

# **Investigating New Zealand-Australia Productivity Differences: New Comparisons at Industry Level**

**Productivity Hub Symposium:  
Unpicking New Zealand's Productivity Paradox**

**Te Papa, Wellington, 2 July 2013**

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# Industry-level productivity comparisons: background

- NZ-Australia productivity differences have been widely analysed at aggregate economy level
- Less research on NZ's comparative strengths and weaknesses at industry level (except for IMF, 2002, and NZIER, 2011)
- Biggest difficulty has been lack of purchasing power parity (PPP) exchange rate estimates at industry level
- IMF (2002) used broad industry-level expenditure PPPs produced by OECD which are principally designed to assist with international comparisons of living standards
- NZIER (2011) used market exchange rates – disadvantages of short-term volatility; plus limited relevance to non-traded goods

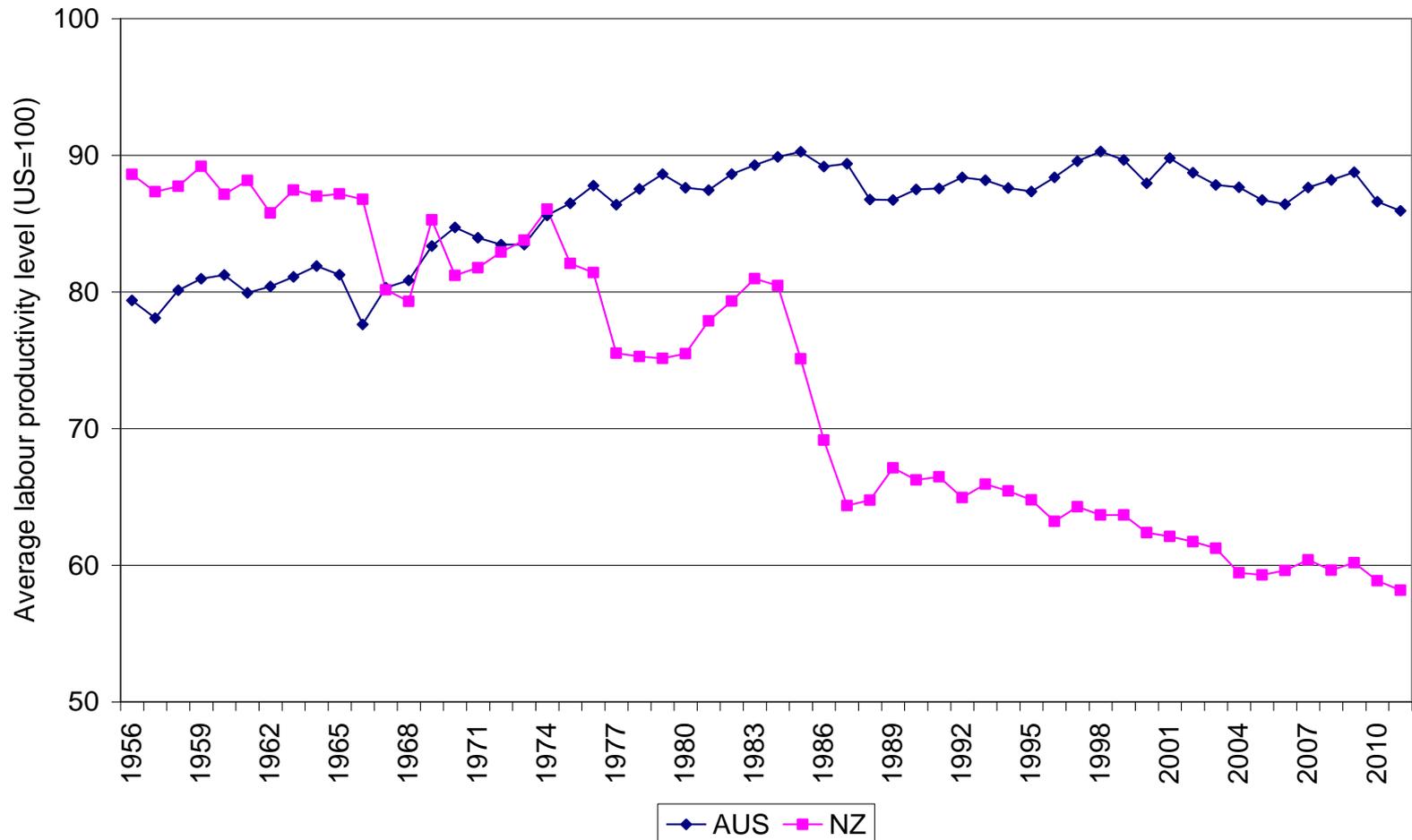
# Key features of this study

- Use industry-specific PPP exchange rate estimates prepared by the Groningen Growth and Development Centre as well as latest OECD PPPs
- New estimates of capital-intensity and skills at industry level in NZ and Australia
- Underlying data based on most recent ANZSIC 2006 industrial classification in both countries – available back to 1997
- Benchmark comparisons of Average Labour Productivity (ALP) and relative Multi-Factor Productivity (MFP) levels in 24 market industries in 2009
- New comparisons of ALP and MFP growth rates at industry level between 1997-2010

