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Commercial Buildings Capital Consumption and the U.S. National Accounts

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RER Study: Commercial Buildings Capital Consumption in the U.S.

Sponsors:

The American Seniors Housing Association; the Building Owners and Managers Association International; the International Council of Shopping Centers; NAIOP, The Commercial Real Estate Development Association; the National Apartment Association; the National Association of Home Builders; the National Association of Real Estate Investment Trusts; the National Association of REALTORS; the National Multifamily Housing Council

With thanks to Data Providers:

Real Capital Analytics Inc.
National Council of Real Estate Investment Fiduciaries
Green Street Advisors

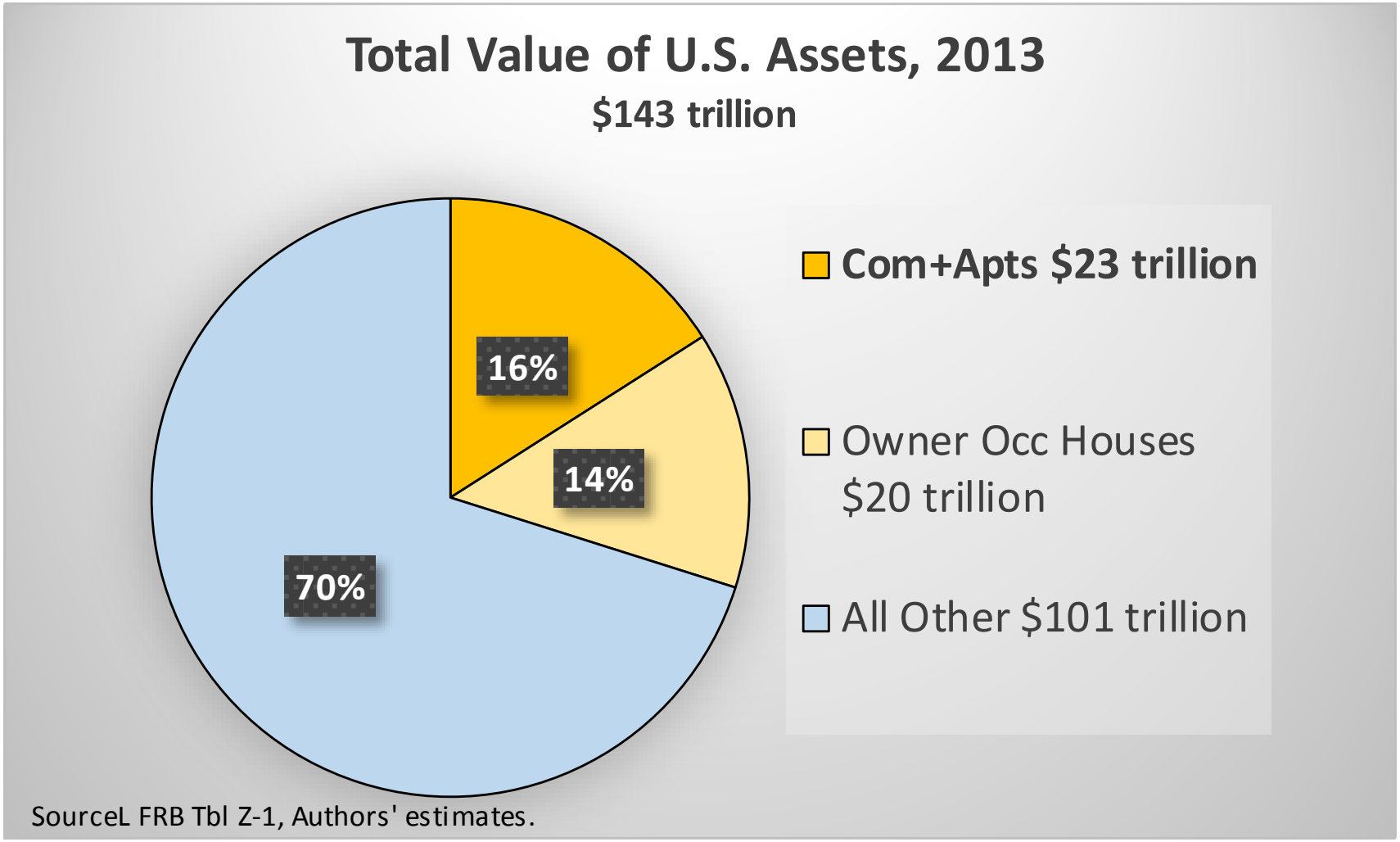
Commercial Buildings Capital Consumption in the U.S.

Capital Consumption

= Gross Depreciation

= Net Depreciation + CapEx

Focus of study: “CRE” (= Com + Apts) is a HUGE asset class…



Contributions of the Study…

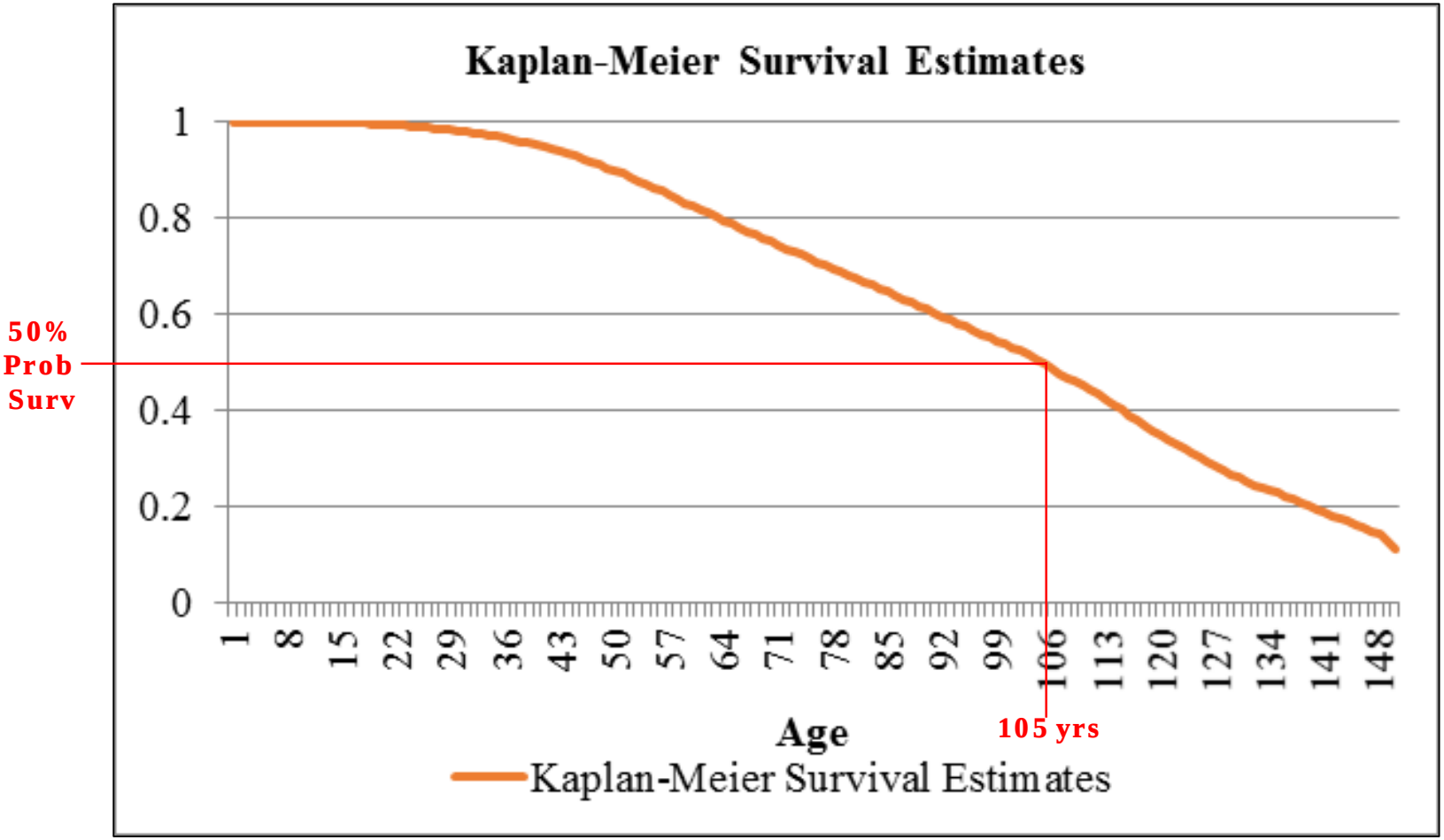
- **UPDATE:** First major study of CRE depreciation since Hulten-Wykoff's 1981 based on 1972 UST survey 8000 subjective observations (not including apartments).

- **LARGER, BETTER SAMPLE:** Based on Real Capital Analytics Inc 2001-2014 data of 120,000 objective transaction prices (including apartments).

- **INCLUDES CAPEX:** First study to include capital improvement expenditures (based on 15,700 NCREIF properties; 1300 Green Street Advisors apartment REIT properties):

Contributions of the Study…

First study with sufficient data to construct empirical based survival probability curve for commercial buildings in U.S. (life expectancy = 100 yrs).



Mean lifetime = 100 yrs; Median lifetime = 105 yrs.

Contributions of the Study…

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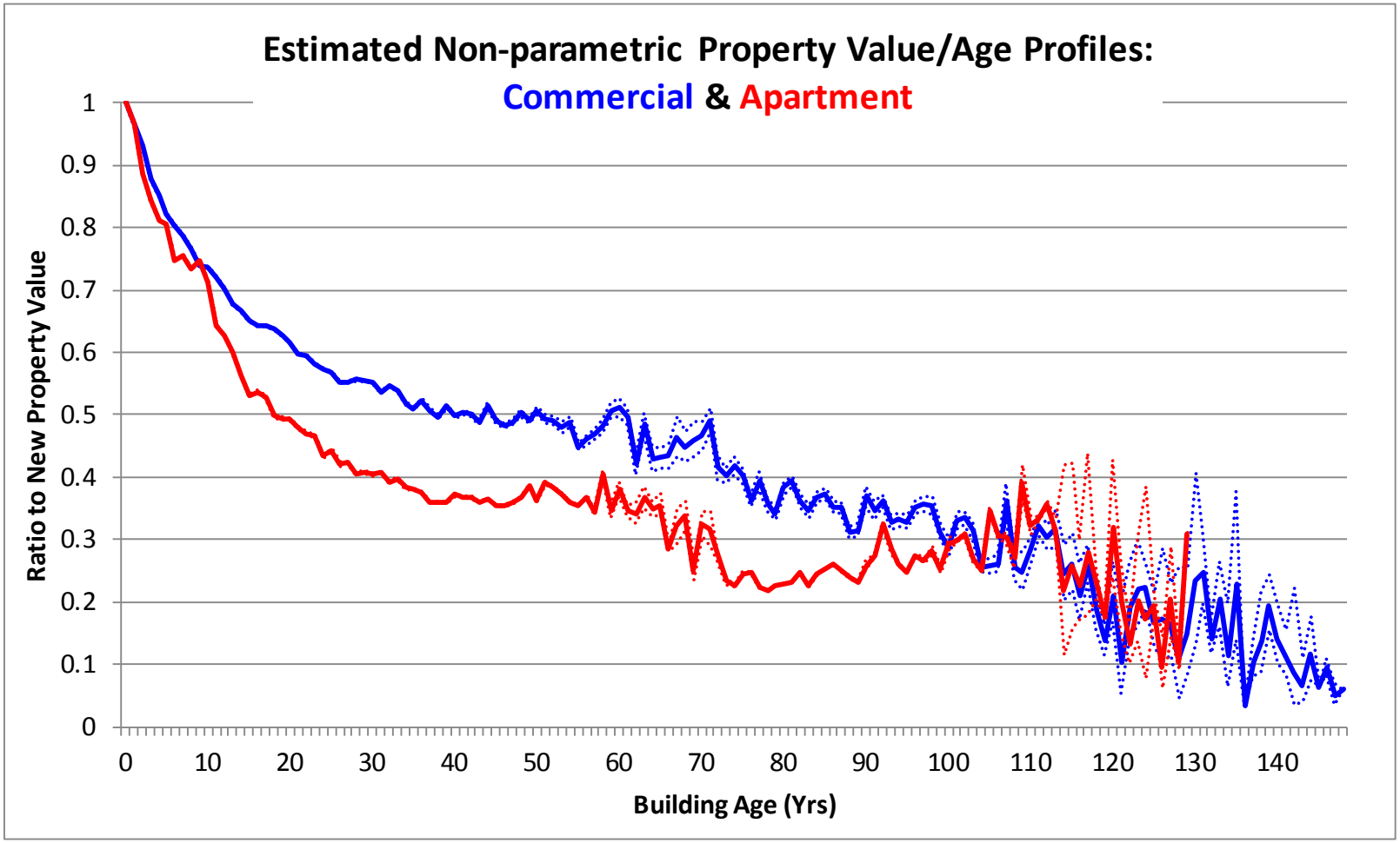
First study with sufficient data to construct non-parametric (fully flexible) **value/age profiles** of commercial properties…



