



Instituto Superior de Economia e Gestão

UNIVERSIDADE TÉCNICA DE LISBOA

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ECONOMETRIA APLICADA E PREVISÃO

TRABALHO FINAL DE MESTRADO

DISSERTAÇÃO

AN EMPIRICAL STUDY ON DEPRIVATION IN PORTUGAL

JORGE FILIPE AZAMBUJO VELOSO

JULY - 2014



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ABSTRACT

The aim of this dissertation is to determine the socio-economic and demographic determinants of Material Deprivation Intensity, and investigate their changes when considering different macroeconomic backgrounds - moderate growth *versus* recession (Portuguese economy, years 2004 and 2012), and the additional groups - Income and Non-Income Poor.

This work uses the 9 Material Deprivation indicators currently in use by Eurostat in the 27 European Union Member States to model the Material Deprivation Score. Given that the interest variable is a count variable, we will apply methodological framework for count data modeling, more particularly, Poisson and Zero-Inflated Poisson models.

The results have shown what are the key determinants of the Material Deprivation Intensity, and also that they don't change, in a significant way, in face of the considered macroeconomic backgrounds and groups.

RESUMO

O objetivo deste trabalho é identificar os determinantes socio-económicos e demográficos da Intensidade da Privação Matéria, e investigar as suas alterações quando se considera diferentes contextos macroeconómicos - crescimento moderado *versus* recessão (Economia Portuguesa, anos 2004 e 2012) e os grupos complementares - Economicamente Pobres e Não-Pobres.

Este trabalho usa os 9 indicadores de Privação Material presentemente usados pelo Eurostat nos 27 Estados Membros da União Europeia para modelar o *Score* de Privação Material. Dado que a nossa variável de interesse é uma variável de contagem, vamos aplicar métodos para modelação de dados de contagem, nomeadamente, o modelo de Poisson e o modelo Zero-Inflated Poisson.

Os resultados mostram quais são os principais determinantes da Intensidade da Privação Material, e que estes não variam, de forma significativa, face aos diferentes cenários macroeconómicos e grupos considerados.

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1. INTRODUCTION

Starting with earlier work of Townsend (1979) passing through Mack and Lansley (1985) and to our actual days, a long way has been done across the path of measuring poverty based on the concept of Material Deprivation (MD).

Although the difficulties in finding a consensus portfolio of items (goods and services) to consider in a MD analyses of poverty; the difficulties related with the proper way of weighting the selected items: equal weighting or unequal weighting and within this last one, prevalence weighting (where the most frequently possessed items receive a higher weight) *versus* consensus weighting (where the items considered most necessary within the population receive greater weights); the subjectivity concerning the definition of a threshold above which an individual/ household may be considered material deprived; and without forgetting the eventual necessity of periodic revision of the selected items in order to capture living patterns and expectations about life which may change along time and between countries (Guio *et al* 2012), there seems to be without question the higher and growing importance of this multidimensional measurement of poverty within the social sciences and also the political circles¹.

This work aims to contribute to the literature by developing an in-depth analysis of the European Union Statistics on Income and Living Conditions microdata, in order to capture the socio-economic and demographic determinants of

¹ Let's just consider the EU 2020 targets of lifting at least 20 million people in the European Union from the risk of poverty, see: Council of the European Union (2010), being MD one of the three core indicators considered to reflect the multidimensional nature of poverty, see Social Protection Committee (2010); the other two being low income and living in a low work intensity household.

MD Intensity, measured by the 9 MD indicators² adopted by the Eurostat for all the 27 European Union Member States in 2009.

This dissertation will investigate the determinates of MD Intensity and if they change when considering different macroeconomic backgrounds - Portuguese economy, years 2004 and 2012 (corresponding to a period of moderate economic growth, followed by a period of economic recession, caused by the structural adjustment of the public debt), and also between the additional groups - Income and Non-Income Poor³.

The dissertation will be restricted to the analyses of the Portuguese case.

2. A BRIEF REVIEW OF THE RELEVANT LITERATURE

The measurement of poverty based upon the concept of MD has brought a great deal of discussion into the best way of doing it. This has resulted in a wide range of analytical methodologies that have been used in order to achieve this purpose. Some of these methodologies are:

The Fuzzy Set Theory (FST) first proposed by Cerioli and Zani (1990) allowing the adoption of distinct degrees of poverty. This methodology was later refined by Cheli and Lemmi (1995), by deriving the threshold below which an individual/household is considered poor in relation to a certain attribute directly from its distribution function;

² For more detail see: Appendix A, Table I

³ Considering the widely used line of poverty defined as 60 per cent of the median equivalent income “*the point at which people struggle to share the ordinary expectations of the majority*” Blastland (2009).

The Latent Class Analysis (LCA) that relates in a probabilistic way a latent variable (in this context, poverty) with a set of “imperfect” indicators of it, also known as manifests. In the LCA, each individual/household is attributed to one and only one of the latent variable classes, depending on the level and type of latent poverty suffered. One of the advantages in relation to other methodologies is that removes the need of specifying a threshold of poverty. It can be found examples of this methodology in Breen and Moiso (2003), Whelan and Maître (2004), and Mayo (2004);

The Self Organising Maps (SOM) that consist in creating distinct profiles of clusters (in this context, of poverty) by extracting meaningful patterns from multidimensional deprivation indicators, without the need of weighting them or resorting to synthetic measures as sometime happens in LCA analyses that e.g. in a first stage may use Confirmatory Factor Analyses to identify a range of deprivation dimensions that will after be categorized to enter in the LCA, as stressed out by Pisati *et al* (2010);

The Structural Equation Modelling (SEM), that reduces a large number of poverty indicators to a small number of dimensions (or factors), with the plus, as highlighted by Tomlinson *et al* (2007), of allowing the researcher to control how the variables associate with the latent unobserved factor, and also allowing for measurement errors of variables to be isolated and controlled. A less positive aspect is that remains the need of defining an arbitrary threshold of poverty. See Hajdu (2007)⁴.

Using the previous and other methodologies to measure poverty based on a multidimensionality approach, if we focus on the somehow more rare literature that

⁴ See also Lucchini *et al* (2013).

searches to bring light into the socio-economic and demographic determinants of MD, we will find examples in:

D'Ambrosio *et al* (2009), where the authors use three different measurements of poverty: the FST; the Information theory; and the Axiomatic (considering the Foster-Greer and Thorbecke method⁵), to analyse and compare the determinants of poverty in and between five European countries throughout Logistic Regression;

Along the same line, Ferro-Luzzi *et al* (2006) use Factor Analyses to obtain different poverty dimensions that after are combined into a composite measure of poverty, and use Logistic Regression to find its determinants;

For the Portuguese case, we can find examples in Bastos and Machado (2009) where the authors first use the FST method to build a composite index of deprivation, and after “*evaluate the impact of socio-demographic and economic attributes on the probability of being deprived*” using a Probit Model;

In Rodrigues and Andrade (2010) the authors use different methodologies to aggregate the material deprivation indicators and develop a measure of Consistent Poverty (both material and monetary) whereby they analyze its determinants.

Following a slightly different approach, somehow more focused on the determinants of MD Intensity, we can find examples in Coromaldi and Zoli (2007) where the authors use a non linear Principal Component Analyses to derive different dimensions of poverty and rank the individual into different degrees of deprivation. After, they use an Ordered Probit (being the depend variable the intensity of the individuals poverty, according to the number of poverty dimensions in which the individuals are deprived) to analyse the poverty intensity determinants.

⁵For more details see: Foster, J., Greer, J., and Thorbecke, E. (1984). “A class of decomposable poverty Measures”. *Econometrica*, 52(3).

For the Portuguese case we can find an identical example in Fernandes *et al* (2013), where the authors analyse the determinants of poverty intensity by first building an index of Housing Comfort, secondly they use the Foster-Greer and Thorbecke measurement of poverty to separate households into three different and mutually excluded degrees of deprivation: Poor, Middle Class and Rich, and finally run an Order Probit to find its determinants.

In this dissertation we will use Poisson and Zero Inflated Poisson models⁶ in order to investigate the socio-economic and demographic determinants of MD Intensity, their changes considering different macroeconomic backgrounds - Portuguese economy, years 2004 and 2012, and also between the additional groups - Income and Non-Income Poor.

To build the MD Score it will be used the 9 MD indicators currently in use by Eurostat in the 27 European Union Member States.

3. METHODOLOGY

A great deal of studies on poverty are based on the concept of income. Some of the advantages of considering a monetary metric are: easy interpretation, transparency and comparability (Ferro-Luzzi *et al* 2006). Although these advantages, in this paper we are interested in a more direct measure of poverty that can capture living patterns and expectations about life (Guio *et al* 2012).

⁶For more details about these models, see among others: Long and Freese (2006); Winkelmann (2008); and, Cameron and Trivedi (2009)

Our aim will be to investigate the determinants of Material Deprivation (MD) Intensity and see if they change when considering different macroeconomic backgrounds - moderate growth *versus* recession, and also the additional groups - Income and Non-Income Poor.

Given that the explained variable, the MD Score⁷, is a count variable, we will use Poisson and the Zero Inflation Poisson Models, to attain this purpose.

