# Earnings dynamics, foreign workers and the stability of inequality trends in Luxembourg, 1988-2009

Denisa Maria Sologon\* Philippe Van Kerm\*\*

\*CEPS/INSTEAD, Luxembourg; Maastricht University; IZA, Germany (Corresponding author: denisa.sologon@ceps.lu) \*\*CEPS/INSTEAD, Luxembourg

4th SEEK Conference, Public Finance and Income Distribution in Europe, Mannheim, 2014

Financed by a Marie Curie Post-Doc Fellowship under the Marie Curie Actions of the European Commission (FP7-COFUND) and by the Fond Nationale de la Recherche Luxembourg.

## Context

- ► the rise in income inequality global policy concern
- the rise in *earnings* inequality key driver of the growth in family income inequality
  - globalization and skill-biased technological change have amplified returns to skills => main forces behind increasing earnings inequality in the last three decades
  - role of labour market institutions in curtailing inequality increases



## Context

- much of the empirical literature long-term changes in earnings inequality reflect an increase in persistent wage differentials between workers or increased transitory variations
  - the former consistent with explanations related with increasing returns to skills and education
  - ▶ the latter increased labour market risks and volatility

(e.g., Abowd and Card (1989), Moffitt and Gottschalk (1995, 1998, 2002, 2011), Baker (1997), Dickens (2000), Haider (2001), Baker and Solon (2003), Ramos (2003), Kalwij and Alessie (2007), Cappellari (2004), Biewen (2005), Gustavsson (2007, 2008), Meghir and Pistaferri (2011), Sologon and O'Donoghue (2012))

 most studies with a long time-series dimension - permanent inequality increased in most industrialized countries between the 1970s/1980s and the 1990s/2000s both in Europe and North America (except Sweden)

- trends in permanent and transitory earnings inequality among male workers in Luxembourg between 1988 and 2009
- originality three-fold :
  - (1) a large-scale administrative dataset on earnings and employment => a flexible model of earnings dynamics that nests many specification recently used (a wide range of dynamics - age, cohort and time variations in both earnings components)
    - complete coverage of the working-age population, spanning 22 years  $\approx$  370,000 men (>3 million person-year observations), with very low reporting or recollection error and no selective attrition (other than migration or death)
    - top-coding correction through a multiple imputation procedure



- originality three-fold (contnd) :
  - (2) owing to the scale of our data distinguish trends for natives and foreign workers by estimating models separately for each subgroup => estimate their contribution to the overall inequality trends (and its components), disentangling trends in within-group inequality, between-group differentials and the relative share of each group in total employment



- originality three-fold (contnd) :
  - (3) Luxembourg case study is yet unexplored and is of interest per se due to the industrial transition and the magnitude of the concurrent labour market changes over this period
    - period of sustained economic growth and industrial re-development from an industry-driven economy to an economy dominated by the tertiary sector (financial sector in particular)
    - sustained economic growth => increased labour demand (especially for high skilled workers) => massive inflow of foreign workers—immigrants and cross-borders



## Contextual background - Luxembourg





- originality three-fold (contnd) :
  - (3) Luxembourg case study is yet unexplored and is of interest per se (contnd)
    - rising demand for high skill labour and the limited supply of domestic workers - strong upward pressure on earnings inequality
    - potentially mitigated by :
    - (i) a growth-induced increase in the demand for labour across the overall skill distribution;
    - (ii) the abundant supply of cross-border workers
    - (iii) strong labour market institutions
    - the trends in earnings inequality in Luxembourg empirical indication as to whether strong labour market regulation and large foreign labour supply can counterbalance strong inequality increasing pressures.



