A modification of the GEKS index when product turnover is high

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Background

- The GEKS is a multilateral price index which is transitive.

- It is based on an underlying price index (Törnqvist index) which is used to make bilateral comparisons between periods belonging to a fixed time window.

$$P_{t-1,t[1;K]}^{GEKS} = \prod_{k=1..K} \left(P_{t-1,k} * P_{k,t} \right)^{\frac{1}{K}}$$

- The rolling version of the GEKS has been widely applied to scanner data in order to ensure chain drift free results (see *Ivancic et al (2011)*).

Background

- The GEKS tends to be flatter than the FE index on the same window length.
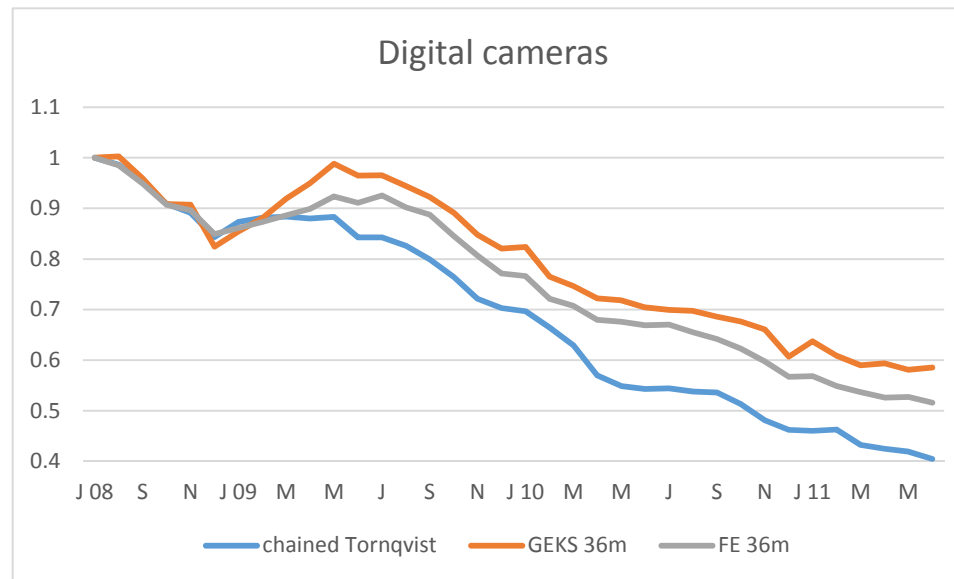
- These results were derived from a scanner data set covering consumer electronics, with high product turnover
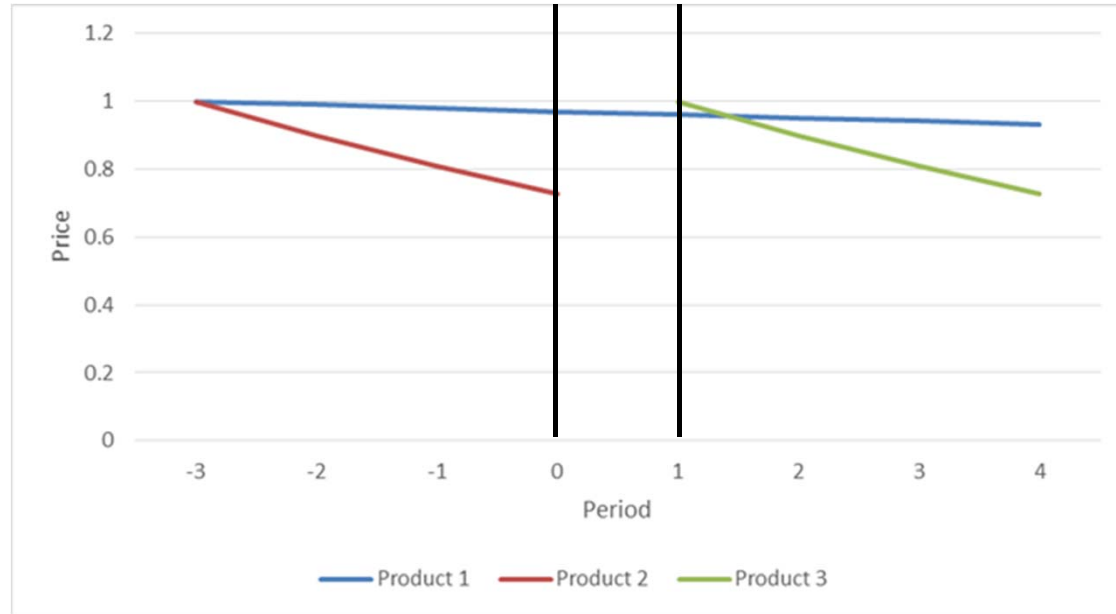
Background