The Poisson model:

The Poisson model assumes that the response variable (the MD Score, Y_i) has a Poisson distribution that as the form:

$$P(y_i|x_i) = \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!} \quad (3.1)$$

where the conditional mean is specified by $\lambda_i = E(y_i|x_i) = \exp(x_i' \beta)$, being the conditional mean equal to the conditional variance: $E(y_i|x_i) = Var(y_i|x_i)$, with $x_i' = (x_{i,1}, x_{i,2}, \dots, x_{i,p})$ the vector of covariates (the determinants of MD Intensity) and $\beta' = (\beta_1, \beta_2, \dots, \beta_p)$ the vector of unknown parameters.

Under the assumption that the observations for (y_i, x_i) , $i = 1, \dots, n$ are independent, it's possible to use the Maximum likelihood technique to estimate the interest parameters. The log-likelihood function is written as:

$$\ln L(\beta) = \sum_{i=1}^n [y_i x_i' \beta - \exp(x_i' \beta) - \ln(y_i!)] \quad (3.2)$$

After estimating the interest parameters, it can be analyzed the marginal effect of $E(y|x)$ with respect to x_k , that is given by:

$$\frac{\partial E(y|x)}{\partial x_k} = \beta_k \exp(x' \beta) = E(y|x) \beta_k \quad (3.3)$$

⁷ In the next chapter 'Data' we will detail the "construction" of the MD Score.

As it can be seen from the above equation, the marginal effects in Poisson models depend on both the coefficient of x_k , that is β_k , and the expected value of y given x . Therefore, the interpretation of the β_k is not as straightforward as it is in the linear models where they indicate the expected change in the response variable originated by a unit change in the covariate. To overcome this limitation, it will be estimated the average marginal effects, as it is use to be done.

The violation of the assumption of conditional mean equal to conditional variance conducts to biased standard errors and consequently incorrect evaluation of the statistical significance of the estimated parameters. There are two main reasons that contribute to the violation of this assumption: one is due to unobserved heterogeneity which will be safeguard by using robust standard errors (and also robust to within cluster dependence - the cluster variable being the household); a second reason is due to an excess of zero observations in relation to the ones that would be expected considering the Poisson distribution. To deal with this second case it will be used Zero Inflated Poisson models (for the All samples as well as the Non-Income Poor samples).

Zero-inflated Poisson model (ZIP):

The ZIP model was introduced by Lambert (1992) to deal with excess of zeros in modeling count data. It does so by assuming that the response variable has the following form:

$$Y_i \sim \begin{cases} 0, & \text{with probability } \theta_i \\ \text{Poisson}(\lambda_i), & \text{with probability } 1 - \theta_i \end{cases} \quad (3.4)$$

Thus, Y_i occurs according to the process

$$P(Y_i = y_i | x_i, z_i) = \begin{cases} \theta_i(z_i) + (1 - \theta_i(z_i))\text{Poisson}(\lambda_i; 0 | x_i), & \text{if } y_i = 0 \\ (1 - \theta_i(z_i))\text{Poisson}(\lambda_i; y_i | x_i), & \text{if } y_i > 0 \end{cases} \quad (3.5)$$

Being $\lambda_i = E(y_i|x_i) = \exp(x_i' \beta)$, z_i the vector of covariates defining the probability θ_i , $Poisson(\lambda_i; 0|x_i) = \exp(-\lambda_i)$ and $Poisson(\lambda_i; y_i|x_i) = \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!}$. The mean of ZIP is $E(y_i|x_i, z_i) = (1 - \theta_i)\lambda_i$ and the variance is $Var(y_i|x_i, z_i) = (1 - \theta_i)(\lambda_i + \theta_i \lambda_i^2)$. As it's clear, the ZIP model is over dispersed, since the variance exceeds the mean. The over dispersion is the result of splitting the data into the two statistical processes because of the excess of zeroes. Additionally, to safeguard from possible miss specification of the variance due to unobserved heterogeneity it were used robust standard errors (robust to within cluster dependence - the cluster variable being the household).

It's easy to see that the ZIP model can be reduced to the classical Poisson model, if $\theta_i = 0$.

The $\theta_i(z_i)$ probability can be modeled by using e.g. a Logit model that as the form:

$$\theta_i(z_i) = \frac{\exp(z_i' \gamma)}{[1 + \exp(z_i' \gamma)]} \quad (3.6)$$

being z_i the covariates vector defining the probability θ_i and γ the vector of its corresponding parameters. The vector z_i can include elements of x_i (in this dissertation $z_i = x_i$). The likelihood function of (Y_i) can be defined as follows:

$$L = \prod_{i: y_i=0} [\theta_i(z_i) + (1 - \theta_i(z_i)) \exp(-\lambda_i)] \prod_{i: y_i \neq 0} [(1 - \theta_i(z_i)) \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!}] \quad (3.7)$$

Parameters interpretation is the same as in the Poisson model.

After the ZIP model estimation, it will be conducted a Vuong test for the comparison: ZIP *versus* Poisson model.

The **Vuong test**⁸ uses the Kullback-Leibler information criterion KLIC to measure the “distance” between two models, defined as:

$$KLIC := E[\log P(y_i|x_i)] - E[\log P_N(y_i|x_i)] \quad (3.8)$$

where $P(\cdot|\cdot)$ is the true but unknown conditional probability of y_i given x_i , and $P_N(y_i|x_i)$ is the estimated model. Considering the ZIP and the Poisson model, the ZIP model will be preferable to the Poisson model if it has a smaller KLIC - indicating a greater proximity to the true probability:

$$E[\log P(y_i|x_i)] - E[\log P_{ZIP}(y_i|x_i)] < E[\log P(y_i|x_i)] - E[\log P_{Poisson}(y_i|x_i)] \quad (3.9)$$

$$\Leftrightarrow E[\log P_{ZIP}(y_i|x_i)] - E[\log P_{Poisson}(y_i|x_i)] > 0$$

$$\Leftrightarrow E(m_i) > 0, m_i = \log \left(\frac{P_{ZIP}(y_i|x_i)}{P_{Poisson}(y_i|x_i)} \right)$$

The Vuong test tests the null hypothesis that the two models fit equally well the data, $E(m_i)=0$. The test statistic is given by:

$$V = \frac{\sqrt{n} \left(\frac{1}{n} \sum_{i=1}^n m_i \right)}{\sqrt{\frac{1}{n} \sum_{i=1}^n (m_i - \bar{m})^2}} \quad (3.10)$$

under the null hypothesis, the statistic is asymptotically normally distributed by the Central Limit Theorem. Since the estimated log-likelihood is a consistent estimator of KLIC, it allows to establish the consistency and asymptotic normality of the test statistic.

⁸ See: Vuong (1989)

At 5% significance level, the ZIP model is preferred if $V \geq 1.96$ (implying that it is the one with smaller KLIC); if $V \leq -1.96$ then the Poisson model is preferred; and if $|V| < 1.96$ then the two models are equivalent.

4. DATA

In this work we aim to investigate the determinants of Material Deprivation (MD) Intensity, and investigate their changes considering different macroeconomic backgrounds - moderate growth *versus* recession, and also considering the additional groups - Income and Non-Income Poor.

We will use the European Union Statistics on Income and Living Conditions microdata for the Portuguese case, years 2004 and 2012.

The reference population includes all the private Portuguese households and their present members residing in Portugal – in the selected households, only the individuals who were 16 year and more were interviewed. The collected information considers the House level, covering areas such as: income, housing and social exclusion; and the Personal level, covering areas such as: education, labour information, health and income⁹.

For the year 2004, the sample comprehends 4985 households, implying 9190 Non-Income Poor and 2500 Income Poor individuals - after the applied filters it remained: 8180 Non-Income Poor and 2095 Income Poor individuals; for the year

⁹ For further detail see:

http://epp.eurostat.ec.europa.eu/portal/page/portal/income_social_inclusion_living_conditions/introduction#

2012 the sample comprehends 6257 households, implying 11041 Non-Income Poor and 2543 Income Poor individuals - after the applied filters it remained: 10751 Non-Income Poor and 2424 Income Poor individuals¹⁰.

To build the MD ‘Score’ we use the 9 MD indicators adopted in 2009 by Eurostat for all the 27 European Union Member States. The complete list of the MD indicators is presented in Appendix A, table I.

The MD ‘Score’ is a count of the number of MD indicators¹¹ unsatisfied by the Individual, meaning that when an Individual verifies “Inability to...” or “Enforced lack of...” a MD indicator, then its score is added by one¹². Therefore the range of the MD Score are the integers from 0 to 9.

In Appendix A, table II, we have the ‘Percentage Distribution of the MD Score in the Samples’. Analyzing the table it becomes clear the excess zeros problem in the ‘All’ as well as the ‘Non-Income Poor’ samples for both 2004 and 2012 years, with 30% and over Individuals verifying ‘0’ MD Score, by contrast with the roughly 10% of the Individuals in the Income Poor samples. As expected, we can also observe that the concentration of individuals in the lower levels of the MD Score is much higher in the Non-Income Poor samples.

The ‘Group Mean Tests (t-tests), for the MD Score’ presented in Appendix A, table III, corroborate the previous outcome: we can observe that the MD Score for the individuals belonging to the Income Poor samples is, in average, higher than the one for the individuals belonging to the Non-Income Poor samples. Unexpected is to see that the Mean tests between the considered economic background show that the MD

¹⁰ For further detail see: ‘Missing data’ in Appendix C.

¹¹ For a discussion on some aspects related with the “suitability”, “validity”, “reliability” and “additivity” of this MD indicators see Guio *et al* (2012).

