



Article

Multinomial Logistic Regression to Estimate and Predict the Job Opportunities for People with Disabilities in Chile

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Abstract: In Chile there is a growing interest from society in improving the access of people with disabilities to the labor market. However, applied research on this topic is not abundant. The purpose of this research is to estimate the job opportunities of people with disabilities in Chile. For this, the data from the second Chilean national disability study were used to make a Multinomial Logistic Regression Model that would help to predict the probability of certain variables that influence job opportunity. For the generated model, variables related to the additional income of people (subsidies or extra income), educational level attained, pursuit of studies, and the degree of disability itself were found. It was determined how some variables affect the employment opportunity, particularly, variables related to continuity and access to studies.

Keywords: labor inclusion; disability; employment; econometric modeling



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1. Introduction

Disability is simultaneously part of the human condition and vaguely recognized in world history [1]. At some point in the life cycle, almost everyone may have a temporary or permanent disability [1].

The Convention on the Rights of Persons with Disabilities [2] defines disability according to the social model as "people with disabilities include those who have long-term physical, mental, intellectual or sensory deficiencies that, when interacting with various barriers, may prevent their full and effective participation in society on equal terms with others".

In the bibliometric review proposed by Jurado-Caraballo et al., there is evidence of the increase in research on disability in recent years, constituting a new paradigm in academic research, given the interest in journals to show the evolution of research on work disability [3].

There are different laws in Latin America that seek to protect people with disabilities socially, which are not necessarily homogeneous in the way that people with disabilities are conceived [4] or what is the extent of legal coverage (e.g., social protection). The Pinilla–Roncancio research [4] compares the laws of five Latin American countries, including Chile, and it is found that at least the trend in such laws is to take as a basis the international disability classification model (ICF), according to which both social and environmental factors are considered. However, such legislations are essential for the inclusion of people with disabilities in the labor market and tend to ignore the risks related to living with a disability and being excluded both socially and economically.

1.1. Disability and Employment in the World

Both in disability reports of the WHO [5] and the United Nations [6] there is agreement that the comparison of employability rates of people with disabilities versus people without

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disabilities is a difficult task due to the lack of specific information, different definitions of disability by country and that the overall employability rate is usually not disaggregated by disability; hence, in a sense, the degree of insertion of people with disabilities in the world is an inconspicuous reality [7]. According to OECD data, the average unemployment rate of people with disabilities in 27 countries studied was 66% [8].

In the United States, of the total number of people with disabilities in 2020, 13.3% did not occupy a place in the labor market [9]. Similarly, in Canada [10] in 2020, 11.8% were recorded.

Inequalities in terms of labor market participation have been described yet little has been known about the underlying causes of such inequality [11]. Thern et al. attempted to describe, in the case of Sweden, how education affects employability for marginalized groups as well as non-marginalized groups at work.

Related research [12] has even attempted to describe the impact that labor integration policies had on disability subsidies. This is particularly important in modern society, since the trend has been in the last 30 years to enhance public policy in a way that improves the employability of people with disabilities, achieving a more inclusive society and subsequently improving the self-value of people with disabilities which can be recorded economically through less use of state subsidy benefits. Recent studies [12] conducted in Europe confirm that the individual determinants (health, education, gender, marital status) for employability in disability are varied but only explain for each European country, not in a common, transnational way. However, the variable "degree of disability" did turn out to be predictive of employability.

In the United States, some studies [13] have shown that in order for people with disabilities to be able to access a job, and with a fair salary, they need people to take care of them (guardianship) and a certain type of housing that allows them some habitability and even organizations that provide support in job placement.

Mizunoya et al., in their research regarding disability, analyzed 15 developing countries, heterogeneous in their level of development, legislative and political background, evidencing the statistical gap between the lowest employment rates for people with disabilities. However, in some countries women with disabilities are more likely to be employed than those without disabilities [14].

In Latin America, statistics for people with disabilities without participating in the labor market are often incomplete or missing [15] and usually outdated [14,16,17]. Even so, the figures are—according to statistics generated by each of the respective countries—in Peru 82% [18], Colombia 80% [19] and according to the processing of ECLAC census databases [15,20] in Brazil 50%, Costa Rica 58%, Ecuador 51% and Mexico 77%.

Several researchers agree [21,22] that this lack of research on disability in the Southern Cone is an alarming element and of great concern.

1.2. Disability and Employment in Chile

According to the II National Disability Study [23], of the total national population, 16.7% are in a situation of disability and the barriers to access the world of work for people with disabilities in Chile are clear: 57.8% of the total number of people with disabilities are not inserted in the labor market compared to 31% of people without disabilities. Depending on the type of disability, the results are even more pronounced: inactivity for people with severe disabilities is 75.7% [23].

It is important to note that this second ENDISC measurement provided for measuring disability in Chile is based on a model that allows comparisons with a conceptual base and standard language on functioning and disability, in this case the one proposed by the WHO, the "International Classification of Functioning" [6,7].

Research based on ENDISC II [24] was able to determine how some less prevalent disability subdiagnoses, such as anxiety and depression, are highly influenced by the social and physical context, for example being able to access means of transport to get to work and physical working conditions.

