0.00001364	0.353	75,852	1.035	0.903	20,569	194.1	0.0216	3,992	1.713	0.604
1977	0.00001388	0.342	78,248	1.086	0.910	21,046	194.2	0.0221	4,088	1.838	0.591
1978	0.00001491	0.310	83,869	1.250	0.949	21,647	194.0	0.0248	4,199	2.193	0.570
1979	0.0000160	0.325	85,805	1.37	0.952	22,092	194.0	0.0267	4,285	2.522	0.545
1980	0.0000189	0.334	88,028	1.66	0.951	22,668	194.2	0.0315	4,401	2.931	0.568
1981	0.0000379	0.505	92,123	3.49	0.957	23,556	194.2	0.0636	4,574	6.655	0.524
1982	0.0000753	0.502	96,476	7.26	0.961	24,577	194.2	0.1268	4,773	14.42	0.504
1983	0.0000968	0.432	100,930	9.77	0.965	25,562	194.4	0.164	4,969	19.01	0.514
1984	0.0001416	0.383	104,285	14.77	0.968	26,341	194.4	0.240	5,122	29.88	0.494
1985	0.000519	0.731	108,917	56.5	0.985	27,052	194.3	0.895	5,256	104.0	0.543
1986	0.00262	0.632	116,300	305	0.996	28,554	194.4	4.58	5,551	532.8	0.573
1987	0.01283	0.668	119,082	1,527	0.996	29,228	194.4	22.40	5,682	2,554	0.598
1988	0.0701	0.721	121,365	8,514	0.998	29,729	194.4	122.74	5,780	13,727	0.620
1989	0.1174	0.693	120,918	14,193	0.979	30,190	194.4	201.56	5,868	25,049	0.567
1990	0.1582	0.658	124,808	19,745	0.976	31,336	194.0	270.70	6,079	37,392	0.528
1991	0.289	0.660	128,168	36,981	0.982	32,014	193.8	496.73	6,204	68,478	0.540
1992	0.364	0.605	130,415	47,491	0.981	32,672	193.4	626.34	6,319	98,658	0.481
1993	0.415	0.636	134,662	55,883	0.988	33,575	192.9	719.07	6,476	125,367	0.446
1994	0.505	0.706	139,456	70,376	1.000	34,364	192.9	884.61	6,630	159,848	0.440
1995	0.631	0.756	140,531	88,722	0.983	35,302	192.5	1,087.86	6,796	206,462	0.430
1996	0.730	0.827	143,381	104,667	0.983	36,022	192.5	1,257.70	6,935	249,632	0.419
1997	0.775	0.850	146,293	113,322	0.995	36,176	193.2	1,351.36	6,988	286,033	0.396
1998	0.855	0.875	157,880	134,917	1.016	37,496	196.9	1,522.82	7,383	332,819	0.405
1999	0.893	0.878	160,869	143,710	1.004	38,662	196.9	1,573.31	7,612	373,970	0.384
2000	1.000	1.000	163,318	163,318	1.000	38,910	199.5	1,753.30	7,762	415,641	0.393
2001	1.155	1.160	162,986	188,204	1.046	39,543	187.3	2,117.65	7,406	453,553	0.415
2002	1.271	1.229	170,629	216,854	1.072	40,705	185.9	2,387.65	7,569	510,023	0.425
2003	1.353	1.267	179,629	242,959	1.089	41,719	187.9	2,582.31	7,840	589,397	0.412
