Financial evaluation of urban investment

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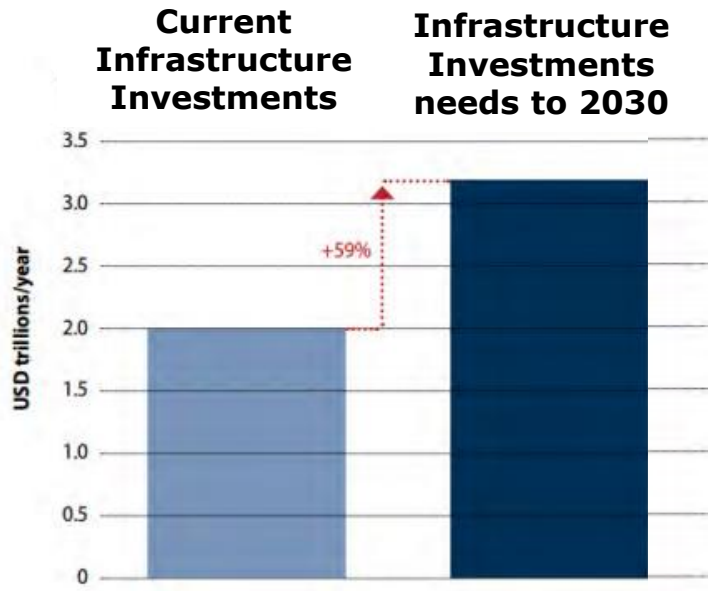
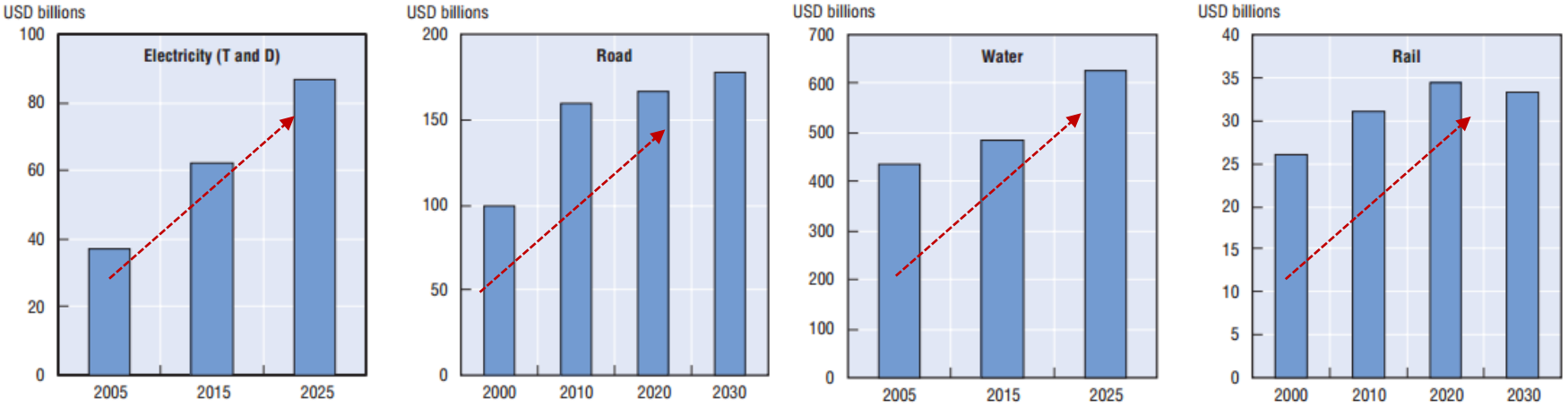
Context



"Approximately USD 2 trillion is currently invested annually in infrastructure (transport, energy and water). An additional USD 1.2 trillion is estimated to be required annually to meet global infrastructure needs to 2030."

Source: OECD (2014), *Update on the OECD's Work on Climate Finance and Investment*. Figure based on Kennedy and Corfee-Morlot (2012 and 2013), McKinsey Global Institute (2013), WEF (2012).

Average annual infrastructure investment requirements in OECD countries to 2025/30 In billions USD



Source: OECD (2007), *Infrastructure to 2030: Telecom, Land Transport, Water and Electricity*, OECD Publishing

Context

In the wake of the **financial crisis**, local government have been dealing with reductions in their public finances.

