

**14.462**  
**Spring, 2020**

**Ledgers and Database Management,  
Integrated Financial Statements, and  
an Application to Distributional and  
Regional Accounts**

**(Lecture 2)**

Robert M. Townsend

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# Distributed Ledgers: Plan of Attack for the Analysis

- ❖ Economics of what distributed ledgers can do by analyzing the functions of key individual components
- ❖ Separately
  - Does not have to be in combination- another pitfall
- ❖ Compare, contrast, and innovate by merging for each function the economics framework with the frameworks of computer science and data management disciplines
  - Clarifying the technology
  - Propose new designs
- ❖ Put each component in context, with examples
- ❖ Emphasizing what each component of DLT brings to the table

# One Context: SEA, Townsend Thai Project-- Financial Access, a G20 Goal

## ❖ Rural Annual

- Started in rural areas in 1997 with 192 villages
- Resurvey in 64 villages every year since 1998
- Expanded to North and South in 2003 and 2004

## ❖ Rural Monthly

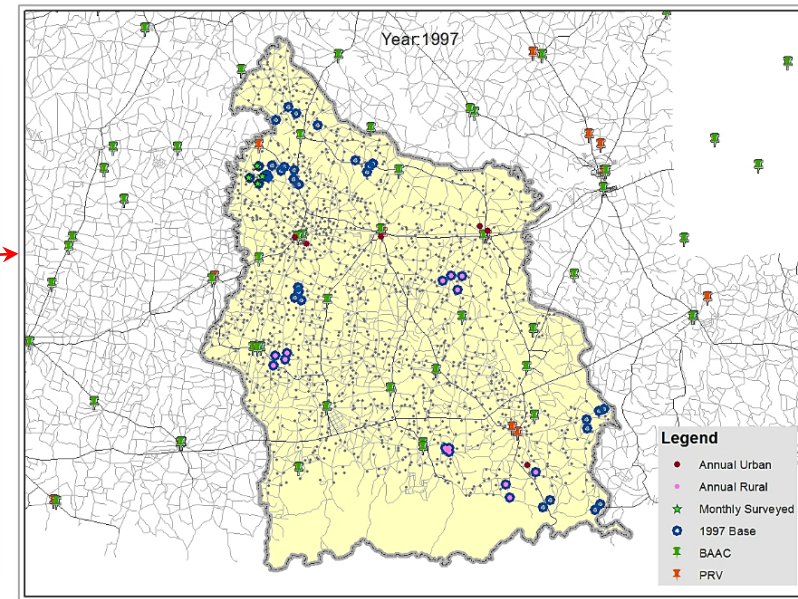
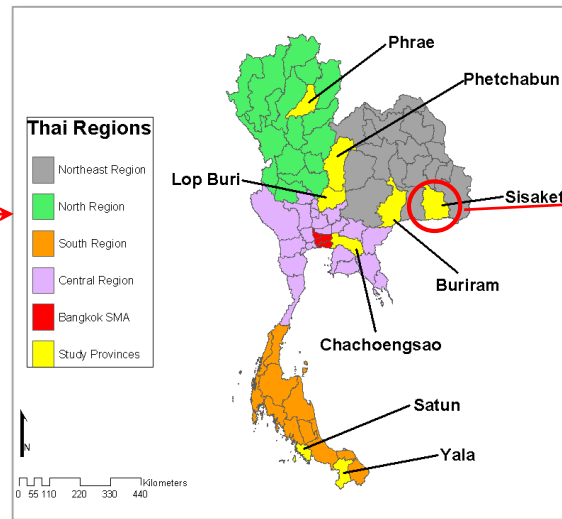
- Started in 1998, 720 new households
- Survey design: 16 villages, 44 hhs in each
- 230 continuous months

## ❖ Urban Annual

- Extended to urban areas in 2005

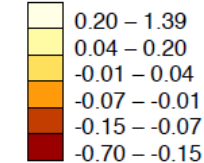
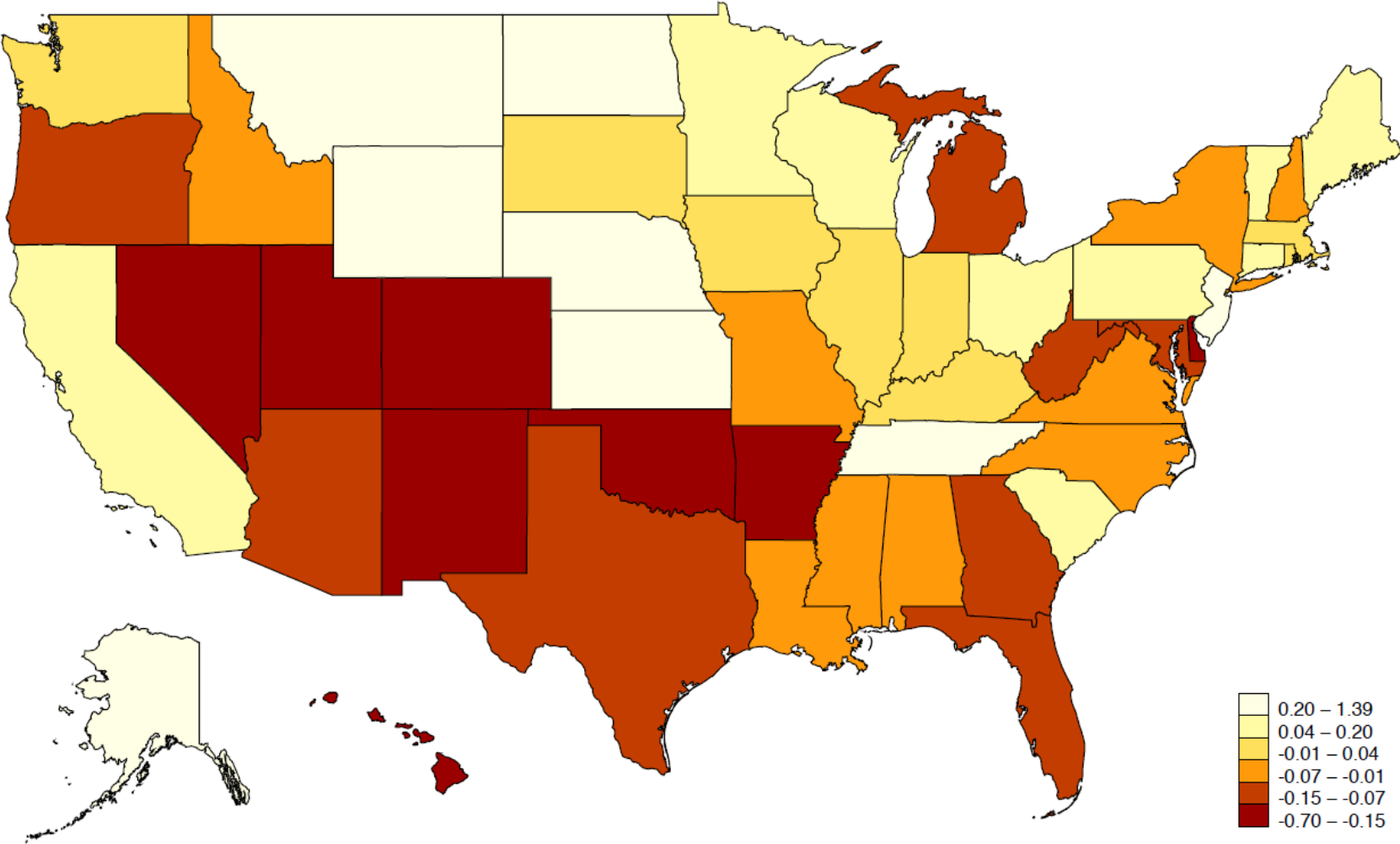
## ❖ Urban Monthly

- Started in 2013
- 18 continuous months



# Geographic Distribution of Current Account in 2007

## Current Account over GDP (2007)



# Ledgers as Accounts

First component

# Ledgers are Financial Accounts

Table A.2. *Income Statement of Household A*

Month	5	6
Revenue from Cultivation		
Revenue from Livestock	30,485	27,753
Livestock Produce	28,985	27,753
Capital Gains	1,500	
Revenue from Fish and Shrimp		
Revenue from Business	184,360	145,360
Revenue from Labor	11,440	11,440
Provision		
Other Revenues	6,000	3,000
<b>Total Revenues</b>	<b>232,285</b>	<b>187,553</b>
Cost of Cultivation		
Cost of Livestock	31,944	30,281
Capital Losses		
Depreciation (Aging)	3,281	3,263
Other Expenses	28,663	27,018
Cost of Fish and Shrimp		
Cost of Business	220,176	167,323
Cost of Labor Provision		
Cost of Other Production Activities		
<b>Total Cost of Production</b>	<b>252,120</b>	<b>197,604</b>

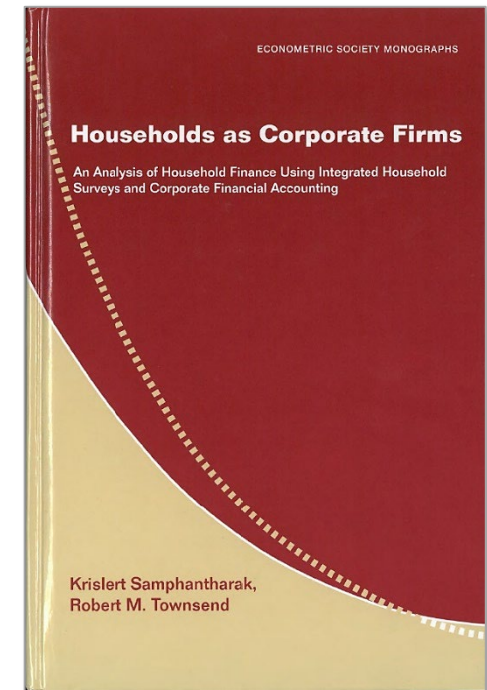
Table A.1. *Balance Sheet of Household A*

Month	5	6
Cash in Hand	1,966,139	1,862,121
Account	688,971	805,259
Receivables		
Deposits at Financial Institutions	167,271	167,969
ROSCA (Net Position)	33,000	37,000
Other Lending	153,136	153,136
Inventories	1,346,939	1,440,729
Livestock	326,280	323,018
Fixed Assets	967,342	973,759
Household Assets	598,758	596,261
Agricultural Assets	66,104	65,829
Business Assets	2,479	11,669
Land and Other Fixed Assets	300,000	300,000
<b>Total Assets</b>	<b>5,649,079</b>	<b>5,762,991</b>

Table A.3. *Statement of Cash Flows of Household A*

Month	5	6
Net Income (+)	-22,684	-12,889
Adjustments:		
Depreciation (+)	6,075	6,046
Change in Account Receivable (-)	-147,488	-116,288
Change in Account Payable (+)	149,960	149,960
Change in Inventory (-)	-126,465	-106,205
Change in Other Current Assets (-)	1,781	3,263
Consumption of Household-Produced Outputs (-)	-350	-314
<b>Cash Flow from Production</b>	<b>-139,171</b>	<b>-76,427</b>

- ❖ It's accounting, keeping the books
- ❖ Bitcoin is flow, as in statement of cash flow, and stock, as in balance sheet



# Reconciled Ledgers as a Database

- ❖ Example, Thai villages: measure currency transactions monthly, for 20 years
- ❖ Put cash flow accounts on common ledger: “just” a new integrated database
  - $i$  transacts with  $j$ , but is  $j$  in the database? if so, is  $j$  also reporting transaction with  $i$ ?
- ❖ Doing this uncovers discrepancies, one of the main things DLT can remedy! (even if nothing else, one component at a time)
- ❖ Example, Australian stock exchange-no need for T+2
  - Two parties A and B meet on an outside trading platform and agree to trade. Information is sent by the trading platform to the clearing exchange, writes an encoded message on the distributed ledgers, can be read by A and B and references a contract ID, run digital asset’s DAML code on the contract to verify that it does what it is expected to do
- ❖ Analogy to double-entry bookkeeping for accuracy as a huge innovation
  - Luca Pacioli, 1494, the “father of accounting,”

# Raises the issue of Database Management Systems: Traditional vs. Distributed Ledgers

- ❖ A ledger as a traditional database, user can **Create, Read, Update, or Delete (CRUD)**
- ❖ The risk: Anyone with sufficient access to it can destroy or corrupt data
  - so users are reliant on the security infrastructure of the database operator and must trust
  - Alternative: the decentralized system of distributed ledgers, but comes known database problems
- ❖ The CAP theorem: Impossible to simultaneously provide more than two out of the three
  - **Consistency** – where every read receives the most recent write or an error
  - **Availability** – where every request receives a (non-error) response
  - **Partition Tolerance** – in which the system continues to operate and does not cease operations despite multiple versions



# Consensus and Synchronization

- ❖ Consensus Problem of Distributed Computing: Impossible to guarantee that any asynchronously connected set of communicating nodes can agree on even a single bit value (Fischer)
- ❖ But if nodes are Synchronized, must choose, as in CAP
  - When a network partition occurs, one has to decide to cancel the operation, which decreases availability but ensures consistency, or proceed with the operation but risk inconsistency.
  - Algorithms take a stand on these tradeoffs and typically involve costs

