

Technological Change and Accumulated Capital :A Dynamic Decomposition of Japan's Growth

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Keio Data Base :Keio Economic Observatory

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Official Statistics

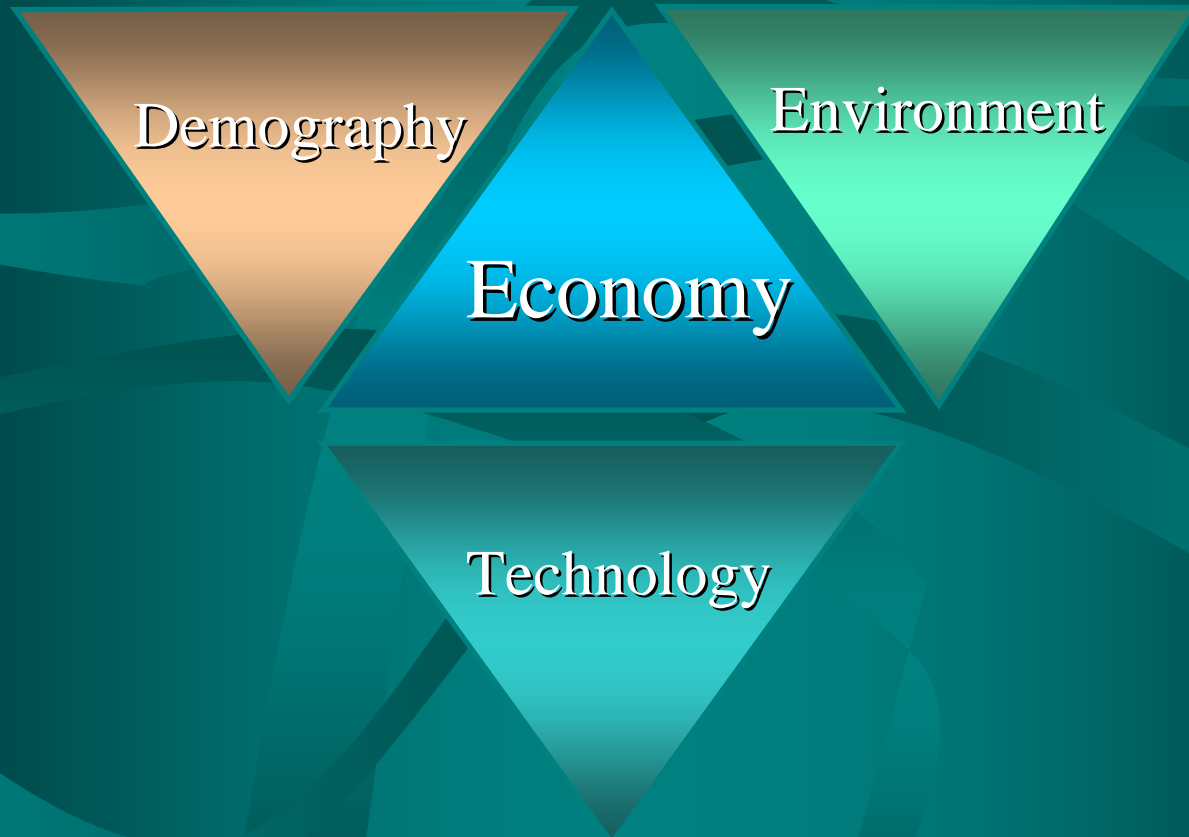
- **Input-Output Table**

- **Basic Table** : every five years from 1955
 - activity base - 519×403 (1995)
- **Extended Table** : every year from 1973

- **Capital Measurement**

- **Capital Formation Matrix** : every five years from 1970
- **Capital Stock Matrix** : National Wealth Survey in 1955,70

KEO Data Base (KDB)



KDB

- Input-Output Table
 - every year during 1960-95
- Measurement of Capital
 - every year during 1955-92
 - **Capital Formation Matrix** : I_{ij}
 - **Capital Stock Matrix** : S_{ij}
- Measurement of Labor
 - every years during 1960-92
 - **Man, Hour and Wage**
industry × age × sex × education × employment status

I-O Table: X Table

Time-Series X-table

[Intermediate Inputs]

43 commodities

8 scraps

[Non-competitive Imports]

raw oil, natural gas,

iron ore, others

[Year]

1960-95

	commodity	industry	Final Demand	domestic	E	M	Output
com.	X						
scrap input							
ind.							
non-competitive import							
scrap output							
value added							
Output							



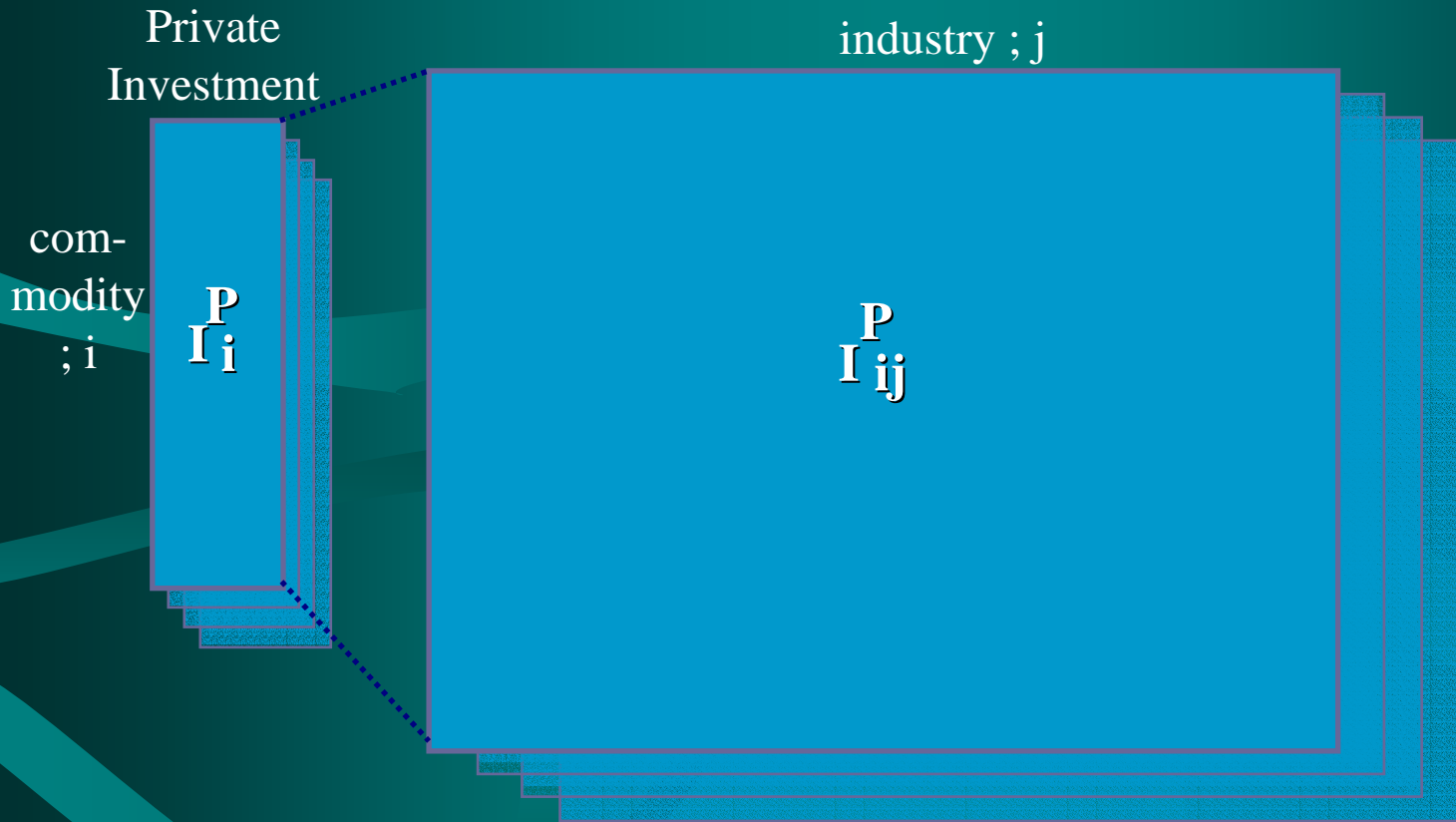
「Input-Output Table」

Management and Coordination Agency

in 1960,65,70,75,80,85,90

Private Investment

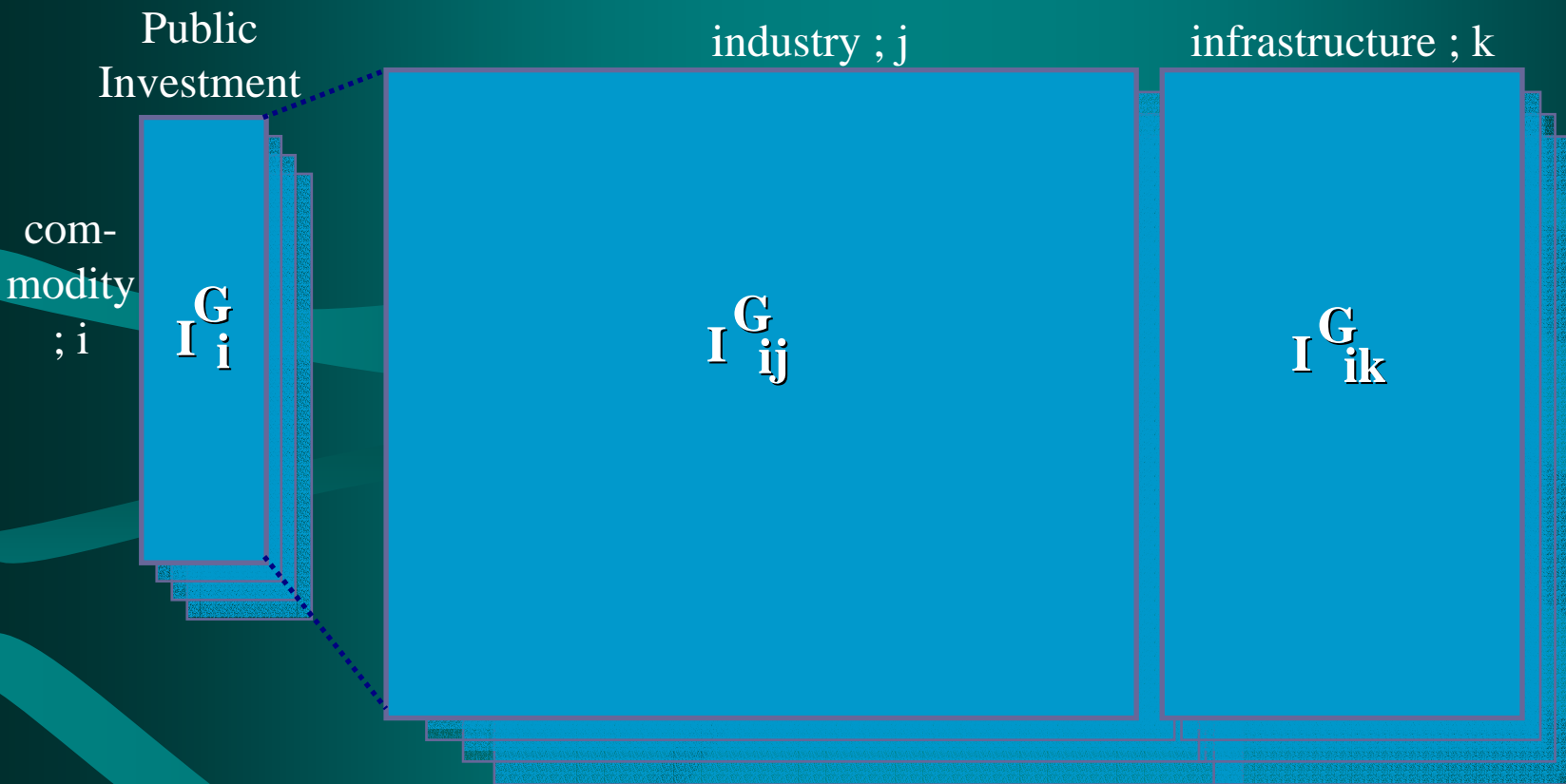
Private Fixed Capital Formation Matrix



「Fixed Capital Formation Matrix」
Management and Coordination Agency
in 1970,75,80,85,90