2004	1.479	1.286	191,220	282,740	1.153	42,845	183.9	2,989.93	7,880	692,598	0.408
2005	1.693	1.359	196,190	332,091	1.161	43,968	182.6	3,446.33	8,030	826,880	0.402
2006	1.895	1.417	204,612	387,743	1.171	44,496	186.6	3,890.86	8,305	963,023	0.403
2007	2.005	1.384	217,956	436,921	1.217	45,540	186.9	4,278.62	8,510	1,134,141	0.385
2008	2.744	1.539	235,037	645,022	1.238	46,313	194.8	5,957.62	9,022	1,453,526	0.444
2009	3.070	1.608	257,307	789,835	1.266	48,177	200.5	6,814.80	9,658	1,608,208	0.491
2010	3.369	1.616	258,961	872,512	1.292	49,679	191.8	7,632.08	9,527	1,894,913	0.460
2011	4.200	1.698	271,869	1,141,943	1.308	51,058	193.5	9,631.05	9,881	2,461,503	0.464
2012	5.033	1.865	274,556	1,381,971	1.313	51,592	192.6	11,588.99	9,937	2,921,852	0.473
2013	5.766	2.005	262,292	1,512,468	1.259	52,370	189.0	12,733.04	9,899	3,221,887	0.469
2014	6.533	2.182	262,663	1,716,071	1.316	52,913	179.3	15,075.81	9,486	3,517,546	0.488
2015	6.935	2.302	271,235	1,880,976	1.331	53,000	182.7	16,188.19	9,683	3,772,552	0.499
2016	7.275	2.352	281,000	2,044,242	1.381	53,460	180.9	17,617.48	9,670	4,050,630	0.505
2017	8.066	2.519	280,778	2,264,795	1.404	53,861	176.4	19,862.11	9,502	4,505,414	0.503
2018	8.171	2.464	300,758	2,457,622	1.440	54,413	182.4	20,636.14	9,924	4,988,139	0.493
2019	8.909	2.614	309,458	2,756,843	1.462	54,824	183.5	22,832.95	10,062	5,433,657	0.507

Note: [1)] Corresponding price index of labor input defined by implicit index computed by V^L/L. [2)] Labor input volume calculated by using the Törnqvist-Theil quantity index evaluated in 2000 price.

Table 12: Compositions of Number of Workers

	$N_{(mil)}/N$	N_{g2}/N		N_e/N						
	Military	Female	Female (non-military base)	Never attended	No completed primary	Finish primary	Completed lower secondary	Completed secondary	Vocational	College, university, and higher
		g=2	g=2	e=1	e=2	e=3	e=4	e=5	e=6	e=7
1970	6.1	48.1	51.2	16.5	45.1	28.4	6.9	2.4	0.3	0.4
1971	6.2	48.1	51.3	15.8	44.8	28.7	7.4	2.6	0.3	0.4
1972	6.3	48.2	51.3	15.1	44.5	28.7	8.1	2.8	0.3	0.5
1973	6.8	48.0	51.4	14.5	43.9	28.9	8.8	3.0	0.4	0.5
1974	6.3	48.3	51.5	14.0	43.8	28.9	9.3	3.1	0.4	0.5
1975	7.1	48.0	51.6	13.3	43.1	29.2	10.0	3.3	0.4	0.5
1976	5.9	48.6	51.6	12.6	43.4	29.3	10.4	3.4	0.4	0.5
1977	5.8	48.7	51.6	11.8	43.1	29.6	10.9	3.6	0.4	0.5