- The aim of this paper is to explore the reasons behind the tendancy of the GEKS to be flatter than the FE – is it related to the product turnover?

- A modification of the GEKS method will be proposed, called the intGEKS, which appears to prevent such behaviour.

- The Multilateral Time-Dummy Hedonic index (TD) will be used as a benchmark price index.

- The TD index
  - explicitly uses characteristics of the products;
  - reflects price movements of new and disappearing products;
  - satisfies transitivity.

Example
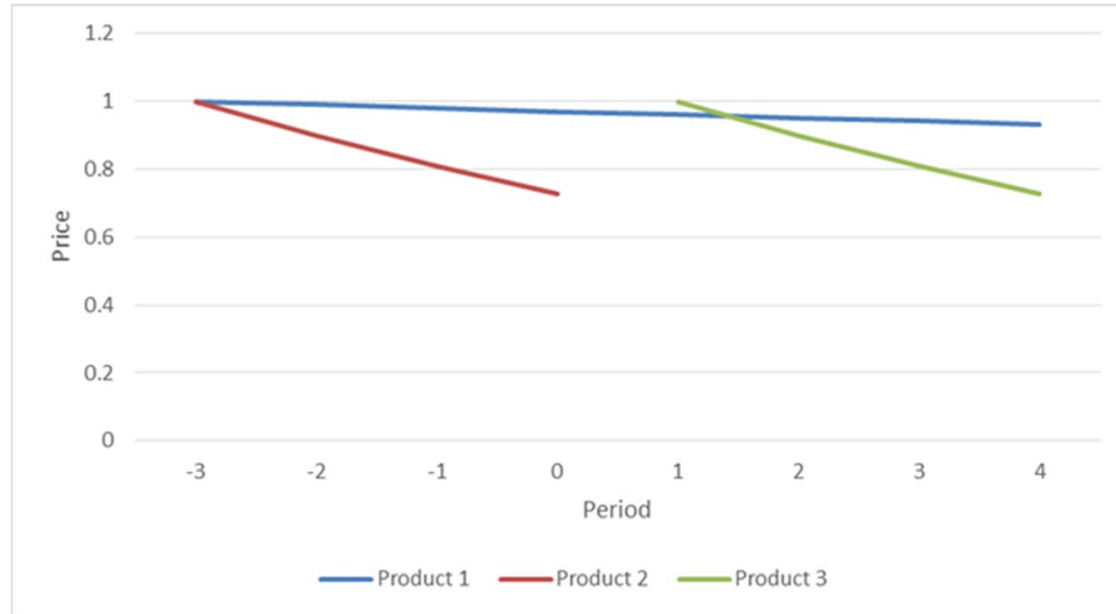
- Product 1 decreases each period by 1%. It is available during all periods.
- Product 2 decreases each period by 10%. It is available during the first four periods.
- Product 3 decreases each period by 10%. It is available during the first four periods.
- The two products that are available in each period both have a 50% share.
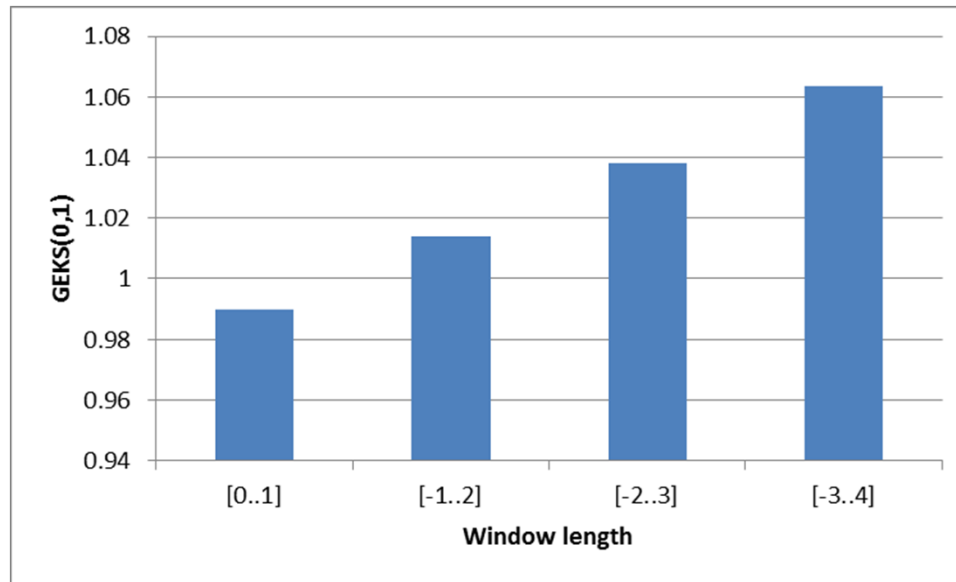
Example