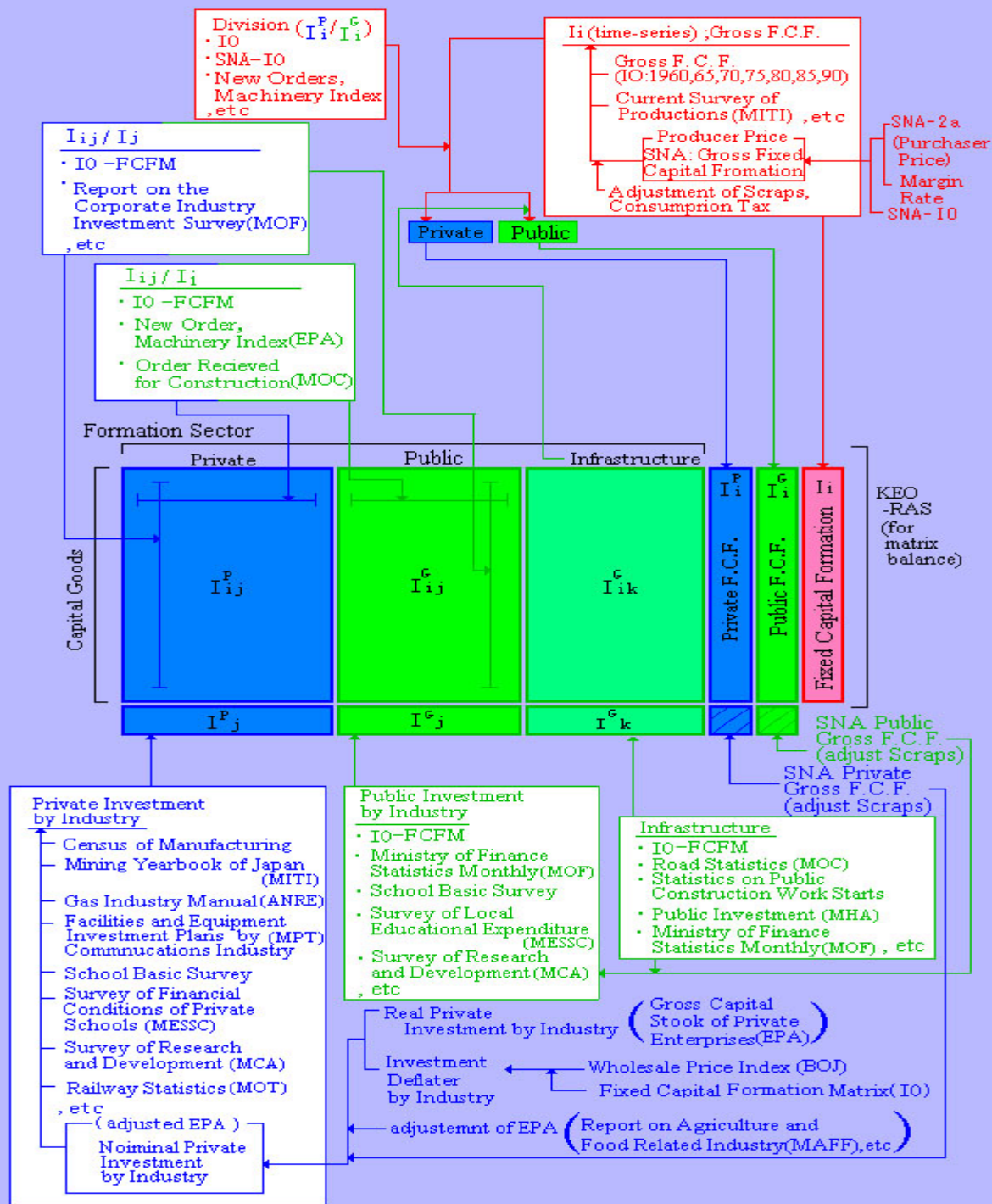
Public Investment

Public Fixed Capital Formation Matrix

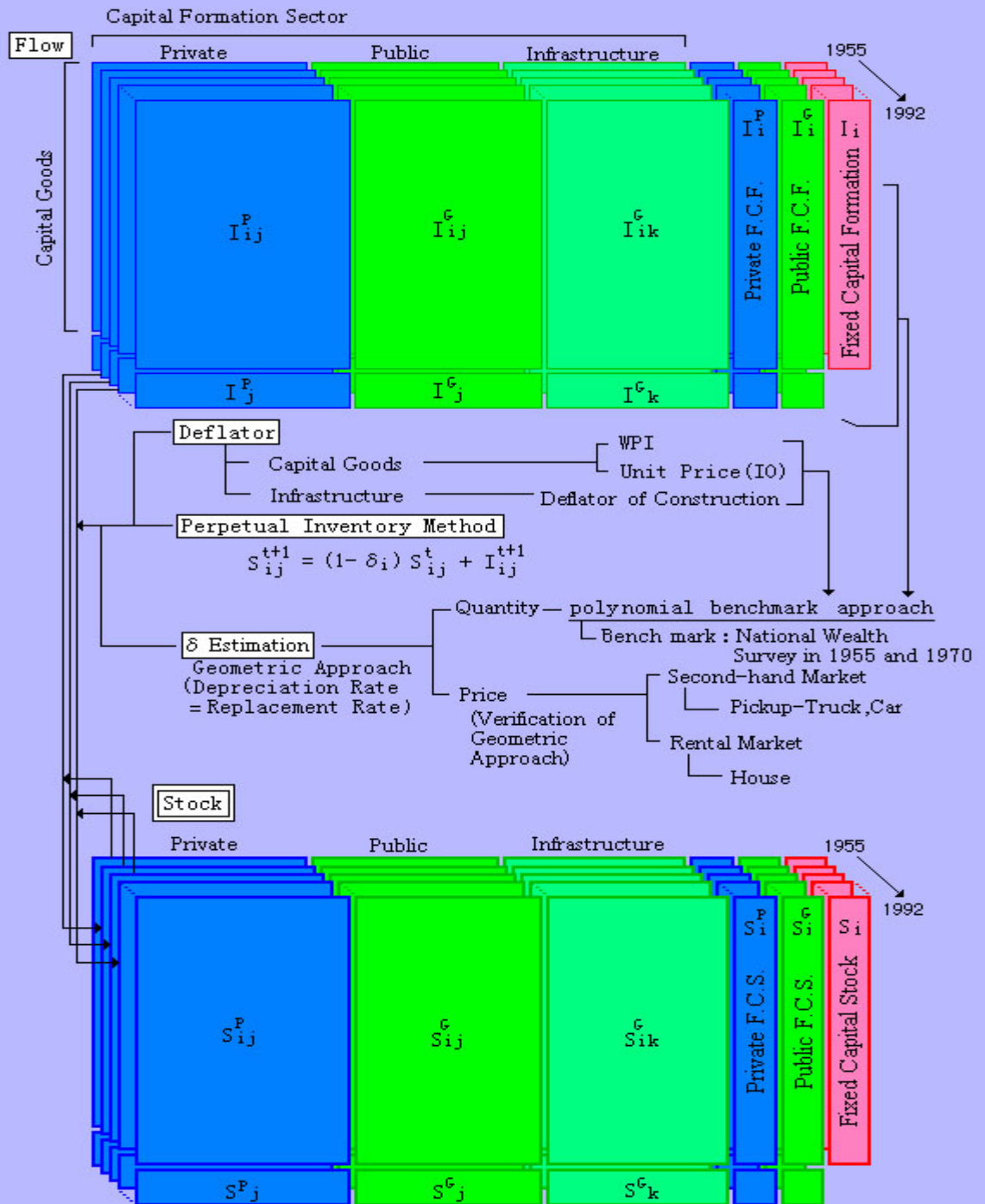


「Fixed Capital Formation Matrix」
Management and Coordination Agency

Estimation of Capital Formation Matrix



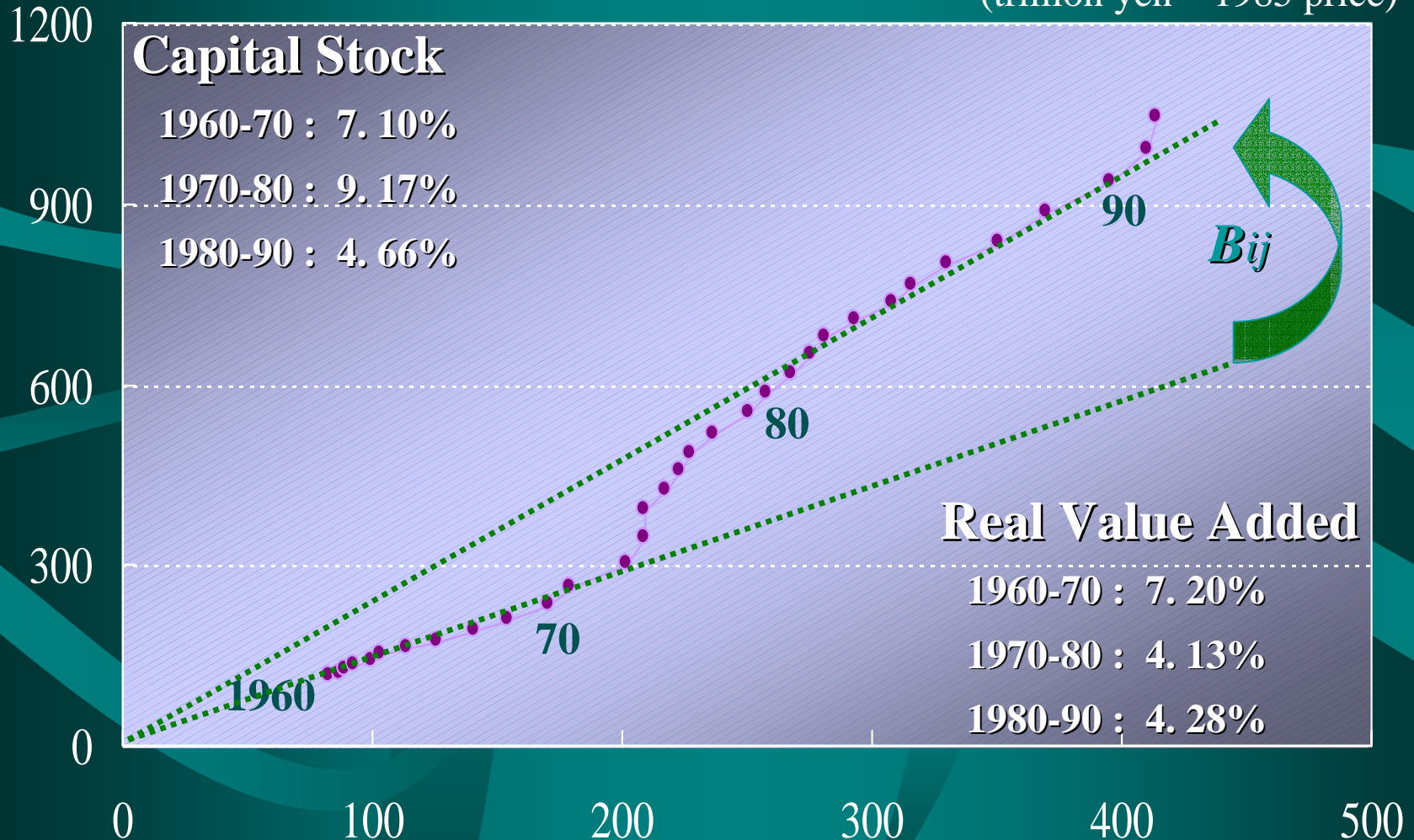
Estimation of Capital Stock Matrix



Capital Stock and Value Added

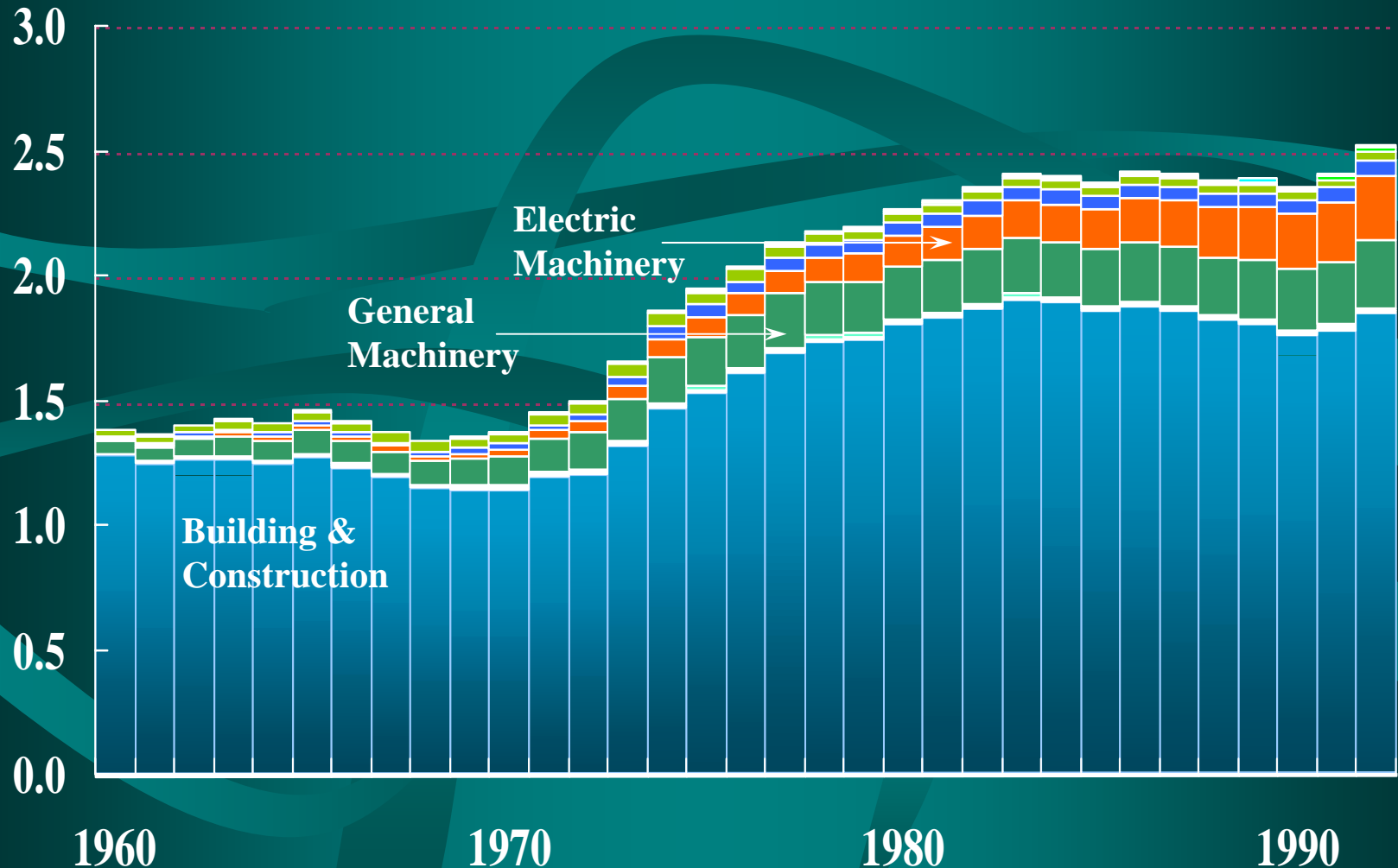
: Aggregated Level

(trillion yen - 1985 price)



