Earnings Volatility: Within-Year Variation of Wages and Non-Employment Spells

Melanie Borah (OvGU), Kabir Dasgupta (NZWRI),

Gail Pacheco (NZWRI), Alexander Plum (NZWRI)

Applied Econometrics Workshop
Wellington, 19 Oct 2018

NEW ZEALAND WORK RESEARCH INSTITUTE

AUT UNIVERSITY NEW ZEALAND

SNZ Disclaimer

- Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975.
- The results presented in this study are the work of the authors, not of Statistics NZ.

NEW ZEALAND WORK RESEARCH INSTITUTE

AUT UNIVERSITY NEW ZEALAND

Motivation

Background:

- Widespread indicator used to measure wage mobility → standard deviation of the distribution of changes in log(earnings)
- However: a wage change may be either temporary or long-term
  - ➢ Wages might fluctuate temporarily due to overtime or bonus payments, seasonal profits or unpaid leaves
  - ➢ A job loss can be considered as a temporary interruption
- Prevailing identification strategy has some drawbacks
  - ➢ Comparing changes in annual earnings
  - ➢ Comparing changes in a particular time point (month)

Motivation

Aim of this study:

Separate <u>short-term</u> from <u>long-term</u> wage variations by accounting for within-year wage changes and periods of non-employment and to determine their influence on the measure of earnings volatility:

- Constructing a conceptual framework
- Defining three marker on earnings volatility, two referring to the prevailing identification strategy and a third accounting for within-year variation of wages and non-employment spells
- Empirical examination: Using three survey dataset (BHPS for UK, SOEP for Germany, HILDA for Australia) and a population-wide administrative dataset from Inland Revenue (NZ)

Motivation

Findings:

1) A decline of earnings volatility can only be partially observed in survey data
2) A substantial decrease can be found when using administrative data
3) Findings are robust for various sample specifications
4) Age and percentile related patterns pronounced in administrative data

Literature Review

- Nichols & Rehm 2014, p. S99: ‘inequality at a point in time is of little intrinsic interest if incomes are changing rapidly or frequently’
- Numerous studies base their analyses on annual earnings data from the US Panel Study of Income Dynamics (PSID) (see e.g. Haider 2001, Moffitt & Gottschalk 2002, Moffitt & Zhang 2018)
- Harmonized survey data on partly divergent income measures has been employed in cross-country comparisons (see e.g. Gangl 2005, Rodríguez et al. 2008, Bartels & Boenke 2013, Nichols & Rehm 2014)
- Minimizing the prevalence of measurement error, several studies make use of administrative income records as do Baker & Solon (2003) for Canada, Gustavsson (2008) for Sweden and Schröder et al. (2014) for Germany

Literature Review

- Cappellari & Jenkins (2014), using BHPS data, and Bartels & Boenke (2013), using SOEP data, offer a direct comparison of volatility measures depending on annual and monthly earnings information:
  - Cappellari & Jenkins (2014): results suggest that volatility measures based on annual gross earnings exceed those based on monthly figures
  - Bartels & Boenke (2013) find the same pattern
- None of the two studies provides a closer account of the reasons behind this difference

Conceptual framework

- Binary indicator on employment E_{itm}
- Standard random effects model:

$$\log Y_{it_m} = \mu_t + \alpha_i + \nu_{it_m}$$

$$Y_{it_m} = e^{(\mu_t + \alpha_i + \nu_{it_m})}$$

- Individual i's annual earnings Y_{it} is given by:

$$Y_{it} = \sum_{m=1}^{M_{it}} e^{(\mu_t + \alpha_i + \nu_{it_m})}$$

- Individual i's average earnings in each period m can be represented by:

$$\bar{Y}_{it_m} = \frac{1}{M_{it}} \sum_{m=1}^{M_{it}} e^{(\mu_t + \alpha_i + \nu_{it_m})}$$

