Estimating the rate of return to capital in the EU

LSE MPA Capstone Project

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Eduardo Canales
Ashley Lau
Han Chul Lee
Giorgio Manenti
Kei Owada
Project roadmap

1. Introduction
2. Data source
3. Methodology
4. Application
5. Conclusion
Project roadmap

- What is the motivation behind the project and our original contribution?

1. Introduction
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Motivation: Changing economic conditions in Europe

- Following the 2008 global financial crisis, governments are now facing tighter budget constraints and, in some cases, restrictions on access to international capital markets.

What does this mean for public investment?

- Potential for public investment to crowd out alternative investment.
- Re-evaluation of the way public investment projects are assessed through cost-benefit analysis for EU countries.
The role of the rate of return to capital in project appraisal

Social cost-benefit analysis

- Examines the flow of costs and benefits of a given investment over several time periods with a social discount rate (SDR).

Social Discount Rate

Social Time Preference
Reflects the rate at which society is willing to trade present for future consumption

Social Opportunity Cost
Reflects forgone benefits from displaced resources of alternative investments

Rate of Return to Capital

National Accounts
Our project: Mission and guiding principles

**Objective**

*Develop a simple methodology to estimate national rates of return on investment using widely available national accounts data.*

**Guiding principles**

- Simplicity
- One accessible source for national accounts
- Applicability to all EU countries
- Calculated for the whole economy, and the public and private sectors
How our project expands existing work

Our research approach

• We focused on two **main areas of research**:
  - Social cost-benefit analysis
  - Macroeconomic literature

• What we found:
  - **Standard methods** based on national accounts deal with **recurrent issues** and are **country-specific**.

• What we did:
  - We addressed these issues by elaborating our methodology to make it **applicable to a wide range of countries**.

### Income

- **Unincorporated enterprises**: Income attributed to capital/labour (Harberger, 1972; Chou *et al.*, 2016)
- **Taxation**: Gross/net of direct and indirect taxes (Poterba, 1997; Jenkins and Kuo, 2007)

### Stock of capital

- **Definition**: Reproducible/non-reproducible capital (Jenkins and Kuo, 2003; Caselli and Feyrer, 2007)
- **Depreciation** (Chou *et al.*, 2016, Dhareshwar, 1993)

### Scope

- **Sector**: Whole economy/public and private sectors (Harberger 1977; Bai *et al.*, 2016)
- **Country**: Country-specific/cross-country estimates (Harberger 1978; Rincon-Aznar 2009)
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- What is the most suitable national accounts data source?
Our approach for selecting the data source

Shortlist selection

- National accounts, single source for multiple countries, and updated regularly → Eurostat, IMF\(^1\), World Bank\(^2\), UN\(^3\), OECD\(^4\)

Criteria to select the data source

- Coverage of all EU countries
- Breakdown of data by sector e.g. Public investment
- Breakdown of investment data e.g. Construction, machinery
- Breakdown of income data e.g. Mixed income, rents

\(^1\) International Financial Statistics
\(^2\) World Development Indicators
\(^3\) undata
\(^4\) OECD.Stat
Why do we select Eurostat?

<table>
<thead>
<tr>
<th></th>
<th>Eurostat</th>
<th>IMF</th>
<th>World Bank</th>
<th>UN</th>
<th>OECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coverage of EU countries</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Breakdown of data by Sector</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Breakdown of investment data</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Breakdown of income data</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

(1) Bulgaria, Croatia, Cyprus, Malta, and Romania are not covered in the national accounts section.
(2) Operating surplus and rents are not available.
(3) Rents is not available.
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How do we develop, step by step, our methodology for the whole economy, and the public and private sectors?
Defining the rate of return to capital

### Scope of capital

<table>
<thead>
<tr>
<th>Rate of return to total capital</th>
<th>Rate of return to reproducible capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate reproducible stock from national accounts and then add to it an estimate of the value of land and natural resources stock.</td>
<td>Estimate only the reproducible capital stock and subtract from the numerator income attributable to non-reproducible capital.</td>
</tr>
</tbody>
</table>

### What we are going to estimate onward

\[
\text{Rate of return to reproducible capital} = \frac{\text{Return to reproducible capital}}{\text{Stock of reproducible capital}}
\]
Return to capital from GDP