# Hybrids: The Way We Should Be Thinking About the Problem

- ❖ Hybrid systems emerge in practice: Between the end-points of strictly hierarchical (military, command control) traditional database vs. fully connected, synchronized network meshes, which do not scale
- ❖ Though not necessarily as deliberate choices (Mallett 2009)
- ❖ Constrained optimal partitioning: Example of how costly connections among agents can lead to subgroups
- ❖ Single vs. multiple platforms
  - Fixed costs per node for each bilateral connection
  - Despite ever-decreasing per capita costs and ever-increasing gains from having all agents in one mutual fund, due to portfolio diversification and the law of large numbers, marginal costs can exceed marginal benefits from increasing group size.
  - Townsend (1978)

# From Survey Data to Complete Financial Accounts

- ❖ Well beyond paper respondent survey
- ❖ Are households reporting bank transactions consistent with data from corresponding banks?
- ❖ Browning, Crossley, and Winter (2014) seek to integrate the collection of wealth, income and spending data in the British Household Panel Survey so that for each household the intertemporal budget constraint holds.
- ❖ An Office for National Statistics (ONS) Economic Expert Working Group (EEWG) envisions using web surveys, mobile surveys, and phone apps to scan barcodes and till receipts.
- ❖ There is now also electronic data surrendered voluntarily by customers, as with Mint, and the use of commercial bank information by information aggregators.
- ❖ Use of DLT to create complete financial accounts is not as far as away as it might seem, a priori.
- ❖ Consensus categorization
  - Run the code on transactions to create complete set of accounts
    - Income, balance sheet, cash flow

# Integrated Regional Accounts

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November 13, 2019

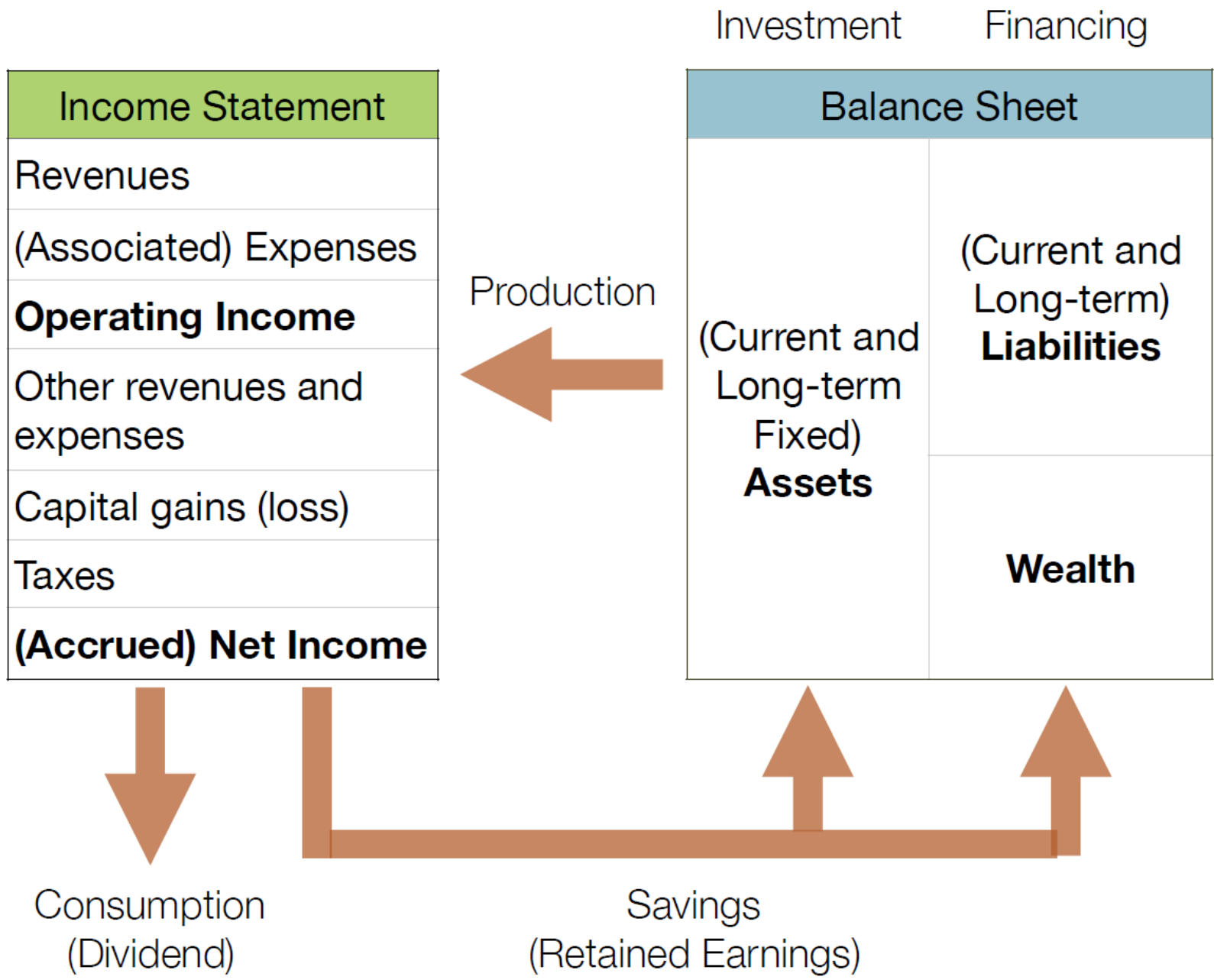


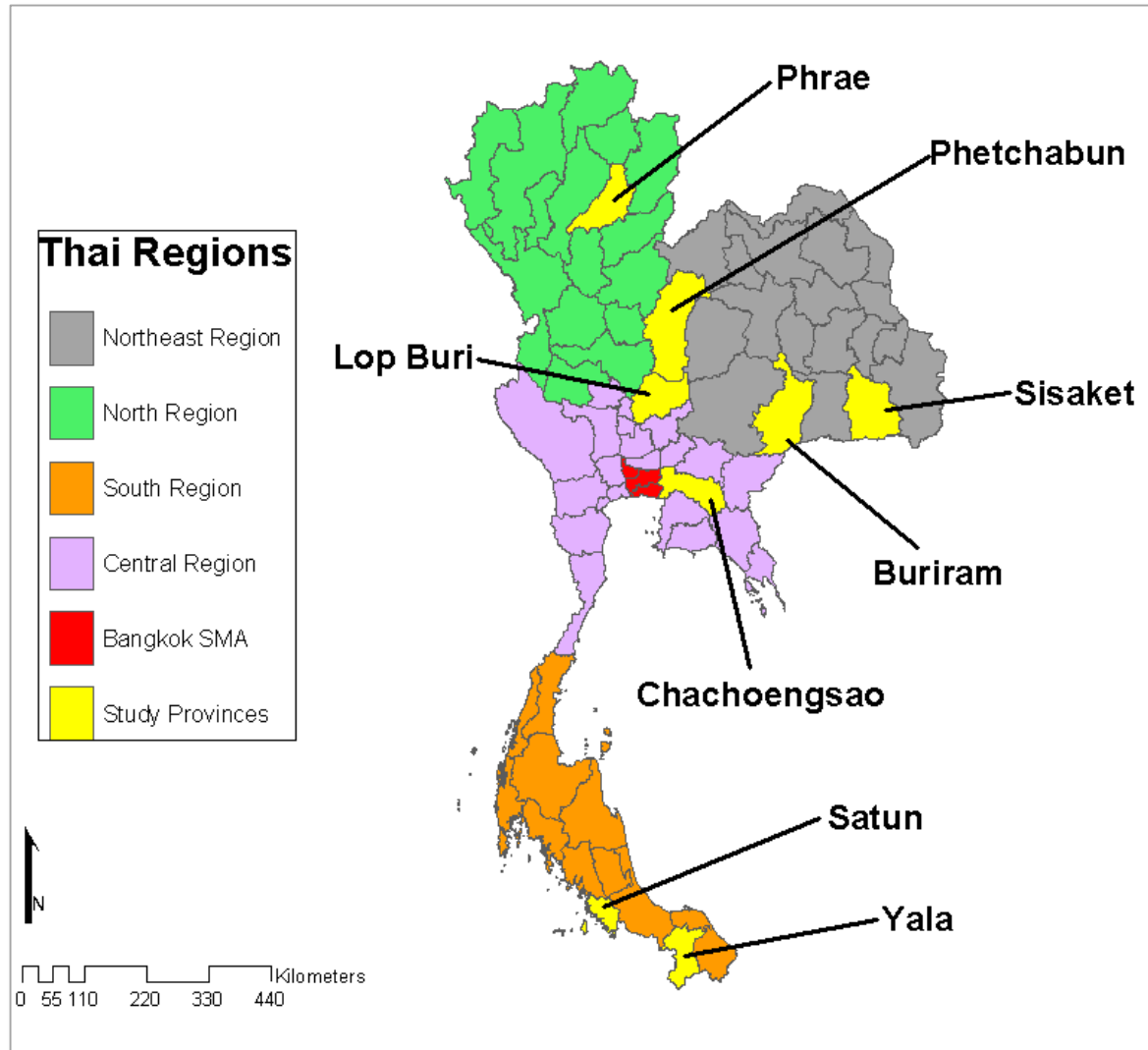
Table 4.1. *Examples of Transactions and Their Records*

Transaction	Example of Corresponding Survey Questions	Balance Sheet	Income Statement	Statement of Cash Flows
Receive wage income in cash	<b>JM4D</b> What is the total amount of cash payments that you received since the last interview for doing this job? Include the value of any cash tips, bonuses or overtime payments. If no cash payments were received, record 0.	Increase in cash; Increase in cumulative savings	Revenue from labor	Net income (Cash inflow)
Use cash to pay telephone bill	<b>XM1A [6]</b> Since the last interview, have you or members of your household made any cash purchases of [telephone and telecommunication services]? If yes, what is the total amount that you and members of your household have spent on [telephone and telecommunication services] since the last interview?	Decrease in cash; Decrease in cumulative savings	Consumption	Consumption (Cash outflow)
Deposit cash with the production credit group	<b>SM3B</b> How much have you deposited to [the production credit group] in total since the last interview?	Decrease in cash; Increase in deposits at financial institutions		Increase in deposits at financial institutions (Cash outflow)

Source: Samphantharak and Townsend (2009)

# **The Impact of Isolationist Policy: Disentangling Real and Financial Factors Through the Lens of Integrated Regional Financial Accounts**

Paweenawat, Archawa and Robert M. Townsend (2020)





# Individual Level Accounts

# Paweenawat and Townsend (2020) “The Impact of Isolationist Policy: Disentangling Real and Financial Factors Through the Lens of Integrated Regional Financial Accounts”

## 2.8 Financial Statements of Example Households

### 2.8.1 Household A

For the first example, we consider a typical working household in Lop Buri. In 1999, this household consisted of a male household head, his wife, and a four-years-old daughter. The household head was 38 years old, while his wife was 34 years old. Both the household head and his wife only have the primary-level education (4 years and 6 years, respectively). In 2000, this household had another daughter.

In 1999, both adult members worked at a shoe-making factory. Later that year, the household head switched to work as a construction worker. In the next year, the wife moved to work at a garment company making knitted dresses. Since 2001, both adult members have changed their jobs several times. This pattern is quite common in Thai rural villages and suggests high job mobility among Thai wage workers. This household also raised a small flock of chickens and ducks. In 2001, this household branched out to cultivation activity and grew chili. And in 2005, this household invested in a friend’s cantaloupe farm. However, labor income is always the main source of this household income. Table 1 reports the statement of income and retained earnings of this household in 1999. Figure 1 shows the composition of household A’s income over time.

In 1999, the average value of fixed assets of this household is 159,251 Baht (69,251 Baht excluding land). Household A is ranked at the 24<sup>th</sup> percentile by the value of fixed assets (the 33<sup>rd</sup> percentile if land is excluded). Therefore, household A has relatively low wealth by the Lop Buri standard. Table 2 reports the average balance sheet of this household in 1999. Household A held most of its wealth in land and household assets.