Property price as function of building age. Dotted lines are 95% statistical confidence bounds.

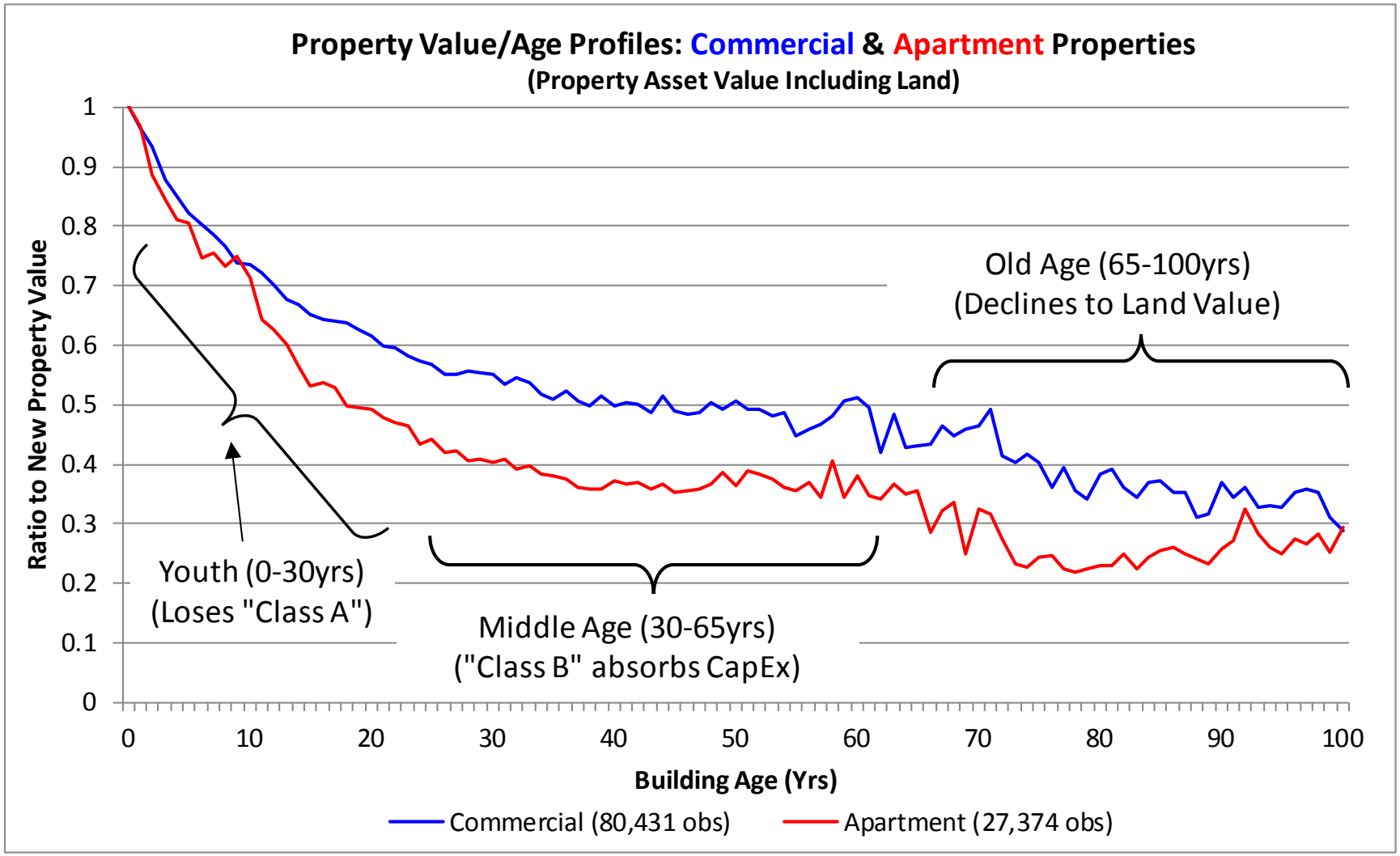
Major Findings of the Study…

- Depreciation is huge: Over ***$700 billion*** per year (4% of GDP).
- Net depreciation is only half the total; CapEx is equal.
- Depreciation varies with building age.
- Net depreciation is ***highly accelerated*** in early phase of building life (< 30 yrs old).
- CapEx is larger in mid-life (30-65 yrs).
- Apartments depreciate a bit faster than non-resi CRE.

Annual Gross Depreciation Rates for 25-year-old Building:				
	Commercial:		Apartment:	
Percent of Value of:	Property	Structure	Property	Structure
Net Depreciation	1.6%	3.1%	2.4%	3.9%
Capex	1.8%	3.5%	2.0%	3.4%
Gross Depreciation	3.4%	6.6%	4.3%	7.3%