The **limited availability** of projects supply has sharply **affected local investment** in development and infrastructure activity, aggravating the **infrastructure financing gap.**

Institutional Investors such as pension funds may therefore play an active role in bridging the infrastructure gap*.

* OECD (2011), Pension funds investment in infrastructure. A survey. OECD Publishing

Context

To **attract and foster private sector participation** local authorities need to prove the **financial feasibility** of urban projects.

Financial evaluation of investment: literature review

Existing research examines the frequency of appraisal methods used by private investors to decide weather an investment is **financially feasible.**

Results show:

- Preference for

  - ✓ **Internal Rate of Return (IRR)**
  - ✓ **Net Present Value (NPV)**
  - ✓ **Payback Period (PB)**

Capital Budgeting Tool (level of technical difficulty, L=Low, M=Medium, H=High)*	Size of Capital Budget (in millions)	Always (100%)
Net Present Value (NPV) * (L)**	Less than $100	32.9%
	$100 - $499.9	56.0%
	Greater than $500	67.3%
	Full Sample	**49.8%**
Internal Rate of Return (IRR) **(L)	Less than $100	30.3%
	$100 - $499.9	49.3%
	Greater than $500	60.0%
	Full Sample	**44.6%**
Payback ** (L)	Less than $100	26.0%
	$100 - $499.9	14.1%
	Greater than $500	17.0%
	Full Sample	**19.4%**
Discounted Payback (L)	Less than $100	17.6%
	$100 - $499.9	11.3%
	Greater than $500	18.8%
	Full Sample	**15.5%**
Profitability Index* (L)	Less than $100	2.8%
	$100 - $499.9	11.4%
	Greater than $500	2.3%

Ryan and Ryan "*Capital budgeting practices of the fortune 1000: how have things changed?",* Journal of business and management, 2002.

Financial evaluation of investment: literature review

- Trend of using more than one methods in recent years.
- Use of **more than one method** in relation to the availability of financial expertise within the private investor.

	Small %	*Medium* %	*Large* %
No method	3	–	–
Single method			
Payback	3	–	–
ARR	–	–	–
IRR	6	–	–
NPV	–	4	8
Two methods			
Payback + ARR	3	4	–
Payback + IRR	3	4	3
Payback + NPV	3	4	–
ARR + IRR	9	8	–
ARR + NPV	3	4	3
IRR + NPV	9	4	11
Three methods			
Payback + ARR + IRR	12	4	–
Payback + ARR + NPV	9	–	5
Payback + IRR + NPV	12	33	24
ARR + IRR + NPV	–	4	13

Arnold and Hatzopoulos "*The theory-practice gap in capital budgeting: evidence from the United Kingdom*", Journal of business finance & accounting, 27(5) and (6), 2000.

Financial evaluation of investment: Literature review

- Attempt of creating an **aggregation** of different capital budgeting techniques.

Aggregation function: $Z_i = F(B_{i1}, B_{i2}, \ldots, B_{im}, w_1, w_2, \ldots, w_m)$, $i=1, \ldots, n$; $j=1, \ldots, m$;

where: Z_i – fuzzy set determined at interval $\langle 0, 1 \rangle$,
F – aggregation function, in particular cases linear function,
n – number of variants of the investments planned,
m – number of criteria assumed for the evaluation of individual variants.

Lapunka and Pisz "*Multi criterion efficiency evaluation of investment projects performed in uncertainty conditions*".

Objectives

1) How are urban investments financially evaluated?

2) Is a **financial index** an effective tool to assess the financial feasibility of **urban projects**?

Analysis of an example of Financial Index

In order to address our objectives, we analyse the performance of an ideal **Financial Index** created trough the **linear aggregation of the most three used capital budget techniques** opportunely converted in indices (unitary order of magnitude) in order to be summed.

$$\mathrm{FI} = \boldsymbol{\alpha} * \mathit{IRR\ Index} + \boldsymbol{\beta} * \mathrm{NPV}\ \mathit{Index} + \boldsymbol{\gamma} * \mathrm{Payback}\ \mathit{index}$$

Analysis of an example of Financial Index

$$\text{FI} = \boldsymbol{\alpha} * \textit{IRR Index} + \boldsymbol{\beta} * \text{NPV } \textit{Index} + \boldsymbol{\gamma} * \text{Payback } \textit{index}$$

Who decides the **weights**? Might they be too **arbitrary**? Do they show the **preferences** of private investors?

