

# The Interindustry Dynamic Macroeconomic Model of Thailand

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## Outline of the Presentation

- I. Overview
- II. The Model: The INTERDYME
- III. Preliminary results of PADS

## I. Overview: Motivation and Objective

- In order to do the policy analysis, we must understand how the economy works.
- Because economic activities are integrated and interacted, comprehensive economic models that account for every part of the economy are required.
- The objective:
  - To build an interindustry model for Thailand, incorporating the optimization program.
  - To employ the model to guide for a national economic development plan.

## II. The Model: INTERDYME

The **Inter**industry **D**ynamic  
**M**acroeconomic Model

## Components of the Interdyme

- Real side (output-employment):
  - Calculate sectoral output and labor requirement.
- Price-income side:
  - Calculate sectoral price and income variables.
- The Accountant:
  - Calculate gross output, price deflators, national income, personal disposable income, and personal saving.

## The Real Side

- Sectoral output and labor requirement are calculated.
- Equations for final demands:
  - Private consumption
  - Fixed investment
- Outputs are calculated by solving:
$$q = A.q + f$$
- Labor requirements are implied by the calculated outputs and equations for labor productivity (output per labor).

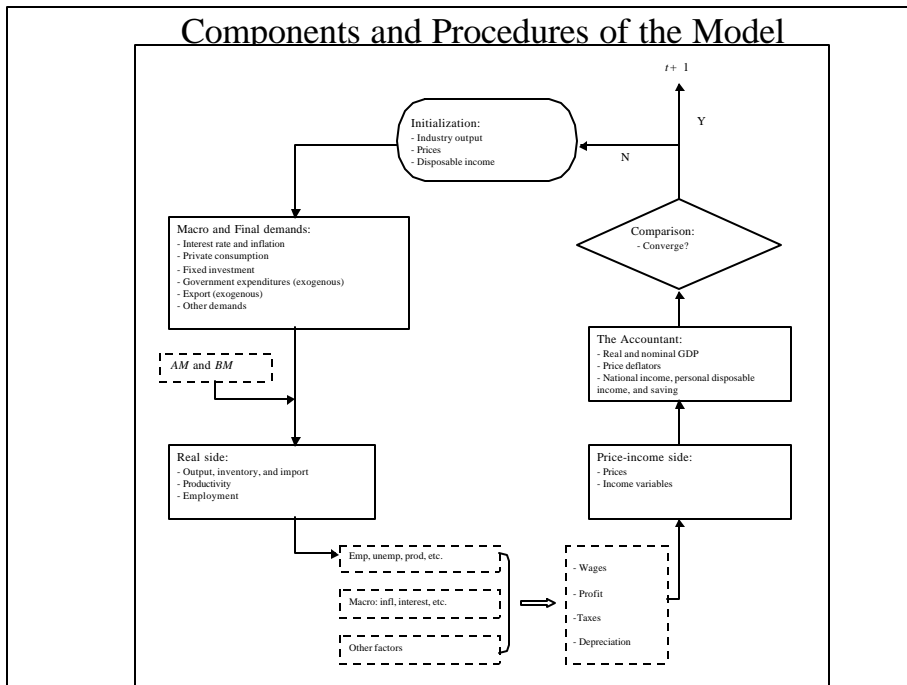
## The Price-Income Side

- Sectoral price and income are calculated.
- Equations for value-added:
  - Wage equation
  - Profit equation
  - Depreciation equation
  - Tax equation
- Price calculated by solving:  $p = p.A + v$

## The Accountant

- Aggregate components of final demand.
- Aggregate components of value-added.
- Calculate implied deflators.
- Calculate national income:
  - Net indirect taxes - from value-added,
  - Provision for consumption of fixed capital - regression.
- Calculate personal disposable income - regression.
- Calculate personal saving - regression.

National Accounts of Thailand	
Operation	Description
+	Private Consumption Expenditure
+	General Government Consumption Expenditure
+	Gross Domestic Fixed Capital Formation
+	Change in Inventories
+	Export of Goods and Services
-	Import of Goods and Services
=	<b>Gross Domestic Product (GDP)</b>
+	Net Factor Income Payment from The Rest of The World
=	<b>Gross National Product (GNP)</b>
-	Indirect Taxes less Subsidies
-	Provision for Consumption of Fixed Capital
=	<b>Net National Product at Factor Cost or National Income</b>
-	Savings of Corporations and Government Enterprises
-	Direct Taxes on Corporations
-	Corporate Transfer Payments
-	General Government Income from Property and Entrepreneurship
+	Interest on The Public Debt
+	Interest on Consumers' Debt
+	Social Security Benefit
+	Corporate Transfer Payments to Persons
+	Current Transfers from General Government
+	Current Transfers from The Rest of The World
=	<b>Personal Income</b>
-	Direct Taxes
-	Current Transfers to General Government
-	Social Security Contribution
=	<b>Personal Disposable Income</b>
-	Private Consumption Expenditure
-	Interest on Consumers' Debt
-	Current Transfers to The Rest of The World
=	<b>Personal Savings</b>



