

# **Innovation & the performance of New Zealand firms**

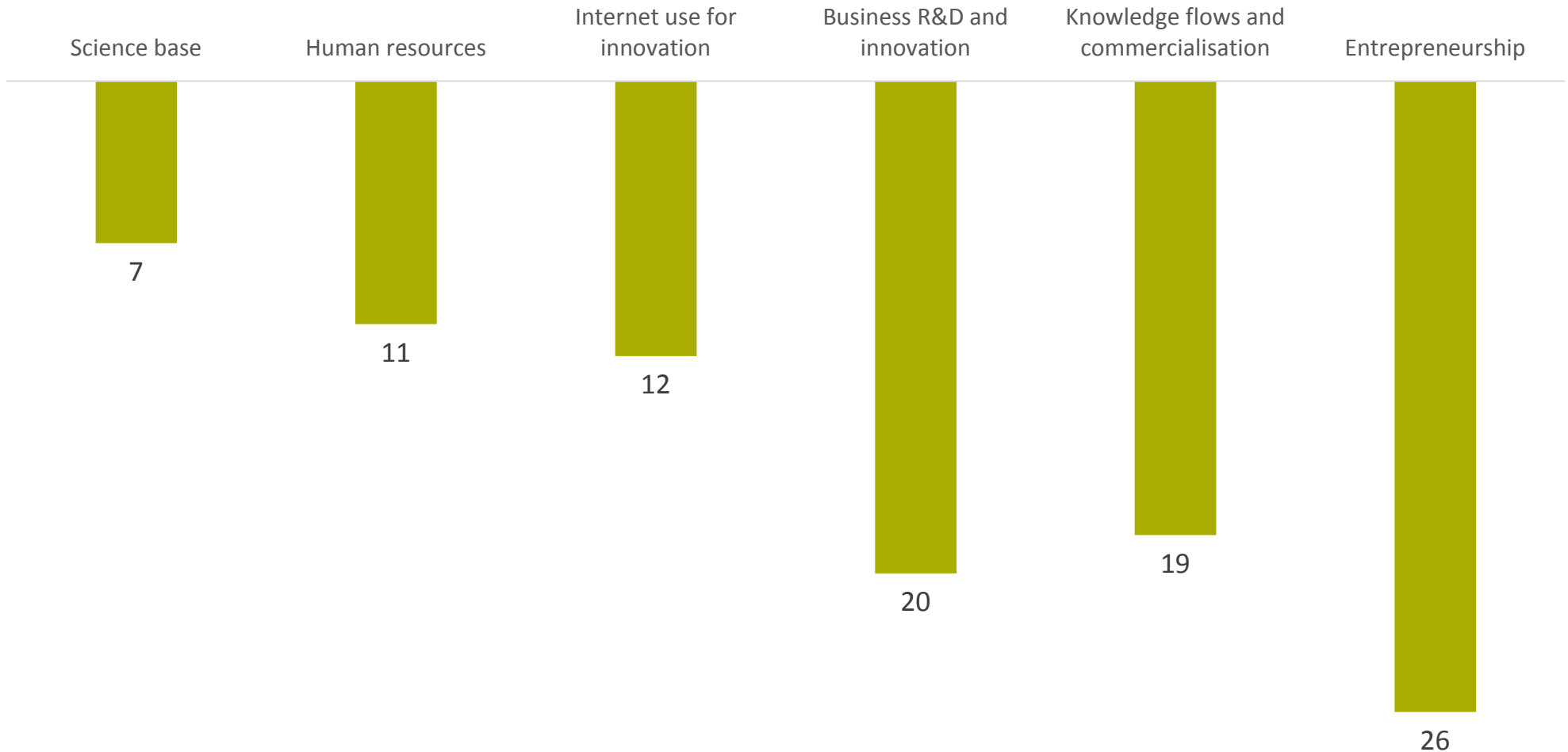
Simon Wakeman

APIC conference

2 December 2017

# International comparisons show NZ near top of OECD rankings in generating science but lower ranked in commercialising innovation

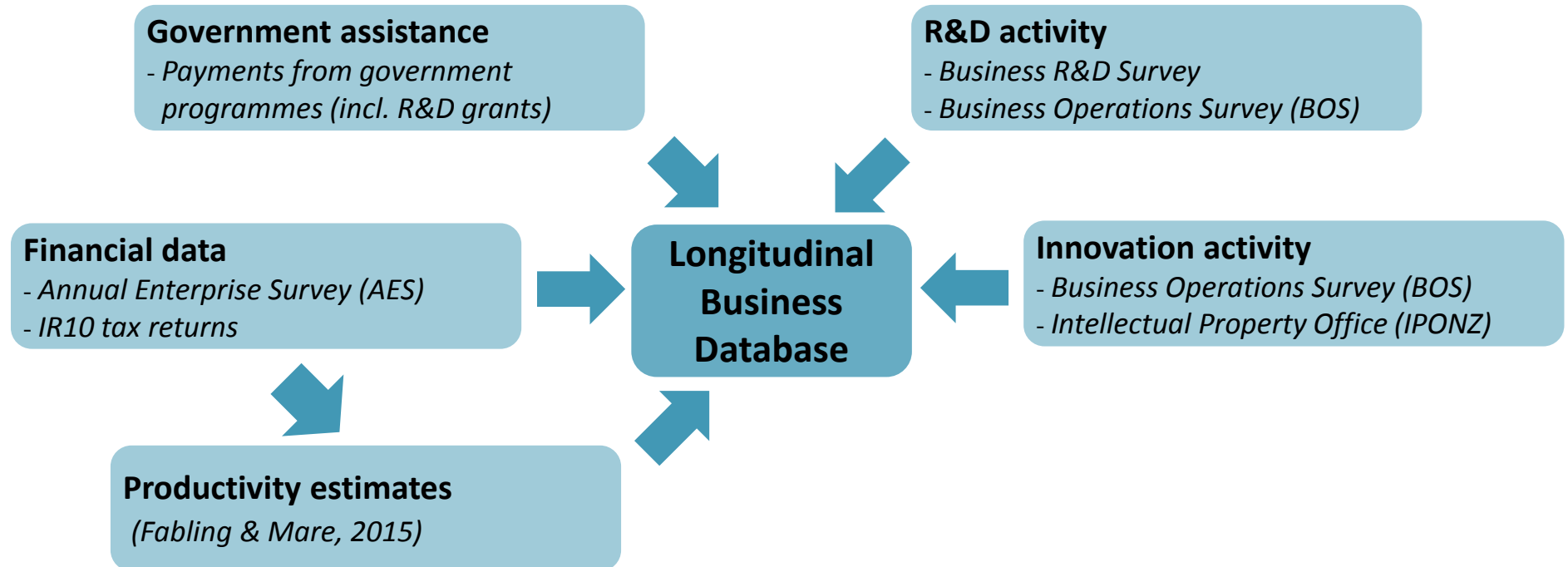
## NZ'S AVERAGE RANKING IN TOP-LEVEL CATEGORIES OF OECD STATISTICS



# Use Statistics NZ's Longitudinal Business Database to study relationship between innovation and productivity for New Zealand firms

