Estimating Rates of Return on Capital

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Rate of Return on Capital (RoRK)

- RoRK is important for applied growth economic work
  - Measures the contribution of investment to economic growth (Solow, 1956), i.e. provides a basis for assessing the contribution of capital investment to the growth process

- RoRK is a key guide for estimating the opportunity cost of capital

- Presents a significant part of growth diagnostics (HRV)
  - Q1: Is investment in physical capital low because: (i) the return on capital is low, or (ii) the cost of financing is too high?
RoR K: Definition

RoR K ($\rho_t$) is the ratio of the value of national income accrued to capital ($Y^k_t$) to the value of the national capital sock ($K_t$)

$$\rho_t = \frac{Y^K_t}{K_t}$$
Income Accruing to Capital

Total Capital Income = (National Income - Total Labor Income)

\[ Y_t^K = Y_t - Y_t^L \]

Total Labor Income = (Total Wages & Salaries + Imputed Wages & Salaries)

\[ Y_t^L = \sum_{j=1}^{h} (p_j X_j + s_{UE}^L Y_j) \]

- sum of wages and salaries in the national accounts plus the share of labor in the income of non-incorporated enterprises (UE) times income of the unincorporated enterprises

**Imputed Wages & Salaries:** a fraction of average income \( Y_j \) generated by a typical employee in each sector to account for proprietors, partners, self-employed, and unpaid family members
Estimation procedure: Problems

• Data in National Accounts are usually not in directly applicable form!
• The marginal productivity of labor in the public sector may differ from wages and salaries paid
• National accounts frequently identify employee compensation with income from labor, which implies that the income of unincorporated enterprises is entirely attributed to capital
Income Accruing to Labor:
Example

<table>
<thead>
<tr>
<th></th>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incorporated Firms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages&amp;Salaries (Nat.Acc.)</td>
<td>9,212.27</td>
<td>6,529.64</td>
<td>3,681.27</td>
</tr>
<tr>
<td>Number (Nat.Acc./Census)</td>
<td>29,765.00</td>
<td>45,032.00</td>
<td>32,011.00</td>
</tr>
<tr>
<td>Average Earnings</td>
<td>0.31</td>
<td>0.15</td>
<td>0.12</td>
</tr>
<tr>
<td><strong>Unincorporated Firms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number (Nat.Acc./Census)</td>
<td>985.00</td>
<td>5,283.00</td>
<td>28,287.00</td>
</tr>
<tr>
<td>Average Earnings</td>
<td>0.31</td>
<td>0.15</td>
<td>0.12</td>
</tr>
<tr>
<td>Imputed Wages&amp;Salaries</td>
<td>304.86</td>
<td>766.04</td>
<td>3,253.01</td>
</tr>
<tr>
<td><strong>Total Labor Income</strong></td>
<td>9,517.13</td>
<td>7,295.68</td>
<td>6,934.27</td>
</tr>
</tbody>
</table>
Earnings Directly Attributable to Capital

Income accruing to capital

\[
Y^K_t = Y_t - \sum_{j=1}^{h} (p_j X_j + s^L_{UE} Y_j)
\]

Share of National Income Accruing to Capital \( (s^K) \)

\[
S^K = \frac{Y_t - \left( \sum_{j=1}^{h} p_j X_j + s^L_{UE} Y_t \right)}{Y_t}
\]

Rule of thumb:

\~ 60 percent of the national income accrues to labor and
\~ 40 percent to capital
Total capital stock comprises of different categories of assets, usually:

- **Fixed Assets**
  - Machinery and equipment
  - Buildings and construction

- **Inventory**

- **(Land)**
Methodology

Perpetual Inventory Method:

Net capital stock for period \( (K_t) \) is a function of the net capital stock \( (K_{t-1}) \) plus Gross Investment \( (I_{t-1}) \) during the year minus depreciation \( (D_{t-1}) \)

\[
K_t = K_{t-1} + I_{t-1} - D_{t-1}
\]  

(1)

Assumptions:

- depreciation method has to be chosen
- level & time profile of depreciation rate has to be made
- initial capital stock has to be constructed
Perpetual Inventory Method

- Geometric depreciation, $\delta$

- Perpetual capital stock accumulation

$$K_t = (1 - \delta)K_{t-1} + I_{t-1} \quad (2)$$

- With infinite number of investment periods

$$K_t = \sum_{i=0}^{\infty} (1 - \delta)^i I_{t-i} \quad (3)$$

- With limited number of investment periods

$$K_t = (1 - \delta)^t K_1 + \sum_{i=0}^{t-1} (1 - \delta)^i I_{t-i} \quad (4)$$

capital stock depreciates at a constant rate, $\delta$

“perpetual” as all assets part of inventory of capital stock forever

Kt is a weighted sum of past investment, where the weights are a decreasing function of the distance between the current period t and the investment period.
Estimating the Initial Stock of Capital

• Initial stock of each type of reproducible capital:

\[ K_1 = \frac{I_t}{(\delta + \gamma)} \]

Where:
I is gross investment,
\( \delta \) is the rate of depreciation,
\( \gamma \) is the annual rate of growth of capital stock, and
K is the capital stock at the beginning of the year.
Estimating the Initial Stock of Fixed Capital Assets

1. Take *Gross Investment* for fixed assets (buildings and construction; and machinery and equipment) to generate capital-stock series (source: National Income Accounts).

2. Assume appropriate rates of depreciation ($\delta$).

3. Assume growth rate of capital stock ($\gamma$): *in steady state*, investment and capital grow at the same rate.

4. Estimate the initial stock of each type of reproducible capital:

\[ K_1 = \frac{I_t}{(\delta + \gamma)} \]
Estimating Stock of Inventories

1. Retrieve *Net Inventory Accumulation* from National Accounts
2. Calculate *Marginal Inventory-to-GDP ratio*
   – Alternatively, use another (similar) country’s average *Marginal Inventory-to-GDP ratio*
3. Apply this ratio to the initial year GDP to estimate the *Initial Inventory Stock*
4. Derive *Inventory Stock* series by adding *Net Inventory Changes* to *Initial Stock of Inventory* for each year after
The Rate of Return on Capital

1. Estimate Total Capital Stock
   \[ K_t = \Sigma [\text{Fixed Capital}_t; (\text{Inventories})_t] \]

2. National Income Accruing to Capital
   \[ Y^K_t = Y_t - \sum_{j=1}^{h} (p_j X_j + s_{UE}^{L} Y_j) \]

3. Estimate the rate of return \((\rho_t)\)
   \[ \rho_t = \frac{Y_t - Y^L_t}{K_t} \]
Checks and Adjustments: Depreciation Check

1. Compare the depreciation ($\delta_{FA} = \delta_{construction & buildings} + \delta_{machinery & equipment}$) across each group of fixed assets to the depreciation from national accounts ($\delta_{National Accounts}$)

2. If estimates are on the lower side, reduce depreciation (e.g. by 20%, i.e. $\delta_{construction & buildings} = 2\%$ and $\delta_{machinery & equipment} = 5\%$)

3. If estimates are on the higher side, increase depreciation

4. Estimate new capital stock for each group of fixed assets

5. Perform depreciation checks again and compare to the adjusted national accounts depreciation
RoRK Accounting

- Decomposes changes in RoRK into changes in capital stock and in income accruing to capital
- Explains how much of the change in RoRK can be attributed to (i) changes in the income accruing to capital; (ii) the changes in the capital stock
- Back to the HRV diagnostic tree
Selected References


Selected References