Conceptual framework

- *Marker* S^t *comparing the wages of a single specific month of consecutive years:*

$$S_t = \sqrt{\mathrm{Var}\left[\log \mathrm{Y}_{itm} - \log \mathrm{Y}_{i(t-1)m}\right]}$$

$$S_t = \sqrt{\mathrm{Var}\left[(\alpha_i + \mu_t + \nu_{itm}) - \left(\alpha_i + \mu_{t-1} + \nu_{i(t-1)m}\right)\right]}$$

$$\mathrm{S}_t = \sqrt{\mathrm{Var}\left(\left[\nu_{itm} - \nu_{i(t-1)m}\right]\right)}$$

NEW ZEALAND WORK RESEARCH INSTITUTE

AUT UNIVERSITY NEW ZEALAND

Conceptual framework

- *Marker S_t^a comparing the annual sum of earnings of consecutive years:*

$$S_t^a = \sqrt{\mathrm{Var}\left[\log(\mathrm{Y}_{it}) - \log\left(\mathrm{Y}_{i(t-1)}\right)\right]}$$

$$S_t^a = \sqrt{\mathrm{Var}\left[\left(\alpha_i + \mu_t + \log\left(\sum_{m=1}^{12} e^{v_{itm}} \,|E_{itm} = 1\right)\right) - \left(\alpha_i + \mu_{t-1} + \log\left(\sum_{m=1}^{12} e^{v_{i(t-1)m}} \mid E_{i(t-1)m} = 1\right)\right)\right]}$$

$$S_t^a = \sqrt{\mathrm{Var}\left[\log\left(\sum_{m=1}^{12} e^{v_{itm}} \,|E_{itm} = 1\right) - \log\left(\sum_{m=1}^{12} e^{v_{i(t-1)m}} \,|E_{im} = 1\right)\right]}$$

$$S_t^a = \sqrt{\mathrm{Var}\left[\log M_{it} - \log M_{i(t-1)}\right]}$$

$$\lim_{M_{it}, M_{i(t-1)} \to \infty} S_t^a = 0.$$

NEW ZEALAND WORK RESEARCH INSTITUTE

AUT UNIVERSITY NEW ZEALAND

Conceptual framework

- *Marker S_t^m comparing periodic (monthly) mean earnings of consecutive years:*

$$S_t^m = \sqrt{\mathrm{Var}\left[\log \bar{Y}_{itm} - \log \bar{Y}_{i(\mathrm{t}-1)\mathrm{m}}\right]}$$

$$S_t^m = \sqrt{\mathrm{Var}\left[\left(\alpha_i + \mu_t + \log\left(\sum_{m=1}^{12} e^{v_{itm}} | E_{itm} = 1\right) - \log M_{it}\right) - \left(\alpha_i + \mu_{t-1} + \log\left(\sum_{m}^{12} e^{v_{i(t-1)m}} | E_{i(t-1)m} = 1\right) - \log M_{i(t-1)}\right)\right]}$$

$$S_t^m = \sqrt{\mathrm{Var}\left[\left(\log M_{it} + \log\left(e^{\frac{\sigma_v^2}{2}}\right) - \log M_{it}\right) - \left(\log M_{i(t-1)} + \log\left(e^{\frac{\sigma_v^2}{2}}\right) - \log M_{i(t-1)}\right)\right]}$$

$$\lim_{M_{it}, M_{i(t-1)} \to \infty} S_t^m = 0$$

NEW ZEALAND
WORK RESEARCH INSTITUTE

AUT UNIVERSITY
NEW ZEALAND

Conceptual framework

Following relationships between Marker:

- If there is no monthly variation of wages ($\sigma_\nu^2 = 0$), then $S_t = S_t^m = 0$. Under the additional condition that $M_{it} = M_{i(t-1)}\ \forall\ i$, it also holds that $S_t^a = 0$.
- In case of monthly variation of wages ($\sigma_\nu^2 > 0$) and a sufficiently large number of months in employment, $S^t > S_t^m$ as the impact of the random time specific shock diminishes in S_t^m as compared to S^t.
- If $M_{it} = M_{i(t-1)}\ \forall\ i$, then $S_t^m = S_t^a$. Otherwise, $S_t^m < S_t^a$ as S_t^m excludes periods of non-employment.
- If $M_{it} = M_{i(t-1)} = 1\ \forall\ i$, then $S_t = S_t^a = S_t^m = \sqrt{\mathrm{Var}\left(\nu_{it_m} - \nu_{it-1_m}\right)}$.

