From National Accounts to Inclusive Wealth: A Framework to Bridge Between Market and Accounting Priced Capitals

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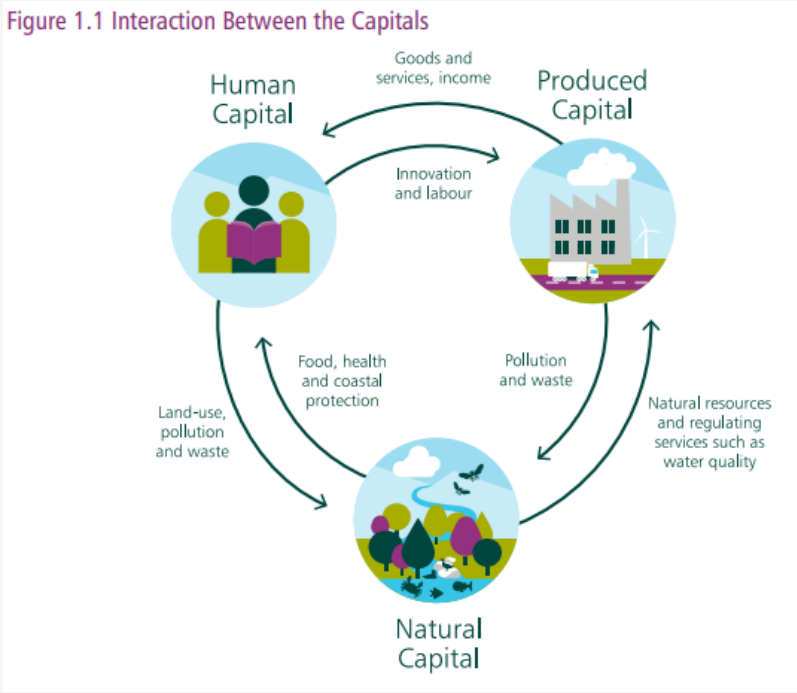
Context and Motivation: Inclusive Wealth

Inclusive Wealth is:

> *The social value (based on accounting prices) of an economy's total stock of **natural**, **produced** and **human capital** assets.*
> *(Dasgupta Review, 2021)*

Provides a measure of sustainable economic progress for current and future generations.

