

# Aggregate Earnings Inequality in Europe: Permanent Differences or Transitory Fluctuations?

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## Abstract

*This paper examines the relationship between aggregate inequality and its underlying components for a number of European countries. We use a well established GMM approach to separate the permanent component from the transitory component of earnings inequality. Our results show that three quarters of the observed cross-country differences in aggregate inequality in Europe is accounted for by differences in permanent inequality, reflecting differences in individual characteristics that persist throughout the life-cycle.*

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## 1. Introduction

In recent years a number of studies have distinguished between two components of aggregate inequality: inequality that reflects differences across individuals or groups that are due to permanent characteristics (so called ‘permanent’ inequality) and inequality arising from temporary shocks, which cause disadvantage at a point in time but have limited persistence, giving rise to higher mobility (‘transitory’ inequality). When the transitory component is high, aggregate measures of inequality at a point in time overstate long-run inequality, and thus may reduce concerns about high inequality in a given year (see for example Buchinsky and Hunt (1999)). Similarly one may be less concerned with observed differences in aggregate inequality across countries, if these differences reflect differences in mobility. In this paper we consider this issue by examining the relationship between permanent inequality, transitory inequality and aggregate inequality across a number of European countries.

We use a well established GMM procedure<sup>1</sup> to carry out a decomposition of earnings inequality for 12 European countries from 1994 to 2001. We show that this approach can be used to provide a simple graphical representation of the extent to which high aggregate inequality is offset by higher mobility, as well as a formal decomposition that allows us to explicitly measure this relationship. In keeping with previous work (OECD (1996) and Rodriguez et al (2008)) we find a positive relationship between mobility and aggregate inequality. However our findings reveal that differences in aggregate earnings inequality in Europe are not driven by differences in earnings

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<sup>1</sup> Previous applications of this approach include Sologon and O’Donoghue (2009), Daly and Valetta (2008), Moffitt and Gottschalk (1995, 2002, 2008), Kalwij and Alessie (2007), Capellari (2004), Ramos (2003), Haider (2001), Dickens (2000) and Baker (1997).

mobility, with almost 75% of the observed differences in inequality across countries reflecting differences in permanent inequality.

## 2. GMM Approach to Estimating Permanent and Transitory Inequality

Following others we write log earnings over the life-cycle as a function of labour-market experience,  $X_{it}$  and a residual,  $y_{it}$  :

$$Y_{it} = g(X_{it}, \delta_t) + y_{it} \quad (1)$$

The residual component,  $y_{it}$ , can in turn be written as the sum of a permanent component,  $\alpha_i$ , due for example to fixed characteristics such as the level of education, and a transitory one,  $v_{it}$ , reflecting temporary shocks that affect the individual or the labour market. That is

$$y_{it} = p_t \alpha_i + \lambda_t v_{it} \quad (2)$$

where  $\alpha_i$  and  $v_{it}$  are random variables with mean zero and variances  $\sigma_\alpha^2$  and  $\sigma_v^2$  respectively and  $p_t$  and  $\lambda_t$  are ‘factor loadings’ that allow these variances to change over time in a way that is common across individuals. Our objective is to identify the separate roles played by the permanent and transitory shocks in determining inequality. We follow standard practice by first estimating  $y_{it}$  as the residuals from OLS regressions of equation (1).<sup>2</sup> These residuals are then used to model the covariance structure described by equation (2). Persistence in the transitory shocks,  $v_{it}$ , is modelled using either an AR(1) or ARMA(1,1) process, with AR parameter  $\rho$  and MA parameter  $\theta$ . This simple model

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<sup>2</sup> In the empirical application,  $g$  is a simple quadratic in experience.

captures many of the important features of earnings dynamics models, namely time-varying variances and serial correlation of the transitory shocks. Other, more elaborate specifications are often used, including a heterogeneity and/or a random walk element in the permanent component, cohort effects in the permanent and/or transitory components and cohort-specific initial variances. We experimented with many of these specifications for our countries but were unable to identify key parameters of the more complex models with the available data.<sup>3</sup> For each country we report findings based on the most elaborate model robustly supported by the data.<sup>4</sup>