¹² The MD indicator ‘Inability to avoid arrears’ is the composite of three pointers: ‘arrears on mortgage or rent payments’, ‘arrears on utility bills’ or ‘arrears on hire purchase installments or other loan payments’. If the household verified arrears in any of those items, then the score of its members were added by one.

Score is inferior when the economy is under recession than when it's not. In order to bring some light into the previous result, we have decided to calculate the 'Percentage Distribution of the MD Indicators (in the Samples), and the Percentage Points (p.p.) change between them', for the considered years. The results are presented in Appendix A, table IV, and from them we can see that: the MD indicator 'Inability to face unexpected financial expenses' has a positive change of 90,1 p.p., for the 'All' samples, from the year 2004 to the year 2012; in the Income Poor samples the MD indicator 'Inability to avoid arrears (mortgage or rent payments, utility bills or hire purchase instalments)' has an increase of 36,9 p.p. from the year 2004 to the year 2012; in a different direction, we see that the MD indicators that verified the strongest reduction, from the year 2004 to the year 2012, were: the 'Enforced lack of a telephone', 'Enforced lack of a washing machine' and 'Enforced lack of a colour TV', with a decrease of 66,5 p.p., 48,3 p.p. and 41,4 p.p., respectively. It's now clear that the durable items - probably acquired during the best period of the economy, were the ones bringing down the MD Score, while the non-durable items were the ones bringing up the MD Score. These results are somehow more in conformity with what would be expected, and seem to point out a change in the MD structure between both years, as a result of the changes operated in macroeconomic background.

In Appendix B, table I, we present the 'Description of the Covariates Used in the Poisson and Zero Inflation Poisson Analyses'. Other variables such as e.g. 'Age' or 'Suffer from any a chronic (long-standing) illness or condition' were considered, but due to high correlation or association with variables such as 'Number of years spend on paid work' and 'Limitation in activities because of health problems' respectively, have been drop out to avoid collinearity problems. Income variables were not

considered since one of the aims of the work was to analyze separately the effects of being Non-Income and Income Poor on the determinants of the MD Intensity.

The database verified some missing data, what we had to account in our analyses. A detailed discussion on the missing data issues and procedures is available in Appendix C – ‘Data Specifications’. In this appendix we also discuss the “construction” and “limitations” of some of the tested covariates.

In the next chapter we analyse the regressions outputs in order to access the socio-economic and demographic determinants of MD Intensity and investigate their changes when considering different macroeconomic backgrounds - moderate growth *versus* recession, and the additional groups - Income and Non-Income Poor.

5. EMPIRICAL RESULTS

To evaluate the socio-economic and demographic determinants of the Material Deprivation Intensity (MDI) in Portugal, considering different macroeconomic backgrounds - moderate growth *versus* recession (years 2004 and 2012), and the additional groups - Income and Non-Income Poor, several Poisson and Zero Inflation Poisson models have been calculated.

The Zero Inflation Poisson models were used in the All samples as well as in Non-Income Poor samples, since the data, in these samples, presented a clear problem of excess zeros, see Appendix A – table II, that violates the equidispersion assumption

of the Poisson model. The Vuong test has confirmed superiority of the Zero Inflation Poisson models over the Poisson models, see Appendix A - table V.

Appendix A - table VI, present the Wald Chi Square ‘Tests of Statistical Significance for the Regression Coefficients’. When we analyze the results for the Inflation models, it’s clear that in 2012 there is an increase of the number of the Statistically Significant determinants of the MD Incidence in relation to 2004 - we recall that the inflation model evaluate the probability of the score of the Individual be zero, i.e., not existing MD. The acquiring of statistic significance from a covariate such as the ‘Percentage of Employee Members (in the Household)’ combined with the lost of statistical significance of a covariate such as ‘Occupation’, seem to be the reflex of the deterioration of the labor market conditions, with its rate increasing from 6.7% in 2004 to 15.7% in 2012¹³, and the consequent lost of income and benefits for the workers.

The results of the estimated models are compiled in Appendix A - tables V. All the following analyses and conclusions report to the results presented in that table.

For the estimated models the ‘Marital Status’ shows that the Individuals who are ‘married’ are the ones more protected against MDI, pointing out the overall importance of the “traditional” family structure and the solidarity between its members in bringing down MDI. Similar results were found by Coromaldi and Zoli (2007). Evidence for Portugal can be found in Crespo *et al* (2011).

It’s interesting to notice that the ‘bachelors’ perform worse than the ‘separated/ divorced’ in terms of MDI.

¹³ See: INE – Inquérito ao Emprego at www.pordata.pt/Portugal/Ambiente+de+Consulta/Tabela

The previous results seem to be somehow connected with the results for the covariate ‘Households’, where the Individuals whose households consist of ‘one adult’ are the ones suffering from more MDI, even when compared to the Individuals whose household consist of ‘one adult with one dependent children’, what is somehow unexpected - we believe that the reason behind this may be related with an inner feeling of “can’t fail for the well being of the child”, motivating the adult to search and come forward with new solutions to reduce the MDI. It’s also interesting to notice that households consisting of ‘two adults, at least one aged 65 years and over’ suffer from a more significant MDI in 2004 than in 2012. - This can, in some way, be related with the degradation of the labor market, suggesting that the existence of a fix income in the household contributes positively to the decrease of the MDI. These results seem to highlight the overall importance of the family (whatever the form it acquires), and the solidarity (economic and/ or emotional) between its members, in order to bring down MDI, somehow enlarging the conclusions already perceived upon the covariate ‘Marital Status’.

The effect of the ‘Financial Burden of Housing Cost’ in the MDI, is the expected one - heavier the “burden”, higher the MDI.

The ‘Number of Years Spend on Paid Work’, seems to suggest that longer the paid working experience, lower the MDI. These results can be motivated by two effects: the monetary costs associated with firing a long term worker, and also the fact that (in some areas) a more experienced worker can be a sought worker, allowing a faster integration into the labor market. Nevertheless and due to the reasons pointed out in the Appendix C, we advise caution when reading these results.

As expected, higher the ‘Percentage of Employed Members - in the household’, lower the MDI. Evidence for Portugal can be found in Bastos and

Machado (2009). In a related way, Alves (2009) has concluded that higher the number of members in the household working, lower the probability of being Poor.

The 'Main Activity – on December' shows that apart from the employee working half-time' all the other employed Individuals perform equal or better than the reference class 'employee working full-time', what may be the outcome of a poor wage policy. It's unexpected to see that the ones engaged in 'domestic tasks and caring responsibilities' as well as the 'unfitted to work/ disabled' and the 'inactive' perform better than the ones in the reference class 'employee working full-time'. We believe that further investigation should be driven into these Individuals in order to understand better these results. In the Group analysis it's interesting to notice the magnitude of the effect of being 'self-employed working full-time' in reducing MDI - independently of the economic background considered. Again, further investigation should be conducted into these Individuals in order to understand better this effect.

'Occupation' highlights the importance of professional integration in safeguarding from MDI. As expected, all the classes perform better than the reference class 'elementary occupations', exception being made to the class 'skill agricultural and fishery workers', year 2012, what can be related with uncertainty and seasonality within these sectors of activities. The classes 'legislators, senior officials and managers', 'professionals' and 'technicians and associated professionals' are the ones benefiting from less MDI – it's well known that Portugal is one of the European Union countries with highest income inequalities between its workers - especially between low rank and higher rank ones, what may help explain these results. It's also worth mentioning the overall reduction of the magnitude of coefficients associated with the previous classes, when comparing the year 2004 to the year 2012, implying an equal leveling of the MDI for the different occupations - we believe that this may

be related with the adjustments verified in the labor market - in particularly with the decrease of wages as a result of a larger working supply.

When it comes to 'Education', the outcome confirms the expected results that - higher the 'Education' lower the MDI. In a related way, Bastos and Machado (2009) and Alves (2009) concluded that higher the education, lower the probability of being Poor in Portugal. It's worth noticing that in the Group analysis, the magnitude of the effect of the class 'university' in reducing MDI for the Group of the Income Poor. Whelan *et al* (2012) had concluded that the impact of 'Education' is "*significantly stronger in low income countries*", to what extent this result seems to enlarge that conclusion to the "*low income*" individuals within the country itself (Portuguese case), emphasizing the overall role of Education, especially within the Group of the Income Poor, in bringing down MDI.

The 'Limitations in Activities because of Health Problems' is also a key determinant of MDI. The results are as expected - higher the limitations, higher the MDI. Evidence for Portugal and other six European countries¹⁴ about the higher probability of Individuals with health problems falling into poverty can be found in Dekkers (2003).

6. CONCLUSION

In this dissertation we have analyzed the socio-economic and demographic determinants of Material Deprivation Intensity (MDI) in Portugal, and have investigated their changes when considering different macroeconomic backgrounds -

¹⁴ Belgium, Denmark, France, Italy, Finland and United Kingdom

moderate growth *versus* recession (years 2004 and 2012), and also the additional groups - Income and Non-Income Poor.

Our MD ‘Score’ is a count of the number of MD indicators (Appendix A - table I) unsatisfied by the Individual, meaning that when an Individual verifies “Inability to...” or “Enforced lack of...” a MD indicator, then its score is added by one.

As expected, determinants such as ‘Financial Burden of Housing Cost’, ‘Percentage of Employed Members – in the household’, ‘Education’ and ‘Limitations in Activities because of Health Problems’ show to be key drivers of MDI, being the signs of their effects the expected ones.