NEW ZEALAND WORK RESEARCH INSTITUTE

AUT UNIVERSITY NEW ZEALAND

Conceptual framework

We can summarize these hypotheses for two empirically relevant cases:

- First, we may choose to consider only continuously employed individuals:

$$\text{If } M_{it} = M_{it-1} = 12 \; \forall \; i \text{ and } \sigma_{\nu}^{2} > 0\text{, then } S_t > \; S_t^a = S_t^m.$$

- Second, we might want to extend the analysis to individuals who have experienced periods of non-employment:

$$M_{it} \neq M_{i(t-1)} \text{ for some } i \text{ and } \sigma_{\nu}^{2} > 0\text{, which implies that , } S_t^m < \; S_t^a \text{ and } S_t^m < \; S_t.$$

Data

- Men (25-55), (continuously) employed in both years
- Consumer Price Index
- Information on last *a)* month’s gross labour income, *b)* annual gross labour income and *c)* annual weeks/months employed required
- BHPS (1991-2008)
- SOEP (1984-2016)
- HILDA (2002-2015)
- IDI (2000-2015)

Empirical findings

Monthly variation of wages:

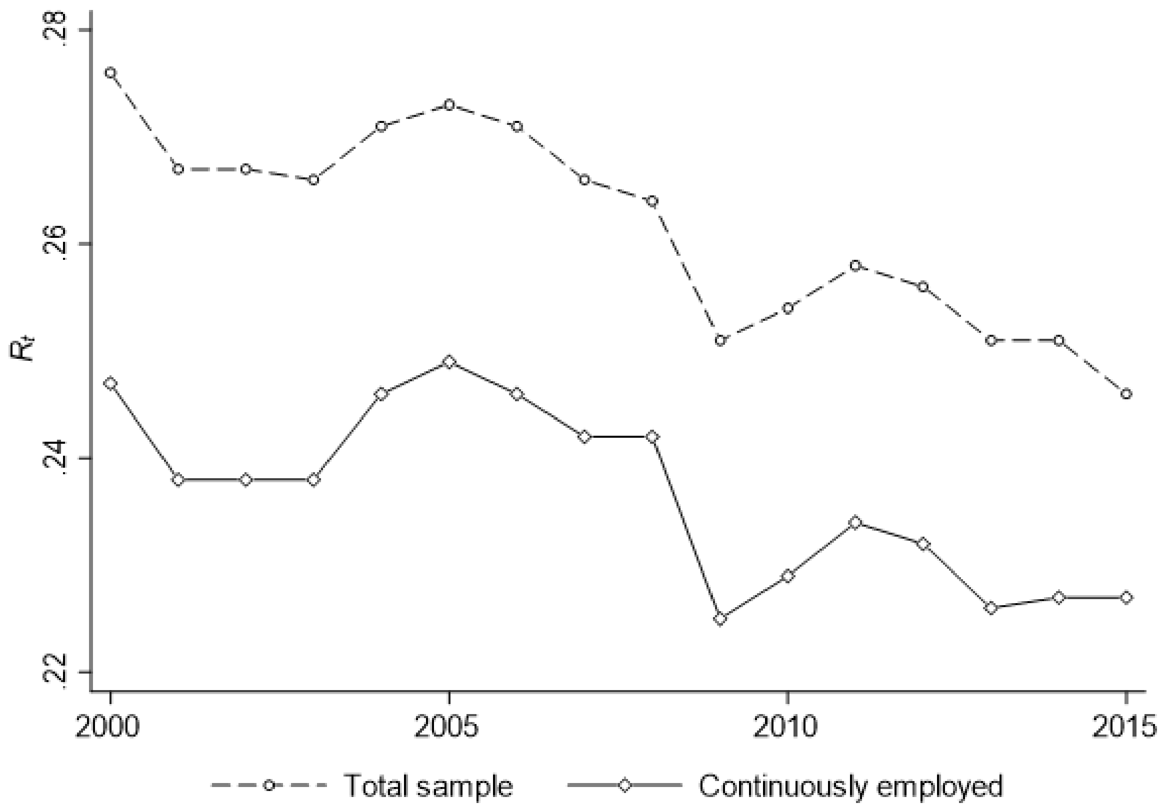
$$R_t = \frac{\sum_i \left(\frac{\left(\sum_m \left(\widehat{w}_{it_m} - \hat{\mu}_{it} \right)^2 \right)^{.5}}{\hat{\mu}_{it}} \right)}{N}$$