The model is estimated by GMM, whereby sample moments are matched to population moments. In this specification, the true variance-covariance matrix has diagonal elements:

$$\sigma_1^2 = p_1^2 \sigma_\alpha^2 + \lambda_1^2 \sigma_{v1}^2, \text{ for } t = 1 \quad (3)$$

$$\sigma_t^2 = p_t^2 \sigma_\alpha^2 + \lambda_t^2 (\rho^{2t-2} \sigma_{v1}^2 + K \sum_{w=0}^{t-2} \rho^{2w}), \text{ for } t > 1$$

and off-diagonal elements:

$$\text{Cov}(y_t, y_{t+s}) = p_t p_{t+s} \sigma_\alpha^2 + \lambda_t \lambda_{t+s} (\rho^s \sigma_{v1}^2 + \rho^{s-1} \theta \sigma_\varepsilon^2), \text{ for } t = 1, s > 0 \quad (4)$$

$$\text{Cov}(y_t, y_{t+s}) = p_t p_{t+s} \sigma_\alpha^2 + \lambda_t \lambda_{t+s} (\rho^{2t+s-2} \sigma_{v1}^2 + \rho^s K \sum_{w=0}^{t-2} \rho^{2w} + \rho^{s-1} \theta \sigma_\varepsilon^2), \text{ for } t > 1, s > 0$$

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<sup>3</sup> Typical problems encountered included negative variances, high standard errors on key parameters, values of  $\rho$  greater than 1 and extreme sensitivity to starting values.

<sup>4</sup> This resulted in estimation of an AR model for Belgium, Denmark, Finland Ireland, Italy and Portugal and an ARMA model for Austria, France, Germany, Netherlands, Spain and the United Kingdom.

where  $K = \sigma_\varepsilon^2(1 + \theta^2 + 2\rho\theta)$  <sup>5</sup>

The parameter vector to be estimated is given by  $\varphi = \{\sigma_\alpha^2, \rho, \sigma_\varepsilon^2, \sigma_{v1}^2, p_1 \dots p_T, \lambda_1 \dots \lambda_T, \theta\}$ .

Identification requires a normalization of the factor loadings; in keeping with the literature, we set  $\lambda_1$  and  $p_1$  equal to one. We then use this parameter vector to recover the individual components of aggregate inequality.

### 3. Data

To examine inequality in Europe we use the eight waves of the European Community Household Panel Data (ECHP) for Belgium, Denmark, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain, and the UK, the seven waves available for Austria and the six waves available for Finland.<sup>6</sup> These data are the only available panel data with appropriate comparable earnings variables across a range of European countries.<sup>7</sup> The years covered by the survey are 1994-2001. For each country we construct unbalanced panels from the initial sample. These comprise all males aged 21-65 who are neither in full-time education nor retired and who report earnings in any year. Our measure of earnings is total labour market earnings in the previous month. Observations with earnings in the top and bottom 1% of the sample are excluded. All men in the relevant age range who report earnings in any year are included.

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<sup>5</sup> The moments of the AR specification are obtained by setting  $\theta=0$ .

<sup>6</sup> We did not use data for Sweden or Greece. The Swedish component of the ECHP is not a panel and therefore is not suitable for this type of analysis. The scheduling of interviews in the Greek surveys led to concerns about comparability with other countries.

<sup>7</sup> For a discussion of the appropriateness of datasets such as the ECHP for GMM estimation of the covariance structure of earnings, see Doris et al (2010).

#### 4. Results

The results from the parametric model characterised by equations (3) and (4) are summarized in Figure 1.<sup>8</sup> This shows aggregate inequality, as well as its permanent and transitory components, for each country, averaged over the sample period. As is well-known, we see large differences in aggregate inequality across countries with Ireland, Portugal, Spain and the UK having high inequality, and Italy, Denmark Belgium and Austria having low inequality.

To analyse the relationship between aggregate and transitory inequality, we calculate the Spearman rank correlation between the two. The resulting correlation coefficient of 0.50 (p-value 0.10) indicates a positive relationship, in keeping with previous work (OECD (1996) and Rodriguez et al (2008)). However Figure 1 suggests that despite this relationship, most of the observed differences in cross-country aggregate inequality is accounted for by differences in permanent inequality. We will return to this issue in more detail later.