k	$P_{0,k}$	$P_{k,1}$	$P_{0,k} * P_{k,1}$
Period -3	1.189	0.961	1.142
Period -2	1.122	0.970	1.089
Period -1	1.059	0.980	1.038
Period 0	1.000	0.990	0.990
Period 1	0.990	1.000	0.990
Period 2	0.980	1.059	1.038
Period 3	0.970	1.122	1.089
Period 4	0.961	1.189	1.142
		$P_{0,1,[-3;4]}^{GEKS}$	1.063

The underlying bilateral indexes $P_{0,k}$ and $P_{k,1}$ are defined on different sets of matched products.

→ The stronger price declines of product 2 (or product 3) are taken into account in an asymmetric way.

→ The GEKS is adjusted upwards.

Example

k	$P_{0,k}$	$P_{k,1}$	$P_{0,k} * P_{k,1}$
Period -3	1.189	0.961	1.142
Period -2	1.122	0.970	1.089
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Period 3	0.970	1.122	1.089
Period 4	0.961	1.189	1.142
		$P_{0,1,[-3;4]}^{GEKS}$	1.063

Enlarging the window length worsens the imbalance created by products 2 and 3 being partly unavailable.

The intersection GEKS

- The intersection GEKS (intGEKS) avoids this imbalance by restricting the bilateral comparisons to products available in all three periods t-1, t and k.

$$P_{t-1,t[1;K]}^{GEKS} = \prod_{k=1..K} \left(P_{t-1,k} * P_{k,t}\right)^{\frac{1}{K}}$$

| Products available in **t-1** and in **k** | Products available in **k** and in **t** |

