An analysis of the relationship between job finding and IRT estimated deprivation

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ABSTRACT

In the present work we exploit information on living conditions of individuals to estimate a latent variable representing deprivation, need and financial pressure. We use this variable, together with several controls, to assess whether bad economic situation in general and deprivation in particular act as an incentive to search for a job and increase job finding probabilities. In addition, we analyse whether the impact of unemployment benefits on search effort and employment probability is different depending on the starting degree of deprivation of individuals. Our results show that deprivation exerts some role in increasing the success probability of job search but we find little evidence that it affect the effect that benefits have on reemployment.

JEL CODES: I32; I38; C40.

Keywords: IRT; deprivation; job search; unemployment duration.

1. Introduction

There are several factors that determine the success of the job search process of unemployed individuals. Some of these factors are related to the macroeconomic situation while others are more directly related to the individual characteristics of the unemployed workers or to the effects that labour market institutions have on the specific worker. From a theoretical point of view, job search theory has developed a framework that helps in understanding the process of job search and the resulting employment probability and unemployment duration. The basic mechanism behind this theory is that the availability of job vacancies and the search effort determine the offers arrival rate while the reservation wage determines the number of acceptable job offers. As it easy to understand, lower search effort and higher reservation wages reduce employment probability and increase unemployment duration.

Within this line of reasoning search effort and reservation wages depend on the degree of need and of financial stress of individuals and, consequentially, personal and household economic

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situation play an important role in the determination of job finding probability and unemployment duration. Roughly speaking, unemployed workers living in richer households should experience better financial conditions and should feel less pressure to search actively for a job or to accept the very first offer they receive: therefore, all things being equal, wealthier unemployed should experience longer duration. This reasoning highlights some possible interactions between financial conditions and unemployment benefits. First, the latter directly improve unemployed workers financial conditions reducing incentives to search and increasing, at least theoretically, unemployment duration. Second, benefits may be less relevant in mitigating financial stress if individuals, or their households, can count on a solid economic background: therefore the detrimental effect that benefits have on unemployment duration may be smaller for individuals from better-off families.

Empirical analyses have tried to verify some of these effects and their interactions: Bloeman and Stancanelli (2001) uses net financial assets to estimate reservation wages and the impact of the latter on transition toward employment, Bloemen (2002) measures the effect of net wealth on labour market transitions and Corsini (2012) analyse the effect that some indicators of economic well-being have on unemployment duration. All these works detect that better economic conditions increases unemployment duration.

Other works have focused on the interaction between financial pressure and unemployment benefits: Chetty (2008) uses data from the US to disentangle the moral hazard and liquidity constraint effects that benefits have on unemployed workers. The results indicate that the liquidity constraint seems to be more relevant than the moral hazard effect and similar conclusions were reached by Card et al. (2007) using a regression discontinuity approach on Austrian data. In an analysis for Italy, Corsini (2013) sorts individuals in groups on the base of household wealth and subjective well-being perception and finds that the effect of benefits on unemployment duration is drastically different for individuals belonging to these different groups.

All the above analyses tried to assess the role of the economic condition, financial stress and deprivation using some variables that should be, at least indirectly, related to it. In some cases financial wealth was used (Bloeman and Stancanelli 2001, Bloeman 2002), in others cases the analyses relied on other variables that measured some dimensions of the economic conditions or that were proxies of them (Corsini 2012) and in some other instances differences in some key variables were used to sort individuals in groups that differed in terms of the degree of need (Card et al. 2007, Chetty 2008 and Corsini 2013). In our current contribution we try to directly estimate the deprivation (and financial stress) of households and use it to directly analyse if it has a role in the success of the job search process: to our knowledge this has not been done before.