In Figure 2 we compare our estimates of permanent inequality with independently generated features of the wage structure to see if they are correlated in the expected way. In particular we examine the correlation between a country's ranking in terms of permanent inequality and the ranking of the wage premium due to educational differences. The wage premium is taken from the OECD database and measures the difference in gross wages between males with tertiary education over those with upper secondary

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<sup>8</sup> The parameter estimates and standard errors for each country are provided in Table A1 of the Appendix.

education.<sup>9</sup> Figure 2 shows a positive correlation between the ranks. This is consistent with the standard interpretation of permanent inequality in this literature.

To examine the relationship between transitory inequality, permanent inequality and aggregate inequality in more detail, we decompose variation in inequality across countries. By construction, aggregate inequality for country  $j$ ,  $\sigma_j^2$ , is the sum of permanent inequality ( $\sigma_{pj}^2$ ) and transitory inequality ( $\sigma_{Tj}^2$ ). Therefore the variation in aggregate inequality across countries can be written as:

$$Var(\sigma_j^2) \equiv Var(\sigma_{pj}^2 + \sigma_{Tj}^2) = Var(\sigma_{pj}^2) + Var(\sigma_{Tj}^2) + 2Cov(\sigma_{pj}^2, \sigma_{Tj}^2) \quad (5)$$

The first term reflects differences in permanent inequality across countries, the second differences in transitory inequality, while the covariance term picks up any trade-off or complementarities between the two components. A graphical presentation of this decomposition can be seen in Figure 3. The first term in (6) is captured by variation in the horizontal dimension of the graph, the second by variation in the vertical dimension and the third by the slope of the scatter plot. As noted earlier these data suggest that most of the variation in observed inequality across European countries occurs in the horizontal dimension, reflecting differences in permanent inequality. This is confirmed in the results given in Table 2, which decompose the variation in average inequality across the 12 countries using equation (6). The result in column two shows that 73% of the variation in aggregate inequality across countries in our sample is due to differences in the level of permanent inequality, 20% due to differences in transitory inequality and the remainder

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<sup>9</sup> These data were taken from Education at a Glance OECD Indicators 2005, Table A9.2b with the exception of Austria which was taken from Strauss and de la Maisonneuve (2007).

reflecting the positive association between these two components. For the most part, the higher levels of inequality observed in some European countries do not reflect higher mobility/opportunity but rather permanent differences that remain throughout an individual's lifetime.

## **5. Conclusions**

In this paper we examine the nature and determinants of inequality across 12 European countries using the European Community Household Panel. Differences in permanent inequality account for the majority of the difference in aggregate inequality across these countries. This suggests the existence of an underclass of workers in high inequality countries, who will not only earn significantly below average earnings at any point in time, but who can also expect this disadvantage to persist over their life-time. Tackling inequality in these countries is not merely a question of providing insurance against income shocks but rather requires a concerted effort to address the skill-disadvantages of those at the bottom end of the income distribution.