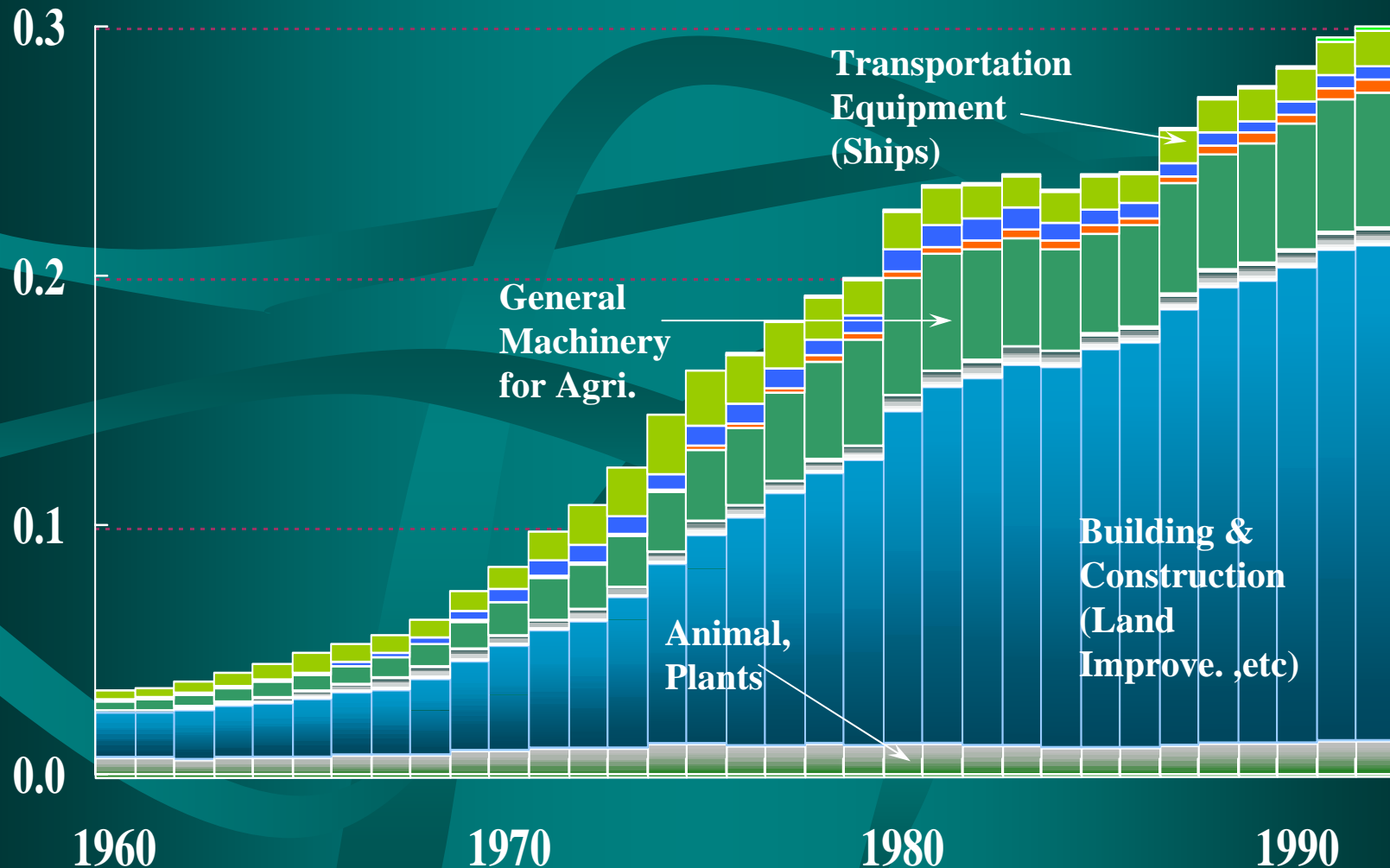
Capital Coefficient - *Bij*

: Aggregated Level



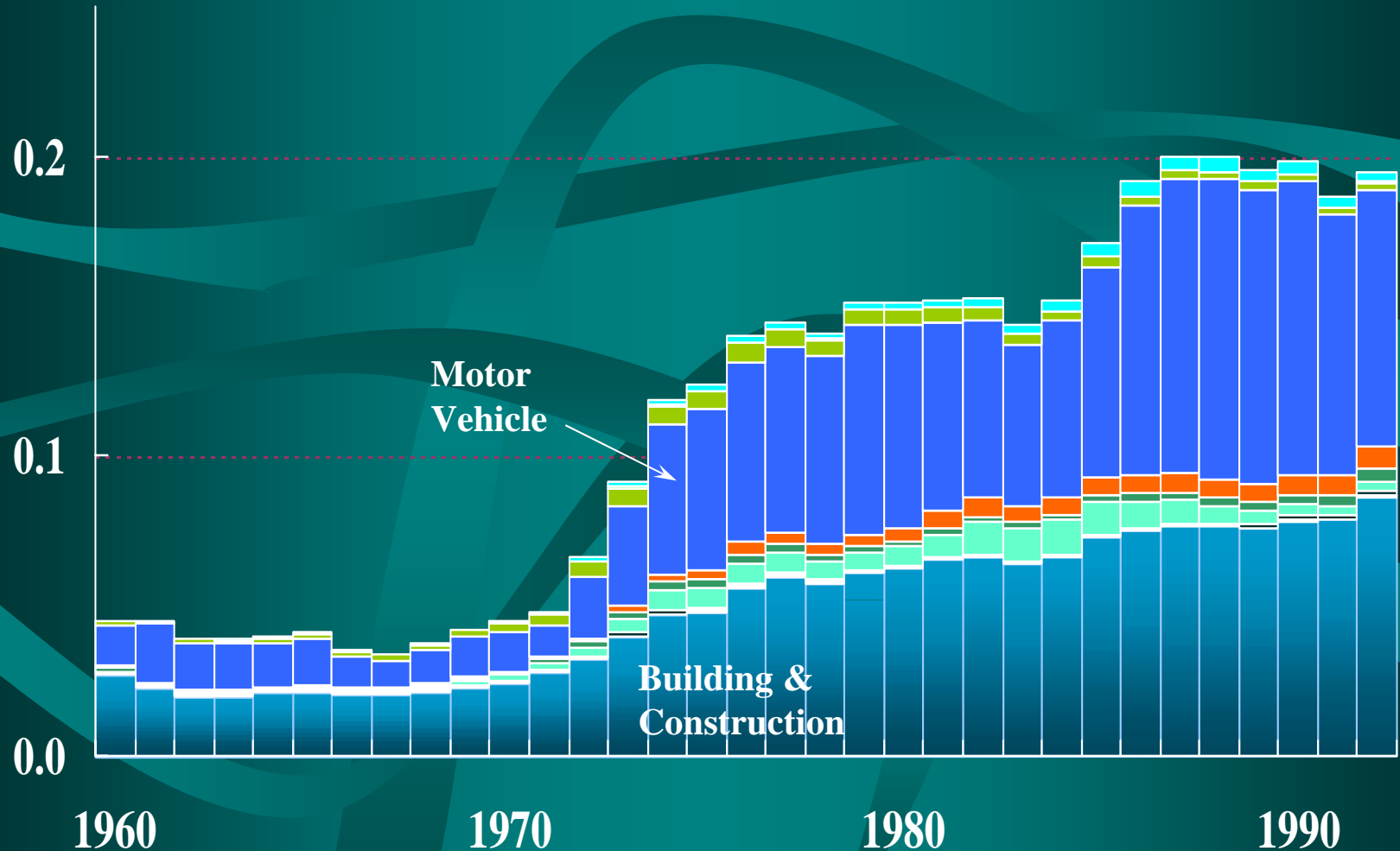
Capital Coefficient - *Bij*

: Agriculture, Forestry and Fishery Industry



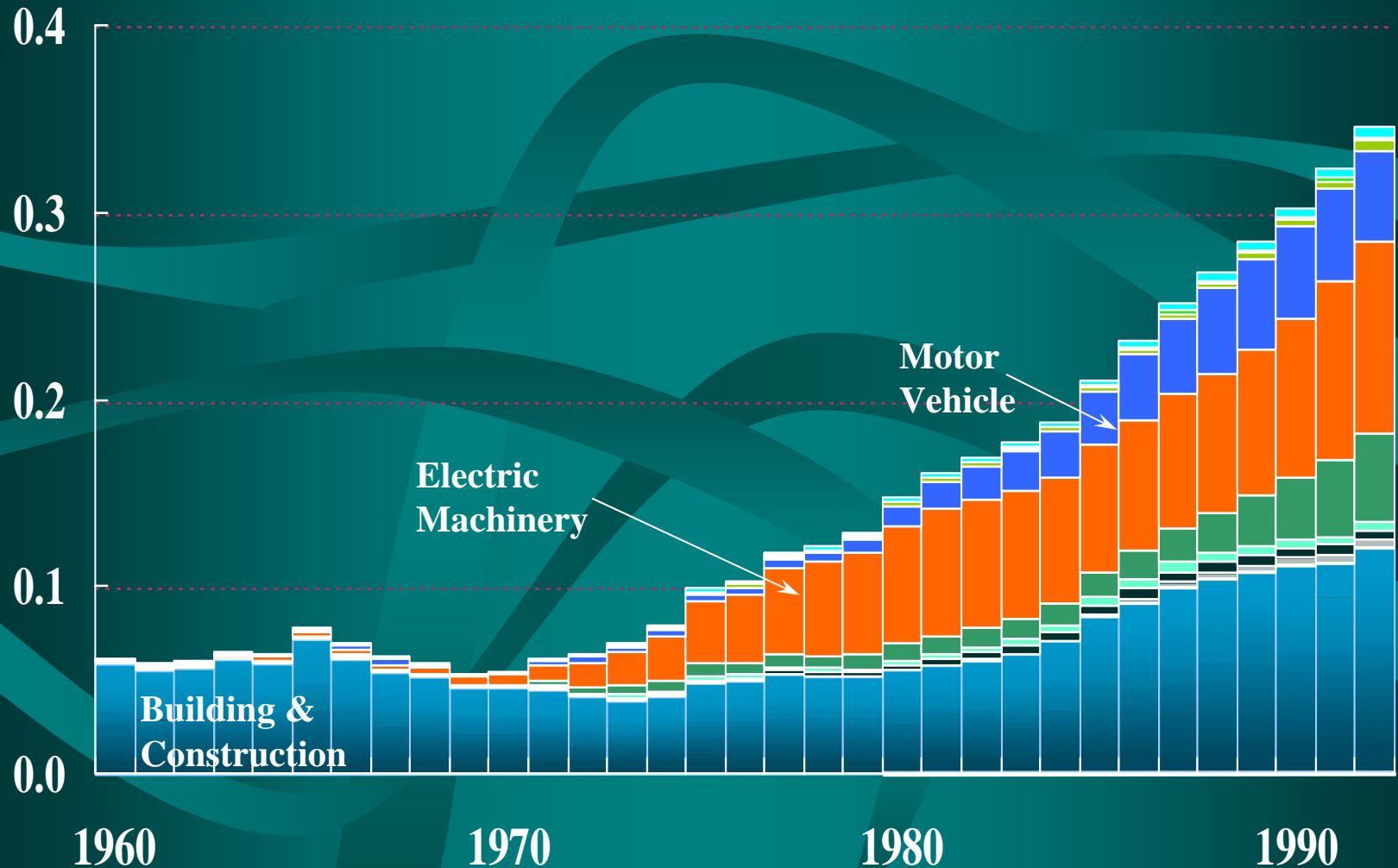
Capital Coefficient - *B_{ij}*

: Road Transportation



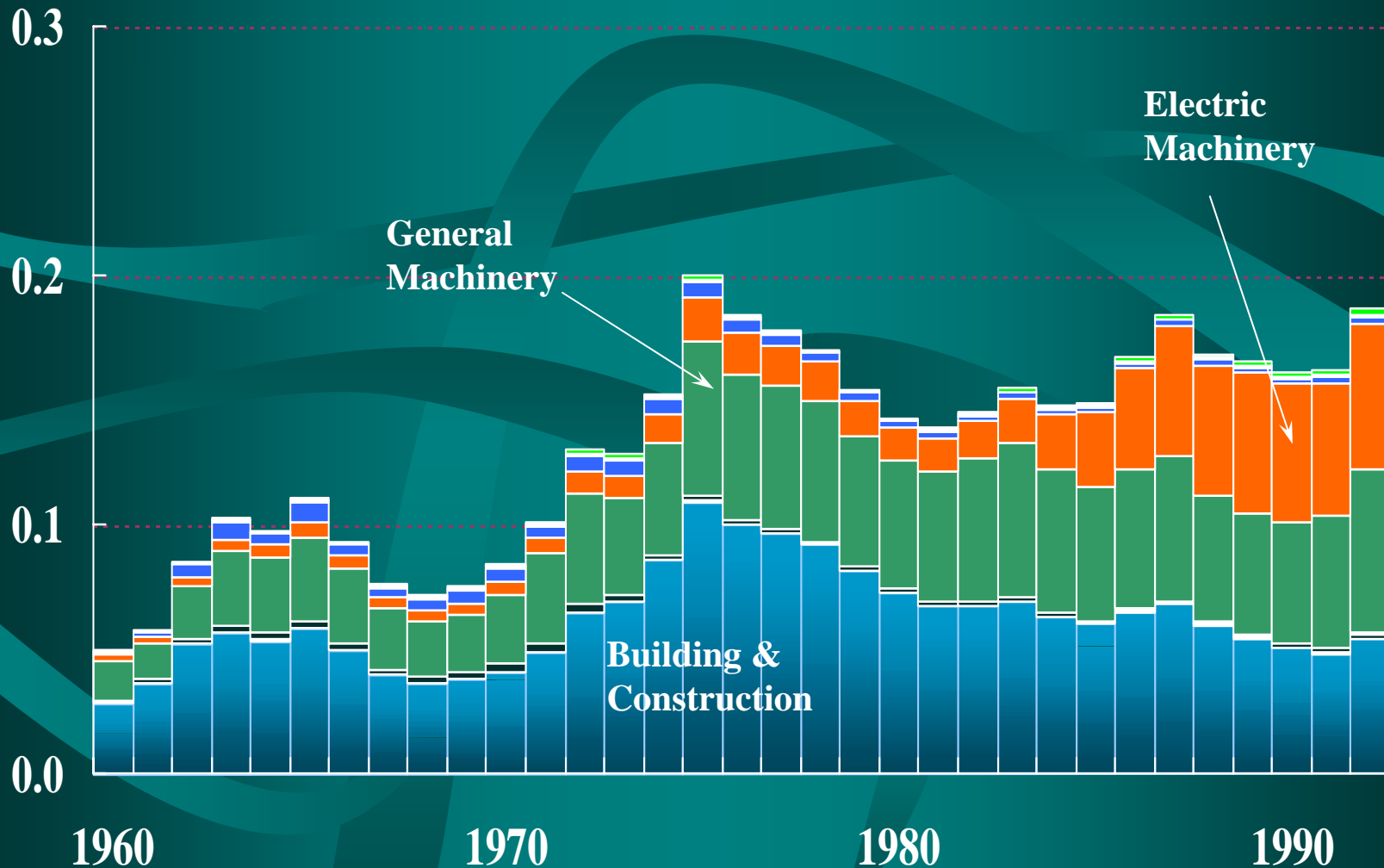
Capital Coefficient - *B_{ij}*

: Service except Commerce, Trans., Medical, etc