Social determinants such as the ‘Marital Status’ and ‘Household’ highlight the importance of family (“traditional” or not), and the solidarity within its members in bringing down MDI.

The two considered macroeconomic backgrounds - moderate growth *versus* recession, don’t seem to point out significant differences in the determinants of MDI. Nevertheless, it’s worth mentioning that the two economic backgrounds highlighted some meaningful differences when considering the MD Incidence, with variables such as ‘Percentage of Employee Members (in the Household)’ acquiring statistical significance, and others such as ‘Occupation’ losing their statistical significance. These results seems to be the reflex of the operated changes verified in the labor market, with an increase of the unemployment rate from 6.7% in 2004 to 15.7% in 2012.

The two different macroeconomic backgrounds also brought some interesting conclusion about the structure of the MD Intensity: with the MD indicators related with the non-durable items being the ones that more contribute to the increase of the

MDI in 2012, and the MD indicators related with the more durable items being the ones that more contribute to the decrease of the MDI in 2012, by contrast with 2004.

The additional groups analyses - Non-Income and Income Poor, also don't seem to point out significant differences in the determinants of MDI. Nevertheless, it's worth mentioning the magnitude of the effect of an higher education, specially within the group of the Income Poor, or the effect of being 'self-employed working full-time', also within the Income Poor group, in bringing down MDI.

The results also show that the Income Poor groups are the ones suffering from more MDI, independently of the considered economic background.

Overall, in this dissertation we have shown what are the key determinants of MDI, and also that they don't change in a significant way in face of the considered macroeconomic contexts - moderate growth *versus* recession, and also between the additional groups - Income and Non-Income Poor.

We have also shown that the structure of the MDI seems to change along the considered macroeconomic backgrounds, as well as the considered additional groups, what should be taken into consideration when designing policies toward the relive of MDI.

Limitations:

It can be point out two main limitations in this study:

The first one results from the list of MD indicators used in the MDI Score. Since it was the purpose of this study to be restricted to the 9 MD indicators currently in use by the 27 European Member States, we wish to acknowledge what has been

pointed out by Guio *et al* (2012) “*The main limitations of the MD indicators currently used at European Union level are the small number of items in which they rely and the weak reliability of some of these items. A small number of items means that there is a risk of unreliable measurement of MD in some European Union member states*”.

Somehow, the fact that the mean difference of the MD Score between the year 2004 and 2012 (Appendix A - Table IV) have shown that the MD Score for the year 2004 (moderate growing economy), is superior of that for the year 2012 (recession economy), seems to confirm these concerns;

The second one results from the way it was build the MD Score. It was our choice to use an equal weighting approach¹⁵. Nevertheless, it would be useful to see if the results here obtained remain robust to other weighting methodologies such as prevalence weighting or consensus weighting. Due to data limitations, the consensus weighting is out of range, as for the prevalence weighting we reserve it for future studies.

¹⁵For a discussion on equal and unequal weighting approaches, pros and cons, see Guio *et al* (2009).

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APPENDIX A - TABLES

Table I - List of the Material Deprivation Indicators

I1. Inability to face unexpected financial expenses
I2. Inability to afford paying for one week annual holiday away from home
I3. Inability to avoid arrears (mortgage or rent payments, utility bills or hire purchase instalments)
I4. Inability to afford a meal with meat, chicken, fish or vegetarian equivalent every second day
I5. Inability to keep home adequately warm
I6. Enforced lack of a washing machine
I7. Enforced lack of a colour TV
I8. Enforced lack of a telephone
I9. Enforced lack of a personal car

Table II - Percentage Distribution of the Material Deprivation Score in the Samples

MD SCORE	2004			2012		
	All	N.-I. Poor	Poor	All	N.-I. Poor	Poor
0	30,19%	35,04%	11,26%	30,72%	35,51%	9,49%
1	23,46%	24,61%	19,00%	24,65%	25,56%	20,63%
2	23,15%	22,67%	25,06%	22,17%	21,34%	25,87%
3	12,78%	11,08%	19,43%	13,34%	11,70%	20,63%
4	6,11%	4,32%	13,13%	6,13%	4,21%	14,65%
5	2,56%	1,22%	7,78%	2,34%	1,43%	6,35%
6	1,13%	0,72%	2,72%	0,43%	0,21%	1,36%
7	0,50%	0,29%	1,29%	0,20%	0,02%	0,99%
8	0,11%	0,06%	0,29%	0,01%	0,01%	0,04%
9	0,01%	0,00%	0,05%	0,01%	0,00%	0,00%
Total	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
Observations	10275	8180	2095	13175	10751	2424

All: All Sample;
N.-I. Poor: Non-Income Poor

Table III - Group Mean Tests (t-tests), for the Material Deprivation Score

H0: The Means are not significantly different		Mean Differ.	D.F.	Statistic	P-Value
		Num. D.F.	Den D.F.		
2004:	Method: Satterthwaite (if different variances)	-1,1346	2845	-29,08	<,0001
N-I. Poor minus Poor	H0: The variances are equal	2094	8179	1,51	<,0001
2012:	Method: Satterthwaite (if different variances)	-1,1116	3250	-33,70	<,0001
N-I. Poor minus Poor	H0: The variances are equal	2423	10750	1,39	<,0001
All Sample:	Method: Satterthwaite (if different variances)	0,0724	21342	3,81	<,0001
2004 minus 2012	H0: The variances are equal	10274	13174	1,14	<,0001
N-I. Poor:	Method: Satterthwaite (if different variances)	0,0456	17112	2,36	0,018
2004 minus 2012	H0: The variances are equal	8179	10750	1,11	<,0001
Poor:	Method: Satterthwaite (if different variances)	0,0686	4278	1,45	0,147
2004 minus 2012	H0: The variances are equal	2094	2423	1,20	<,0001

N.-I. Poor: Non-Income Poor; Num.D.F.: Numerator degrees of freedom of the f-test; Den.D.F.: Denominator degrees of freedom of the f-test;
In gray are presented the f-test of equality of variances in order to select the method to determine the degrees of freedom of the equality of means t-test:
Satterthwaite (if different variances); Pooled (if equal variances).

Table IV - Percentage Distribution of the Material Deprivation Indicators (in the Samples), and Change in Percentage Points between them

	2004			2012			Δ in p.p. (2004-2012)		
	All	N.-I. Poor	Poor	All	N.-I. Poor	Poor	All	N.-I. Poor	Poor
I1. Inability to face unexpected financial expenses	18,51%	14,75%	34,28%	35,18%	30,42%	55,80%	90,1%	106,3%	62,8%
I2. Inability to afford paying for one week annual holiday away from home	59,34%	54,58%	77,81%	59,32%	54,44%	80,47%	0,0%	-0,3%	3,4%
I3. Inability to avoid arrears (mortgage or rent payments, utility bills or hire purchase instalments)	7,67%	6,69%	11,47%	7,67%	5,82%	15,71%	0,1%	-12,9%	36,9%
I4. Inability to afford a meal with meat, chicken, fish or vegetarian equivalent every second day	5,17%	3,86%	10,19%	3,43%	2,26%	8,52%	-33,5%	-41,4%	-16,3%
I5. Inability to keep home adequately warm	37,35%	32,86%	54,69%	27,16%	24,04%	40,69%	-27,3%	-26,8%	-25,6%
I6. Enforced lack of a washing machine	3,12%	1,88%	7,88%	1,61%	0,98%	4,34%	-48,3%	-47,6%	-44,9%
I7. Enforced lack of a colour TV	0,77%	0,41%	2,17%	0,45%	0,33%	0,99%	-41,4%	-19,1%	-54,5%
I8. Enforced lack of a telephone	3,58%	2,32%	8,41%	1,20%	0,77%	3,08%	-66,5%	-67,0%	-63,4%
I9. Enforced lack of a personal car	12,07%	9,11%	23,47%	9,55%	7,13%	20,01%	-20,9%	-21,7%	-14,8%
Observations:	10275	8180	2095	13175	10751	2424			

All: All sample; N.-I. Poor: Non-Income Poor;
 Δ in p.p. (2004-2012): Change in percentage points

Table V - Poisson and Zero-Inflated Poisson Regressions Output and Average Marginal Effects