1978	5.6	48.7	51.6	11.0	43.8	29.4	11.1	3.7	0.4	0.5
1979	4.6	49.2	51.5	10.4	43.8	29.6	11.4	3.8	0.4	0.6
1980	4.5	49.3	51.6	9.7	43.6	29.7	12.1	3.9	0.4	0.6
1981	4.4	49.4	51.6	9.5	43.0	29.4	12.5	4.2	0.6	0.8
1982	4.2	49.6	51.7	9.4	42.4	29.2	12.9	4.5	0.8	1.0
1983	4.7	49.4	51.7	9.2	41.5	29.1	13.3	4.7	1.0	1.1
1984	4.7	49.4	51.8	9.1	40.9	29.0	13.6	5.0	1.1	1.3
1985	3.8	49.9	51.8	9.0	40.5	29.1	13.5	5.1	1.3	1.5
1986	4.0	49.8	51.9	8.8	39.7	29.3	13.8	5.3	1.4	1.6
1987	4.3	49.7	51.9	8.6	39.0	29.3	14.1	5.6	1.6	1.8
1988	4.2	49.8	52.0	8.5	38.4	29.4	14.3	5.7	1.8	1.9
1989	4.1	49.9	52.0	8.3	37.7	29.5	14.7	5.9	1.9	2.1
1990	3.4	49.9	51.6	7.9	35.1	29.6	16.9	6.3	2.1	2.1
1991	3.2	49.6	51.2	7.5	32.3	29.3	19.4	6.8	2.4	2.2
1992	2.6	49.6	50.9	7.1	29.9	29.1	21.8	7.2	2.6	2.2
1993	2.6	49.3	50.6	6.7	27.4	28.8	24.2	7.7	2.9	2.3
1994	2.0	49.3	50.3	6.4	25.1	28.5	26.5	8.0	3.1	2.3
1995	1.8	49.1	50.0	6.0	23.1	28.1	28.8	8.4	3.3	2.3
1996	1.7	48.8	49.7	5.5	21.1	27.7	31.0	8.8	3.5	2.3
1997	1.5	48.2	48.9	5.0	20.4	27.4	30.5	10.2	3.9	2.7
1998	1.4	47.9	48.5	3.9	18.7	28.8	30.8	10.7	3.9	3.1
1999	1.4	47.4	48.0	4.2	18.2	28.4	30.4	11.2	4.2	3.4
2000	1.3	47.4	48.0	4.0	16.6	28.9	31.2	11.2	4.8	3.4
2001	1.3	47.5	48.1	3.9	16.6	31.8	28.7	11.5	3.8	3.6
2002	1.3	47.8	48.4	3.7	15.9	31.3	29.2	11.8	3.9	4.1
2003	1.3	47.9	48.5	4.3	15.7	31.0	29.2	11.3	4.1	4.4
2004	1.2	48.1	48.6	4.4	13.8	29.4	31.5	11.7	4.3	4.9
2005	1.1	48.3	48.8	4.1	13.1	29.0	32.6	11.1	5.2	4.9
2006	1.1	47.9	48.4	3.9	14.8	30.3	29.5	10.1	6.5	4.9
2007	1.1	47.5	48.0	3.7	12.7	28.6	31.0	10.2	8.7	5.3
2008	1.1	47.1	47.6	4.0	11.9	28.2	31.8	9.5	9.1	5.5
2009	1.0	47.6	48.1	4.6	13.6	27.5	28.6	10.7	8.6	6.5
2010	1.1	47.3	47.8	4.1	11.3	24.7	31.6	13.9	7.1	7.4
2011	1.0	47.3	47.7	3.8	11.5	24.1	30.7	14.9	7.0	8.1
2012	1.0	47.4	47.9	3.7	11.0	24.1	29.6	16.0	7.1	8.6
2013	1.0	47.5	48.0	3.5	10.7	23.6	29.1	17.5	6.2	9.3
2014	1.0	47.7	48.2	3.4	10.2	23.1	28.5	19.0	5.5	10.2
2015	1.0	47.4	47.9	3.3	10.3	23.7	30.1	15.1	6.0	11.6
2016	1.0	47.5	47.9	3.1	9.3	23.3	29.8	16.6	5.5	12.5
2017	1.0	47.2	47.6	3.2	9.0	22.5	29.1	18.2	4.9	13.2
2018	1.0	46.7	47.2	3.1	8.6	21.9	28.9	19.4	4.3	13.8
2019	1.0	46.3	46.7	2.9	7.9	21.4	28.3	21.2	4.0	14.2

Unit: %.

Table 12: Compositions of Number of Workers (Cont.)

