

A Model for Structure-based Comparison of Many Categories in Small-Multiple Displays

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Comparison of Multi-variate Data

- Categorical & numerical attributes
- Example: sales data

- **Dimensions** (*categorical*)

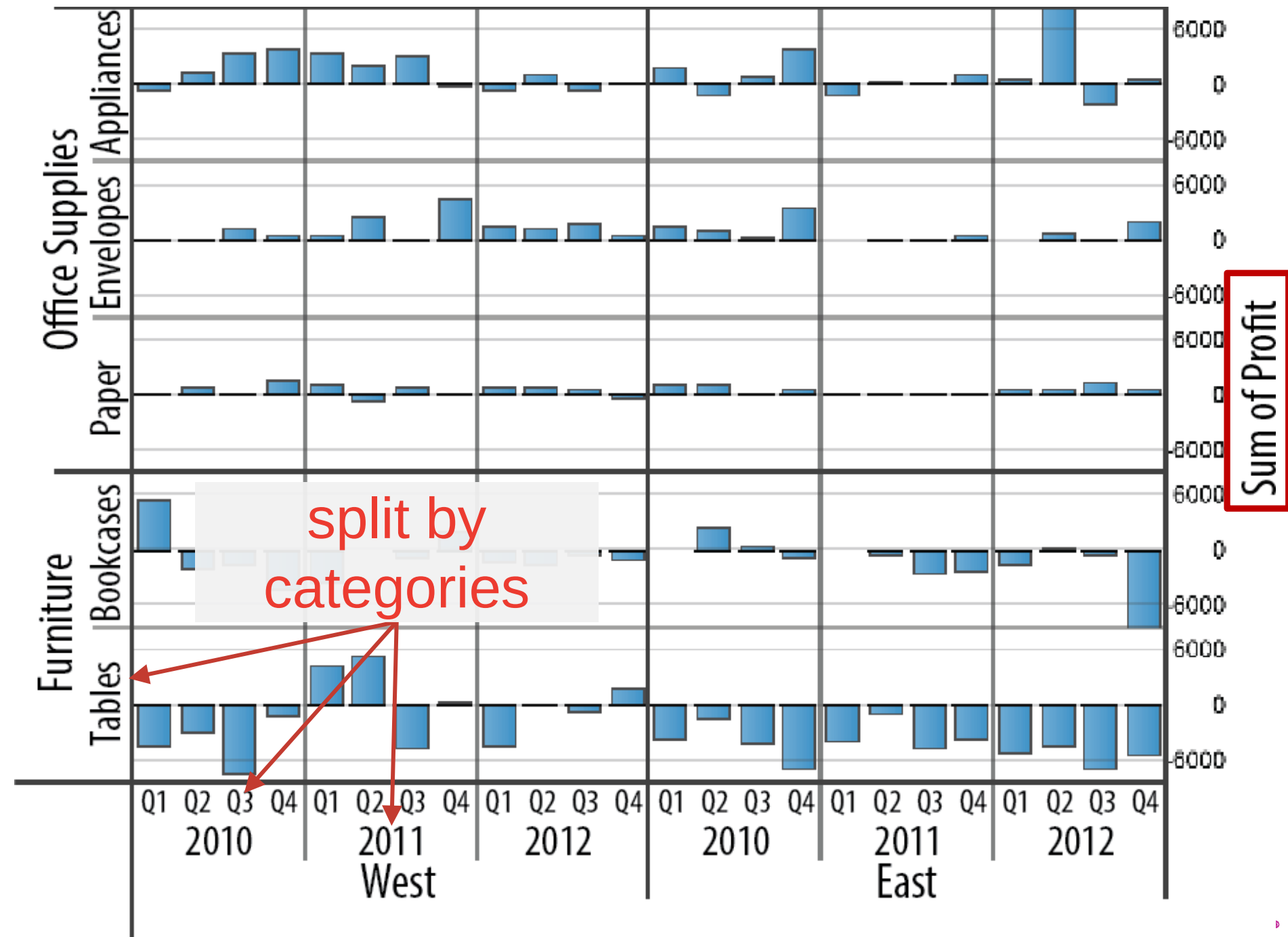
- Geographic region
- Product category
- Product

- **Timestamps**

- Ship date
- Order date

- **Measures** (*numerical*)

- Profit
- Sales



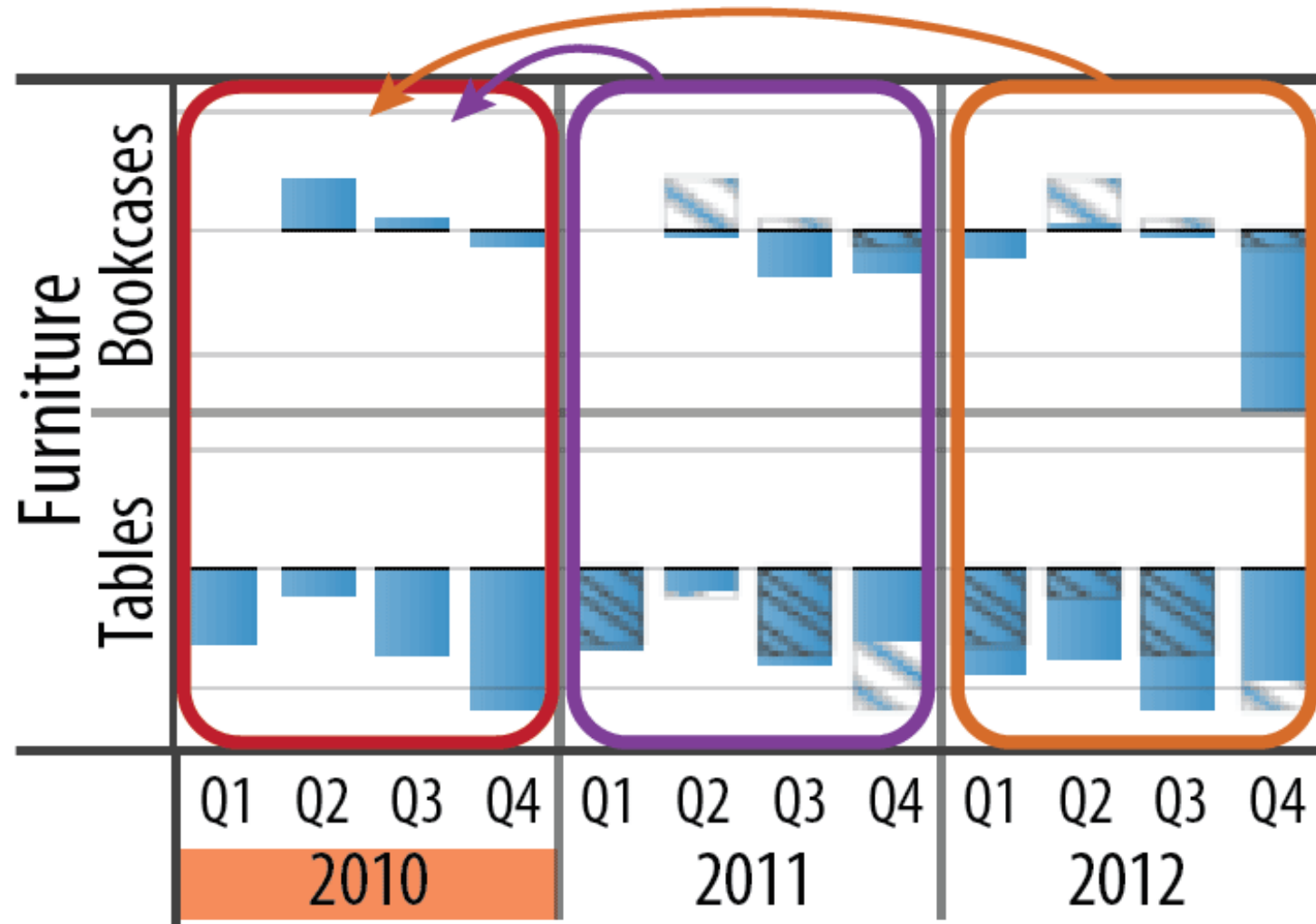
Small-multiple Displays

- Comparison by juxtaposition
- Ineffective with many categories
- Precise comparison when aligned