# Order of presentation

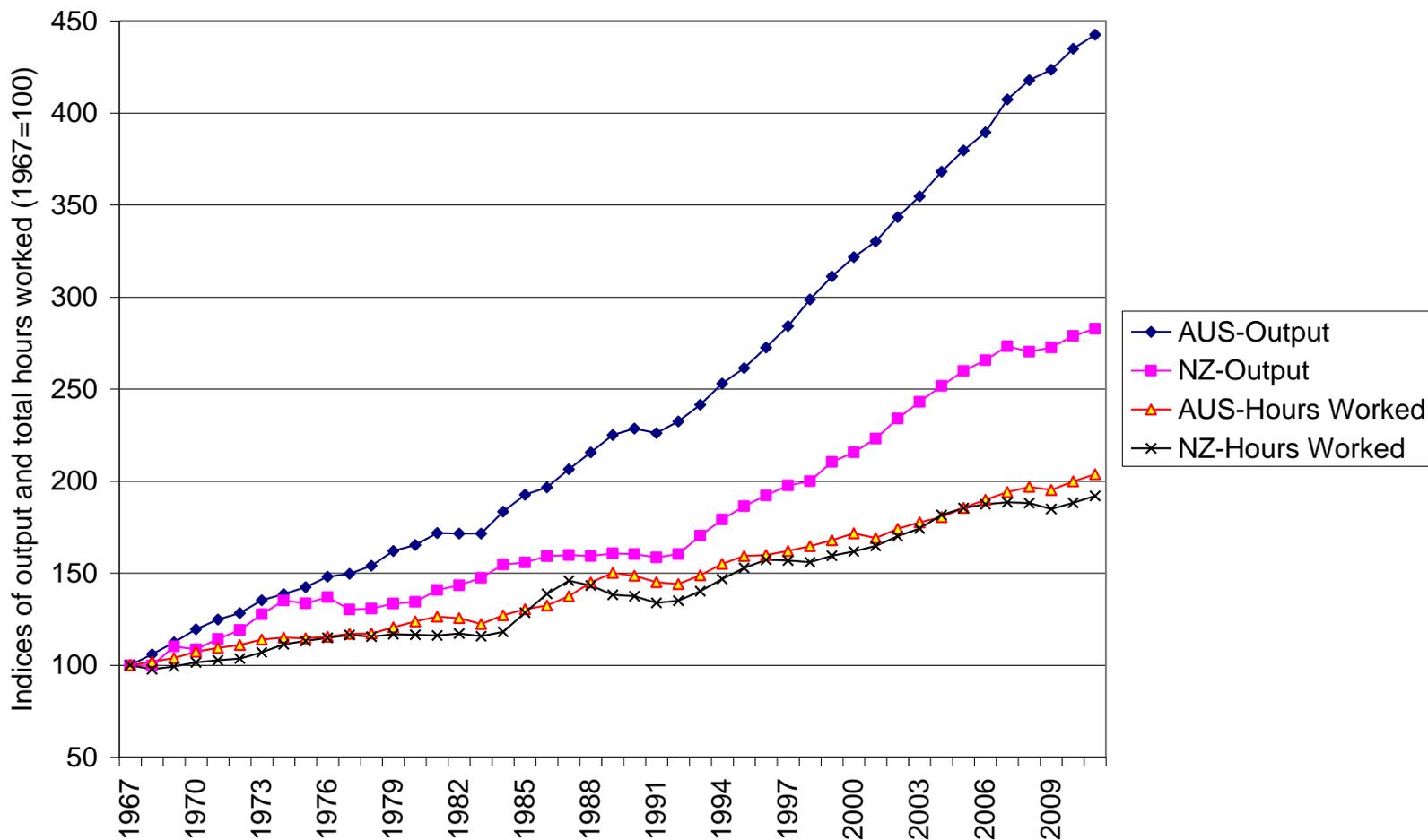
- NZ-Australia productivity gap in long-term perspective
- Comparisons of ALP levels in market industries
- Relative capital-intensity and skill levels in both countries
- Comparisons of MFP levels in market industries
- Growth accounting: decomposition of ALP gaps between capital-intensity, skills and MFP components
- Identify 'proximate' causes of NZ-Australia productivity differences at industry level
- Hope to clear the ground for new research into 'ultimate' causes of these productivity differences

**Figure 2.2: Average GDP per hour worked in New Zealand and Australia, 1956-2011, Index numbers: US=100**



Source: Conference Board Total Economy Database, January 2012

**Figure 2.3: Total GDP and annual hours worked in New Zealand and Australia, 1956-2011, Index numbers: 1967=100**



Source: Conference Board Total Economy Database, January 2012

# PPP exchange rates

- Groningen PPP estimates for 1997 in US\$ updated to 2009, using industry-level price deflators for the United States as well as for NZ and Australia
- Alternative industry-level PPP estimates derived from disaggregated PPP data obtained from OECD
- OECD price data more up to date than GGDC but gaps in product coverage by the OECD mean that industry-specific OECD PPP estimates can only be obtained for 11 of the 24 industries
- For the remaining industries, we use OECD PPPs derived for either GDP as a whole or for aggregated manufacturing or service industries
- All OECD-based PPP estimates adjusted for retail and wholesale trade and transportation margins and for taxes with the aid of industry-level information derived from Supply-Use Tables for each country

# Comparisons of ALP levels, 2009

- Using Groningen PPPs, estimated ALP in total market industries in NZ is 62% of the Australian level
- Using OECD PPPs, equivalent figure is 67%
- *Using both sets of PPPs*, Australia is ahead on ALP in agriculture, forestry and fishing; mining; most branches of manufacturing; construction; wholesale; retail; accommodation and food services; and financial services
- NZ is ahead on ALP in food and drink manufacturing; electricity, gas and water; rental, hiring and real estate services; and arts and recreation services
- *Using Groningen PPPs alone*, there are signs of NZ being ahead in professional, scientific and technical services and matching Australia in information media and telecoms services – while Australia leads in transport, postal and warehousing

# Differences in industrial structure (1)

- Shift-share decomposition: roughly 30% of the NZ-Australian gap in ALP for aggregate market industries can be attributed to differences in employment structure
- Australian employment more concentrated in industries with comparatively high absolute levels of value added per employee such as mining, utilities (electricity, gas and water) and financial services
- NZ employment more concentrated in comparatively low value added industries such as agriculture and manufacturing as a whole

# Differences in industrial structure (2)

<b>Sector name</b>	<b>Mean of NZ and Australian productivity levels (US\$ per hour worked)</b>	<b>NZ industry shares of total hours worked (%)</b>	<b>Australian industry shares of total hours worked (%)</b>
Agriculture, forestry and fishing	17	10	5
Mining	151	1	3
Manufacturing	25	17	13
Electricity, gas, water and waste services	243	1	2
Construction	55	12	13
Knowledge-intensive services	55	18	20
Other services	25	42	44
<b>TOTAL MARKET INDUSTRIES</b>	<b>40</b>	<b>100</b>	<b>100</b>

# Measuring relative capital-intensity (1)

- Derive benchmark comparisons of net capital stocks per hour worked at industry level in 2009
- Start with National Accounts data on gross fixed capital formation for 1986-2009
- Convert investment data to US\$ using OECD PPPs for investment goods by asset type
- Use perpetual inventory method to cumulate constant price investments and deduct value of depreciated assets, using common industry-specific depreciation rates (US estimates)
- Then take 2009 benchmark comparison of net capital stocks per hour worked and use SNZ and ABS estimates of growth in capital services at industry level to generate 1997-2010 time series around the 2009 benchmark

