

# NZ Hospital Performance (2001-09)

Outputs, Inputs, and Productivity

# Motivating questions

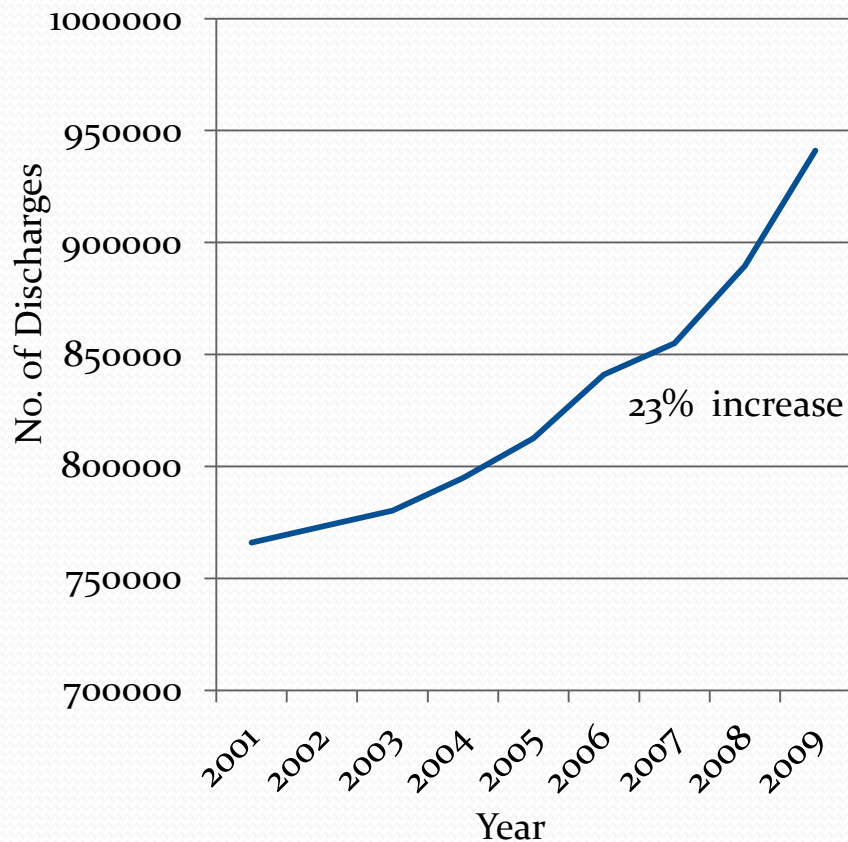
- Have NZ hospitals become more/less productive in the past 9 years (2001-09)?
  - What is the evidence?
  - What are the limitations in drawing inferences from available data and statistical models?
- Are there identifiable differences in hospital productivity across DHBs?
  - What is the evidence?
  - What factors explain differences?
  - What are the limitations in drawing inferences from available data and statistical models?

# Hospital Outputs

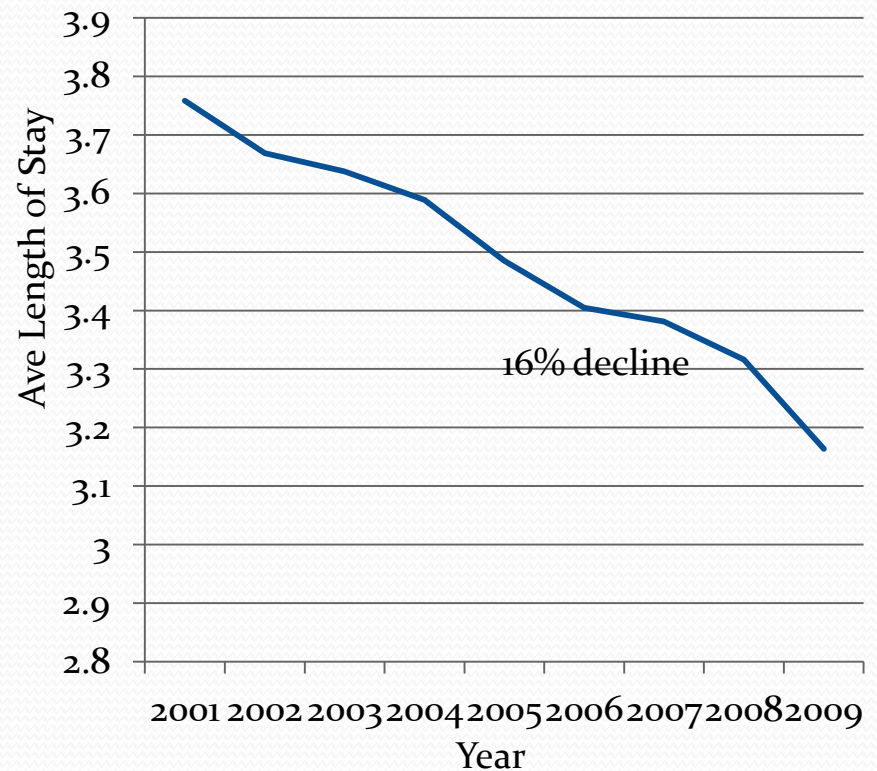
- Data
  - NMDS 2001-2009
    - all facilities, all discharges
- Measures
  - Case mix weighted total discharges per month/year
    - using relative resource use by DRG (WEIS) as weights
  - Average length of stay
  - Proportion of day stays
- Shortcoming
  - No outpatient & emergency department visits
    - ~25% (or more) of total hospital output