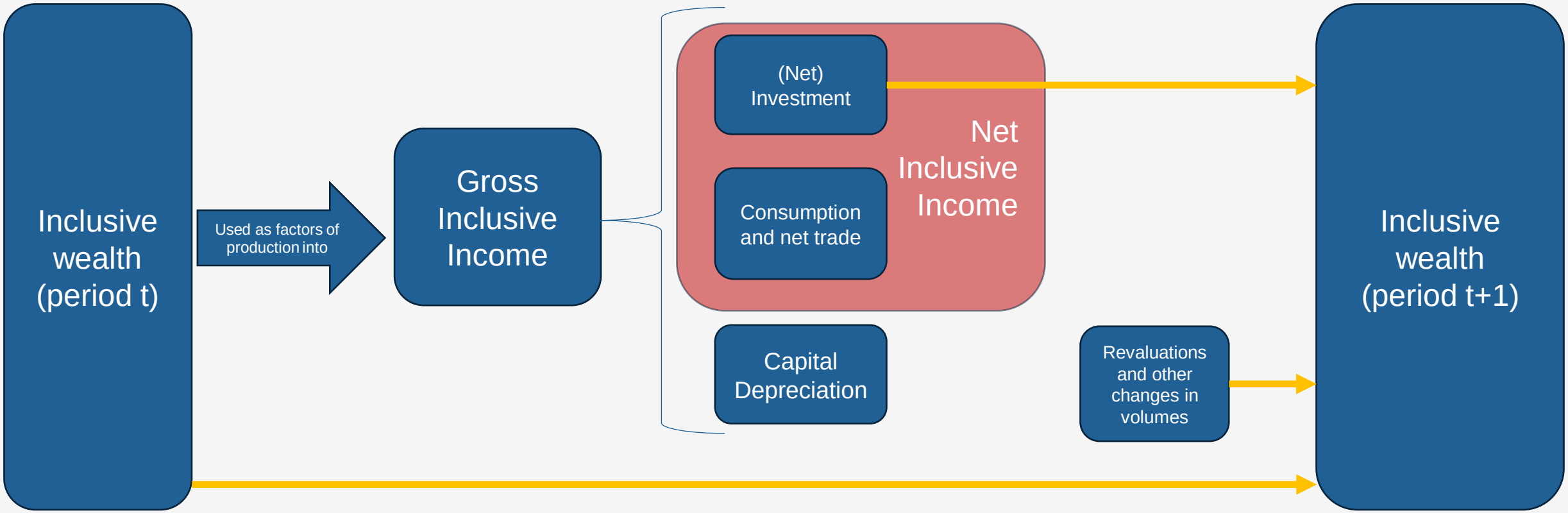


Dasgupta Review, 2021

$$\boldsymbol{Inclusive\ Wealth = Produced\ capital + Human\ capital + Natural\ capital}$$

Where Produced, Natural and Human capital are calculated in Accounting/Shadow Prices

Context and Motivation: Inclusive Wealth Accounting



(Simplified for illustrative purposes)

Context and Motivation: Shadow Prices

Dasgupta Review, 2021

Shadow price:

Shadow prices measure the *social* value of a good/service, rather than the *private* value typically reflected in the market/exchange price

Key question: Can we reconcile measurement in shadow prices with national accounting?

YES!

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Framework

$$Shadow\ Price = Exchange\ Price + Net\ Externality$$

For this framework:

- An **externality** is defined as the occurrence whereby a **production activity** affects the **exchange price** of another production activity, or directly affects **final consumption**, without a corresponding transaction taking place
- The only activities considered are production activities which take place **within the expanded production boundary**
- An externality can affect the exchange price of activity in the same period the externality is produced, in future periods, or both
- The "**net externality**" associated with activity x is defined as the sum value of the **externalities produced by activity x**, **minus the value of the externalities produced by other activity** which affect activity x

Framework

Model algebra available in Annex slides

- Output given by a production function with the stock of the wider range of capitals as inputs

$$Y_t = f(A_t, H_t, K_t, N_t)$$

Taking Produced Capital, K, as example:

- **Exchange price** of Produced capital K = discounted flow of **benefits captured by the owners of capital K** (as income or income in kind), regardless of where those benefits come from
- **Accounting price** value of capital K = discounted flow of **benefits caused by K** regardless of who captures the benefits (including owners of other capitals, as well as consumers)

$$Net\ Externality = Shadow\ Price\ -\ Exchange\ Price$$

Framework

- The change in value of an externality associated with capital, K, between two periods should be equal to the externality associated with investment in K, $E_{t-1}^{K,I}$, plus the externality associated with other changes in prices and volumes, $E_{t-1}^{K,OPV}$, minus the value of the externalities associated with capital services (depreciation and capital gain/loss), $E_{t-1}^{K,CS}$