Analysis of an example of Financial Index

$$FI = \alpha * IRR\ Index + \beta * NPV\ Index + \gamma * Payback\ index$$

Does a **correlation** exist between these elements? Do they provide **similar information**?

If true, does such combined index provide **new information** concerning the decision process or **muddle**?

Analysis of an example of Financial Index

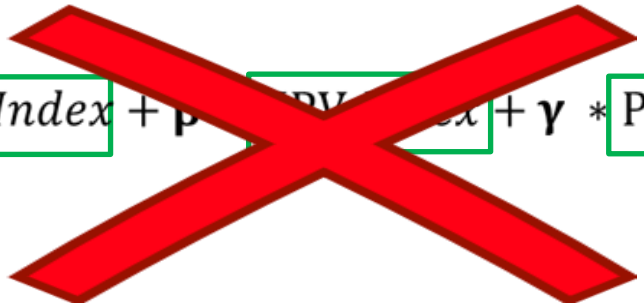
Although in their mathematical formulation IRR and NPV may provide **conflicting** information in certain circumstances, for investments with a **single change of sign** in the cash flows (case of **urban investments**):

⇨

- a **unique IRR** is admitted
- **IRR** and **NPV** always provide a result in **agreement**

Analysis of an example of Financial Index

$$FI = \alpha * IRR\ Index + \beta * NPV\ Index + \gamma * Payback\ index$$



Does a **correlation** exist between these elements? Do they provide **similar information**?

If true, does such combined index provide **new information** concerning the decision process or **muddle**?

New Financial Index for urban investment: Which elements to include in it?

Criteria			Indicators
Structural project characteristics	Financial Mechanisms	Risk	
Length			Economic Life of the project
Size			Capex
Size	Use of EU Grants and/or National Public Contribution		Initial Investment
Revenues			Cash Inflows per year
		Length of time required to recover the cost of the investment	Payback
Sector		Sector	IRR benchmark
		Country	IRR benchmark
		Return	IRR equity , IRR project
	Uses of financial resources (loans and/or private capital)		IRR equity / IRR project

New Financial Index for Urban Investment: Formulation

$$New\,FI = \underbrace{\frac{IRR_{eq} - IRR_{bm}}{IRR_{pr}}}_{I_1} * \underbrace{\frac{EL}{PB}}_{I_2}$$

New Financial Index for Urban Investment: Formulation

$$New\ FI = \underbrace{\frac{IRR_{eq} - IRR_{bm}}{IRR_{pr}}}_{I_1} * \frac{EL}{PB}$$

I_1

I_1: $\frac{IRR_{eq} - IRR_{bm}}{IRR_{pr}}$ $\left[\frac{\% - \%}{\%}\right]$

$\boldsymbol{IRR_{eq}}$ = IRR of **equity** or *levered* IRR

$\boldsymbol{IRR_{bm}}$ = IRR **benchmark** or minimum acceptable IRR for private investors

$\boldsymbol{IRR_{pr}}$ = IRR of the **project** or *unlevered* IRR

New Financial Index for Urban Investment: Formulation

$$New\ FI = \underbrace{\frac{IRR_{eq} - IRR_{bm}}{IRR_{pr}}}_{I_1} * \frac{EL}{PB}$$

If $IRR_{eq} \neq IRR_{pr}$, levered:

$$I_1 = \frac{IRR_{eq}}{IRR_{pr}} - \frac{IRR_{bm}}{IRR_{pr}}$$

$I_1 < 0$ If $IRR_{eq} < IRR_{bm}$

$I_1 = 0$ If $IRR_{eq} = IRR_{bm}$

$I_1 > 0$ If $IRR_{eq} > IRR_{bm}$ **financially feasible**

New Financial Index for Urban Investment: Formulation

$$New\,FI = \underbrace{\frac{IRR_{eq} - IRR_{bm}}{IRR_{pr}}}_{I_1} * \frac{EL}{PB}$$

If $IRR_{eq} = IRR_{pr}$:

$$I_1 = 1 - \frac{IRR_{bm}}{IRR_{eq}} \begin{cases} I_1 < 0 & \text{If } IRR_{eq} < IRR_{bm} \\ I_1 = 0 & \text{If } IRR_{eq} = IRR_{bm} \\ 0 < I_1 < 1 & \text{If } IRR_{eq} > IRR_{bm} \end{cases}$$

New Financial Index for Urban Investment: Formulation

$$New\ FI = \frac{IRR_{eq} - IRR_{bm}}{IRR_{pr}} * \frac{EL}{PB}$$

I2

Weight

I2: $$\frac{EL}{PB} = \frac{EL}{S} * \text{Rev} \quad \left[\frac{ys}{£} * \frac{£}{ys}\right] \qquad I2 > 1$$

$\boldsymbol{EL}$ = Economic Life of the project

$\boldsymbol{S}$ = Size of the Investment = Initial Investment − Grants

$\boldsymbol{Rev}$ = Cash Inflows per period

Data

Data is collected from six projects carried out under the JESSICA Initiative launched by the European Investment Bank.