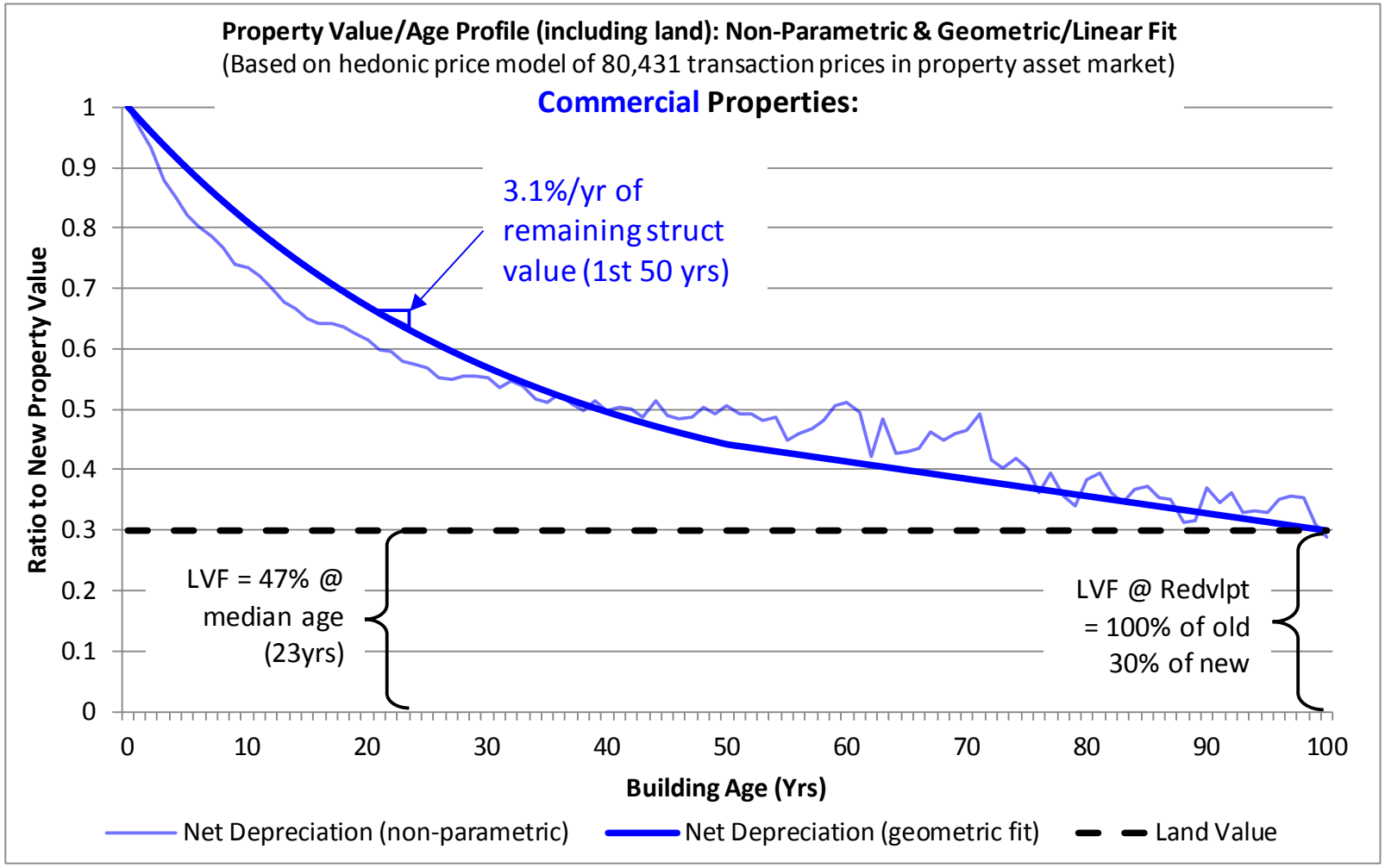
Major Findings of the Study…

- **Buildings are *anthropomorphic*: Three Stages of Life…**



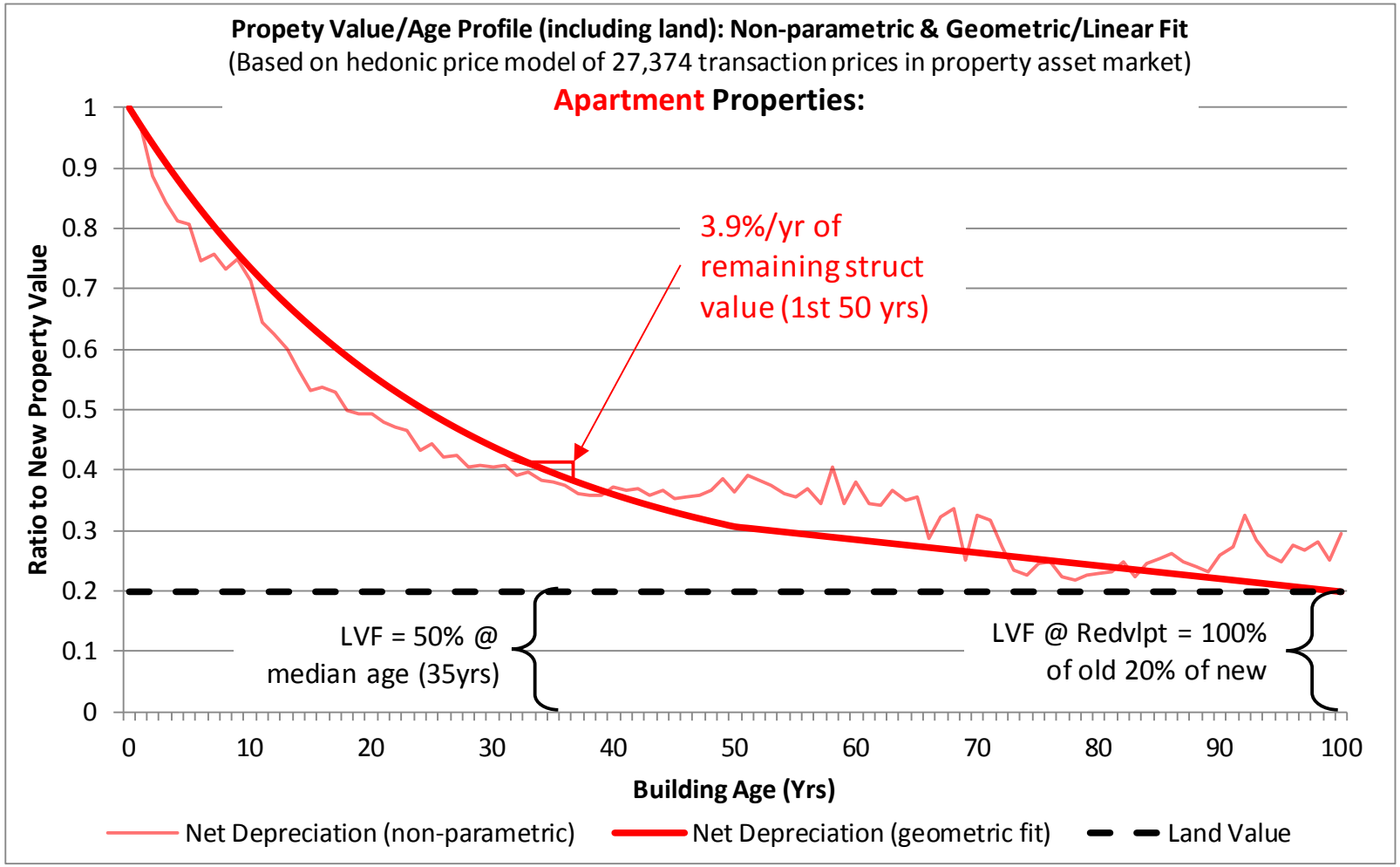
Non-residential Commercial Buildings…

- **Land Value is 30% of Newly Built Property Value,**
- **Land is 47% of median-bldg-age property value (23 yrs).**



Apartment Buildings…

- **Land Value is 20% of Newly Built Property Value,**
- **Land is 50% of median-bldg-age property value (35 yrs).**



Apartment Buildings…

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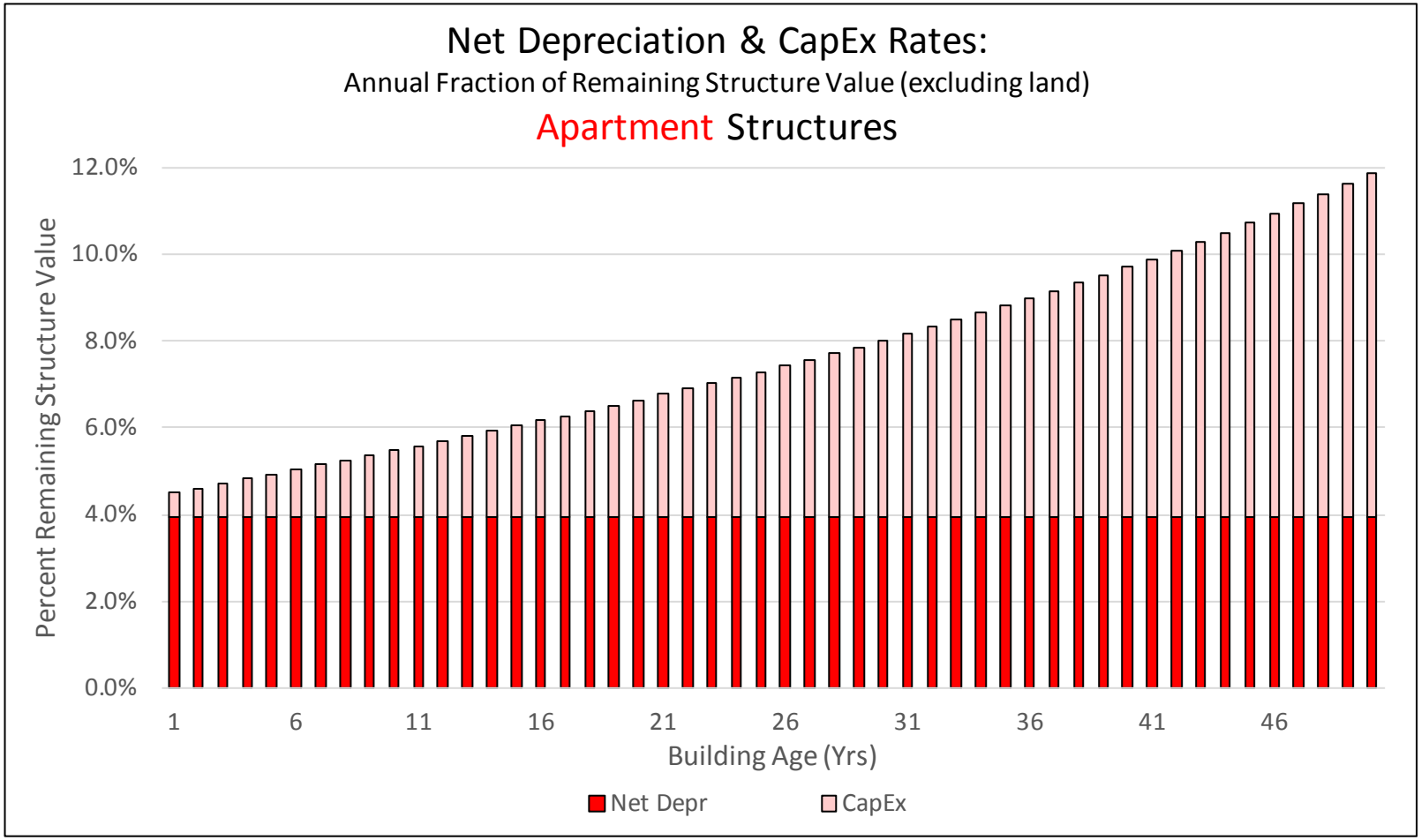
At median age (35 yrs), Net Depr 3.9%/yr, CapEx 4.9%/yr,

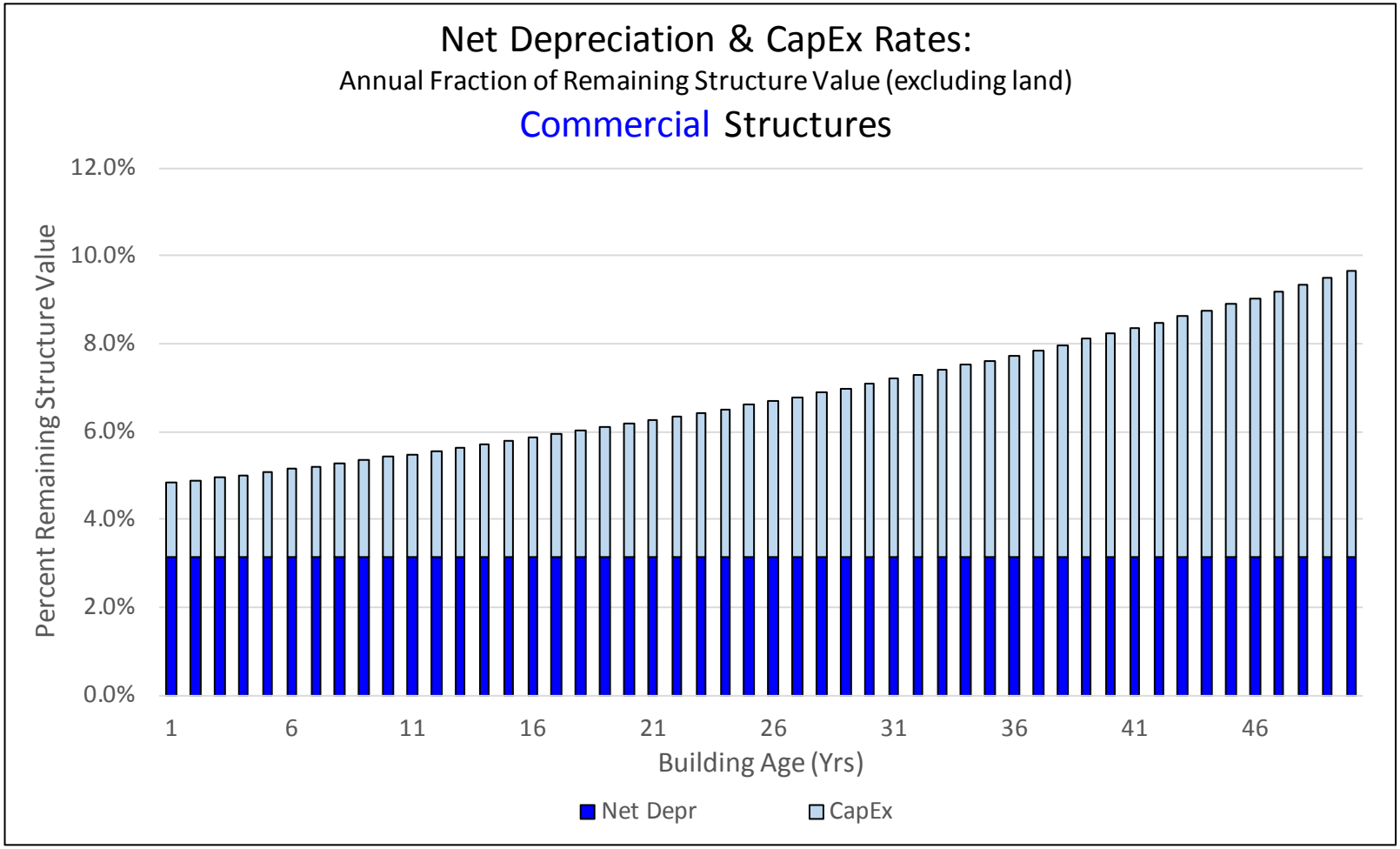
Gross Depr = 8.8%/yr (of remaining structure value)_