	2004						2012					
	ALL		N.-I. Poor		Poor		All		N.-I. Poor		Poor	
	Coeff. ^(a) (ZIP)	AME (ZIP)	Coeff. ^(a) (ZIP)	AME (ZIP)	Coeff. (POI)	AME (POI)	Coeff. ^(a) (ZIP)	AME (ZIP)	Coeff. ^(a) (ZIP)	AME (ZIP)	Coeff. (POI)	AME (POI)
Gender												
Female	-0.003 (0.01)	-0.001 (0.02)	0.022 (0.02)	0.029 (0.02)	-0.05** (0.02)	-0.123** (0.05)	-0.036*** (0.01)	-0.019 (0.02)	-0.039** (0.02)	-0.009 (0.02)	-0.012 (0.02)	-0.028 (0.05)
Male												
Marital Status												
Separated / divorced	0.126*** (0.04)	0.259*** (0.07)	0.151*** (0.06)	0.26*** (0.08)	0.098 (0.07)	0.235 (0.17)	0.143*** (0.03)	0.264*** (0.05)	0.185*** (0.04)	0.291*** (0.06)	0.052 (0.05)	0.124 (0.12)
Bachelor	0.279*** (0.03)	0.544*** (0.05)	0.259*** (0.04)	0.449*** (0.05)	0.246*** (0.04)	0.635*** (0.12)	0.159*** (0.02)	0.327*** (0.04)	0.177*** (0.03)	0.321*** (0.04)	0.115*** (0.04)	0.281*** (0.10)
Widowed	0.047 (0.03)	0.035 (0.05)	0.078* (0.04)	0.059 (0.06)	0.084 (0.05)	0.201 (0.13)	-0.001 (0.03)	-0.028 (0.05)	0.045 (0.04)	0.021 (0.05)	-0.016 (0.05)	-0.036 (0.12)
Married												
Household												
One adult	0.147*** (0.05)	0.282*** (0.09)	0.191*** (0.07)	0.311*** (0.07)	-0.047 (0.08)	-0.118 (0.21)	0.202*** (0.05)	0.336*** (0.07)	0.217*** (0.06)	0.301*** (0.08)	0.112* (0.07)	0.281* (0.17)
One adult with one dependent children	0.098 (0.08)	0.208* (0.12)	0.056 (0.10)	0.112 (0.13)	0.054 (0.10)	0.14 (0.28)	0.1 (0.06)	0.213** (0.09)	0.107 (0.09)	0.211** (0.11)	0.069 (0.08)	0.17 (0.21)
Two adults aged less than 65 years	-0.001 (0.05)	0.033 (0.07)	0.002 (0.07)	0.03 (0.07)	-0.018 (0.09)	-0.046 (0.22)	0.026 (0.05)	0.044 (0.06)	0.03 (0.06)	0.046 (0.07)	0.017 (0.07)	0.04 (0.16)
Two adults, at least one aged 65 years and over	0.142*** (0.05)	0.207*** (0.08)	0.162*** (0.06)	0.194** (0.08)	0.023 (0.08)	0.059 (0.20)	0.048 (0.05)	0.056 (0.07)	0.085 (0.06)	0.087 (0.07)	0.006 (0.07)	0.013 (0.17)
Two adults with two dependent children	-0.051 (0.05)	-0.069 (0.07)	-0.104 (0.07)	-0.11 (0.07)	-0.081 (0.09)	-0.197 (0.21)	-0.125** (0.05)	-0.166*** (0.06)	-0.132** (0.07)	-0.148** (0.07)	-0.091 (0.07)	-0.207 (0.16)
Two adults with three + dependent children	0.047 (0.08)	0.139 (0.11)	-0.049 (0.17)	0.011 (0.14)	0.024 (0.09)	0.062 (0.25)	-0.025 (0.07)	-0.148 (0.10)	0.015 (0.13)	-0.179 (0.14)	-0.043 (0.08)	-0.1 (0.18)
Other households with dependent children	0.048 (0.05)	0.123 (0.08)	0.087 (0.06)	0.178** (0.08)	-0.009 (0.08)	-0.022 (0.21)	-0.015 (0.04)	0.039 (0.06)	0.0001 (0.06)	0.068 (0.07)	-0.016 (0.06)	-0.037 (0.15)
Other households without dependent children	-0.044 (0.05)	-0.041 (0.07)	0.025 (0.06)	0.058 (0.07)	-0.157* (0.09)	-0.37* (0.21)	0.011 (0.04)	0.059 (0.06)	0.051 (0.06)	0.111* (0.06)	0.032 (0.07)	0.078 (0.17)
Two adults with one dependent children												
Dwelling Type												
Building with less than 10 apartments	0.072 (0.05)	0.117 (0.07)	0.081 (0.07)	0.108 (0.07)	0.1 (0.09)	0.242 (0.21)	0.018 (0.04)	0.032 (0.05)	0.069 (0.05)	0.085 (0.06)	-0.062 (0.06)	-0.15 (0.15)
Townhouse	0.112** (0.05)	0.244*** (0.07)	0.116* (0.06)	0.198*** (0.07)	0.122 (0.08)	0.296 (0.20)	0.021 (0.04)	0.1* (0.06)	0.054 (0.06)	0.129** (0.06)	-0.022 (0.06)	-0.056 (0.15)
House	0.079* (0.05)	0.16** (0.06)	0.086 (0.06)	0.146** (0.07)	0.053 (0.09)	0.124 (0.20)	0.026 (0.04)	0.111** (0.05)	0.068 (0.05)	0.153*** (0.06)	-0.063 (0.06)	-0.152 (0.15)
Building with 10 or more apartments												
Tenure Status												
Mortgage/ Tenant	0.285*** (0.03)	0.562*** (0.05)	0.291*** (0.04)	0.503*** (0.06)	0.265*** (0.05)	0.699*** (0.14)	0.274*** (0.03)	0.526*** (0.04)	0.288*** (0.03)	0.49*** (0.05)	0.207*** (0.04)	0.519*** (0.11)
Owner												
Financial Burden of Housing Cost												
Heavy	0.755*** (0.06)	1.335*** (0.06)	0.758*** (0.07)	1.194*** (0.06)	0.7*** (0.12)	1.554*** (0.19)	0.922*** (0.08)	1.433*** (0.05)	1.012*** (0.11)	1.353*** (0.05)	0.761*** (0.12)	1.503*** (0.16)
Burden	0.378*** (0.06)	0.538*** (0.05)	0.39*** (0.07)	0.496*** (0.05)	0.322*** (0.12)	0.582*** (0.18)	0.496*** (0.08)	0.646*** (0.04)	0.578*** (0.11)	0.621*** (0.04)	0.398*** (0.12)	0.645*** (0.16)
Low												
Degree of Urbanization												
Intermediate area	0.046 (0.03)	0.11** (0.05)	0.051 (0.04)	0.109** (0.05)	0.028 (0.05)	0.068 (0.13)	0.026 (0.03)	0.061 (0.04)	0.046 (0.03)	0.072* (0.04)	-0.001 (0.04)	-0.004 (0.10)
Thinly populated area	0.021 (0.03)	0.102** (0.05)	0.025 (0.04)	0.095* (0.05)	-0.005 (0.05)	-0.012 (0.13)	-0.031 (0.03)	-0.005 (0.04)	-0.025 (0.03)	0.012 (0.04)	-0.089** (0.04)	-0.213** (0.11)
Densely populated area												
Number of Years Spend on Paid Work												
	-0.001 (0.00)	-0.001 (0.00)	-0.001 (0.00)	-0.002* (0.00)	-0.001 (0.00)	-0.002 (0.00)	-0.002*** (0.00)	-0.002* (0.00)	-0.001 (0.00)	-0.0005 (0.00)	-0.003*** (0.00)	-0.007*** (0.00)
Observations	10275		8180		2095		13175		10751		2424	

***** Coefficient is significant at 10%/5%/1% level;
 Robust standard errors in parentheses;
 All: All Sample;
 N.-I. Poor: Non-Income Poor;
 ZIP: Zero-Inflated Poisson model;
 POI: Poisson model;
 Coeff.: Estimated coefficients;
 Coeff.^(a): Estimated coefficients for the ZIP model (the estimated coefficients of the Inflated model are not presented);
 AME: Average Marginal Effect

Table V - Poisson and Zero-Inflated Poisson Regressions Output and Average Marginal Effects (cont.)