Table 1 – Statement of income and retained earnings of household A

Uses		Sources	
Expenses from production		Revenues from production	
Cultivation	0	Cultivation	0
Livestock	181	Livestock	340
Fish and shrimp	0	Fish and shrimp	0
Business	0	Business	0
Labor	0	Labor	91,150
Other	730	Other	260
Interest expense	10,000	Interest revenue	0
Depreciation	3,435	Capital gains	0
Insurance premium	0	Less: Capital losses	0
Property tax	0	Insurance indemnity	0
Net income before tax			
Income tax	0		
Consumption	54,076		
Savings	23,329		
Charges against total revenue	91,750	Total Revenue	91,750

Figure 1 – The composition of household A's income over time

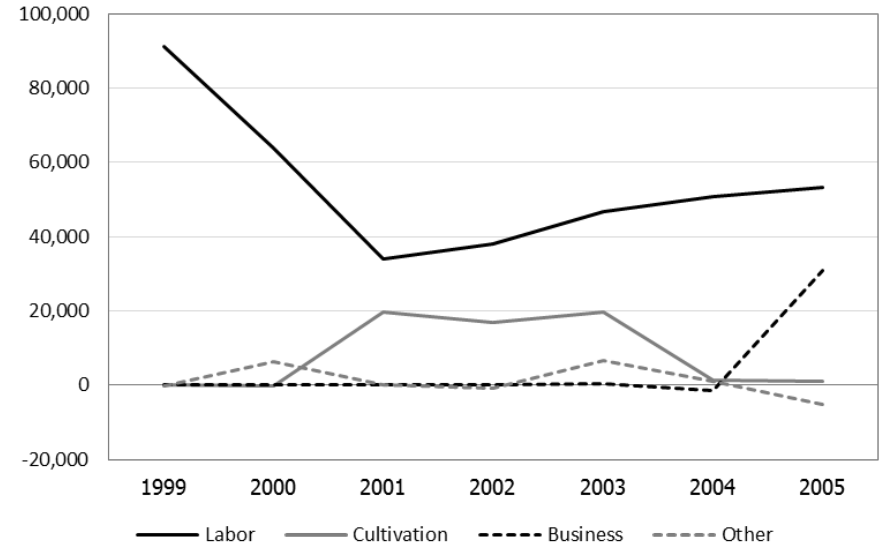


Table 2 – Balance sheet of household A

Assets		Liabilities and net wealth	
Current assets		Current liabilities	
Financial assets		Account payable	0
Cash	22,992	Other borrowing	37,417
Account receivable	0	Household's net wealth	
Other lending	0	Contributed capital	118,192
Deposits	5,560	Current retained earnings	50,779
ROSCA (net position)	14,125	Gifts (net transfer)	-1,602
Inventories	1,777		
Prepaid insurance	0		
Livestock	1,081		
Fixed assets			
Household assets	69,251		
Agricultural assets	0		
Business assets	0		
Land and other fixed assets	90,000		
Total assets	204,786	Total liabilities and net wealth	204,786

Figure 2 – The composition of household A's wealth

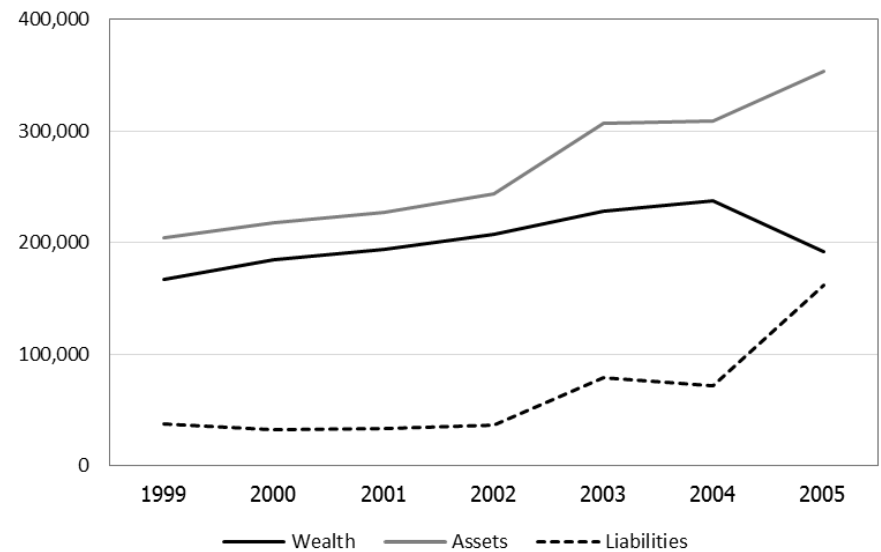


Figure 2 shows the composition of household A's wealth level over time. In early years (1999–2002), household A's liability level is quite stable, and the increase in household A's asset level comes from the increase in household A's savings. From 2003, on the other hand, household A also uses loans to finance its asset accumulation. Table 3 reports the statement of cash flow of household A.

Table 3 – Statement of cash flow of household A

<b>Change in cash holding</b>	<b>-11,479</b>
<b>Cash flow from production</b>	<b>84,096</b>
(+) Income from production	87,447
(+) Depreciation of assets	3,435
(+) Change in account payable	0
(-) Change in account receivable	0
(-) Change in inventory	-40
(-) Consumption of household production	-6,746
(-) Net capital gains from production	-90
<b>Cash flow from financing, investment, &amp; consumption</b>	<b>-95,575</b>
(+) Net capital gains from financial assets	0
(-) Capital expenditure on fixed assets	-10,795
(+) Net interest income	-10,000
(-) Tax expenditure	0
(-) Consumption expenditure	-47,330
(-) Insurance premium	0
(-) Capital expenditure on livestock	250
(-) Change in deposit at financial institutions	-940
(-) Change in ROSCA position	-10,750
(-) Lending	0
(+) Borrowing	-14,000
(+) Net gifts and transfer	-2,010
(+) Change in contributed capital	0
(+) Insurance indemnity	0
<b>Statistical discrepancy</b>	<b>0</b>
<b>Change in cash holding from balance sheet</b>	<b>-11,479</b>

Creating, village, regional, and national income and product accounts, NIPA, and flow of funds accounts

# Utilizing BEA National Income Product Accounts: 1975, 2007

Table 9 – Creating production account from statement of income

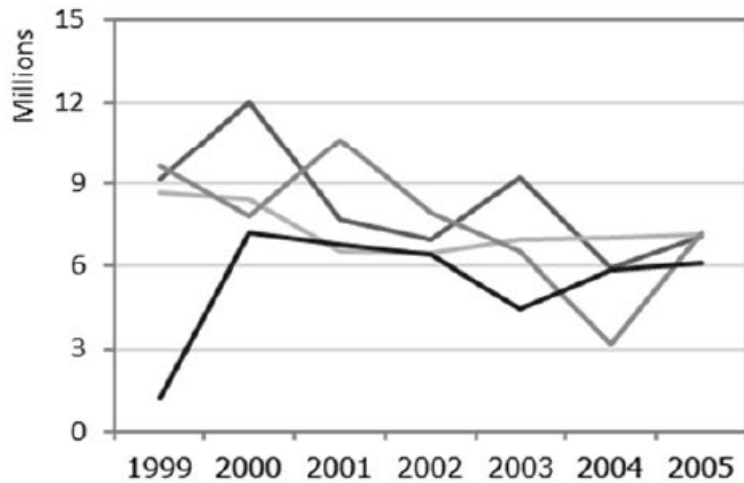
Statement of income	
Uses	Sources
Expenses from production	Revenues from production
Interest expense	Interest revenue
Depreciation	Capital gains
Insurance premium	<i>Less:</i> Capital losses
Property tax	Insurance indemnity
Net income before tax	
Charge against revenue	Total revenue

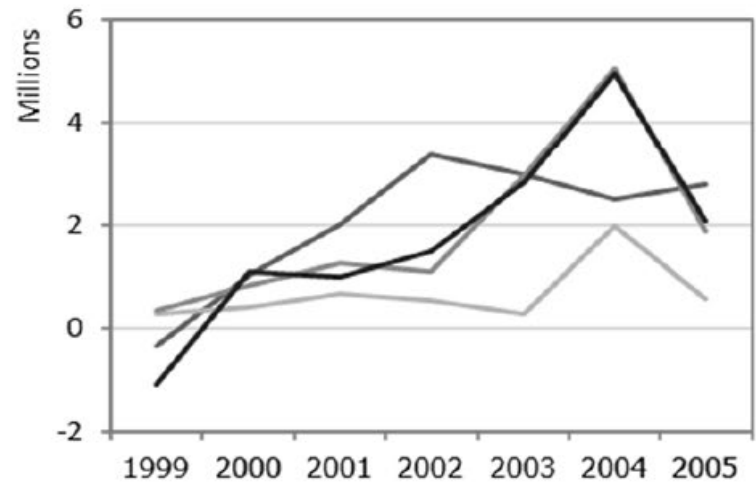
Production account	
Uses	Sources
Interest expense	Revenues from production
<i>Less:</i> Interest revenue	<i>Less:</i> Expenses from production
Insurance premium	
Property tax	
Profits	
Net income before tax	
<i>Less:</i> Capital gains	
<i>Plus:</i> Capital losses	
<i>Less:</i> Insurance indemnity	
Charge against output	Output

Figure 13 – Villages' output (scale varies by provinces)

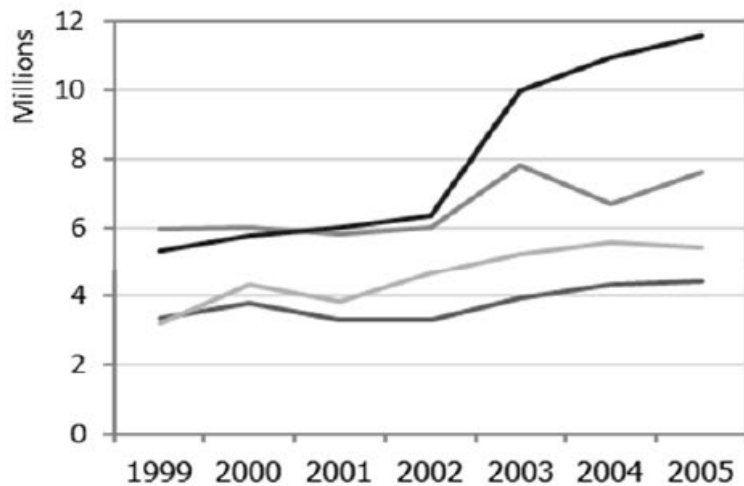
Chachoengsao



Buri Ram



Lop Buri



Si Sa Ket

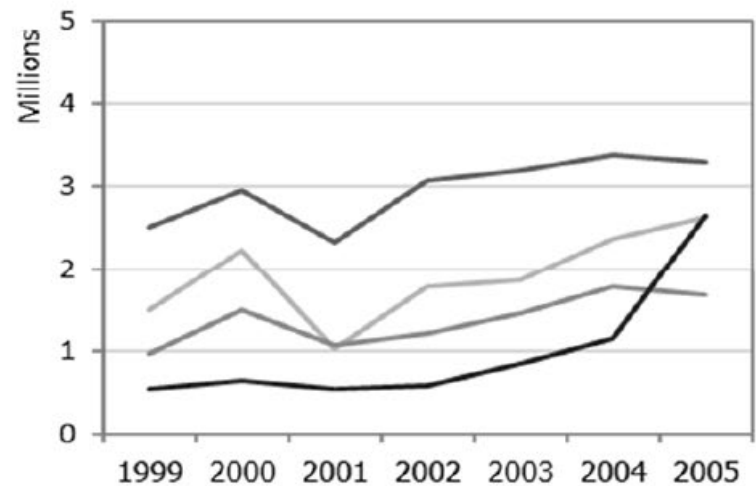
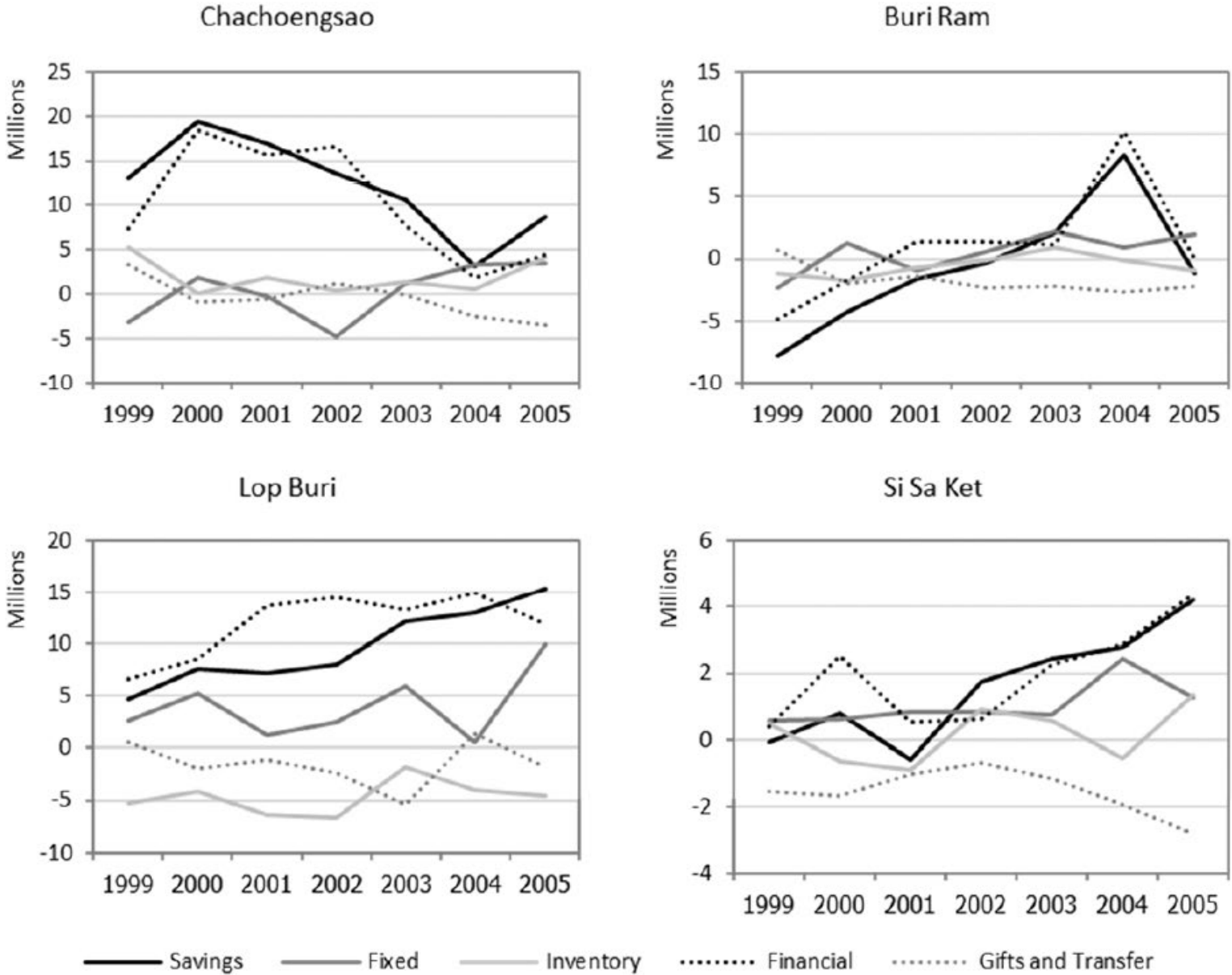