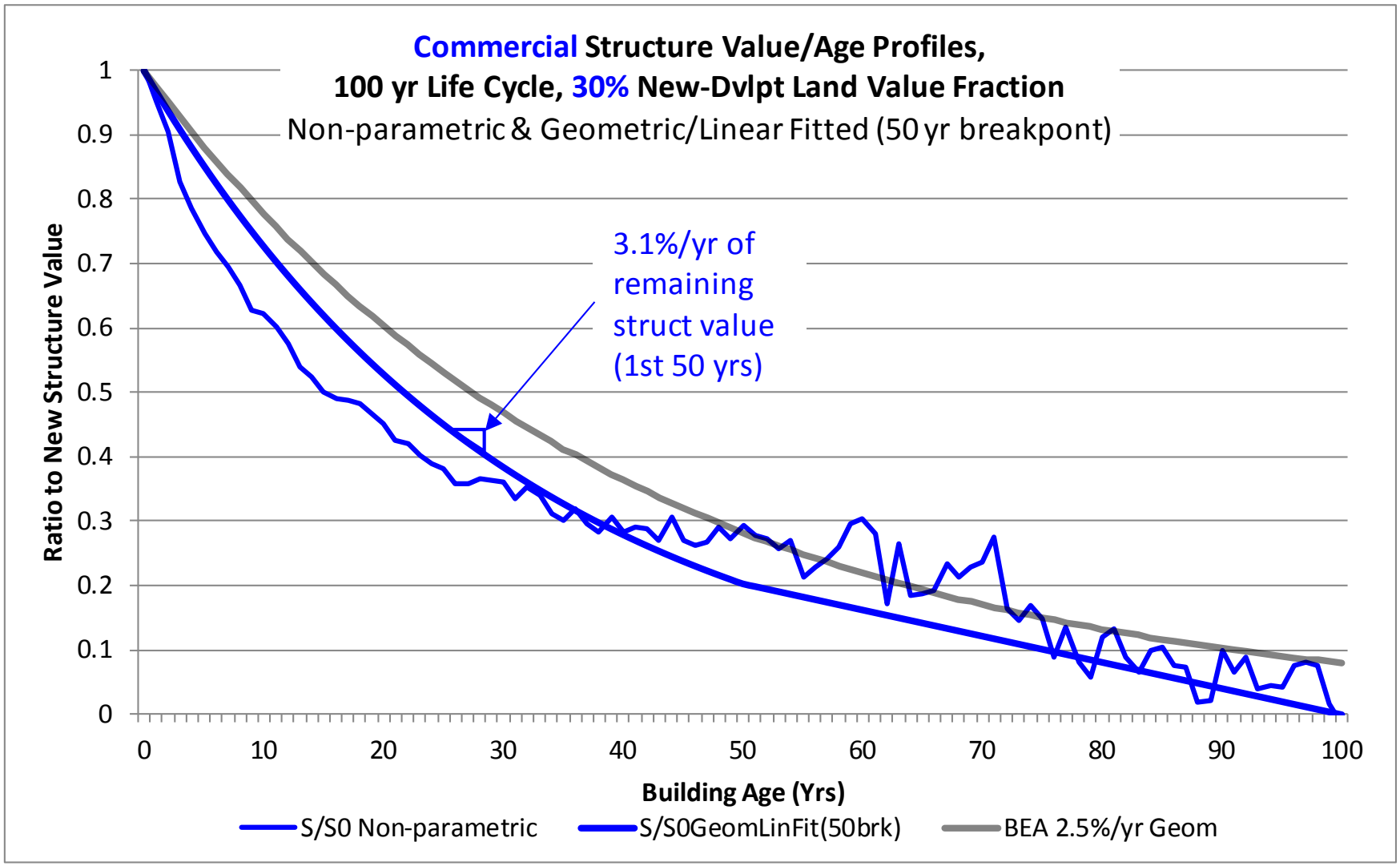
Non-residential Commercial Buildings…

At median age (23 yrs), Net Depr 3.1%/yr, CapEx 3.5%/yr,

Gross Depr = 6.6%/yr (of remaining structure value)

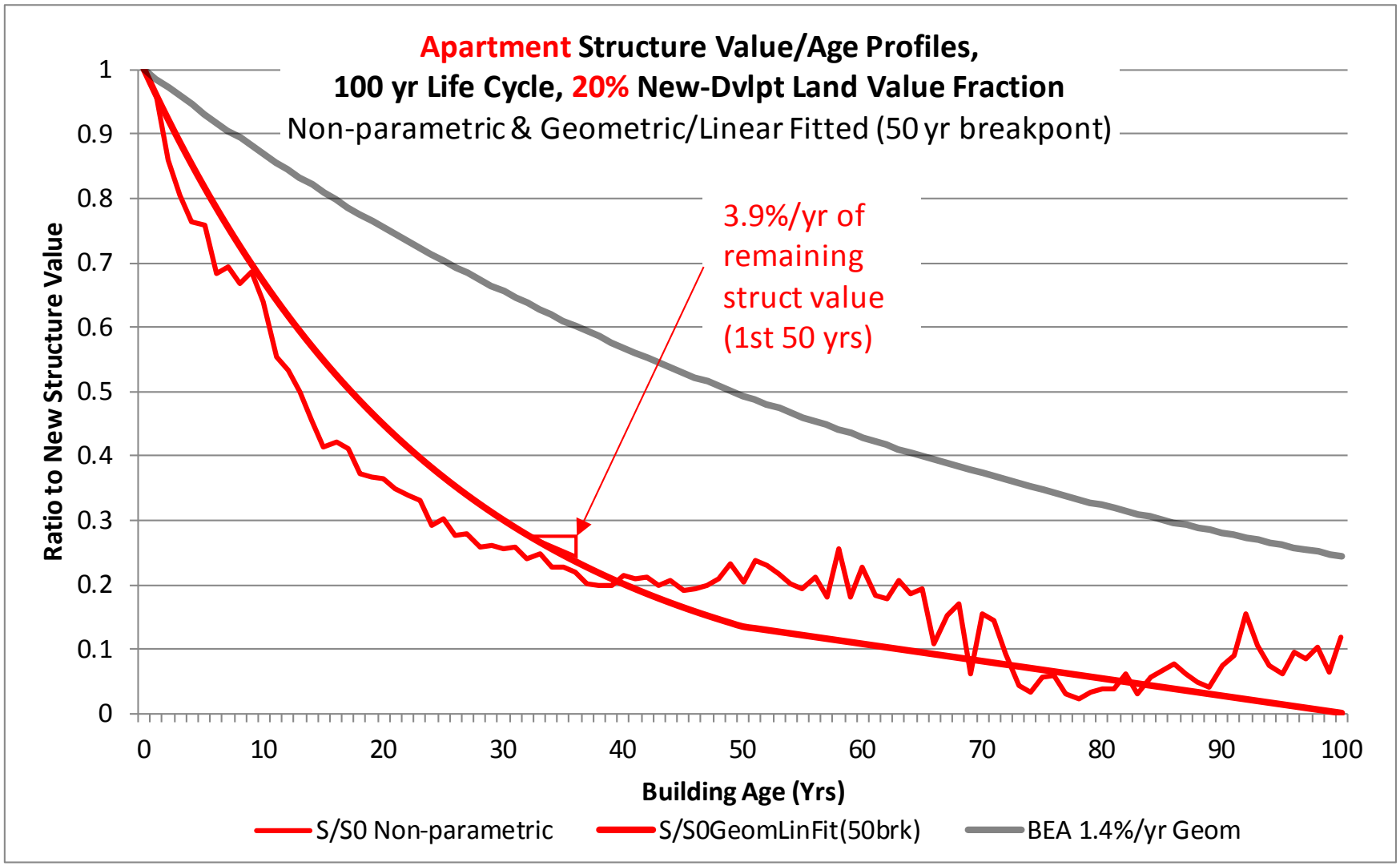


Comparison to BEA Depreciation Assumptions:



25 yrs: BEA -47%, MIT -55% (geom), MIT -62% (non-parametric)

Comparison to BEA Depreciation Assumptions:



25 yrs: BEA -30%, MIT -63% (geom), MIT -70% (non-parametric)

Major Findings of the RER Study…

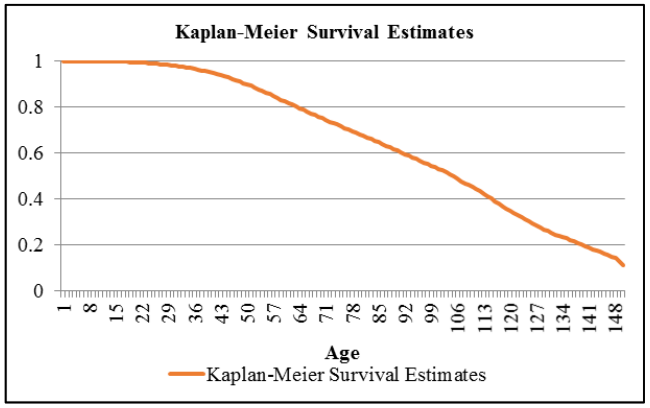
- Depreciation is huge: Over ***$700 billion*** per year (4% of GDP).
- Net depreciation is only half the total; CapEx is equal.
- Depreciation varies with building age.
- Net depreciation is ***highly accelerated*** in early phase of building life (< 30 yrs old).
- CapEx is larger in mid-life (30-65 yrs).
- Apartments depreciate a bit faster than non-resi CRE.
- BEA significantly under-estimating rate of CRE net depreciation.

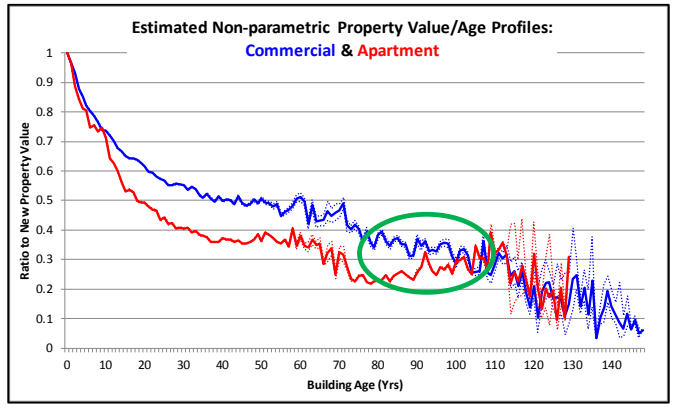
Technical Point: How do we know relevant land value fractions (30% commercial, 20% apartments)? Two ways…

1) Direct evidence from transaction prices of properties bought as "development sites" subsequently sold developed, Ratio of prices:

	Mean NDLVF	N
Apartment	0.18	139
Commercial	0.32	691
Total	0.30	830

2) Survival analysis (ages of buildings @ demolition) life expectancy (100 yrs) combined with remaining property value fraction (30%, 20%) at age where non-parametric (flexible) value/age profile flattens out (80-110 yrs), indicating no further depreciation (just land value):





Follow Up Topic:
A US Commercial Property Land Price Index

Using recent discoveries about depreciation & capex & land values to develop ***land price indices*** for commercial property in the U.S. based on the Residual Value Theory...

