Wage earnings volatility in the private sector in France since 1968

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Introduction

Why be interested in earnings volatility ?

- earnings volatility implies a loss of welfare, if not smoothed by the social system or by financial markets
- volatility and inequalities both contribute to yearly earnings dispersion (permanent / transitory earnings decomposition)

Suspicion of an increasing volatility in France in the last decades.

- rise of mass unemployment
- the average employment duration shortens (Aeberhardt & Marbot 2012)
- the share of insecure employment rises

Introduction

Few works about earnings volatility on French data:

- description of the distribution of annual rates of growth (Aeberhardt & Charnoz, 2008)
- level of volatility between 1970 and 1975 (Barge & Payen, 1982):
  - volatility accounts for 10% of earnings variance
- level and evolutions of volatility between 1990 and 2000 (Bonhomme & Robin, 2009):
  - volatility accounts for 30% of earnings variance, sinusoidal evolution

We study evolutions on the period 1968 to 2009.

Plan

What is volatility ?

Regarding motivations, volatility should measure the unpredictability of earnings, but:

- "unpredictability" depends on the horizon of prediction
- individuals' abilities to prediction are hard to measure and model

Volatility is simply the stationary term (usually ARMA) in a model of earning dynamics (short horizon of prediction).

It is a residual depending on permanent earning modeling.

Modeling permanent earning dynamics

Many terms can be included in permanent earning:

- individual effect (Gottschalk & Moffit, 1994)
- random walk (Gottschalk & Moffit, 2002)
- heterogeneous trajectories
  - heterogenous growth (Haider 2001, Guvenen 2009)
  - heterogenous quadratic growth (Barge & Payen, 1982)
  - heterogenous quadratic + exponential growth (Magnac & Pistolesi & Roux, 2013)

No structural model about earnings (wages only).
Which specification fits better the data ?

Dealing with endogenous selection

Some (non random) people have no earnings several years and zeros cannot be included in a model of log-earnings.
Probability of zeros is linked to the level and volatility of earnings.

What to do ?

- imputation of minimum earnings (Jensen & Shore, 2009): low creates extreme values, high creates stability, imputed share changes
- work with an unbalanced panel (Gottschalk & Moffit, 2002, 2011): selection bias changing every year
- balance panel by date of birth (Haider, 2001, Baker & Solon, 2003, Meghir & Pistaferri, 2004): selection bias at the entry and exit of birth cohorts

None of these treatments can surely avoid bias in volatility evolutions.

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Well measured but restricted earnings

Administrative panel data (DADS):

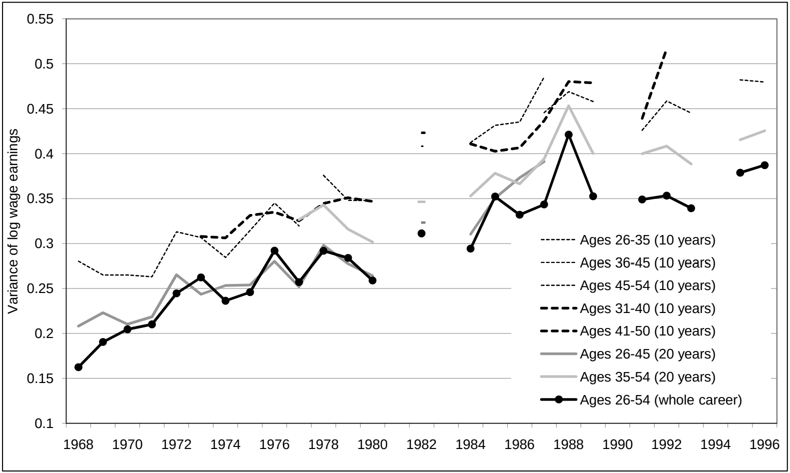
- long period of observation (1967-2009), but five missing years (1981, 1983, 1990, 1994, 2003)
- no sample attrition
- small measurement errors
- big amount of individuals

To reduce participation issues, we restrict sample to men, 25 to 55 years old.

Earnings collected in the data are restricted to private sector wage earnings. Entries and exits of the private job market emphasize the problem of zeros.