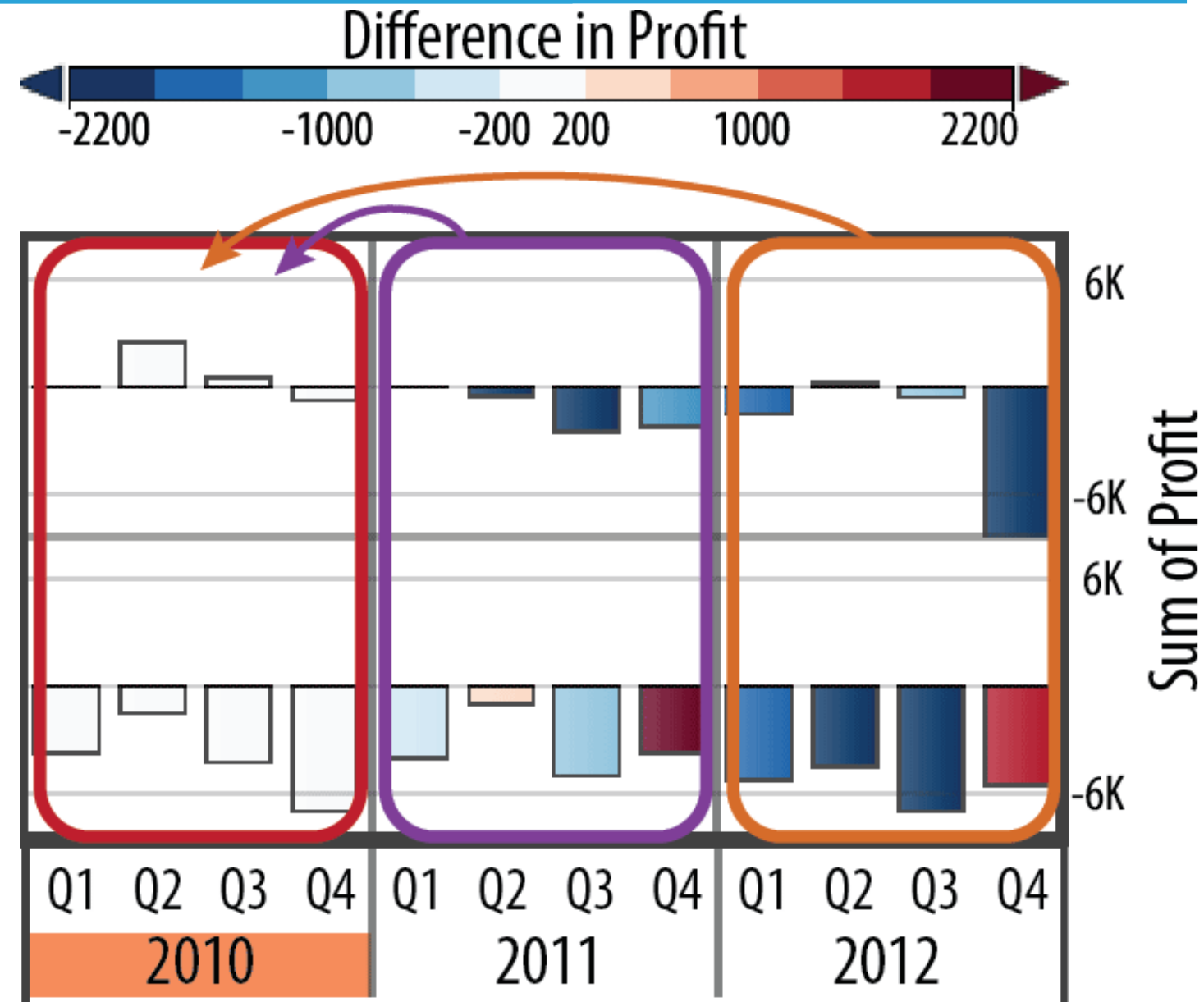


Visual Comparison [Gleicher et al. 2011]

Compare to **2010**



Overlay (superposition)



Explicit encoding

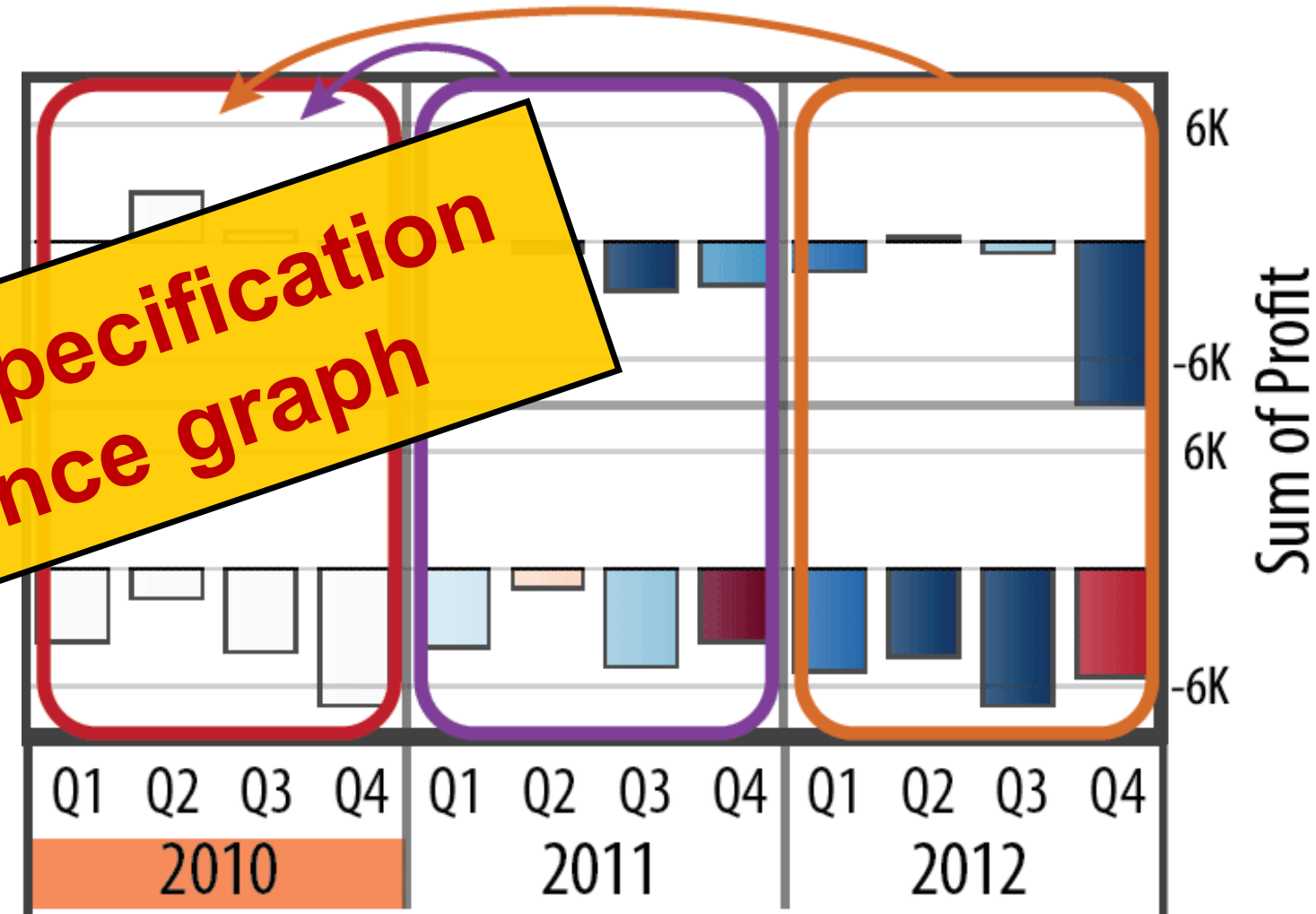


Visual Comparison [Gleicher et al. 2011]

Compare to **2010**



Overlay (superposition)