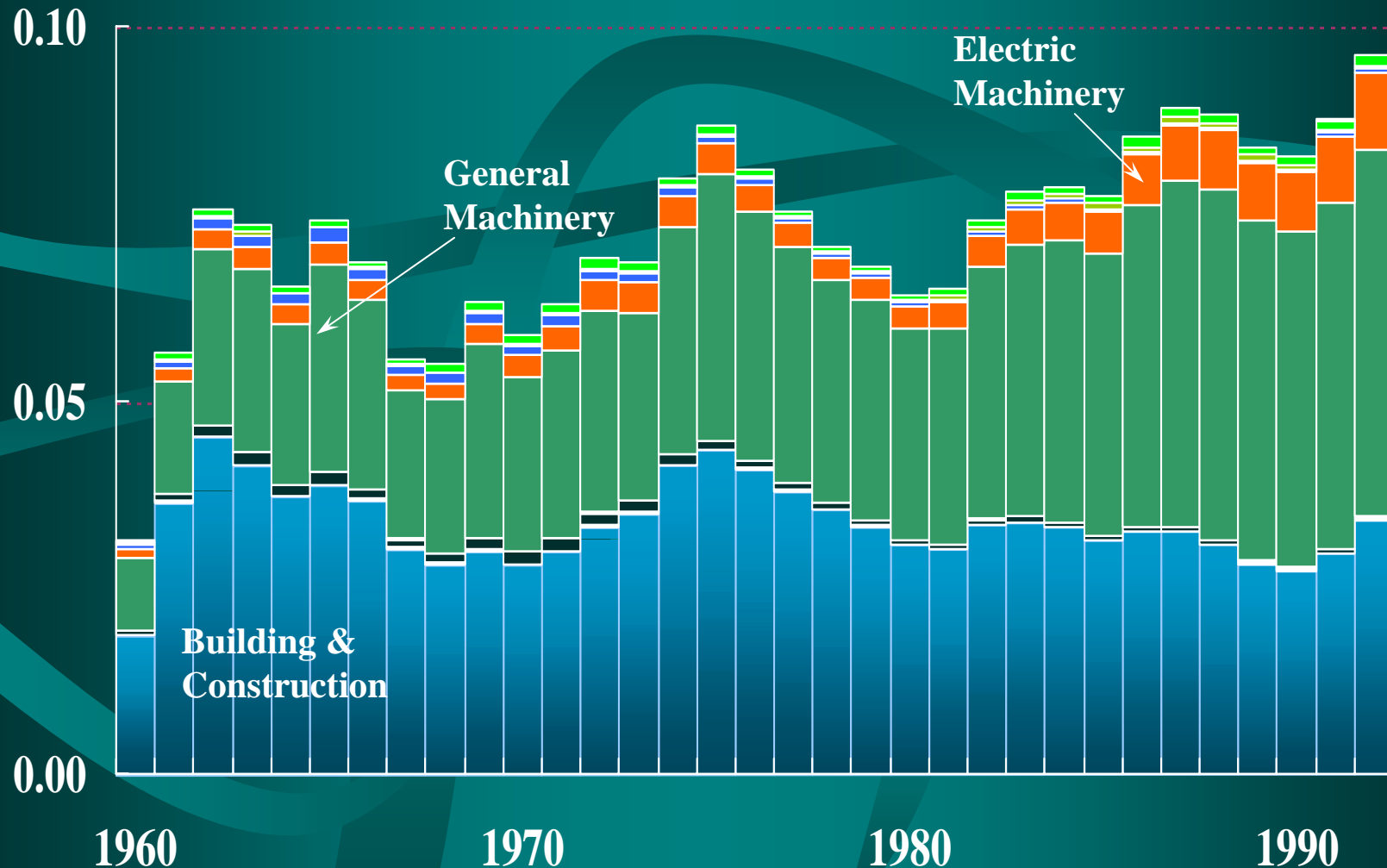
Capital Coefficient - *Bij*

: General Machinery Manufacturing



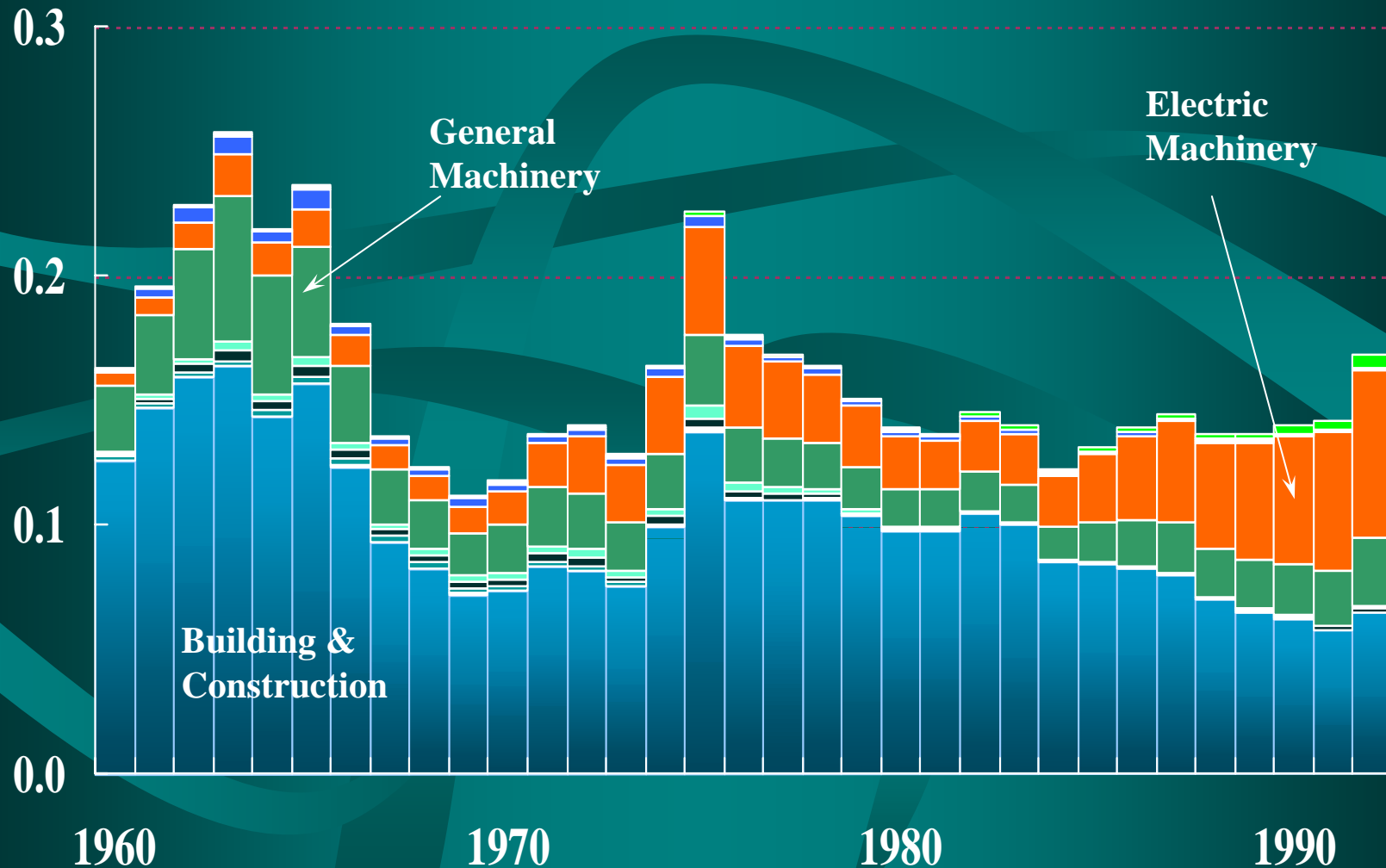
Capital Coefficient - *Bij*

: Motor Vehicle Manufacturing



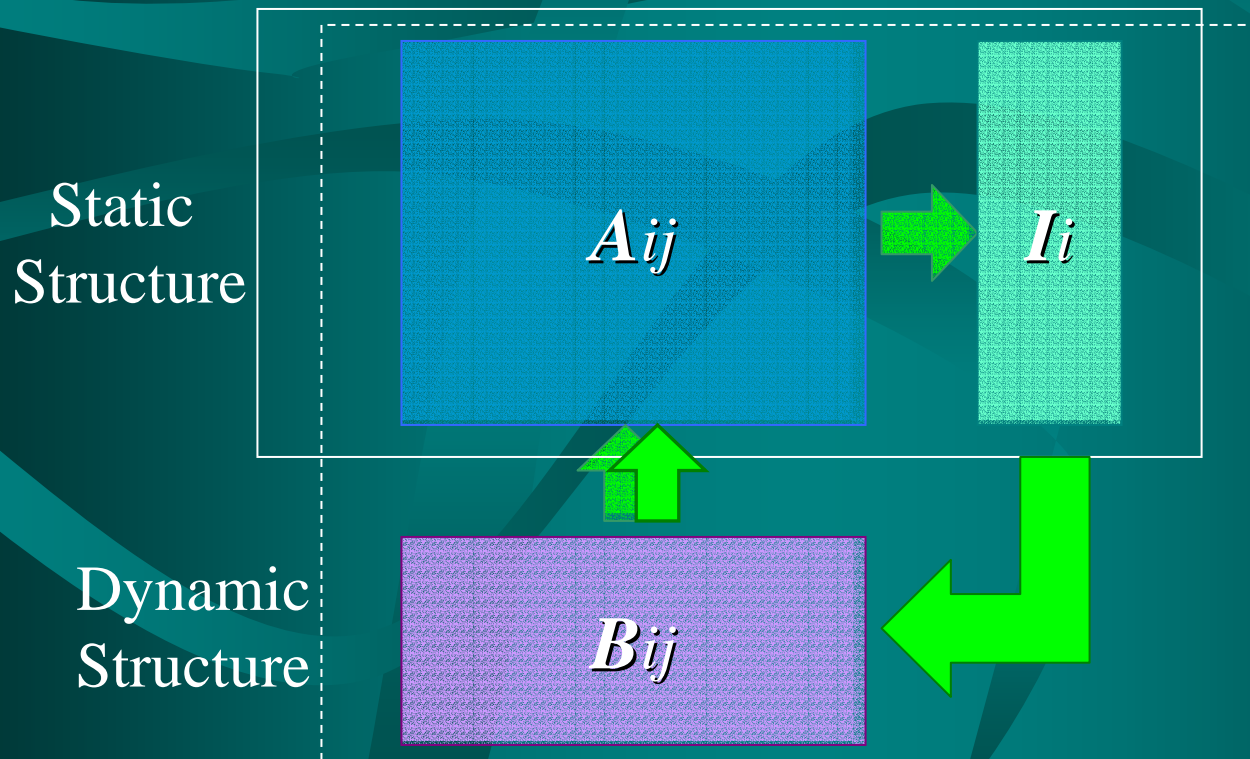
Capital Coefficient - *B_{ij}*

: Electric Machinery Manufacturing



Structural Change

- Definition of Economic “Structure”
 - $A_{ij} = X_{ij} / X_j$: Input Coefficient
 - $B_{ij} = S_{ij} / X_j$: Capital Coefficient