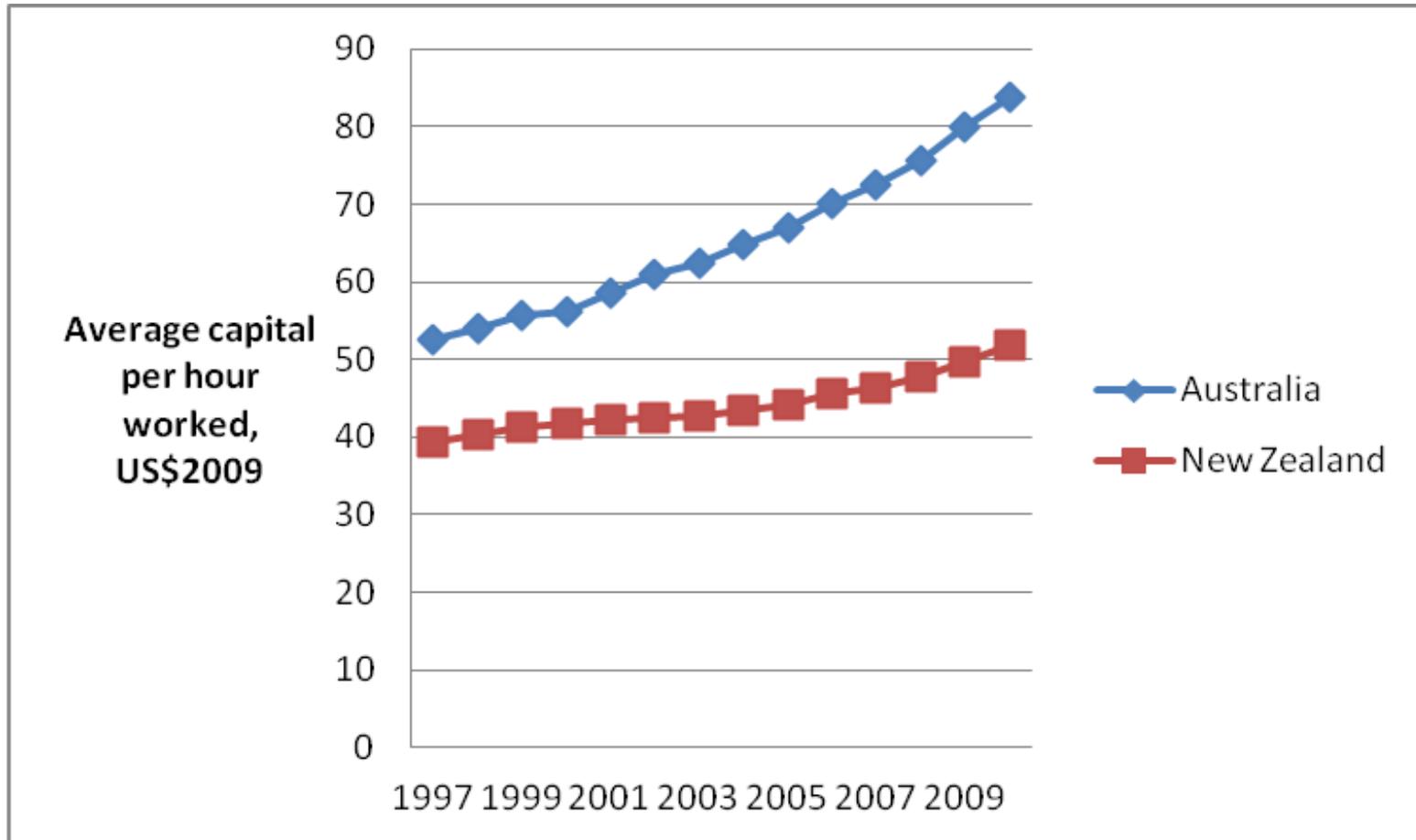
# Measuring relative capital-intensity (2)

- Biggest problems for comparability:
  - SNZ estimates of intangible assets exclude R&D
  - SNZ estimates of cultivated biological resources exclude livestock
  - SNZ includes computers with other plant, machinery and equipment
- Distinguish four groups of capital assets which can be adequately compared between the two countries:
  - Structures (comprising non-residential buildings and other construction) and land improvement (excluding livestock)
  - Plant, machinery and equipment (including computers)
  - Transport equipment
  - Intangible assets (excluding R&D)
- Impact of excluded capital assets on relative ALP will be picked up in estimates of residual MFP

# Relative levels of capital-intensity

- Across total market industries, average capital per hour worked in NZ is 62% of the Australian level
  - Structures and land improvement 57%
  - Plant, machinery and equipment (incl. computers) 78%
  - Transport equipment 83%
  - Intangible assets (excl. R&D) 78%
- Broadly consistent with previous findings using different methods (Hall and Scobie, 2005; Schreyer, 2006; NZIER, 2011)
- Australia ahead on capital-intensity in wide range of industries: agriculture, mining, manufacturing, construction, most services
- New Zealand more capital-intensive in only 5 of 24 industries and only one of these (electricity, gas and water) has a high absolute level of capital-intensity