	N_a/N											N_s/N		
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65+	Employee	Own account worker	Contributing family worker
	a=1	a=2	a=3	a=4	a=5	a=6	a=7	a=8	a=9	a=10	a=11	s=1	s=2	s=3
1970	14.5	14.3	14.1	11.2	11.3	9.0	8.1	6.2	4.8	4.2	2.3	34.5	47.0	18.5
1971	15.1	15.0	13.9	10.8	11.0	9.0	7.9	6.2	4.7	4.2	2.3	34.4	47.1	18.5
1972	15.5	15.9	13.8	10.5	10.5	9.0	7.8	6.1	4.5	4.1	2.2	34.5	47.0	18.5
1973	15.7	17.0	13.9	10.1	10.0	9.0	7.5	6.1	4.4	4.1	2.2	34.9	46.7	18.4
1974	15.8	17.7	13.9	10.0	9.5	9.0	7.4	6.1	4.3	4.1	2.1	34.7	46.8	18.4
1975	15.8	18.6	14.6	9.7	9.0	8.8	7.3	6.0	4.2	4.0	2.0	35.3	46.4	18.3
1976	15.8	18.8	14.7	9.6	8.7	8.6	7.4	6.0	4.2	4.0	2.1	34.4	47.1	18.5
1977	15.7	19.2	15.3	9.5	8.4	8.3	7.4	5.9	4.2	3.9	2.1	33.8	47.5	18.7
1978	15.9	19.4	15.8	9.4	8.1	7.9	7.5	5.8	4.3	3.8	2.2	33.1	48.0	18.9
1979	15.8	19.3	16.2	9.6	8.0	7.5	7.5	5.7	4.3	3.8	2.2	31.9	48.9	19.3
1980	15.6	19.5	16.8	9.9	7.8	7.2	7.4	5.7	4.3	3.7	2.2	31.3	49.3	19.4
1981	15.4	19.5	17.3	10.4	7.6	6.9	7.2	5.7	4.3	3.5	2.2	30.4	49.9	19.7
1982	15.2	19.4	17.7	11.0	7.5	6.7	7.0	5.8	4.2	3.4	2.2	30.0	50.2	19.8
1983	14.9	19.5	18.1	11.6	7.4	6.5	6.6	5.8	4.1	3.3	2.1	29.5	50.6	19.9
1984	14.6	19.4	18.4	12.2	7.5	6.4	6.3	5.8	4.0	3.2	2.1	29.0	51.0	20.1
1985	14.5	19.0	18.4	12.8	7.8	6.3	6.0	5.8	4.1	3.1	2.1	28.8	51.1	20.1
1986	14.3	18.9	18.7	13.2	8.2	6.2	5.8	5.6	4.1	3.0	2.0	30.7	49.7	19.6
1987	14.1	18.8	18.8	13.6	8.7	6.2	5.6	5.4	4.1	2.8	2.0	29.1	50.9	20.0
1988	13.9	18.6	18.8	13.8	9.3	6.2	5.5	5.1	4.2	2.7	2.0	29.4	50.6	19.9
1989	13.7	18.4	18.8	14.1	9.8	6.4	5.4	4.9	4.2	2.5	1.9	29.7	50.4	19.9
1990	13.6	18.1	18.3	14.4	10.4	6.6	5.2	4.6	4.2	2.6	2.0	29.1	50.9	20.0
1991	13.4	17.9	18.1	14.7	10.8	7.0	5.1	4.3	4.0	2.6	2.0	28.7	51.1	20.1
1992	13.2	17.5	17.8	15.0	11.3	7.5	5.0	4.1	3.9	2.7	2.1	27.9	51.7	20.4
1993	12.9	17.3	17.6	15.1	11.6	8.0	5.0	3.9	3.7	2.8	2.1	27.8	51.8	20.4