### III. The Estimation of Thailand's Private Consumption

#### The Perhaps Adequate Demand System

- PADS suggested by Almon (1996).
- Designed for a long-term forecasting model.
- No explicit assumptions about a representative agent and a specific form of utility function.
- A recent empirical work of PADS:
  - Bardazzi and Barnabani (2000)
- Alternative: Almost Ideal Demand System
  - Suggested by Deaton and Muellbauer (1980).
  - The most popular system.
  - However, the budget share equation implies peculiar consumption behavior.

# PADS Functional Form

$$x_i(t) = (a_i + b_i(y/P) + c_i\Delta(y/P) + d_i\dot{t}) \cdot \left(\frac{p_i}{P}\right)^{l_i} \prod_{k=1}^n \left(\frac{p_i}{p_k}\right)^{l_{ik}S_k} \cdot \left(\frac{p_i}{P_G}\right)^{m_i} \left(\frac{p_i}{P_g}\right)^{n_g}$$

where;  $P_G = \left(\prod_{k \in G} p_k^{S_k}\right)^{1/\sum_{k \in G} S_k}$ ,  $P_g = \left(\prod_{k \in g} p_k^{S_k}\right)^{1/\sum_{k \in g} S_k}$  and  $P = \prod_{k=1}^n p_k^{S_k}$

## Consumption Sectors and the Specification of Groups

<p><b>[1] Food</b></p> <p style="padding-left: 20px;"><b>[1.1] Protein</b></p> <p style="padding-left: 40px;">2 Meat</p> <p style="padding-left: 40px;">3 Fish</p> <p style="padding-left: 20px;">1 Rice and Cereals</p> <p style="padding-left: 20px;">4 Milk, Cheese and Eggs</p> <p style="padding-left: 20px;">5 Oil and Fat</p> <p style="padding-left: 20px;">6 Fruits and Vegetables</p> <p style="padding-left: 20px;">7 Sugar, Preserves, and Confectionery</p> <p style="padding-left: 20px;">9 Other food</p> <p><b>[2] Beverages</b></p> <p style="padding-left: 20px;">8 Coffee, Tea, Cocoa, etc.</p> <p style="padding-left: 20px;">10 Non-alcoholic beverages</p> <p style="padding-left: 20px;">11 Alcoholic beverages</p> <p><b>[3] Dress</b></p> <p style="padding-left: 20px;">13 Footwear</p> <p style="padding-left: 20px;">14 Clothing</p> <p style="padding-left: 20px;">15 Other personal effects</p> <p><b>[4] Utilities</b></p> <p style="padding-left: 20px;">16 Rent and Water charges</p> <p style="padding-left: 20px;">17 Fuel and Light</p>	<p><b>[5] House Furnishing</b></p> <p style="padding-left: 20px;">18 Furniture and Furnishings</p> <p style="padding-left: 20px;">19 Households equipment</p> <p style="padding-left: 20px;">20 Domestic Services</p> <p style="padding-left: 20px;">21 Other expenditure</p> <p><b>[6] Transportation</b></p> <p style="padding-left: 20px;"><b>[6.1] Private Transportation</b></p> <p style="padding-left: 40px;">24 Personal Transportation Equipment</p> <p style="padding-left: 40px;">25 Operation of Personal Transportation</p> <p style="padding-left: 20px;">26 Public Transportation</p> <p><b>[7] Recreation</b></p> <p style="padding-left: 20px;">28 Entertainment</p> <p style="padding-left: 20px;">29 Hotels, Restaurants, and Cafes</p> <p style="padding-left: 20px;">30 Books, Newspapers and Magazines</p> <p style="padding-left: 20px;">31 Other Recreation</p> <p><b>[8] Ungrouped</b></p> <p style="padding-left: 20px;">12 Tobacco</p> <p style="padding-left: 20px;">22 Personal Care</p> <p style="padding-left: 20px;">23 Health Expenses</p> <p style="padding-left: 20px;">27 Communication</p> <p style="padding-left: 20px;">32 Financial services</p> <p style="padding-left: 20px;">33 Other services</p>
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## The Estimation Procedure

- Non-linear least square estimation.
- Achieve sensible results by soft constraint.
- Meaning of sensible results.
- Steps of constraining.