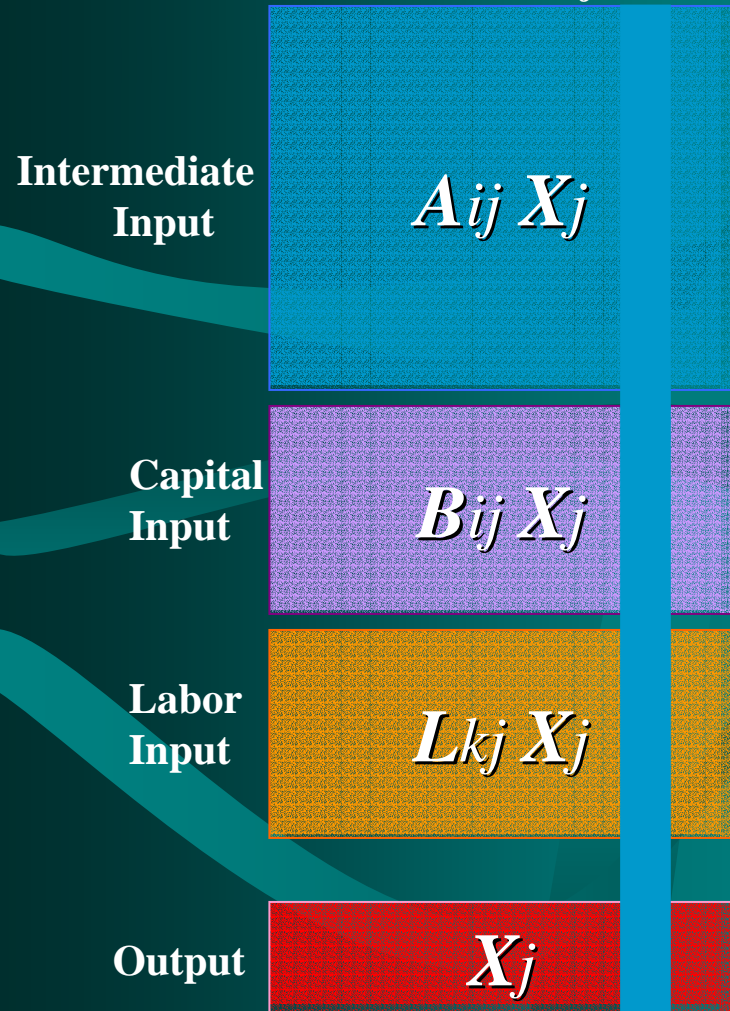


Industry-base TFP

I-O Table

j-Industry

TFP ; T_j



- Industry-base
- Structural Change

A_j, B_j, L_j

- Production Function

$$X_j = f(K_j, L_j, X_{ij}, T_j)$$

The Rate of Traditional TFP Growth in sector j

X_j : real gross output

X_{ij} : intermediate input I

L_{lj} : labor input of type l

K_{kj} : capital input of type k

p_{jt}, p_{lj}, p_{kj} : prices of output, labor and capital inputs

$$\left(\frac{\dot{T}_j}{T_j}\right)_t = \left(\frac{\dot{X}_j}{X_j}\right)_t - \sum_i \frac{p_{ijt} X_{ijt}}{p_{jt} X_{jt}} \left(\frac{\dot{X}_{ij}}{X_{ij}}\right)_t - \sum_l \frac{p_{ljt}^L L_{ljt}}{p_{jt} X_{jt}} \left(\frac{\dot{L}_{lj}}{L_{lj}}\right)_t - \sum_k \frac{p_{kjt}^K K_{kjt}}{p_{jt} X_{jt}} \left(\frac{\dot{K}_{kj}}{K_{kj}}\right)_t$$

Static Unit TFP

Unit Structure
of i - commodity

Static Unit TFP ; T_i

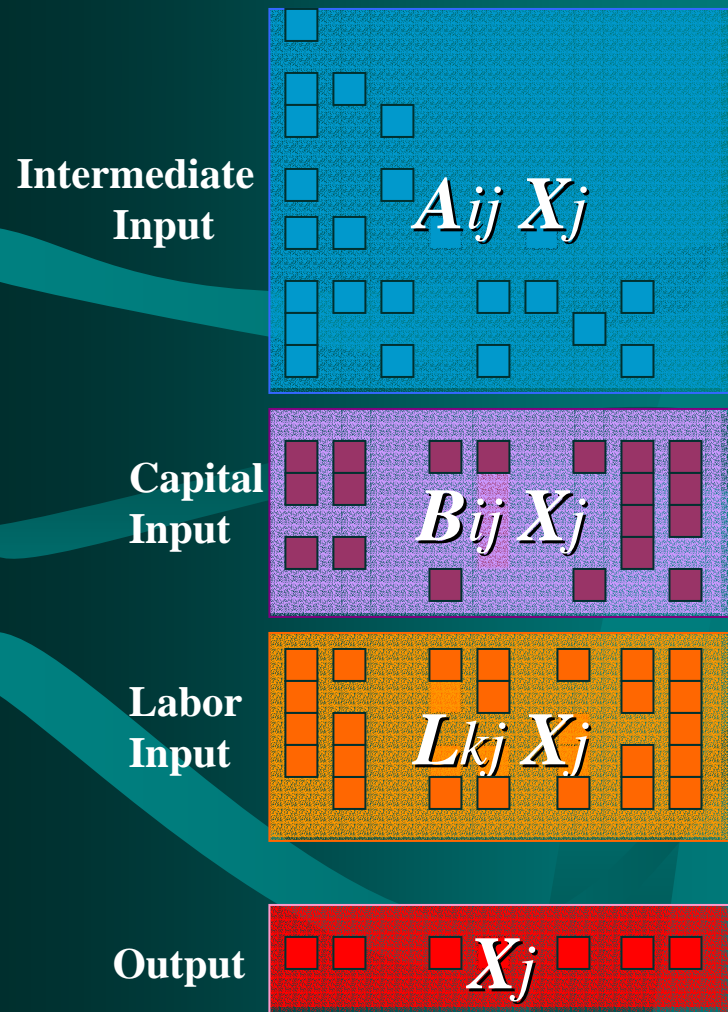
- Unit Structure
- Structural Change

$$A_{ij}, B_{ij}, L_{kj}$$

- Aggregation of Industry-base TFP

$$\frac{\dot{T}_i}{T_i} = \sum_j \frac{P_j X_j}{P_v V} \frac{\dot{T}_j}{T_j}$$

- Pecuniary Spillover Effects through Static Technological Relationship



Static Unit TFP of Commodity i

$$\mathbf{L}_t^* = \mathbf{B}_t^L \left\langle (\mathbf{I} - \mathbf{A}_t)^{-1} \mathbf{e}_{(i)} \right\rangle$$

$$\mathbf{K}_t^* = \mathbf{B}_t^K \left\langle (\mathbf{I} - \mathbf{A}_t)^{-1} \mathbf{e}_{(i)} \right\rangle$$

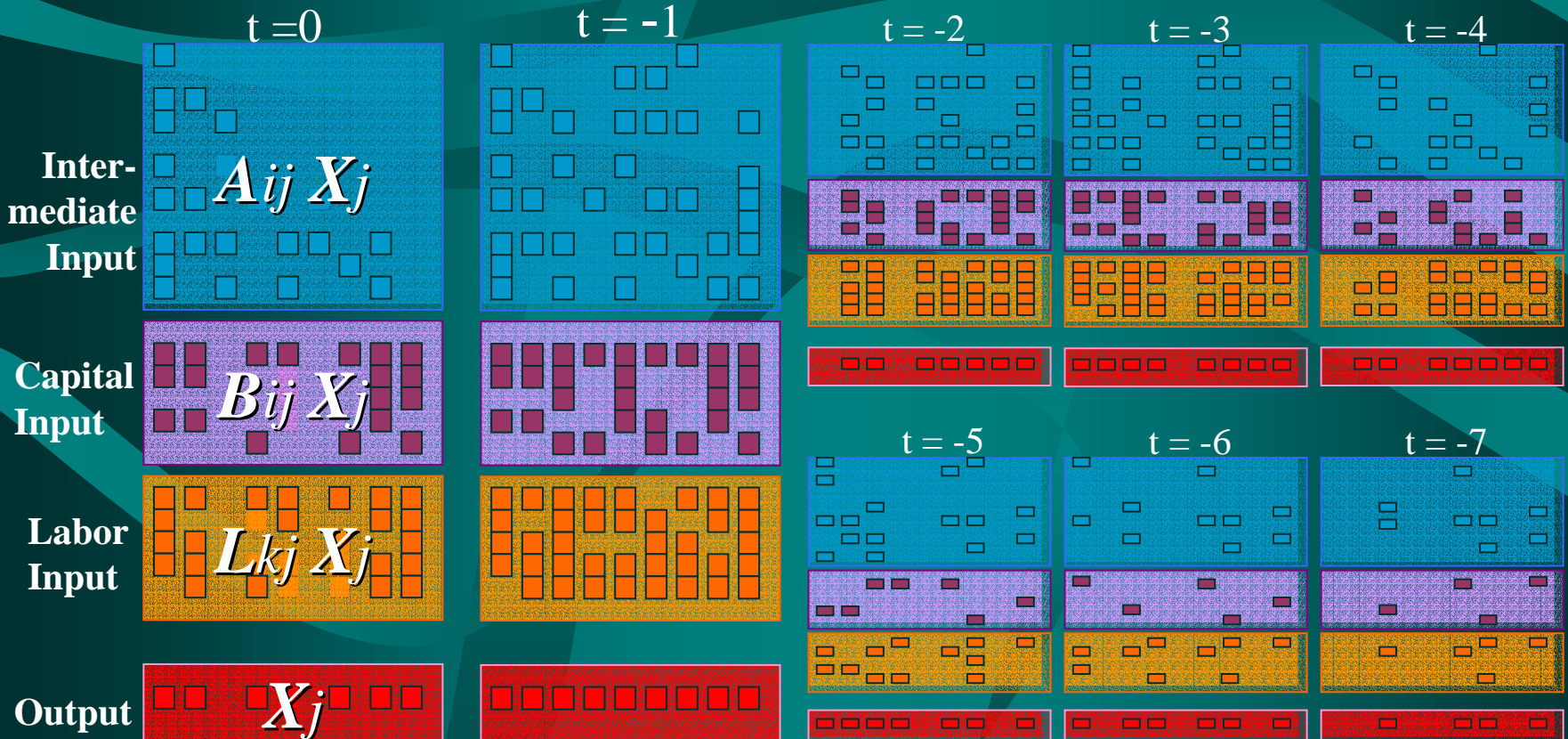
$$\begin{pmatrix} \dot{T}_i \\ T_i \end{pmatrix}_t^U = - \sum_j \sum_l \frac{p_{lj,t}^L L_{lj,t}^*}{p_{i,t}} \begin{pmatrix} \dot{L}_{lj}^* \\ L_{lj}^* \end{pmatrix}_t - \sum_j \sum_k \frac{p_{kj,t}^K K_{kj,t}^*}{p_{i,t}} \begin{pmatrix} \dot{K}_{kj}^* \\ K_{kj}^* \end{pmatrix}_t$$

Dynamic Inverse

Static IO Balance ; $A_{ij} X_j + I_{ij} + C_i = X_i$

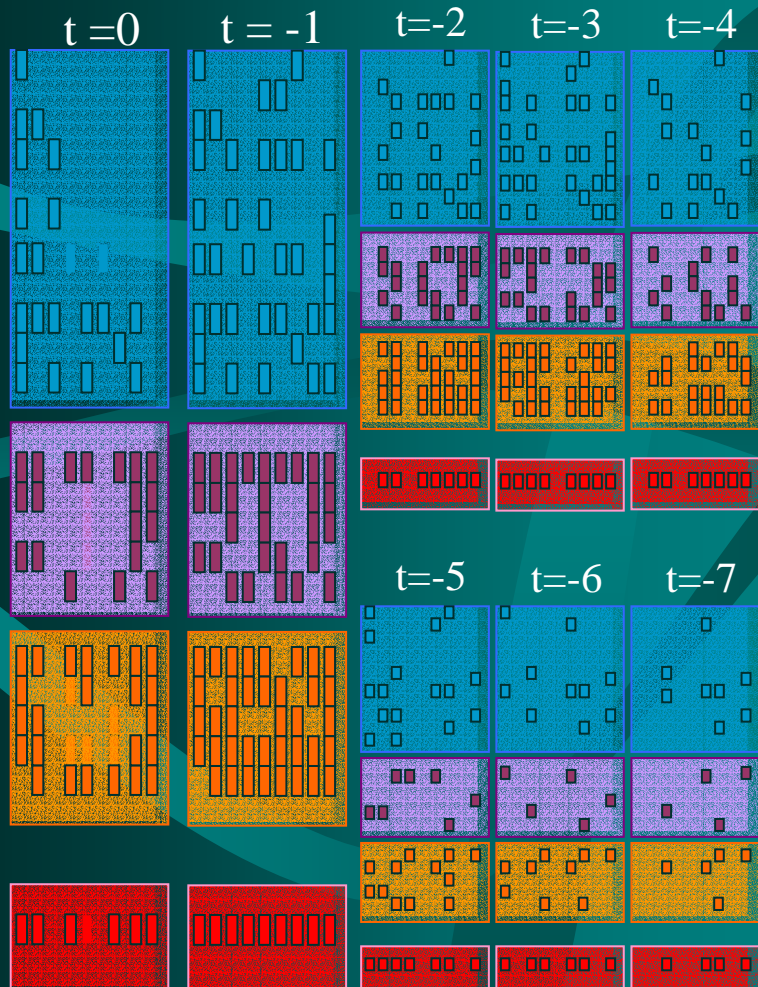
Capital Accumulation ; $K_{ij}^{t+1} = (1 - \delta_{ij}) K_{ij}^t + I_{ij}^t$

Dynamic IO Balance ; $A_{ij}^t X_j^t + B_{ij}^{t+1} X_j^{t+1} - (1 - \delta_{ij}) B_{ij}^t X_j^t + C_i^t = X_i^t$



Dynamic Unit TFP

Dynamic Unit Structure of i - commodity



Dynamic Unit TFP ; T_i^*

- Decomposition by Dynamic Inverse
- Structural Change

$$A_{ij}^t, B_{ij}^t, L_{kj}^t, t=0, \dots, -$$

- Aggregation of
Time-series Static Unit TFP

$$\frac{\dot{T}_i^*}{T_i^*} = \frac{\dot{T}_i^0}{T_i^0} + \frac{K^0 r^0}{P^0 V^0}_{t=-1} \quad \text{and} \quad \frac{\dot{T}_i^t}{T_i^t}$$

- Pecuniary Spillover Effects
through Capital Accumulation
and Structural Change

Dynamic Unit TFP

$$\left(\frac{\dot{T}}{T}\right)_t^{\text{D}(\mathbf{f}_t^*)} = \left(\frac{\dot{T}}{T}\right)_t^{\text{U}(\mathbf{f}_t^*)} + \sigma_{K,t}^* \sum_{\tau=1}^{\infty} \Phi_{t-\tau}^* \left(\frac{\dot{T}}{T}\right)_{t-\tau}^{\text{U}(\mathbf{f}_{t-\tau}^*)}$$