1994	12.7	17.0	17.2	15.2	11.9	8.5	5.1	3.7	3.6	2.8	2.2	29.3	50.7	20.0
1995	12.6	16.8	17.0	15.3	12.2	8.9	5.3	3.6	3.4	2.9	2.2	26.8	52.5	20.7
1996	12.4	16.6	16.8	15.3	12.3	9.2	5.5	3.4	3.3	2.8	2.3	27.0	52.4	20.6
1997	11.5	16.2	17.2	15.1	12.7	9.9	6.0	3.6	3.0	2.5	2.1	27.1	56.9	16.1
1998	11.1	15.6	16.4	15.3	13.2	10.6	6.5	3.8	3.0	2.4	2.1	29.9	54.8	15.2
1999	10.4	15.7	16.3	14.6	13.6	10.8	7.0	4.2	2.9	2.3	2.2	26.3	58.0	15.7
2000	9.5	14.6	15.7	15.0	13.8	12.0	7.5	4.7	2.9	2.2	2.0	26.6	58.4	15.0
2001	10.5	14.1	15.6	14.6	13.9	11.7	7.9	4.9	2.8	1.9	1.8	29.9	54.8	15.3
2002	9.8	13.4	14.5	14.6	13.8	12.4	8.9	5.7	3.0	2.0	1.9	29.4	54.6	16.0
2003	9.0	13.0	13.4	14.1	14.0	12.9	10.1	6.4	3.4	1.9	1.8	30.7	54.5	14.7
2004	8.8	12.6	12.2	13.3	13.4	13.6	11.0	7.4	3.8	2.0	1.9	34.6	52.8	12.6
2005	7.9	13.1	11.7	12.7	13.6	13.5	11.7	7.6	4.4	1.8	2.0	34.6	52.6	12.8
2006	7.3	13.3	13.8	13.5	13.3	12.7	10.7	7.2	4.0	1.9	2.3	34.7	52.6	12.7
2007	6.5	11.2	12.4	12.5	13.2	13.1	11.6	8.5	5.0	2.5	3.4	34.8	52.5	12.7
2008	6.5	11.5	13.0	12.6	13.3	12.5	11.1	8.6	4.9	2.5	3.5	37.1	48.2	14.7
2009	6.9	11.3	13.6	12.8	12.5	11.4	11.3	8.5	5.4	2.7	3.4	39.0	44.3	16.7
2010	6.4	11.4	14.1	13.0	12.6	11.6	10.8	8.7	5.3	2.8	3.3	38.3	42.6	19.1
2011	5.7	10.4	13.6	12.7	12.7	11.9	11.3	9.2	5.9	3.2	3.4	39.0	42.9	18.1
2012	4.9	10.0	13.1	12.5	12.8	12.3	11.7	9.5	6.4	3.5	3.4	39.3	43.7	17.1
2013	4.9	9.8	12.7	12.7	12.6	12.2	11.3	9.7	6.8	3.8	3.5	39.5	43.8	16.7
2014	4.4	9.5	12.8	13.1	12.6	12.2	11.0	9.9	7.1	3.9	3.5	42.4	41.0	16.6
2015	4.4	10.2	12.8	13.9	12.6	11.8	10.4	9.5	6.9	4.0	3.5	45.2	38.3	16.5
2016	3.9	9.8	12.9	13.9	12.7	11.9	10.6	9.6	7.1	4.1	3.4	47.5	37.3	15.3
2017	3.9	9.8	12.6	13.8	13.1	12.1	10.8	9.7	6.9	4.1	3.3	48.7	36.6	14.7
2018	3.6	9.2	13.0	13.6	13.4	12.1	11.3	9.6	7.0	4.0	3.2	50.3	35.7	14.0
2019	3.4	8.7	13.0	14.0	13.8	12.1	11.3	9.6	6.9	4.0	3.1	50.7	35.4	13.9

Unit: %.