In essence:

$$P = L + S$$

$$dP = dL + dS$$

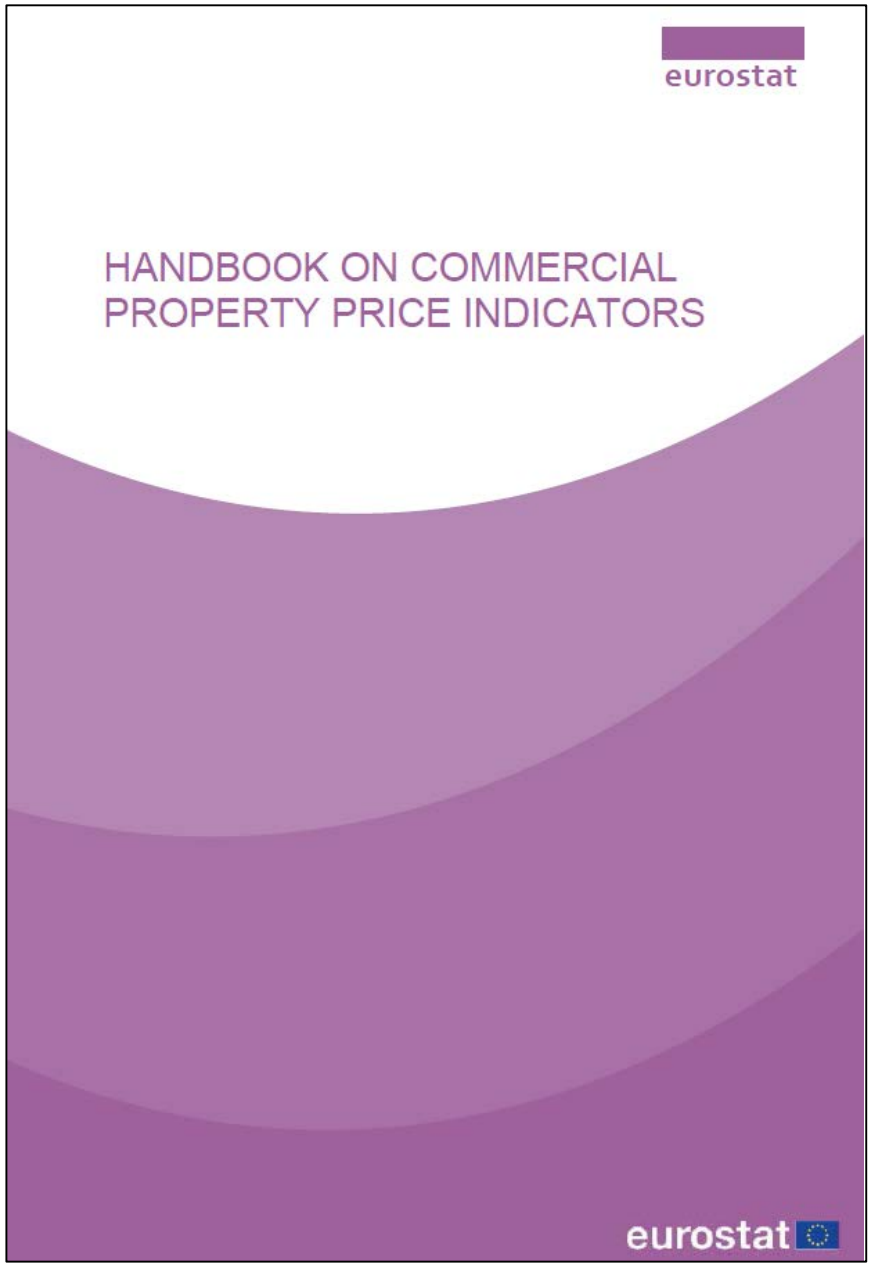
$$dP/P = dL/P + dS/P$$

$$dP/P = (L/P)dL/L + (S/P)dS/S$$

$$dL/L = (dP/P - (S/P)dS/S)/(L/P)$$

$$dL/L = (P/L)dP/P, \text{ if } dS/S=0.$$

Where (P/L) is the "land leverage ratio" (gearing in land val).



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Recently completed project of the U.N. Interagency Working Group on Price Statistics (IAWGPS), instigated by the G-20 Group of countries, to help fill an important "gap" in national economic statistics.

Sponsored by Eurostat, the official international "*Handbook on Commercial Property Price Indicators*" – CPPI – provides an overview and guidelines helpful to official economic statisticians. (It's not just for Europe.)

CPPIs in the National Accounts…

1) Start with Quality-controlled ("same-property") Asset Values: VA_t (unadjusted). Relates to observed values of same actual property at two points in time. Diewert-Shimizu terminology: "Asset Value Price Index (PA)". **Most directly useful CRE Asset Price Index for Financial System Oversight & Investment Industry.**

Together with data on Capital Improvement Expenditures (CE_t) and Depreciation (D_t), provides:

2) Adjusted quality-controlled ("same-property") Asset Values: VA_t adjusted for CE_t and D_t. **Label this index the "CPPI."** Diewert-Shimizu terminology: "Accounting Price Index (P)." **Most useful CRE Asset Price Index for National Accounts.** (Can in principle equally well start with (2) and go to (1) with CE_t & D_t data.)

Together with data on Building Construction Prices ($BCCI_t$) and Land Value Fractions (VL_t/VA_t), provides:

3) Pure Price (Quantity Constant) & Pure Quantity (Price Constant) Entries and Indices for Structures and Land.

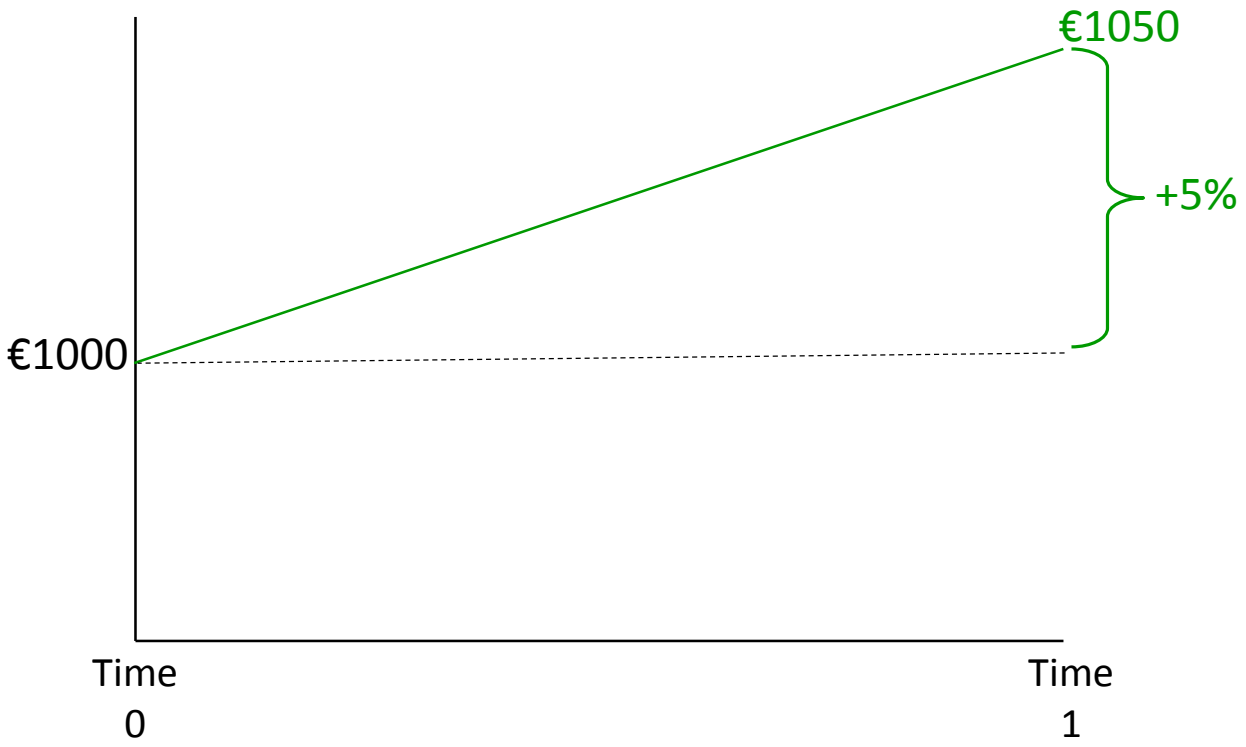
Considerable <u>Flexibility</u> in Type of "Starting Point Index."

See numerical example as follows…

CPPIs in the National Accounts…

Property "A": VA_0 = Asset value at beginning of period = €1000

VA_1 = Asset value at end of period (unadjusted) = €1050



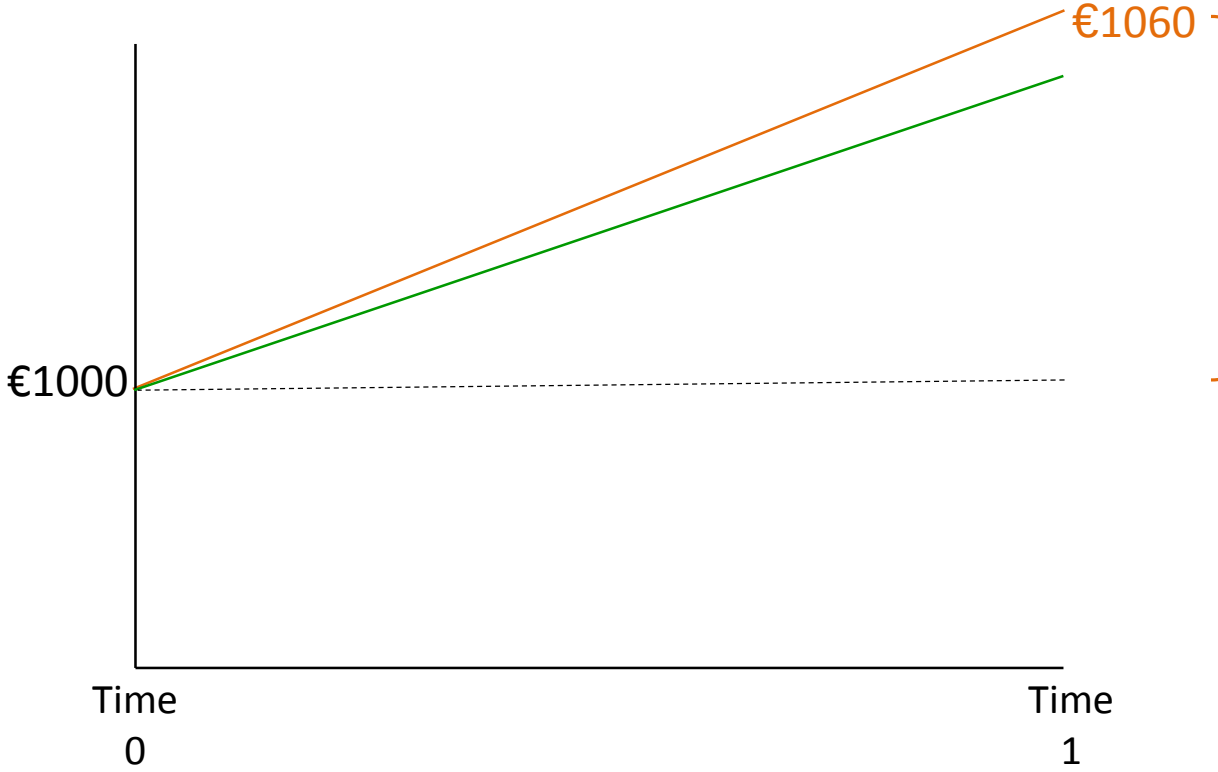
Same-Property Asset Value Change (VA) is the *starting point* :

- Most directly observable empirical metric. Easiest to build a good index.
- Directly reflects the traded good (whole asset), PriceXQuant for Land+Struct.
- Directly relevant & useful for financial oversight (lenders, central bank).
- Directly relevant & useful for investors (what owner experiences).

CPPIs in the National Accounts…

Property "A": Some of the value increase due to CapEx: CE_1= €10.

Some value increase is held down due to structure depreciation: D_1= €20.