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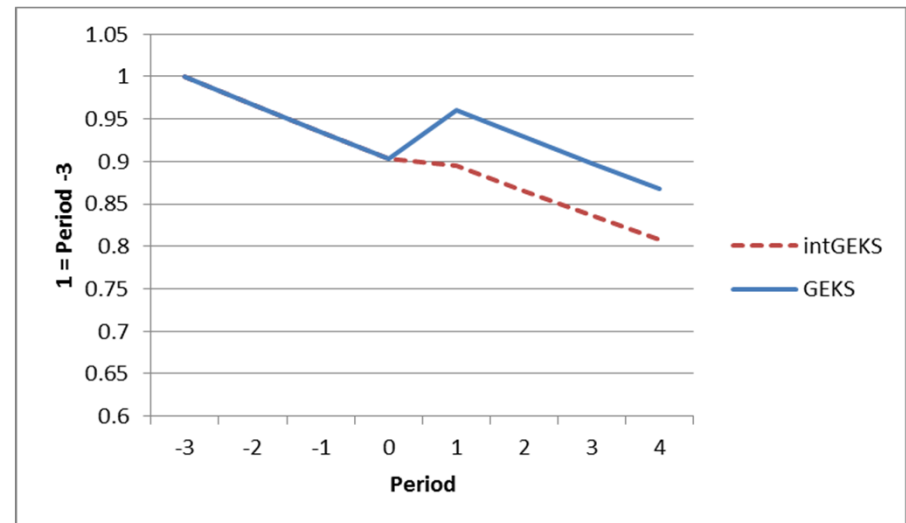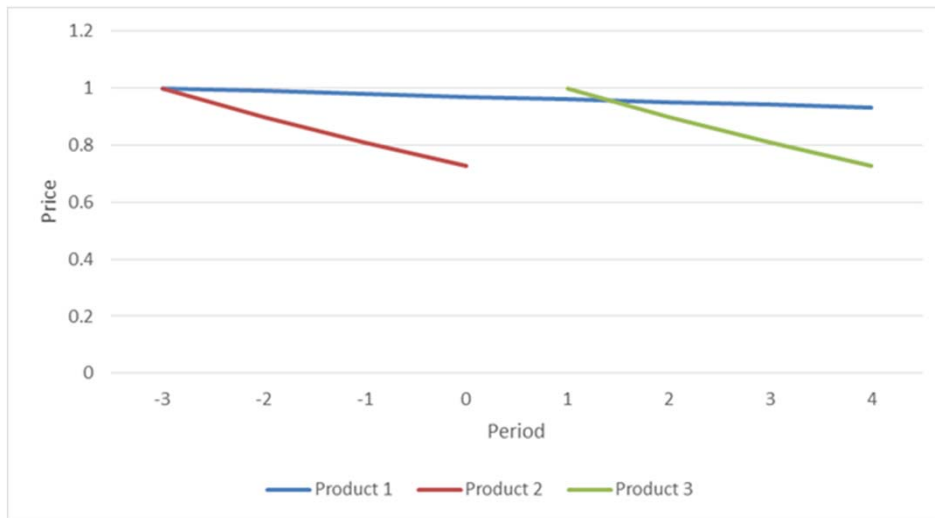$$P_{t-1,t[1;K]}^{intGEKS} = \prod_{k=1..K} (P_{t-1,k} * P_{k,t})^{\frac{1}{K}}$$

| Products available in **t-1** and in **k** | Products available in **k** and in **t** | Products available in **t-1** and in **k** and in **t** | Products available in **k** and in **t** and in **t-1** |

The intersection GEKS

If exactly the same products are available in t-1 and in t, then the GEKS is equivalent to the intGEKS.

→ In our example, both approaches only differ because of the [0,1] link.

The intersection GEKS

The intGEKS can violate transitivity. For instance:

$$P^{intGEKS}_{1,2[1;K]} * P^{intGEKS}_{2,3[1;K]} \neq P^{intGEKS}_{1,3[1;K]}$$

However:

- The degree of violation of the transitivity property can be expected, in the short-term, to be small.

- The rolling versions of the GEKS also formally violate the transitivity requirement.

- Empirical results will show that the intGEKS sits very close to the TD which is known to be transitive.

More generally, in a context of high product turnover rates, what is the relevance of the transitivity property ?

Data

- Scanner data set purchased by Statistics New Zealand from Gfk (sales, quantities and product characteristics).