Table 13: Compositions of Labor Income

	V^L_{g2}/V^L	V^L_e/V^L						
	Female	Never attended	No completed primary	Finish primary	Completed lower secondary	Completed secondary	Vocational	College, university, and higher
	g=2	e=1	e=2	e=3	e=4	e=5	e=6	e=7
1970	38.5	9.1	41.4	34.5	10.5	3.3	0.3	0.9
1971	38.6	8.7	40.9	34.4	11.2	3.6	0.4	0.9
1972	38.7	8.4	40.9	33.7	12.0	3.7	0.4	0.9
1973	38.7	8.1	40.9	33.2	12.6	3.8	0.4	0.9
1974	38.9	7.5	39.7	33.6	13.7	4.2	0.4	1.0
1975	38.3	6.9	37.6	34.2	15.2	4.6	0.4	1.1
1976	39.3	6.8	39.0	33.4	14.8	4.5	0.4	1.0
1977	39.5	6.5	38.4	33.4	15.5	4.7	0.4	1.1
1978	39.8	6.3	39.9	32.4	15.2	4.7	0.4	1.1
1979	40.6	6.3	40.0	32.2	15.2	4.8	0.5	1.1
1980	40.3	5.7	38.0	32.4	16.9	5.3	0.5	1.2
1981	40.8	6.0	38.8	31.5	16.4	5.3	0.6	1.5
1982	41.2	6.1	38.8	31.1	16.2	5.4	0.8	1.7
1983	40.9	5.9	37.3	30.9	17.0	5.8	0.9	2.1
1984	41.2	6.0	37.1	30.8	16.9	5.9	1.1	2.3
1985	41.5	5.6	34.3	30.9	18.0	6.9	1.4	2.9
1986	41.3	5.4	32.9	31.1	18.6	7.3	1.5	3.2
1987	41.5	5.6	33.1	30.6	18.3	7.3	1.6	3.4
1988	42.0	5.8	34.4	30.7	17.4	6.8	1.6	3.3
1989	41.9	5.5	32.8	30.5	18.3	7.4	1.8	3.7
1990	41.8	4.9	29.2	30.4	20.8	8.4	2.2	4.0
1991	41.6	4.8	27.2	29.9	23.0	8.8	2.4	3.9
1992	41.4	4.2	23.5	28.5	26.3	10.2	2.9	4.3
1993	40.8	3.8	20.1	27.7	29.1	11.4	3.4	4.6
1994	43.3	3.4	17.4	25.7	32.0	12.7	4.0	4.8
1995	44.4	3.2	16.0	24.2	33.7	13.5	4.5	4.9
1996	45.2	3.1	14.8	23.7	35.5	13.6	4.7	4.7
1997	43.8	2.5	13.9	22.1	33.2	16.6	5.7	5.9
1998	43.3	1.8	12.5	22.5	32.2	18.1	5.9	7.0
1999	42.8	1.9	12.2	21.4	31.0	18.9	6.7	8.0
2000	42.8	1.7	10.9	20.9	30.9	19.3	8.0	8.4
2001	42.7	1.5	10.5	22.8	28.4	20.8	6.6	9.3
2002	42.9	1.4	9.6	21.4	28.3	21.7	6.9	10.6
2003	42.6	1.6	9.6	21.4	28.7	20.4	7.2	11.1
2004	43.6	1.6	8.0	19.8	30.8	20.6	7.2	11.9
2005	43.6	1.4	7.4	18.9	31.6	19.5	9.0	12.1
2006	41.2	1.6	8.7	20.3	28.1	18.0	11.4	11.9
2007	39.8	1.5	7.1	19.0	29.0	17.0	14.4	12.0
2008	38.3	1.7	7.0	18.2	28.8	15.9	15.9	12.5
2009	37.9	2.1	7.6	16.0	26.4	18.0	15.0	14.8
2010	39.2	1.7	6.7	15.5	27.3	23.2	10.8	14.8
2011	40.4	1.5	6.4	16.1	26.5	23.8	10.5	15.1
2012	41.8	1.6	6.3	14.6	25.3	25.6	10.4	16.4
2013	41.3	1.2	4.5	14.7	24.1	28.0	8.6	18.9
2014	42.7	1.0	4.0	14.6	24.5	29.1	7.4	19.4
2015	42.2	1.2	4.2	14.8	27.3	23.6	7.8	21.2
2016	41.7	1.1	3.6	15.5	25.6	26.4	7.1	20.7
2017	42.3	1.1	3.8	13.2	25.6	28.8	6.1	21.3
2018	42.1	1.1	3.7	13.9	24.3	30.8	5.0	21.2
2019	42.2	1.1	3.5	13.1	23.8	33.2	4.6	20.7

Unit: %.