**Figure 4.1: Average capital per hour worked (US\$2009), total market industries, 1997-2010**



# Explaining differences in relative capital-intensity

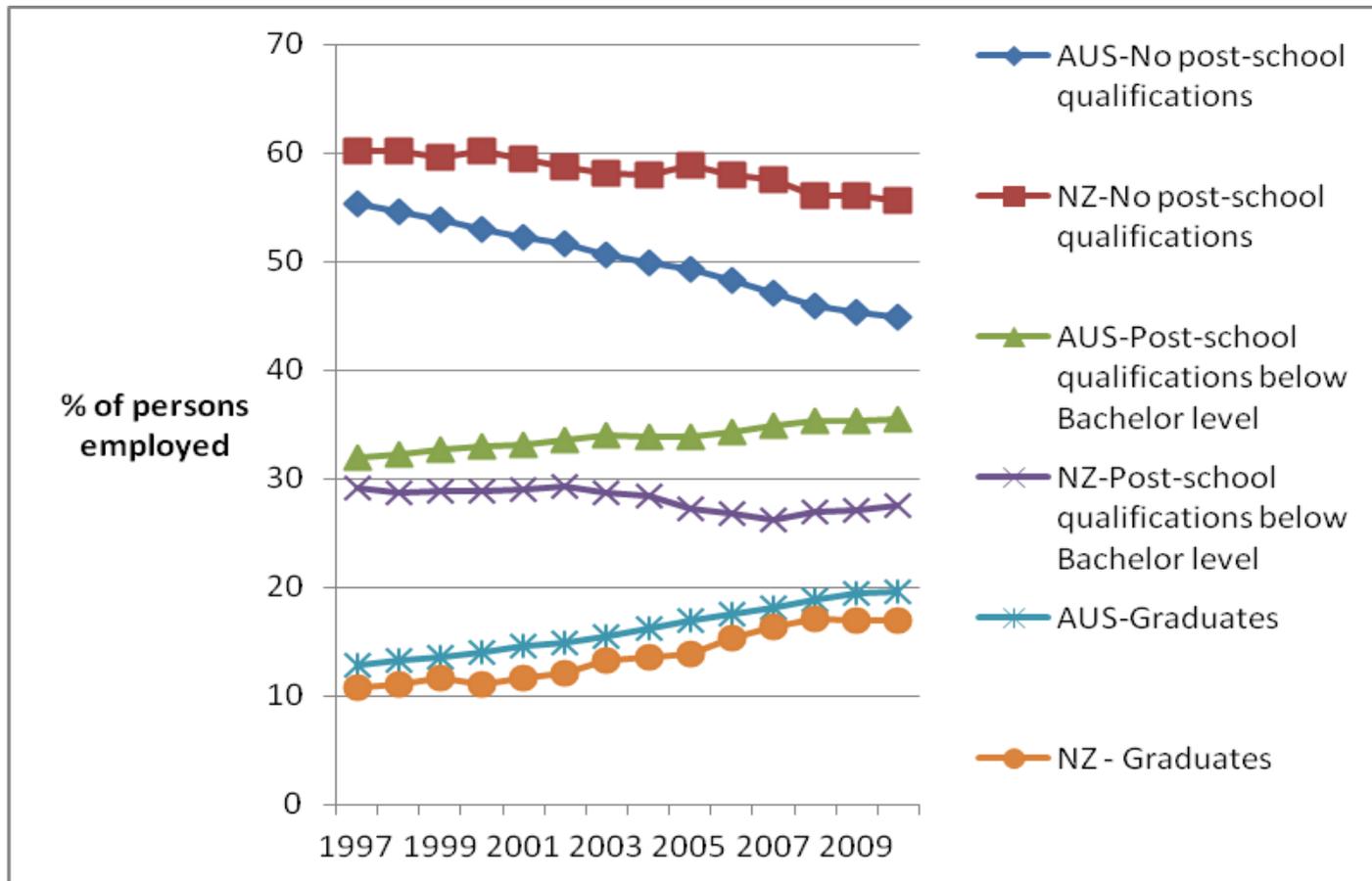
- Almost 40% of the Australian lead on average capital per hour worked can be attributed to differences in industrial structure
- Competing explanations regarding relatively low levels of business investment in NZ:
  - Relatively low labour costs in NZ compared to the costs of capital (IMF, 2002; Hall and Scobie, 2005)
  - Relatively high costs of borrowing for investment purposes in NZ, partly linked to relatively low rates of domestic saving (OECD, 2011)
  - Negative effects of relatively low MFP levels on firms' investment intentions (Dupuy and Beard, 2008)
  - Hulten (2009) emphasises two-way interdependence between MFP and capital-deepening

# Measuring relative skill levels

- Identify three qualification groups at industry level in each country:
  - Graduates (Bachelor degrees and higher degrees)
  - Post-secondary school qualifications below Bachelor degree level
  - No post-school qualifications
- Benchmark on relatively low-skilled 'No post-school qualifications' category and then use ratios of mean wages in the other two qualification groups to low-skilled wages in each country as indicators of labour quality differences between the respective qualification groups
- In this way all hours worked by workers in Groups 1 and 2 can be calculated as 'effective units of labour' relative to Group 3

# Australia-NZ differences in workforce qualifications

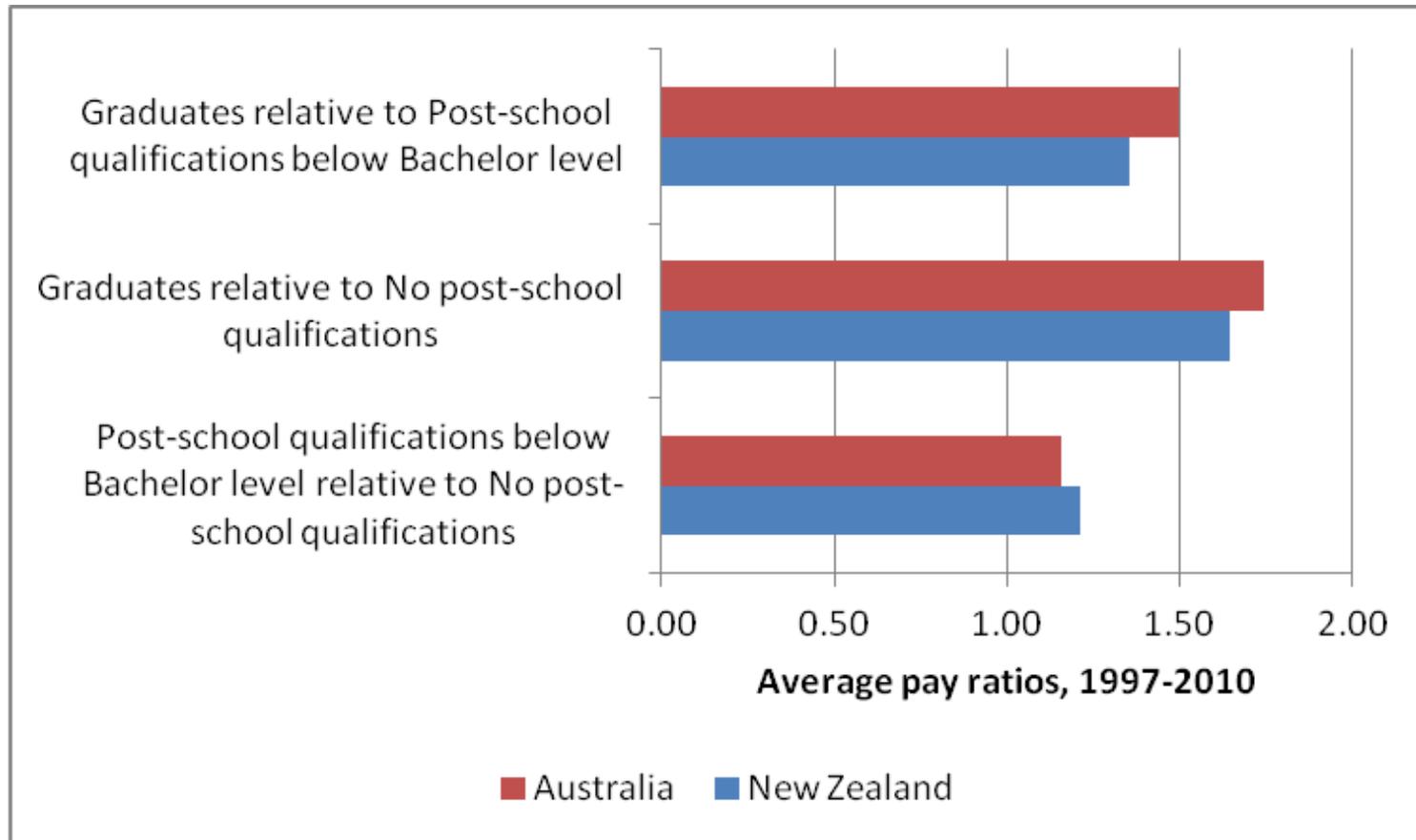
**Figure 5.1: Highest qualifications held by workers in total market industries, 1997-2010**