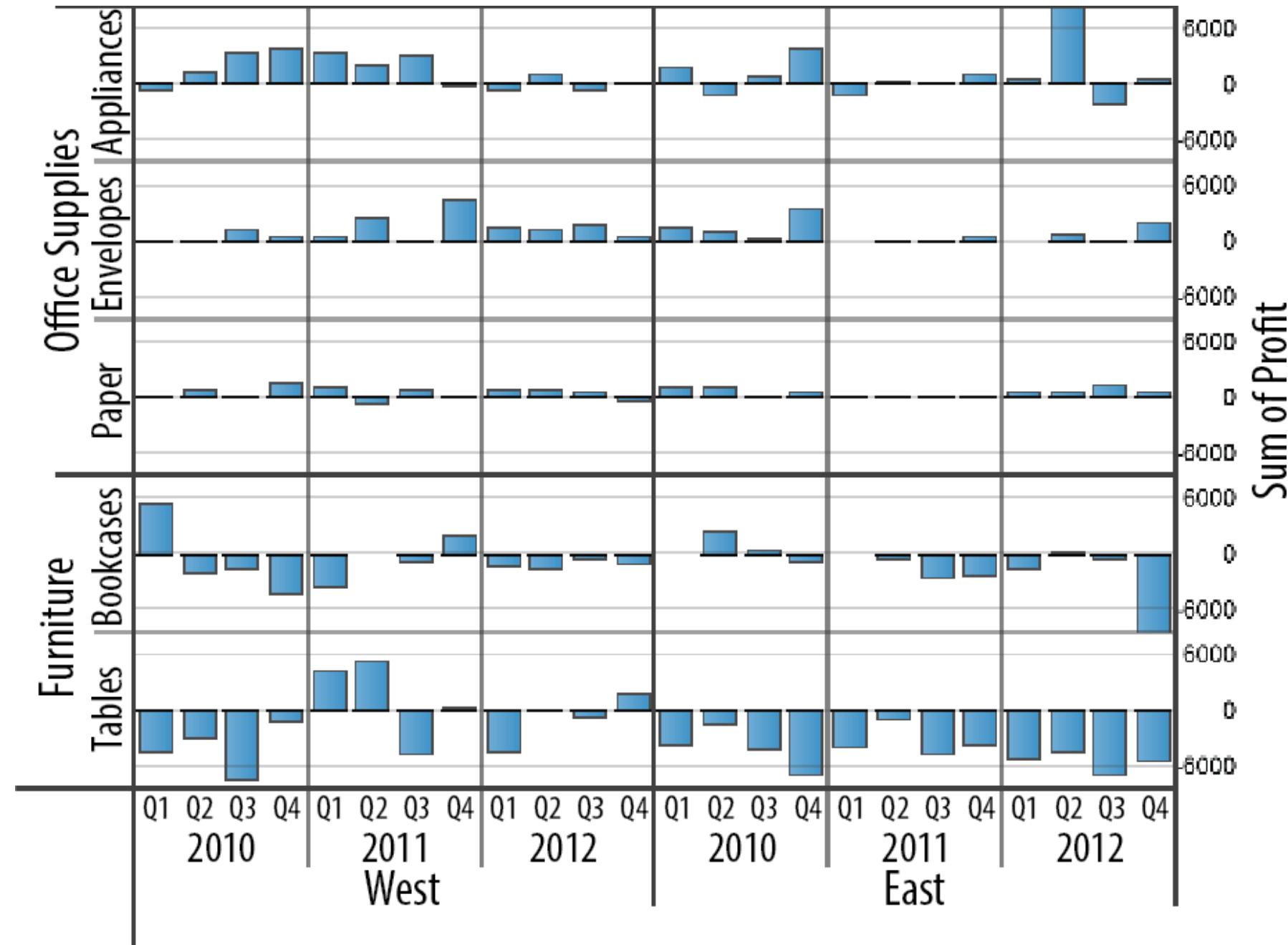


Explicit encoding

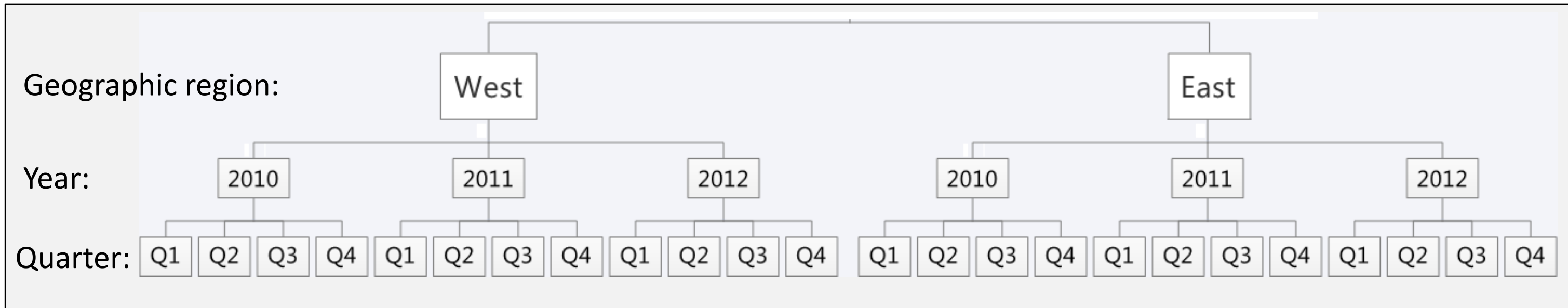


Many Options for Comparison

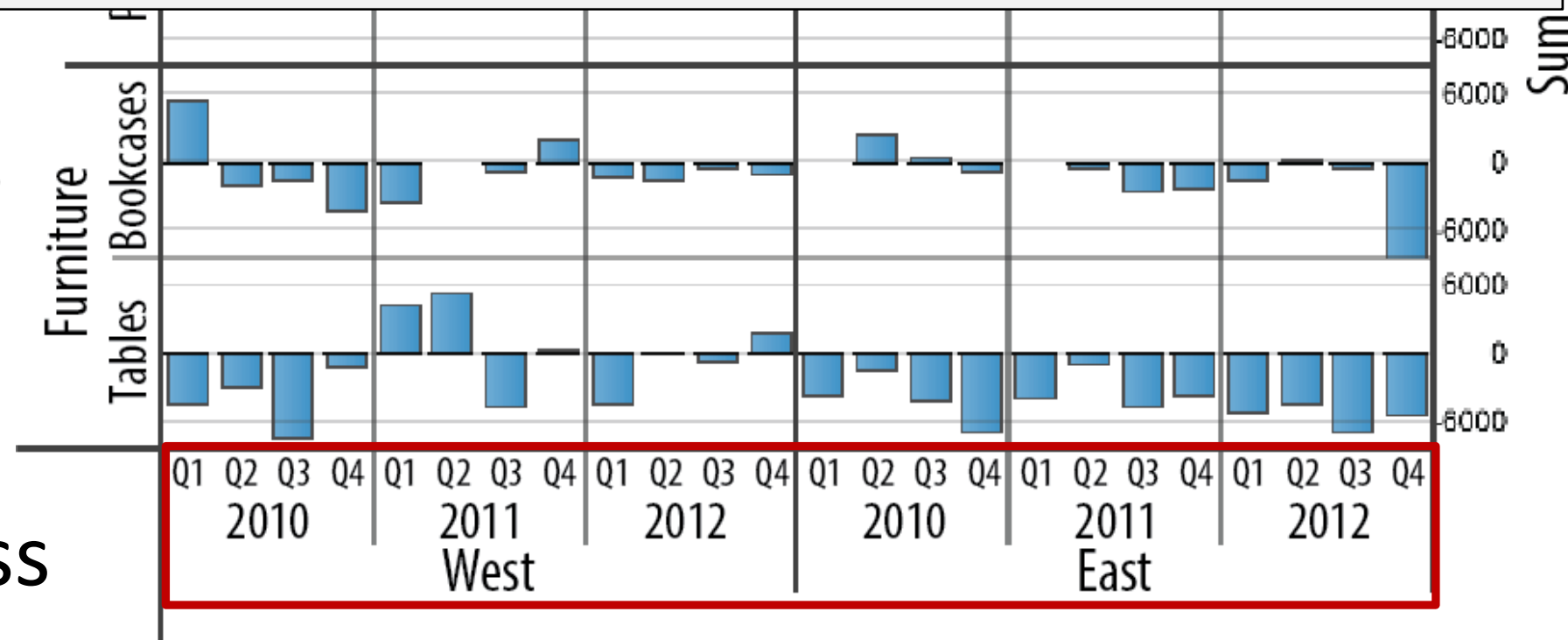
- Compare to maximum
- Compare East to West
- Compare years to 2010
- Compare each year to previous one
- Compare quarters to average per year