# Hospital Output – over the years

## No. of discharges

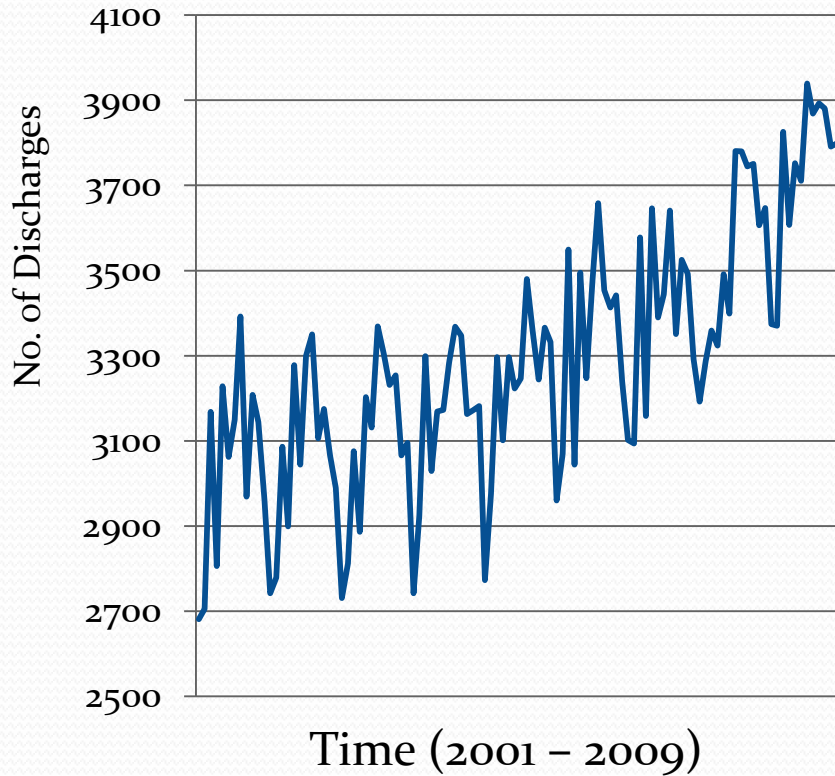


## Average length of stay (days)

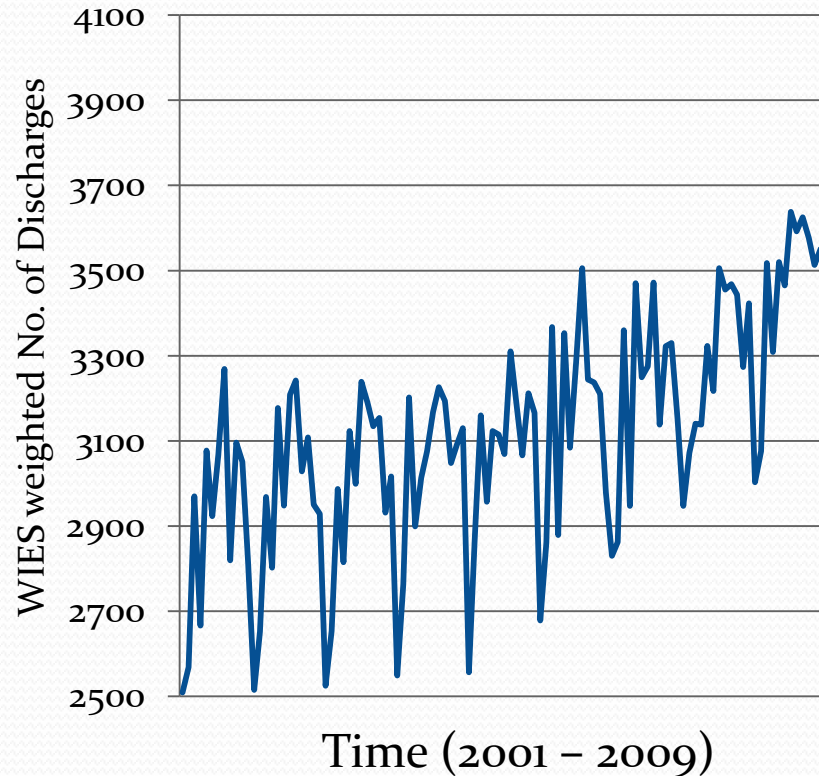