In particular, we assume that the degree of deprivation and financial stress is a latent trait that is correlated to several other variables: we use data from the EU-SILC survey to obtain these latter variables and use them to estimate the latent trait representing deprivation and financial stress with an Item Response Theory model. Once we have obtained an estimation for this latent trait we perform an econometric analysis on the individuals probability of finding a job and determine the

direct effect of these trait and its interaction with unemployment benefits. We perform this analysis for four European countries: France, Italy, Poland and Spain

Basically, we start from the concept of deprivation, something that describes a state of disadvantage relative to rest of the community (see Townsend 1987), and we use a statistical method to identify situations where need, financial pressure and liquidity constraints appear to be present: in this contents we are not directly referring to the observable monetary situation but to the real situation where several non-observable and non-measurable components have a role. Relative aspects, accessibility to some goods and services and even subjective and psychological perceptions are all relevant in determining a situation of need and deprivation. In this sense, the IRT methodology is particularly suitable as it is often used to assess variables that have a psychological component. This methodology exploits qualitative information gathered in "items" (usually drawn from survey or tests) to estimate a latent variable that is related to the observed items: in our case we will use qualitative data on the household living conditions to estimate the degree of need and financial pressure. In practice we are assuming that the degree of need is a latent traits that affect some aspects of living conditions. Previous examples of the analysis of deprivation that use IRT methodology can be found in Cappellari and Jenkins (2007) and Szeles and Fusco (2011). In out specific case we extend the IRT estimation model to allow for the use of both binary and non-binary variable and we thus rely on Graded Response models.

Our analysis has relevant policy implications. First of all it is quite straightforward that welfare policies should be conceived to help individuals in need but, if they succeed in mitigating their need, they also have an impact on the economic behaviour and incentives of the recipients. Therefore, when designing welfare policies, it is important to understand what is the effect of deprivation on individuals economic behaviour and, with this respect, we provide a piece of evidence on the effect of the former on job search success. We also focus more in details on unemployment insurance trying to see if the potential detrimental effect of benefits on employment probabilities is indeed present and to what extent it is particularly relevant on worse-off household. This is a key issue when designing unemployment insurance system and identifying those individuals that are particularly prone to the perverse effect of benefits can help in designing proper requirements and tools to offset the perverse effect.

The work is organized as follows: in section two we describe the data we use; in section three we present the IRT methodology; in section form we perform the empirical analysis, estimating the deprivation score and determinants of job finding. Finally, in section five we conclude.

2. Data description

Our analysis relies on data from the 2013 and 2014 EU-SILC survey to obtain information that can be grouped in two branch: the first are qualitative information on the living conditions of the households while the second are individual information on labour status and other socio-demographic aspects. Variables from the first group allows to estimate households degree of financial pressure and deprivation: this estimated variable will then be used, together with variables from the second group to estimate the probability of finding a job focusing on the role of the deprivation variable and on its interaction with benefits reception. It is important to stress that deprivation is estimated at the households level and is then imputed to all individuals belonging to a given household: we are thus assuming that the individual job search process is affected by the economic situation of his/her household.

We report in Table 1 the first group of variables; they are all qualitative data using binary or ordinal metric: for easiness of interpretation all variables were recoded so that higher values are associated to worse living conditions (and should therefore be correlated with higher degree of need). We have data on 8847 households for Finland, 10403 for France, 15306 for Italy, 9985 for Poland and 9506 Spain: all of them comes from the 2013 survey.

Variable	Metric	Notes
Do not have capacity to afford paying for one week annual holiday	Binary	
Do not have capacity to have meat/fish every other day	Binary	
Do not have capacity to face unexpected financial expenses	Binary	
Cannot afford a colour TV	Binary	
Cannot afford computer	Binary	
Cannot afford car	Binary	
Not able to keep home adequately warm	Binary	
Has been on arrears on utility bills	Graded	0=no, 1=once, 2=more than once
Has been on arreras on mortgage or rent payments	Graded	0=no, 1=once, 2=more than once
Burden of housing costs (hs140)	Graded	0= not burden, 1= slight burden, 2= heavy burden
Burden of debts from hire purchases or loans (hs151)	Graded	0= not burden, 1= slight burden, 2= heavy burden
Ability to make ends meet (hs120)	Graded	From 0 to 5, 0= very easily, 5=with great difficulty

Table 1. Qualitative variables on living conditions

The second group of variables contains standard information about socio-economic characteristics of unemployed workers: age, gender, education and a dummy describing reception of unemployment benefits. In addition, we produce a dummy variable representing whether, after 4 months of the interview, the worker found a job: this will be the dependent variable of our analysis. All the data refers to 2013 but, in order to obtain information on employment condition during the whole 2013 it was necessary to use the 2014 EU-SILC survey.