Model for Structure-based Comparison



- Formalism to define references (what-to-what)
- Based on hierarchical structure of display
- Comparison within/across hierarchy levels



Display configuration from cross/nest operator

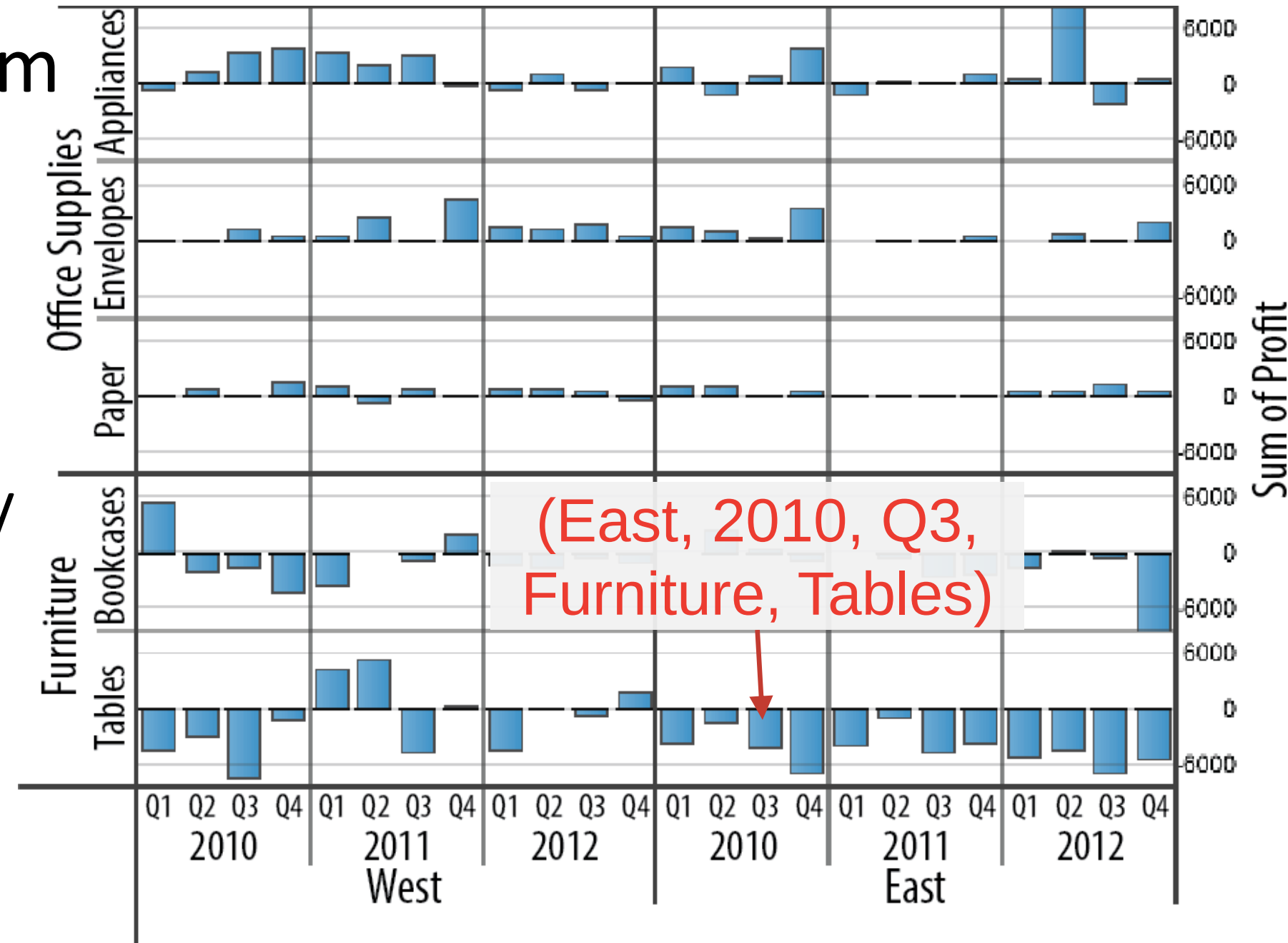
{West, East} x

{2010, 2011, 2012} x

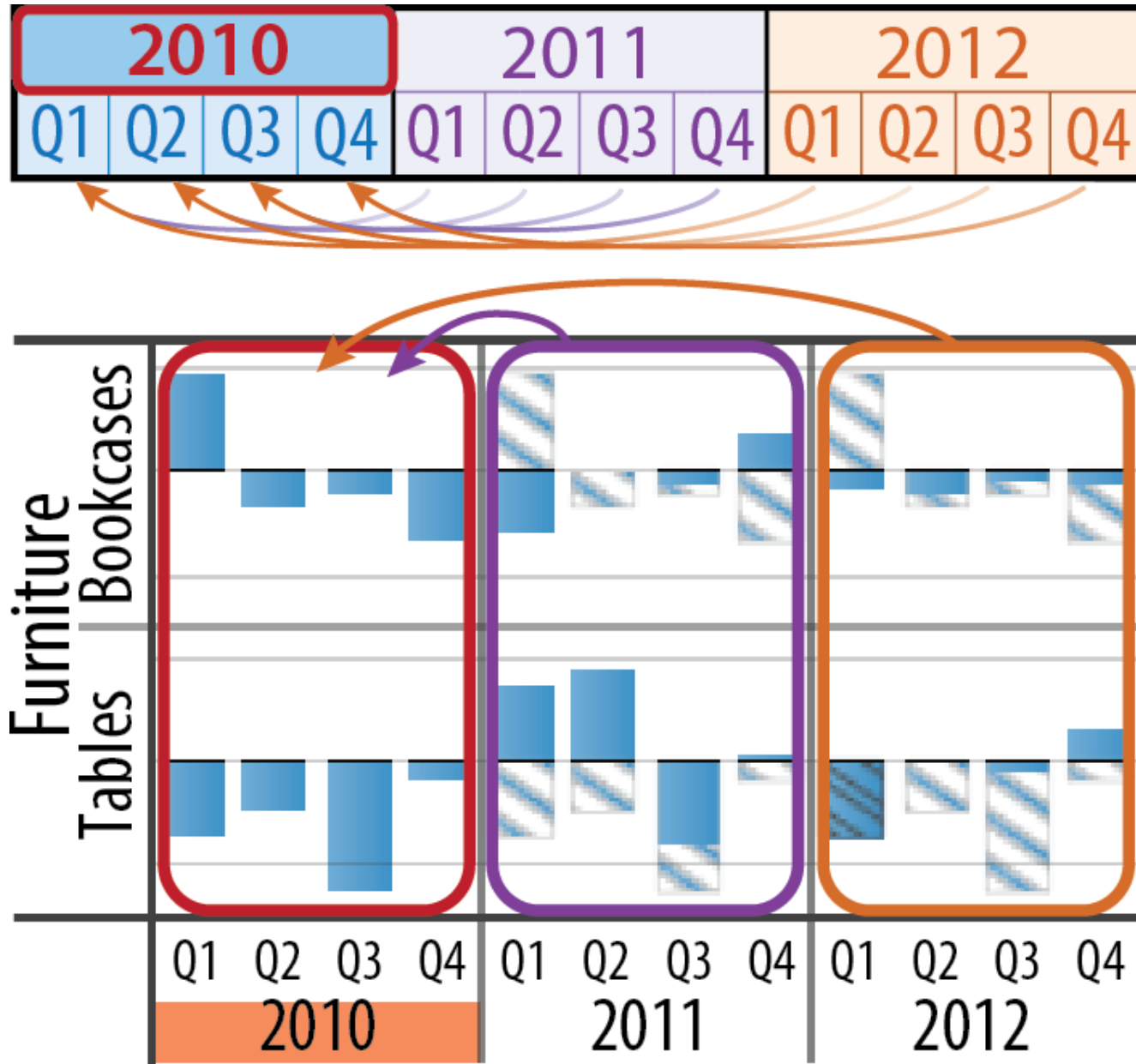
{Q1, Q2, Q3, Q4} x

{Furniture, Office Suppl.} /