	2004						2012					
	ALL		N.-I. Poor		Poor		All		N.-I. Poor		Poor	
	Coeff. ^(a)	AME	Coeff. ^(a)	AME	Coeff.	AME	Coeff. ^(a)	AME	Coeff. ^(a)	AME	Coeff.	AME
	(ZIP)	(ZIP)	(ZIP)	(ZIP)	(POI)	(POI)	(ZIP)	(ZIP)	(ZIP)	(ZIP)	(POI)	(POI)
Percentage of Employed Members (in the household)	-0.383***	-0.644***	-0.33***	-0.492***	-0.181***	-0.446***	-0.394***	-0.705***	-0.344***	-0.57***	-0.264***	-0.634***
	(0.05)	(0.07)	(0.07)	(0.08)	(0.07)	(0.16)	(0.04)	(0.06)	(0.05)	(0.06)	(0.05)	(0.13)
Main Activity (on December)												
Unemployed	0.056**	0.136***	0.052	0.108**	0.022	0.058	0.015	0.075**	-0.009	0.036	-0.037	-0.093
	(0.03)	(0.05)	(0.04)	(0.05)	(0.04)	(0.12)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.08)
Domestic tasks and caring responsibilities (2012)	---	---	---	---	---	---	-0.103***	-0.148***	-0.205***	-0.269***	-0.11**	-0.27**
							(0.04)	(0.05)	(0.05)	(0.06)	(0.05)	(0.12)
Student	-0.14**	-0.211***	-0.144**	-0.189**	-0.114	-0.282	-0.071*	-0.113*	-0.092*	-0.135**	-0.148**	-0.355***
	(0.06)	(0.08)	(0.07)	(0.08)	(0.08)	(0.19)	(0.04)	(0.06)	(0.05)	(0.07)	(0.06)	(0.14)
Unfitted to work / disabled (2012)	---	---	---	---	---	---	-0.135***	-0.305***	-0.158***	-0.326***	-0.102	-0.25
							(0.04)	(0.08)	(0.05)	(0.09)	(0.08)	(0.19)
Inactive	-0.127***	-0.197***	-0.228***	-0.299***	-0.063	-0.159	-0.114**	-0.22***	-0.119*	-0.236***	-0.172**	-0.408**
	(0.03)	(0.04)	(0.04)	(0.05)	(0.04)	(0.10)	(0.05)	(0.08)	(0.07)	(0.08)	(0.08)	(0.18)
In retirement	-0.021	-0.037	-0.099***	-0.122***	-0.028	-0.071	-0.048*	-0.069*	-0.108***	-0.132***	-0.054	-0.137
	(0.03)	(0.05)	(0.04)	(0.05)	(0.05)	(0.14)	(0.03)	(0.04)	(0.03)	(0.04)	(0.05)	(0.12)
Employee working half-time	0.156***	0.279***	0.185***	0.288***	-0.058	-0.147	0.108**	0.218***	0.051	0.116	0.1	0.272
	(0.05)	(0.09)	(0.06)	(0.10)	(0.08)	(0.19)	(0.04)	(0.08)	(0.06)	(0.08)	(0.07)	(0.18)
Self-employed working full-time	-0.118***	-0.171***	-0.176***	-0.209***	-0.22***	-0.515***	-0.171***	-0.206***	-0.227***	-0.263***	-0.243***	-0.528***
	(0.04)	(0.05)	(0.05)	(0.06)	(0.06)	(0.13)	(0.04)	(0.05)	(0.06)	(0.06)	(0.06)	(0.12)
Self-employed working half-time	-0.04	-0.119	-0.097	-0.18**	-0.125*	-0.308**	-0.005	-0.029	-0.034	-0.095	---	---
	(0.05)	(0.08)	(0.07)	(0.09)	(0.06)	(0.15)	(0.07)	(0.11)	(0.10)	(0.13)		
Employee working full-time												
Occupation: ISCO-88 (year 2004); ISCO-08 (year 2012)												
Skill agricultural and fishery workers	0.032	0.057	0.01	-0.012	0.059	0.161	0.103***	0.235***	0.073**	0.141*	0.121***	0.31***
	(0.03)	(0.07)	(0.04)	(0.08)	(0.04)	(0.12)	(0.03)	(0.06)	(0.04)	(0.08)	(0.04)	(0.11)
Clerks	-0.191***	-0.388***	-0.179***	-0.353***	-0.04	-0.104	-0.192***	-0.338***	-0.232***	-0.341***	-0.059	-0.138
	(0.04)	(0.06)	(0.05)	(0.06)	(0.08)	(0.20)	(0.05)	(0.06)	(0.05)	(0.06)	(0.08)	(0.17)
Craft and related workers	-0.109***	-0.21***	-0.083***	-0.169***	-0.113***	-0.281***	-0.039	-0.033	-0.069**	-0.055	0.039	0.094
	(0.02)	(0.05)	(0.03)	(0.05)	(0.04)	(0.09)	(0.02)	(0.04)	(0.03)	(0.05)	(0.04)	(0.10)
Armed forces	-0.133	-0.29*	-0.064	-0.207	-0.378***	-0.828***	-0.069	-0.121	-0.194	-0.232	---	---
	(0.10)	(0.15)	(0.10)	(0.14)	(0.09)	(0.17)	(0.15)	(0.18)	(0.26)	(0.22)		
Legislators, senior officials and managers	-0.39***	-0.693***	-0.377***	-0.66***	-0.128**	-0.318**	-0.182***	-0.348***	-0.212***	-0.343***	-0.14*	-0.314*
	(0.07)	(0.08)	(0.10)	(0.08)	(0.05)	(0.13)	(0.05)	(0.07)	(0.07)	(0.07)	(0.08)	(0.17)
Plant and machine operators and assemblers	-0.16***	-0.241***	-0.124***	-0.168***	-0.128**	-0.316**	-0.134***	-0.19***	-0.129***	-0.142***	-0.098*	-0.224*
	(0.03)	(0.06)	(0.04)	(0.06)	(0.06)	(0.14)	(0.03)	(0.04)	(0.03)	(0.05)	(0.05)	(0.12)
Professionals	-0.616***	-0.87***	-0.588***	-0.766***	---	---	-0.367***	-0.563***	-0.42***	-0.548***	---	---
	(0.11)	(0.10)	(0.16)	(0.11)			(0.09)	(0.08)	(0.10)	(0.08)		
Service workers and shop and market sales workers	-0.143***	-0.273***	-0.13***	-0.239***	---	---	-0.065***	-0.117***	-0.07**	-0.11**	-0.039	-0.093
	(0.03)	(0.05)	(0.03)	(0.05)			(0.02)	(0.04)	(0.03)	(0.04)	(0.04)	(0.10)
Technicians and associated professionals	-0.421***	-0.684***	-0.367***	-0.577***	---	---	-0.301***	-0.472***	-0.328***	-0.441***	---	---
	(0.07)	(0.08)	(0.08)	(0.08)			(0.04)	(0.05)	(0.05)	(0.05)		
Elementary occupations												
Education												
University	-0.575***	-1.078***	-0.605***	-0.992***	-0.67***	-1.383***	-0.447***	-0.922***	-0.393***	-0.82***	-0.538***	-1.152***
	(0.09)	(0.09)	(0.11)	(0.10)	(0.16)	(0.24)	(0.07)	(0.08)	(0.09)	(0.08)	(0.13)	(0.22)
High-school (12 years)	-0.511***	-0.966***	-0.522***	-0.882***	-0.575***	-1.238***	-0.366***	-0.734***	-0.348***	-0.669***	-0.326***	-0.77***
	(0.05)	(0.07)	(0.07)	(0.08)	(0.09)	(0.16)	(0.04)	(0.06)	(0.05)	(0.06)	(0.06)	(0.14)
Middle-school (9 years)	-0.348***	-0.734***	-0.406***	-0.726***	-0.281***	-0.693***	-0.273***	-0.539***	-0.28***	-0.505***	-0.186***	-0.47***
	(0.04)	(0.07)	(0.05)	(0.07)	(0.06)	(0.15)	(0.03)	(0.05)	(0.04)	(0.06)	(0.05)	(0.13)
Until 1st level education (6 years)	-0.16***	-0.376***	-0.173***	-0.374***	-0.129***	-0.342***	-0.143***	-0.305***	-0.131***	-0.27***	-0.146***	-0.376***
	(0.02)	(0.05)	(0.03)	(0.06)	(0.03)	(0.09)	(0.02)	(0.04)	(0.03)	(0.05)	(0.03)	(0.09)
Not Educated												
Limitations in Activities because of Health Problems												
Limited	0.098***	0.206***	0.091***	0.174***	0.102***	0.252***	0.081***	0.156***	0.073***	0.139***	0.091***	0.221***
	(0.02)	(0.03)	(0.03)	(0.04)	(0.03)	(0.08)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.08)
Very limited	0.166***	0.356***	0.214***	0.393***	0.092**	0.226**	0.137***	0.284***	0.152***	0.276***	0.144***	0.358***
	(0.03)	(0.05)	(0.03)	(0.05)	(0.04)	(0.10)	(0.02)	(0.04)	(0.03)	(0.04)	(0.04)	(0.10)
Not limited												
Observations	10275		8180		2095		13175		10751		2424	
Log Likelihood	-14287.52		-10649.83		-3516.6794		-18000.25		-13890.11		-3975.992	
R²	0.4035		0.3768		0.0000		0.3868		0.3489		0.3188	
AIC	2.803		2.632		3.409		2.750		2.606		3.327	
BIC	-65287		-51371		-8575		-87859		-70923		-10502	
Vuong Test	10		8,72				10,77		9,83			

*** Coefficient is significant at 10%/5%/1% level;
 Robust standard errors in parentheses;
 All: All Sample
 N.-I. Poor: Non-Income Poor;
 ZIP: Zero-Inflated Poisson model;
 POI: Poisson model;
 Coeff.: Estimated coefficients;
 Coeff.^(a): Estimated coefficients for the ZIP model (the estimated coefficients of the Inflated model are not presented);
 AME: Average Marginal Effect
 AIC: Akaike Information Criterion;
 BIC: Bayesian Information Criterion (or Schwarz criterion)

Table VI - Tests of Statistical Significance for the Regression Coefficients (Wald tests)