3. Using item response theory to estimate deprivation and financial pressure

Item response theory (IRT) falls within the context of the measurement of latent constructs. A latent construct can only be determined indirectly, through the use of a series of so called manifest variables: usually a test made of several items (the observed variables) is submitted to a sample of subjects in order to understand the unobservable characteristic of interest (the latent

trait). In other words, the final aim of IRT is to determine the position of the individual along some latent dimension, representing the unobservable characteristic of the individuals.

Although latent constructs exist in many fields and areas, IRT models have been originally developed to overcome psychometric and educational assessment issues (Lord and Novick, 1968; Minton et al, 1988). In fact, in these fields the latent nature of the object of analysis (individuals' ability and psychological profile) and the test characteristics (detection of the items that better discriminate between respondents) are both simultaneously relevant. To this end, IRT represents the principal methodological technique that allows to estimate both the respondents' score and the item properties (Hambleton and Swaminathan, 1985; van der Linden and Hambleton, 1997).

Advances of IRT were due to the needing to go beyond the lacks of the classical test theory (CTT), examples of CTT limitations are the sensitivity to sample conditions and the impossibility to interpret individual latent traits and test characteristics in different contexts. Furthermore, IRT allows the simultaneous evaluation of both individual latent trait and the assessment of the importance of the items on the test.

Although several IRT and multidimensional IRT models have been developed in relation to the nature of the observed items, the number of estimated parameters and the number of underlying latent traits (Reckase, 2009), given the data available for our study and our purposes (, we focus on the two-parameter logistic model and the graded response model.

Let consider a random vector, $\boldsymbol{Y}_i$, of p item responses for the i-th individual ($i = 1, \dots n$) and the resultant observed responses, $\boldsymbol{y}_i = (y_{i1}, \dots, y_{ip})$. Let denote with θ_i the latent trait of the i-th subject. Latent trait is assumed to follow a standard normal distribution.

There are three principal assumptions for IRT models:

i. Item responses are affected only by the latent trait (unidimensionality assumption).
ii. A change in the probability of a response is fully described by the item characteristic curve (ICC) and the boundary characteristic curve (BCC) for binary and graded items, respectively. Namely, ICCs and BCCs show how the probability of a response changes with respect to a change in the latent trait.
iii. Pairwise item responses are statistically independent given the underlying latent trait (local independence): $P(\boldsymbol{y}_i|\theta_i) = \prod_{j=1}^{p} P\left(y_{ij}\middle|\theta_i\right)$.

3.1 The two-parameter logistic model

The two-parameter logistic model (2PL) is used for items that can be coded as binary variables, i.e. correct /incorrect, and allows to specify the probability π_{ij} of a correct response by the subject i to the item j, as a function of the predictor η_{ij}, which depends on θ_i and on the vector $\boldsymbol{\xi}_j$ of parameters characterizing item j ($j = 1 \dots p$).

$$\eta_{ij} = f(\theta_i, \boldsymbol{\xi}_j) \tag{1}$$

2PL model is obtained when we use a logistic distribution (2) and each item is characterized by two kind of parameters $\boldsymbol{\xi}_j = \{\alpha_j, \beta_j\}$: the *difficulty parameter* β_j and the *discrimination parameter* α_j. The predictor (1) becomes $\eta_{ij} = \alpha_j(\theta_i - \beta_j)$ and model (2) becomes the 2PL model (3) (Birnbaum 1968).

