

Reconciling projected capital deepening with historical estimates

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Objective of the wider project

- To develop a modelling reference case against which the economy-wide impacts of future policies can be assessed
- Involves projecting the structure of the Australian economy forward through time
- Focus is on the whole economy (not just the market sector)
 - *Need to understand these drivers at the industry level*

Focus of today's presentation

- To understand the sources of difference between model-based projections of capital input growth & historical estimates
 - *Projections derived from the Victoria University Multi-Regional model (VUMR) model*
- Historical period analysed: 1974-75 to 2013-14
- Projections period covers: 2013-14 to 2059-60
- Builds on presentation given to last year's Economic Measurement Group
 - *Especially in relation to the measurement of capital inputs*

Outline of presentation

- Overview of the VUMR model
- Overview of the modelling reference case
- Difference between model-based projections of capital input growth & historical estimates
- Reasons why projected capital deepening may be lower than history
- Role played by differences in
 - *The measures of capital used*
 - *The underlying source of MFP growth*
- Wrap-up
- Possible discussion topic

Overview of the VUMR model

- Formerly known as the MMRF model
- CPI model numeraire
- Models each state & territory as a separate economy
- Representative regional household assumed to maximise utility subject to its income
 - *Households consumption (above subsistence level) responds to changes in aggregate expenditure & ALL prices*
- Producers minimise the cost of production
- Investment adjusts to equilibrate rate of return
- Capital income flows apportioned on basis of ownership
- Foreign demand responds to price of Australian exports
 - *Exporters can accrue short-term returns in response to price changes; dissipated by switching sales between markets*

Strategy adopted for developing the modelling reference case

- Focus on main demographic & economic changes
 - *Intended to be stylised ('vanilla flavoured')*
- Express at the highest meaningful level
 - *Primarily focus on national & industry effects*
 - *Flow on state/regional effects driven by industry structure & demography*
- Guided by long-term historical trends
 - *Abstract from short-term dynamics unless necessary*
 - *Abstract from the effect of short to medium policy changes*
- Draw on other studies where appropriate
 - *Such as the Intergenerational Reports (IGR)*
- Modelling reference case documented in PC (2012)
 - *Economy-wide Modelling of Impacts of COAG Reforms - Supplement (Being updated)*

The modelling reference case covers

- Demography (population)
 - *Fertility & mortality rates; net overseas migration*
- Labour markets (participation)
 - *Participation rates; employment/unemployment rates; average hours worked*
- Productivity
 - *Industry-specific labour productivity*
- Terms of trade & the external sector
 - *Terms of trade; commodity prices; export volumes; investment*
- Other considerations
 - *Model numeraire, patterns of household consumption; government finances; some macroeconomic aggregates*