	2004			2012		
	All (ZIP)	N.-I. Poor (ZIP)	Poor (POI)	All (ZIP)	N.-I. Poor (ZIP)	Poor (POI)
Gender	(0,05)	(1,34)	(5,66)**	(7,91)***	(6,43)**	(0,28)
Marital Status	(95,42)***	(52,26)***	(31,35)***	(53,58)***	(39,25)***	(11,08)**
Household	(37,13)***	(26,36)***	(9,35)	(53,66)***	(35,09)***	(9,17)
Dwelling Type	(5,47)	(3,76)	(3,93)	(0,39)	(2,12)	(1,99)
Tenure Status	(95,12)***	(65,58)***	(28,46)***	(113,89)***	(79,19)***	(25,20)***
Financial Burden of Housing Cost	(303,26)***	(203,32)***	(110,37)***	(456,65)***	(322,87)***	(129,72)***
Degree of Urbanization	(2,20)	(1,80)	(0,64)	(4,83)*	(5,30)*	(5,46)*
Number of Years Spend on Paid Work	(0,94)**	(1,45)	(0,63)	(7,22)***	(1,17)	(9,80)***
Percentage of Employed Members (in the household)	(68,27)***	(23,84)***	(7,59)***	(125,08)***	(52,80)***	(24,61)***
Main Activity (on December)	(46,68)***	(58,25)***	(20,88)***	(44,43)***	(36,53)***	(33,56)***
Occupation: ISCO-88 (year 2004); ISCO-08 (year 2012)	(116,03)***	(61,41)***	(34,99)***	(117,64)***	(80,83)***	(26,21)***
Education	(122,51)***	(85,52)***	(53,28)***	(101,16)***	(54,72)***	(37,18)***
Limitations in Activities because of Health Problems	(43,26)***	(41,59)***	(10,35)***	(35,07)***	(25,68)***	(16,34)***
Households with Dependent Children						
	(Logit)	(Logit)		(Logit)	(Logit)	
Gender	(0,20)	(0,00)		(15,82)***	(15,12)***	
Marital Status	(26,85)***	(15,17)***		(12,40)***	(9,06)**	
Household	(7,52)	(6,83)		(13,79)*	(18,67)**	
Dwelling Type	(8,44)**	(3,18)		(11,30)**	(6,83)*	
Tenure Status	(8,11)***	(5,74)**		(14,24)***	(9,11)***	
Financial Burden of Housing Cost	(22,91)***	(15,54)***		(88,98)***	(48,49)***	
Degree of Urbanization	(7,98)**	(5,58)*		(3,21)	(2,69)	
Number of Years Spend on Paid Work	(0,27)	(0,60)		(1,26)	(0,70)	
Percentage of Employed Members (in the household)	(2,11)	(1,72)		(14,00)***	(12,40)***	
Main Activity (on December)	(5,41)	(3,92)		(14,37)	(10,74)	
Occupation: ISCO-88 (year 2004); ISCO-08 (year 2012)	(23,78)***	(24,57)***		(17,69)*	(9,74)	
Education	(107,91)***	(213,62)		(34,23)***	(24,63)***	
Limitations in Activities because of Health Problems	(17,13)***	(10,00)***		(8,50)**	(6,31)**	
Observations	10275	8180	2095	13175	10751	2424

*/**/*** Coefficient is significant at 10%/5%/1% level;

Chi-square statistics in parentheses;

All: All sample; N.-I. Poor: Non-Income Poor;

ZIP: Zero-Inflated Poisson model; Logit: inflated model predicting membership into the "certain zero" group of the ZIP model. It uses the Logit model with the same covariates of the Poisson model;

POI: Poisson model;

Notes: The Wald test is a parametric test used here to test how significant the explanatory variables are in the proposed statistical models. Our null hypothesis is that the covariate coefficient (or coefficients, in the case of covariates such as the 'Marital Status') is (are jointly) equal to zero, implying that the variable is not statistically significant in the proposed model.

Under the null hypothesis the Wald statistic has an asymptotic chi-square distribution, with as many degrees of freedom as the number of restrictions being tested (see: www.statlect.com/Wald_test.htm).

APPENDIX B – DATA DESCRIPTION

Table I - Description of the Covariates Used in the Poisson and Zero-Inflated Poisson Regressions

Variable	Label
Gender	
Female	1 if Gender is Female; 0 otherwise.
Male	Reference variable.
Marital Status	
Separated / divorced	1 if Marital Status is Separated or Married; 0 otherwise.
Bachelor	1 if Marital Status is Bachelor; 0 otherwise.
Widowed	1 if Marital Status is Widowed; 0 otherwise.
Married	Reference variable.
Household	
One adult	1 if the Household consists of One adult; 0 otherwise.
One adult with one dependent children	1 if the Household consists of One adult with one dependent child; 0 otherwise.
Two adults aged less than 65 years	1 if the Household consists of Two adults both aged less than 65 years old; 0 otherwise.
Two adults, at least one aged 65 years and over	1 if the Household consists of Two adults with at least one aged 65 years old and over; 0 otherwise.
Two adults with two dependent children	1 if the Household consists of Two adults with two dependent children; 0 otherwise.
Two adults with three + dependent children	1 if the Household consists of Two adults with three or more dependent children; 0 otherwise.
Other households with dependent children	1 if it's a Household with dependent children that isn't enlisted in the previous variables, and also different from Two adults with one dependent children; 0 otherwise.
Other households without dependent children	1 if it's a Households without dependent children that isn't enlisted in the previous variables; 0 otherwise.
Two adults with one dependent children	Reference class: Two adults with one dependent children
Dwelling Type	
Building with less than 10 apartments	1 if living in an apartment or flat with less than 10 dwellings; 0 otherwise.
Townhouse	1 if living in a semi-detached or terrace house; 0 otherwise.
House	1 if living in a detached house; 0 otherwise.
Building with 10 or more apartments	Reference variable: Living in an apartment or flat with 10 or more dwellings.
Tenure Status	
Mortgage/ Tenant	1 if owner paying mortgage or tenant/ subtenant paying rent at prevailing or market rate; 0 otherwise.
Owner	Reference class: outright owner or accommodation is rented at a reduced rate (lower than the market price).
Financial Burden of Housing Cost	
Heavy	1 if the Financial burden of the total housing cost is a Heavy burden; 0 otherwise.
Burden	1 if the Financial burden of the total housing cost is Somewhat a burden; 0 otherwise.
Low	Reference variable: Not burden at all.
Degree of Urbanization	
Intermediate area	1 if the Degree of Urbanization is an Intermediate area; 0 otherwise.
Thinly populated area	1 if the Degree of Urbanization is a thinly populated area; 0 otherwise.
Densely populated area	Reference variable: Densely populated area.
Number of Years Spend on Paid Work	It accounts for the Number of years spend on paid work as employee or self-employee. The range goes from 0 to 65.
Percentage of Employed Members (in the household)	It accounts for the Percentage of employed (part-time or full-time), self-employed (part-time or full-time), or retired members in the household (excluding the Ones studying or under compulsory military service; for the year 2012 are also excluded the Ones fulfilling domestic tasks and care responsibilities). The range goes from 0 to 1.
Main Activity (on December)	
Unemployed	1 if Unemployed; 0 otherwise.
Domestic tasks and caring responsibilities (2012)	1 if performing Domestic tasks and caring responsibilities; 0 otherwise.
Student	1 if studying, having a training or work unpaid experience; 0 otherwise.
Unfit to work / disabled (2012)	1 if unfit to work or disabled; 0 otherwise.
Inactive	1 if Inactive; 0 otherwise.
In retirement	1 if retired or early retired; 0 otherwise.
Employee working half-time	1 if Employee working half-time; 0 otherwise.
Self-employed working full-time	1 if Self-employed working full-time; 0 otherwise.
Self-employed working half-time	1 if Self-employed working half-time; 0 otherwise.
Employee working full-time	Reference variable: Employee working full-time
Occupation: ISCO-88 (year 2004); ISCO-08 (year 2012)^(a)	
Skill agricultural and fishery workers	1 if Skill agricultural or fishery workers; 0 otherwise.
Clerks	1 if Clerks; 0 otherwise.
Craft and related workers	1 if Craft or related workers; 0 otherwise.
Armed forces	1 if belonging to the Armed forces; 0 otherwise.
Legislators, senior officials and managers	1 if Legislators, senior officials or managers; 0 otherwise.
Plant and machine operators and assemblers	1 if Plant or machine operators or assemblers; 0 otherwise.
Professionals	1 if Professionals; 0 otherwise.
Service workers and shop and market sales workers	1 if Service workers or shop or market sales workers; 0 otherwise.
Technicians and associated professionals	1 if Technicians or associated professionals; 0 otherwise.
Elementary occupations	Reference variable: Elementary occupations.
Education	
University	1 if tertiary education level was attained; 0 otherwise.
High-school (12 years)	1 if (upper) secondary or post-secondary no tertiary education level was attained; 0 otherwise.
Middle-school (9 years)	1 if lower secondary education level was attained; 0 otherwise.
Until 1st level education (6 years)	1 if Pre-primary or Primary education level was attained.
Not Educated	Reference variable: The person has never been in education (and/ or is illiterate).
Limitations in Activities because of Health Problems	
Limited	1 if limited in activities because of health problems; 0 otherwise.
Very limited	1 if very strong limited in activities because of health problems; 0 otherwise.
Not limited	Reference variable: Not limited in activities because of health problems.

(a) For more detail information see Appendix B - Table II 'ISCO - International Standard Classification of Occupations'

Table II - ISCO: International Standard Classification of Occupations

Legislators, senior officials and managers	
11 Legislators, senior officials and managers	-Legislators and senior government officials. -Senior officials of special-interest organizations.
12 Corporate managers	-Directors and chief executives. -Production and operations managers. -Other specialist managers.
13 Managers of small enterprises	-Managers of small enterprises.
Professionals	
21 Physical, mathematical and engineering science professionals	-Physicists, chemists and related professionals. -Mathematicians, statisticians and related professionals. -Computing professionals.
22 Life science and health professionals	-Architects, engineers and related professionals. -Life science professionals. -Health professionals (except nursing). -Nursing and midwifery professionals.
23 Teaching professionals	-College, university and higher education teaching professionals. -Secondary education teaching professionals. -Primary and pre-primary education teaching professionals. -Special education teaching professionals. -Other teaching professionals.
24 Other professionals	-Business professionals. -Legal professionals. -Archivists, librarians and related information professionals. -Social science and related professionals. -Writers and creative or performing artists. -Religious professionals. -Public service administrative professionals.
Technicians and associate professionals	
31 Physical and engineering science associate professionals	-Physical and engineering science technicians. -Computer associate professionals. -Optical and electronic equipment operators. -Ship and aircraft controllers and technicians. -Safety and quality inspectors.
32 Life science and health associate professionals	-Life science technicians and related associate professionals. -Health associate professionals (except nursing). -Nursing and midwifery associate professionals.
33 Teaching associate professionals	-Primary education teaching associate professionals. -Pre-primary education teaching associate professionals. -Special education teaching associate professionals. -Other teaching associate professionals.
34 Other associate professionals	-Finance and sales associate professionals. -Business services agents and trade brokers. -Administrative associate professionals. -Customs, tax and related government associate professionals. -Police inspectors and detectives. -Social work associate professionals. -Artistic, entertainment and sports associate professionals. -Religious associate professionals.
Clerks	
41 Office clerks	-Secretaries and keyboard-operating clerks. -Numerical clerks. -Material-recording and transport clerks. -Library, mail and related clerks. -Other office clerks.
42 Customer services clerks	-Cashiers, tellers and related clerks. -Client information clerks Service workers and shop and market sales workers.
51 Personal and protective services workers	-Travel attendants and related workers. -Housekeeping and restaurant services workers. -Personal care and related workers. -Other personal services workers.
52 Models, salespersons and demonstrators	-Protective services workers. -Fashion and other models. -Shop, stall and market salespersons and demonstrators. (Cont->)

Table II - ISCO: International Standard Classification of Occupations (Cont.)