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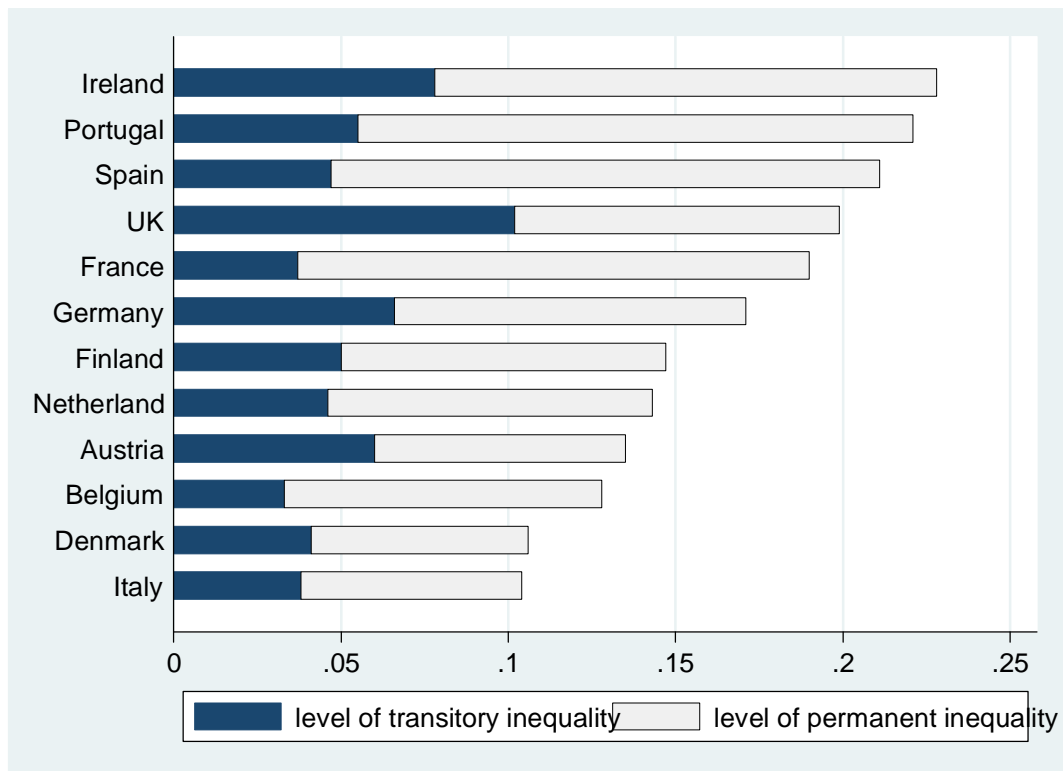
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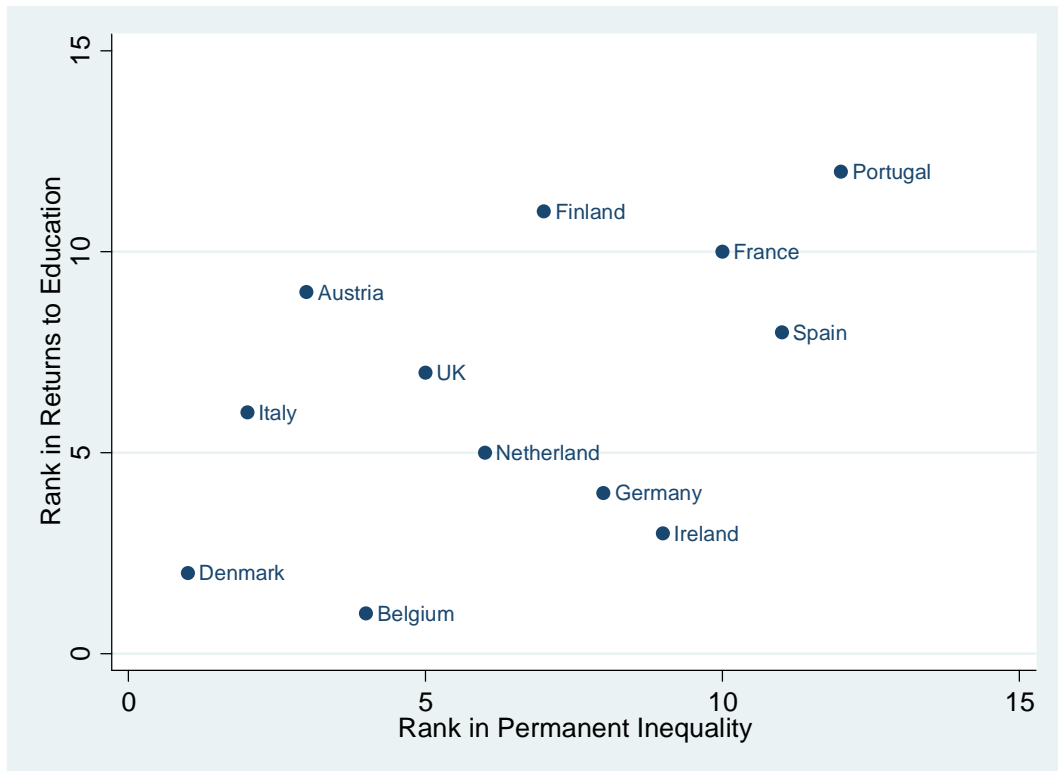
**Table1. Decomposition of Variation in Aggregate Inequality Across European Countries**