---

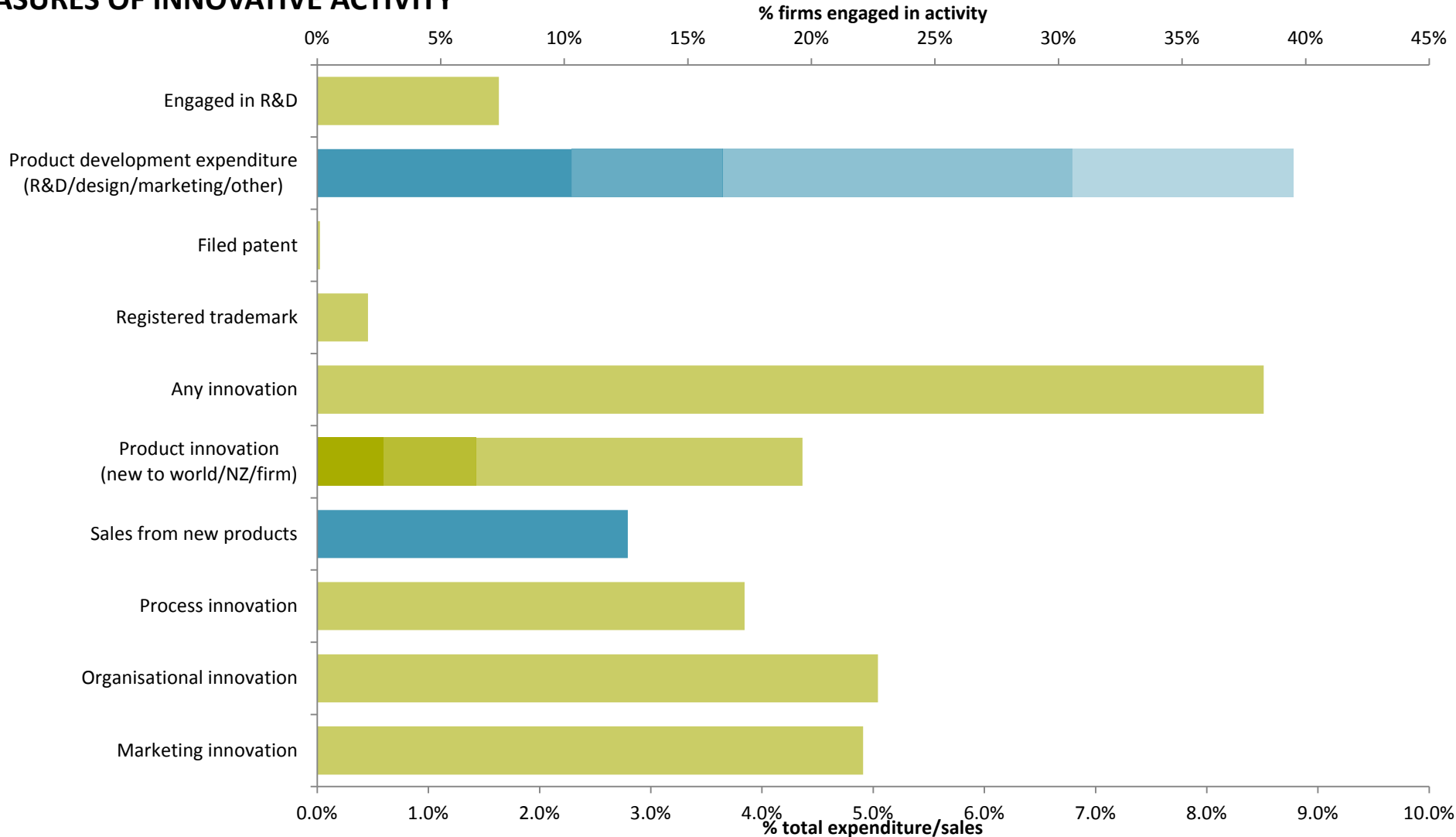
## DATA SOURCES



Access to the data presented was managed by Statistics New Zealand under strict micro-data access protocols and in accordance with the security and confidentiality provisions of the Statistic Act 1975. These findings are not Official Statistics. The opinions, findings, recommendations, and conclusions expressed are those of the author/researcher, not Statistics New Zealand or the New Zealand Productivity Commission.

# Range of measures in LBD show different rates of innovation

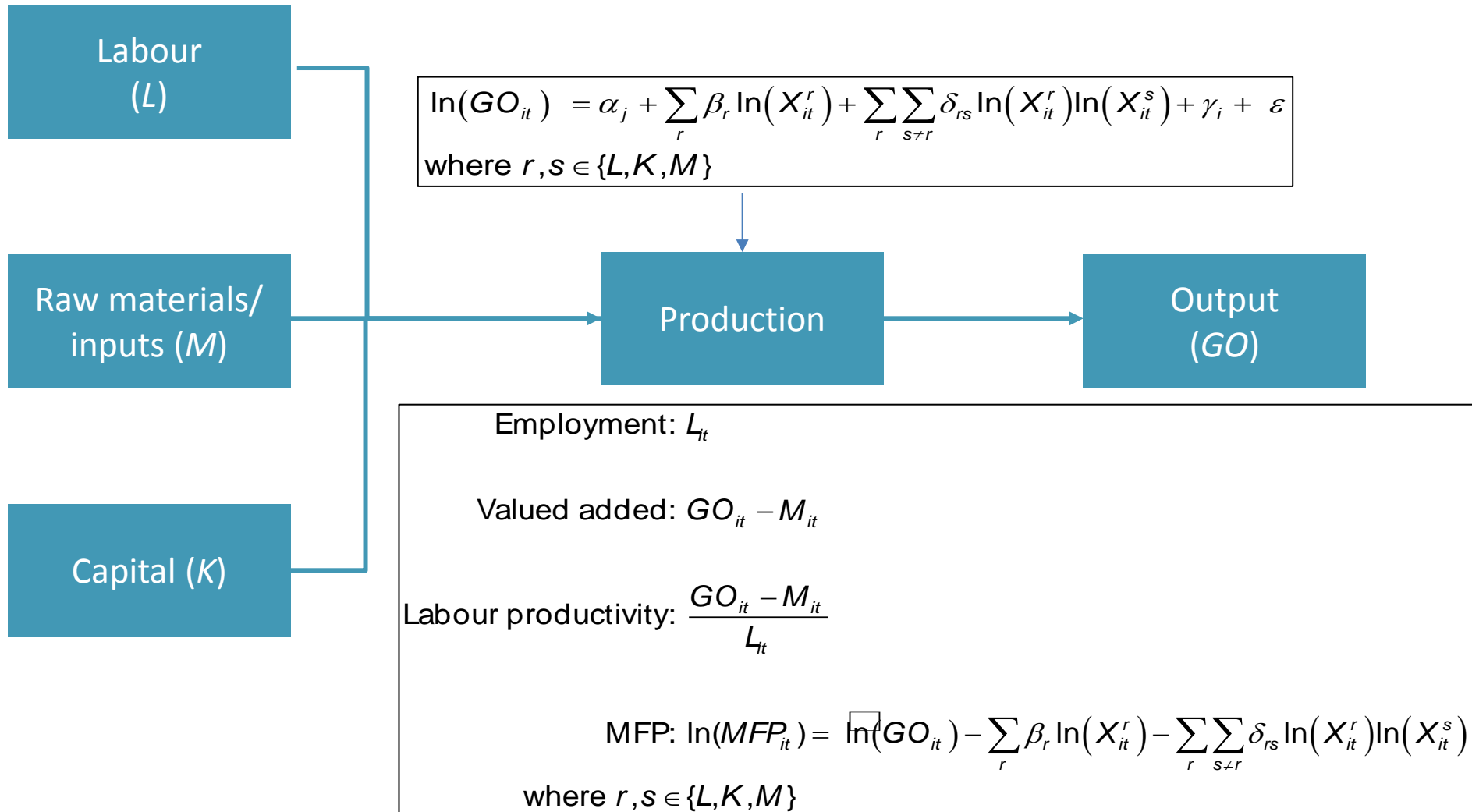
## MEASURES OF INNOVATIVE ACTIVITY



Sample contains responses to Business Operations Survey (2005-2013).