- Economic return of capital on domestic investment is the contribution of capital to the economy as a whole (Jenkins and Kuo, 2007):
  - Sum of the private net of tax returns on capital, plus
  - All direct and indirect taxes generated by this capital

**Income approach**

- Compensation of employees
- Gross operating surplus
- Mixed income
- Taxes on products less subsidies

**Challenges**

- Subtract **rents** from income accruing to capital (consistency with scope).
- Identify income accruing to capital of **unincorporated businesses**.
- Allocate share of **indirect taxes accrued to capital**.
How do we estimate income accruing to capital?

Operating surplus (gross of direct taxes)
- Surplus on production activities before account has been taken of the interest, rents or charges

Mixed income (gross of direct taxes)
- Income from self-employment that mixes wages and salaries, and also profits due to work carried out as an entrepreneur
- Share accruing to capital: 1/3 (parameter from the literature)

Indirect taxes – subsidies
- Indirect taxes can be accrued to reproducible capital (e.g. excise taxes on fuel or energy) and to the labour side (e.g. VAT)
- Estimation strategy: \((\text{Tax on products and imports less subsidies and VAT}) \times \frac{\text{Operating surplus + Mixed income \times 1/3}}{(\text{GDP} - \text{tax on products and imports less subsidies})}\)

Rents
- Income receivable by the owner of a natural resource (land or subsoil resources) for putting the natural resource at the disposal of another institutional unit
From national accounts data to the stock of capital?

The Perpetual Inventory Method (PIM)

• Commonly used method to estimate capital
• The stock of capital is the accumulation of the stream of past investments

\[ K_t = K_{t-1} + I_t - D_t \]

Where:
- The net capital stock at the end of the previous period \( t-1 \): \( K_{t-1} \)
- Gross investment in the period: \( I_t \)
- Consumption of fixed capital: \( D_t = \delta K_{t-1} \)

\[ K_t = (1 - \delta)^t K_0 + \sum_{i=0}^{t-1} (1 - \delta)^i I_{t-i} \]
How do we estimate the stock of capital?

Scope of the capital: Fixed assets + inventories

<table>
<thead>
<tr>
<th>Components</th>
<th>Fixed assets</th>
<th>Inventories</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_t$</td>
<td>Gross fixed capital formation</td>
<td>Changes in inventories</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Two types:</td>
<td>Not necessary</td>
</tr>
<tr>
<td></td>
<td>o Construction: 2.5%</td>
<td><em>(Data given as net changes)</em></td>
</tr>
<tr>
<td></td>
<td>o Machinery &amp; equipment: 8%</td>
<td></td>
</tr>
<tr>
<td>$K_0$</td>
<td>$K_0 = \frac{I_1}{(g_{K1} + \delta)}$</td>
<td>$K_0 = \frac{\text{Marginal inventory}}{GDP} \times GDP_0$</td>
</tr>
<tr>
<td></td>
<td><em>(g_{K1}: Capital growth rate)</em></td>
<td>o Assume <em>marginal = average</em> inventory/GDP ratio</td>
</tr>
<tr>
<td></td>
<td>o Assume the capital grows at the same rate as GDP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Three years average for $I_1, g_{K1}$ to reduce random variation</td>
<td></td>
</tr>
</tbody>
</table>
From whole economy to public and private sectors

\[
\text{Rate of return to reproducible capital} = \frac{\text{Return to reproducible capital}}{\text{Stock of reproducible capital}}
\]

Whole economy

Public sector

Private sector
How do we derive public and private rates?