# Total Discharges per month

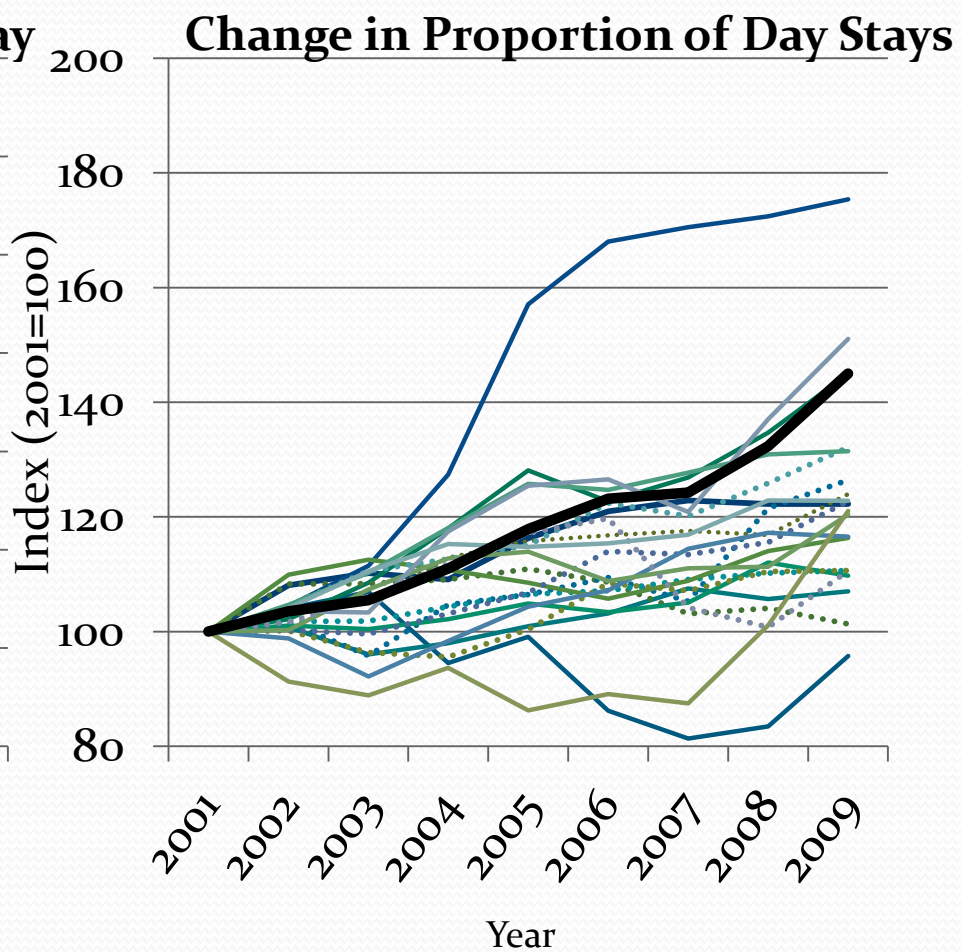
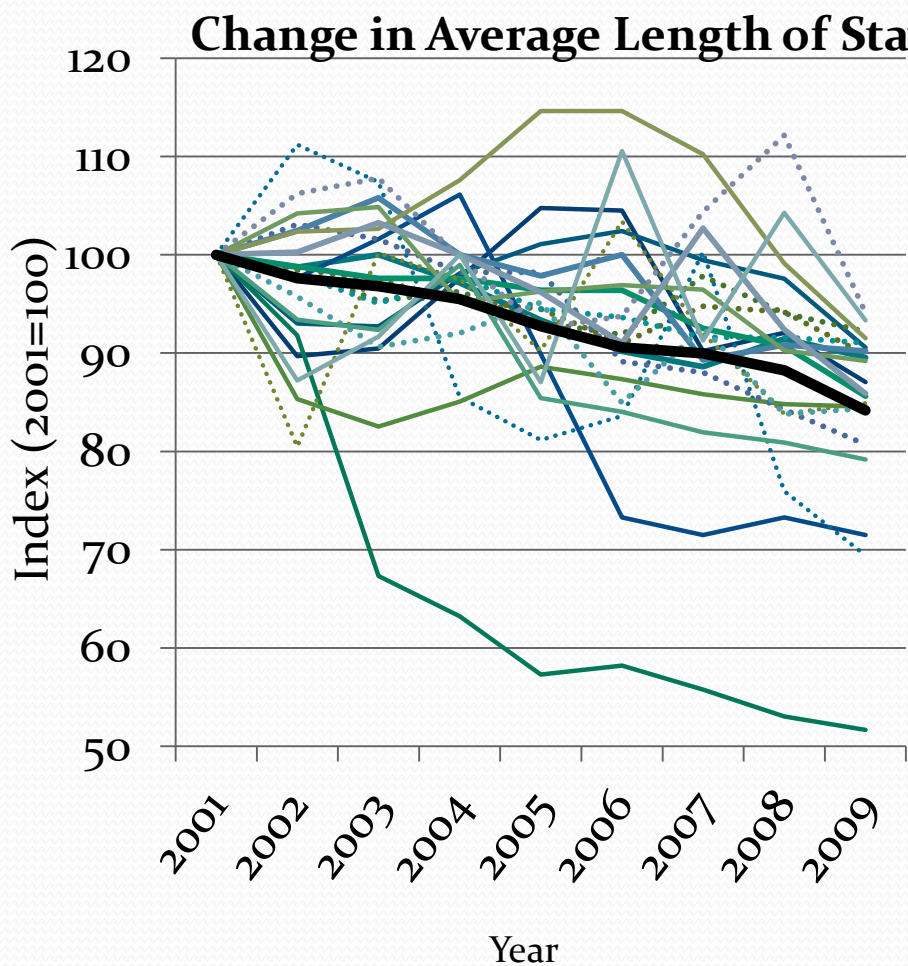
## Mean discharges per month



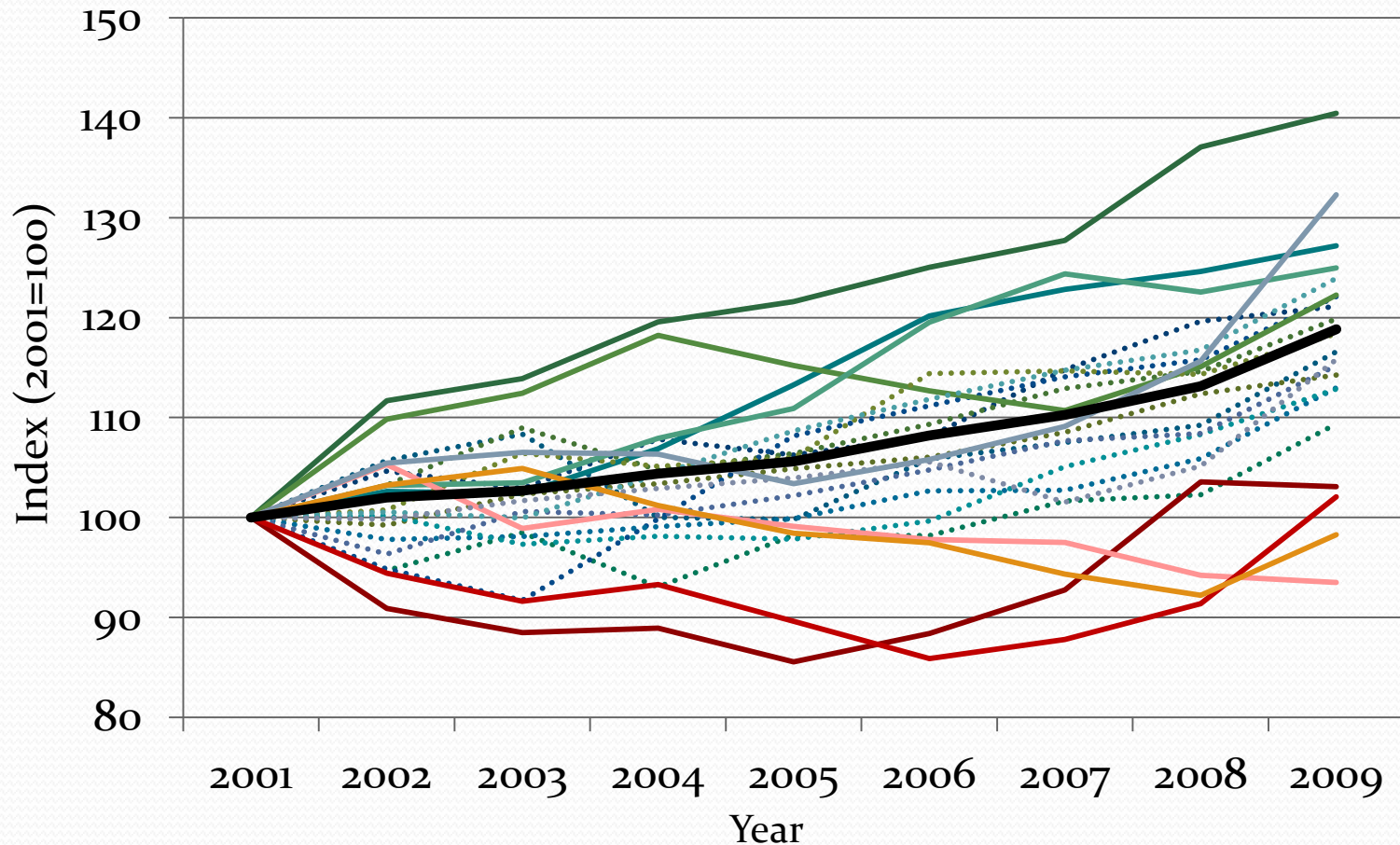
## Mean WEIS-weighted discharges per month