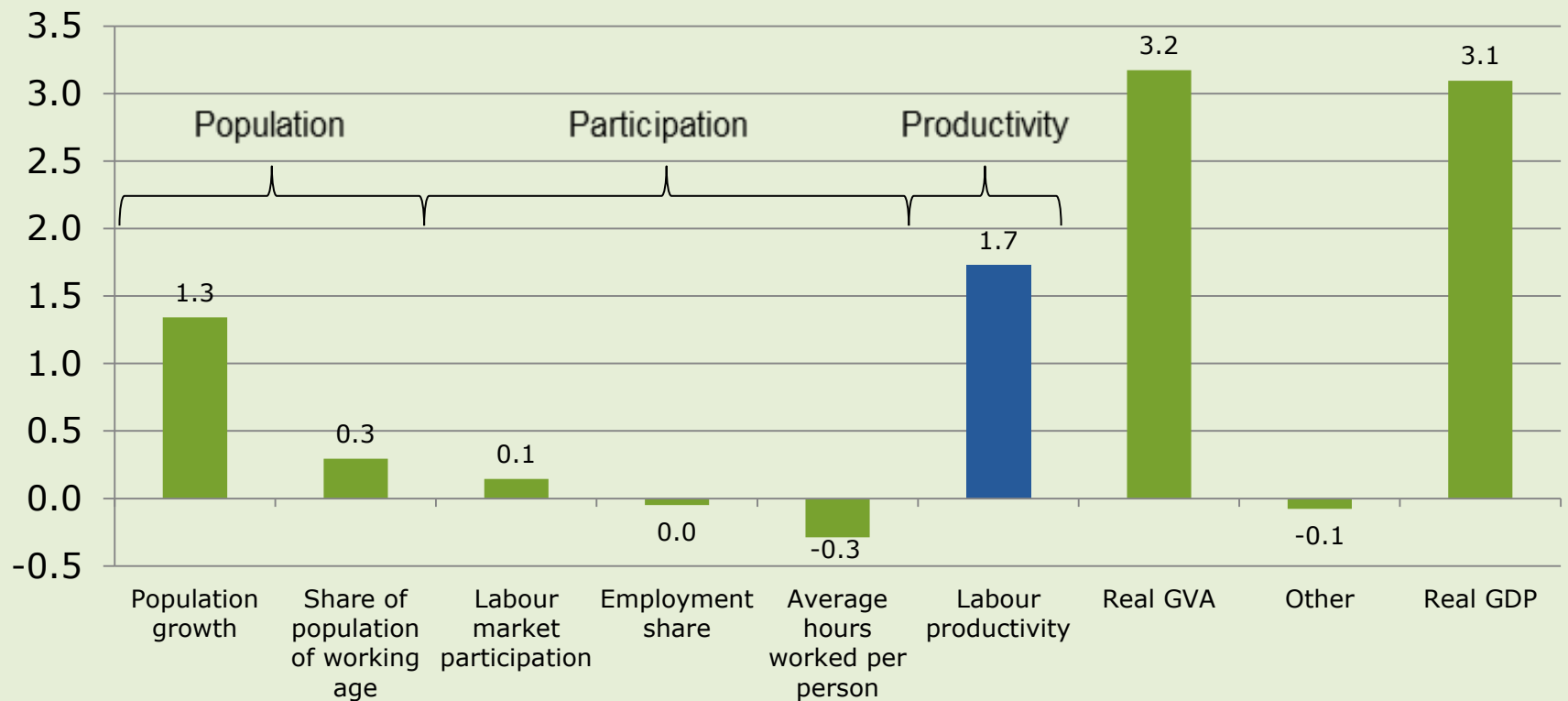
General approach adopted for each component

- Analyse long-term historical trends
 - *Varies depending on available data*
 - *... but frequently ~last 40 years (longer for demography)*
- Start from economy in 2009-10
- Up-rate to the economy in 2013-14 within the reference case framework
 - *Use actual data where available*
- Linearly unwind to long-run trend by 2017-18
 - *To correspond to assumed return of ToT to long-run average*
- Long-run trend then assumed to apply to 2059-60
- Assume effects of unspecified future policies similar to past policies 'embedded' in the data