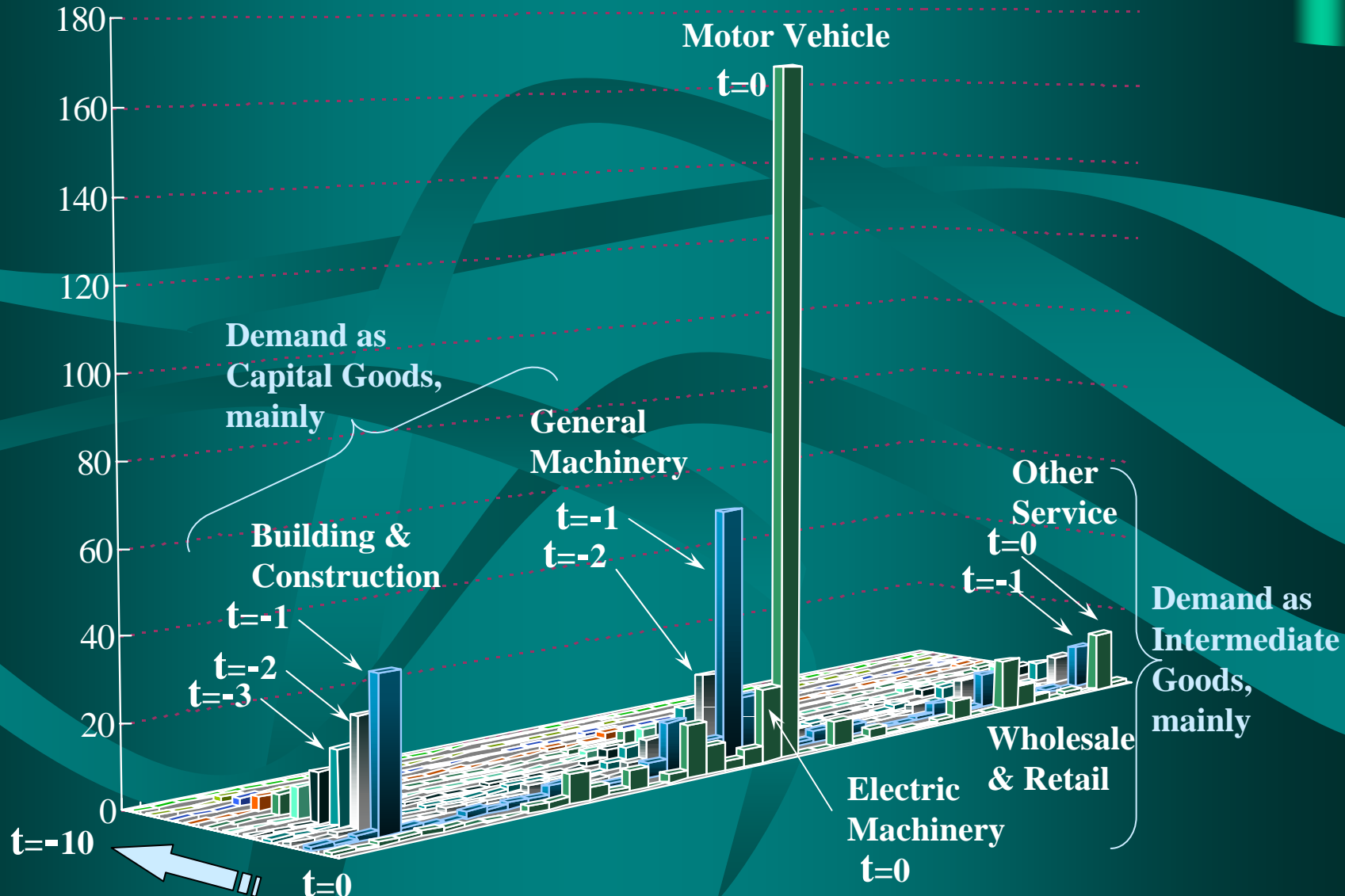
and

$$\left(\frac{\dot{T}}{T}\right)_t^{\text{D}(\mathbf{f}_t^*)} = \left(\frac{\dot{f}^*}{f^*}\right)_t - \sigma_{L,t}^* \left(\frac{\dot{L}^*}{L^*}\right)_t - \sigma_{K,t}^* \sum_{\tau=1}^{\infty} \Phi_{t-\tau}^* \sigma_{L,t-\tau}^* \left(\frac{\dot{L}^*}{L^*}\right)_{t-\tau}$$

$$\Phi_{t-\tau}^* = s_{t-\tau}^* s_{t-\tau+1}^* \left(\frac{(1-\delta)S_{t-\tau+1}^*}{I_{t-\tau+1}^*} + \sigma_{K,t-\tau+1}^* \right)$$

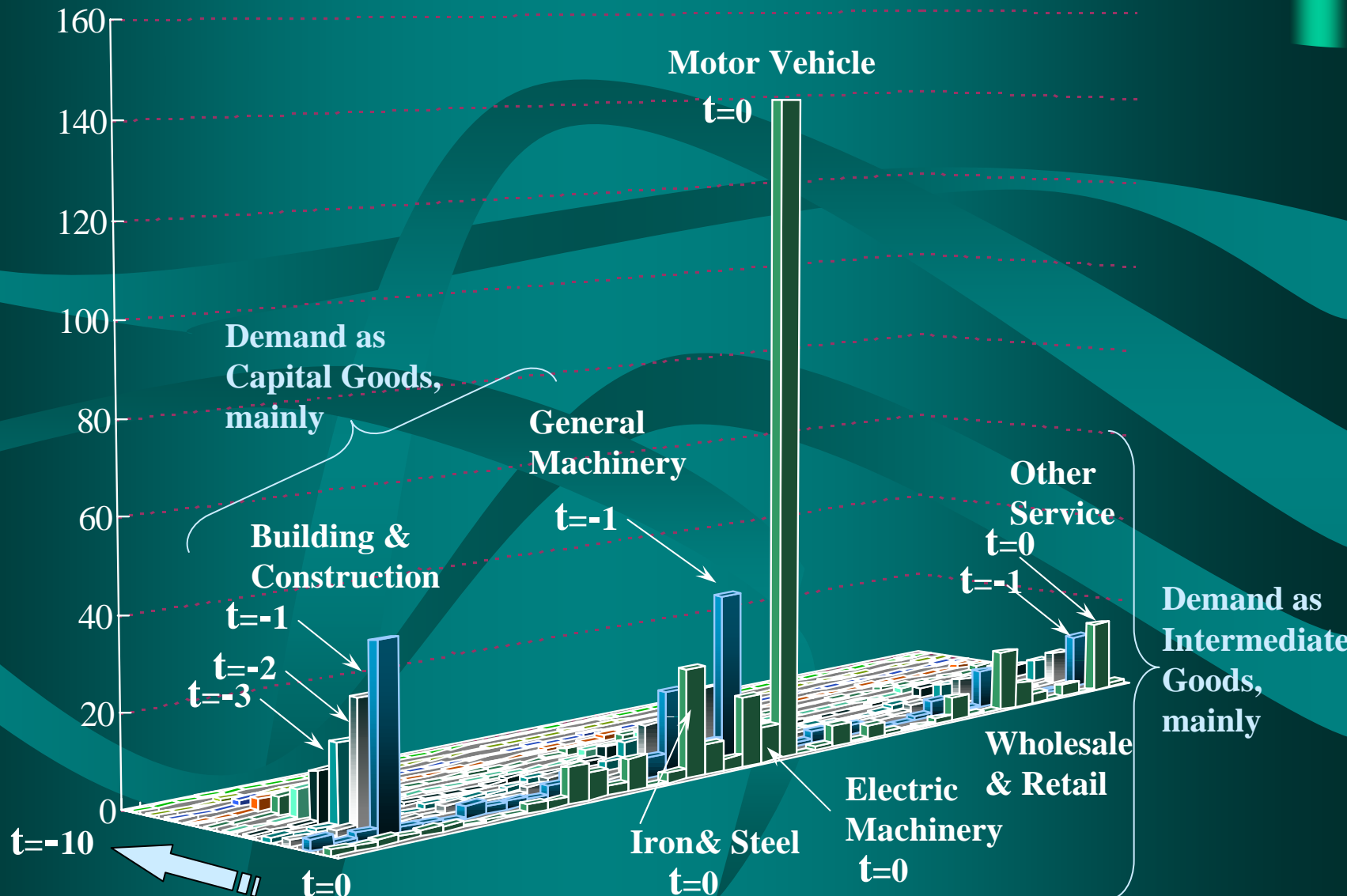
Dynamic Inverse

: Required Output Induced by Motor Vehicle Demand in 1992



Dynamic Inverse

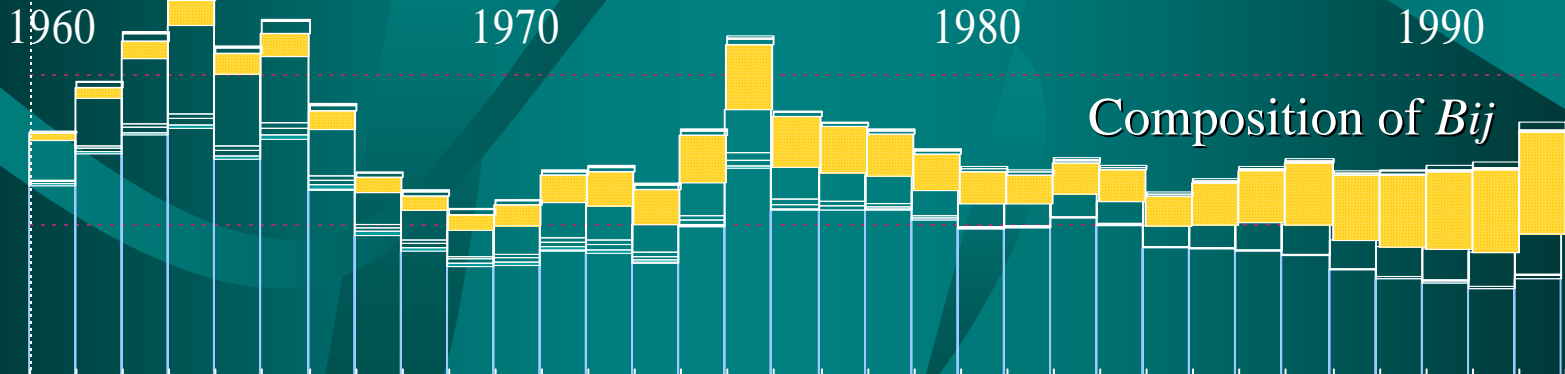
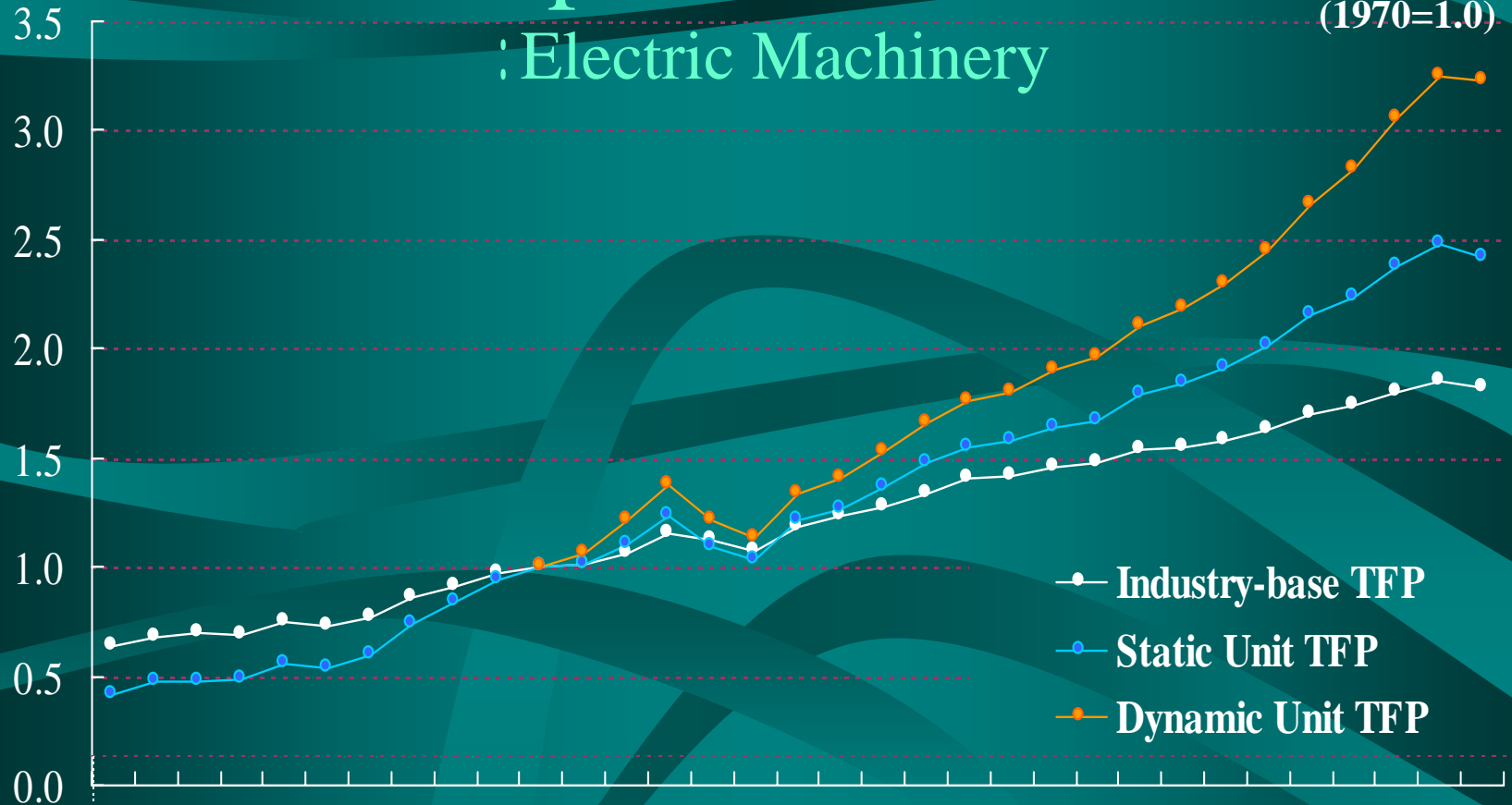
: Required Output Induced by Motor Vehicle Demand in 1980