# Average length of stay & proportion day stays



# Change in WEIS-weighted Annual discharges



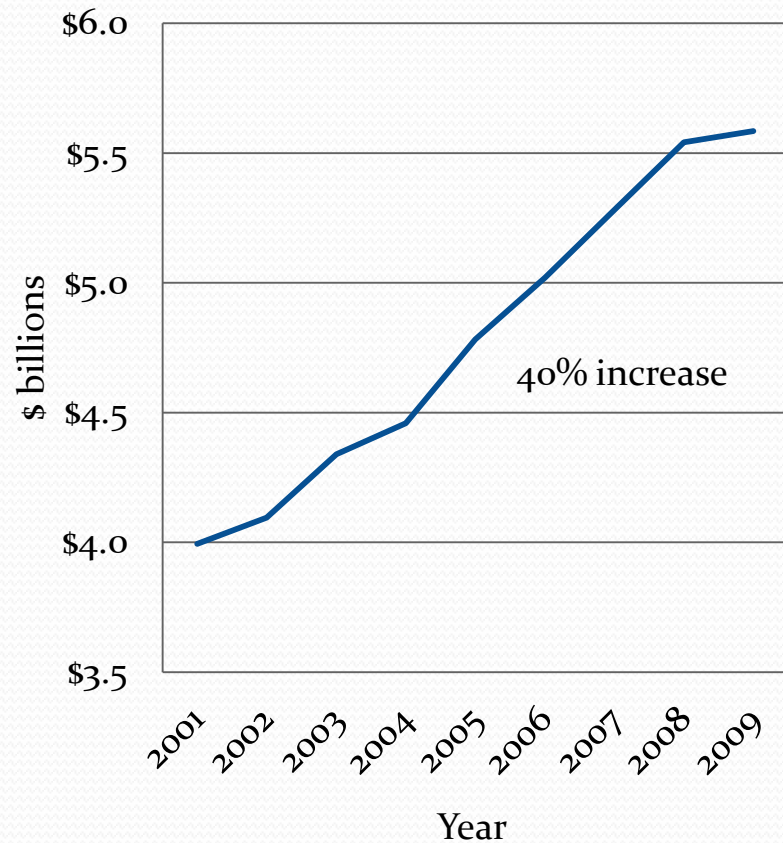
# Hospital Inputs

- Data
  - DHB Provider expenditures 2001-2009 (MoH)
    - By month, disaggregated by type, with FTEs
- Measures
  - Total real expenditures in 2001 NZD (1<sup>st</sup> Qtr)
  - Deflation using GDP deflator (Stats NZ)
  - Proportions by type of expenditure (later)
- Shortcoming
  - DHB-level aggregation
  - No breakdown by inpatient, outpatient, ED