# Use approach for estimating productivity of NZ firms developed by Fabling & Mare (2015)

## MEASURING FIRM PERFORMANCE



# On average innovating firms larger but less productive than non-innovating firms in year in which innovation occurs

## RELATIVE OUTPUT LEVEL INNOVATORS VS. NON-INNOVATORS BY INNOVATION MEASURE

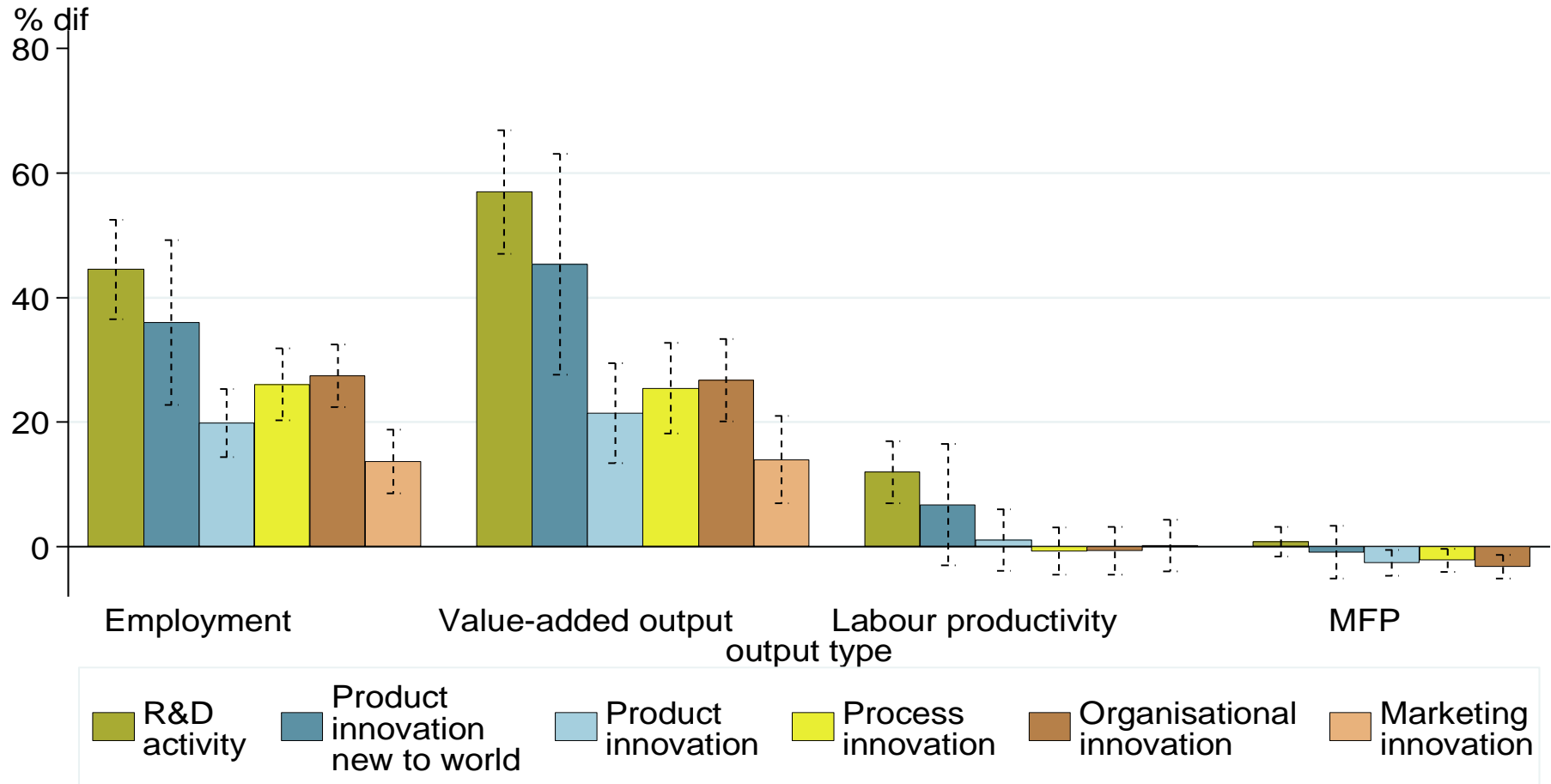


Chart shows difference in performance measure predicted from series of OLS regressions of output level in year 0 on innovation in year 0 with controls for year and industry. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with performance measures up to 2012. Observations weighted by BOS sampling weights.

## Use difference-in-differences approach to measure impact of innovation on productivity

---

### EMPIRICAL APPROACH

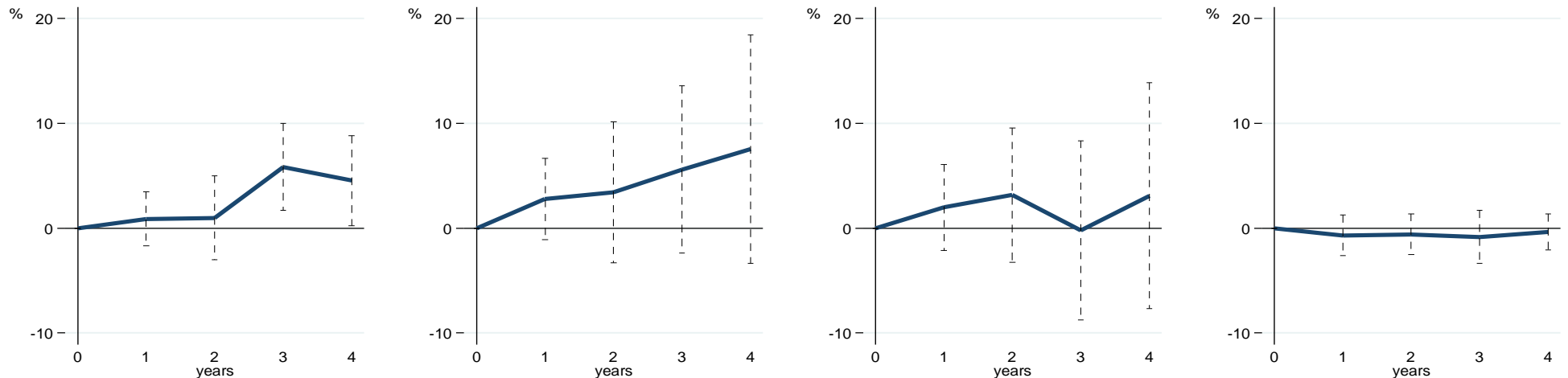
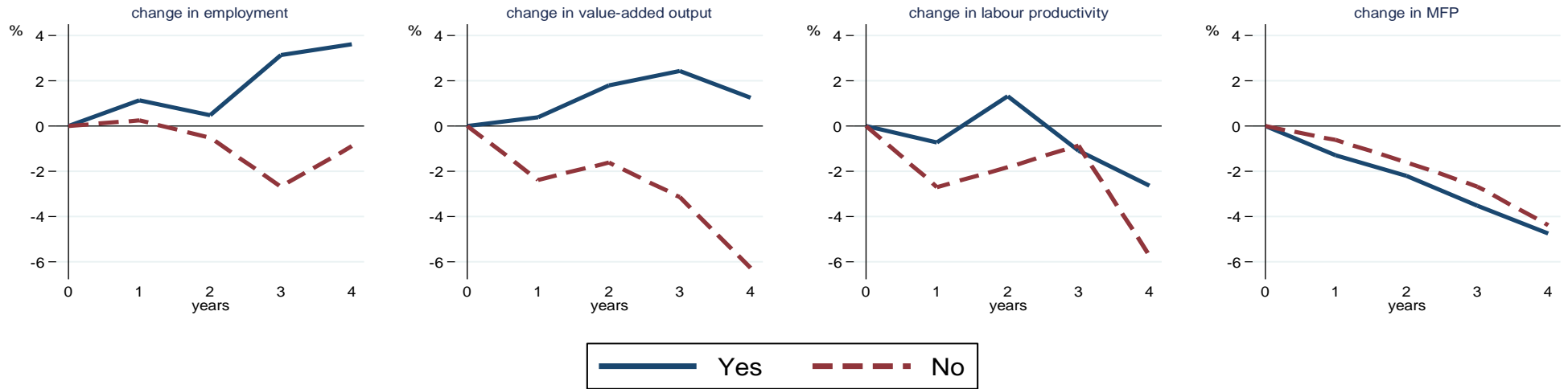
- Regress change in firm output/productivity ( $\ln Y_{in} - \ln Y_{i0}$ ) on innovation in year 0 ( $I_0$ )

$$\ln Y_{in} - \ln Y_{i0} = \alpha + \beta_I I_{i0} + \beta_X X_{i0} + t + \varepsilon$$

- Compare within-firm differences in output  $\Rightarrow$  controls for unobserved firm characteristics affecting output levels
- Control for observed firm characteristics (age, size, industry, etc.)  $\Rightarrow$  controls for observed firm characteristics affecting changes in output
- For MFP, use 2-year moving average  $\Rightarrow$  accounts for measurement error
- Weight observations by BOS sampling weights times predicted gross output  $\Rightarrow$  quantities corresponds to aggregate economic output/productivity
- Do not instrument for innovation (cf Crepon, Duguet & Mairesse, 1998)

# Firms engaged in R&D activity have faster employment and output growth than non-R&D-active firms but productivity growth not different