	Project Name	Sector	Data
	Project 1 – Energy savings	ENERGY	Economic Life
	Project 2 – Biomass plant	ENERGY	Size of the investment
 	Project 3 – Renewable energy	ENERGY	Operational project cash flows
	Project 4 – Technological Park	IND	Financing cash flows: - private equity - Jessica equity - Commercial loan - Jessica loan
	Project 5 – Business Incubator	EDU	
	Project 6 – Multifunctional building	COM	

New Financial Index for Urban Investment: Results

	IRR eq	IRR bm	IRR pr	EL	S	Rev	New FI
Project 1	12,37%	8,00%	8,14%	15	503.226	41.801	0,67
Project 2	17.95%	10.00%	12.72%	11	3,528	1,073	2.09
Project 3	29.66%	10.00%	18.25%	20	18,438,287	3,997,809	4.67
Project 4	4.19%	10.00%	7.17%	20	10,137,021	926,046	- 1.48
Project 5	3.77%	8.00%	7.31%	20	2,531,022	375,713	- 1.72
Project 6	20.97%	10.00%	18.69%	20	143,360,161	43,384,230	3.55

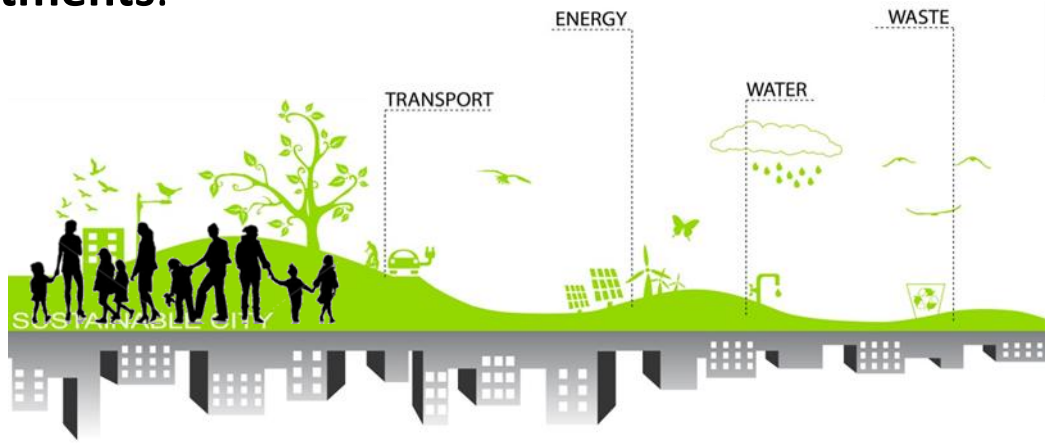
New Financial Index for Urban Investment: Results

	IRR eq	IRR bm	IRR p	EL	S_Capex	S_Grant	Rev	PB	New FI
Project 1	12,37%	8,00%	8,14%	15	1.103.226	600.000	41.801	12	0,67
Project 2	17.95%	10.00%	12.72%	11	5,028	1,500	1,073	3	2.09
Project 3	29.66%	10.00%	18.25%	20	30,638,287	12,200,000	3,997,809	5	4.67
Project 4	4.19%	10.00%	7.17%	20	0,137,021		926,046	11	- 1.48
Project 5	3.77%	8.00%	7.31%	20	5,062,043	2,531,022	375,713	7	- 1.72
Project 6	20.97%	10.00%	18.69%	20	143,360,161		43,384,230	3	3.55

Conclusions

- The **new financial index** captures comprehensively the multidimensional financing issues of **urban investments** and therefore provides additional **useful information on the financial evaluation process.**

- The identified variables included in the construction of such an index make it a useful decisional tool for local authorities for **attracting private sector interest in urban investments**.



Thank you very much for your attention.

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