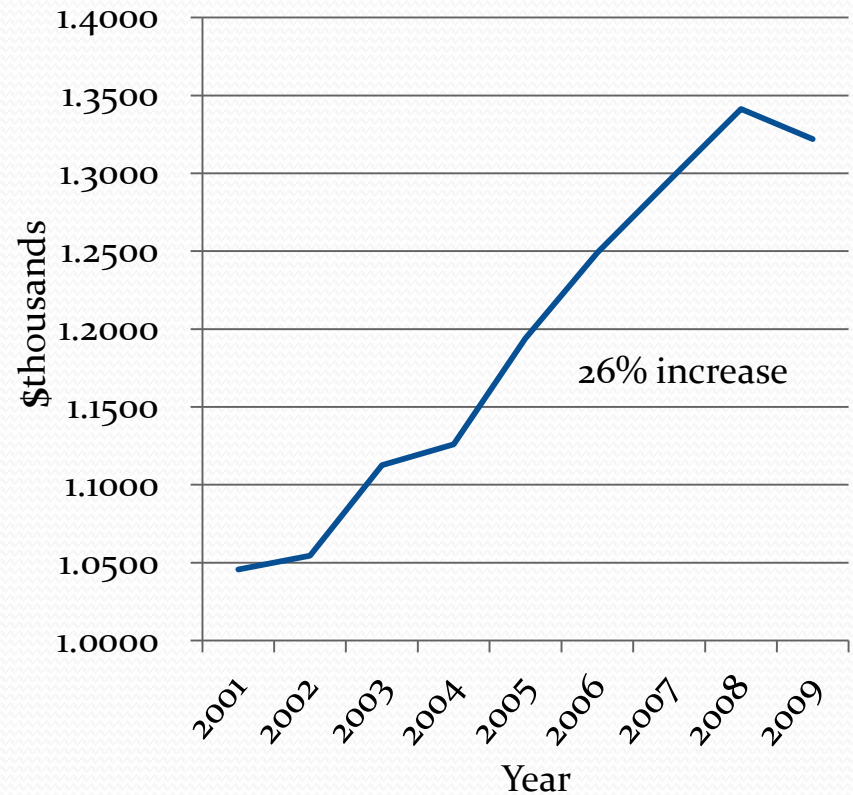


# DHB provider expenditure over the years

## Total DHB (real) expenditure

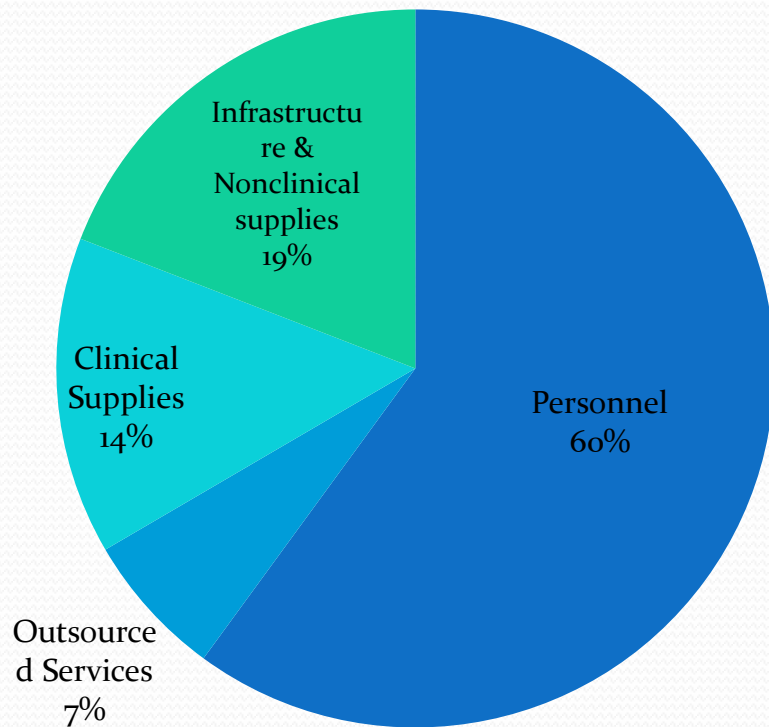


## DHB (real) expenditure per capita

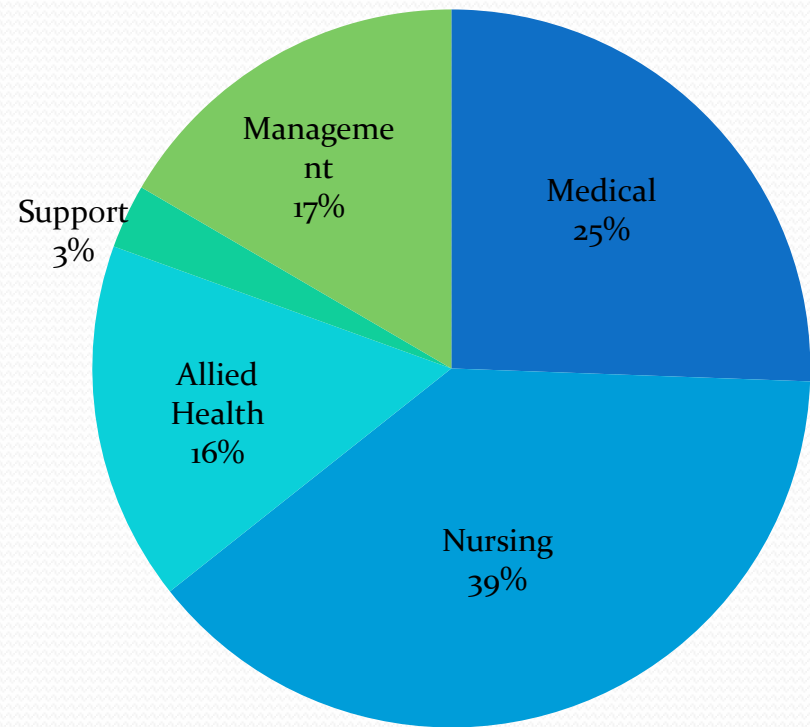


# DHB Expenditure breakdown

## Input Expenditure shares

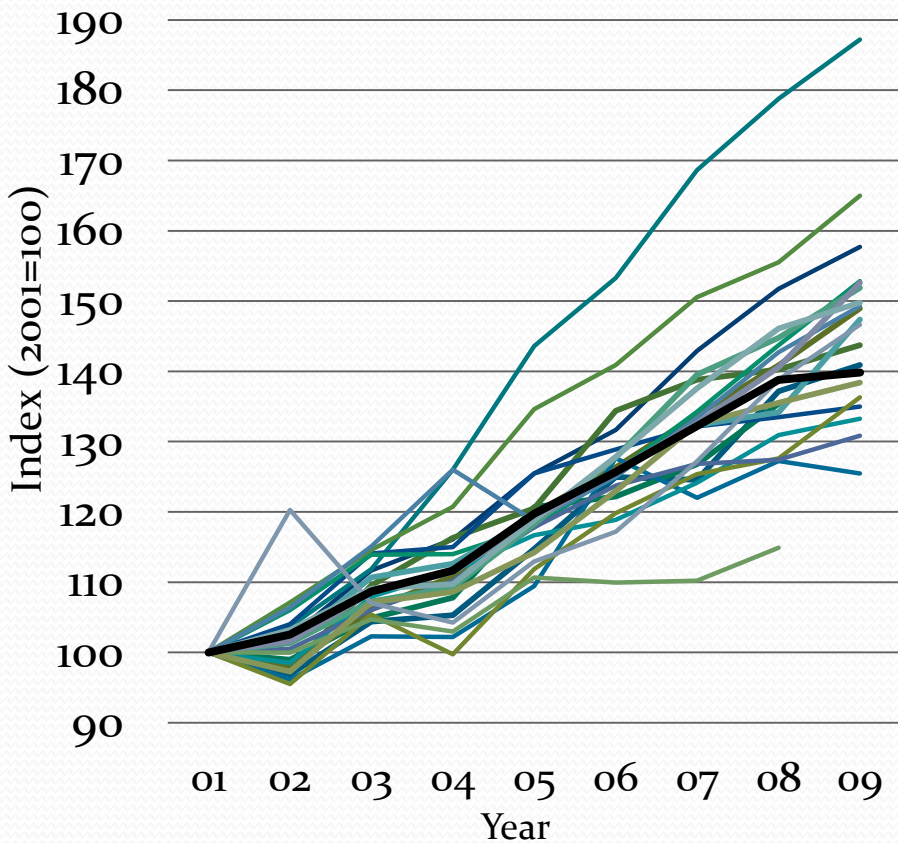


## Personnel Expenditure shares

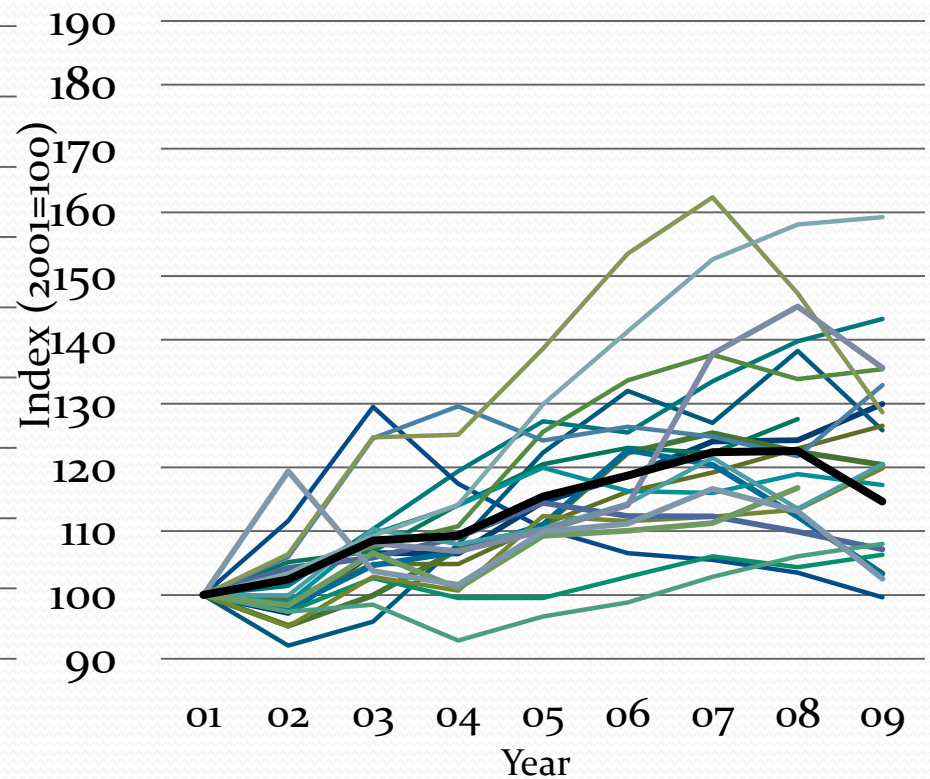


# DHB Expenditure variation

## Total Real Expenditures



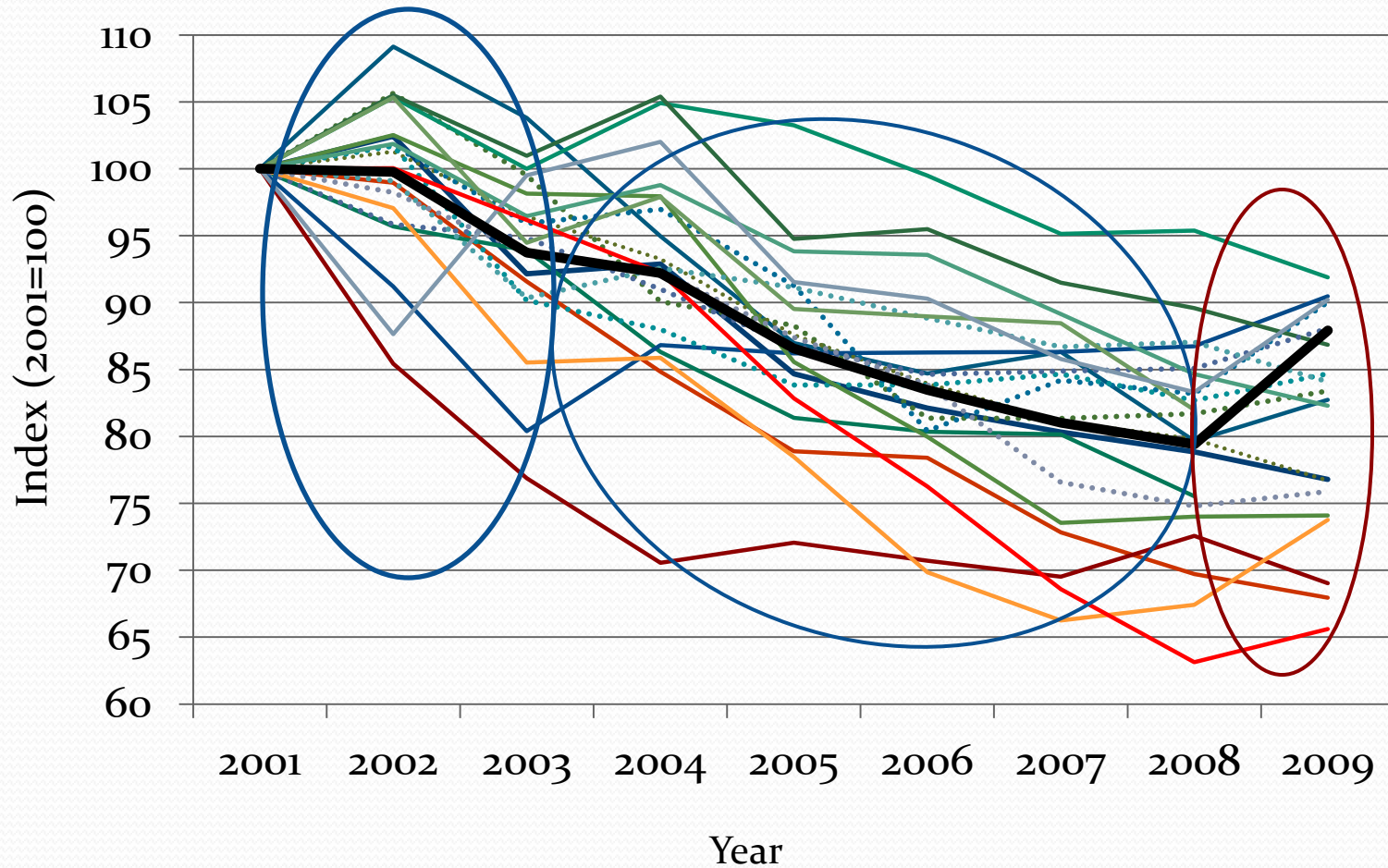
## Real Expenditure per discharge



# Productivity

- Measure: Output per \$ of (input) expenditure
  - NMDS Outputs = inpatient stays (case mix weighted)
    - incl. day stays counted as 0.5 days
    - Excl. outpatient & ED visits
  - DHB provider expenditures in 2001 NZD(MoH)
    - Deflated by GDP deflator (StatsNZ)
- Results
  - 12% decline between 2001 & 2009
    - BUT measure is based on inpatient stays so underestimates productivity
    - IF share of outpatient and ED increased over time then decline is over-stated **DID SHARE increase by >12%?**
  - Substantial variation across DHBs