$$\pi_{ij} = P(Y_{ij} = 1|\theta_i) = \frac{\exp(\eta_{ij})}{1+\exp(\eta_{ij})} \Rightarrow \text{logit}(\pi_{ij}) = \eta_{ij} \tag{2}$$

$$\text{logit}(\pi_{ij}) = \alpha_j(\theta_i - \beta_j) \qquad \theta_i \sim N(0,1) \tag{3}$$

In our framework, for each binary observed variable, the difficulty parameter represents how relevant is that variable to detect the overall situation of need and deprivation, while the discrimination parameter reflects the ability of that observed variable to differentiate between individuals/families.

3.2 Samejima's graded response model

IRT models for polytomous items operate in a different way from binary models, in fact, while for binary models the knowledge of the characteristics of a response is sufficient to model the complementary response, for polytomous items each category function must be modeled separately (Samejima, 1996). Therefore, ordered polytomous items are treated as "concatenated dichotomous" items (Samejima, 1969, 1996): dichotomizations of item response data are combined to ensure suitable response functions for each item category.

The graded response model (GRM)[3] for ordinal items was introduced by Samejima in 1969 and represents the generalization to ordinal data of the 2PL IRT model. Examples of graded responses

[3] If a certain item is characterized by only two categories, the GRM coincides with the 2PL model.

are Lykert-type scales (for example, from “strongly-disagree” to “strongly agree”) and answers ordered on the basis of a range of scores.

Let consider a set of p ordinal items, Y_j, where each item has K_j ordered categories, indexed by k. Hence, each item is described by $K_j - 1$ thresholds or boundaries: $\kappa_{j,1}, \dots, \kappa_{j,K_j-1}$. The probability to reach category k or higher increases monotonically as the latent trait growths and the boundaries satisfy the so called order constraint: $\kappa_{j,1} < \cdots < \kappa_{j,K_j-1}$.

With reference to the dichotomization process, the GRM is specified with respect to the probability that the response will be observed in *category k or higher*: the probability π_{ijk} that the i-th respondent will achieve the k-th category on item j is hence computed as the difference between the probability of responding above the lower boundary for the category $\pi^*_{ij,k}$ and the probability of answering above the category's upper boundary $\pi^*_{ij,k+1}$:

$$\pi_{ij,k} = P\left(Y_{ij} = k \middle| \theta_i\right) = \pi^*_{ij,k} - \pi^*_{ij,k+1} \qquad \theta_i \sim N(0,1) \tag{4}$$

where $\pi^*_{ij,1} = 1$, $\pi^*_{ij,K_j+1} = 0$ and $\pi^*_{ij,k} = P\left(Y_{ij} \geq k \middle| \theta_i\right) = \frac{\exp\left(\alpha_j \theta_i - \kappa_{j,k}\right)}{1 + \exp\left(\alpha_j \theta_i - \kappa_{j,k}\right)}$.

The discrimination parameter α_j represents the slope of the response functions and does not vary between all the category responses of the same item. This feature guarantees the presence of non-negative probabilities (Steinberg and Thissen, 1995). The boundary parameters $\kappa_{j,k}$ vary within an item, according to the order constraint $\kappa_{j,k-1} < \kappa_{j,k} < \kappa_{j,k+1}$, and at each level of $\theta = \kappa_{j,k}$ the examinee has a probability of 0.5 of endorsing the category (Reeve, 2002).

4. Empirical analysis

In this section we produce estimation for the latent variable representing the degree of deprivation and financial pressure and we then use it, together with others independent variables, to assess the determinant of job finding.

4.1 Estimating deprivation and financial pressure

We now apply the IRT methodology to assess the degree of deprivation and financial pressure of households: this actually allows us to estimate the latent construct measuring the degree of need and deprivation. We apply our method to households from Finland, France, Italy, Poland and

Spain performing each estimation separately for each country. We report in Table 2 the descriptive data statistics of this estimated variable.