Public sector

- **Same methodology** used for the rate for the economy as a whole but:
  - **Income accruing to capital:**
    - No breakdown of data of indirect taxes by sector
    ⇒ Assumed the share of indirect taxes and subsidies should be equal to the proportion of the operating surplus of the public sector with respect to the whole economy
  - **Stock of capital:**
    - No breakdown fixed investment by asset type
    ⇒ Assumed the asset composition for public sector should be equal to the economy as a whole

Private sector

- **“Residual approach”**: Income accruing to capital and stock of capital calculated as difference between the estimates for the economy as a whole and the estimates for the public sector
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- What can we learn from the application of our methodology to a sample of four EU countries?
Selection of countries for our application

1. **HIGH GDP PER CAPITA**
   - **Germany**
     - GDP: € 3 trillion
     - GDP per capita (PPS): 124
     - Debt/GDP: 71.2%
     - Manufacturing/GDP: 20.5%
     - Region: Western

2. **HIGH GDP**
   - **Finland**
     - GDP: € 209 billion
     - GDP per capita (PPS): 109
     - Debt/GDP: 63.6%
     - Manufacturing/GDP: 14.6%
     - Region: Northern

3. **MED GDP PER CAPITA**
   - **Czech Republic**
     - GDP: € 167 billion
     - GDP per capita (PPS): 87
     - Debt/GDP: 40.3%
     - Manufacturing/GDP: 24.3%
     - Region: Eastern

4. **LOW GDP**
   - **Greece**
     - GDP: € 176 billion
     - GDP per capita (PPS): 68
     - Debt/GDP: 177.4%
     - Manufacturing/GDP: 8.4%
     - Region: Southern

*PPS = Purchasing Power Standard, where 100 = Average of 28 EU countries
What we can learn from our application results: Whole economy

<table>
<thead>
<tr>
<th>Country</th>
<th>Results</th>
<th>Whole economy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2013</td>
<td>2014</td>
</tr>
<tr>
<td>Germany</td>
<td>9.04%</td>
<td>9.10%</td>
</tr>
<tr>
<td>Finland</td>
<td>8.32%</td>
<td>8.31%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>9.73%</td>
<td>10.15%</td>
</tr>
<tr>
<td>Greece</td>
<td>9.03%</td>
<td>8.92%</td>
</tr>
</tbody>
</table>

- The range of the rates among the four countries is **8.3-10.5% for whole economy**.
- The rates for each of the countries are relatively stable in the three-year period.
- For the two countries where we have partially comparable benchmark values* (Germany: 8.3%, Finland: 7.1%), the figures that we found are generally in line with these values.

What we can learn from our application results: Public and private sector

<table>
<thead>
<tr>
<th>Country</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public sector</td>
</tr>
<tr>
<td>Germany</td>
<td>4.99%</td>
</tr>
<tr>
<td>Finland</td>
<td>6.10%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>7.63%</td>
</tr>
<tr>
<td>Greece</td>
<td>3.92%</td>
</tr>
</tbody>
</table>

- The rate for the private sector is always higher than the rate for the public sector, and in some cases the difference can be very large.
Sensitivity analysis for depreciation and mixed income

In the extreme cases for depreciation and mixed income, the range of the rates among the four countries is 7.3 – 11.6%.

| Country          | Main results | Sensitivity rest |  |  |
|------------------|--------------|------------------|  |  |
|                  | Base case    | Depreciation rate| Mixed income to capital |  |  |
|                  |              | Lower case      | Higher case     | Lower case | Higher case |  |  |
| Germany          | 9.17%        | 7.76%           | 10.56%          | 8.42%      | 9.54%      |  |  |
| Finland          | 8.38%        | 7.45%           | 9.28%           | 8.00%      | 8.58%      |  |  |
| Czech Republic   | 10.45%       | 9.22%           | 11.62%          | 9.61%      | 10.86%     |  |  |
| Greece           | 8.94%        | 7.99%           | 9.87%           | 7.28%      | 9.77%      |  |  |

* The results denote the rate of return to capital for total economy in 2015
What are the main findings and areas for further research?
Key messages

Our project is based on publicly available national accounts data.

Estimates are consistent with expectations and benchmarks.

Methodology is robust based on the results of our application.
Areas for further research and consideration

Scope

- Explore the possibility of incorporating non-reproducible capital in the definition of the RRC

Public sector

- Go beyond national accounts to capture more accurately the return of the public investment

RRC and SDR

- The use of the RRC in the context of social cost-benefit analysis may lead to the application of higher discount rate, with implications for project appraisal
Our value added

- Rigorous methodology
  - Built on a critical analysis of the literature

- Single approach
  - Directly applicable to all the EU countries, both for private and public sectors

- Practical solution
  - Excel-based tool that is user-friendly, flexible and easy to update in the future
Thank you!