1050 VA unadj
-10 CE

1040 VA adj for CE

1040 VA adj for CE
+20 D

1060 VA adj CE&D

"CPPI" is Property Price Index Adjusted for CapEx & Depreciation:

- Asset value (VA) net of CapEx and gross of Depreciation.
- Represents Pure Price Change for Whole Asset Holding Quantity Constant.
- Requires Same-property Price Index (VA unadjusted, "starting point").
- Requires empirical information on Capital Improvement Expenditure (CE).
- Requires empirical information on Structure Depreciation (D).
- Diewert-Shimizu terminology: "Accounting Price Index (P)."

CPPIs in the National Accounts…

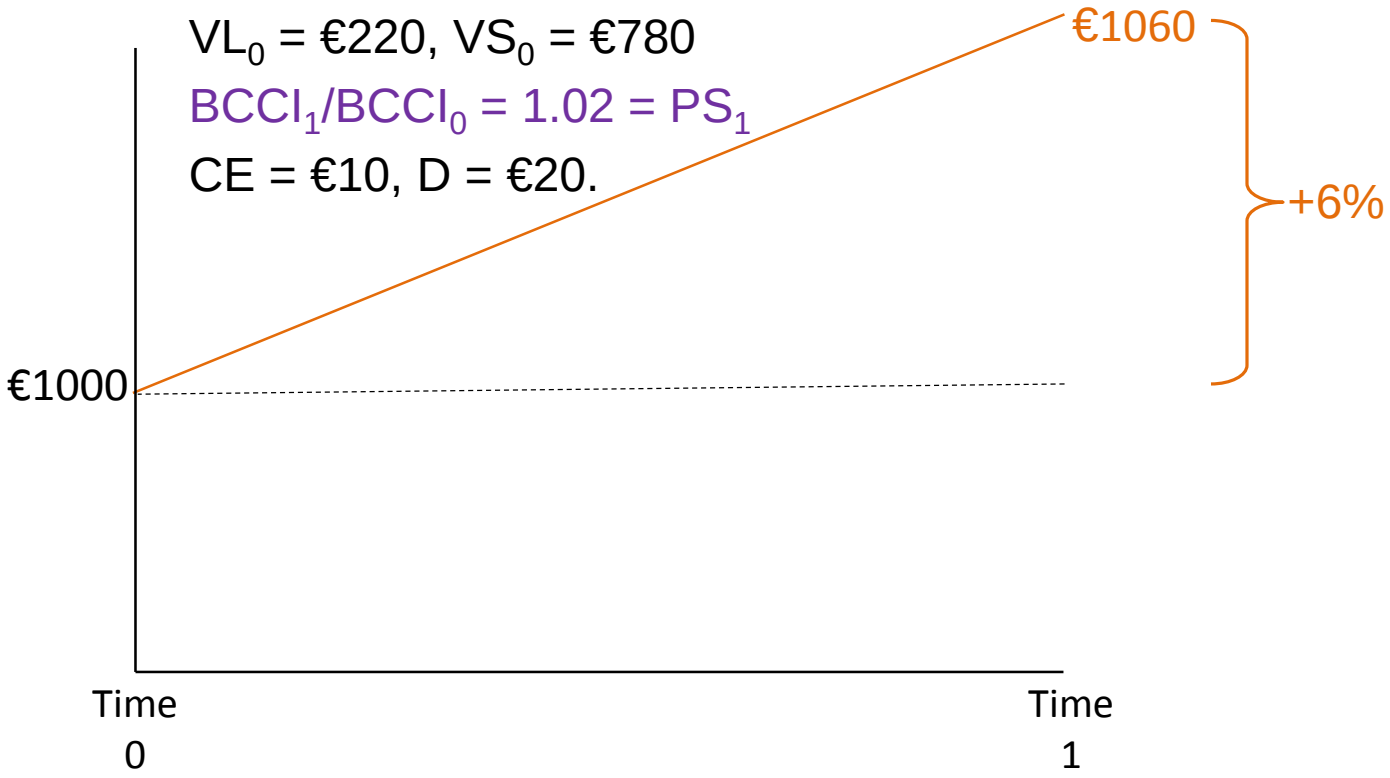
Property "A": VA_0 = Asset value (adjusted) at beginning of period = €1000

VA_1 = Asset value (adjusted) at end of period = €1060

VL_0 = €220, VS_0 = €780

$BCCI_1/BCCI_0 = 1.02 = PS_1$

CE = €10, D = €20.



"CPPI" is Property Price Index Adjusted for CapEx & Depreciation:

- For national accounts, must be broken out into Land & Structure, Price & Quantity components.
- Requires Building Construction Cost Index (BCCI), to track Structure Price (PS).
- Requires Land/Structure Value (VL_0,VS_0) Information at Beginning of Period.
- Easiest and most reliable land/structure value observations when structure is newly constructed (asset first enters accounting books).

CPPIs in the National Accounts…

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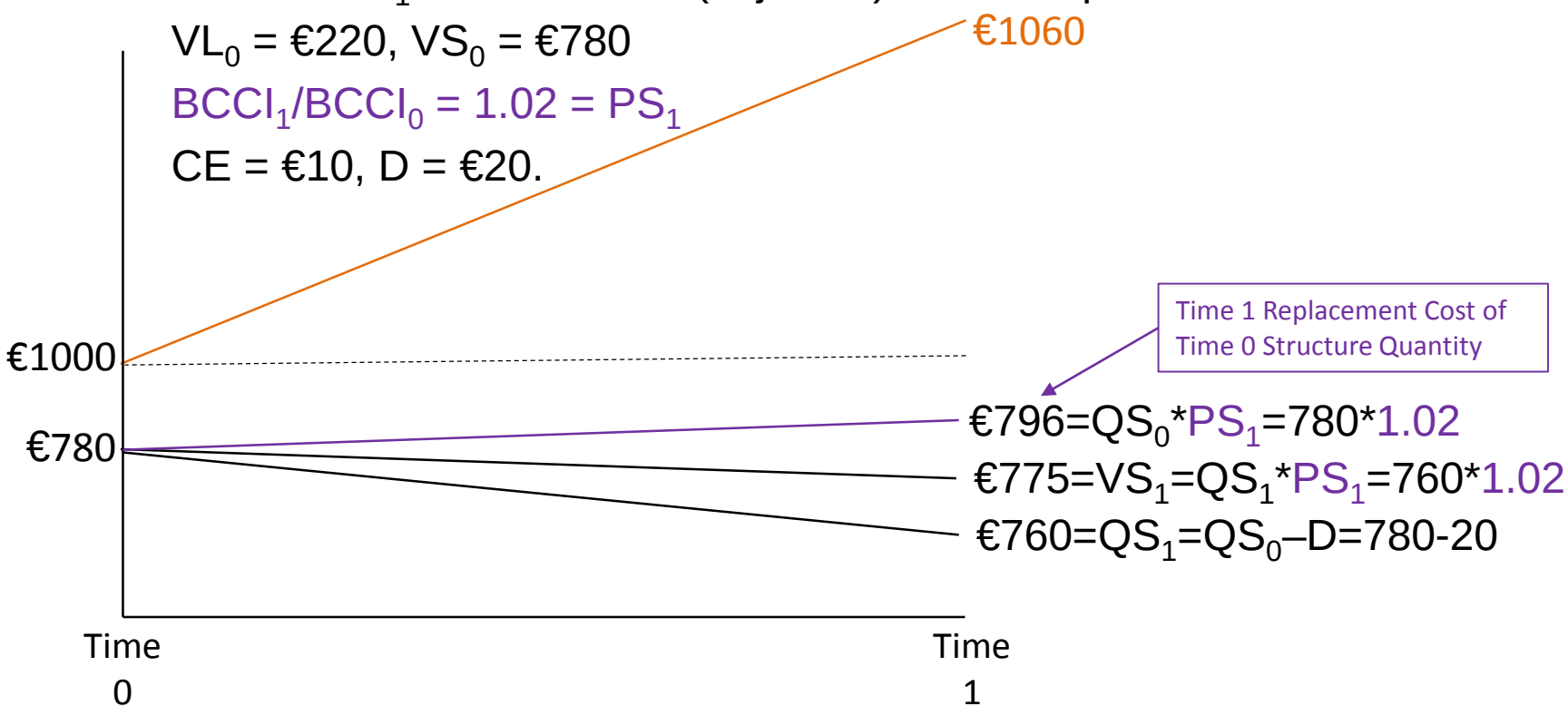

Structure Price Index (BCCI) & Depreciation Info Tracks Structure Value:

- Structure Quantity (QS) Declines with Depreciation (D = €20): 780➔760.
- Structure Price (PS) Changes with BCCI (PS_1=1.02): 780*1.02 = €796.
- Structure Value is Quantity X Price: $VS_1=QS_1*PS_1$=760*1.02 = €775.

CPPIs in the National Accounts…

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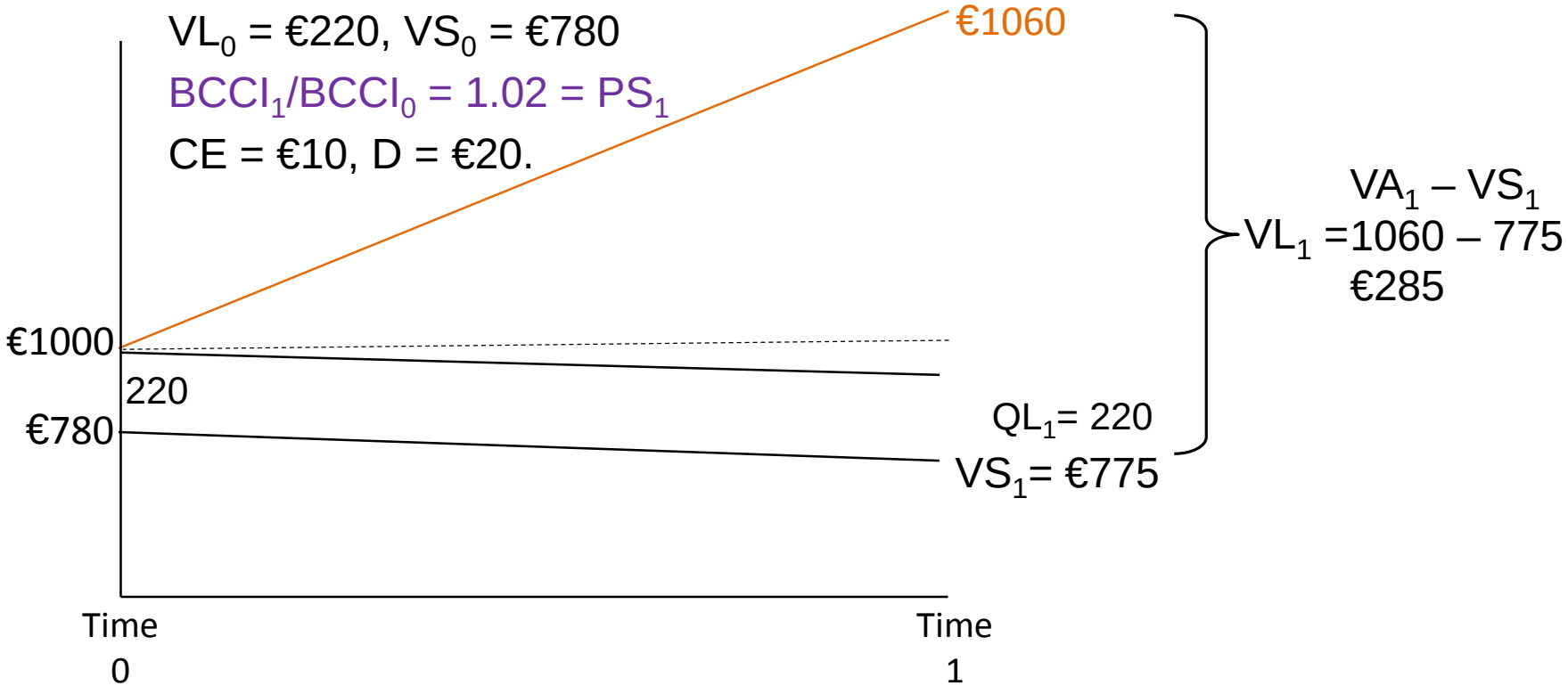
VA_1 = Asset value (adjusted) at end of period = €1060