NEW ZEALAND
WORK RESEARCH INSTITUTE

AUT UNIVERSITY
NEW ZEALAND

Empirical findings

Figure 1: Within-year variation of wages



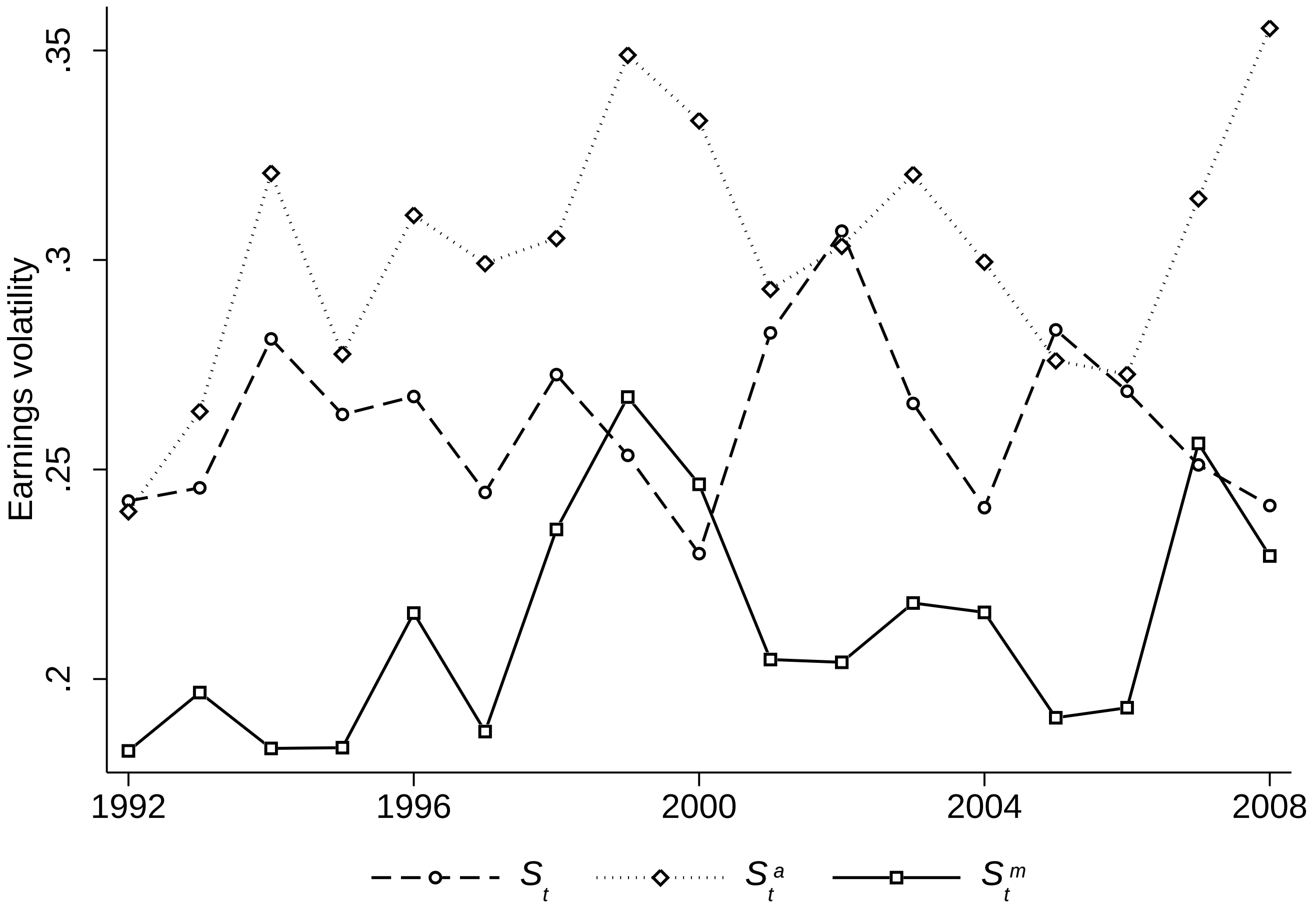
Notes: IDI (2018), own calculations

NEW ZEALAND WORK RESEARCH INSTITUTE

AUT UNIVERSITY NEW ZEALAND

Empirical findings

Figure 2: Earnings volatility (BHPS)