Table 13: Compositions of Labor Income (Cont.)

	V^L_a/V^L											V^L_s/V^L		
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65+	Employee	Own account worker	Contributing family worker
	a=1	a=2	a=3	a=4	a=5	a=6	a=7	a=8	a=9	a=10	a=11	s=1	s=2	s=3
1970	13.5	18.5	19.9	13.7	9.1	6.4	7.5	5.6	3.3	1.9	.6	46.9	36.4	16.7
1971	14.1	19.2	19.6	13.1	9.4	6.2	7.3	5.5	3.3	1.8	.6	46.7	36.5	16.8
1972	14.4	20.1	19.0	12.5	9.5	6.1	7.2	5.5	3.2	1.8	.6	45.4	37.5	17.0
1973	14.6	21.0	18.8	12.0	9.4	6.1	7.0	5.6	3.2	1.9	.6	44.0	38.6	17.4
1974	14.6	22.1	19.1	11.7	9.2	5.8	6.7	5.4	3.0	1.8	.5	46.0	37.4	16.6
1975	14.3	23.3	20.5	11.2	8.9	5.4	6.4	5.1	2.8	1.7	.5	48.8	35.6	15.6
1976	14.5	23.0	19.7	11.1	8.6	5.8	6.7	5.3	3.0	1.7	.5	44.9	38.5	16.7
1977	14.2	23.3	20.3	10.9	8.2	5.9	6.7	5.2	3.1	1.7	.5	44.3	39.1	16.6
1978	14.7	23.3	20.3	10.7	7.9	6.0	6.7	5.1	3.3	1.7	.5	43.0	40.1	17.0
1979	14.6	22.8	20.4	10.8	7.7	6.2	6.7	5.1	3.6	1.6	.6	40.9	41.9	17.3
1980	14.2	24.0	21.4	10.8	7.1	6.3	6.2	4.9	3.0	1.5	.5	43.8	39.8	16.4
1981	14.2	22.8	21.2	11.4	7.3	6.2	6.4	5.2	3.2	1.5	.6	39.2	43.1	17.7
1982	14.1	22.1	21.2	12.2	7.3	6.1	6.3	5.4	3.2	1.5	.6	36.9	44.8	18.3
1983	13.7	22.4	21.8	12.7	7.2	5.9	5.9	5.3	3.0	1.5	.5	37.8	44.1	18.0
1984	13.5	21.9	21.8	13.4	7.3	5.8	5.7	5.4	3.0	1.4	.6	35.9	45.5	18.5
1985	13.1	22.2	22.5	14.0	7.5	5.8	5.3	5.0	2.8	1.3	.5	41.2	41.8	17.0
1986	12.8	22.3	22.9	14.3	7.8	5.7	5.1	4.8	2.7	1.2	.5	44.3	39.6	16.1
1987	12.6	21.7	22.6	14.6	8.3	5.7	5.0	4.6	3.2	1.2	.5	41.1	42.1	16.9
1988	12.8	20.4	21.9	15.2	9.0	5.8	5.1	4.7	3.4	1.2	.5	36.5	45.3	18.2
1989	12.5	20.7	22.2	15.1	9.5	6.0	4.9	4.3	3.3	1.1	.5	39.1	43.5	17.4
1990	12.1	20.8	21.3	15.5	10.2	6.5	4.9	4.0	3.1	1.1	.5	40.6	42.5	16.8
1991	11.9	19.8	20.9	16.2	10.9	6.8	4.9	3.9	3.0	1.1	.5	37.8	44.8	17.4
1992	11.2	19.7	20.9	16.4	11.6	7.5	4.8	3.5	2.6	1.1	.5	40.9	42.7	16.4