Labour productivity growth the main contributor to higher national output

Contributions to real gross domestic product growth, 1974-75 to 2013-14

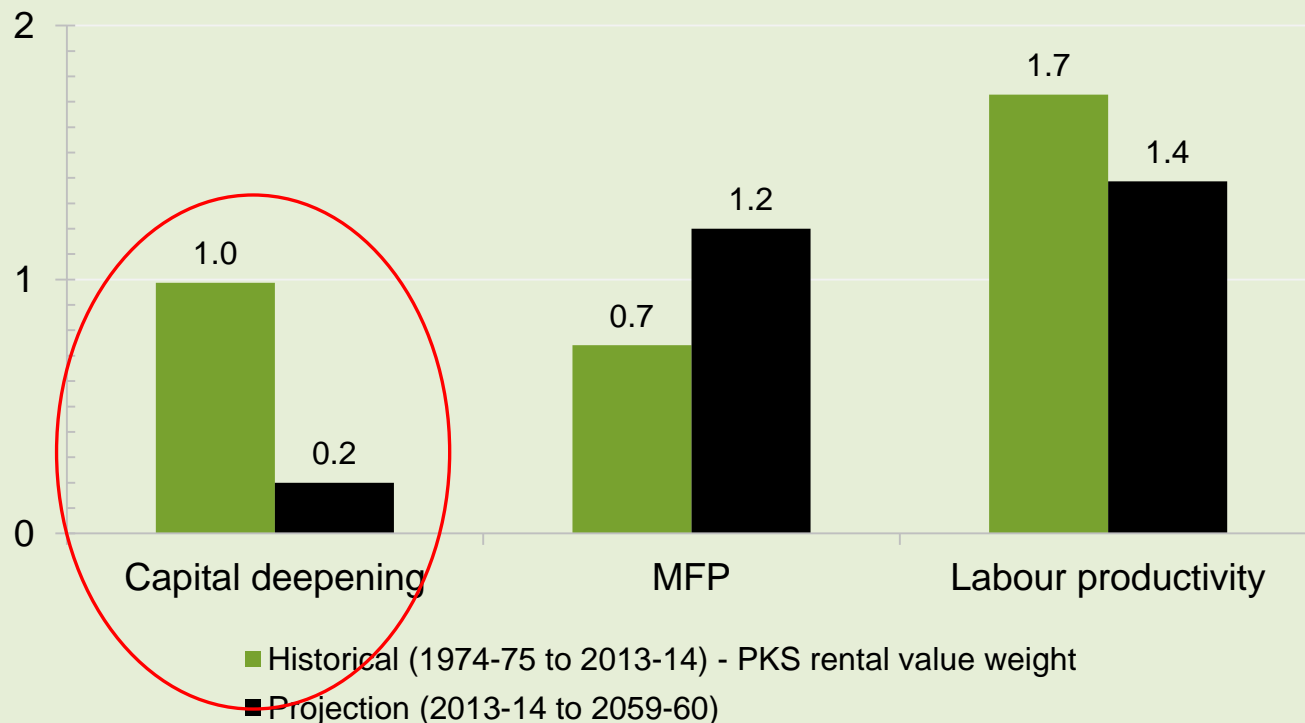
Percentage points



The observation that prompted the topic for today's presentation

Actual & projected average annual sources of labour productivity growth, Australia, 1974-75 to 2059-60

Per cent per year



Many reasons why projected capital deepening may be lower than history

- End of mining boom
 - *Mining industries relatively capital intensive*
- Continued long-run growth of service industries
 - *Relatively labour-intensive sectors such as health, aged care, wholesale trade, retail trade & business services*
- Ageing leading to slower population growth
 - *Less demand for dwellings, which are capital intensive*
- Differences in the measures of capital used
- Differences in the underlying source of MFP growth
- Other factors
 - *Such as other reference case shocks, model theory, model parametrisation, model database*

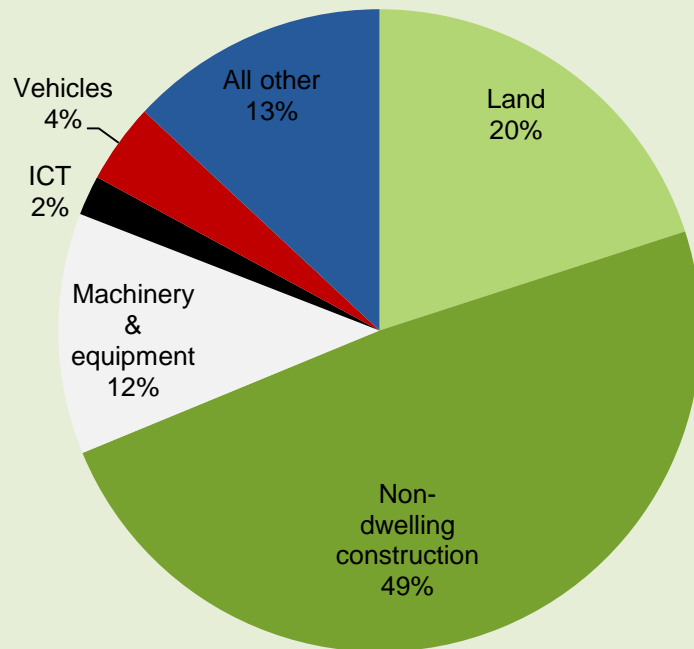
**Focus of
today's talk**

Measure of capital used in VUMR

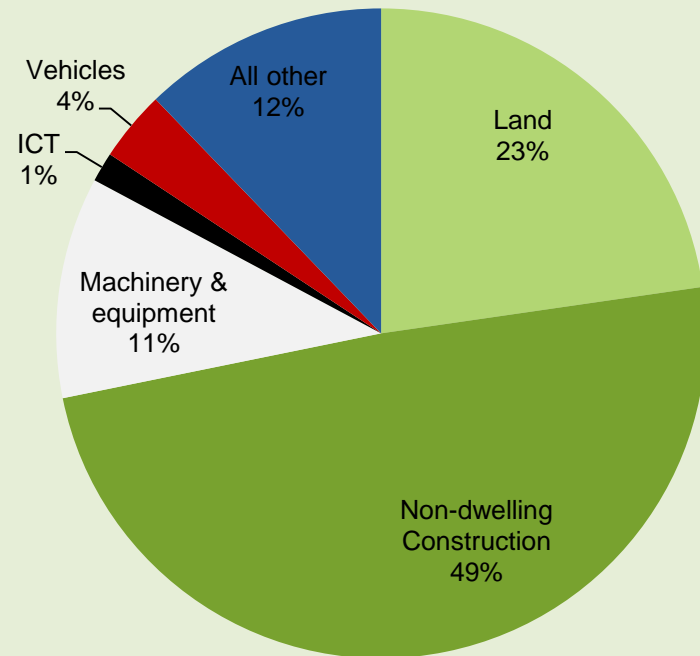
- Net capital stock by industry, weighted by rental price
 - *Standard 'textbook' approach to modelling production*
 - *Covers all industries (including those in non-market sector)*
- Capital stock & income data in database sourced from ABS
 - *Income adjusted to remove cyclical factors, Commission work, secondary production & labour income of self employed*
 - *Industries reflect primary product produced*
- Stylised version of the approach used by the ABS
- But does not include
 - *Individual asset types for each industry (no PIM)*
 - *Changes in productive efficiency of asset types over their life*
 - *Changes in the mix of asset types used within each industry*
 - *Changes in quality of asset types over time*