## RELATIVE GROWTH BY OUTPUT TYPE OF R&D ACTIVE VS NON-ACTIVE FIRMS

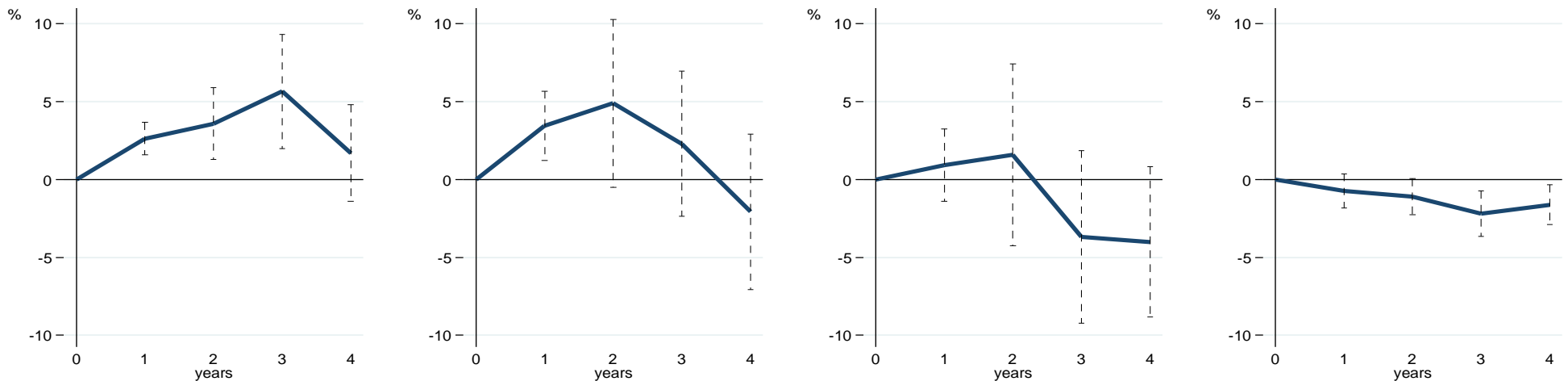
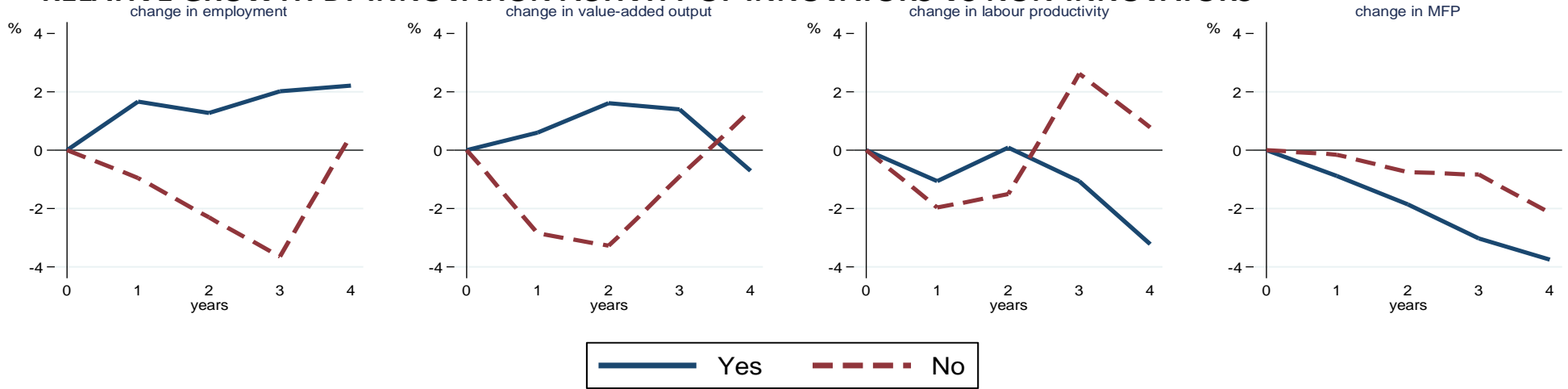


Charts show difference in predictive margins from series of OLS regressions of change in output from year 0 to year  $t$  on innovation in year 0. Regressions include controls for base year and firm characteristics. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-10 2011 with output measures until 2012. Observations weighted by BOS sampling weights times predicted output.



# Similarly firms engaged in innovation grow faster in size but a decline in MFP

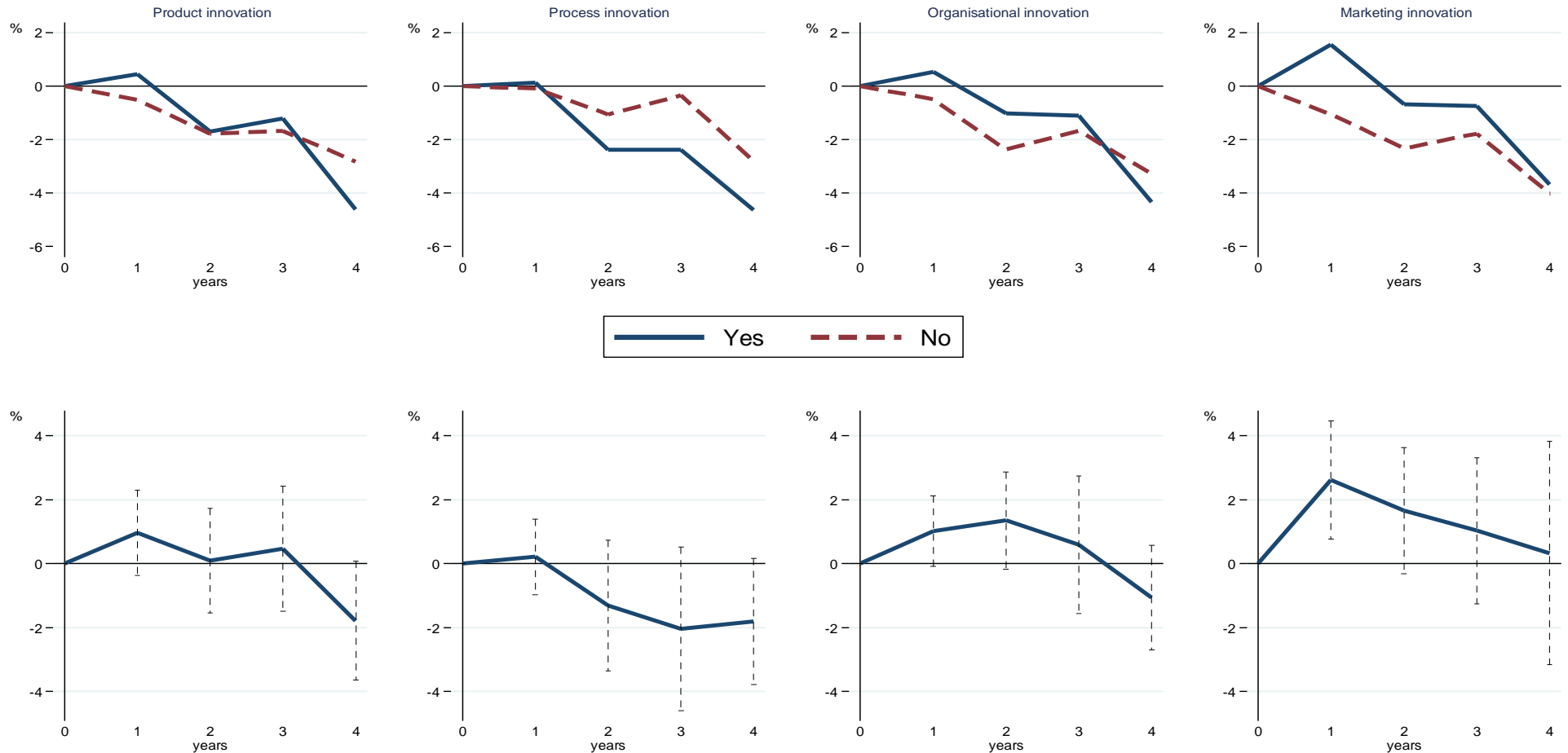
## RELATIVE GROWTH BY INNOVATION ACTIVITY OF INNOVATORS VS NON-INNOVATORS



Charts show difference in predictive margins from series of OLS regressions of change in output from year 0 to year  $t$  on innovation in year 0. Regressions include controls for base year and firm characteristics. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-11 2011 with output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

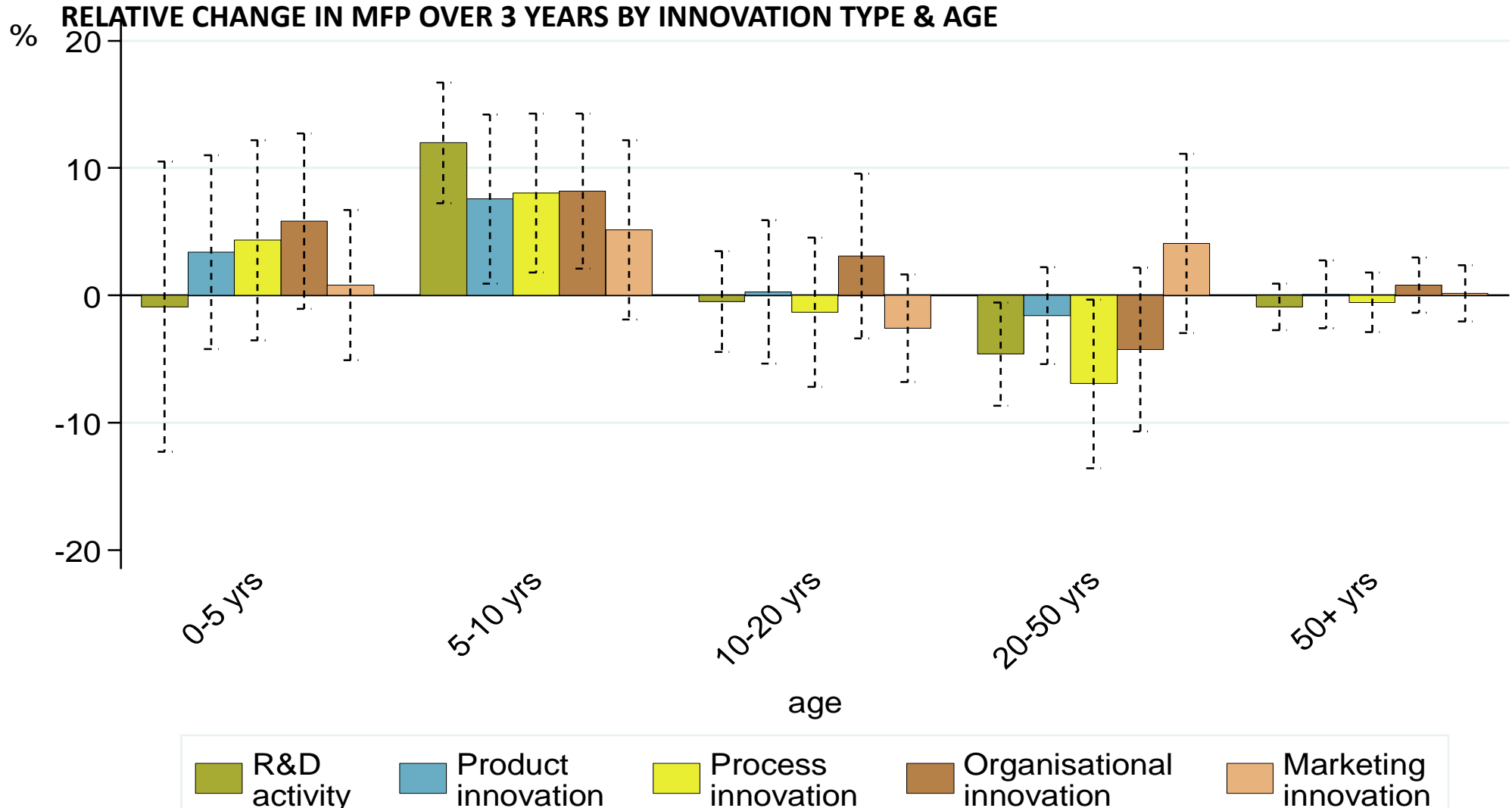
# Only firms engaged in marketing innovation experience significantly higher productivity growth