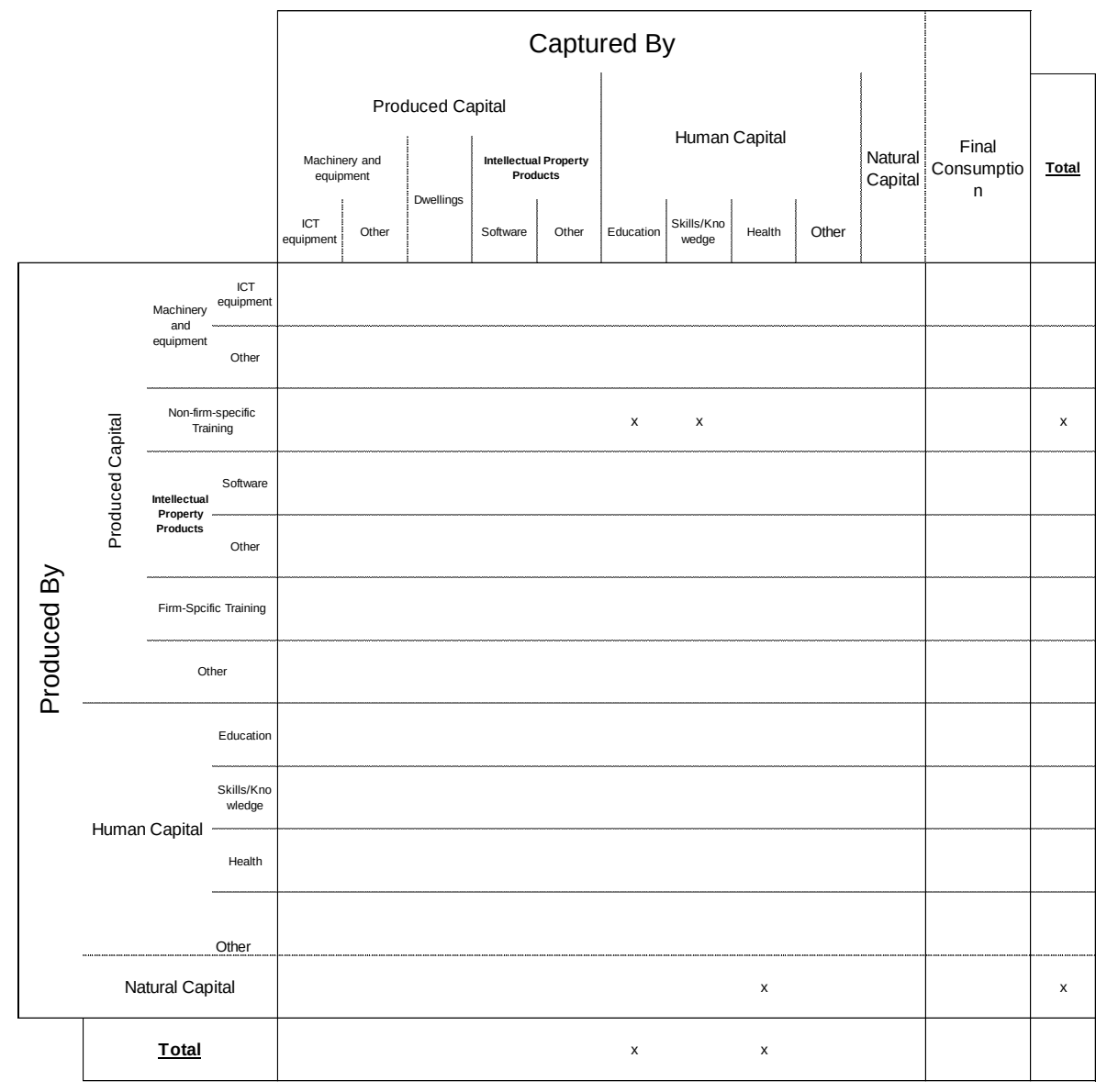
$$E_t^K - E_{t-1}^K = E_{t-1}^{K,I} + E_{t-1}^{K,OPV} - E_{t-1}^{K,CS}$$

- This is similar to the way changes in the value of capital stock are derived

Framework

Externalities associated with particularly phenomenon can be captured in a table like that to the right

Aggregating these tables will give an input-output-like table which can translate exchange prices into shadow prices



			Captured By: Produced Capital – Machinery and equipment – ICT equipment	Produced Capital – Machinery and equipment – Other	Produced Capital – Dwellings	Produced Capital – Intellectual Property Products – Software	Produced Capital – Intellectual Property Products – Other	Human Capital – Education	Human Capital – Skills/Knowledge	Human Capital – Health	Human Capital – Other	Natural Capital	Final Consumption	**Total**
Produced By: Produced Capital	Machinery and equipment	ICT equipment												
		Other												
	Non-firm-specific Training								x	x				x
	Intellectual Property Products	Software												
		Other												
	Firm-Spcific Training													
	Other													
Human Capital	Education													
	Skills/Knowledge													
	Health													
	Other													
Natural Capital										x				x
Total								x		x				