## Price Elasticities and, $\mathbf{m}_G$ and $\mathbf{n}_g$

$$\mathbf{e}_{i,i} = -\mathbf{I}_i(1 - 2s_i) - \sum_{k=1}^n \mathbf{I}_k s_k \quad , \text{ if } i \notin G \text{ and } i \notin g$$

$$\mathbf{e}_{i,i} = -\mathbf{I}_i(1 - 2s_i) - \sum_{k=1}^n \mathbf{I}_k s_k - \mathbf{m}_G \left(1 - \frac{s_i}{\sum_{k \in G} s_k}\right) \quad , \text{ if } i \in G$$

$$\mathbf{e}_{i,i} = -\mathbf{I}_i(1 - 2s_i) - \sum_{k=1}^n \mathbf{I}_k s_k - \mathbf{m}_G \left(1 - \frac{s_i}{\sum_{k \in G} s_k}\right) - \mathbf{n}_g \left(1 - \frac{s_i}{\sum_{k \in g} s_k}\right) \quad , \text{ if } i \in G \text{ and } i \in g$$



# Results at Group Level

## Estimated values of $\mu$ and $\sigma$

Group	$\mu$	Subgroup	$\mu$
1. Food	0.71	i. Protien	1.18
2. Beverages	0.27		
3. Dress	-0.10		
4. Utilities	-1.11		
5. House Furnishing	0.85		
6. Transportation	0.49	ii. Private Transportation	-1.10
7. Recreation	-0.23		

## Expenditure Shares by Group

Group	Share	Ungrouped Sectors	Share
Food	0.244	Tobacco	0.022
Protein	(0.070)	Personal Care	0.019
Beverages	0.074	Health Expenses	0.074
Dress	0.111	Communication	0.008
Utilities	0.098	Financial Services	0.009
House Furnishing	0.084	Other Services	0.009
Transportation	0.111		
Private transportation	(0.062)		
Recreation	0.137	Total	1.000

## Results for 33 sectors

Results by product:

The mu: 0.71 0.27 -0.10 -1.11 0.85 0.49 -0.23

The nu: 1.18 -1.10

nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
1	Rice and Cereals	1	0	1	1	1	1	-0.79	0.068	0.14	-0.61	-0.14	-0.04	1.00	0.44
2	Meat	1	1	1	1	1	1	-0.63	0.052	0.38	0.47	-0.20	-0.52	3.44	0.56
3	Fish	1	1	1	2	1	1	-1.67	0.018	0.81	0.74	-11.66	-0.13	14.45	0.52
4	Milk, Cheese and Eggs	1	0	1	1	1	1	-0.86	0.017	0.93	-2.20	-0.04	-0.05	6.72	0.75
5	Oil and Fat	1	0	1	1	1	1	-0.79	0.010	1.16	-0.31	-0.05	-0.11	4.38	0.82
6	Fruit and Vegetables	1	0	1	1	1	1	-0.68	0.047	0.76	-0.54	-0.16	-0.17	2.76	0.11
7	Sugar, Preserves and C	1	0	1	1	1	1	-0.71	0.010	0.86	-0.66	-0.04	-0.20	4.17	0.86
8	Coffee, Tea, Cocoa, et	2	0	1	1	1	1	-0.31	0.003	1.21	-1.52	-0.22	-0.16	6.62	0.88
9	Other Food	1	0	1	1	1	1	-0.68	0.022	0.34	-0.41	0.02	-0.21	8.05	0.87
10	Non-alcoholic beverage	2	0	1	1	1	1	0.02	0.033	1.42	-0.73	-0.02	-0.37	3.55	0.15
nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
11	Alcoholic beverages	2	0	1	1	1	1	0.45	0.038	1.34	-1.09	0.17	-0.76	3.98	0.57
12	Tobacco	0	0	1	1	1	1	0.25	0.022	0.52	-0.06	0.67	-0.45	4.16	0.58
13	Footwear	3	0	1	1	1	1	0.41	0.007	1.25	-1.99	-0.08	-0.53	5.81	0.75
14	Clothing	3	0	1	1	1	1	0.24	0.097	1.27	-0.26	-0.01	-0.40	2.30	0.39
15	Other personal effects	3	0	1	1	1	1	0.73	0.007	1.79	1.33	-0.08	-0.84	7.20	0.28
16	Rent and Water charges	4	0	1	1	1	1	0.49	0.076	0.55	-2.05	0.49	-0.38	2.28	0.49
17	Fuel and Light	4	0	1	1	1	1	0.83	0.022	0.78	-1.23	0.53	-0.15	2.58	0.65
18	Furniture and Furnishi	5	0	1	1	1	1	0.41	0.017	1.38	2.29	-0.02	-1.28	6.89	0.48
19	Households Equipment	5	0	1	1	1	1	0.93	0.048	1.79	-0.31	-0.01	-1.41	2.58	0.67
20	Domestic services of H	5	0	1	1	1	1	1.22	0.004	0.85	-0.74	0.14	-2.22	11.64	0.82
nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
21	Other expenditures of	5	0	1	1	1	1	-0.15	0.015	1.32	-1.30	-0.04	-0.76	3.86	0.57
22	Personal care	0	0	1	1	1	1	0.76	0.019	0.67	-0.04	0.64	-0.94	2.07	0.60
23	Health expenses	0	0	1	1	1	1	0.77	0.074	1.06	1.00	0.01	-0.87	6.76	0.80
24	Personal transportatio	6	2	1	1	1	1	0.69	0.033	1.55	2.87	-0.04	-0.69	11.04	0.57
25	Operation of personal	6	2	1	1	1	1	0.81	0.029	1.56	-0.39	-0.05	-0.75	3.99	0.79
26	Public transportati	6	0	1	1	1	1	0.13	0.049	0.89	-0.54	-0.01	-0.60	3.86	0.46
27	Communication	0	0	1	1	1	1	1.17	0.008	2.57	-0.69	-0.03	-1.36	4.59	0.35
28	Entertainment	7	0	1	1	1	1	0.15	0.002	0.95	-3.26	0.36	-0.13	12.11	0.87
29	Hotels, Restaurants, a	7	0	1	1	1	1	0.94	0.098	1.19	0.02	-0.01	-0.90	3.34	0.64
30	Books, Newspapers, and	7	0	1	1	1	1	0.93	0.013	1.50	-1.02	-0.04	-0.90	6.52	0.74
nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
31	Other Recreation	7	0	1	1	1	1	0.02	0.024	1.54	-0.68	-0.05	-0.04	2.99	0.60
32	Financial services	0	0	1	1	1	1	-0.11	0.009	2.03	-0.04	-0.13	-0.10	8.40	0.90
33	Other services	0	0	1	1	1	1	0.25	0.009	1.03	-1.45	-0.05	-0.45	3.18	0.47

#### IV. Model components and Data sources

Component	Classification	Sectors	Source	Availability
<b>Macro time-series:</b>				
Interest rate	-	1	BOT	1978-2002: M
Inflation	-	1	BOT	1979-2001: A
Money supply	-	1	BOT	1970-2002: M, A
Population	-	1	NSO	1963-2000: A
<b>Final demands:</b>				
Private consumption	National account consumption category	33	NESDB	1960-2000: A
Fixed investment	Investing sector	11	NESDB	1970-1999: A
	Type of capital	12	NESDB	1993-2001: Q
Government expenditure	IO sector	58	NESDB	1975-1998: Every 5yrs
Export	IO sector	58	NESDB	1975-1998: Every 5yrs
Other demands	IO sector	58	NESDB	1975-1998: Every 5yrs
Bridge matrix for consumption	-	58x33	-	-
Bridge matrix for investment	-	58x11	-	-
<b>Real side:</b>				
Coefficient matrix	IO sector	58	NESDB	1975-1998: Every 5yrs
Output	IO sector	58	NESDB	1975-1998: Every 5yrs
	National account classification	various	NESDB	1960-2000: A
Inventory	IO sector	58	NESDB	1975-1998: Every 5yrs
Import	IO sector	58	NESDB	1975-1998: Every 5yrs
+ Employment	Employment sector	11	NESDB	1990-2000: A
+ Hours of work (per week)	Employment sector	11	NESDB	1990-2000: A
<b>Price-income side:</b>				
+ Wage	Employment sector	11	NESDB	1990-2000: A
Profit	N/A	-	-	-
Taxes	National account classification	11	NESDB	1960-2000: A
Depreciation	National account classification	11	NESDB	1960-2000: A
Price	IO sector	58	NESDB	1975-1998: Every 5yrs
	National account classification	various	NESDB	1960-2000: A
Provision for consumption of fixed capital (for NI)	-	1	NESDB	1960-2000: A
Personal disposable income	-	1	NESDB	1960-2000: A
Personal saving	-	2	NESDB	1960-2000: A

Note: BOT = Bank of Thailand, NESDB = National Social and Economic Development Board, and NSO = National Statistical Office.