## RELATIVE MFP GROWTH BY INNOVATION TYPE OF INNOVATORS VS NON-INNOVATORS



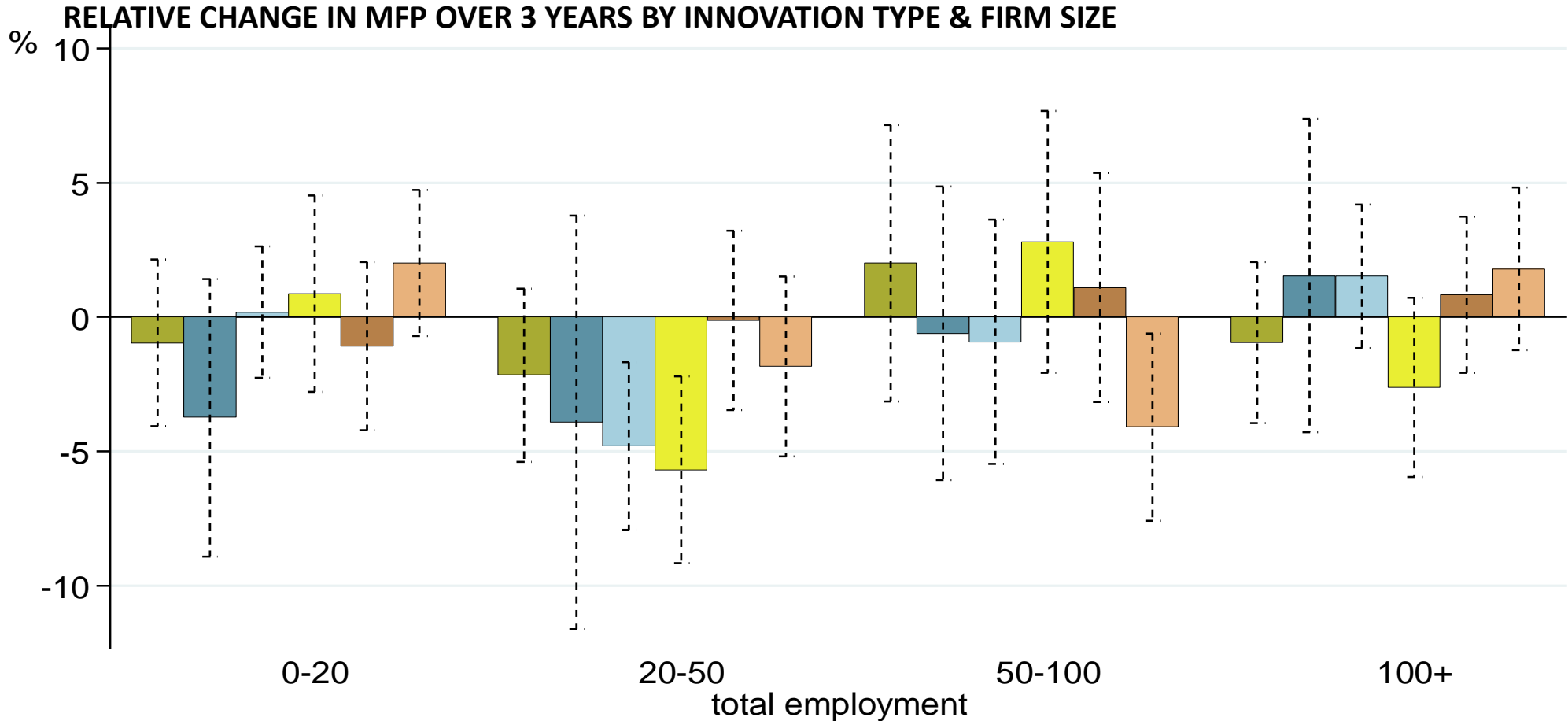
Charts show coefficients from OLS regressions of change in 2-yr-MA of MFP from year 0 to  $t$  on innovation in year 0. Regressions include controls for base year and firm characteristics. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

# Younger firms experience highest boost in productivity growth following innovation



Charts show difference in predictive margins from series of OLS regressions of change in 3-yr MA of MFP from year 0 to year  $t$  on innovation in year 0 interacted with firm characteristics and controls for base year. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with 13 output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

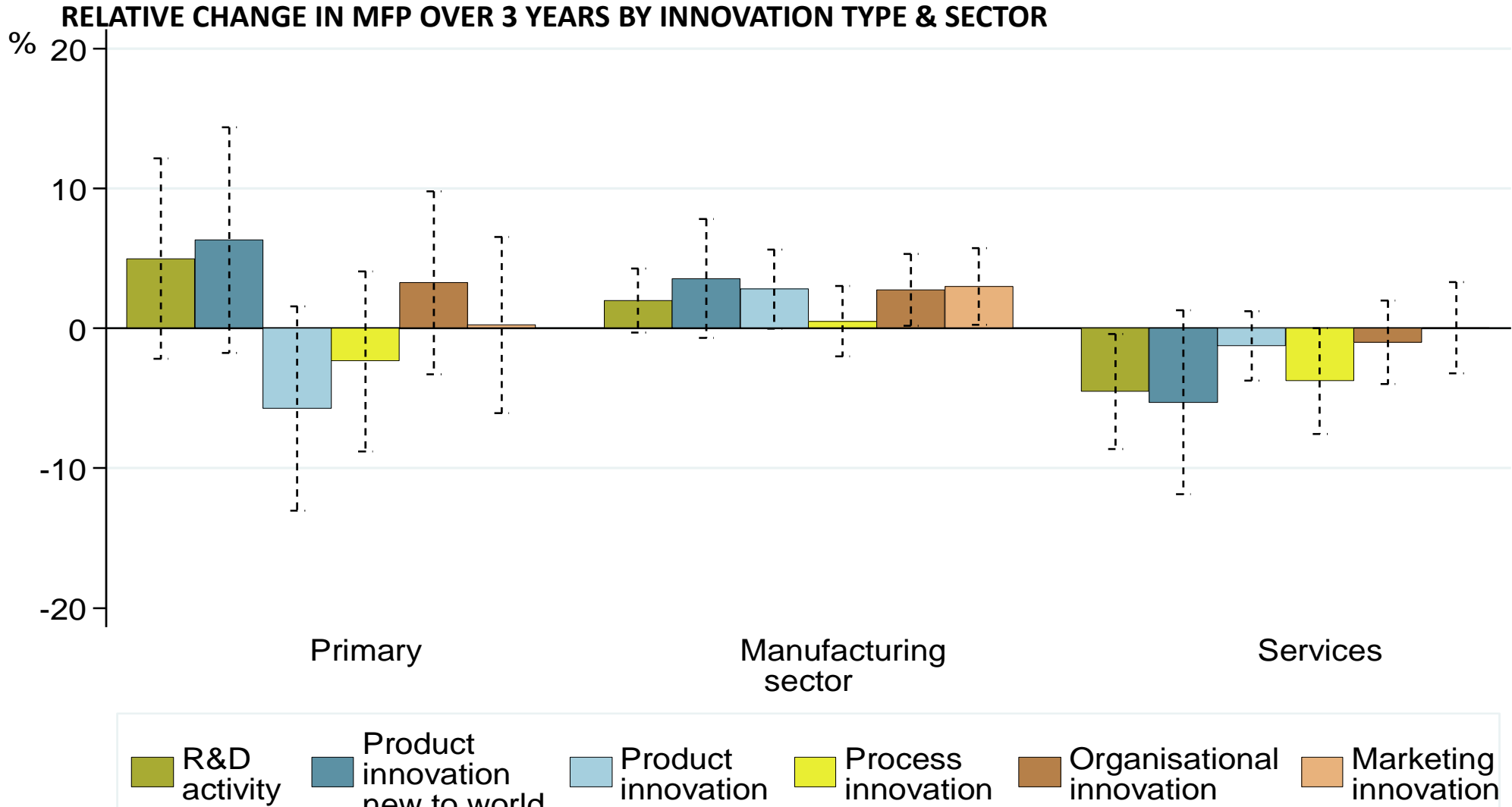
# Small-to-medium-size firms doing product & process innovation perform worse