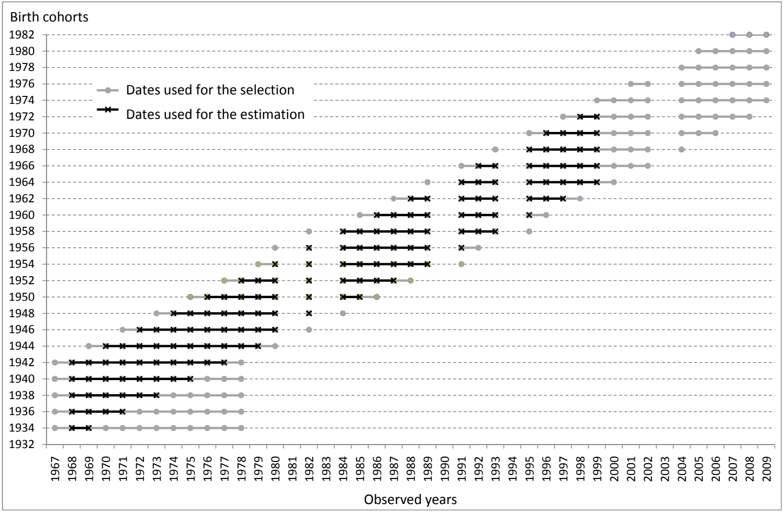
Balancing duration influences dispersion of earnings

Figure: Variance of wage earnings (in log) for different balancing periods - birth cohort 1942



An original balancing method

Figure: Balancing strategy on ages 26-35



An original balancing method

Estimation on ten-year age groups: 26-35, 36-45, 45-54.
Balancing duration is equal for each cohort.
Five age cohorts every year of estimation (age structure constant).

Shortens the period of estimation:

- extreme years 1967 and 2009 are dropped because of entry/exit problems,
- estimation for ages 26-35 stops in 1999,
- estimation for ages 45-54 starts in 1977.

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Main model

y_{ict} is the log-earning of individual i, born on date c, in year t.
$[a_d; a_f]$ is the age interval for estimation.

$$\begin{cases} y_{ict} = f_{ct} + \alpha_t.\mu_{ict} + v_{ict} \\ f_{ct} = \mathbb{E}\left(y_{ict}|c,t\right) \text{ (average cohort trajectory)} \\ \mu_{ict} = a_i + b_i(t-(c+a_d)) \text{ (individual effects and heterogenous growth)} \\ v_{ict} = \rho v_{i,c,t-1} + \lambda_t \xi_{ict} + \theta(\lambda_{t-1}\xi_{i,c,t-1}) \text{ (ARMA(1,1))} \end{cases}$$

With :

$$\mathbb{V}(\xi_{i,c,t-1}) = 1 \text{ and } \mathbb{V}((a_i,b_i)) = \begin{pmatrix} 1 & \rho_{ab}\sigma_b \\ \sigma_{ab}\sigma_b & \sigma_b^2 \end{pmatrix} \text{ whatever c.}$$

α_t catches the changes in structural inequalities.
λ_t measures the magnitude and frequency of transitory shocks.

Each component is assumed independent from others.

Extensions

y_{ict} is the log-earning of individual i, born on date c, in year t.
$[a_d; a_f]$ is the age interval for estimation.

$$\begin{cases} y_{ict} = f_{ct} + \alpha_t.(\mu_{ict} + u_{ict}) + v_{ict} \\ f_{ct} = \mathbb{E}\left(y_{ict}|c, t\right) \text{ (average cohort trajectory)} \\ \mu_{ict} = a_i + b_i(t - (c + a_d)) \text{ (individual effects and heterogenous growth)} \\ u_{ict} = u_{ic,t-1} + \beta\omega_{ict} \text{ (random walk)} \\ v_{ict} = \rho v_{i,c,t-1} + \lambda_t\xi_{ict} + \theta(\lambda_{t-1}\xi_{i,c,t-1}) \text{ (ARMA(1,1))} \end{cases}$$

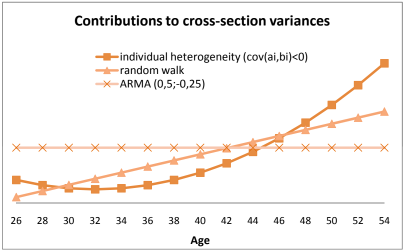
α_t catches the changes in structural inequalities.
λ_t measures the magnitude and frequency of transitory shocks.
β measures the magnitude and frequency of permanent shocks.

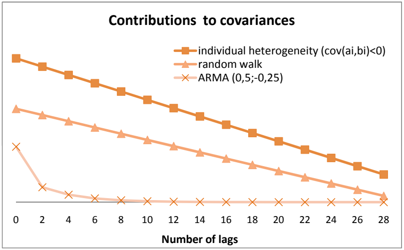
Estimation

Estimation method is standard in this literature:

- centered earnings computed as: $\tilde{y}_{ict} = y_{ict} - \bar{y}_{ct}$
- GMM applied to cohort covariances: $Cov(\tilde{y}_{ict}, \tilde{y}_{ic\tau} | c, t, \tau)$
- grid of starting points to overcome non-convex objective function

Figure: Schematic contributions to intra-cohort second order moments





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Parameters by age groups (main model)