Comparison of TFP

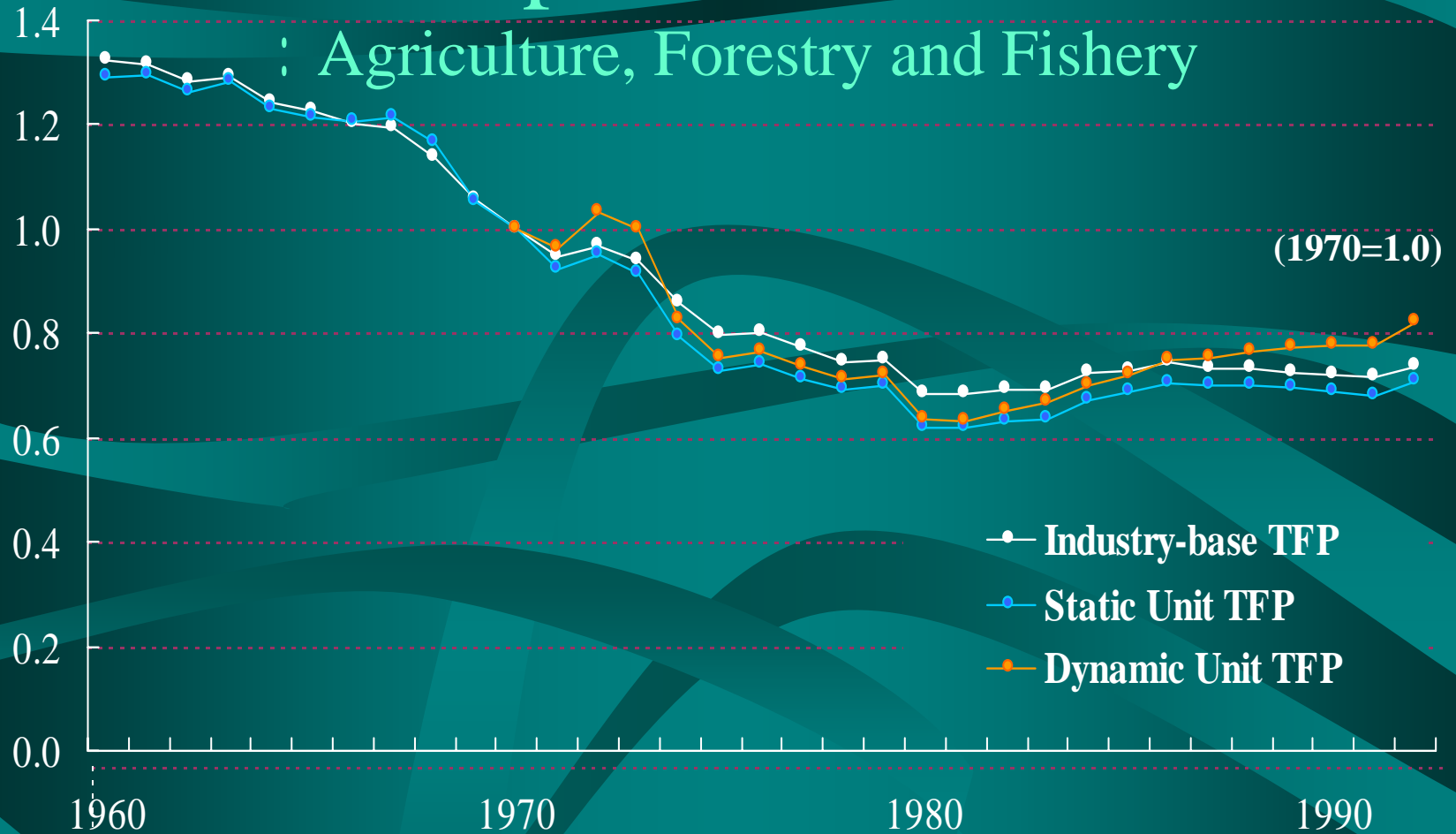
: Electric Machinery

(1970=1.0)

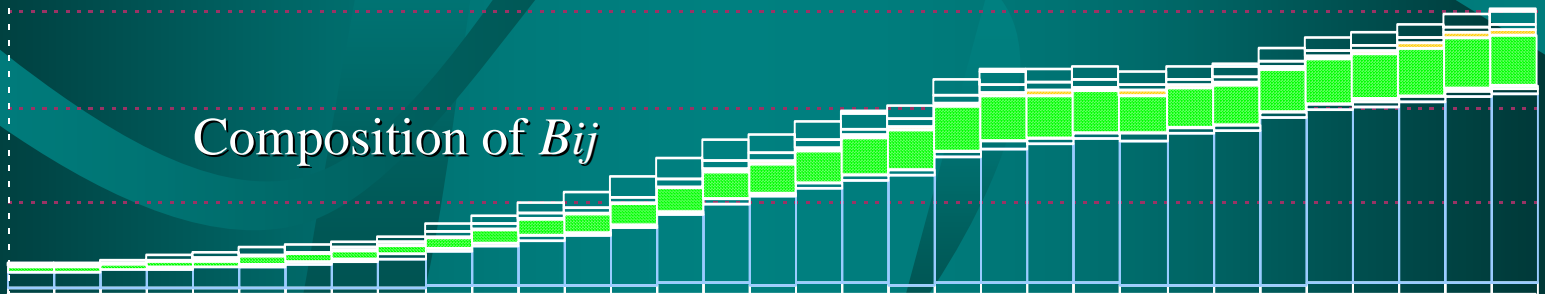


Comparison of TFP

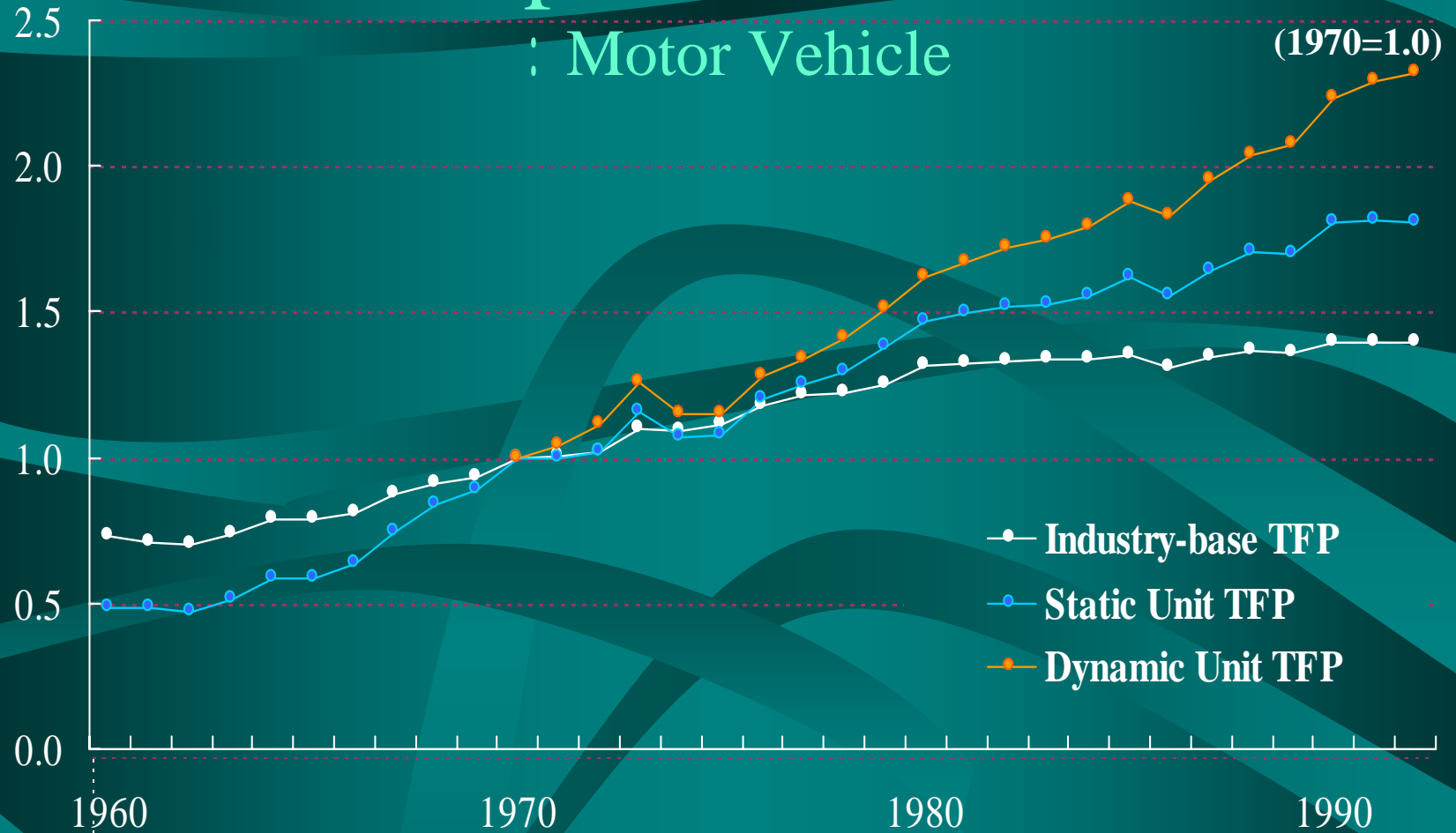
: Agriculture, Forestry and Fishery



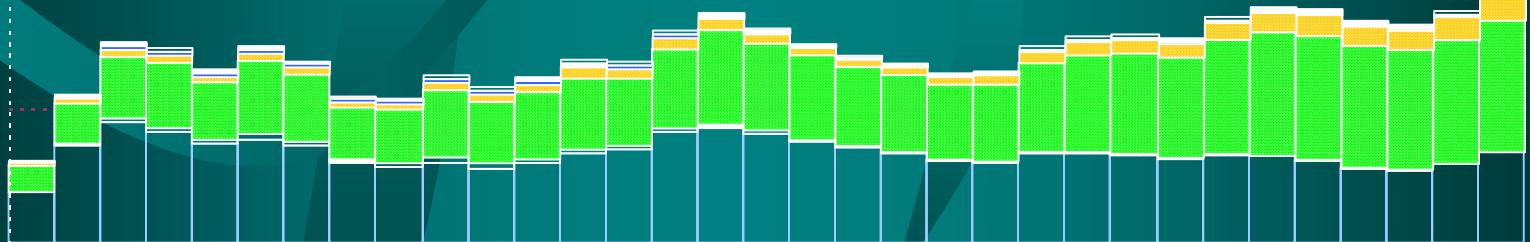
Composition of B_{ij}



Comparison of TFP



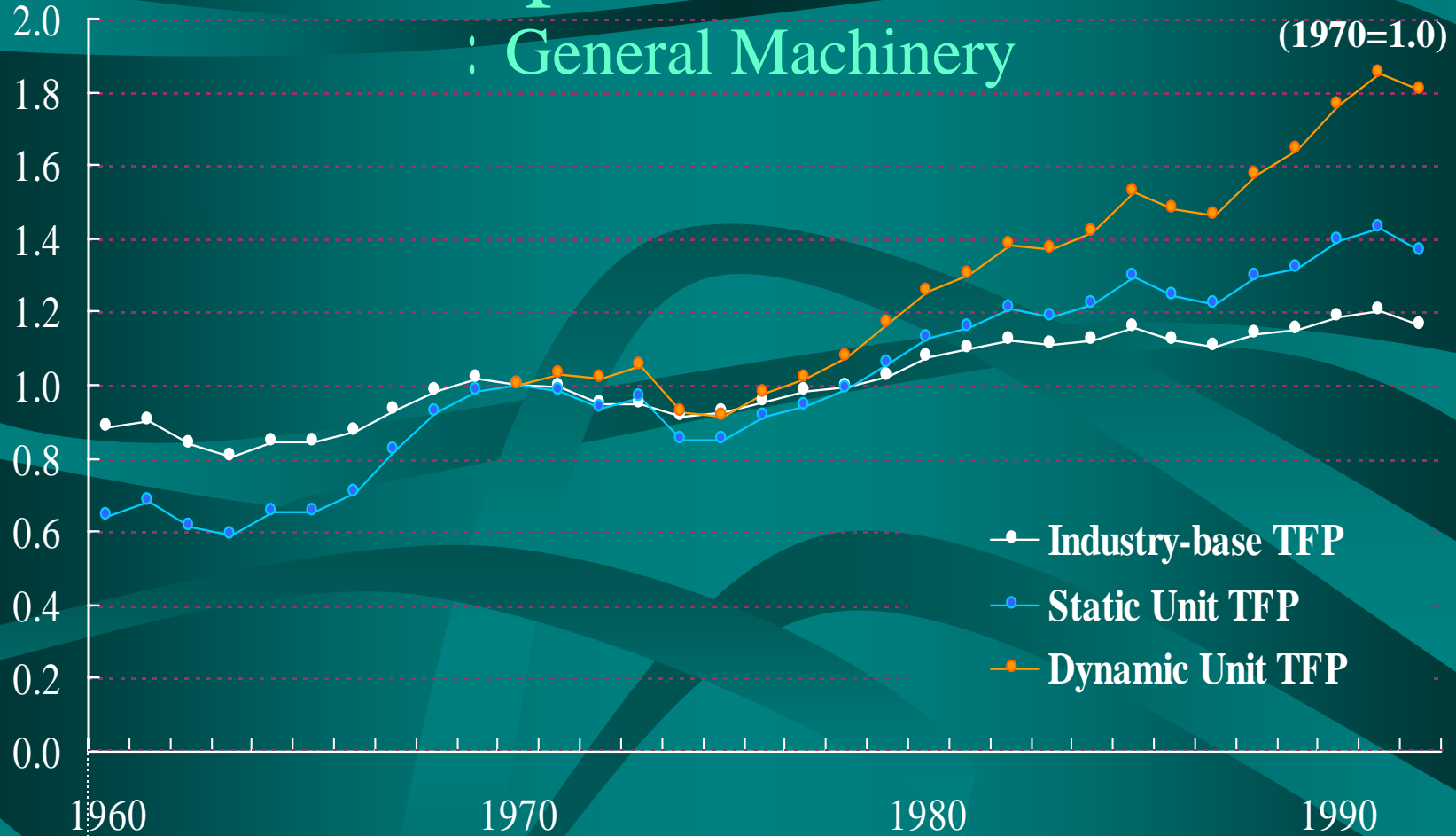
Composition of B_{ij}



Comparison of TFP

: General Machinery

(1970=1.0)