R&D activity
  Product innovation new to world
  Product innovation
  Process innovation
  Organisational innovation
  Marketing innovation

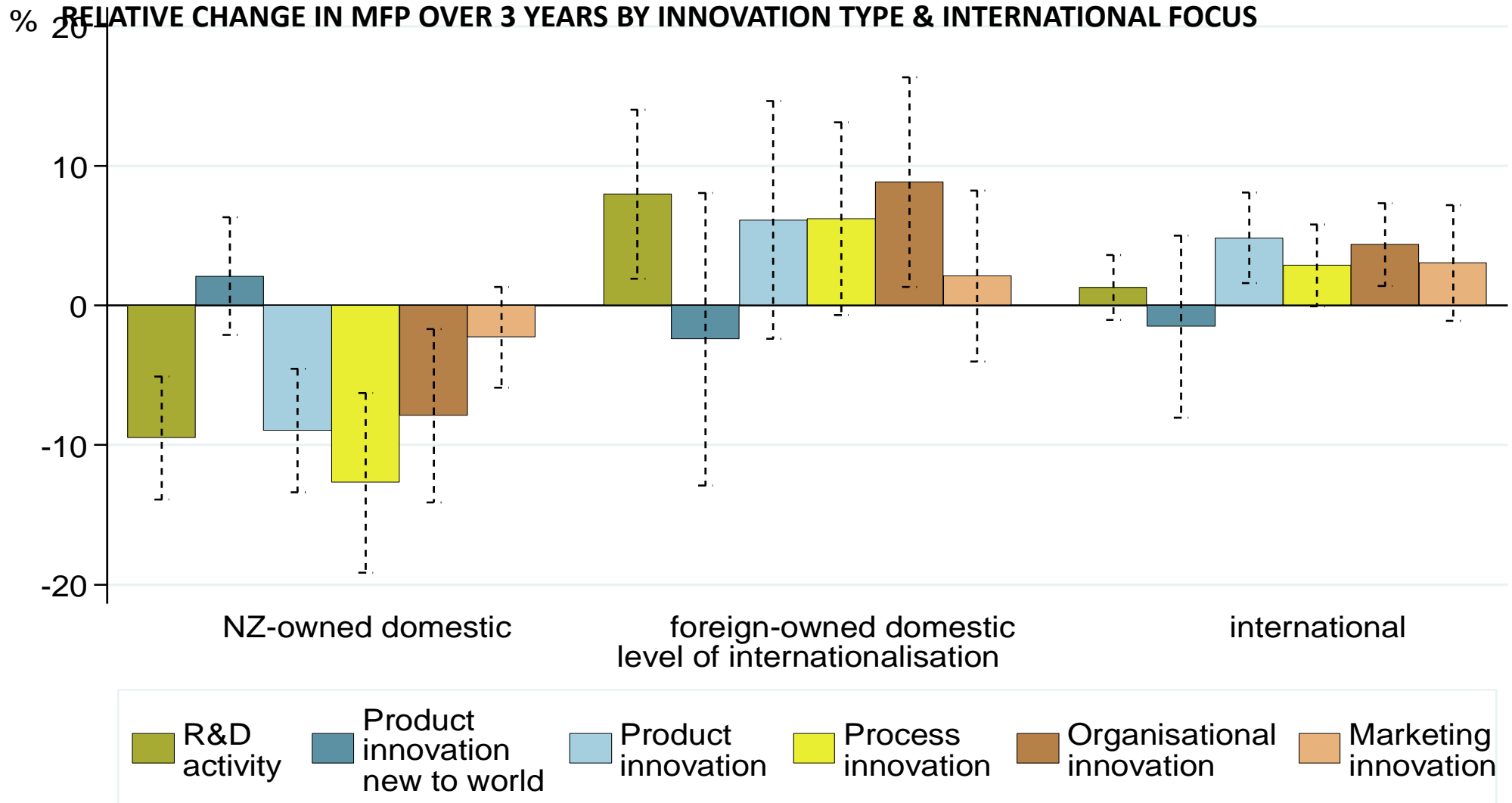
Charts show difference in predictive margins from series of OLS regressions of change in 3-yr MA of MFP from year 0 to year  $t$  on innovation in year 0 interacted with firm characteristics and controls for base year. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with 4 output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

# Firms in manufacturing sector experience strongest impact of innovation on MFP growth



Charts show difference in predictive margins from series of OLS regressions of change in 3-yr MA of MFP from year 0 to year  $t$  on innovation in year 0 interacted with firm characteristics and controls for base year. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with 15 output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

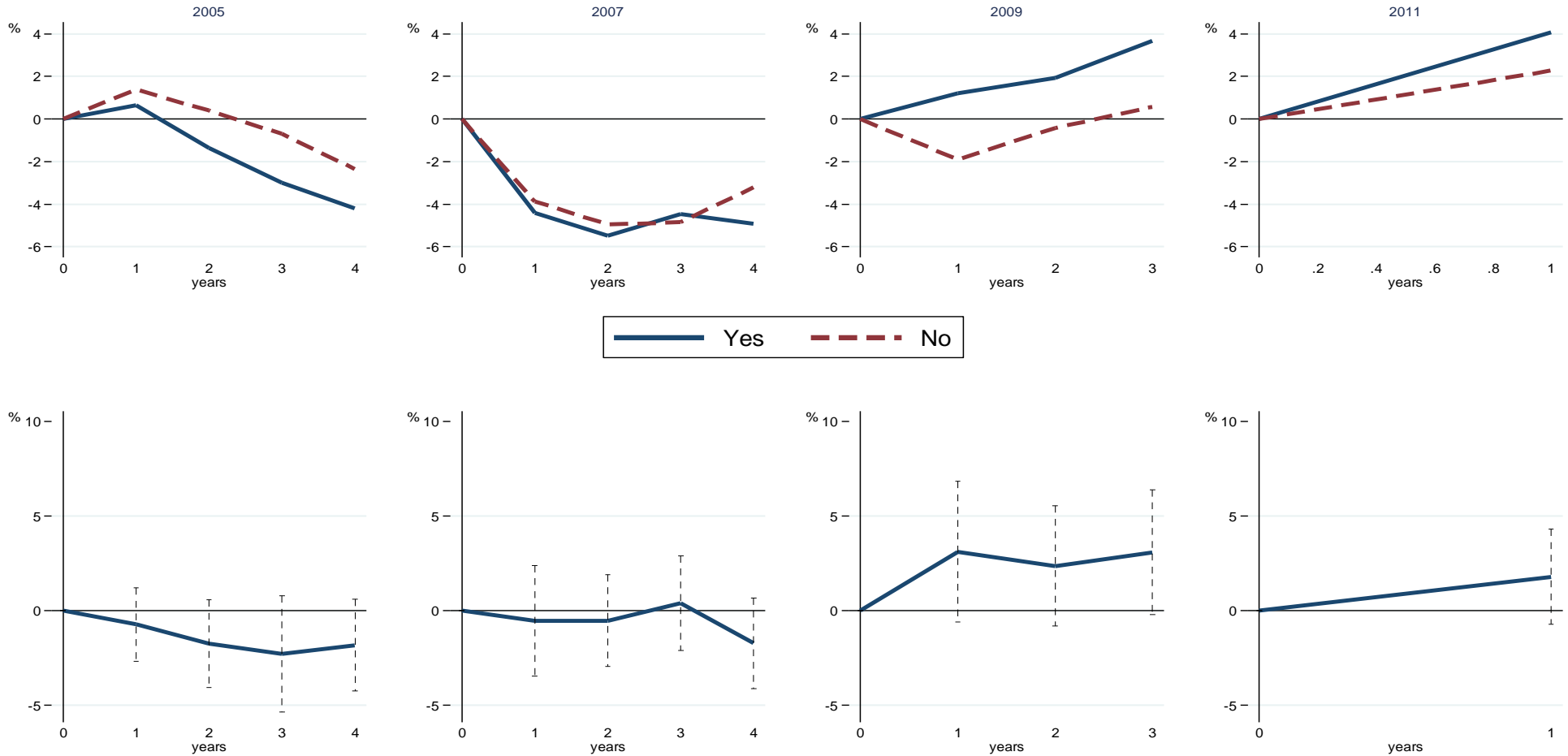
# Internationally connected firms engaged in product or organisational innovation experience higher MFP growth, while domestic firms have lower growth