- Close to full-coverage of the New Zealand market

- Detailed data available from mid 2008 to mid 2011

- 8 consumer electronics product categories: camcorders; desktop computers; digital cameras; DVD players and recorders; laptop computers; microwaves; televisions; and portable media players
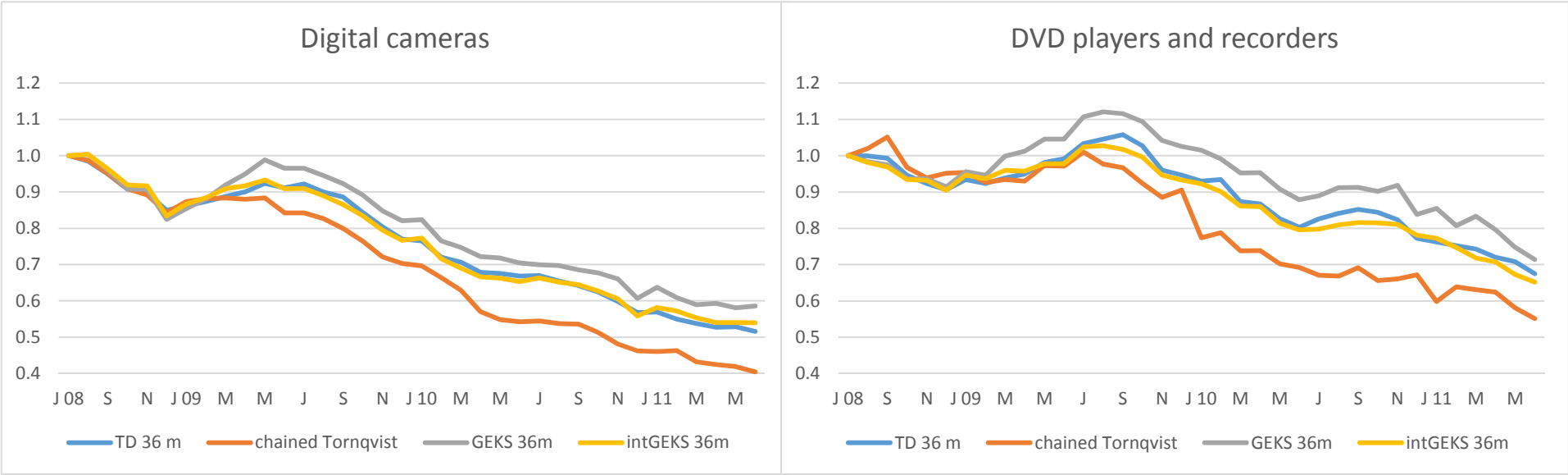
Data

This data set is characterized by a high turnover of products:

| product	birth	death	matched
camcorders	27%	27%	46%
desktops	29%	29%	42%
digcamera	25%	25%	49%
dvds	25%	25%	50%
laptops	29%	29%	43%
microwaves	22%	23%	55%
portmedia	24%	25%	52%
television	24%	23%	53%

Average monthly rates of new, old and matched products (note - not quantity or expenditure weighted)
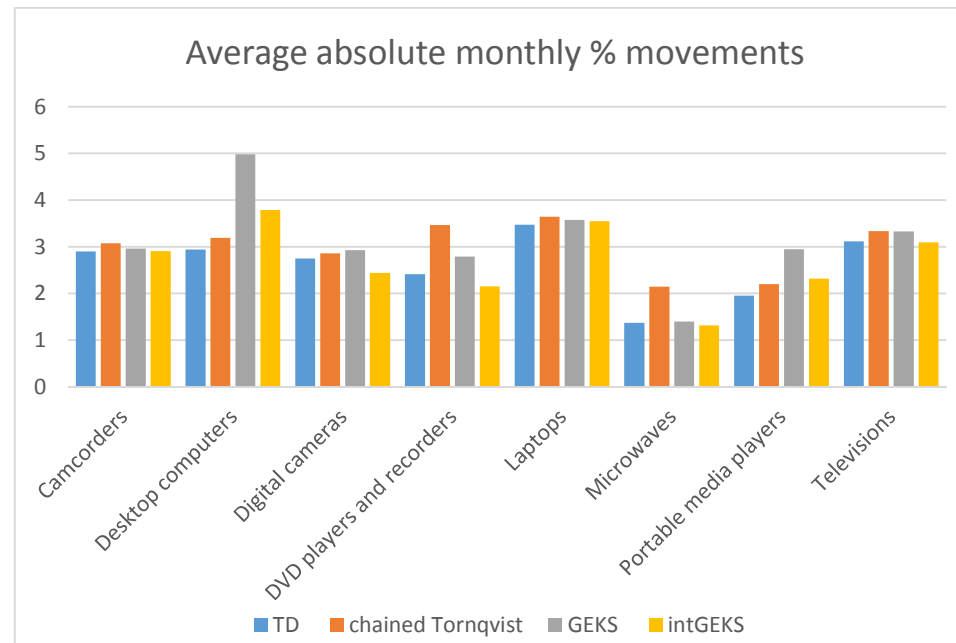
Results