Capital measure in the VUMR model database similar to PKS

PKS 2013-14 \$3.4 trillion



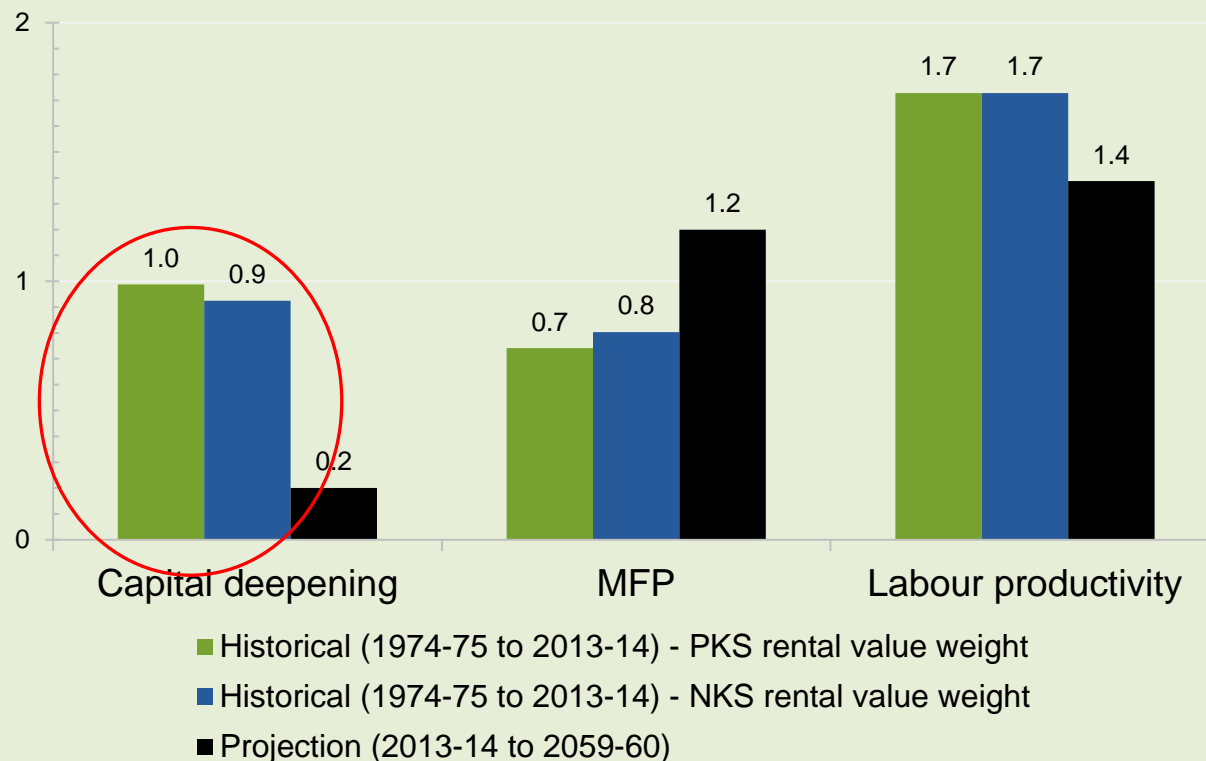
NKS 2013-14 \$3.1 trillion



Historical capital deepening based on NKS similar to that based on PKS

Actual & projected average annual sources of labour productivity growth, Australia, 1974-75 to 2059-60