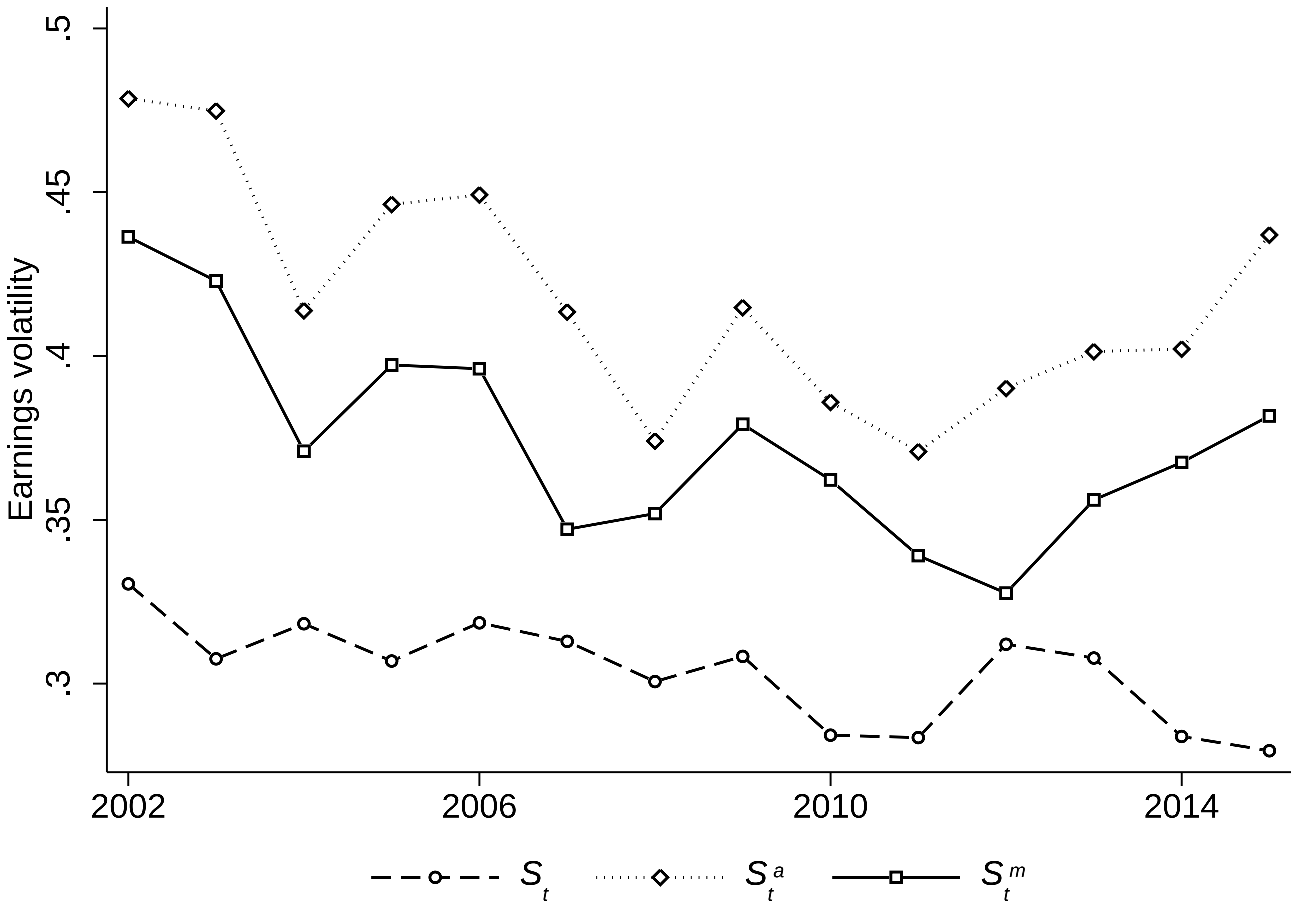


Empirical findings

Figure 2: Earnings volatility (SOEP)

Empirical findings

Figure 2: Earnings volatility (HILDA)