Framework: Summary

- Framework builds on national accounting principles
- **Expands the Production and Asset boundaries** to enable definition of Inclusive Wealth in exchange prices
- Translation from exchange prices to shadow prices is done primarily through a ***reallocation*** of value – i.e. no additional value is added to total Inclusive Wealth through this translation
  - Reallocation between time periods and capitals
  - 'New' value only created where an externality impacts final consumption
  - Excluding impact on final consumption, exchange price and shadow price measures of *total* Inclusive Wealth would be equal, but their subcomponents could/would differ in value
- We now present our initial investigative work beginning to exemplify how this framework could work

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Case Study: Training, Human Capital, and Intangible Assets

Workplace training

- Many consider treating this as a capital – but owned by the worker (as **human capital**), or the firm (**intangible capital**)?
- Using our framework, you can capture in accounting the key insight from the human capital literature, that who owns the results of the training (in an economic sense) depends on whether the training is **firm-specific** or not

Case Study: Training, Human Capital, and Intangible Assets

Effect on worker's pay, and therefore **human capital**

Effect on firm's profit, and therefore **intangible capital**

Consider a worker receiving training from a firm

As the worker's productivity has increased, the **shadow price** of their **human capital** has increased

Skills are transferable

Labour market competition will mean the worker's compensation should rise in line with their increased productivity – and so the **exchange price** of their human capital **rises in line** with the increase in its **shadow price**

If competition is complete, then this increase in worker compensation will be equal to the increase in the firm's revenue – so that profits remain constant. Resultantly, **the exchange price of the firm's capital does not rise**.

Skills are non-transferable

There may be no competitive labour market pressure for the firm to raise wages in line with productivity. The **exchange price of the human capital may not rise at all.**

Revenue will rise more than costs and profits will increase – the firm has effective, economic ownership of this training as an intangible capital, with the **exchange price rising in line with the extra profit** it can expect to receive as a result.

In both cases total **Inclusive Wealth rises in both exchange and shadow prices**.

But measuring in accounting prices the increase in wealth would be attributed to human capital. In exchange prices the increase in wealth would be attributable to an increase in the firm's intangible assets.

The accounting price measures where the value originates, while exchange prices measure who in practice captures the benefit

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Next Steps

- As shadow-price measurement primarily involves *reallocation* of value, at the headline level an exchange-price estimate gives a good approximation
  - On 13th November 2024 ONS will be publishing Inclusive Wealth and Income Accounts in exchange prices
- The Economic Statistics Centre of Excellence (ESCoE) is undertaking research on the best methods to use to measure shadow prices and externalities to begin to populate this framework

Thank you
Any Questions?

(Scan QR code for our email address and links to our publications on inclusive wealth and income)

ANNEX: Model

A simplified model of intergenerational well-being, V_t:

$$V_t = \sum_{z=0}^{\infty} \left[\frac{N_{t+z} \cdot u_{t+z}}{\prod_{\tau=0}^{z}(1 + r_{t+\tau})} \right] = \sum_{z=0}^{\infty} \left[\frac{U_{t+z}}{\prod_{\tau=0}^{z}(1 + r_{t+\tau})} \right]$$

$$\sum_{z=0}^{\infty} \left[\frac{U_{t+z}}{\prod_{\tau=0}^{z}(1 + r_{t+\tau})} \right] = \sum_{z=0}^{\infty} \left[\frac{F_{t+z}}{\prod_{\tau=0}^{z}(1 + r_{t+\tau})} \right] = \sum_{z=0}^{\infty} \left[\frac{Y_{t+z} - I_{t+z}}{\prod_{\tau=0}^{z}(1 + r_{t+\tau})} \right]$$

$$Y_t = f(A_t, H_t, K_t, N_t)$$

Where:

$V_t = intergenerational\ wellbeing\ in\ period\ t$

$N_{t+z} = population\ size\ in\ t + z$

$u_{t+z} = average\ wellbeing/utility\ in\ t + z$

$r_{t+\tau} = discount\ rate\ in\ t + \tau$

$U_{t+z} = total\ utility\ in\ t + z$

$F_{t+z} = final\ consumption$

$Y_{t+z} = gross\ value\ added$

$I_{t+z} = investment$

$A_t = total\ factor\ productivity$

$H_t = stock\ of\ Human\ capital\ in\ t$

$K_t = stock\ of\ Produced\ capital\ in\ t$

$N_t = stock\ of\ Natural\ capital\ in\ t$

ANNEX: Model

$$Exchange\ price\ value\ of\ K_t = \sum_{z=0}^{T}\left[\frac{k_{t+z}^{K} + h_{t+z}^{K} + n_{t+z}^{K}}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right]$$

Where:

$K_{t-1} = Produced\ capital\ K\ at\ the\ end\ of\ period\ t$

$k_{t+z}^{K} = benefits/capital\ services\ from\ Produced\ capital\ capture\ by\ owners\ of\ K\ (as\ income)$

$h_{t+z}^{K} = benefits/capital\ services\ from\ Human\ capital\ capture\ by\ owners\ of\ K\ (as\ income)$

$n_{t+z}^{K} = benefits/capital\ services\ from\ Natural\ capital\ captured\ by\ owners\ of\ K\ (as\ income)$

$T = service\ life\ of\ capital\ K$

$r_{t+\tau} = discount\ rate\ in\ period\ t+\tau$

note: 'income' includes income in kind

ANNEX: Model

$$Accounting\ price\ value\ of\ K_t = \sum_{z=0}^{T} \left[\frac{k^K_{t+z} + k^H_{t+z} + k^N_{t+z} + k^F_{t+z}}{\prod_{\tau=0}^{z}(1 + r_{t+\tau})} \right]$$

Where:

k^H_{t+z} = *benefits/capital services from Produced capital capture by owners of H (as income)*

k^N_{t+z} = *benefits/capital services from Produced capital capture by owners of N (as income)*

k^F_{t+z} = *benefits/capital services from Produced capital captured by consumers (as income)*

note: 'income' includes income in kind

ANNEX: Model

Subtracting the exchange price value of capital K from the accounting price value of K gives the net externality, E_t^K:

$$E_t^K = \sum_{z=0}^{T}\left[\frac{k_{t+z}^K}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right] + \sum_{z=0}^{T}\left[\frac{k_{t+z}^H}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right] + \sum_{z=0}^{T}\left[\frac{k_{t+z}^N}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right] + \sum_{z=0}^{T}\left[\frac{k_{t+z}^F}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right] - \left\{\sum_{z=0}^{T}\left[\frac{k_{t+z}^K}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right] + \sum_{z=0}^{T}\left[\frac{h_{t+z}^K}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right] + \sum_{z=0}^{T}\left[\frac{n_{t+z}^K}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right]\right\}$$

$$E_t^K = \sum_{z=0}^{T}\left[\frac{k_{t+z}^H}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right] + \sum_{z=0}^{T}\left[\frac{k_{t+z}^N}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right] + \sum_{z=0}^{T}\left[\frac{k_{t+z}^F}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right] - \left\{\sum_{z=0}^{T}\left[\frac{h_{t+z}^K}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right] + \sum_{z=0}^{T}\left[\frac{n_{t+z}^K}{\prod_{\tau=0}^{z}(1+r_{t+\tau})}\right]\right\}$$

The net externality is the externality on K from capitals H and N as well as on final consumption, minus the externality on capitals H and N from K