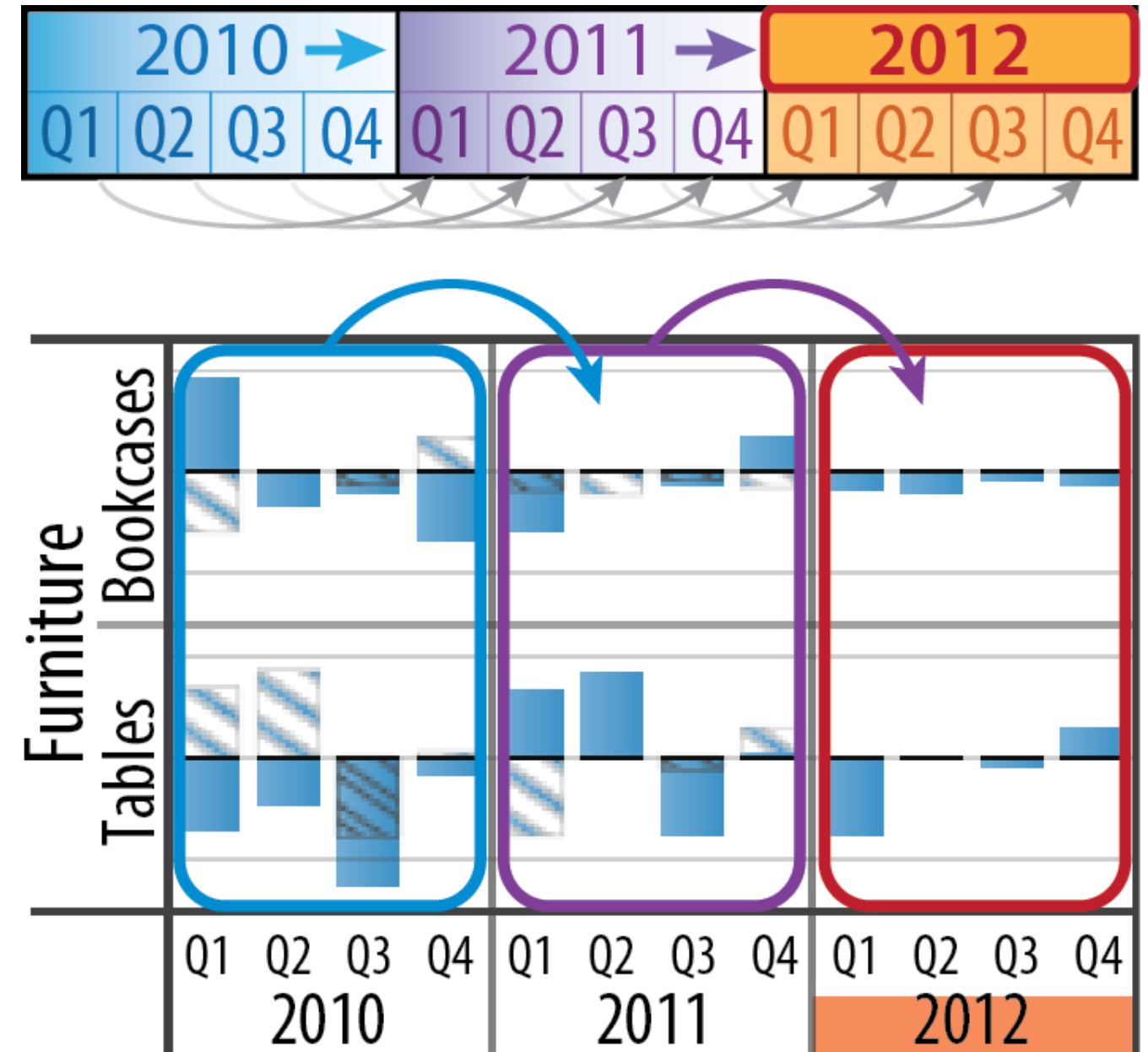
{Tables, Bookcases, Paper, Envelopes, Appliances}



Our Model: Absolute vs. Relative Comparison



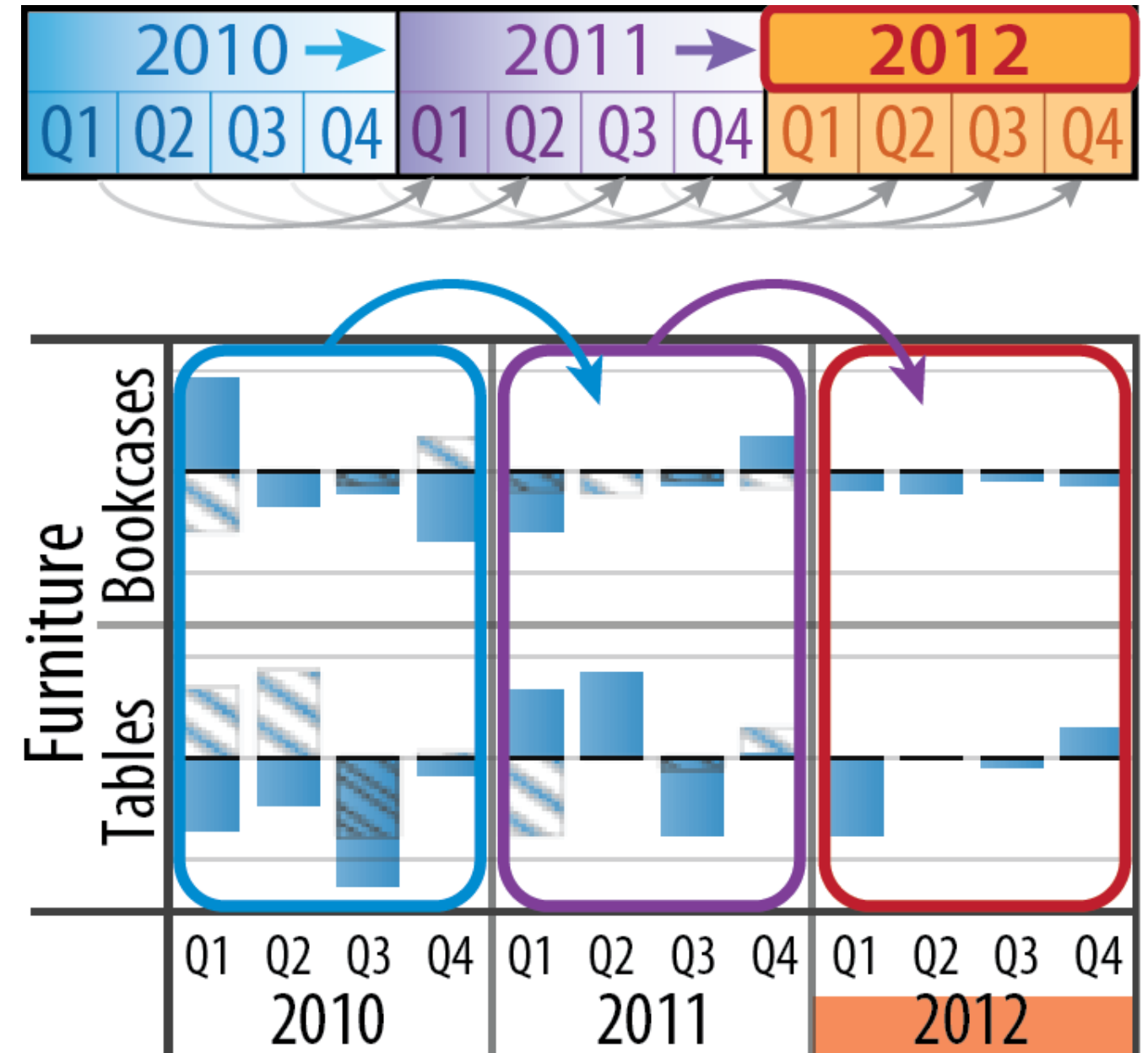
Compare to **2010**



Compare to **next year**



- **Comparing dimensions**
relate different categories
(e.g., years)
- **Refining dimensions**
relate equivalent categories
(e.g., quarters)