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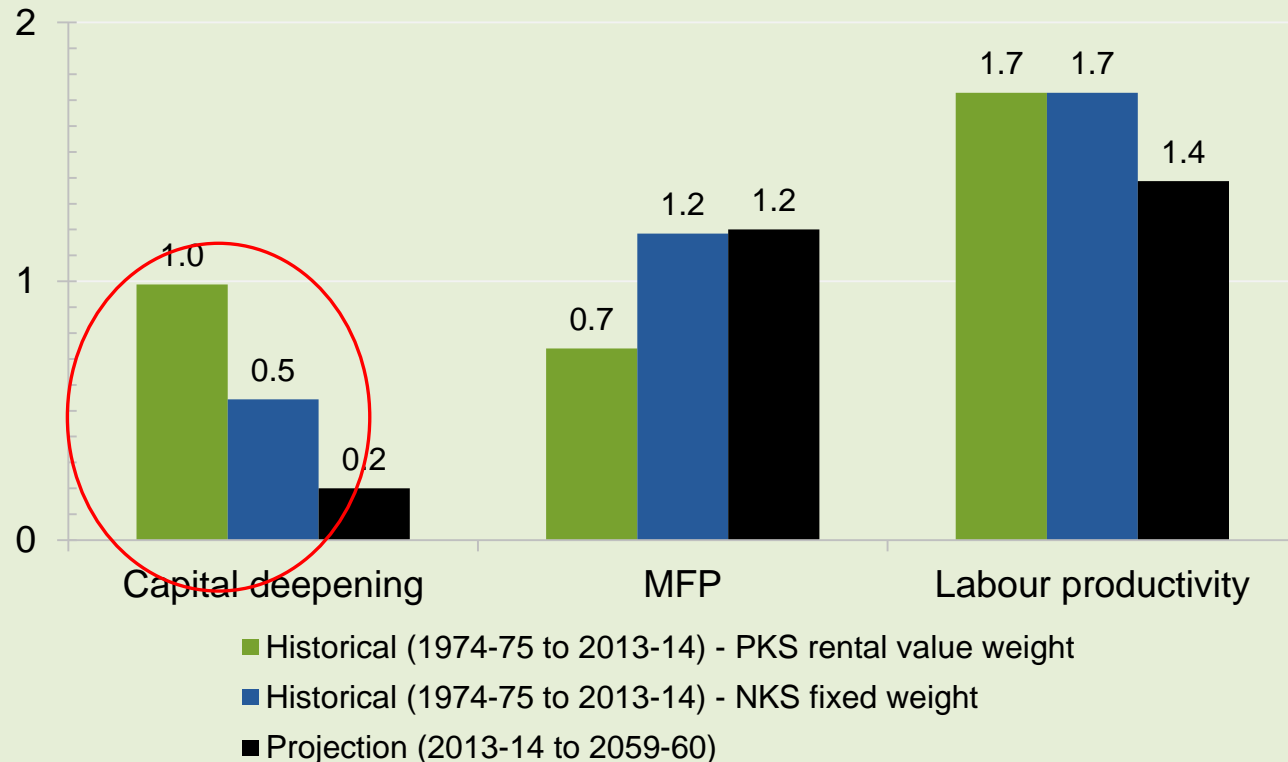
... but the way capital growth is measured maybe more important

- ABS productive capital stock takes into account changes in
 - *The productive efficiency of asset types over their life*
 - *The mix of asset types used in production*
 - *The quality of asset types over time*
- Gives rise to additional capital deepening
- Capital inputs incorporate 'embodied' technical change
 - *Rather than additional MFP growth*
- These effects not captured in models such VUMR
- Instead, gives rise to 'disembodied' technical change
 - *Results in additional MFP growth*
 - *Effects similar to changes in capital utilisation recorded in productivity measures*
- Test this by holding historical asset weights fixed
 - *To align weight with that used in the projection period*

Around half of missing capital deepening may be compositional & embodied changes

Actual & projected average annual sources of labour productivity growth, Australia, 1974-75 to 2059-60

Per cent per year



Measures of capital deepening can be sensitive to the accounting for sources of growth

- Changes in MFP can arise from many factors
 - *Labour-augmenting technical change*
 - ... Affects the efficiency with which labour is used in production
 - *Capital-augmenting technical change*
 - ... Affects the efficiency with which capital is used in production
 - *Primary factor-augmenting technical change*
 - ... Affects the efficiency with which labour & capital are used in production
- Historical sources of changes in MFP not clear
 - *PC (2012) found that available Australian evidence mixed; did not clearly support labour-augmenting technical change*
- But need to make assumptions about the source of MFP growth in the modelling of future projections
 - *Assumed to arise through primary factor-augmenting technical change affecting both labour & capital inputs*