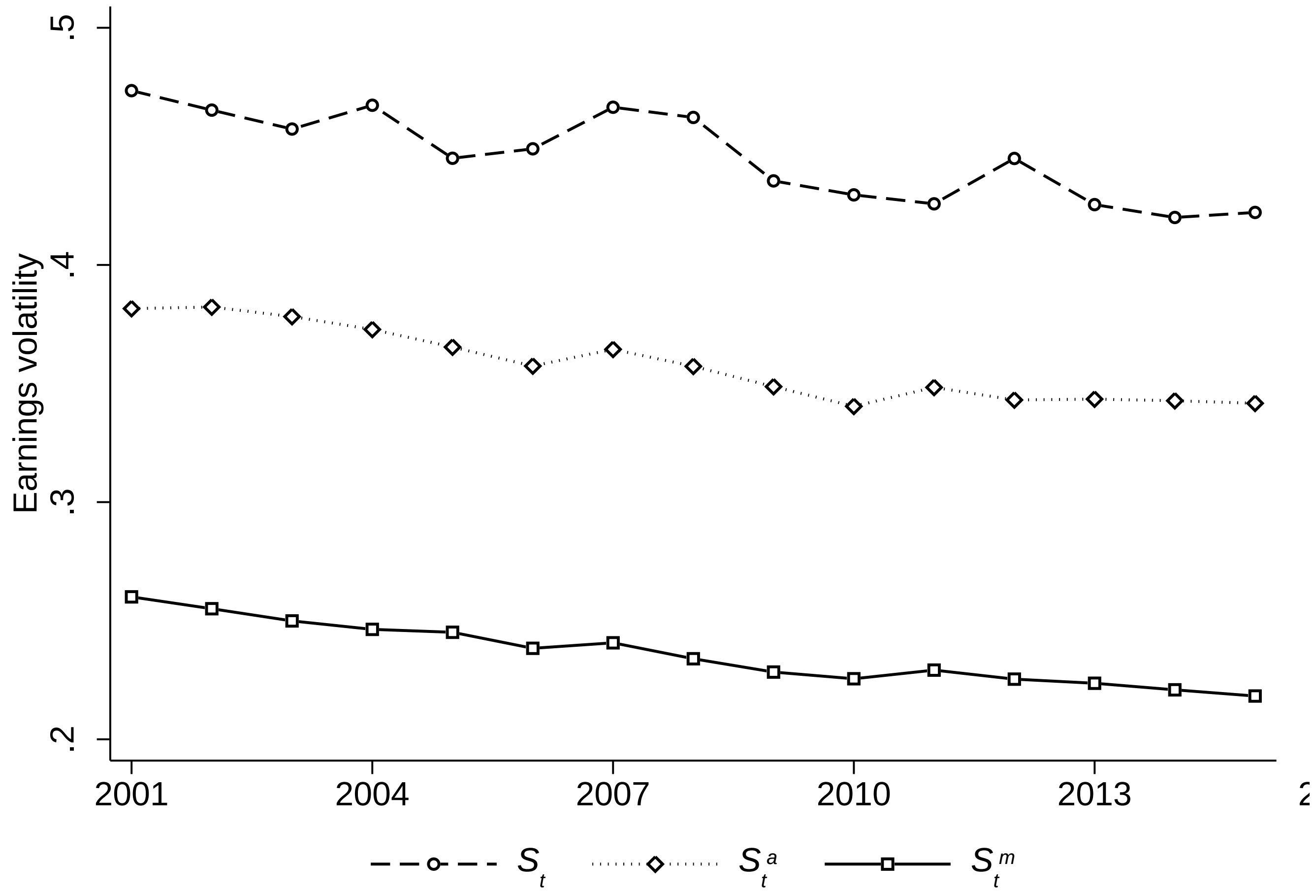


NEW ZEALAND
WORK RESEARCH INSTITUTE

AUT UNIVERSITY NEW ZEALAND

Empirical findings

Figure 2: Earnings volatility (IDI)