# Change in Productivity over time



# Modelling variation in productivity

- Data: Panel of monthly data on case-mix weighted hospital output (partial) and DHB provider expenditure for 9 years
- Super-population perspective for statistical inference
- Hospital productivity of DHB at time  $t$  is a function of ...
  - time-varying DHB characteristics (eg. case mix, organization, resource allocation)
  - time-invariant DHB characteristics (eg. Population size and demographic composition, location)
  - time-varying DHB-invariant characteristics (policy directive)

$$Productivity_{DBH,t} = f_{DBH,t}(X_{DBH,t}, Z_{DBH}, W_t)$$

- Some characteristics observed, some not
- Dynamic (changing) relationships – with past characteristics (including productivity itself)

# Productivity variation: Regression models

- Static Models

$$y_{it} = \alpha_i + \beta' x_{it} + \gamma_t + u_{it} \quad \begin{array}{l} i = 1, \dots, 21 \text{ DHBs} \\ t = 2001, \dots, 2009 \end{array}$$

- Specifications estimated (so far)

- Pooled with robust standard errors for DHB clustering
- Random effects
- Fixed effects

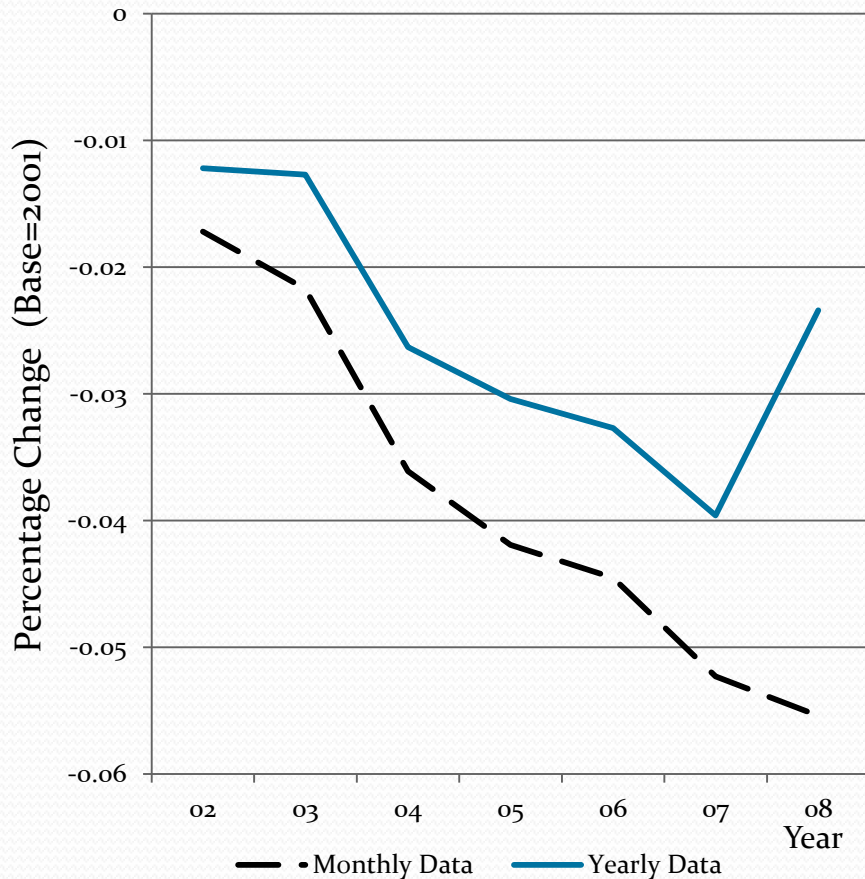
- Dynamic Models

$$y_{it} = \alpha_i + \beta' x_{it} + \lambda y_{i,t-1} + u_{it}$$

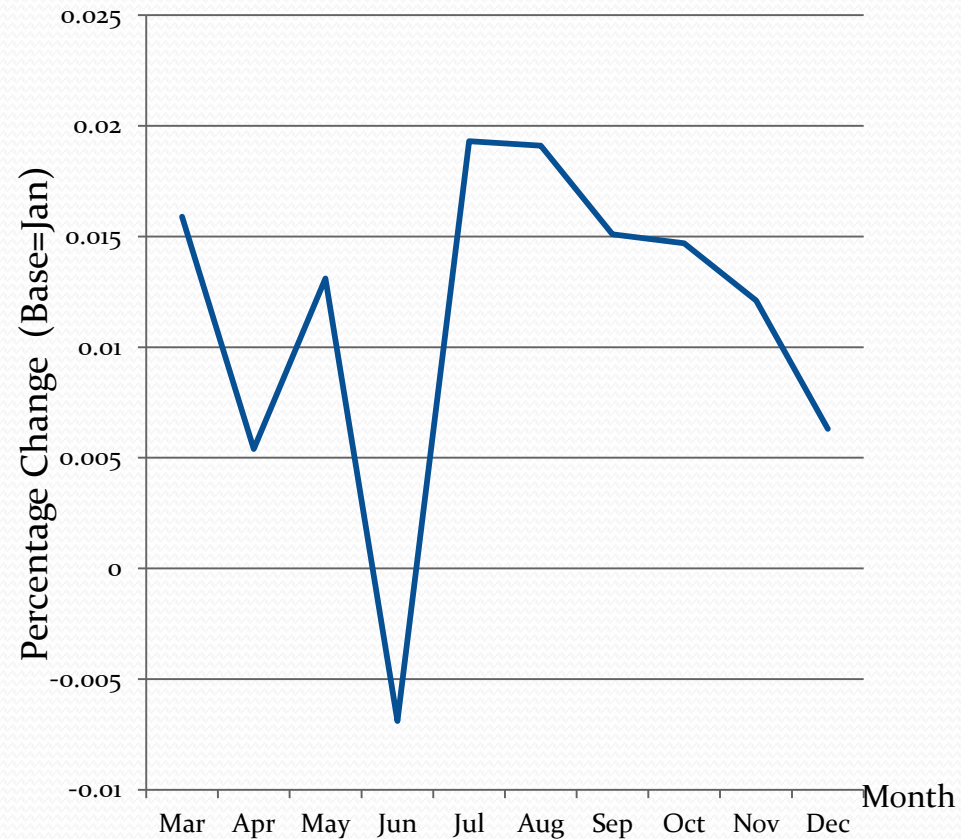
- Lagged dependent variables
- Endogenous regressors (input expenditures, acute admissions, etc)