Sources: Derived from ABS, Survey of Education and Work and SNZ, New Zealand Income Survey.

# Pay differentials by qualification group

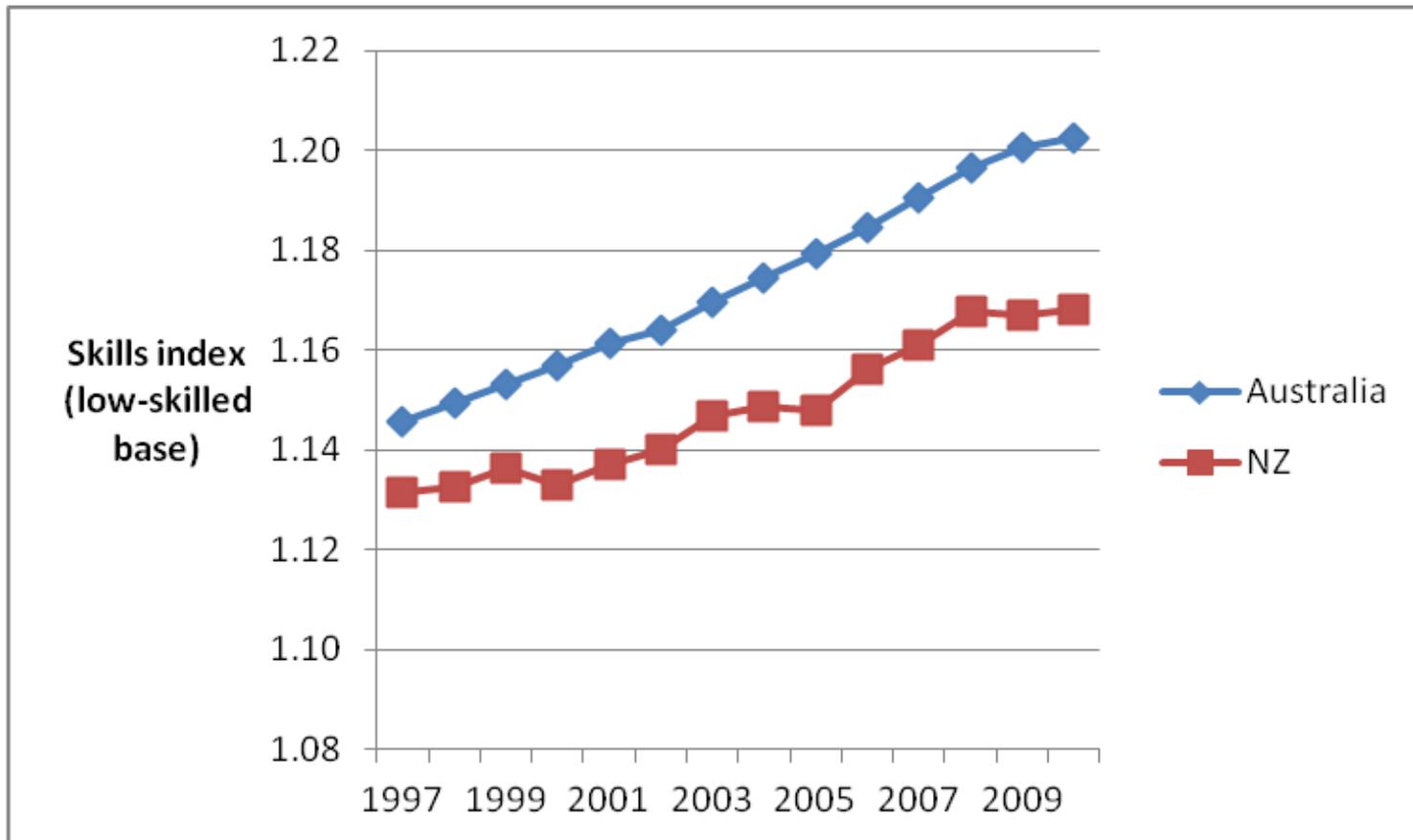
**Figure 5.2: Average pay ratios, 1997-2010, analysed by qualifications group**



Sources: Derived from ABS, Survey of Income and Housing and SNZ, New Zealand Income Survey.