Charts show difference in predictive margins from series of OLS regressions of change in 3-yr MA of MFP from year 0 to year  $t$  on innovation in year 0 interacted with firm characteristics and controls for base year. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with 6 output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

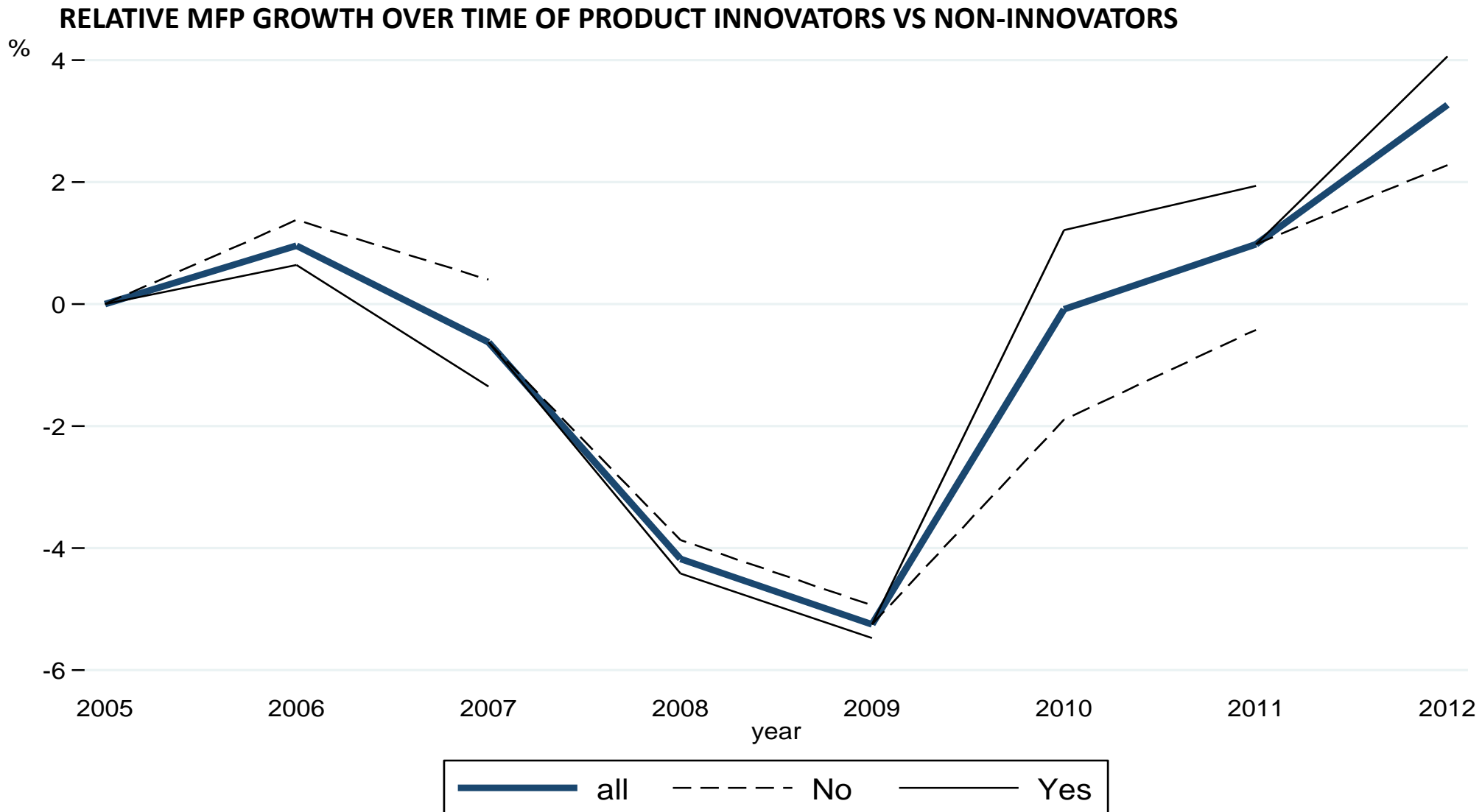
# Returns to innovation vary dramatically by year

## RELATIVE MFP GROWTH BY YEAR OF PRODUCT INNOVATORS VS NON-INNOVATORS



Charts show coefficients from OLS regressions of change in 2-yr-MA of MFP from year 0 to t on innovation in year 0. Regressions include controls for base year and firm characteristics. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

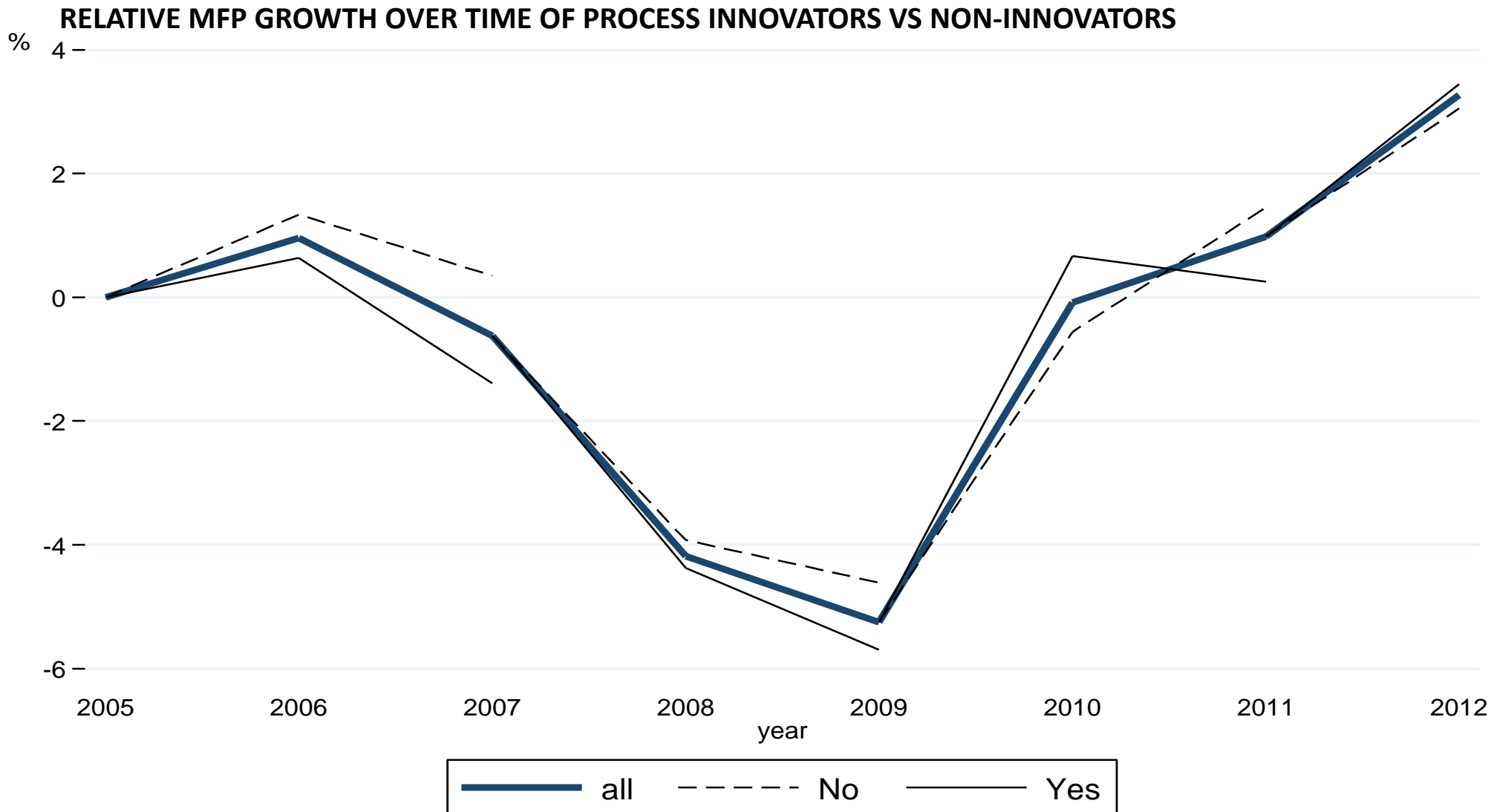
# Product innovators experience higher MFP growth during economic recovery but possibly lower growth during economic downturn



Charts show coefficients from OLS regressions of change in 2-yr-MA of MFP from year 0 to t on innovation in year 0. Regressions include controls for base year and firm characteristics. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