## Preview of our results

- modest increase in earnings inequality despite drastic labour market changes over this period
- net result of more complex underlying changes :
  - marked increases of persistent inequality among cross-border workers and among immigrants
  - growing contribution of foreign workers
  - divergence in persistent differentials between subgroups
  - decrease in earnings instability (primarily for native workers)



#### └─ D at a

## Data

- Administrative data (IGSS) professional career : 1988-2009
- Measure of earnings real log gross hourly wage (adjusted for CPI 2009) (corrected for top-coding)
- ► Male workers aged 20 to 57, born between 1940 and 1980, recorded working at least once between 1988 and 2009
- Dropped individuals :
  - at least 5 years of inactivity gaps because of disability or who retired before the age of 57 with a disability
- Analysis by 41 birth-year cohorts



### Table: Sample Size by Birth Cohort

Choop         Procop         Procop </th
born h         observed         prace in all yeas         in theorical processes         prace
1941         1966         1966         1964         11         65.69         77.39         1968         1964         42         75           1963         209         1144         13         50.07         0.7.1         1968         200         1044         205         21044         205         21044         205         21044         205         21044         205         21044         205         21044         205         21044         377         2105         1044         205         2104         45         57           1966         2072         27036         15         59.09         60.65         1988         200         44         57           1966         4207         14         64.55         57.65         1988         200         45         57           1960         506         5017         20         46.78         54.26         1988         207         38         57           1950         566         5017         723.6         24.60.0         22.79         1088         200         35         57         1988         200         35         57         1983         507         59         58         595         1985
1940         2050         19504         120         64.10         65.07         1988         1964         64         77           1944         2050         1944         13         59.07         62.71         1988         200         44         57           1944         2050         24057         14         60.14         62.22         1988         201         44         57           1946         2072         20736         15         50.01         60.65         1988         201         44         57           1946         3772         30933         10         55.14         61.12         30.00         100         24.3         57           1946         461         19         13.36         57.05         1988         2005         346         30.5         75           1950         546         5017         20         46.73         54.13         108         2008         30.5         75           1950         546         5017         22         46.63         22.3         108         2008         30.5         155           1957         7976         67093         22         44.63         50.5         1988 </td
1360         2029         21434         13         5907         0,71         1908         2009         21434         13         5907         0,71         1908         2009         21434         13         5907         0,71         1908         2000         44         57           1966         3702         27036         15         59,09         00,65         1988         002         44         57           1967         4300         42874         17         54,44         58,38         1088         1008         401         44         57           1967         4300         42874         17         54,44         58,38         1088         2004         44         57           1960         3661         6011         723         6042         21         47,63         54,26         1988         2007         38         57           1950         6631         6731         735         22         46,63         52,33         1988         2009         38         57           1950         6641         7354         22         46,63         22,45         1988         2009         38         51           1957         7199
1944         2085         2087         14         60.14         00.22         1988         2011         44         57           1966         3702         3083         16         55.01         61.12         1988         2001         44         57           1966         3702         3083         16         55.01         61.12         1988         2003         44         57           1968         4011         4884         18         53.33         77.85         1988         2003         40         57           1988         4011         4884         18         53.33         77.85         1988         2007         38         78           1981         56.13         72.35         22.44         87         73         87.33         1988         2008         37         77           1981         56.13         777         72.35         22.4         46.03         22.78         1988         2008         38         6           1981         5031         7747         22.4         46.03         20.78         1988         2009         31         35         5           1985         5055         5053         1980
1966         972         27736         15         15,000         00,65         1988         1982         1987         45         15           1964         7372         27736         15         15,000         00,65         1988         100         100         100         100         100         100         100         100         100         14         17           1967         420         42674         17         54,44         53,35         7,85         198         100         441         57           1980         1038         546,14         19         1,138         77,05         108         100         30         57           1980         503         5641         73         46,05         13,33         198         200         30         57           1981         503         5611         7375         108         100         30         57           1982         7377         7047         22         46,03         20,04         198         100         33         51           1987         7077         07645         22         40,08         107,38         108         100         20         20
1946         7920         20603         16         5531         00.13         1080         2033         40         57           1946         6401         46374         17         55.44         53.35         57.85         1938         2004         41         77           1948         6401         46364         18         53.35         57.85         1938         205         60         57           1950         5346         5614         19         51.35         57.85         1938         205         60         35         57           1950         5346         56017         20         40.76         44.45         138         108         2007         38         57           1950         5346         56017         22         46.63         23.35         53.5         1938         2009         35         55           1957         517         9451         22         45.63         50.55         1938         2009         35         55           1957         617         9451         22         42.60         50.35         1938         2009         35         54           1958         8957         9613
1947         4350         4357         17         5.644         53.35         1968         200         44         57           1960         461         450         4354         17         5.644         53.35         1968         200         44         57           1960         501         4646         10         51.38         57.65         1968         200         30         57           1950         5366         5017         20         47.73         44.13         1968         200         30         57           1951         5643         6452         21         47.73         44.13         1968         200         32         57           1951         5643         7547         22         46.03         52.70         1968         200         33         55           1956         7377         5045         22         46.03         50.55         1988         200         32         5           1956         7576         67893         22         44.30         40.36         1988         200         32         5           1950         9642         10217         22         41.32         40.36 <td< td=""></td<>