Compare to **next year**





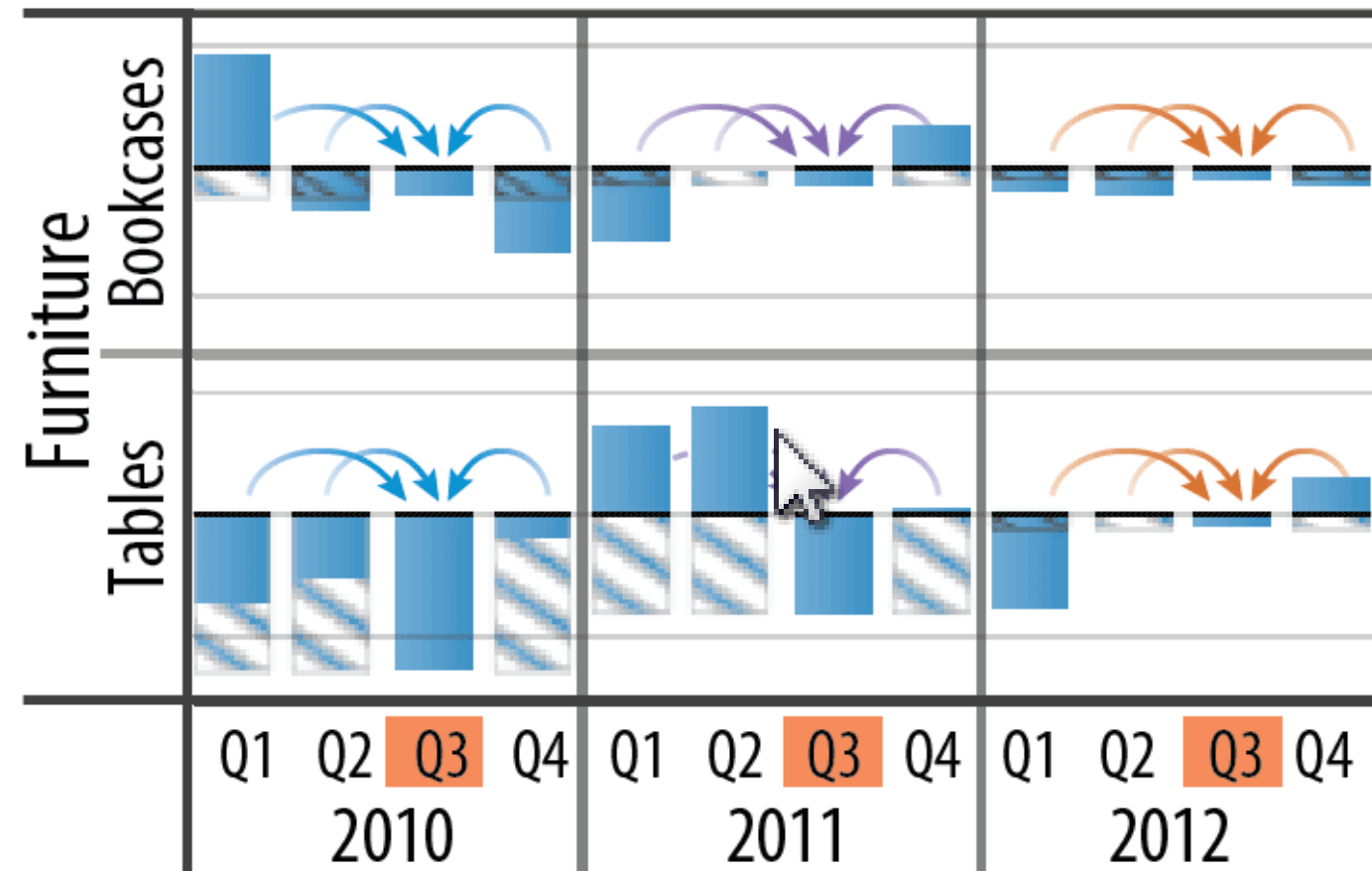
Reference n -tuple

$r_{\text{abs}} = \{r_1, r_2, \dots, r_n\}$ where
 $(r_i = \emptyset) \wedge (r_i \in \text{dimension}_i)$

n ... number of dimensions

$r_{\text{abs}} = \{\emptyset, \text{Q3}, \emptyset, \emptyset\}$
 year — quarter — product category

Change categories where $r_i \neq \emptyset$ (comparing dimensions)



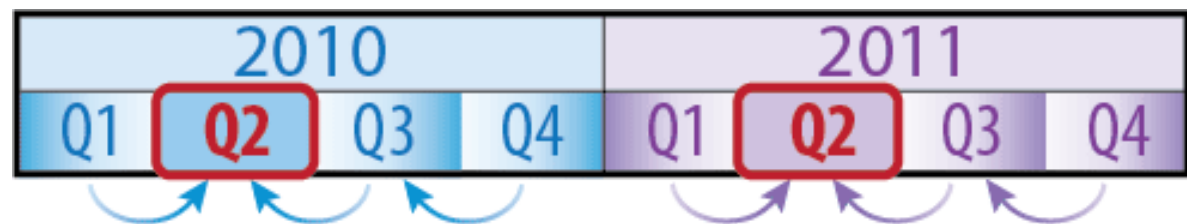


- Compare to preceding/ following category within comparing dimension
- Comparing dimensions need logical ordering

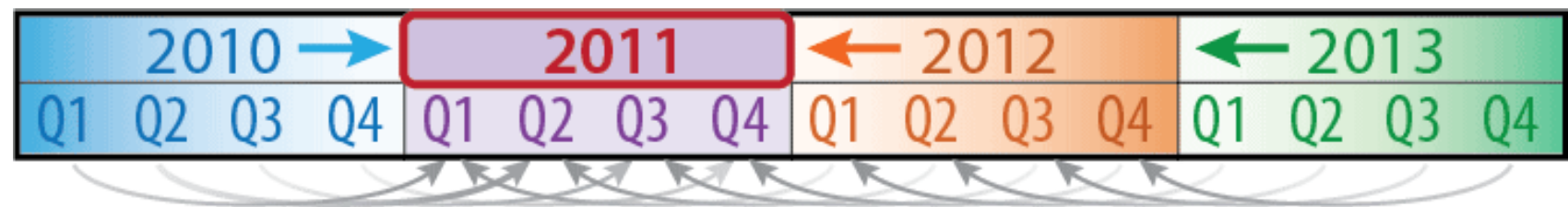
Compare to **next year**



- Reference n -tuple $r_{\text{rel}} = \{r_1, r_2, \dots, r_n\}$ where
 $(r_i = \emptyset) \wedge (r_i \in \text{ordinal dimension}_i)$ $n \dots$ number of dimensions
- Increase/decrease categories where
 $r_i \neq \emptyset$ (comparing dimensions)