Variation in Aggregate Inequality $\text{Var}(\sigma_i)$	Variation in Permanent Inequality	Variation in Transitory Inequality	2*Covariance
.00194	.0014032 (73%)	.00039 (20%)	.00014 (7%)

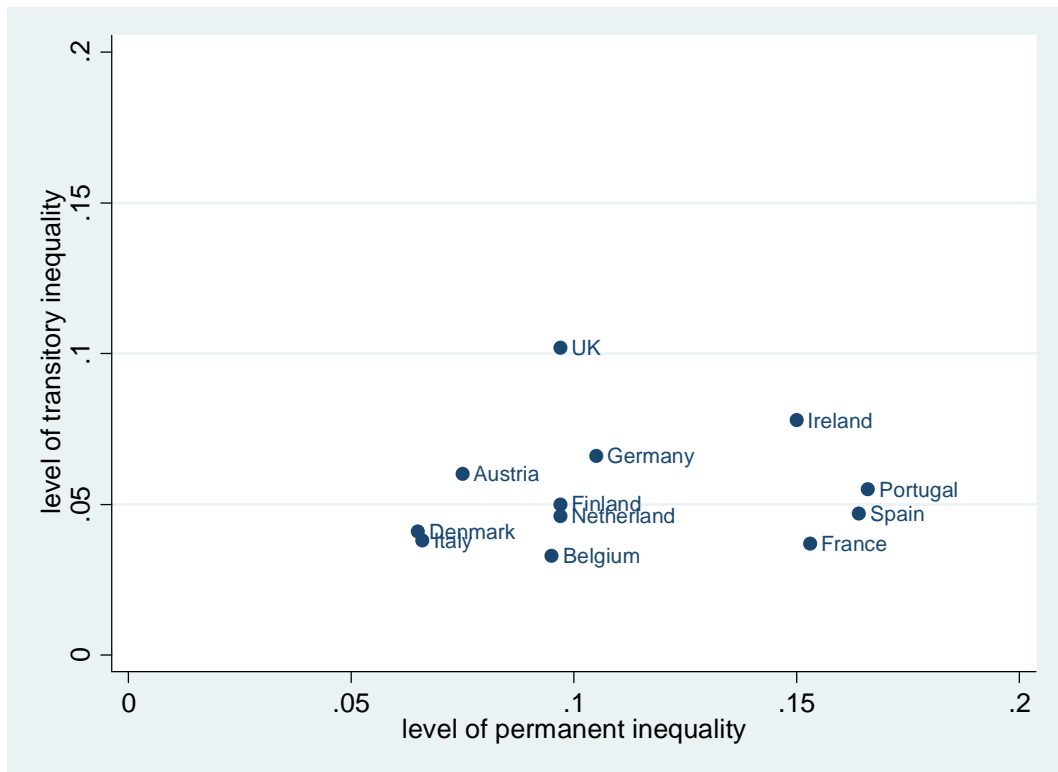
**Figure 1. Components of Aggregate Inequality**



**Figure 2: Relationship between permanent inequality and rates of return to Education**



**Figure 3: Relationship between Transitory Inequality and Permanent Inequality**



## Appendix

**Table A1. Parameter Estimates of Covariance Structure Model for 12 European Countries (Standard Errors in parentheses\*)**