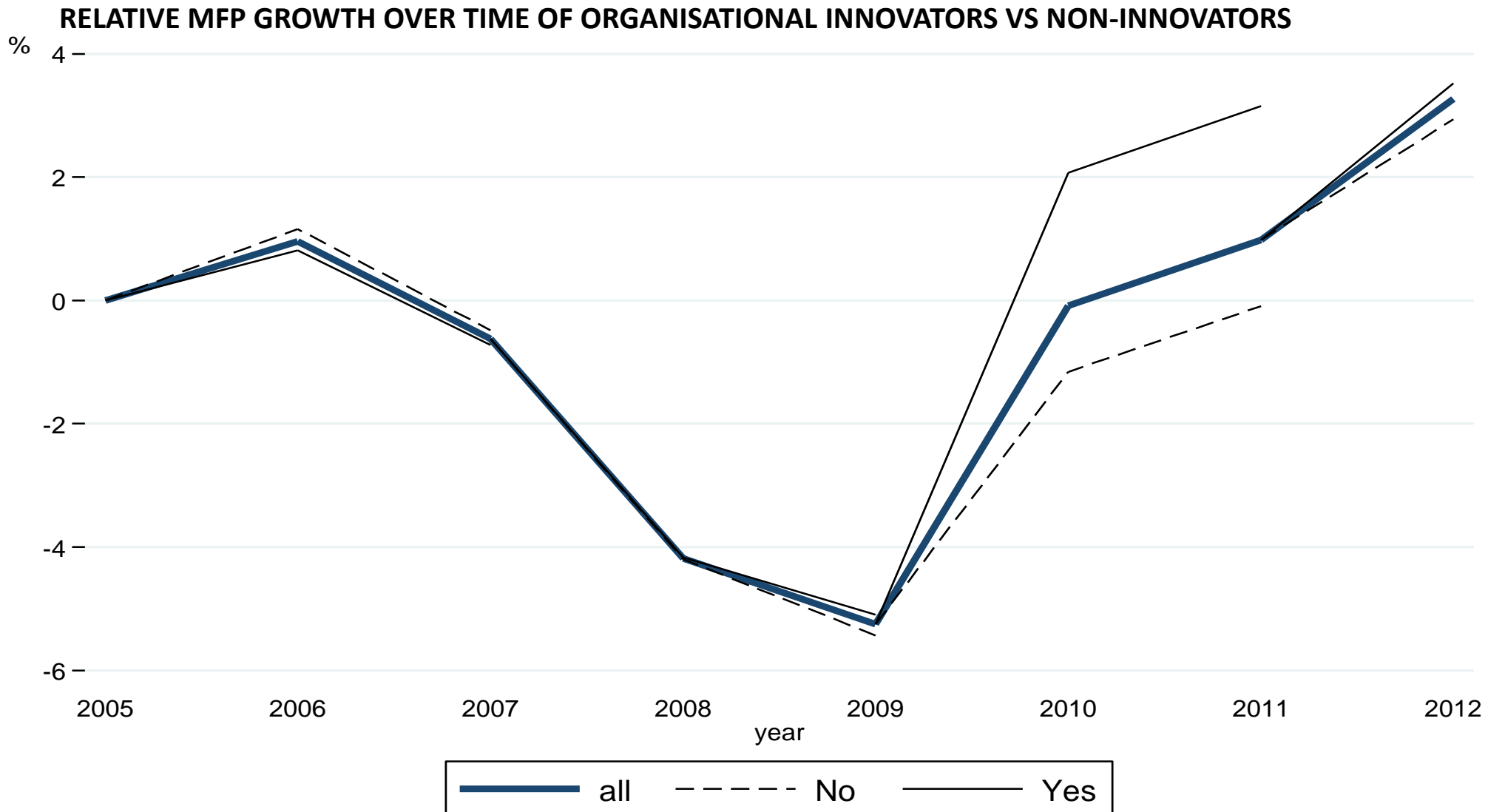


## Returns to process innovation do not vary significantly by year



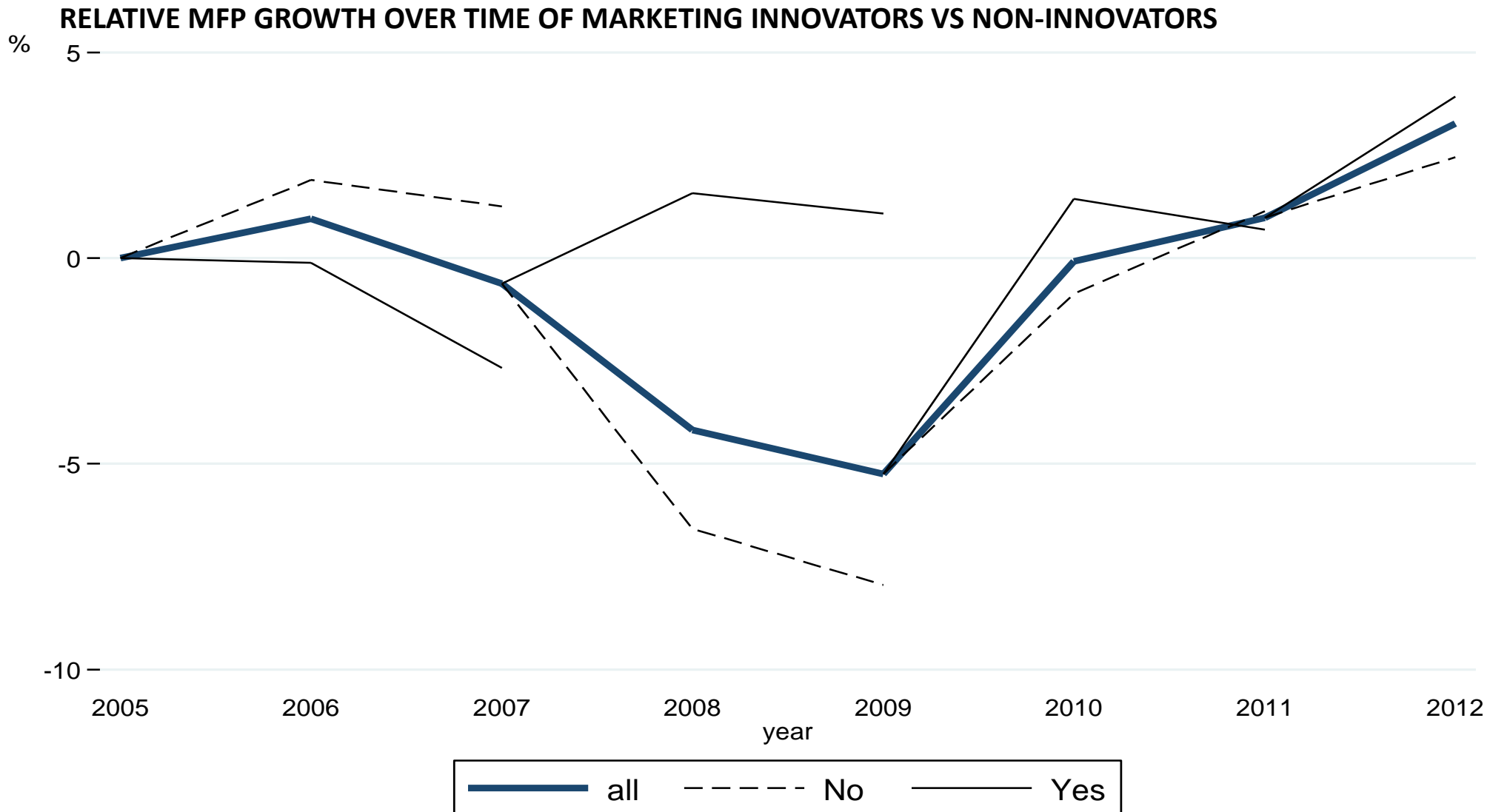
Charts show coefficients from OLS regressions of change in 2-yr-MA of MFP from year 0 to t on innovation in year 0. Regressions include controls for base year and firm characteristics. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

# Firms doing organisational innovation during economic downturn experience significantly higher returns during economic recovery



Charts show coefficients from OLS regressions of change in 2-yr-MA of MFP from year 0 to t on innovation in year 0. Regressions include controls for base year and firm characteristics. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

# Firms that had introduced marketing innovation did significantly better during economic downturn



Charts show coefficients from OLS regressions of change in 2-yr-MA of MFP from year 0 to t on innovation in year 0. Regressions include controls for base year and firm characteristics. Bars show 95% confidence intervals. Sample contains firms in BOS 2005-2011 with output measures until 2012. Observations weighted by BOS sampling weights times predicted output.

## **Innovation matters for productivity, but more for some firms than others**

---

### **FINDINGS**

- R&D and innovation associated with growth in output but not necessarily with productivity
- Firms doing marketing innovation, younger firms, manufacturing firms, and firms with international connections have highest relative performance following innovation
- Returns to innovation varies across time, and appears related to wider economics conditions

### **CONCLUSIONS**

- More to innovation than R&D
- Non-technological-types of innovation matter as much if not more
- Market conditions important
- Some types of firms get more value out of innovation than others