Table 11 – Creating saving-investment account from changes in balance sheet

Change in balance sheet	
Uses	Sources
Change in financial assets	Change in current liabilities
Cash	Accounts payable
Deposits	Other borrowings
Accounts receivable	Change in household's net wealth
ROSCA (net position)	Contributed capital
Other lending	Gifts
Change in prepaid insurance	Current retained earning
Change in inventories	
Change in livestock	
Change in fixed assets	
Distribution of net income	Change in liabilities and net wealth
Saving-investment account	
Uses	Sources
Change in financial assets	Change in household's net wealth
Change in prepaid insurance	Contributed capital
Change in inventories	Gifts
Change in livestock	Current retained earning
Change in fixed assets	
Plus: Depreciation	
Less: Change in current liabilities	
Gross investment	Gross savings

Figure 15 – Allocation of village’s savings (scale varies by provinces)

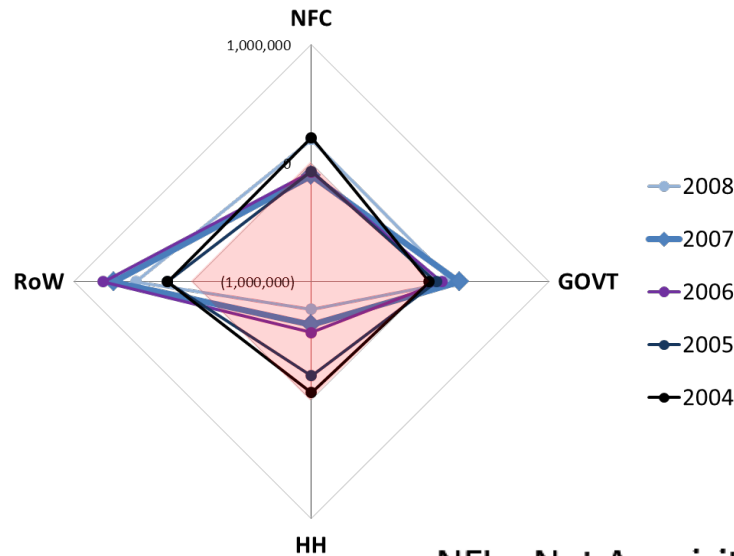


# Flow of Funds

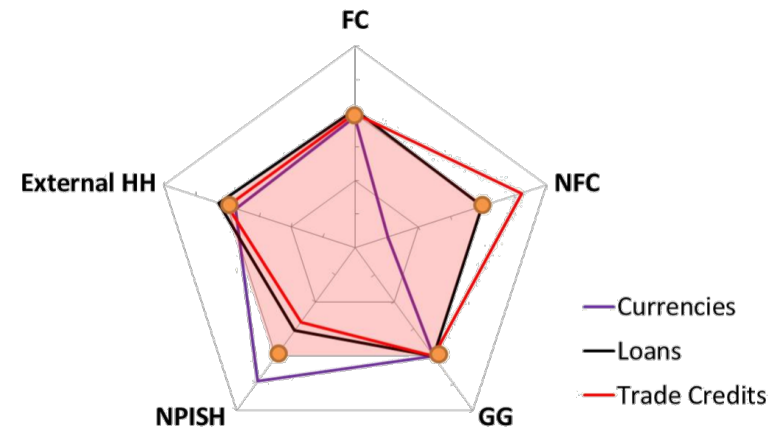
- ❖ Traditional sectors
- ❖ Flow of funds accounts
- ❖ Featuring bank and non-bank financial intermediaries
- ❖ Underway in England and U.S.

- ❖ Flows within sector, too
- ❖ Balance sheet, income, cash
- ❖ By geography
- ❖ Impact of monetary policy at local level

Flow of Funds from Financial Corporation, National



Flow of funds between a village in Chachoengsao and the other sectors in November, 2009

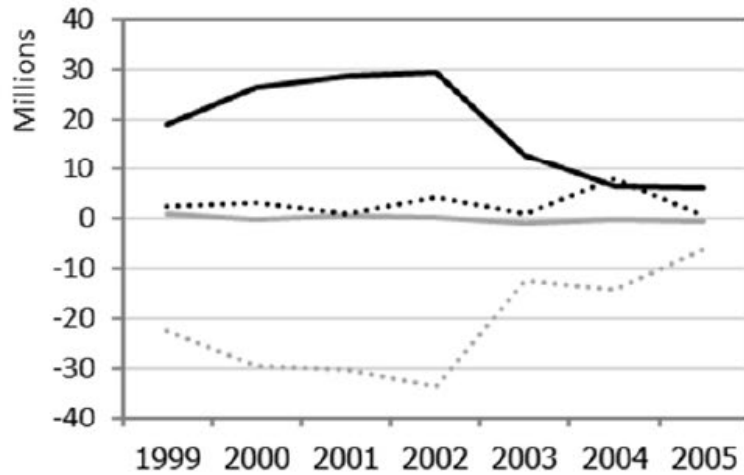


- $NFI = \text{Net Acquisition of Financial Assets (NAFA)} - \text{Net Incurrence of Liabilities (NIL)}$

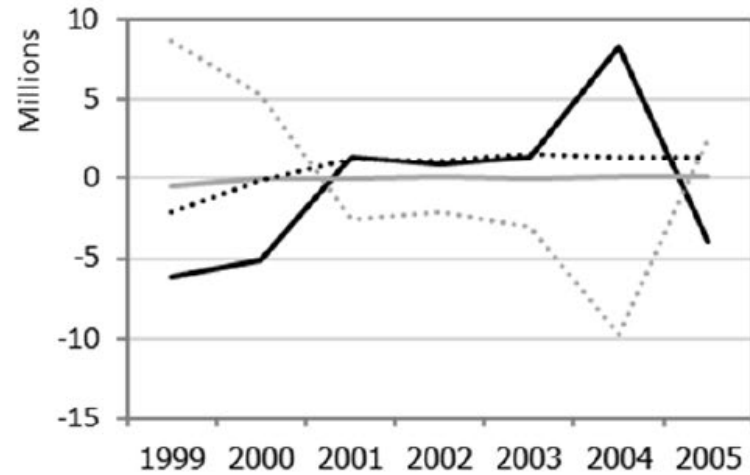
$$\underbrace{NAFA - NIL}_{\text{(Financial) Surplus}} = \underbrace{GS - CF}_{\text{Gross Savings: Expenditures on Capital}}$$