Year	Aus	Bel	Den	Fin	Fr	Ger	Irl	It	Nl	Por	Sp	UK
$\sigma_a^2$	.06 (.02)	.09 (.01)	.06 (.010)	.10 (.01)	.15 (.010)	.10 (.01)	.16 (.01)	.06 (.004)	.09 (.01)	.16 (.01)	.16 (.01)	.10 (.03)
$\rho$	.82 (.26)	.53 (.07)	.53 (.05)	.42 (.10)	.55 (.16)	.63 (.09)	.30 (.05)	.44 (.03)	.41 (.04)	.59 (.07)	.48 (.21)	.83 (.09)
$\sigma_v^2$	.10 (.02)	.05 (.01)	.06 (.01)	.09 (.02)	.08 (.01)	.08 (.01)	.15 (.01)	.05 (.004)	.06 (.01)	.09 (.01)	.08 (.09)	.11 (.03)
$\sigma_\varepsilon^2$	.07 (.02)	.06 (.03)	.03 (.01)	.08 (.06)	.07 (.02)	.05 (.01)	.02 (.01)	.03 (.01)	.09 (.05)	.07 (.02)	.06 (.01)	.07 (.02)
$\lambda_2$	.81 (.08)	.70 (.14)	1.09 (.14)	.69 (.24)	.77 (.07)	1.19 (.09)	1.77 (.35)	1.08 (.110)	.67 (.18)	.80 (.12)	.96 (.12)	.85 (.10)
$\lambda_3$	.79 (.10)	.61 (.13)	1.15 (.19)	.58 (.20)	.62 (.06)	1.09 (.10)	1.76 (.36)	1.04 (.12)	.64 (.18)	.64 (.12)	.86 (.09)	.94 (.10)
$\lambda_4$	.62 (.07)	.58 (.12)	.89 (.15)	.65 (.22)	.62 (.06)	1.01 (.09)	1.45 (.30)	1.03 (.11)	.61 (.17)	.63 (.11)	.83 (.09)	.90 (.09)
$\lambda_5$	.61 (.06)	.52 (.10)	.92 (.15)	.68 (.23)	.52 (.05)	1.01 (.10)	1.54 (.33)	1.02 (.12)	.61 (.17)	.62 (.10)	.79 (.09)	.88 (.09)
$\lambda_6$	.56 (.07)	.56 (.11)	.94 (.15)	.64 (.23)	.53 (.05)	1.06 (.100)	1.64 (.36)	1.04 (.12)	.60 (.16)	.66 (.11)	.79 (.09)	.94 (.10)
$\lambda_7$	.58 (.11)	.57 (.12)	.99 (.16)	-	.61 (.06)	1.02 (.11)	1.71 (.38)	1.03 (.12)	.66 (.18)	.72 (.13)	.80 (.09)	.88 (.08)
$\lambda_8$		.62 (.14)	1.09 (.18)	-	.61 (.07)	1.11 (.13)	1.85 (.42)	1.05 (.13)	.81 (.22)	.67 (.13)	.74 (.10)	.89 (.09)
$p_2$	.81 (.08)	1.01 (.03)	.97 (.04)	1.03 (.03)	1.02 (.02)	.98 (.02)	.96 (.03)	1.00 (.030)	1.02 (.03)	1.02 (.03)	1.05 (.02)	1.05 (.06)
$p_3$	.79 (.10)	1.04 (.04)	.98 (.05)	1.01 (.05)	1.03 (.02)	1.02 (.03)	.97 (.04)	1.05 (.04)	1.02 (.03)	1.05 (.04)	1.06 (.03)	.96 (.10)
$p_4$	.62 (.07)	.102 (.04)	1.02 (.05)	1.01 (.07)	1.02 (.03)	1.02 (.03)	1.00 (.04)	1.09 (.05)	1.04 (.04)	1.07 (.04)	1.09 (.03)	.99 (.15)
$p_5$	.61 (.06)	1.07 (.05)	1.08 (.07)	.91 (.07)	1.04 (.03)	1.05 (.04)	.98 (.05)	1.07 (.05)	1.04 (.04)	1.04 (.05)	1.08 (.03)	.98 (.19)
$p_6$	.56 (.07)	1.04 (.05)	1.12 (.07)	1.00 (.07)	1.03 (.03)	1.07 (.05)	.95 (.05)	1.11 (.05)	1.00 (.04)	1.03 (.05)	.99 (.03)	.97 (.21)
$p_7$	.58 (.11)	1.02 (.05)	1.17 (.07)	-	.99 9.030	1.08 (.05)	.91 (.05)	1.10 (.050)	.96 (.05)	1.00 (.05)	.96 (.03)	.92 (.22)
$p_8$	.-	1.04 (.06)	1.11 (.07)	-	.99 (.03)	1.08 (.05)	.87 (.06)	1.09 (.05)	1.04 (.05)	1.01 (.05)	.99 (.03)	.96 (.23)
$\theta$	-.31 (.10)	-	-	-	-.24 (.11)	-.34 (.06)	-	-	-	-	-.36 (.18)	-.31 (.05)

\* Standard errors have been corrected for the unbalanced nature of the samples