Table: Estimated parameters

Age groups	26-35	36-45	45-54
Individual effect and heterogeneous growth			
$\sigma_a^2 *$ averaged α_t^2	$0,175^{***}$ (0,005)	$0,226^{***}$ (0,005)	$0,238^{***}$ (0,01)
$\sigma_b^2 *$ averaged α_t^2	$0,0014^{***}$ (0,0001)	$0,0006^{***}$ (0,0001)	$1,1.10^{-13}$ ($1,4.10^{-4}$)
ρ_{ab}	$-0,373^{***}$ (0,032)	$-0,020$ (0,045)	$1,3.10^{4}$ ($7,9.10^{12}$)
Volatility (ARMA)			
averaged λ_t^2	$0,123^{***}$ (0,002)	$0,095^{***}$ (0,001)	$0,089^{***}$ (0,00)
ρ	$0,382^{***}$ (0,041)	$0,528^{***}$ (0,041)	$0,827^{***}$ (0,03)
θ	$-0,134^{***}$ (0,034)	$-0,240^{***}$ (0,032)	$-0,424^{***}$ (0,02)

*Reading note: *** significant at 1%, ** significant at 5%, * significant at 10%.*

Time averages are computed on the common period of estimation: 1977 to 1999.

Parameters by age groups (main model)

About structural earnings inequalities:

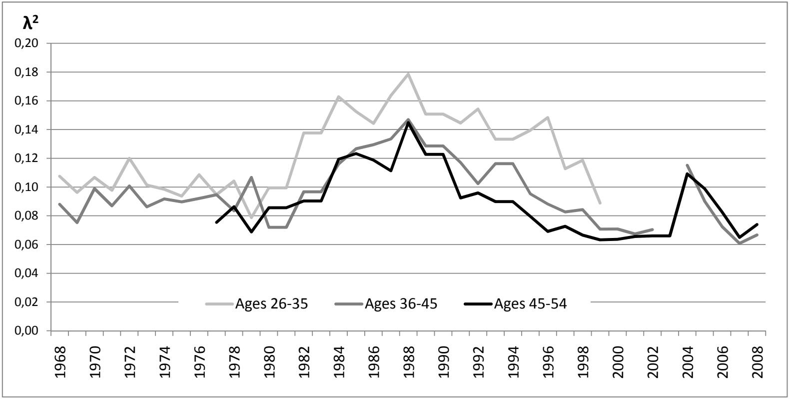
- Structural inequalities are smaller for the first age group.
- Heterogeneous growth is significant but vanishes with age.
- Convergence phase

About volatility:

- Transitory shocks are stronger (or more frequent) for the first age group.
- Transitory shocks become more persistent with age.

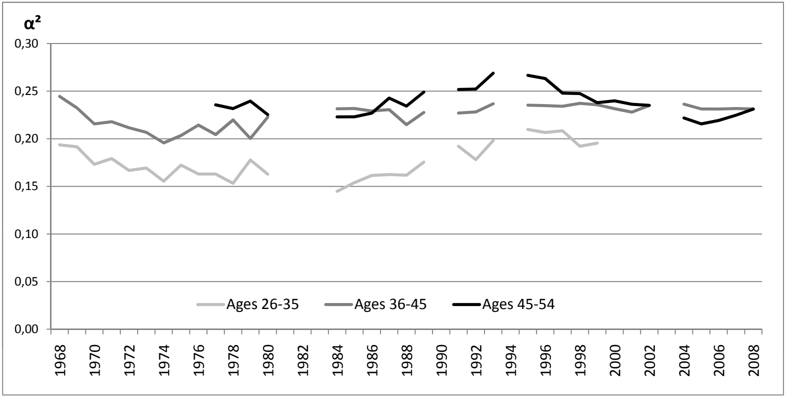
Volatility evolutions (main model)

Figure: Variance of transitory shocks for different dates and ages



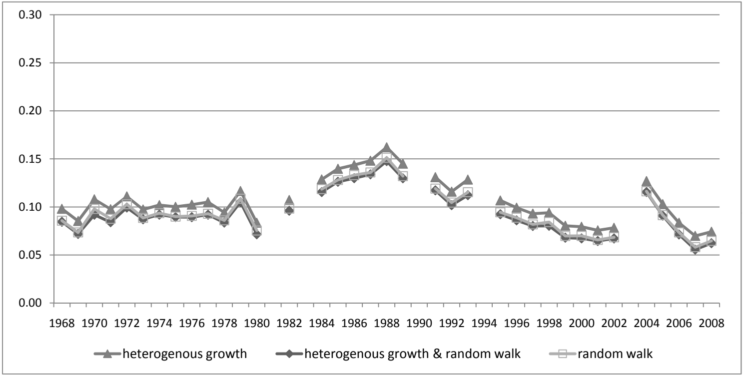
Inequality evolutions (main model)