Country	Obs.	Mean	Std. Dev.	Median	Min	Max
France	10403	.0003367	.9104832	-.0523948	-2.123467	2.990573
Italy	15306	.0002384	.9164799	-.0211721	-2.842005	3.256144
Poland	9985	.0001249	. 9267007	.026095	-2.5508	3.172271
Spain	9506	.000068	.9233668	-.0367781	-2.638893	2.961083

Table 2. Descriptive statistics for estimated deprivation score

4.2 Estimating the determinants of job search success

We now estimate the determinant of job search success for individuals that declared to be unemployed at the time of the interview. Our dependent variable is a binary variable representing whether an unemployed worker has found a job after 4 months from the interview. The independent variables are some standard socio-economic characteristics and the degree of deprivation and financial pressure that we estimated in previous section. In addition, we use a dummy representing whether the individual received unemployment benefits and we also add an interaction term between benefit reception and the estimated degree of deprivation. Finally, we also include a control for previous duration of unemployment at the time of the interview. The estimation is carried out with a probit model with robust estimation for standard errors: each country is estimated separately and results are reported in Table 3.

	FRANCE	ITALY	POLAND	SPAIN
Deprivation	0.0524	-0.128	0.0639	0.173*
	(0.304)	(0.158)	(0.184)	(0.101)
Unemp. Benefits	-0.0600	0.877***	-0.0631	0.803***
	(0.428)	(0.245)	(0.406)	(0.284)
Interaction between benefits and deprivation	0.254	-0.196	0.471	-0.178*
	(0.343)	(0.226)	(0.402)	(0.117)
Age	0.0568	0.0399	0.227***	-0.0377
	(0.0843)	(0.0607)	(0.0846)	(0.0543)
Age squared	-0.00124	-0.000553	-0.00277***	0.000268
	(0.00107)	(0.000769)	(0.00103)	(0.000673)
Female	0.0966	-0.324	-1.005***	0.214
	(0.282)	(0.229)	(0.283)	(0.171)
Secondary education	0.228	0.207	0.0389	-0.446*
	(0.335)	(0.227)	(0.397)	(0.250)
Tertiary education	-0.285	-0.270	0.344	0.348
	(0.436)	(0.465)	(0.538)	(0.223)
Previous duration	-0.492***	-0.257***	-0.320***	-0.259***
	(0.0827)	(0.0221)	(0.0302)	(0.0205)
Constant	-0.432	-1.050	-4.039**	-0.261
	(1.488)	(1.174)	(1.597)	(0.993)
Observations	592	1,164	909	1,810

Table 3: Determinants of job findings, probit estimation.

Our results seem to suggest that deprivation and financial pressure do not exert a relevant role in the job search process: in most cases the coefficient is not significant and only in one case, Spain, we detect a feeble positive effect of deprivation on the probability of finding a job. Even if the sign of the coefficient is usually positive its significance its scarce.
Things are a bit different as far as the interaction of benefits and deprivation is concerned: in this case we find that in Spain this interaction is significantly negative and this suggests that indeed the effect of benefits may be different depending on the starting economic condition of the households: to all extents, in the presence of a larger degree of deprivation, benefits appear to reduce the probability of finding a job.

4.3 Endogeneity issues and Instrumental variables estimation

The previous estimation was based on the assumption that independent variables were not suffering from endogeneity issues or, in other terms, that they were not correlated with the unobserved terms. This assumption might be a bit stretch when it comes to our key variable, the Deprivation score. As a matter of fact, it is possible that individuals from households where deprivation is large may have a background that is, generally speaking, worse off and this could implies worse unobserved characteristics when it comes to explain the determinants of job findings. Similarly, individuals with worse unobserved characteristics may have fared badly in the

past and thus would also produce higher deprivation in their households. All these considerations may implies that there could be a negative correlation between deprivation and the erratic component that explains job finding. In truth, deprivation is obtained at the household level whereas the erratic component is at the individual levels and thus this may mitigate the actual size of these potential correlation.