1940         44846         18         53.53         57.68         1968         20.6         40         F.           1940         4061         44646         18         53.53         57.65         1968         20.6         30         7.           1950         5546         5011         20         46.78         54.20         1988         20.7         38         87           1952         5643         6642         21         46.63         22.33         1068         20.07         38         57           1952         5641         79.7         20.47         22         46.63         22.33         1068         20.07         38         57           1952         5617         70.47         22         46.63         22.33         1068         20.07         33         56           1956         777         70.47         22         44.50         50.55         1988         20.09         31         52           1967         766         7066         1022         42.00         50.33         1088         2009         31         52           1959         9642         100210         22         41.12         40.36 <td< td=""></td<>
1940         5101         5014         1914         1913         1915         1916         1916         1916         1917         1917         1917         1917         1917         1918 <t< td=""></t<>
1900         5346         5301         20         4678         54.26         1908         207         38         57           1912         5346         5617         7378         6462         21         47.33         54.31         1908         2007         38         57           1912         5611         7335         622         46.63         52.33         1908         2009         35         57           1954         7377         50451         722         46.63         52.70         1908         2009         35         55           1954         7199         62451         22         46.63         52.74         1008         2009         35         55           1957         5177         04561         22         46.63         53.55         1098         2009         31         51           1968         9057         90913         22         43.25         50.33         1988         2009         31         52           1969         1040         100717         22         41.20         40.06         1988         2009         24         1098         1009         24         1098         1009         24         45<
1001         6403         6404         11         47.33         54.31         1002         1003 <th< td=""></th<>
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $
1983         6531         7947         12         46,00         57,70         1083         100         109
1934         0 7198         0 8300         12         0 4633         150,04         1988         100         1988         100         1898         100         1898         100         1898         100         1898         100         1898         100         1898         100         1898         100         1898         100         1898         100         1898         100         1898         100         1898         100         1898         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         31         110         100         100         21         41         31         100         110         100         100         100 <th< td=""></th<>
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
3936         7.266         0.7936         1.26         4.400         39.793         1.27         1.093         1.093         1.093         1.093         1.093         1.093         1.093         1.093         1.093         1.093         1.093         1.093         1.093         1.093         1.093         1.033
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $
1990         0807         09011         12         4.30         03.3         1000         1000 <th< td=""></th<>
1393         5940         5940         5940         1001         12         14         1500         1600         1160         10000         1000         1000         1
3000         30140         110740         110745         2         4         432         46.35         1108         1009         2         40         1008         11050         10073         22         40.18         47.55         1098         2009         22         47           1964         13501         13715         12         37.36         46.65         1998         1009         23         44         5           1964         13535         13715         12         3.343         6.60         1698         1009         23         44         5           1966         13076         132860         22         2.02         4.04         4.16         198         2009         24         45           1960         13076         132777         2         2.177         41.05         1990         2009         20         20         20         20         20         20
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $
1980         11185         112051         22         410.8         47.9         131         1308         1109         177         131         120         22         410.8         47.9         131         1308         1109         177         120         177         131         22         37.38         46.95         1988         1109         27         47
1980         11001         12013         22         40.05         40.05         1008         1009         <
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $
Upon         L331         L3/15.1         2/2         3/10.9         46.049         1998         1102         1997         1998         1102         1997         1998         1102         1997         1998         1997         13030         2/2         3/10.9         46.049         1998         1998         1997         1930         1000         3/2         4/2         3/10.9         4/2         6/3         1998
1973         1976         9422         17         18.64         44.62         1993         2006         20         56           1974         1236         8.044         16         1.047         41.69         1994         100         20         20         56           1975         11266         8.044         1.6         1.677         41.69         1994         100         20.85           1976         11647         6.640         4.4         16.40         40.31         1995         20.07         20.33           1976         11649         6.6477         1.3         20.07         43.37         1997         20.92         20.33           1978         11099         5.7666         12         2.24.77         43.30         1998         6.000         1.93         1998         1000         2.03         3         1.93
1974         12398         63094         16         18.77         41.89         1994         209         20         35           1975         11834         7512         15         17.63         42.43         1995         209         20         35           1976         11846         6404         14         18.40         42.31         1995         209         20         35           1977         1489         6477         13         20.07         43.37         1997         209         20         35           1978         11099         57665         12         2.2.47         43.30         1998         1997         1979         10971         5147         11         2.369         1997         1998         1097         2.007         2.017         43.09         1998         1097         1997         1997         10971         5147         11         2.369         1097         1998         1091         40.04         1999         1091         10914         49313         10         2.6.91         6.1.8         2000         2009         202         2.9         2.9         2.9         2.9         2.00         2.009         2.02         2.9
1976         11548         66404         14         18.40         42.31         1995         20.93         33           1977         11409         6777         13         20.07         43.37         1997         20.92         33           1976         11099         57668         12         22.47         43.30         1998         1002         13           1979         10071         5147         11         23.60         44.04         1999         10071         10014         49313         10         2.6.91         45.18         2000         2009         20.23         1990         1.0114         49313         10         2.6.91         45.18         2000         2009         20.23         1.9         1.9         1.0114         49313         10         2.6.91         45.18         2000         2009         20.23         1.9         1.9         1.9         1.011         3.02597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3.05597         3
1977         11469         64777         13         20.07         43.37         1997         109         20         32           1979         1097         5766         12         22.47         43.30         1995         100         50         600
1978 1099 57656 12 22.47 43.30 1998 1000 1000 1000 1000 1000 1000 100
1979 10971 53147 11 23.80 44.04 1999 <u>Uros</u> un se 1980 10914 49813 10 26.91 45.18 2000 2009 <sub>1</sub> 20 <sub>14</sub> 2 <b>g</b> Total 369288 3265927
1980 10914 49313 10 26.91 45.18 2000 2009 20 <sub>N</sub> 29 Total 369288 3265927
Total 369288 3265927