Figure 16 – Village balance of payments

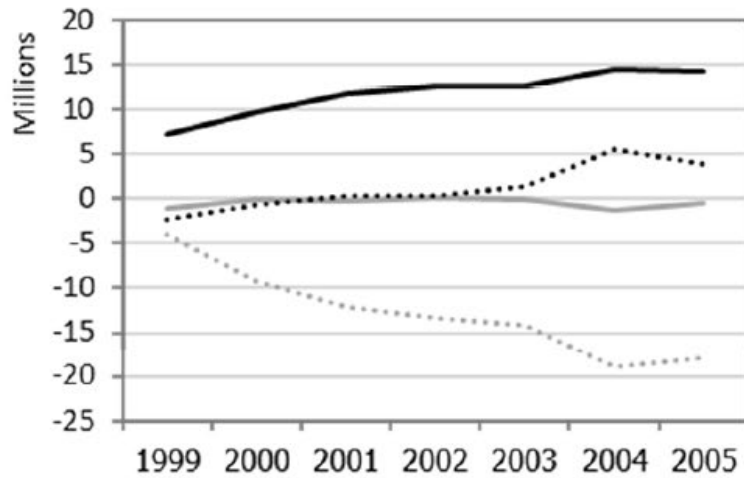
Chachoengsao



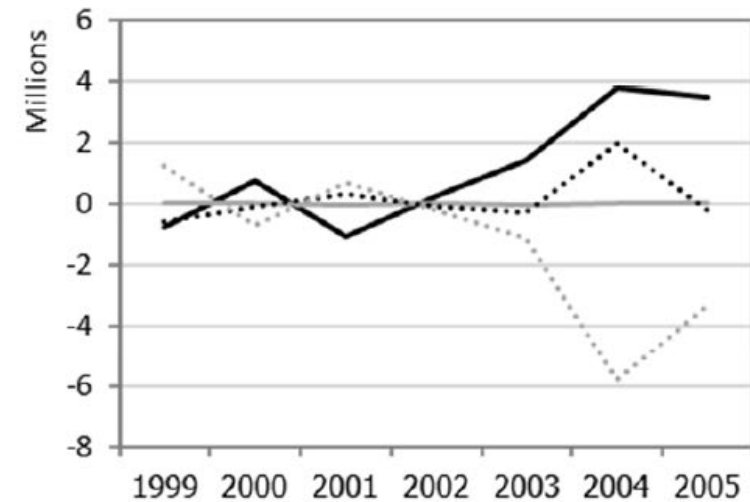
Buri Ram



Lop Buri



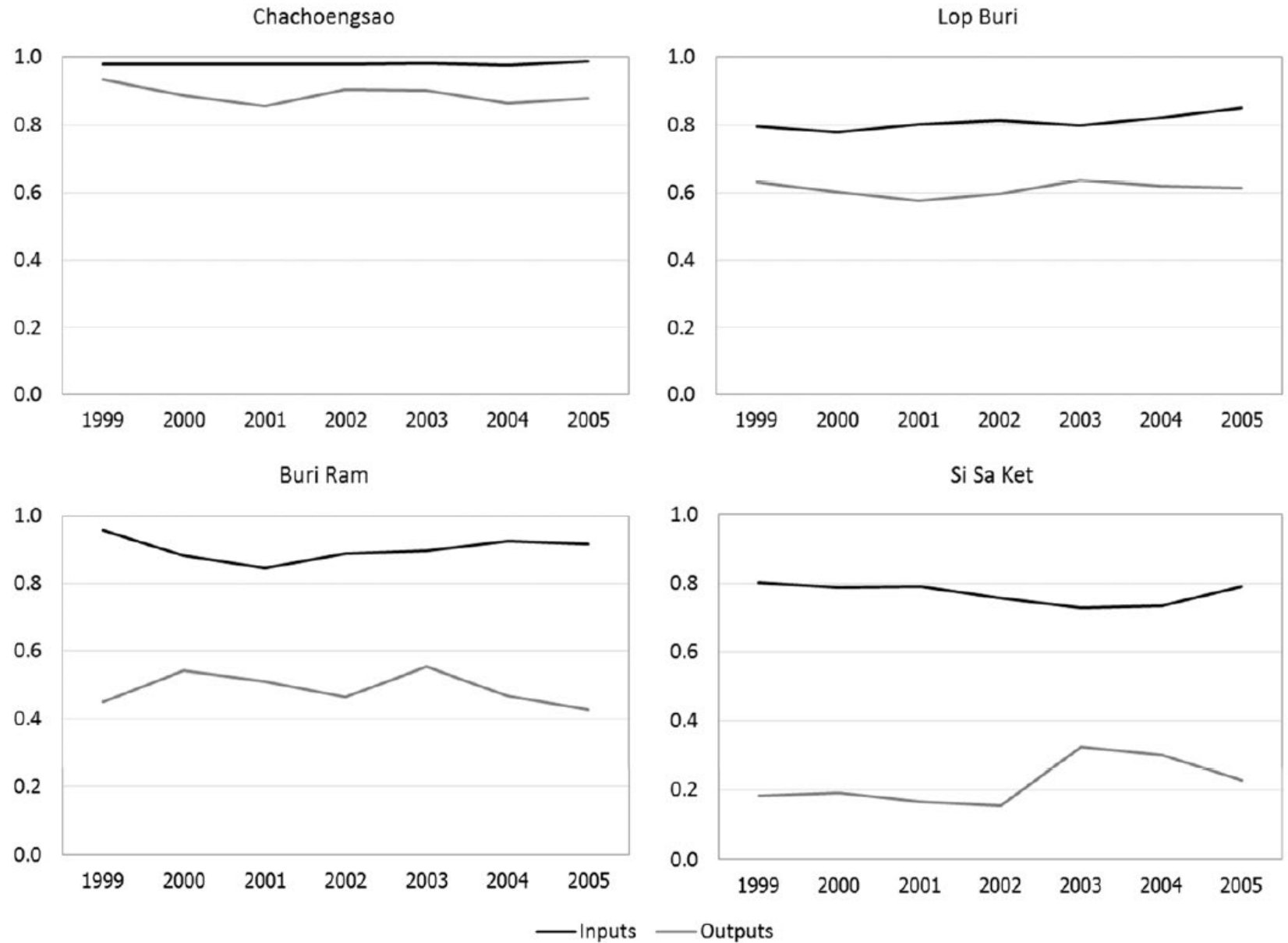
Si Sa Ket



— Current    — Capital    ..... Financial    ..... Cash

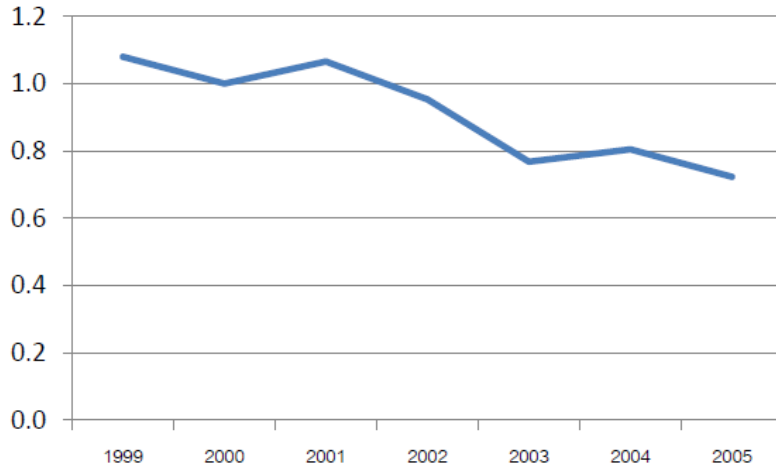
# Additional Community Level Stylized Facts

# Figure 17 – Village openness levels

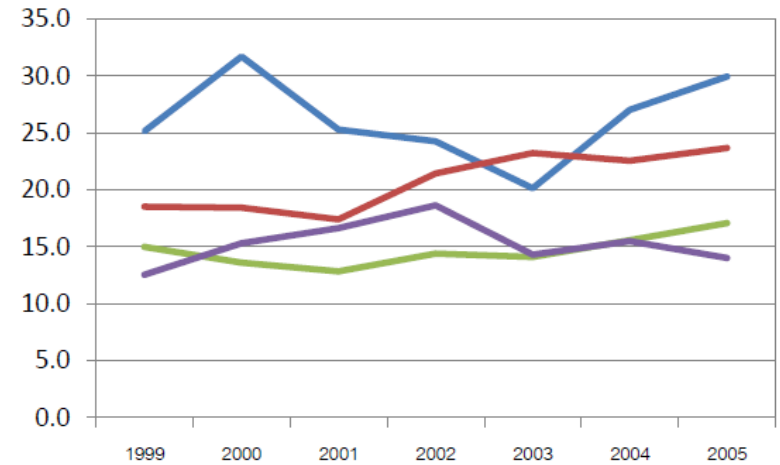


# Prices

### Relative Price (pm/pa)



### Real Wage Rate



### Real Interest Rate

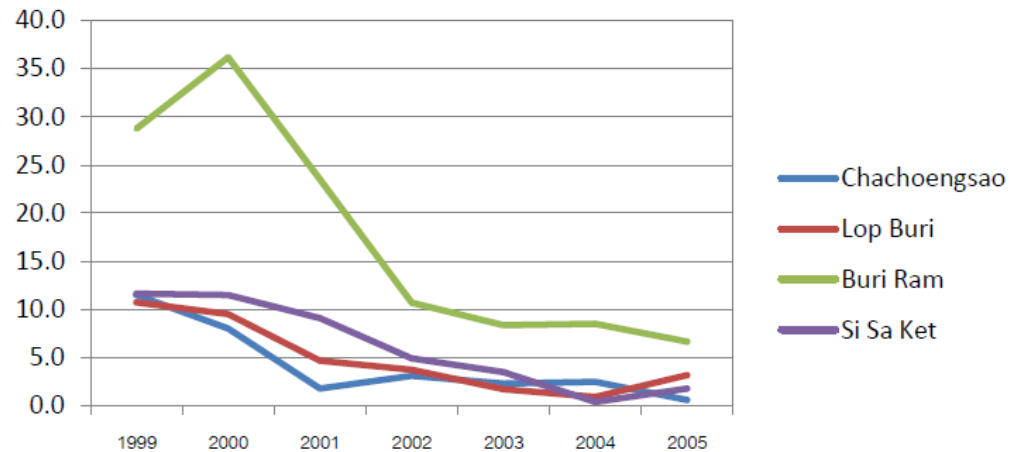
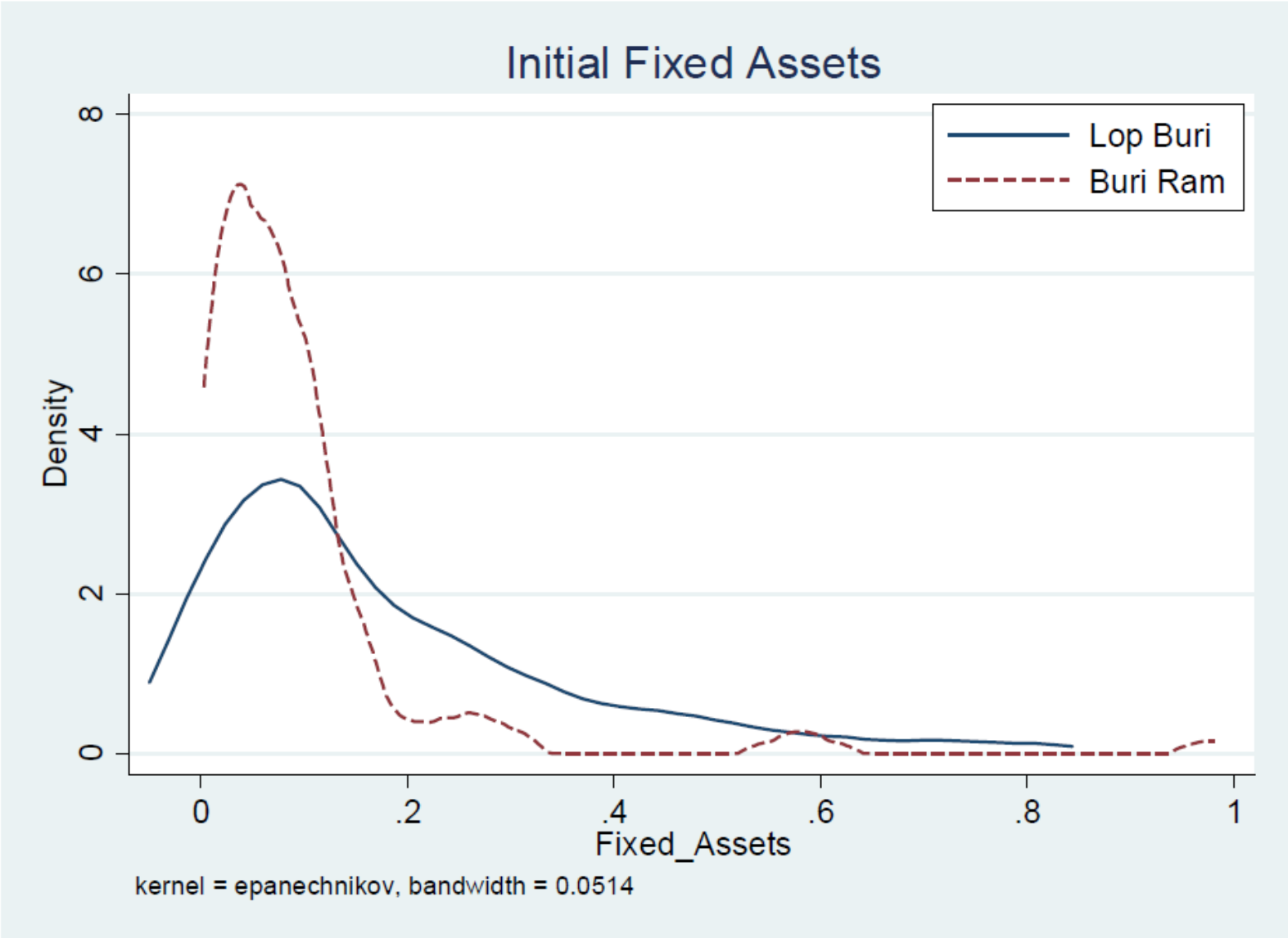


Figure 69 – Initial distribution of fixed assets in Lop Buri and Buri Ram





$$\ln(Y_{it}) = \delta_K \ln(K_{it}) + \delta_L \ln(L_{it}) + \varepsilon_{it} \quad (1)$$

Table 10 – Estimation of production functions

	Cultivation	Business	Livestock	Fish & Shrimp
$\delta_K$	0.2313 (0.0390)	0.3061 (0.0975)	0.3099 (0.1967)	0.5306 (0.1892)
$\delta_L$	0.4564 (0.0375)	0.3922 (0.0873)	0.2260 (0.1052)	0.0660 (0.0963)

Note: Standard errors are in parentheses.

$$a_i = \frac{1}{T} \sum_{t=1}^T \varepsilon_{it} \quad (2)$$

$$a_i = \bar{a} + z_i \quad (3)$$

Table 11 – Estimated sector-average TFP and ability dispersion

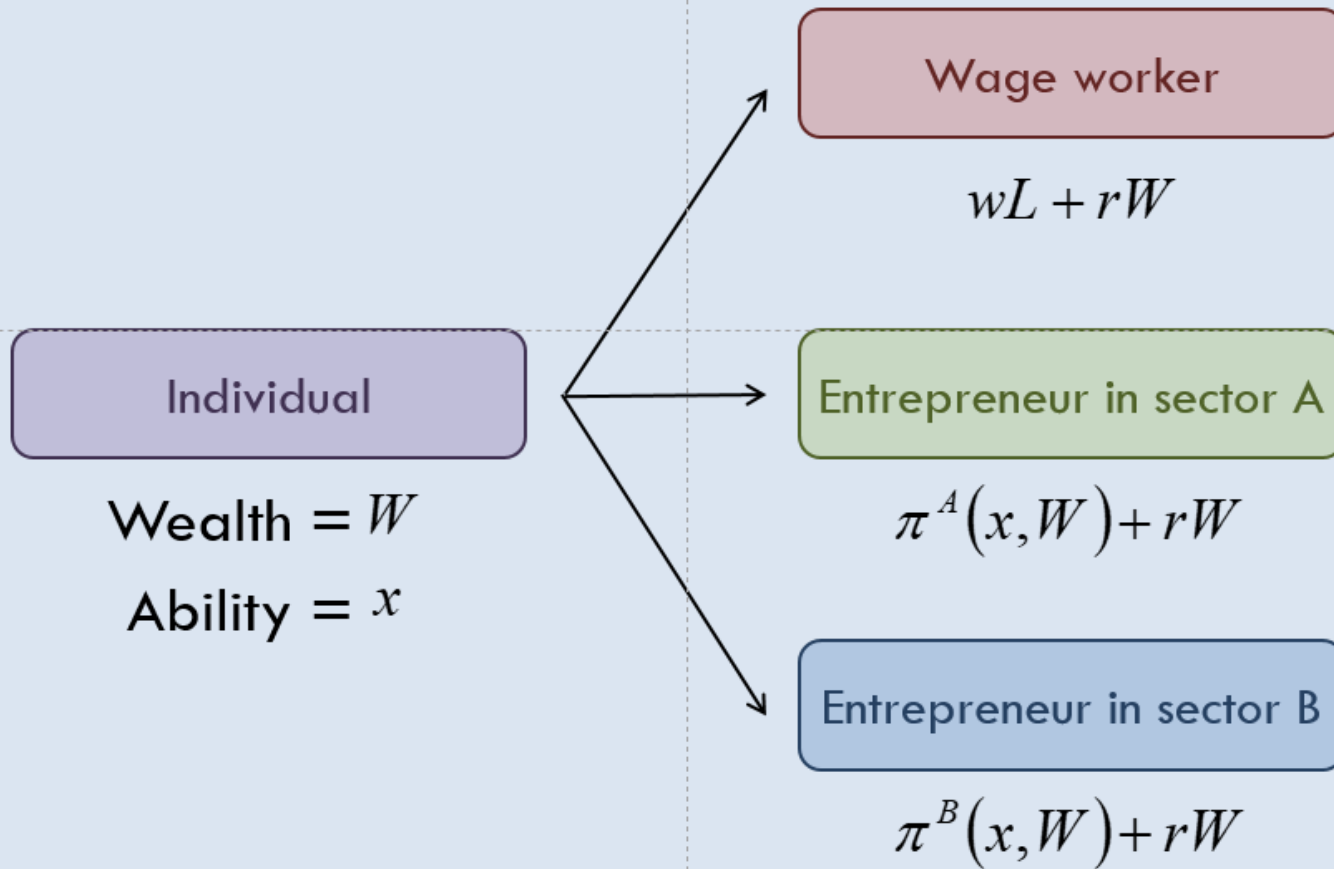
	Cultivation	Business	Livestock	Fish & Shrimp
$\bar{a}$	4.1244	3.7464	4.6071	3.1648
$\sigma_z$	0.8409	0.9644	1.4057	1.8448