Figure: Squared multiplier of inequalities for different dates and ages



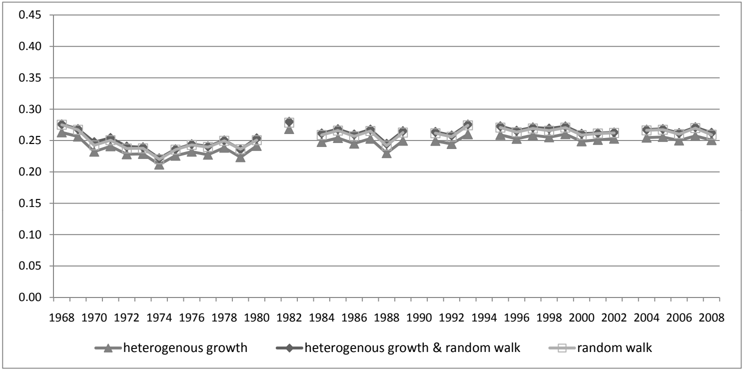
Sensitivity to model specification - volatility

Figure: Contribution of volatility to annual variance of log earnings for different model specifications - Ages 36-45



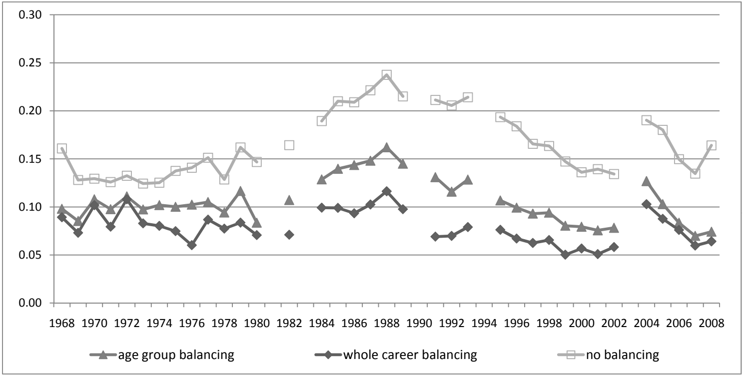
Sensitivity to model specification - inequality

Figure: Contribution of structural inequalities to annual variance of log earnings for different model specifications - Ages 36-45



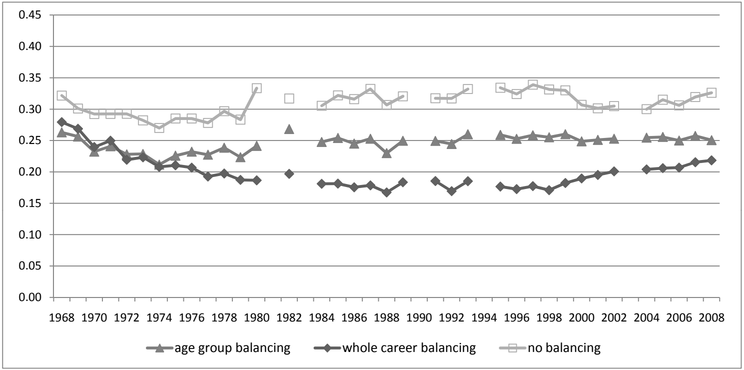
Sensitivity to balancing method - volatility

Figure: Contribution of volatility to annual variance of log earnings for different balancing methods - Ages 36-45



Sensitivity to balancing method - inequality

Figure: Contribution of structural inequalities to annual variance of log earnings for different balancing methods - Ages 36-45



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Results about French volatility

Results concern private wage earnings for a population of males aged 26 to 54, and tied to the private job market.

Individual volatility is important:

- It accounts for one third of annual earnings cross-section variance in France (close to Bonhomme & Robin, 2009).
- This share is less than in the US (0.4 to 0.6) and similar to Canada (Baker & Solon, 2003).
- Individual volatility is far bigger than macroeconomic volatility of average earnings.

Volatility depends on age: exposition to transitory shocks decreases but persistence increases.

Volatility raised in the 1980's and fell in the 1990's.

Methodological results

We propose an original balancing method to reduce selection bias in the study of volatility evolutions: both balancing duration and ages do not change over time.

On French data restricted to private wage earnings, selection issues are important:

- Less selected data have bigger variance of log-earnings, bigger volatility and bigger inequalities.
- Balancing cohorts on whole observed careers creates a U-shape bias on the evolutions of both volatility and inequalities.

On ten-year careers, specification choices between random walk and heterogenous growth has little impact on results.
The variance of earning rates of growth, gives same results about volatility evolutions.