# Estimates of relative skill levels

**Figure 5.3: Trends in estimated skills index in total market industries, 1997-2010**



# Estimated skill differences at industry level

- Australian has narrow lead over New Zealand in total market industries of about three percentage points in 2009
- Australia's narrow lead on measured skills in 2009 prevails in all individual market industries
- Gap only exceeds five percentage points in five industries: mining, chemicals, professional and scientific services, information media and telecommunications and finance and insurance

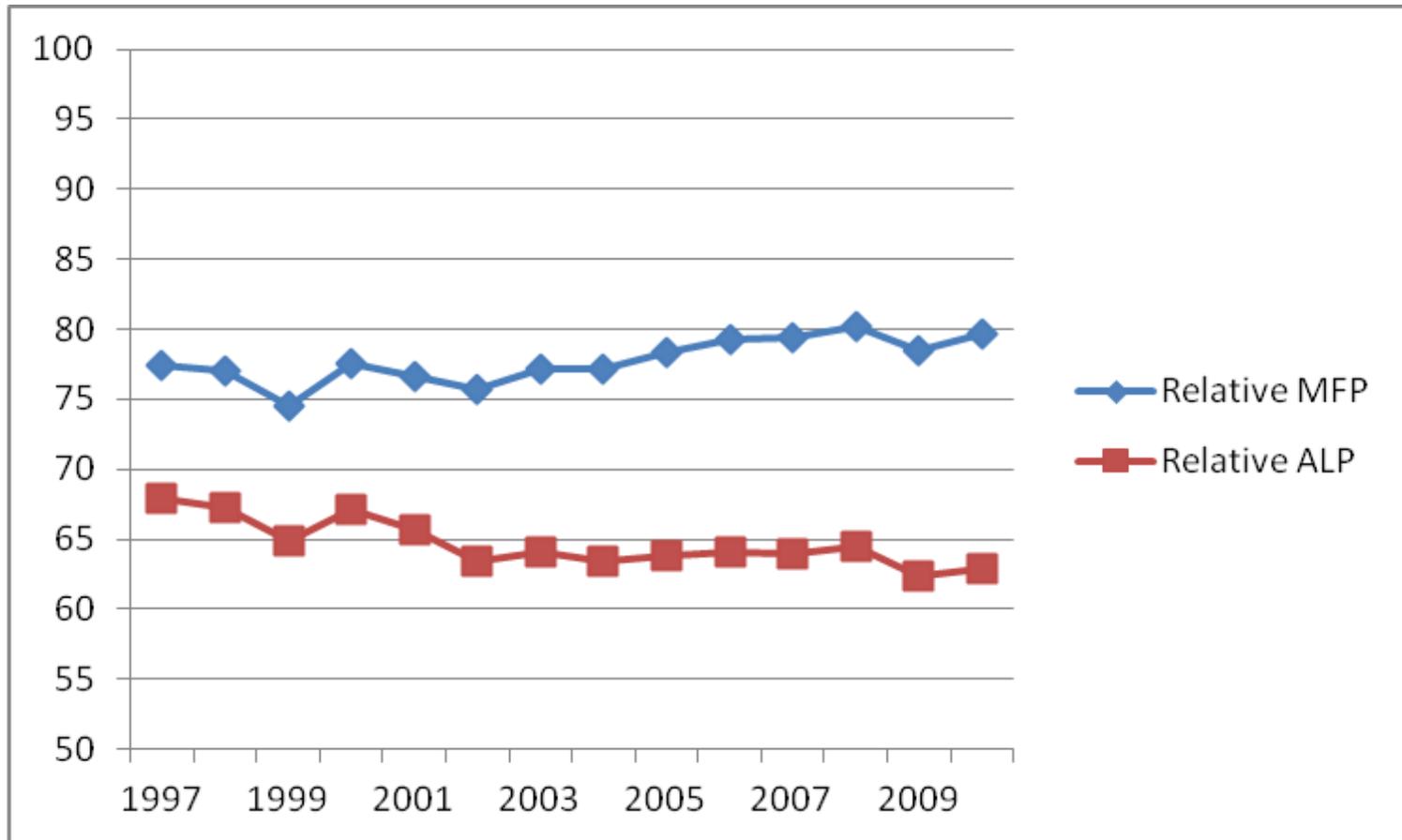
# Estimating relative MFP levels

- In standard growth accounting approach, based on the neoclassical growth model, cross-country differences in average labour productivity (ALP) levels can be decomposed into three components reflecting differences in:
  - Capital-intensity
  - Labour quality (skills)
  - Multi-factor productivity (MFP)
- MFP is estimated residually as the proportion of the cross-country gap in ALP levels which cannot be explained by measured differences in capital-intensity and skills
- Thus MFP can be seen in large part as an indicator of the efficiency with which capital and labour inputs are utilised