1993	11.1	19.5	20.9	16.5	11.9	8.1	4.8	3.3	2.3	1.1	.5	43.6	40.6	15.8
1994	10.1	19.3	20.7	16.7	12.6	9.0	4.8	3.1	2.0	1.1	.6	47.8	38.0	14.1
1995	9.6	18.5	20.2	17.1	13.2	9.7	5.0	3.1	1.9	1.1	.7	45.2	40.5	14.3
1996	9.2	17.7	19.8	17.4	13.6	10.1	5.2	3.2	1.9	1.1	.7	42.9	42.9	14.2
1997	8.7	18.0	19.4	16.5	14.0	11.1	5.9	3.1	1.7	1.0	.6	44.8	44.5	10.6
1998	8.2	17.2	18.1	16.3	14.7	12.2	6.8	3.4	1.7	.9	.6	49.4	40.6	10.0
1999	7.7	16.9	17.8	15.4	15.3	12.6	7.5	3.7	1.7	.9	.6	46.6	43.4	10.0
2000	7.1	15.7	16.8	15.5	15.6	14.0	8.0	4.1	1.7	.8	.6	49.2	41.6	9.2
2001	7.6	15.5	16.9	14.7	15.6	14.0	8.8	4.1	1.6	.7	.5	55.6	35.9	8.5
2002	7.1	14.6	15.1	14.5	15.7	15.0	10.3	4.7	1.8	.7	.5	56.3	35.0	8.7
2003	6.5	14.0	13.8	13.9	15.8	15.5	11.8	5.4	2.1	.7	.5	56.7	35.3	8.1
2004	6.2	13.7	12.2	13.1	15.4	16.2	13.1	6.4	2.3	.7	.5	60.1	33.5	6.4
2005	5.6	13.7	11.5	12.4	15.7	16.2	14.3	6.7	2.7	.7	.6	61.1	32.7	6.2
2006	5.2	13.6	13.9	13.4	15.2	15.3	13.1	6.1	2.7	.8	.8	61.7	32.2	6.1
2007	4.2	10.4	12.6	13.1	15.6	15.5	14.5	8.1	3.8	1.1	1.1	60.8	33.1	6.1
2008	4.3	11.2	14.6	13.3	13.5	14.0	14.4	8.4	3.9	1.1	1.3	63.4	29.1	7.5
2009	4.1	10.9	15.9	14.0	12.5	11.8	15.1	8.7	4.5	1.1	1.3	68.4	23.8	7.8
2010	3.9	9.2	14.6	14.1	12.7	13.7	14.9	8.9	5.0	1.6	1.5	65.9	24.6	9.5
2011	3.1	8.2	14.9	15.2	13.2	14.1	12.1	10.4	5.5	1.9	1.4	64.9	26.2	8.9
2012	2.9	7.6	13.4	14.1	14.6	14.1	14.4	10.0	6.2	1.6	1.2	66.1	25.2	8.8
2013	3.0	9.0	13.4	12.8	15.6	13.0	14.6	10.5	5.4	1.5	1.1	67.7	23.9	8.5
2014	2.4	8.3	12.6	14.9	14.5	15.1	14.4	9.9	5.4	1.5	1.0	70.1	21.9	7.9
2015	2.5	8.8	13.5	15.2	16.8	12.7	12.3	10.8	4.8	1.6	1.2	72.1	20.3	7.6
2016	2.0	8.8	11.2	15.2	16.3	13.7	13.9	10.4	6.0	1.5	1.0	73.5	19.8	6.7
2017	2.1	9.2	12.7	13.4	15.5	14.6	13.7	10.0	6.2	1.5	1.0	74.5	19.0	6.5
2018	1.8	8.7	13.1	11.6	16.5	14.4	14.2	10.5	6.3	1.7	1.1	74.8	18.9	6.4
2019	1.8	8.7	12.5	12.1	17.3	14.6	14.0	10.4	5.6	1.7	1.1	74.7	19.1	6.3

Unit: %.