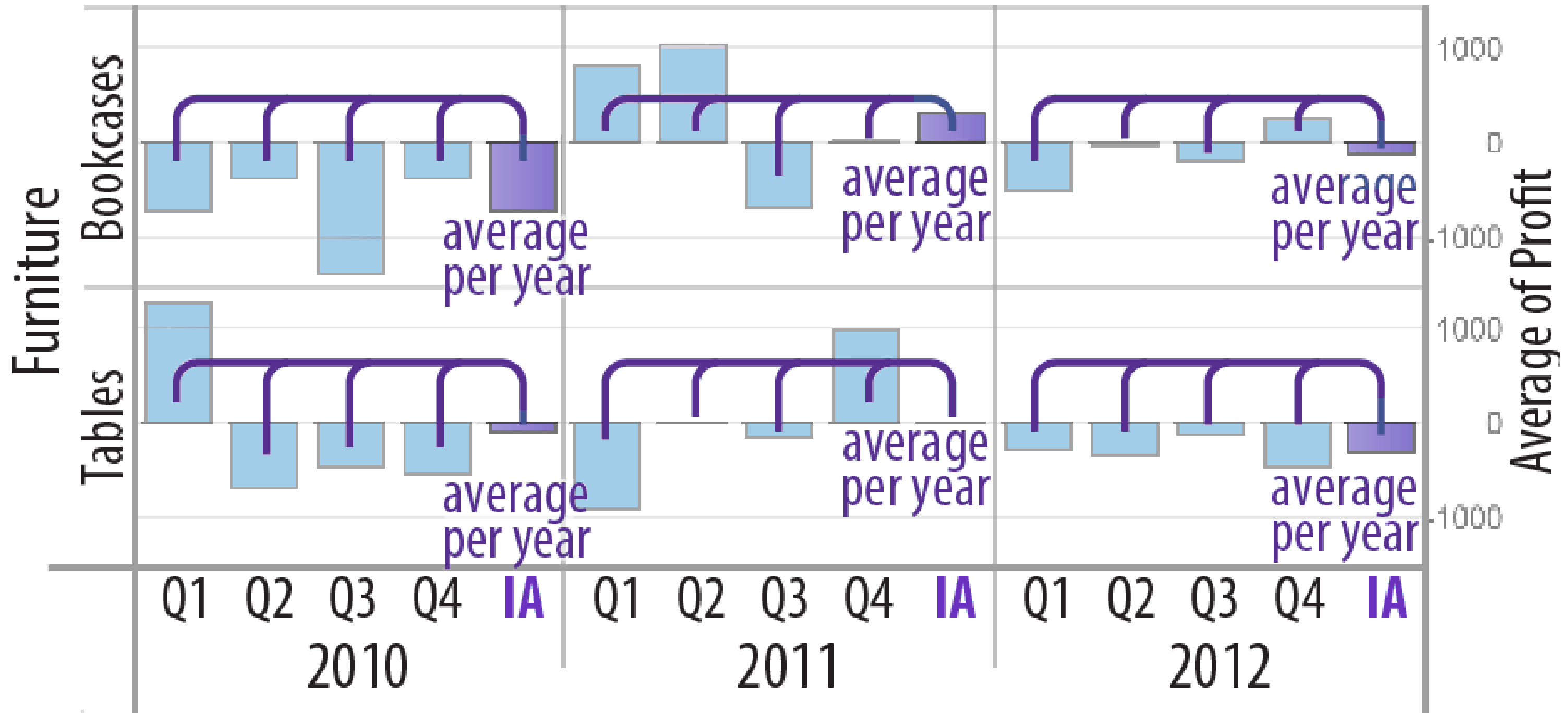
$r_{\text{rel}} = \{\emptyset, \text{Q2}\}$
year — quarter



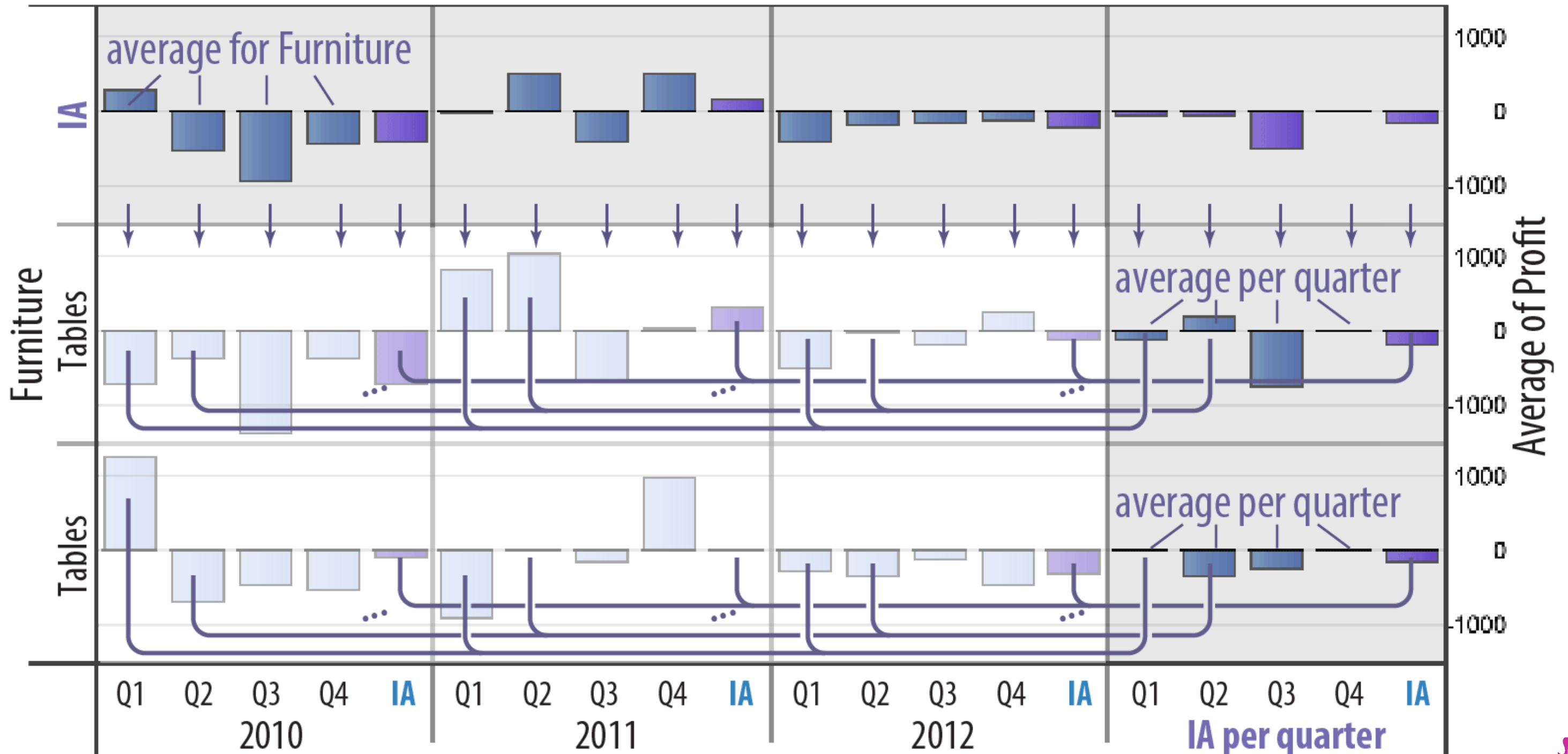
$r_{\text{rel}} = \{\text{2011}, \emptyset\}$
year — quarter



Intermediate Aggregates (IAs)



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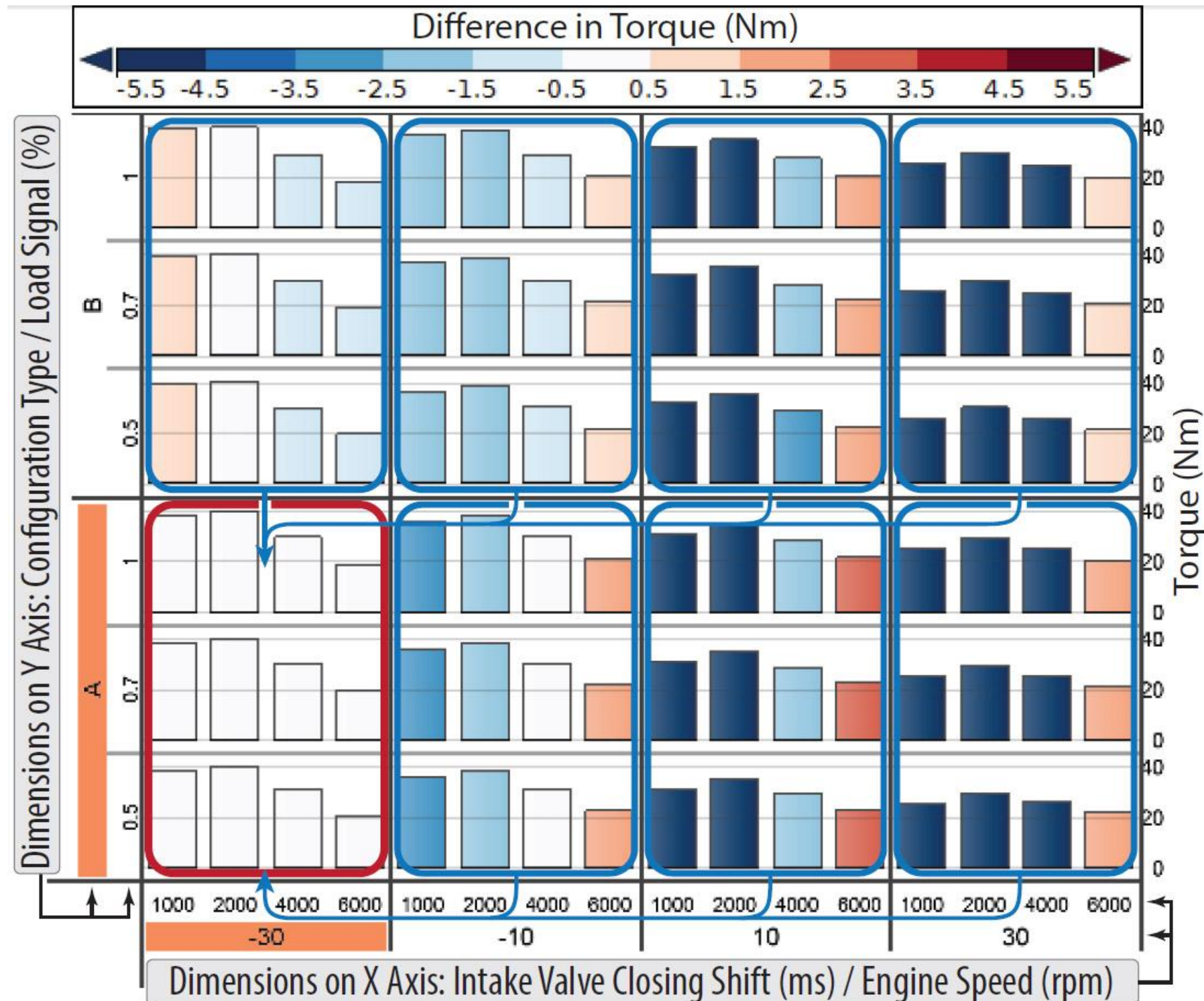