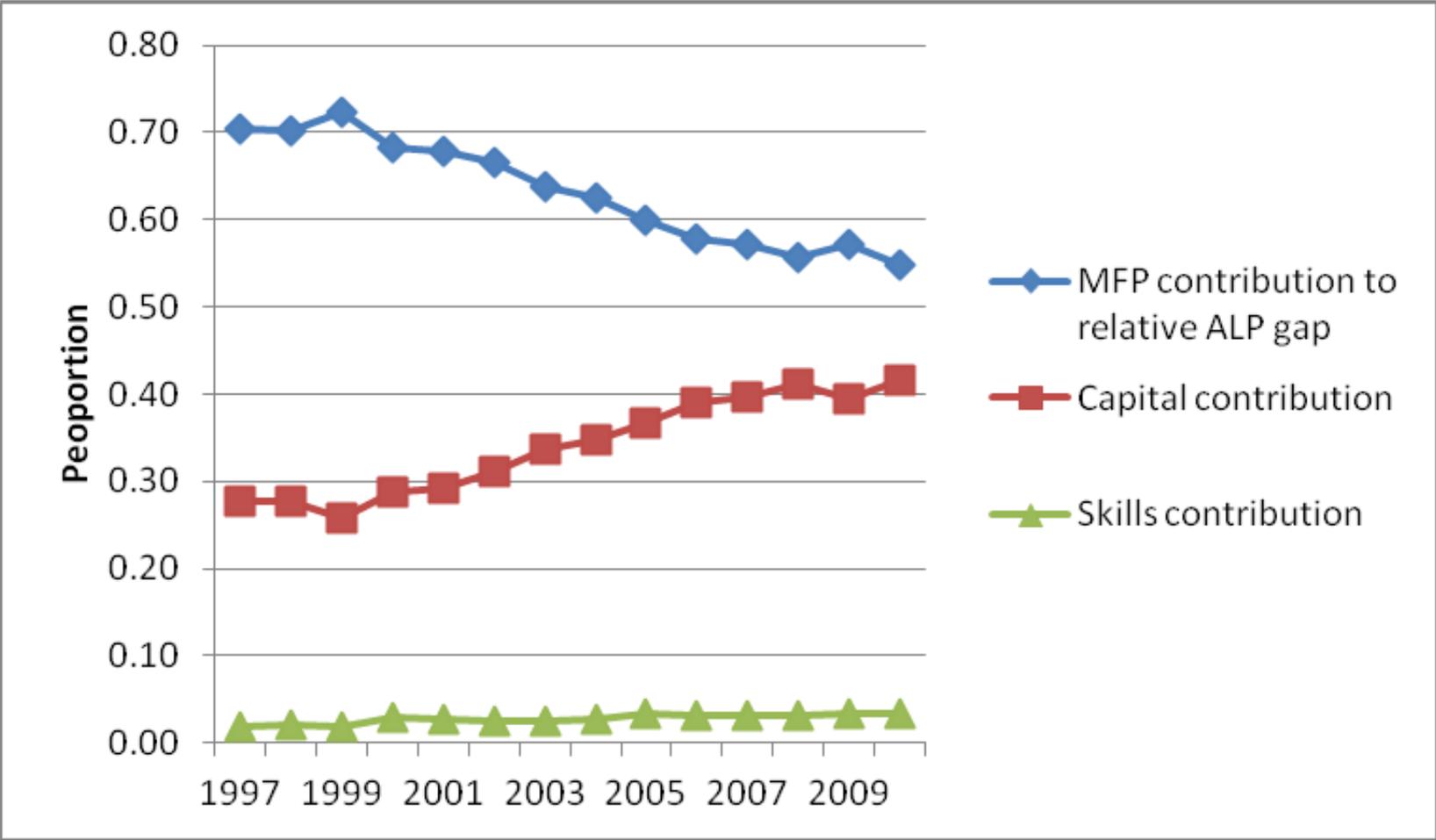
# Interpretation of MFP measure

- Among other things cross-country differences in estimated MFP levels may reflect differences in:
  - capacity utilisation
  - effectiveness with which new technologies are used
  - implementation of innovative work practices
  - diffusion of new ideas and knowledge between firms and industries
  - speed of reallocation of resources from less efficient to more efficient firms
  - firm sizes (production scale)
  - impact of economies of agglomeration (through urban scale)
- At the same time, MFP measures also pick up the effects of unmeasured capital inputs such as land and investments in R&D and innovation which were not included in our capital stocks measure

**Figure 6.1: Relative ALP and MFP levels in total market industries, 1997-2010**  
(Index numbers: Australia = 100)



**Figure 6.2: Estimated contributions of relative capital-intensity, skills and MFP to the relative ALP gap in total market industries, 1997-2010**



# Industry differences in relative ALP and MFP levels

- Estimates suggest that Australia was ahead in 2009 on both ALP and MFP in 12 industries, including agriculture, mining, printing, transport equipment and machinery, construction, wholesale and retail, transport, postal and warehousing and financial services
- NZ ahead on both ALP and MFP in 5 industries: food and drink manufacturing, electricity, gas and water, rental, hiring and real estate services, professional/scientific services and arts and recreation services
- In 3 industries NZ ahead on MFP but behind on ALP: textiles and clothing manufacturing, wood and paper products and accommodation and food services
- Where a country is doing better on MFP than on ALP, the implication is that it benefits from advantages in some of the unmeasured or poorly measured variables which are captured in estimates of residual MFP

			Estimated contributions to gap in ALP (proportions)		
AUSTRALIAN LEAD ON ALP Using Groningen PPP exchange rates	ALP levels, 2009 (AUS =100)	MFP levels, 2009 (AUS =100)	Relative capital-intensity	Relative skills	Relative MFP
<b>TOTAL MARKET INDUSTRIES</b>	62	78	0.39	0.03	0.58
Manufacturing	77	98	0.83	0.07	0.1
Printing	23	24	0.01	0.01	0.99
Financial and insurance services	30	48	0.23	0.02	0.75
Construction	36	35	-0.02	0.01	1.01
Mining	43	47	0.05	0.01	0.94
Non-Metallic Mineral Product Manufacturing	46	56	0.17	0.01	0.82
Transport Equipment, Machinery and Equipment Mfg	48	62	0.25	0.02	0.73
Metal Product Manufacturing	49	96	0.89	0.02	0.10
Wholesale trade	52	77	0.49	0.02	0.48
Transport, postal and warehousing	57	71	0.28	0.03	0.68
Agriculture, forestry and fishing	62	86	0.63	0.01	0.36
Retail trade	62	72	0.23	0.03	0.74
Petroleum, Chemical, Polymer and Rubber Product Mfg	67	94	0.74	0.06	0.20
Wood and Paper Products Manufacturing	77	105	1.16	0.05	-0.21
Accommodation and food services	88	115	1.17	0.01	-0.18
Textile, Leather, Clothing and Footwear Manufacturing	89	110	1.74	0.19	-0.93

			Estimated contributions to gap in ALP (proportions)		
<b>NEW ZEALAND LEAD ON ALP Using Groningen PPP exchange rates</b>	<b>ALP levels, 2009 (AUS =100)</b>	<b>MFP levels, 2009 (AUS =100)</b>	<b>Relative capital-intensity</b>	<b>Relative skills</b>	<b>Relative MFP</b>
Arts and recreation services	108	127	-0.55	-0.04	1.59
Food, Beverage and Tobacco Product Manufacturing	112	123	-0.73	-0.21	1.94
Other services	115	100	1.03	-0.01	-0.03
Furniture and Other Manufacturing	134	91	1.28	-0.05	-0.23
Professional, scientific and technical services	170	178	0.01	-0.12	1.11
Electricity, gas, water and waste services	179	149	0.39	-0.02	0.63
Rental, hiring and real estate services	247	255	-0.04	-0.01	1.06