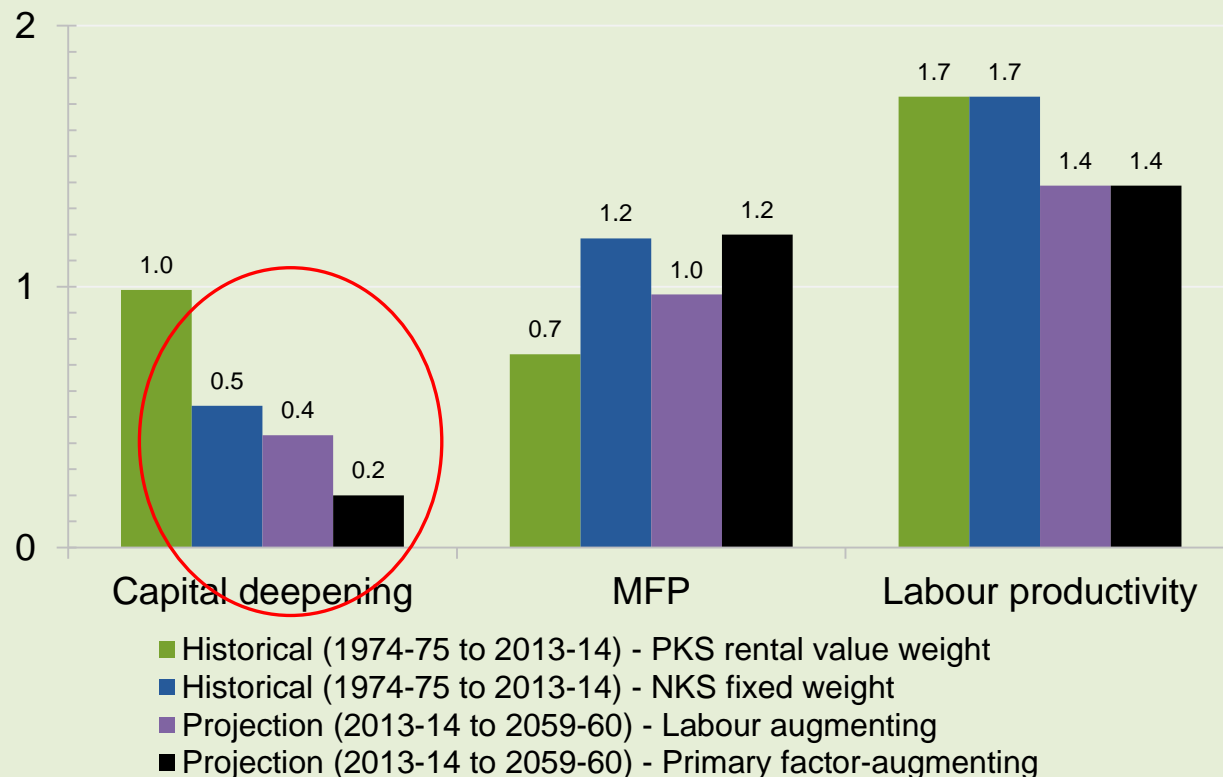
Why the source of MFP growth matters

- Primary factor-augmenting technical change affects the efficiency with which capital is used in production
 - *Labour-augmenting technical change does not*
- Changes in the efficiency with which capital is used
 - *Alters the marginal physical product of capital*
 - *Means less physical units of capital required to produce same output*
 - *Reduces the need for investment in the future*
 - *Gives rise to less capital deepening than otherwise*

The source of MFP growth affects projected capital deepening

Actual & projected average annual sources of labour productivity growth, Australia, 1974-75 to 2059-60

Per cent per year



Wrap-up

- VUMR measure of capital more akin to NKS weighted by rental value than PKS published by ABS
- Projected capital deepening from VUMR to 2059-60 lower than historical estimates
- Historical estimates inflated by embodied technical change
 - *Reflecting no change in the productive efficiency of asset types over their life in the projection period*
- Projected estimates treat embodied technical change as MFP growth
- Consequently, projected estimates of MFP growth higher than historical estimates
- The source of MFP growth also plays an important role in determining the extent of projected capital deepening

Possible discussion topic

- Should embodied change be included in capital or MFP?