Results for the full 36 month window (July 2008 – June 2011).

Results

Average relative difference from TD monthly % movement
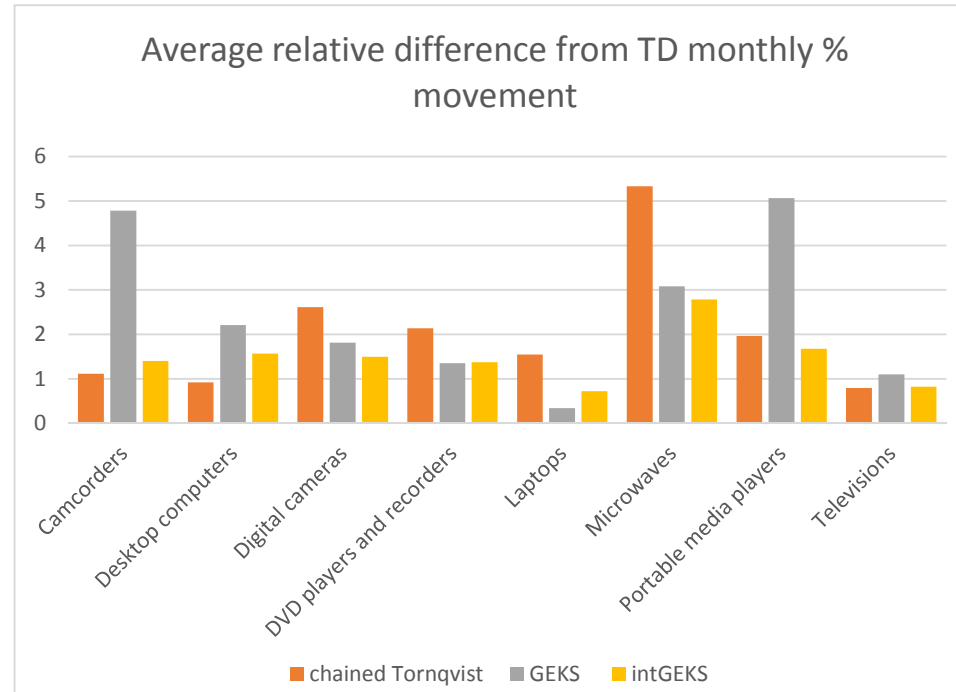
- **The intGEKS sits closer to the TD index than the GEKS does** for six of the eight product categories

Results

Average absolute monthly % movements

Legend: TD, chained Tornqvist, GEKS, intGEKS

Categories: Camcorders, Desktop computers, Digital cameras, DVD players and recorders, Laptops, Microwaves, Portable media players, Televisions

- **The intGEKS is less volatile than the GEKS index** for all eight product categories

Conclusions

- In the context of high product turnover, there is a risk that the GEKS is biased because it treats new and disappearing products asymmetrically.

- A modification (intGEKS) has been proposed which corrects for this.

- The intGEKS is not transitive.

- Empirical results show that the intGEKS sits closer to the TD than the GEKS and that it is less volatile than the GEKS.

- Hence the intGEKS can be an option when no characteristics are available.