# The Model of a Small Open Economy

## Environment

- We consider a two-good two-factor trade model with financial frictions
- The economy consists of a continuum of infinitesimal agents who are different in their wealth level and their ability level
- An agent can choose to become a worker or to become an entrepreneur
- There are two factors of production; capital and labor
- There are two sectors, which differ in their factor intensity
- A worker provides inelastic labor supply,  $L$ , and faces the market wage rate,  $w$
- Agents accumulate their wealth by holding capital
- An agent can either use his capital in his production activity (if he is an entrepreneur) or lend it to other entrepreneurs
- The market for capital is imperfect
- An entrepreneur with  $K$  units of capital can utilize the capital at most  $CK$  for his production activity

# Occupational Choices



# Entrepreneurial Profits

- An entrepreneur in sector A maximizes his profits

$$\pi^A(x, W) = \max_{K, L} (p_A A(x) K^{\alpha_K} L^{\alpha_L} - rK - wL)$$

subject to the borrowing constraint

$$K \leq CW$$

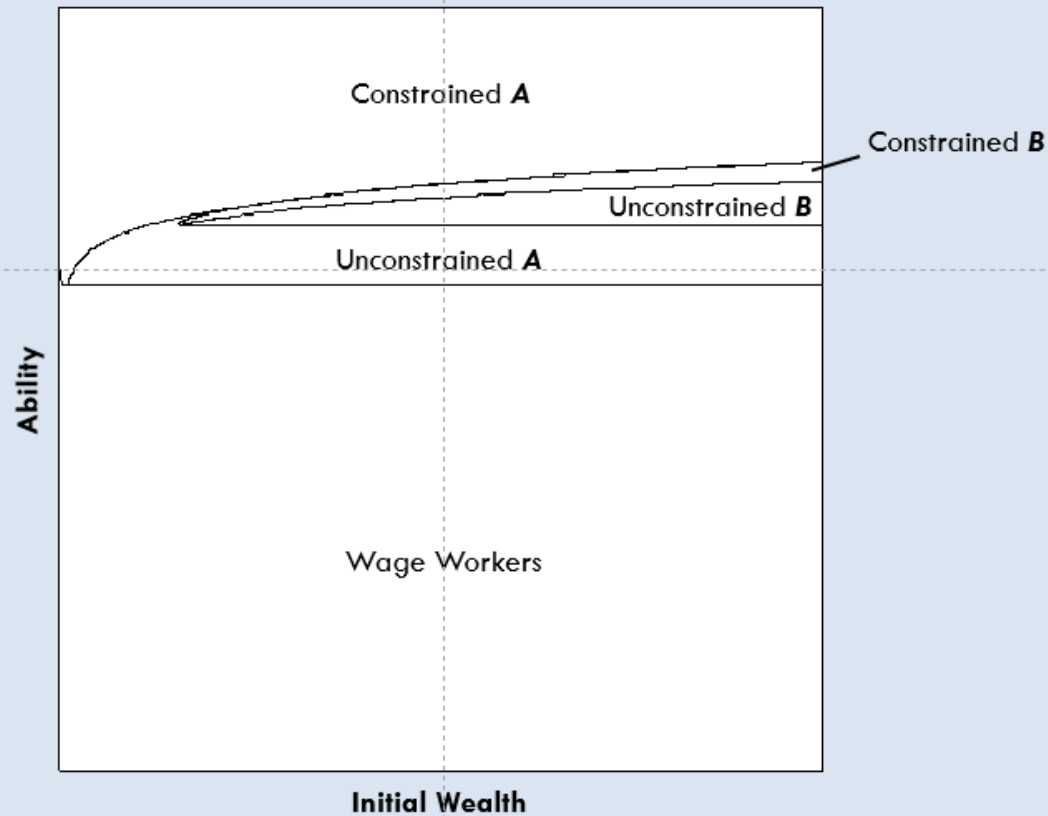
- Similarly, an entrepreneur in sector B maximizes

$$\pi^B(x, W) = \max_{K, L} (p_B B(x) K^{\beta_K} L^{\beta_L} - rK - wL)$$

subject to the borrowing constraint

$$K \leq CW$$

# Occupational Choices: Buri Ram 1999



# Calibration

- Since we start this model as a trade model, the obvious exogenous variables are interest rate, relative price, and borrowing limits
- For interest rate, since we believe we have a good measure of interest rate in the data, we use the observed value
- For relative price and borrowing limit, we don't think we have a very good measures, so we calibrate these two variables
- The model suggests that the relative price should be calibrated against the profit share from each sector, and that the borrowing limit should be calibrated against the wage rate

Figure 37 – The comparison of the actual and the predicted values of output

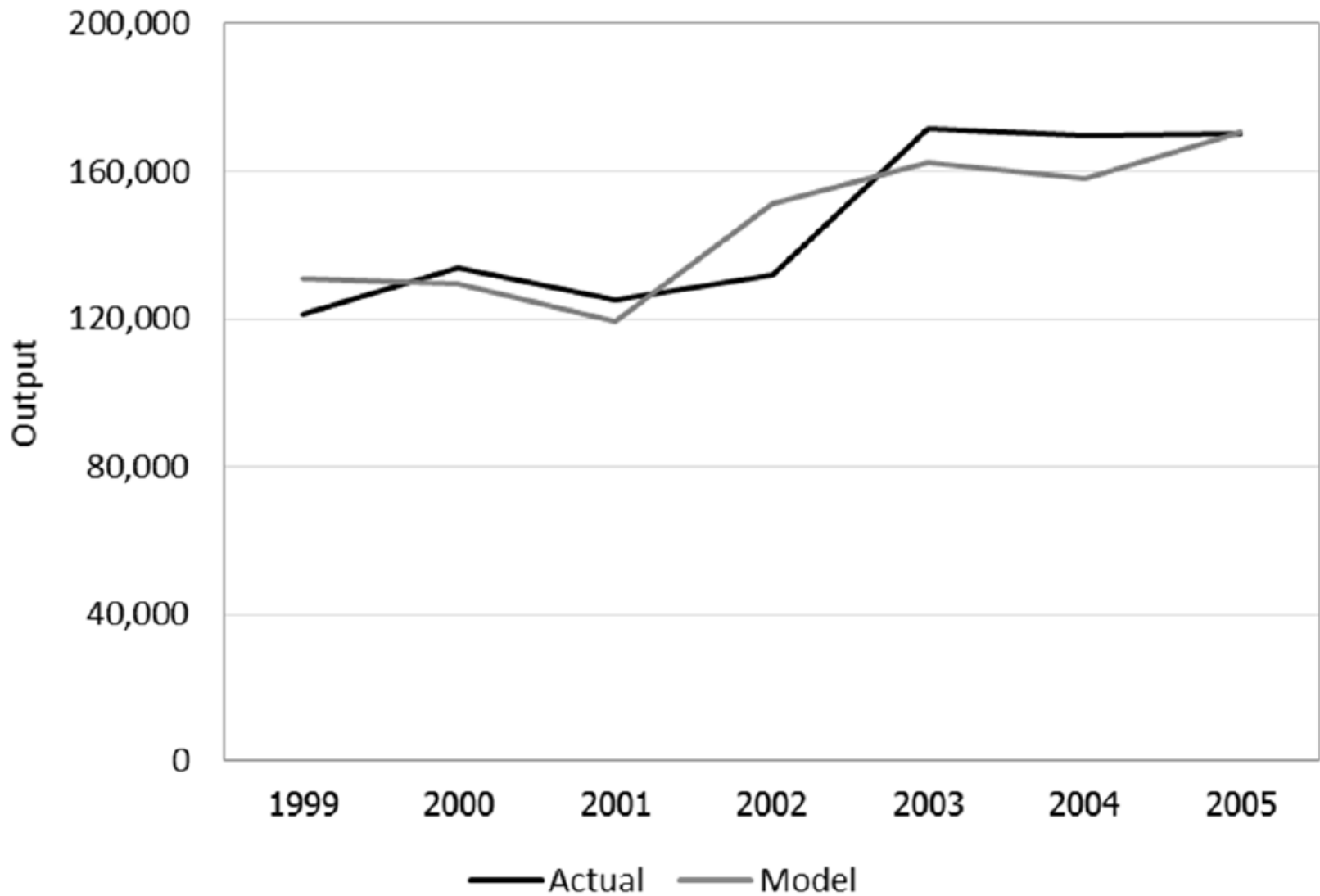
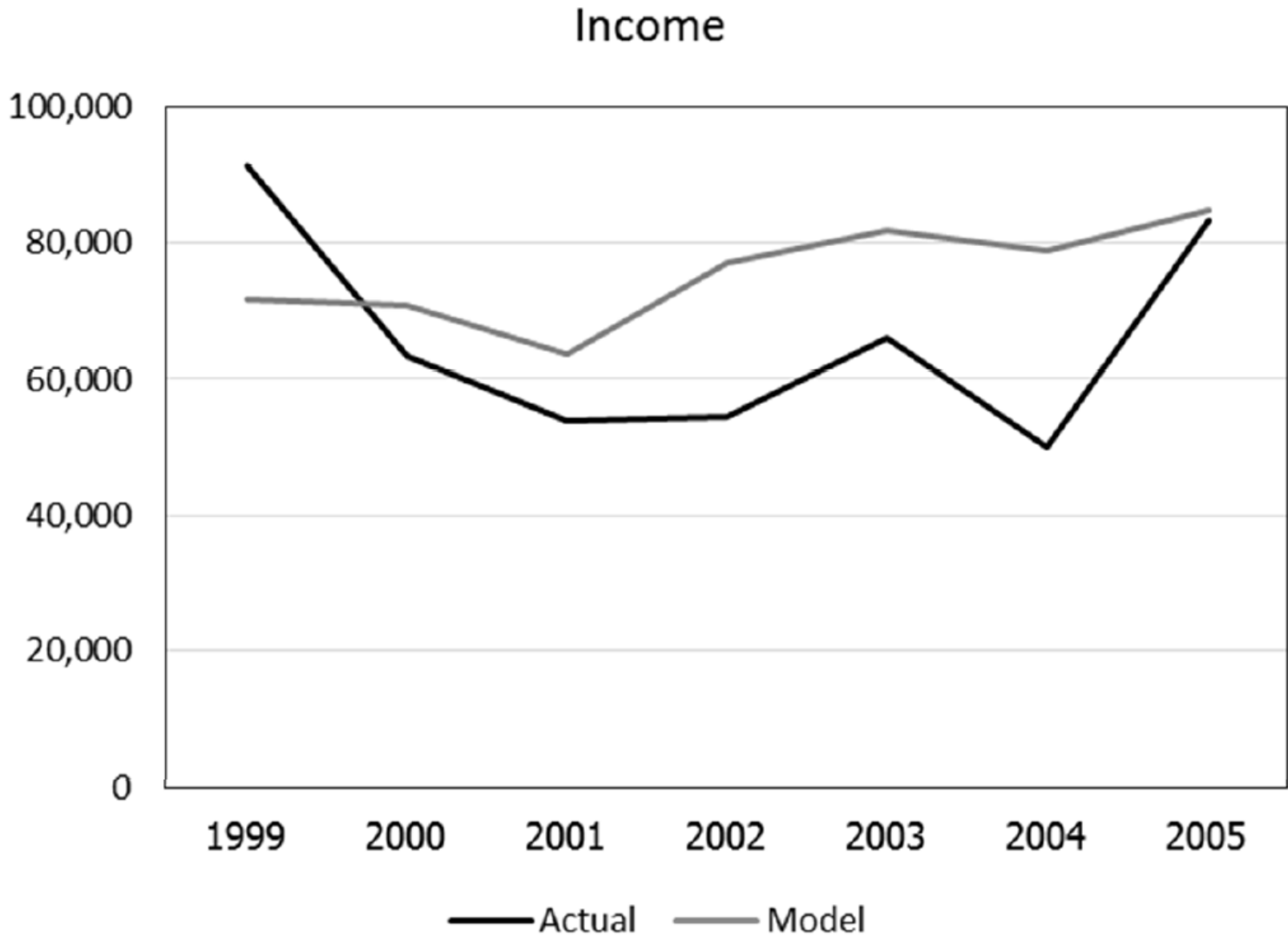