#### Data

## Solution for top-coded earnings

- impute simulated values for top-coded earnings following Jenkins et al. (2011) - approximate the upper tail of the earnings distribution for each year by the Pareto distribution (see, e.g. Atkinson and Piketty, 2010, Kopczuk et al., 2010, Atkinson et al., 2011, Alfons et al., 2013)
- estimate the parameters of the distribution using ML methods and multiply impute each top-coded earnings observation with m = 20 independent random draws from the estimated top income distributions; drop bottom and top 1% by year
- repeat 20 times = > 20 partially synthetic datasets composed of non-coded and imputed values for top-coded earnings
- ► all calculations and estimations replicated on the 20 datasets; the reported estimates - based on by Reiter (2003). CEPS Amastrict University

#### └─ Tr en ds

## Trends

Figure: The variance and mean of log hourly earnings, 1988-2009



## Model

Model which accommodates fine details of the auto-covariance structure of earnings :

$$r_{it} = \gamma_{1c} \lambda_{1t} \mu_{it} + \gamma_{2c} \lambda_{2t} \upsilon_{it}.$$
(1)

$$\mu_{it} = \mu_{i(c+20)} \sim iid(0, \sigma_{\mu_{c+20}}^2) \qquad if \ t = c + 20 \qquad (2)$$

$$\mu_{it} = \mu_{i,t-1} + \pi_{it} \qquad if \ t > c + 20 \qquad (3)$$
  
$$\pi_{it} \sim iid(0, \sigma_{\pi_{t-c}}^2), E(\mu_{i,t-1}, \pi_{it}) = 0$$

$$\begin{aligned}
\upsilon_{it} &= \rho \upsilon_{i,t-1} + \epsilon_{it} + \theta \epsilon_{i,t-1} \\
\epsilon_{it} &\sim (0, \sigma_{\epsilon_{ct}}^2), \upsilon_{i0} \sim (0, \sigma_{c0}^2).
\end{aligned} \tag{4}$$