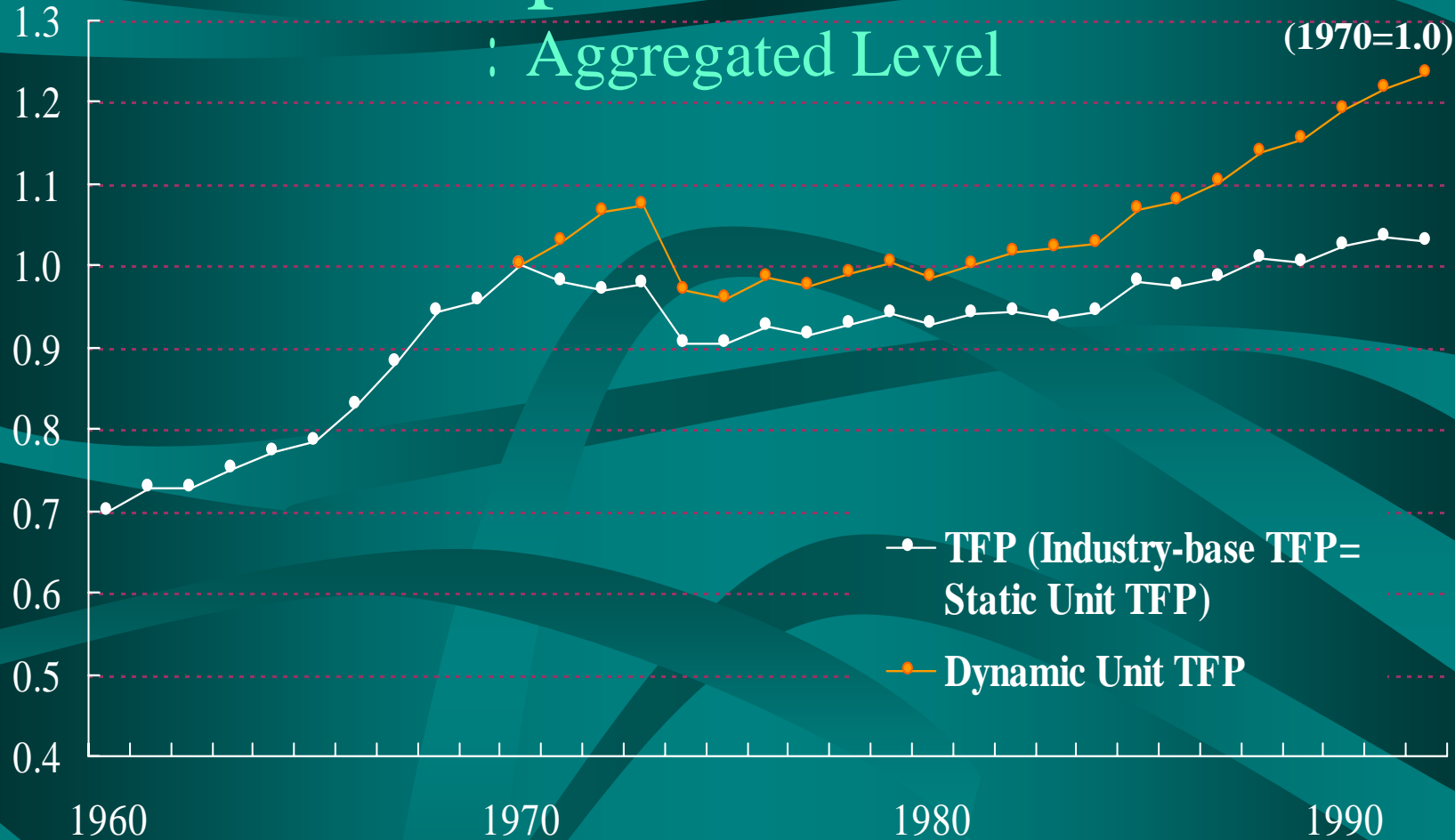
Composition of B_{ij}



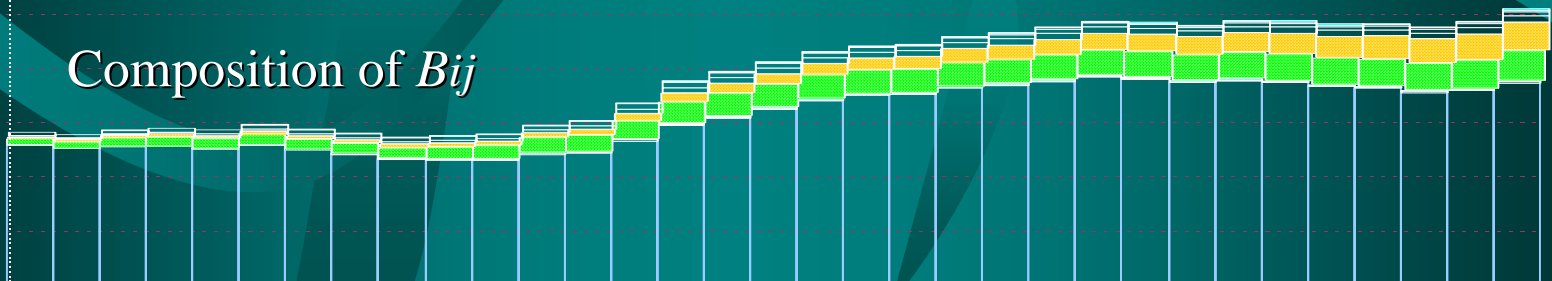
Comparison of TFP

: Aggregated Level

(1970=1.0)

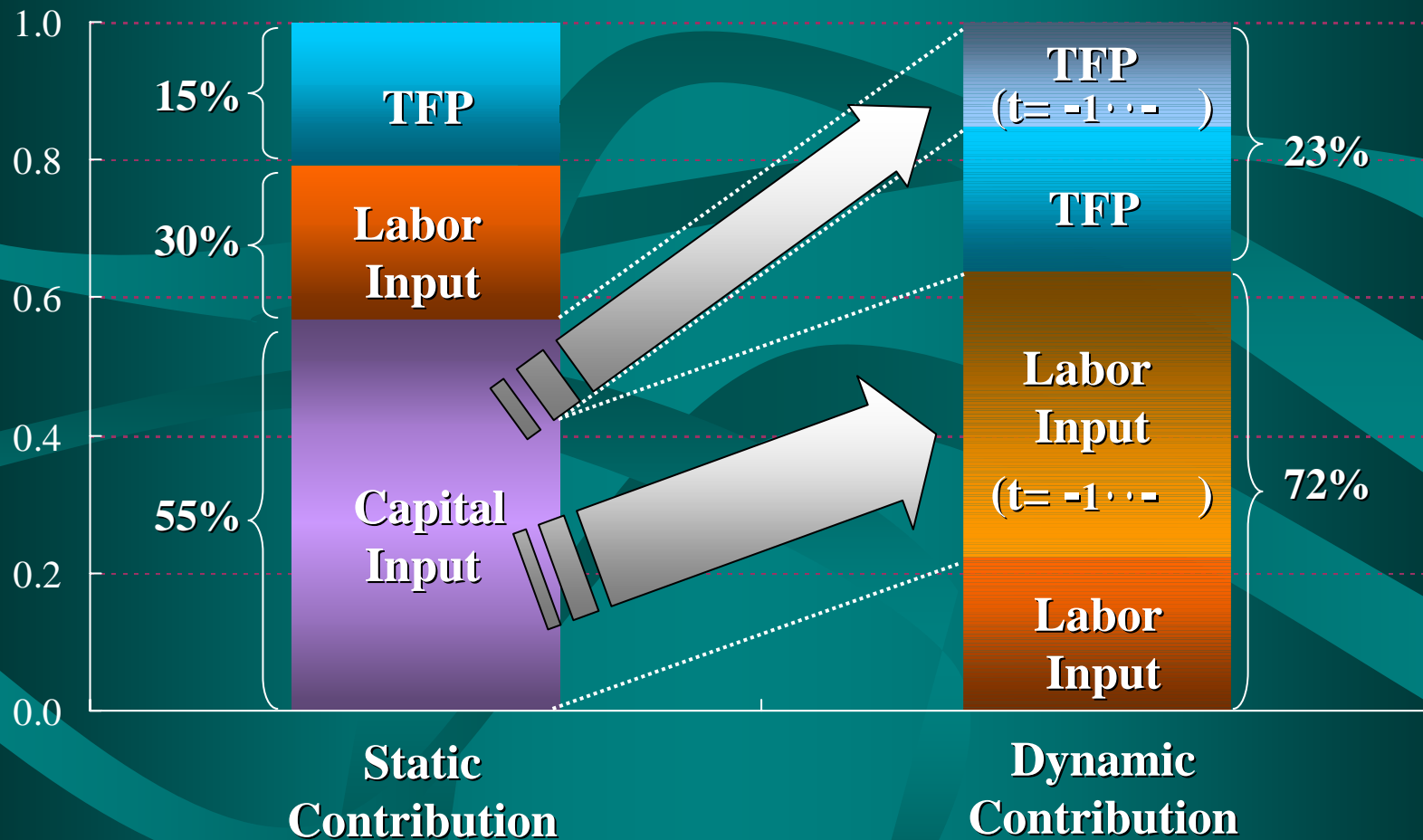


Composition of *Bij*



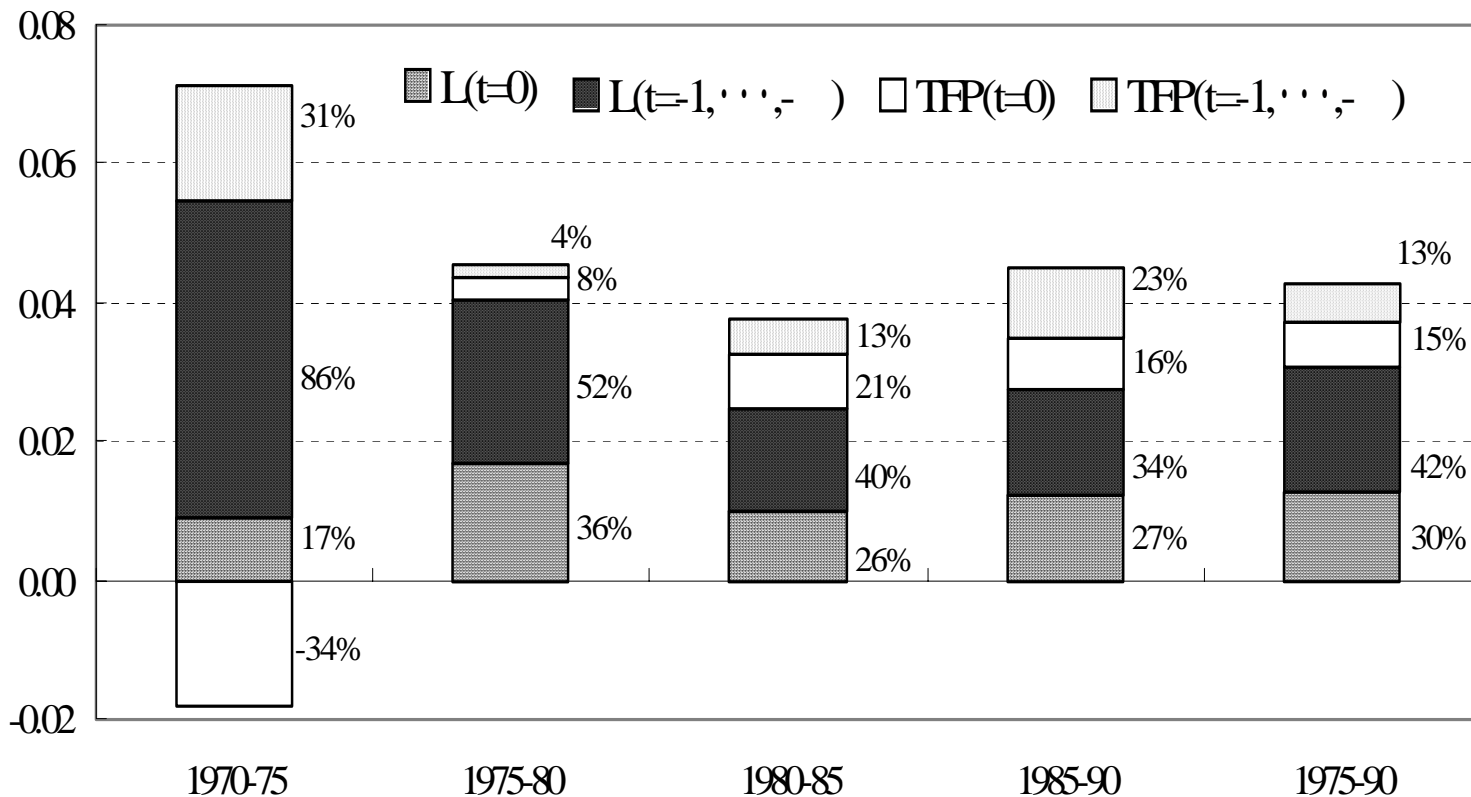
Contribution to Growth

: Aggregated Level



(Real GDP Growth = 1.0 during 1975-90)

Contribution to Growth : Aggregated Level



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If you need more information,
please take a contact to the
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