Figure 41 – Actual income and predicted income of household A

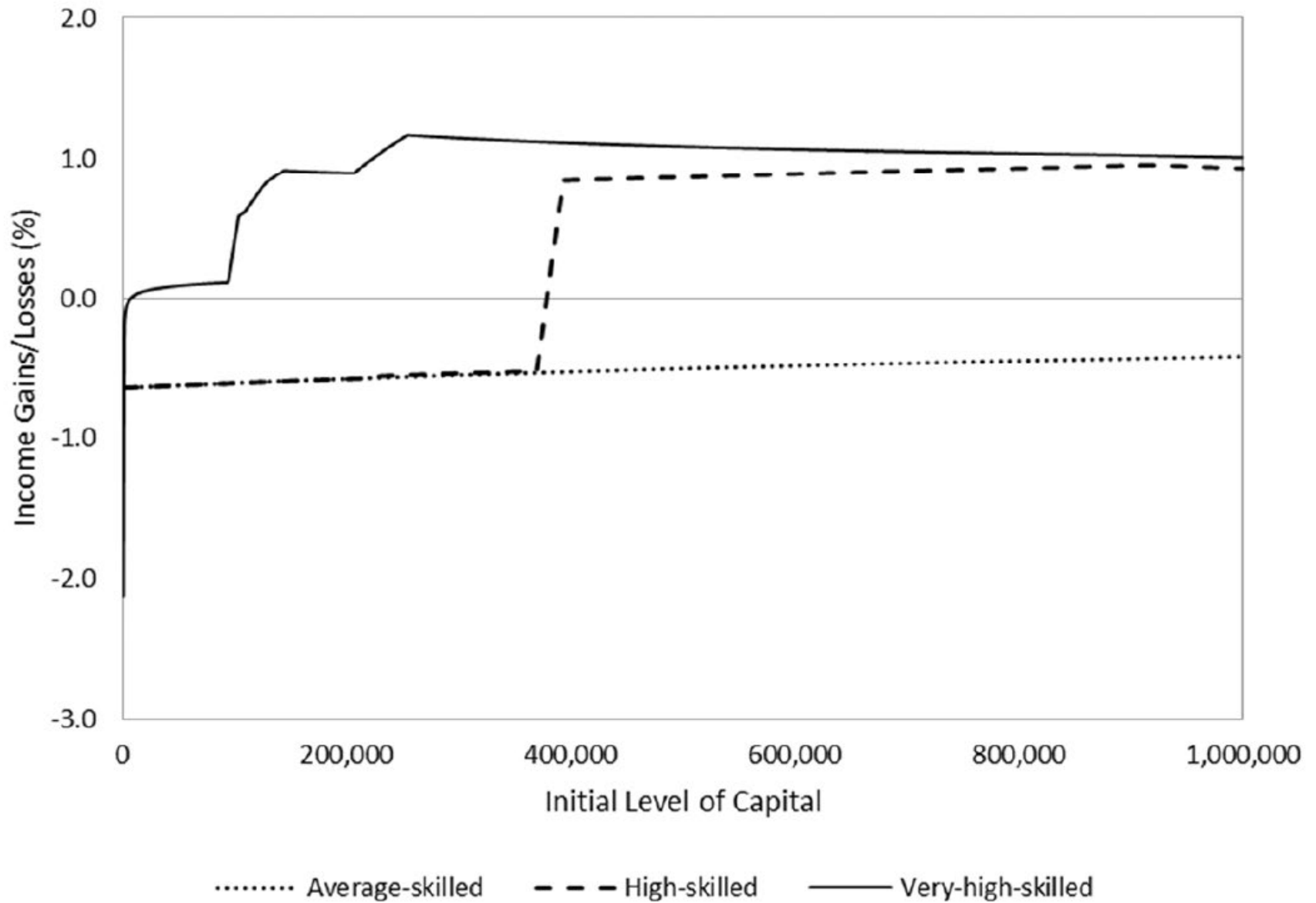




# Counterfactual Exercises: Trade and Financial Frictions

- Next, we conduct counterfactual exercises in which we impose trade and financial frictions to our baseline economy.
- For trade frictions, we consider the iceberg-type trade cost.
- For example, if in our baseline economy, the village exports goods  $a$  and import goods  $m$ , trade frictions will increase the relative price  $p_m/p_a$  (by 1%).
- For financial frictions, we consider the wedge in interest rate.
- For example, if in our baseline economy, the village is the net lender, financial frictions will make the total interest income 1% lower than those in baseline, i.e.,  $1 + r_{CF} = 0.99 * (1 + r_{baseline})$

Figure 64 - Income gains and losses from trade frictions in Lop Buri in 2002



# Integrated Household Surveys: An Assessment of U.S. Methods and an Innovation

Samphantharak, Krislert, Scott Schuh, and Robert M Townsend (2018) *Economic Inquiry*

# U.S. Surveys

Acronym	Title
TTMS	Townsend Thai Monthly Survey [BENCHMARK]
SCPC	Survey of Consumer Payment Choice (Boston Fed)
DCPC	Diary of Consumer Payment Choice (Boston Fed)
SCF	Survey of Consumer Finances (Federal Reserve Board)
CE	Consumer Expenditure Survey (BLS)
PSID	Panel Study of Income Dynamics
HRS	Health and Retirement Study
NASCC	National Asset Scorecard in Communities of Color
FD	U.S. Financial Diaries

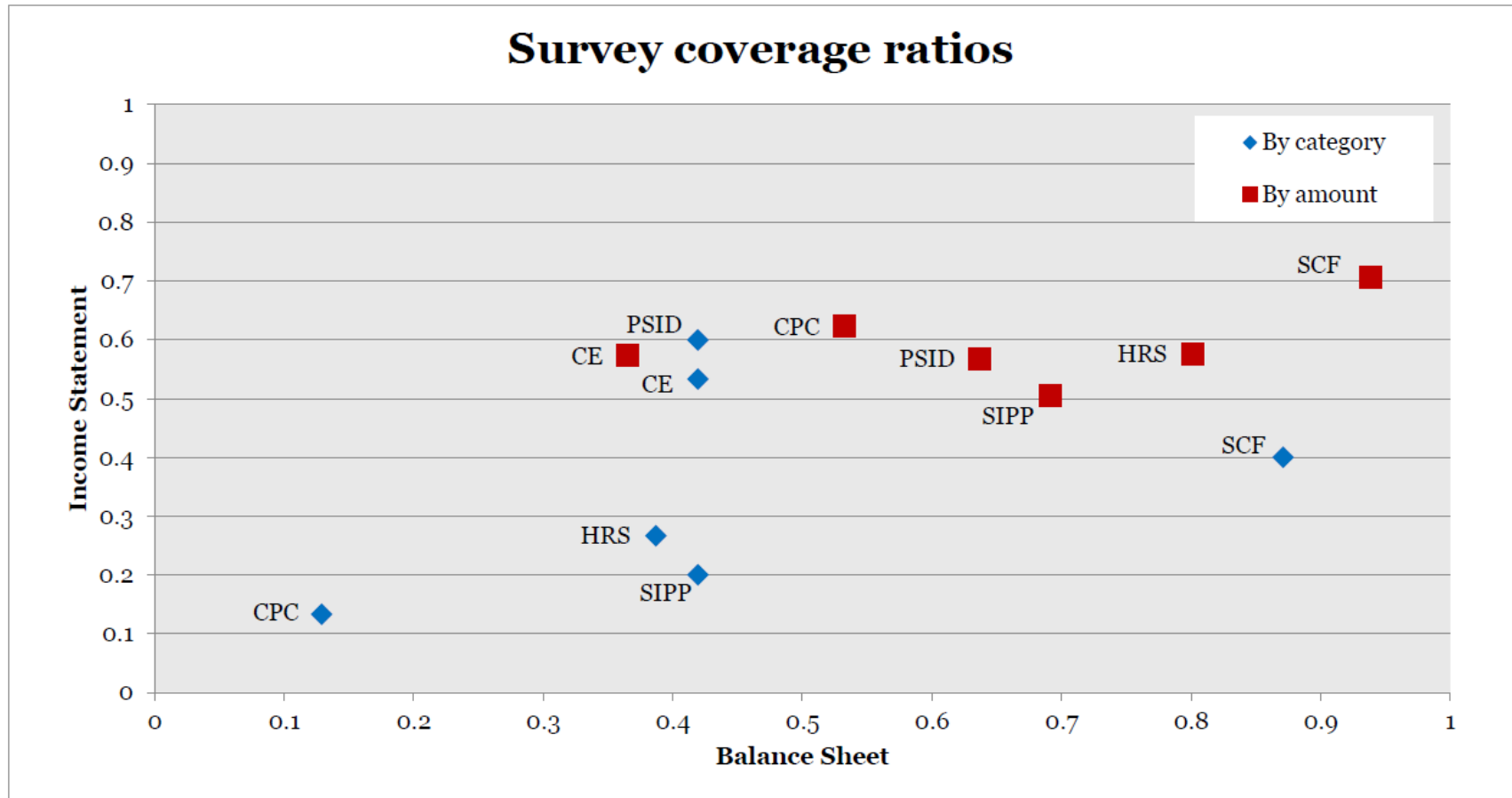
# Balance sheet – assets

	TTMS	SCPC	DCPC	SCF	CE	PSID	HRS	NASCC	FD
<b>Assets</b>									
<i>Financial assets</i>									
<b>SHORT-TERM</b>									
Currency (bills and coins)	X	X	X						X
Bank accounts (checking and saving)	X	O		X		X	X	X	X
Other accounts (prepaid, Paypal, etc.)		O							X
Private virtual currency (Bitcoin etc.)		X							
<b>LONG-TERM</b>		X							
Certificate of deposits				X		X	X	X	X
Mutual funds/hedge fund				X				X	
Publicly traded equity				X		X	X	X	X
Bonds				X		X	X	X	X
Retirement accounts				X		X	X	X	X
Life insurance	X			X		X			
Annuities				X		X		X	X
Trusts/managed investment accounts				X				X	
Loans to people outside the HH	X			X				X	X
Other important assets	X			X			X	X	X
<i>Nonfinancial assets</i>									
Business	X					X	X	X	X
Housing assets	X	X		X		X	X	X	X
Vehicles	X			X		X	X	X	X
Other non-financial assets	X			X				X	

O: Ownership only; X: Ownership and amount; Empty: No information

Source: authors' preliminary calculations; comments and corrections welcome!

# SST (2016): Summary measures of U.S. survey integration with HH financial conditions



CPC=Consumer Payment Choice (Boston Fed); SCF=Survey of Consumer Finances (Federal Reserve Board); HRS=Health and Retirement Survey (U. of Michigan); CE: Consumer Expenditure Survey (BLS); PSID=Panel Study of Income Dynamics (U. of Michigan); SIPP=Survey on Income and Program Participation.

# Cash Flow Errors

**TABLE 4**  
U.S. Surveys: Statements of CF

(Cash Defined as Current Assets)	PSID 2010–2012	CES 2011–2012	SCF 2010–2013	HRS 2010–2012	SIPP 2010–2011
Net income (+)	65,350	60,971	81,856	79,779	38,944
Adjustments:					
Depreciation (+)	0	0	0	0	0
Change in account receivables (–)	0	0	0	0	0
Change in account payables (+)	0	0	0	0	0
Change in inventory (–)	0	0	0	0	0
Change in other (not cash) current assets (–)	0	0	0	0	0
Consumption of household produced outputs (–)	0	0	0	0	0
<b>CF from production</b>	<b>65,350</b>	<b>60,971</b>	<b>81,856</b>	<b>79,779</b>	<b>38,944</b>
Consumption expenditure (–)	–43,766	–44,849	–28,850	–45,073	–22,487
Capital (durable goods) expenditure (–)	0	0	0	0	0
<b>CF from consumption and investment</b>	<b>–43,766</b>	<b>–44,849</b>	<b>–28,850</b>	<b>–45,073</b>	<b>–22,487</b>
Transfers to/from long-term investments	–362	0	1,231	0	0
Leading (–)	0	–151	1,359	50	4,452
Borrowing (+)	4,230	8,089	–4,349	–3,757	–8,988
Net gifts received (+)	0	0	0	0	0
<b>CF from financing</b>	<b>3,868</b>	<b>7,938</b>	<b>–1,759</b>	<b>–3,707</b>	<b>–4,536</b>
Change in cash holding (from statement of CF)	25,452	24,060	51,247	31,000	11,921
Change in cash holding (from statement of balance sheet)	3,091	17,770	3,843	1,678	–18,622
<b>CF error</b>	<b>22,362</b>	<b>6,290</b>	<b>47,404</b>	<b>29,322</b>	<b>30,543</b>
<b>Internal error (%)</b>	<b>25</b>	<b>13</b>	<b>37</b>	<b>24</b>	<b>25</b>
<b>External error (%)</b>	<b>30</b>	<b>8</b>	<b>61</b>	<b>39</b>	<b>42</b>

*Notes:* Table entries are average dollar values for the survey's unit of observation, approximately a household. CF are at a yearly rate and are constructed with the most recent prior data available. Sampling weights provided by each survey were used in calculating the average values. A more detailed data appendix (Appendix S1) and the Stata programs used to construct the tables are available at <http://dx.doi.org/10.7910/DVN/F7JB1K>.