#### Estimation

## Estimation

- model similar to Kalwij and Alessie (2007), with added features from Baker and Solon (2003) (age-specific heteroskedastic transitory variances), and Ostrovsky (2010) and Moffitt and Gottschalk (2011) for the correction for left-censoring for each cohort in the first year observed.
- parameters θ estimated by fitting the theoretical auto-covariance matrix f(θ) (determined by the full model specification) onto the empirical covariance structure using *minimum distance methods*

 $B = V - \overline{V}$ 

assessing subgroup contributions :

— within :

$$\bar{V} = \sum_{g=1}^{\kappa} n_g V_g \tag{7}$$

- between :

#### Results

## Overall decomposition

### Figure: Inequality decomposition all men at age 40





## Permanent inequality subgroup decomposition

Figure: Permanent inequality subgroup decomposition : nationals, immigrants and cross-border workers





## Transitory inequality

# Figure: Transitory inequality : National, immigrants and cross-border workers at age 40



#### Results

# Table: Trend and cyclical variation of the persistent and transitory components

Models	Dependent Variable	Linear trend		Real GDP growth rate		Adjusted R <sup>2</sup>
		Est	SE	Est	SE	
All Men	Permanent Variance Transitory Variance	0.0032	0.0002	0.1417	0.0352	0.9331
		0.0011	0.0002	0.0555	0.1002	0.1010
Nationals	Permanent Variance Transitory Variance	-0.0011	0.0006	-0.0873	0.0812	0.3412 0.7256
lmmigrants	Permanent Variance Transitory Variance	0.0053 -0.0011	0.0004 0.0004	0.0934 -0.1360	0.0840 0.0670	0.8820 0.2590
Cross-Border Workers	Permanent Variance Transitory Variance	0.0058 -0.0012	0.0003 0.0004	0.1493 -0.1888	0.0641 0.0745	0.9360 0.2668



## International context

Figure: Evolution of (A) permanent and (B) transitory variance of log earnings for men in the US (1988-2004), Sweden (1988-1999), Denmark (1988-2004), Germany (1988-2009), Italy (1988-2003), and Luxembourg (1988-2009). (Figure 12, page 29)



## International context

Figure: Relative evolution (1988=100) of (A) permanent and (B) transitory variance of log earnings for men in the US (1988-2004), Sweden (1988-1999), Denmark (1988-2004), Germany (1988-2009), Italy (1988-2003), and Luxembourg (1988-2009).





## Concluding remarks

- modest increase in earnings inequality despite drastic labour market changes over this period - net result of more complex underlying changes
- persistent inequality did grow significantly
  - within the cross-border and within the immigrant workers group
  - between the three workers groups => the distribution of skills and jobs - increasingly heterogeneous across the three groups
- the overall inequality growth was contained by
  - decrease in employment share of nationals
  - increase in employment share of foreign workers (with the lowest within-group persistent inequality)
  - decrease in earnings instability
  - overall favourable trends for natives



## Concluding remarks

- surprising stability of inequality in the face of large changes in the size and structure of employment and fast growth vs. other countries (e.g. Germany)
- results possibly hint at the role of strict labour market regulations and collective bargaining institutions at holding back overall earnings inequality (yet not so much persistent inequality)
- technical note : usefulness of access to large-scale administrative records for inequality trends (detailed analysis within population subgroups and relaxing restrictions on the sophistication of variance component models that can be fit and affect the reliability of inference)



# Thank you!



## Trends

## Figure: Gross value added share contributed by sectors



Source : Calculations based on EUROSTAT data.

## Trends

Figure: Decomposition of the variance of log earnings by population subgroups : Native, Immigrant and Cross-Border workers, 1988–2009