Skilled agricultural and fishery workers	
61 Skilled agricultural and fishery workers	-Market gardeners and crop growers. -Animal producers and related workers. -Crop and animal producers. -Forestry and related workers. -Fishery workers, hunters and trappers.
Craft and related trades workers	
71 Extraction and building trades workers	-Miners, shot firers, stone cutters and carvers. -Building frame and related trades workers. -Building finishers and related trades workers. -Painters, building structure cleaners and related trades workers.
72 Metal, machinery and related trades workers	-Metal molders, welders, sheet-metal workers, structural-metal preparers, and related trades workers. -Blacksmiths, tool-makers and related trades workers. -Machinery mechanics and fitters. -Electrical and electronic equipment mechanics and fitters.
73 Precision, handicraft, craft printing and related trades workers	-Precision workers in metal and related materials. -Potters, glass-makers and related trades workers. -Handicraft workers in wood, textile, leather and related materials. -Craft printing and related trades workers.
74 Other craft and related trades workers	-Food processing and related trades workers. -Wood treaters, cabinet-makers and related trades workers. -Textile, garment and related trades workers. -Pelt, leather and shoemaking trades workers.
Plant and machine operators and assemblers	
81 Stationary-plant and related operators	-Mining and mineral-processing-plant operators. -Metal-processing plant operators. -Glass, ceramics and related plant operators. -Wood-processing- and papermaking-plant operators. -Chemical-processing-plant operators. -Power-production and related plant operators. -Industrial robot operators.
82 Machine operators and assemblers	- Metal- and mineral-products machine operators. -Chemical-products machine operators. -Rubber- and plastic-products machine operators. -Wood-products machine operators. -Printing-, binding- and paper-products machine operators. -Textile-, fur- and leather-products machine operators. -Food and related products machine operators. -Assemblers. -Other machine operators not elsewhere classified.
83 Drivers and mobile plant operators	-Locomotive engine drivers and related workers. -Motor vehicle drivers. -Agricultural and other mobile plant operators. -Ships' deck crews and related workers.
Elementary occupations	
91 Sales and services elementary occupations	-Street vendors and related workers. -Shoe cleaning and other street services elementary occupations. -Domestic and related helpers, cleaners and launderers. -Building caretakers, window and related cleaners. -Messengers, porters, doorkeepers and related workers. -Garbage collectors and related laborers.
92 Agricultural, fishery and related laborers.	-Agricultural, fishery and related laborers.
93 Laborers in mining, construction, manufacturing and transport	-Mining and construction laborers. -Manufacturing laborers. -Transport laborers and freight handlers.
Armed forces	
01 Armed forces	-Armed forces.

APPENDIX C – DATA SPECIFICATIONS

Missing Data:

The database verified some missing data that we had to account for in our analyses.

For the year 2004 we have started with 4985 households, implying 11690 individuals: 78,61% belonging to the Non-Income Poor group and 21,39% to the Income Poor group.

We have excluded the households with missing MD indicators, exception being made for the MD indicator ‘Inability to avoid arrears’- since this indicator is the composite of three pointers: ‘arrears on mortgage or rent payments’, ‘arrears on utility bills’ and ‘arrears on hire purchase installments or other loan payments’, we have only excluded the households who verified missing in these three pointers, or the ones who having one or more pointers at missing, didn’t verified arrears in the available pointer(s). Let’s recall that if the household verified arrears in any of those items, then the MD indicator should take the value one. After these filters, it remained 4529 households, implying 10611 individuals.

Additionally: we have deleted 3 individuals with ‘Occupations’ at missing; 328 individuals with the ‘Number of years spend on paid work’ at missing; 23 households with ‘dwelling type’ at missing; and 1 household with ‘Financial burden of housing cost’ at missing. We have deleted 10 individuals whose ‘Main activity (on December)’ was ‘Compulsory military service’ because of the low number of observations in this class that could compromise the regressions results.

We must refer that some of the households/ individuals verified missing data in more than one MD Indicator or covariate. This being said, the remaining observations comprehended 4453 households, implying 10275 individual. The 1415

excluded individuals are distributed as follows: 71,38% belonging to the Non-Income Poor group and 28,62% to the Income Poor group.

For the year 2012 we have started with 6257 households, implying 13584 individuals: 81,28% belonging to the Non-Income Poor group and 18,72% to the Income Poor group.

We have excluded the households with missing MD indicators, exception being made for the MD indicator 'Inability to avoid arrears' - since this indicator is the composite of three pointers: 'arrears on mortgage or rent payments', 'arrears on utility bills' or 'arrears on hire purchase installments or other loan payments', we have only excluded the households who verified missing in these three pointers, or the ones who having one or more pointers at missing, didn't verified arrears in the available pointer(s). Let's recall that if the household verified arrears in any of those items, then the MD indicator should take the value one. After these filters, it remained 6239 households, implying 13561 individuals.

Additionally: we have deleted 78 individuals with 'Occupations' at missing; 3 individuals with 'Number of years spend on paid work' at missing; 135 individuals with 'Education' at missing; 19 households with 'dwelling type' at missing; and 1 household with 'Financial burden of housing cost' at missing. We have also deleted 3 individuals whose 'Main activity (on December)' was 'Compulsory military service', because of the low number of observations in this class that could compromise the regressions results.

We must refer that some of the households/ individuals verified missing data in more than one MD Indicator or covariate. This being said, the remaining observations comprehended 6181 households, implying 13175 individual. The 409

deleted individuals are distributed as follows: 70,90% belonging to the Non-Income Poor group and 29,10% to the Income Poor group.

“Construction” and “Limitations” of some of the tested covariates:

- Number of years spend on paid work:

In the microdata we found Individuals that had been on a paid work since they were approximately 10 years old (determined by the difference between the age and number of years spend on paid work). This is far from the minimum legal age for work, in Portugal, of 16th years old¹⁶. There were also cases of Individuals with 65 years of paid work, albeit the retirement age in 2012 being of 65 years old for the private sector and 63,5 years old for the public sector, or 55 years old and more with up to 30 years of discounts for the social security system - in this last case with some penalties. Therefore, we question the validity of some of these values, and advice prudence when readying its results.

For those who have never worked, the variable takes the value - zero.

- Percentage of employed members (in the household):

The variable is computed by household, considering the ratio between the total number of individuals employee or self-employee, working full-time or part-time, plus the ones in retirement, divide by the total number of individuals belonging to the same household (subtracted of those who are: studding; in compulsory military community or service; and fulfilling domestic tasks and care responsibilities);

- Occupation:

¹⁶ See: n.º2 of article 68 of subsection V of the Portuguese labor code

Due to data limitation, for the year 2004 this variable was based on the ISCO-88, while for the year 2012 it was based on the ISCO-08¹⁷. Since ISCO structure is different, these variables may not completely overlap for the used years.

Due to the limited number of observations (less than 50 observations) in some categories: ‘Armed forces’, ‘Professionals’, ‘Technicians and associated professional’, year 2004, Income Poor sample; and ‘Professionals’, ‘Service workers and shop and market sales workers’ and ‘Technicians and associated professional’, year 2012, Income Poor sample, we have decided to omit the results of these categories in the referred years;

- Main activity (on December):

Due to the limited number of observations - less than 50 observations, in the categories ‘In compulsory military community or service’, both for 2004 and 2012, all samples; and ‘Self-employee working part-time’, for the Income Poor sample, year 2012, we have decided to omit the results for these categories.

The categories ‘Domestic tasks and caring responsibilities’ and ‘Unfitted to work / disabled’ are only available for the year 2012;

- Education:

Due to the limited number of observations - less than 50 observations, in the class ‘Pre-primary education’, we have decided to join these observations with the ones in the class ‘Primary education’ – we have name this “new” class as ‘Until 1st level of Education’; for the same reasons, we have decide to aggregate the observations in the class ‘Post-secondary non tertiary education’

¹⁷ For more detail on ISCO-88 and ISCO-08 see the Appendix B - table II and visit: www.ilo.org

with the ones in the class ‘(Upper) secondary education’ – we have name this “new” class as ‘High-school (12 years)’.

Although the ‘University’ class, of the Income Poor sample, for the year 2004, had less than 50 observations, we have decided not to aggregate these observations with other categories, and also to present its results.