Land Value Tracked As Residual, Land Quantity Constant:

- Residual Theory of Land Value: $VL_1 = VA_1 - VS_1 = 1060 - 775 = €285$.
- Land Quantity Constant (Natl Acctg: Land neither produced nor consumed):
- $QL_1 = QL_0 = 220$ = Fixed at initial: $VA_0 - VS_0 = 1000 - 780 = 220$

CPPIs in the National Accounts…

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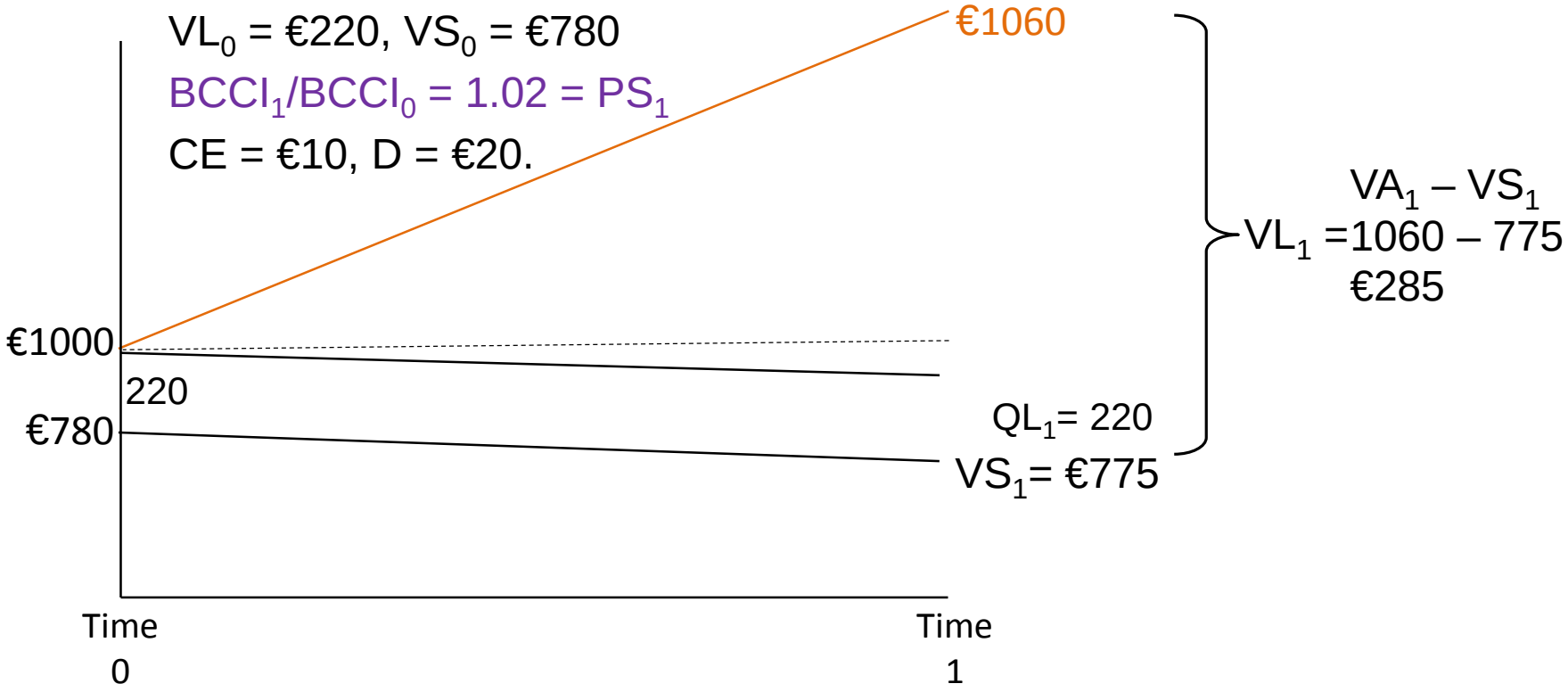
VA_1 = Asset value (adjusted) at end of period = €1060



Land Pure Price Change = Value Change, Since Quantity Constant:

- $PL_1 = VL_1/QL_1 = 285/220 = 1.30$, ➔ $PL_1/PL_0 = 1.30$, ➔ 30% Land Price Growth.
- $VL_1 = QL_1 * PL_1 = 220 * 1.30 = €285$; ← $VL_1 = VA_1 – VS_1 = 1060 – 775 = €285$.
- $VS_1 = QS_1 * PS_1 = 760 * 1.02 = €775$; ➔ 2% Structure Price Growth.
- $VA_1 = VS_1 + VL_1 = 775 + 285 = €1060$; $VA_1/VA_0 = 1.06$, ➔ 6% Asset Price Growth.

CPPIs in the National Accounts…

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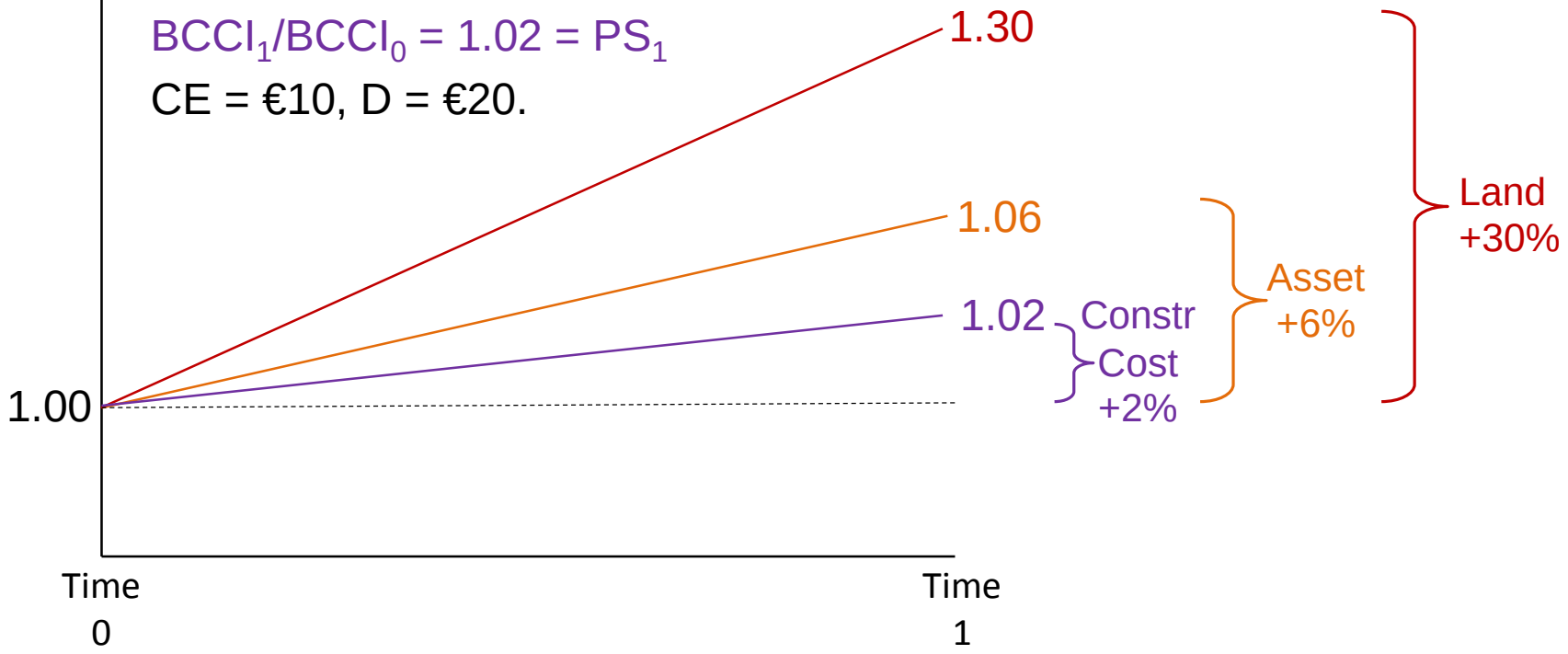


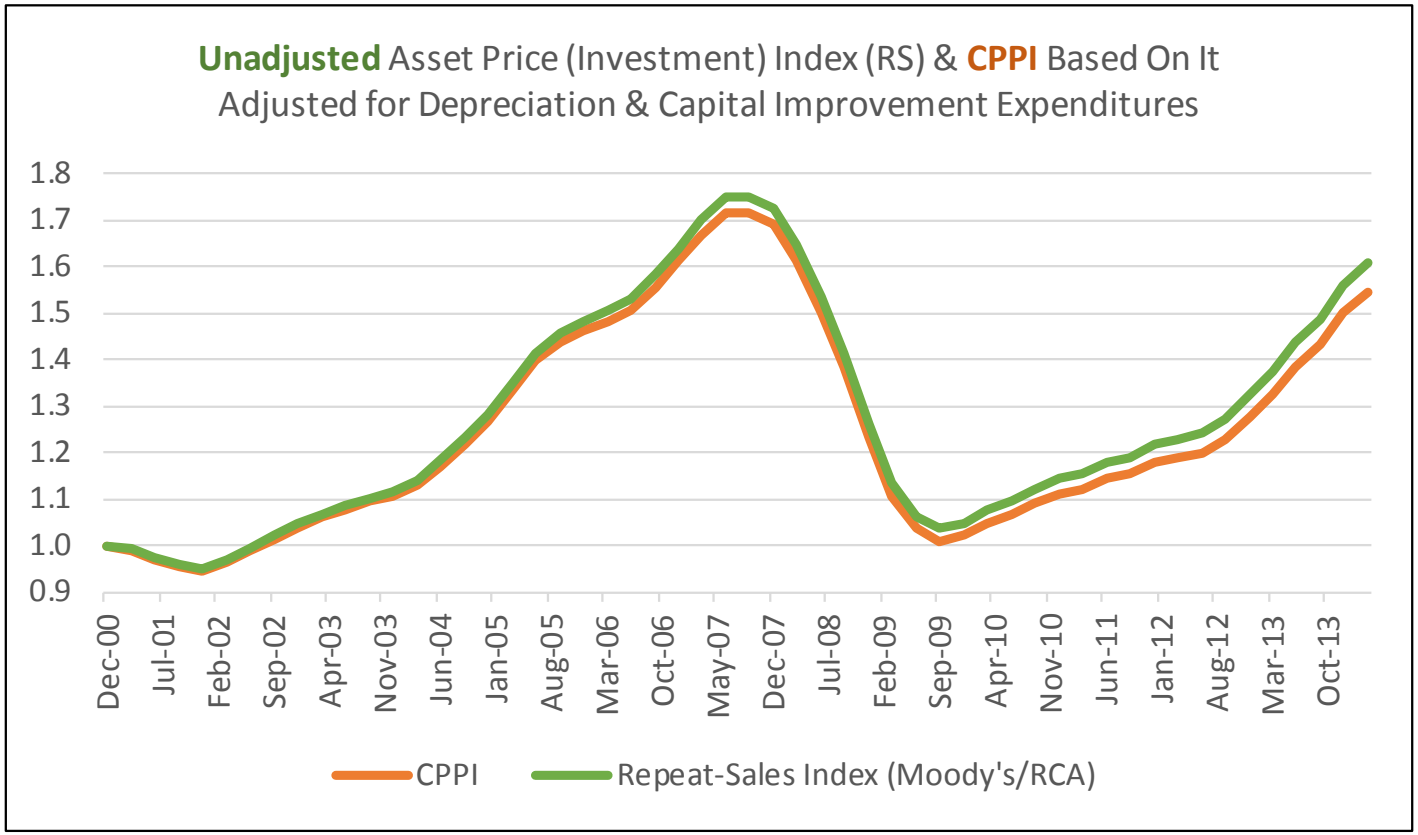
Price Indexing (set to 1.00 in base period):