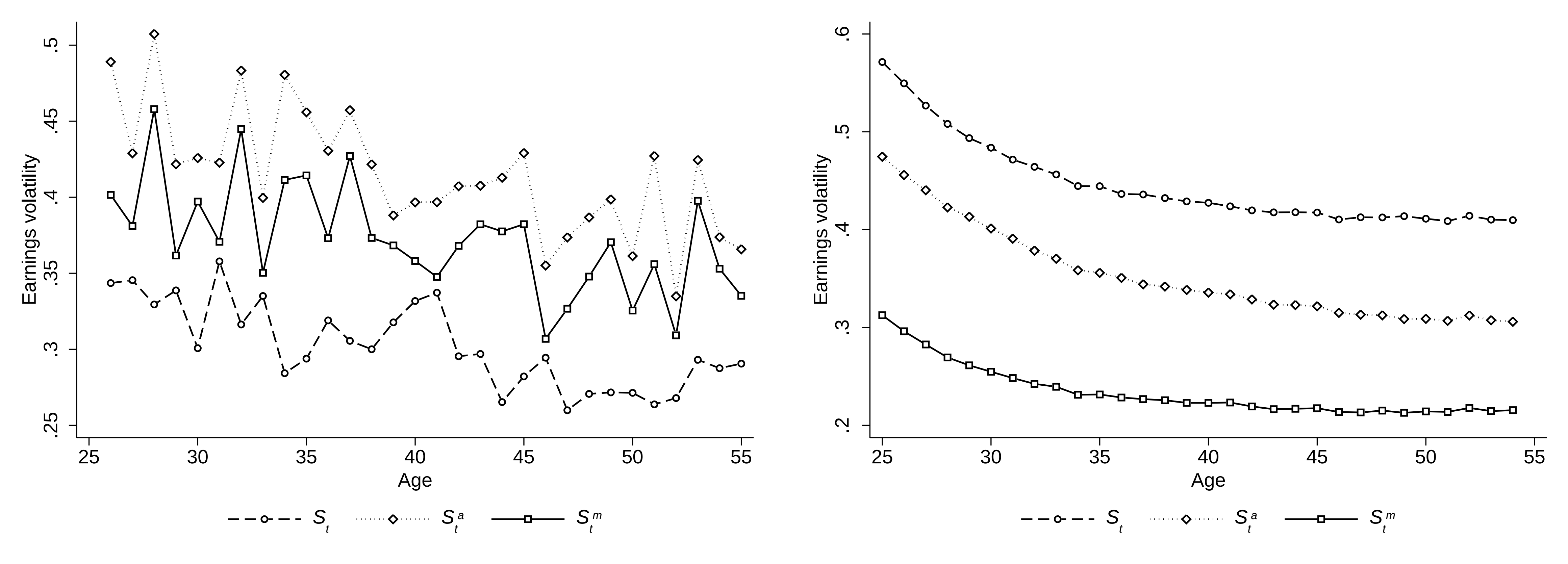
Empirical findings

Table 1: Earnings volatility for different marker

	Total sample				*Continuously employed*			
	BHPS	SOEP	HILDA	IDI	BHPS	SOEP	HILDA	IDI
$\hat{S}_t$	0.261	0.192	0.304	0.446	0.235	0.168	0.280	0.312
	(0.020)	(0.024)	(0.016)	(0.019)	(0.022)	(0.016)	(0.016)	(0.016)
$\hat{S}_t^a$	0.302	0.279	0.418	0.358				
	(0.030)	(0.018)	(0.035)	(0.015)	0.193	0.182	0.326	0.152
$\hat{S}_t^m$	0.212	0.212	0.374	0.236	(0.023)	(0.017)	(0.032)	(0.008)
	(0.027)	(0.017)	(0.031)	(0.013)				
$\hat{S}_t / \hat{S}_t^m$	1.231	0.906	0.813	1.890	1.218	0.923	0.859	2.053
$\hat{S}_t^a / \hat{S}_t^m$	1.425	1.316	1.118	1.517				
T	17	32	14	15	17	32	14	15