In any case, this source of endogeneity, if presence, may bias results and should thus be controlled. A solution for these kind of issues is the use of instrumental variables and two stage regression. The main point in this kind of techniques is to use and instrument that is highly correlated with the endogenous variables (deprivation and the interaction between benefits and deprivation in our case) but uncorrelated with the erratic component of the regression.

In our case we believe a valid instrumental variable is the share of members of the households that earn some income: this variable is obviously related to the degree of deprivation that the household is facing but should not be correlated to unobserved characteristics that explain the re-employment probability of the individual. Similarly we also use the interaction between benefits and the share of income earners to also account the endogeneity of the interaction terms in the main regression.

In Table 4 we present results for two stage probit estimation using the above two instruments. In the table we also reports the coefficients of the first stage regression for the share of earners variable and its interaction with benefits.

The results we obtain show some novelty with respect to the simple probit estimation. The main difference is that, once endogeneity is taken into account, deprivation appear to have a strictly positive effect on job finding in Poland. In addition, also the significance of deprivation coefficient change drastically in Spain: in this case the coefficient is still positive and now larger but significance is smaller and fail to be statistically relevant. This latter result is likely due to the instrumental variable estimation which is known to reduce the efficiency of the estimates; therefore it is difficult to give a clear interpretation of the result for Spain. Finally, the results for France and Italy do not show any relevant change.

	FRANCE	ITALY	POLAND	SPAIN
Deprivation	-0.477	0.205	0.542**	0.319
	(0.401)	(0.334)	(0.242)	(0.232)
Unemp. Benefits	-0.376	0.617**	0.0110	0.566**
	(0.436)	(0.254)	(0.310)	(0.224)
Interaction between benefits and deprivation	0.539	-0.242	0.220	-0.428
	(0.509)	(0.353)	(0.489)	(0.293)
Age	0.0108	(0.146)	0.0906*	-0.0152
	(0.0535)	0.109	(0.0494)	(0.0294)
Age squared	-0.000490	(0.330)	-0.00113*	6.25e-05
	(0.000688)	-0.138***	(0.000607	(0.000364)
			)	
Female	0.104	(0.0122)	-0.455***	0.0936
	(0.172)	0.0181	(0.155)	(0.0954)
Secondary education	-0.0106	(0.0324)	0.279	-0.176
	(0.207)	-0.000254	(0.215)	(0.146)
Tertiary education	-0.434	(0.000412)	0.729**	0.228
	(0.301)	-0.0828	(0.310)	(0.178)
Previous duration	-0.241***	(0.119)	-0.153***	-0.135***
	(0.0351)	0.203	(0.0198)	(0.0114)
Constant	1.165	-1.050	-2.198**	-0.281
	(1.021)	(1.174)	(0.903)	(0.620)
First Stage for Deprivation				
Share of earners in household	-1.651***	-0.951***	-1.116***	-1.430***
	(0.244)	(0.116)	(0.114)	(0.115)
Interaction between share of earners and benefits	0.996**	-0.0169	-0.168	0.407***
	(0.394)	(0.191)	(0.281)	(0.150)
First Stage for Interaction term				
Share of earners in household	0.000676	0.0540	0.000912	0.147
	(0.206)	(0.0676)	(0.0432)	(0.0896)
Interaction between share of earners and benefits	-1.203***	-1.254***	-1.388***	-1.233***
	(0.251)	(0.111)	(0.106)	(0.117)
Observations	559	1,167	909	1,816

Table 4: Determinants of job findings, two stage probit estimation.

5. Conclusions

In our paper we provided an estimation of the degree of need and deprivation that is based on (subjective) information on living condition and that was obtained with IRT methods and we use that estimation to assess the role that deprivation has in providing incentives on job search. Our results suggest that these incentives may exist in some countries (Poland and to some extent

Spain) and therefore deprivation itself can increases, other things being equals, job finding probabilities. On the contrary, we find scarce evidence that the degree of deprivation and financial stress interact with benefits.

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