# Model-based estimates of temporal variation in productivity

## Annual Variation (Base=2001)



## Seasonal Variation (Base=Jan)





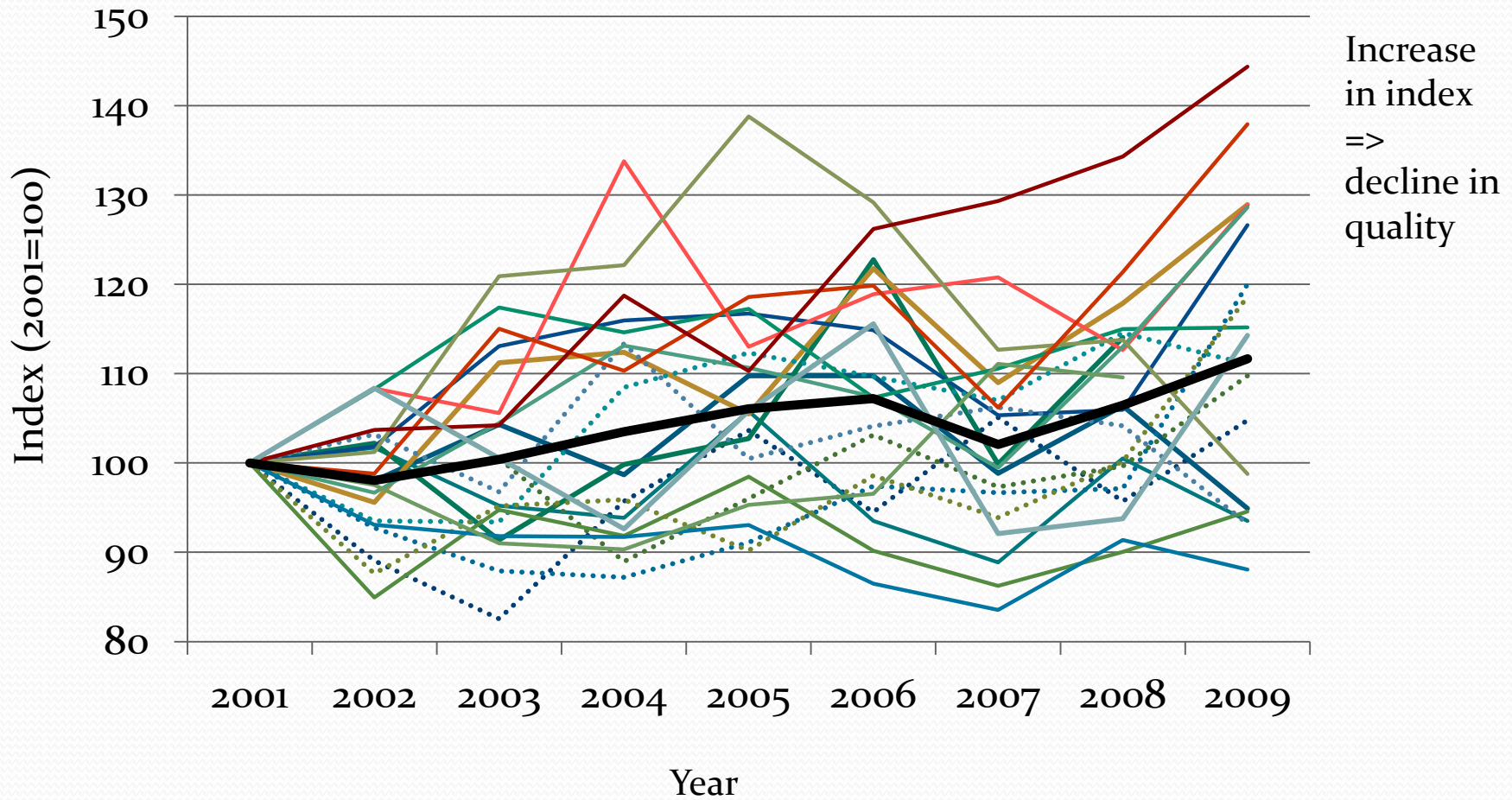
# Other (preliminary) results

- Static models
  - Monthly data
    - DHB fixed effects specification best
    - **Significant effects:** Proportion Pacific (-ve), Proportion newborn (-ve), proportion arranged admissions (+ve), and significant month & year variation (previous slide)
  - Annual data
    - DHB random effects specification best
    - Only year dummies significant (previous slide)
- Dynamic models (so far only with annual data)
  - **Serial correlation in errors so dynamic model more efficient**
  - **Significant effects:**
    - Lagged productivity (+ve): higher past productivity -> higher current
    - Economies of scale (+ve): larger admission volume -> higher productivity

# Quality of hospital services

- **Composite measure** (annual) based on patient safety indicators
  - based on 11 (of 20) provider-level patient safety indicators (PSIs) developed by AHRQ
- **Construction of measure**
  1. **Risk-Adjustment (for each component)**
    - **Patient-level Logistic regressions** for each PSI to derive predicted values of the outcomes of interest on full nine years of data in NMDS.
  2. **Reliability Adjustment (for each component)**
    - Need to adjust indicator for reliability by isolating true variability of indicator.
  3. **Combining 11 components (multi-dimensionality)**
    - Need weighting system to combine indicators of different dimensions into a single composite index.
      - **Equal Weights, Factor Analysis based weights, Expert opinion based weights**

# Change in Hospital Quality



# Model-based results for hospital quality

- Findings from preliminary panel econometric regressions

Significant Effects	Sign
Time	+ve
Proportion Female	+ve
Proportion NZ European	-ve
Proportion Pacific	-ve
Clinical Severity	+ve

- Total DHB expenditures have little explanatory power

# Ongoing work and next steps

1. Further refinement of dynamic models for Productivity, Input expenditures, Quality .....to analyze relationships between these 3 variables in a dynamic model setting
2. Examination of effects of DHB monitoring (MoH data) and changes in hospital output composition (DHB data)
3. Further refinement of hospital (patient safety) quality index using (ongoing) survey data on ranking of PSI by clinicians