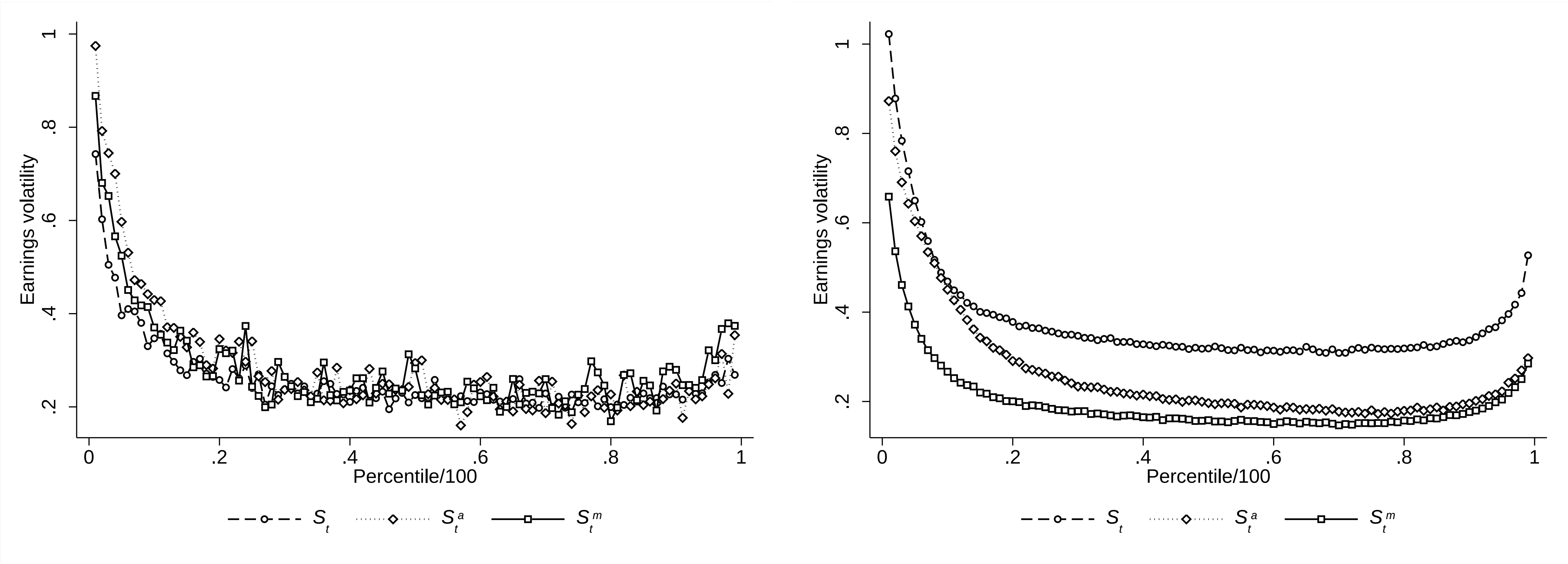
Empirical findings

Figure 3: Earnings volatility (HILDA & IDI), differentiated according to age



Empirical findings

Figure 4: Earnings volatility (HILDA & IDI), differentiated according to percentile



NEW ZEALAND
WORK RESEARCH INSTITUTE

AUT
UNIVERSITY
NEW ZEALAND

Conclusion

Findings:

1) A decline of earnings volatility can only be partially observed in survey data
2) A substantial decrease can be found when using administrative data
3) Findings robust for various sample specifications
4) Age and percentile related patterns pronounced in administrative data

Thank you very much for your time

Questions?