*Sources:* PSID 2010–2013, CE 2011–2012, SCF 2010–2013, HRS 2010–2012, and SIPP 2010–2011. See Section II for more details.

# DCPC Comprehensive Statement of Liquidity Flows: Consistency of Stocks and Flows

TABLE 9  
DCPC Statement of Account Flows, October 2012

	Flows Associated with Accounts							
	Currency	DDA	NFDA	Foreign Currency	LTFA	Revolving Debt	Other Debt	All
<b>A. Production (inflows)</b>	388	5,379	NA	NA	NA	NA	NA	5,767
<b>B. Consumption and investment (outflows)</b>	-1,038	-4,422	-58	NA	—	-1,249	NA	-6,771
B.1 Consumption expenditure	-1,038	-4,422	-58	NA	—	-1,249	NA	-6,771
B.2 Capital (durable goods) expenditure	NA	NA	NA	NA	—	NA	NA	NA
<b>C. Financing</b>	-91	-536	-1	2	NA	-43	669	0
<b>C.1 Deposits (inflows)</b>	498	564	20	2	NA	NA	669	1,753
From currency	—	564	15	2	NA	NA	8	589
From demand deposits	455	—	2	NA	NA	NA	643	1,100
From nonfinancial deposit accounts	21	NA	—	NA	NA	NA	0	21
From foreign currency	0	NA	NA	—	NA	NA	NA	0
From long-term financial assets	NA	NA	NA	NA	—	NA	NA	0
From revolving accounts	22	NA	3	NA	NA	—	18	43
From other debt	NA	NA	NA	NA	NA	NA	—	0
<i>Addendum: Total deposits (inflows)</i>	886	5,943	20	2	NA	NA	669	7,520
<b>C.2 Withdrawals (outflows)</b>	-589	-1,100	-21	0	NA	-43	NA	-1,753
To currency	—	-455	-21	0	NA	-22	NA	-498
To demand deposits	-564	—	NA	NA	NA	NA	NA	-564
To nonfinancial deposit accounts	-15	-2	—	NA	NA	-3	NA	-20
To foreign currency	-2	NA	NA	—	NA	NA	NA	-2
To long-term assets	NA	NA	NA	NA	—	NA	NA	0
To revolving accounts	NA	NA	NA	NA	NA	—	NA	0
To other debt	-8	-643	0	NA	NA	-18	—	-669
<i>Addendum: Total withdrawals (outflows)</i>	-1,627	-5,522	-79	NA	NA	-1,292	NA	-8,524
<b>D. Change in account balance (from Statement of Account Flows)</b>	-741	421	-59	2	NA	-1,292	669	-1,004
<b>E. Change in account balance (from Balance Sheets)</b>	164	NA	NA	NA	-4,501	-673	9,489	-8,816
<b>F. Flow error</b>	905	NA	NA	NA	NA	-619	-8,820	7,812
<b>G. Error (% lagged account balance)</b>	135%	NA	NA	NA	NA	92%	93%	-89%

Source: 2012 DCPC and authors' calculations.

(Samphantharak, Schuh and Townsend 2018)

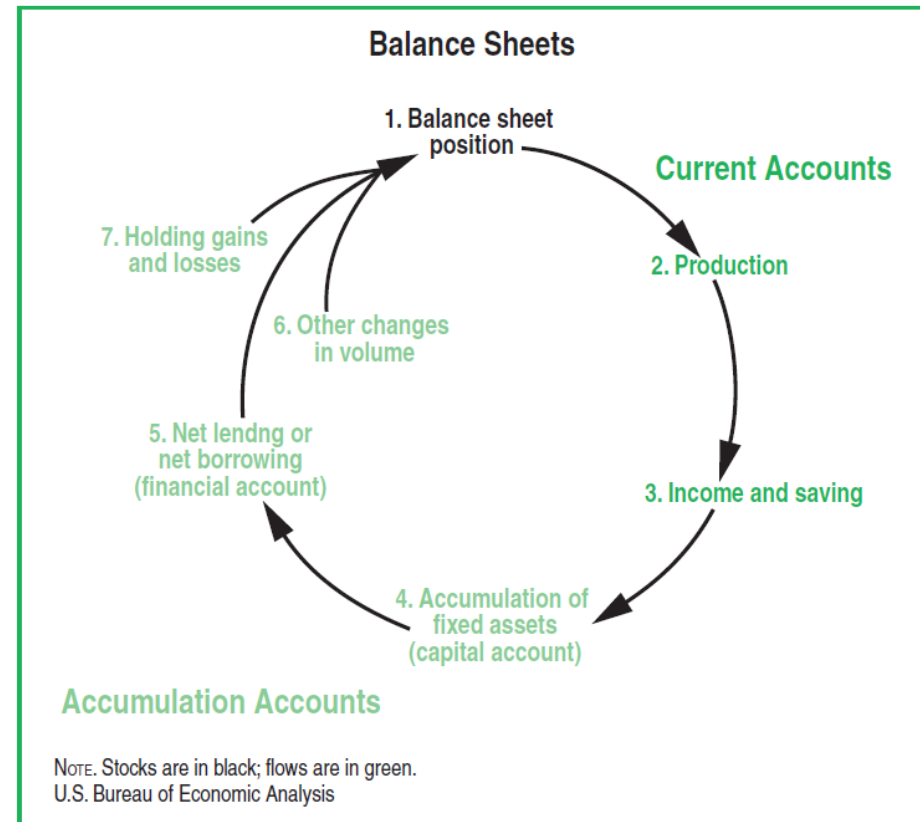


# Preexisting Steps Toward Regional Integrated Financial Accounts

## ❖ A System of National Accounts (SNA) for building Integrated Macro Accounts of the US:

- 1960-2005
- From Bureau of Economic Analysis (BEA) and National Income and Product accounts (NIPA)
- With Federal Reserve Board (FRB) and Flow of Fund Accounts (FFA)
  - Differences between NIPA and SNA
  - Differences between FFA and SNA

Chart 1. Sequence of Accounts





# Regional Accounts, BEA

- ❖ Tell us about the geographic distribution of U.S. economic activity and growth
- ❖ Estimates of gross domestic product by
  - State
  - State and local area personal income
- ❖ Provide a consistent framework for analyzing and comparing individual state and local area economies
- ❖ For example
  - Consumer Spending by State
  - Employment by State, Employment by County, Metro, and Other Areas
  - GDP by Metro Area, GDP by County, GDP by State
  - Personal Income by State (Wages, proprietors' income, dividends, interest, rents, and other income received by each state's residents)

# Regional Integrated Financial Accounts

❖ From SCF utilizing algorithm in Schuh-Townsend

SCF Assets				
Region	Northeast	North Central	South	West
mean_currency	-	-	100	-
mean_checking	17,500	12,400	12,300	15,300
mean_savings	36,800	22,600	17,000	20,900
mean_other_acct	-	-	-	-
mean_cd	6,400	5,800	2,900	6,300
mean_mutualfund	104,500	64,900	83,300	79,600
mean_stock	88,500	34,700	55,900	67,300
mean_bond	13,000	10,200	6,400	12,400
mean_retire	169,100	112,100	100,700	112,200
mean_insur_life	9,000	9,700	6,400	5,100
mean_annuity	7,500	6,200	7,800	5,800
mean_trust	22,500	14,500	15,100	26,600
mean_loan_out	6,200	8,400	6,200	14,800
mean_vehic	19,100	20,700	22,300	23,200
mean_other_fin_asset	-	-	-	-
mean_prim_housing	248,100	130,700	153,900	264,700
mean_other_housing	73,800	77,200	72,500	119,400
mean_business	112,700	168,800	133,100	200,600
mean_other_nonfin_asset	5,800	3,800	7,000	7,800
mean_all	941,800	702,900	704,100	983,300
med_all	255,400	175,700	159,500	233,800

❖ Also for Liabilities, Income, Expenditure and Cash Flow

# Inequality and Distributional Accounts

The first national accounts in history—King's famous social tables produced in the late seventeenth century—were in fact distributional national accounts, showing the distribution of England's income, consumption, and saving across 26 social classes—from temporal lords and baronets down to vagrants—in 1688 (see Barnett ...

Piketty understands this though he continues to make the distinction. The premise of this paper is that the time is ripe to address the problem at a more fundamental level.

Otherwise the measurement of inequality in the US inevitably involves assumptions and extrapolations linking income to the balance sheet. Typically, using IRS data, measures of dividends and interest income are used to infer the balance sheet of financial assets, with the same formula applied uniformly across income classes and regions. Here are some recent efforts.

SMITH, ZWICH, AND ZIDER provide “new estimates of top wealth that account for heterogeneity when capitalizing income flows....Accounting for heterogeneity reduces the growth in top shares since 1980 by [half], leaving the recent wealth estimates above the estate tax series and closer to the SCF.<sup>2</sup> Overall, wealth concentration when accounting for heterogeneity is still very high: the top 1% holds as much wealth as the bottom 90%. However, the “P90-99” class holds more wealth than either group after accounting for heterogeneity. “Our approach also alters the composition of top wealth. We find a larger role for private business wealth and a smaller role for fixed income wealth, consistent with the composition of top wealth in the SCF and estate tax data. Less than half of top wealth takes the form of liquid securities with clear market values.

“Last, we conduct a novel investigation of the geography of wealth inequality. We provide state-level estimates of wealth and explore the evolution of wealth-to-income ratios between 1980 and 2014. The data reveal vast disparities in wealth across regions. For example, wealth in the Northeast exceeds \$450K per capita, whereas wealth in the poorest states in the South is less than \$200K. The coastal states have experienced substantial wealth growth since 1980, with wealth-to-income ratios increasing by between 100% and 300% of national income, while inland states have seen much more modest growth. Thus, the period of aggregate wealth growth in the United States has coincided with striking regional divergence. “

Others also make adjustments to the Piketty Saez and Zucman estimates. Gerald Auten and David Splinter use the same IRS tax data and find that the top 1 percent's share of after-tax income rose from 8.4 percent in 1979 to 10.1 percent in 2015 — an increase less than a third as large.

US Federal agencies continue to work on the underlying data, arbitrating across the agencies and emphasize the importance of timely information.

Moore, Eric Nielsen, Sarah Reber, Molly Shatto, Kamila Sommer, Tom Sweeney, and Alice Henriques Volz 2019

This paper describes the construction of the Distributional Financial Accounts (DFAs), a new initiative that provides quarterly, timely estimates of the wealth distribution based on a comprehensive measure of U.S. household wealth. The DFAs are constructed by integrating two statistical products produced by the Federal Reserve Board: the Financial Accounts of the United States and the Survey of Consumer Finances (SCF). The Financial Accounts are U.S. national accounts that provide quarterly measures of aggregate assets and liabilities for various economic sectors, including households, and the SCF collects detailed measures of a representative sample of household-level balance sheets (including of very wealthy households) every three years. The DFAs combine the SCF's distributional information with the Financial Accounts' quarterly national accounting framework in a manner that is consistent with both data sets.

# Financial flows

- Financial flows (baseline measurement):

$$\text{Current Account}_{st} = \text{Trade Balance}_{st} + \text{Net Income Transfers}_{st}$$

$$\text{Trade Balance}_{st} = \text{Exports}_{st} - \text{Imports}_{st}$$

$$\text{Net Income Transfers}_{st} = \text{Gross State Income}_{st} - \text{Gross State Product}_{st}$$

$$\text{Private Transfers}_{st} = \text{Net Income Transfers}_{st} - \text{Public Transfers}_{st}$$

- Financial flows (alternative measurement):

$$\begin{aligned} \text{Current Account}_{st}^{alt} &= \text{Net worth}_{it} - \text{Net worth}_{i,t-1} \\ &\quad - \text{Capital Investment}_{it} - \text{Housing Investment}_{it}, \end{aligned}$$

$$\text{Net worth}_{it} = \text{Housing networth}_{st} + \text{Stocks}_{st} + \text{Bonds}_{st} - \text{Debt}_{st}$$

Ehrlich, Fukui and Townsend (work in progress)  
“State Risk-Sharing: Financial-Trade Linkages”

# Geographic Distribution of Current Account in 2007

Current Account over GDP (2007)