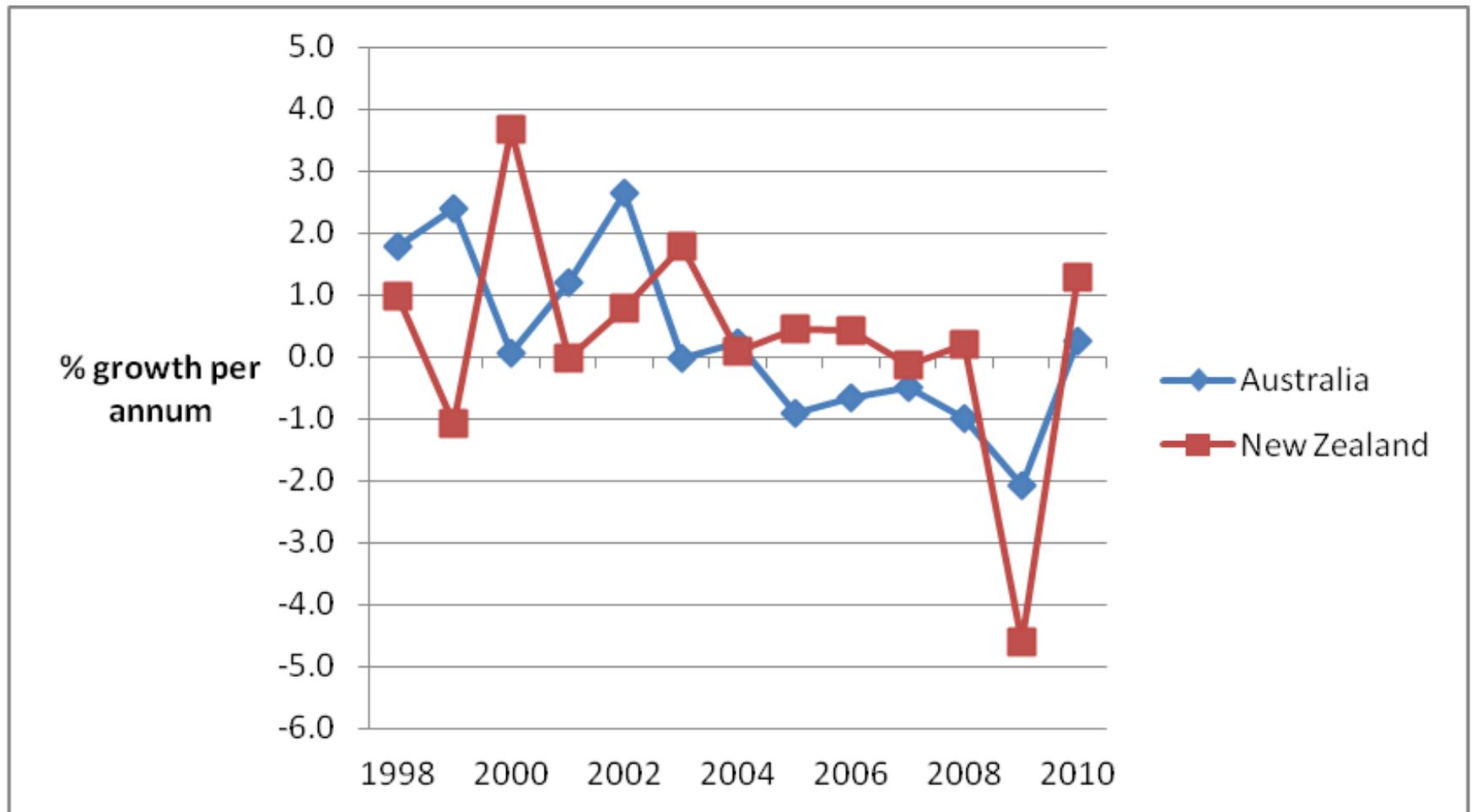
# Inter-industry variation in relative importance of capital-intensity and MFP (1)

- Focussing on 15 industries in which Australia was ahead on ALP in 2009: in six of them higher levels of capital-intensity are found to play a predominant role - metal product manufacturing, agriculture, forestry and fishing, chemicals and related industries, wood and paper products manufacturing, accommodation and food services and textiles and clothing manufacturing
- In another 8 industries it is MFP which contributes most to the Australian lead on ALP: printing, financial services, construction, mining, non-metallic mineral manufacturing, transport equipment and machinery, transport, postal and warehousing and retail trade
- In wholesale trade the contributions of MFP and capital-intensity to the Australian lead on ALP are roughly equal

# Inter-industry variation in relative importance of capital-intensity and MFP (2)

- In 5 of 7 industries where New Zealand is ahead on ALP, the main contribution to that lead comes from MFP: rental, hiring and real estate services, electricity, gas and water, professional/scientific services, food and drink manufacturing and arts and recreation services
- Impact of relative capital-intensity exceeds that of MFP in miscellaneous manufacturing and other services but, in these industry groupings, absolute levels of capital-intensity are low in both countries
- Only one sector where New Zealand is ahead on ALP and relative capital-intensity is important is electricity, gas and water where capital accounts for just under 40% of New Zealand's ALP lead, still only two thirds of the MFP contribution

**Figure 6.3: Annual growth rates in MFP in total market industries, 1997-2010**



# Recent trends in MFP growth at industry level

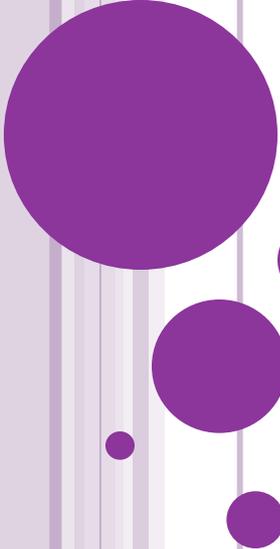
- Signs of NZ catch-up in MFP growth between 2004-08 but largely due to events in Australia
- In eight industries MFP in Australia during this period declined by an average -4% pa or even more: mining, food and drink manufacturing, chemicals and related industries, miscellaneous manufacturing, electricity, gas and water, financial and insurance services and rental, hiring and real estate services
- Much of this decline reflected 'unrequited' growth in production inputs in Australia in response to transitory factors such as drought and more favourable terms of trade facing Australian producers (Parham, 2012)
- This period of adjustment may now be over: when recession hit in 2008-09, New Zealand was much more strongly affected than Australia in a range of industries

# Assessment (1)

- Both relative MFP and relative capital-intensity contribute substantially to Australia's lead on ALP
- MFP predominates at total market industries level but there is wide variation between industries in the relative importance of MFP and capital-intensity
- Key questions for policy-makers:
  - What are the main factors restricting MFP growth in NZ?
  - What are the main factors which explain relatively low levels of business investment in all forms of capital – human capital and innovation capital as well as physical capital?
  - What, if anything, can government do in a cost-effective way to influence current levels of MFP performance and capital formation within NZ firms?

# Assessment (2)

- New research at industry and firm level needed to gather information on causes of inter-country differences in:
  - Proportion of firms operating at international technology frontier
  - Diffusion of new ideas and knowledge across international borders and within New Zealand
  - Speed of reallocation of resources between less efficient and more efficient firms in domestic product markets
  - Vocational education and training element in different qualification groups
  - Business investment in different forms of capital: skills, R&D and innovation capital as well as physical capital



**SYMPOSIUM:**  
**UNPICKING**  
**NEW ZEALAND'S**  
**PRODUCTIVITY PARADOX**

2 July 2013, Oceania, Te Papa Tongarewa