Application Example: Parameter Space Analysis

- Car engine simulation
- Design & operating parameters
- Maximize torque

$$r_{\text{abs}} = \{-30, \emptyset, A, \emptyset\}$$

IVCS — *speed* — *config. type* — *load*

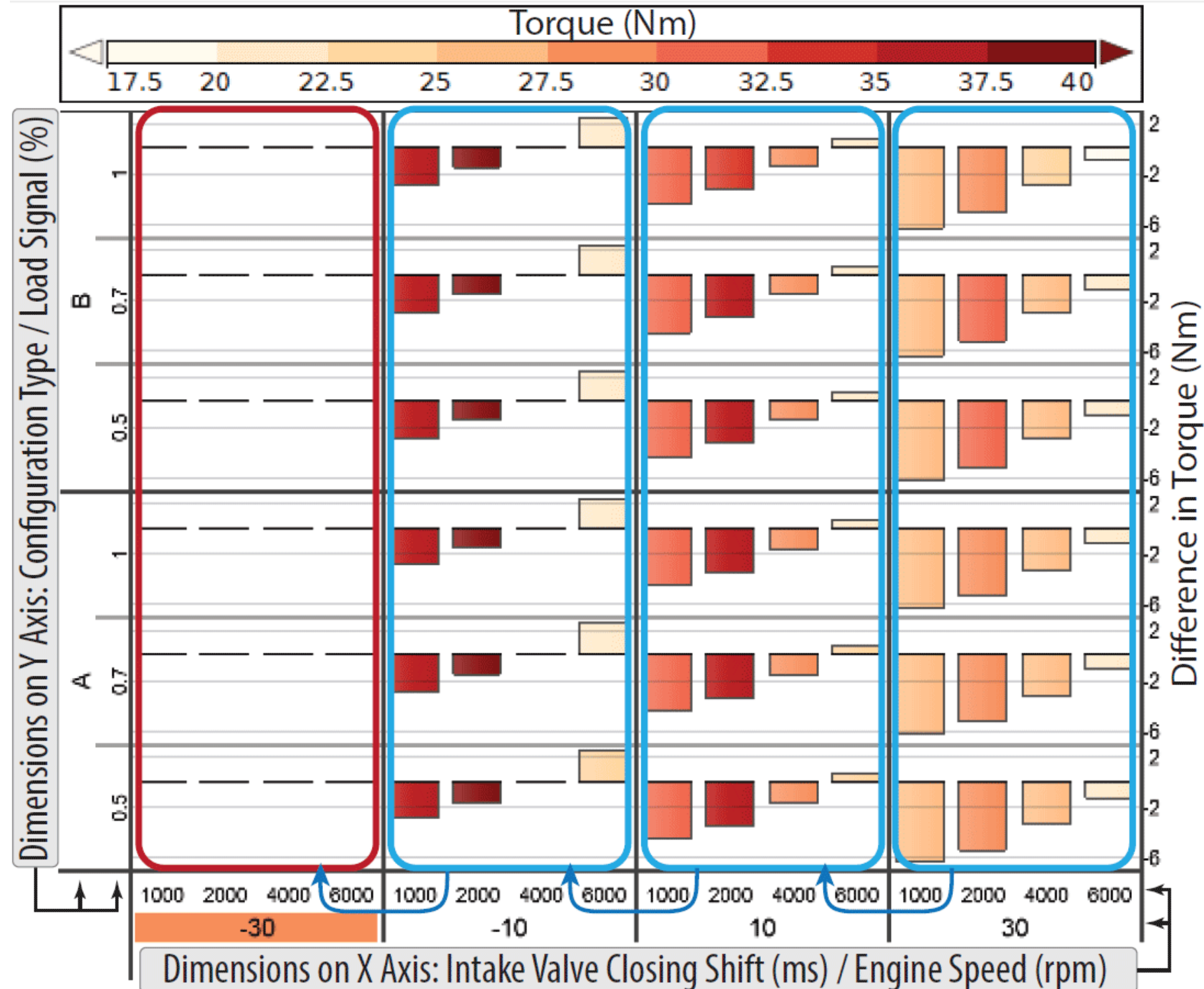


Application Example: Parameter Space Analysis

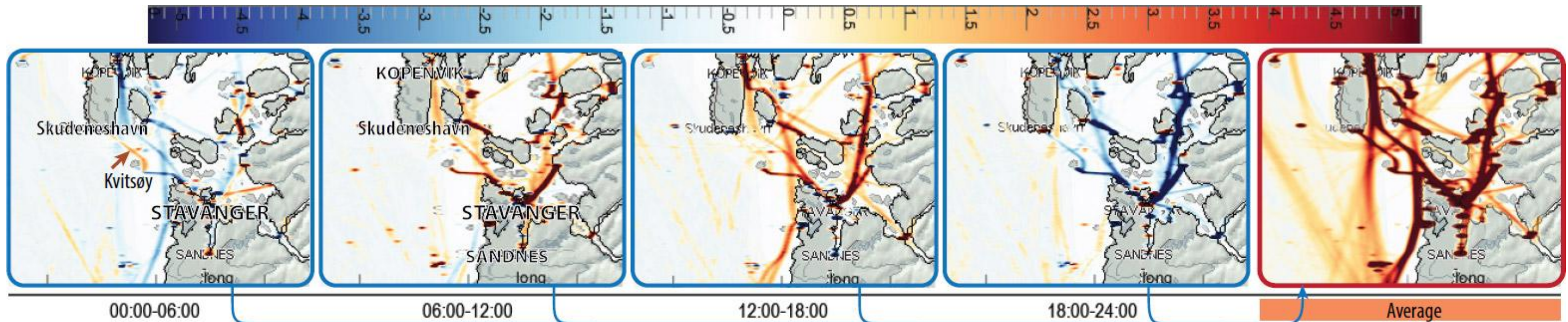
- Sensitivity wrt.
design parameter

$$r_{\text{rel}} = \{-30, \emptyset, \emptyset, \emptyset\}$$

IVCS *speed* *config. type* *load*



- Visualization based on Kernel Density Estimates
[Daae Lampe et al. 2010/2011]
- Peaks and changes in traffic



- Formal model for structure-based comparison
- Definition of comparisons within/across hierarchy levels
- Independent of type of visualization
- Compact specification based on reference tuple
- Applied in different application examples

Future Work

- Integrated visualization of reference graph
- Interactive reference specification



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