- Commercial Land Price Index (CLPI, +30%) Derived From:
- Adjusted Commercial Property Price Index (CPPI, +6%), and:
- Building Construction Cost Price Index (BCCI, +2%), all derived from:
- Unadjusted Same-Property (Quality Controlled) Asset Value Index (e.g., SPAR)
- Using data on CapEx (CE) & Depreciation (D) & Land Value Fraction (LVF)…

CPPIs in the National Accounts…

Real World Example with Realistic Data & Values:

transactions-based Moody's/RCA CPPI (Repeat-Sales type investment capital return index)…



Step 1: Adjusting the Investment Capital Return Index for CE & Depreciation

From **REPEAT-SALES** to **CPPI**.

Diewert-Shimizu labels: From PA ➔ P

CPPIs in the National Accounts…

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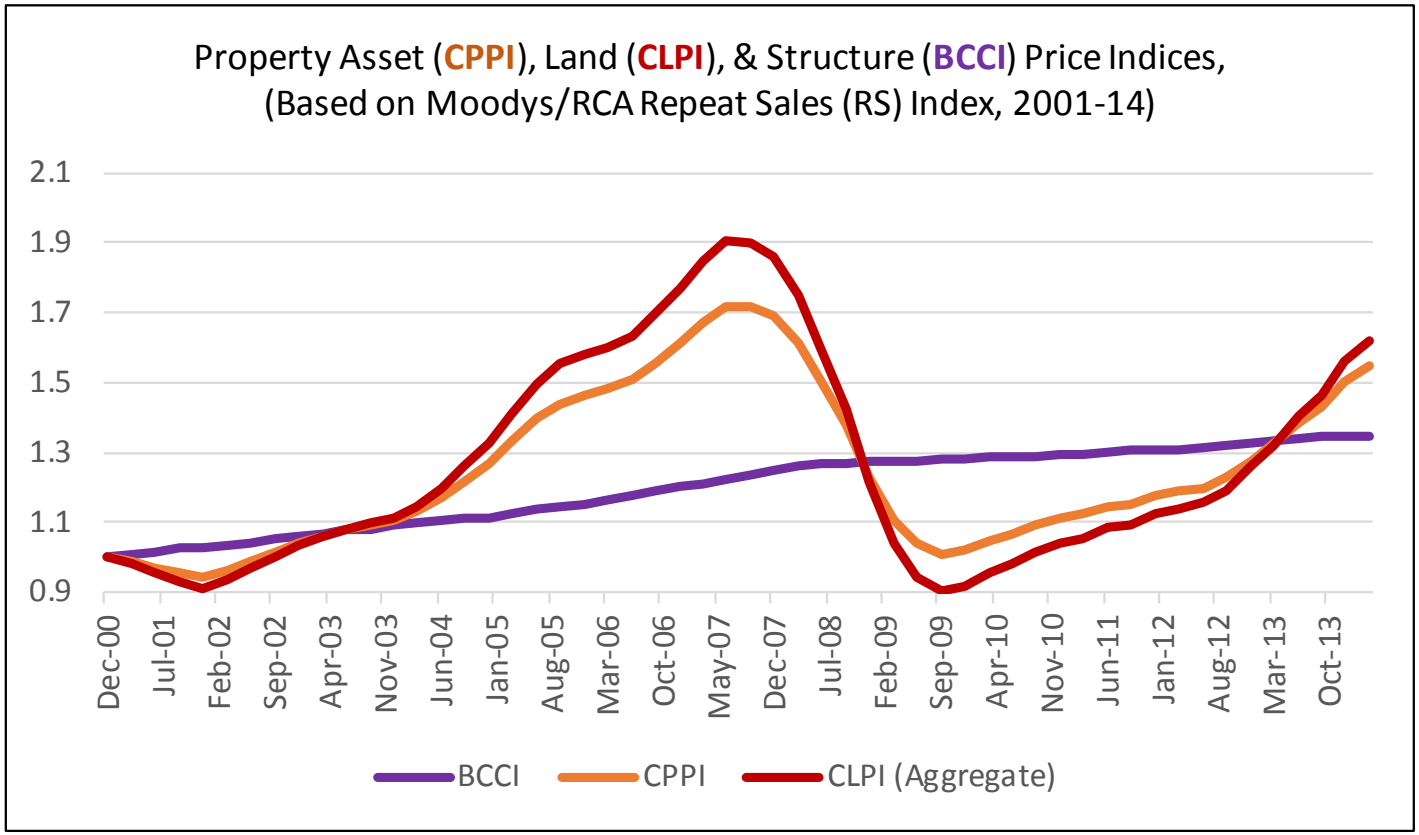
Real World Example with Realistic Data & Values:

transactions-based Moody's/RCA CPPI (Repeat-Sales type investment capital return index)…



Step 2: Deriving the Land Price Index from the CPPI & BCCI using the Residual Theory: From **CPPI** & **BCCI** to **CLPI**.

Diewert-Shimizu labels: From P ➔ PS & PL

Required Data:

1. Starting Point: The Best Possible Same-Property (Quality-Controlled) Property Asset Value Index (maybe SPAR, maybe Repeat-Sales, maybe Hedonic, maybe Appraisal-based, maybe Stock Market-based, etc. Topic of Chs.5-7 in the Handbook). Note: This Starting Point is valuable in its own right, and private sector tends to produce & publish such indices (without burdening the government's budget).
2. The Best Possible Capital Improvement Expenditure (CE) data (many agencies already obtain some such data). E.g., NCREIF, MIT/CRE RER Study
3. The Best Possible Depreciation (D) data (many agencies already obtain some such data). E.g., MIT/CRE RER Study.
4. The Best Possible Construction Cost Price Index (BCCI) data (many agencies already obtain some such data).
5. Data on land value fractions at time of development (an area that needs improvement but work on this is on-going, can be a byproduct of depreciation studies).

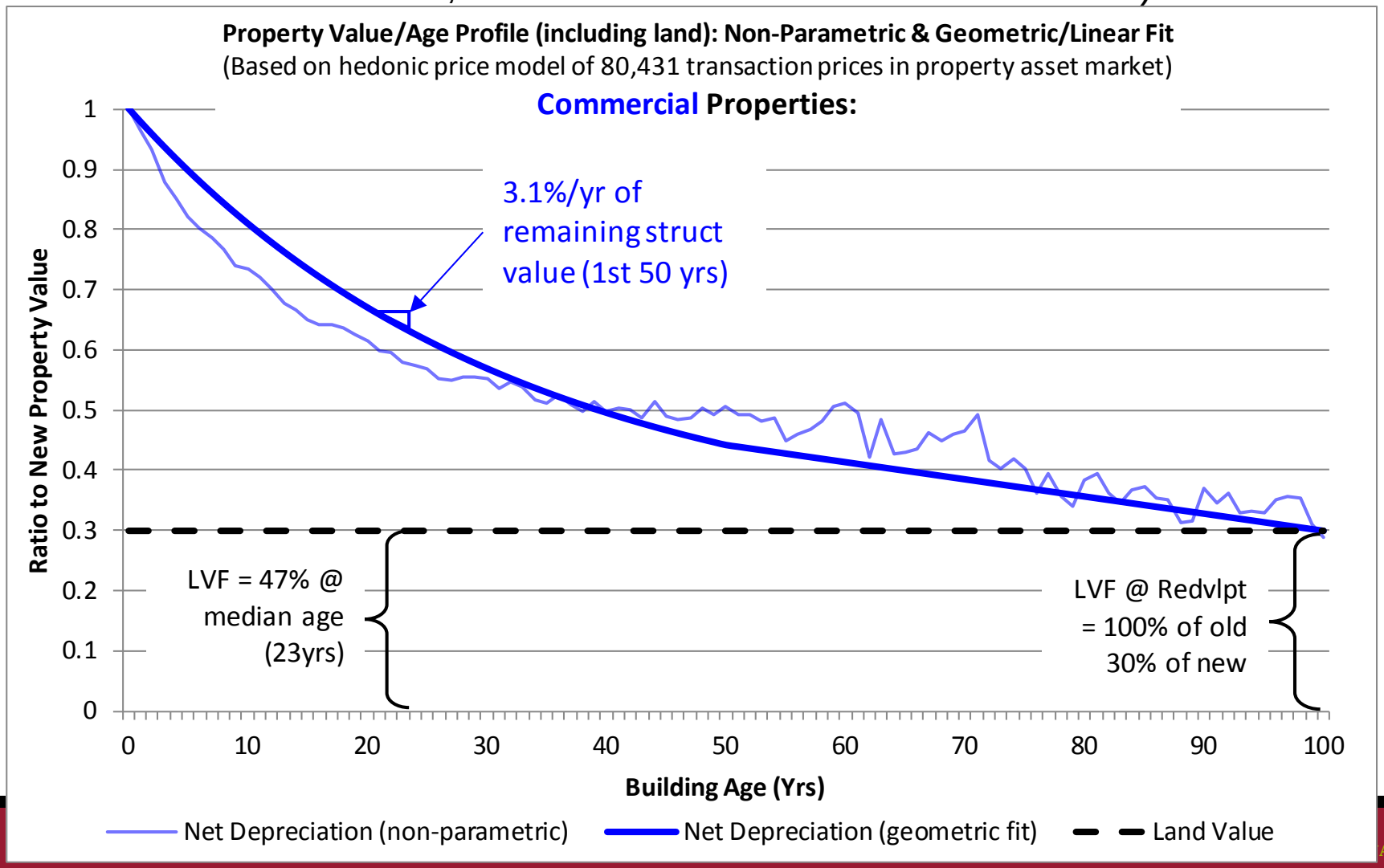
This framework allows great flexibility in the type of starting-point index.

CPPIs in the National Accounts…

Required Data:

Example of Depreciation & Land Value Fraction Empirical Data

(From U.S. Real Capital Analytics Inc. Commercial Property Transactions Database: 80,000 transaction observations 2001-14…)



CPPIs in the National Accounts…

Required Data:

Example of Depreciation & Land Value Fraction Empirical Data

(From U.S. Real Capital Analytics Inc. Apartment Property Transactions Database: 27,000 transaction observations 2001-14…)