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Given the recent emergence of COVID-19, studies already appear in which it is described how the population with disabilities in Chile was not considered in the reports, legislation, and public visibility both locally and in Latin America [25] and even part of the health policies implemented were to the detriment of the population with disabilities, for example those who require institutionalized care or a work setting in a closed area.

These data show how a society excludes certain people from access to the world of work. This is the premise of the social model in disability [26–29] according to which disability is not something inherent to the person—unlike the medical model—but that it is something socially constructed and perpetuated through discourses [30] and other practices that remain over time and that are validated by members of society [31–33].

It is important to highlight the criticism regarding the moment when the public discourse of disability appeared in Chile, which coincided with the first events of the Teletón [21] during the military regime. This discourse was accompanied by an increase in the neoliberalization of the economy [34]. This moment of appearance emphasizes the medical model in disability and association with reconstructive ideas of the person, that is, a conceptualization of disability from the deficit [35] with the aspiration of reaching a new "normality". Araneda-Urrutia and Infante [34], insightfully illustrate this point today, indicating that the media public discourse referring to state violence towards the 200 people who suffered eye damage or loss of vision during the "Social outbreak"—in October 2019—was presented as an "epidemic" or "health emergency" speech, leaving the concept of disability absent from media coverage.

As reported by recent measurements in Chile, but less detailed regarding disability and its related variables, according to the CASEN survey of 2017 [35], for people over 18 years of age, 67% of the people with disability were inactive at work compared to 34% of people without disabilities. Even more revealing, if we take the variables of CASEN 2017 [35] regarding people who consider themselves to be with disabilities (labeled variable 07r1) and it is crossed with the variable (o5) "If they offered you a job, would you be willing to work?" 22.6% would answer Yes (either "yes now" or "yes another time").

In previous research, such as the quantitative description of 2003, ENDISC I, there were studies that showed how the law that encourages labor inclusion in the labor market (law 20,422) did not fully understand how to promote labor inclusion in disability [34].

Although there is not further research on disability in Chile, some research has shown some issues to consider.

From a medical point of view, Durán et al. [36] indicate the underdiagnosis of people with rheumatoid arthritis and their marginalization from the world of work.

Gomez et al. [37] conducted research in the Maule region in Chile, developing an instrument with psychometric characteristics of reliability and validity to be able to assess perception of microentrepreneurs regarding the communication skills of young people with mild intellectual disabilities. This advances, in some sense, the connection between employers and employees of the population with disabilities, with a view to greater labor inclusion.

In addition, investigations were conducted [38] regarding the way in which some people with disabilities can achieve self-determination through the relationship between beliefs, perceptions and parental attitudes towards self-determination, a construct that has become very popular because it supports the idea that the right course of action should be reflected in public policy.

1.3. Econometrics and Its Relationship with the Variables of Work and Disability

Baldwin [39], through econometric methods [40], compares differences in salaries between people with and without disabilities. In such research, by means of the decomposition method, it is possible to discriminate how the differences are explained by means of factors that are attributable to discrimination or some variables that could affect labor productivity.

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Parodi et al. [41] also tried to associate the disability variable with other variables such as sociodemographic and income variables. They were able to establish that in the case of the United States there is a much higher probability of having a low income in households that include occupants with disabilities. In any case, both in households with people with or without disabilities, the characteristics of the head of the household in terms of type of work and education contribute to determining the level of income.

Cawley [42], through probit models, related the weight variable with employment for people with disabilities based on the National Longitudinal Survey of youth from 1979 to 1989. In this regard, it was concluded that weight did not cause work disability; there was an association between the variables, although there was no causality.

There are studies in the world that have managed to go beyond descriptive statistics, being able to determine how some variables affect employment opportunities in people with disabilities through econometric models: education [43], economic income [41], salary [39] and even obesity [42]. In Chile, there is still no record of an econometric study that addresses this important issue.

This research seeks to estimate job opportunities of people with disabilities in Chile. For this, the data from the second Chilean national disability study were used to make a Multinomial Logistic Regression Model that helps predicting the probability of certain variables that have an effect on job opportunity.

2. Methodology

Data and Method

To understand and to estimate the job opportunities for people with disabilities in Chile, we used the dataset from second national study on disability, developed by the Ministry of Social Development and the National Service for Disability in Chile. This descriptive study determines the prevalence of people with disabilities in Chile and allows knowing what their real context is in respect of the general population, in terms of their levels or degrees, body deficits (functional and/or structural), functioning in daily and vital activities, relationship with the environment, social participation and others. It also characterizes people with disabilities in their context in Chile regarding socio-demographic aspects, level and access to education, health, universal accessibility, labor inclusion, political and social participation, culture, sports and recreation, among others, and situation dependency, identifying shortcomings and demands of the population in the indicated areas. In addition, this study evaluates the different gaps that separate the different social segments and territorial areas.

The survey was applied to a (probabilistic) sample of private homes in urban and rural areas of the 15 regions of the country. The sample design, the field test of the instrument and its survey in the field were carried out by the National Institute of Statistics (INE), Chile. The survey included 12265 people between the ages of 18 and over and 5515 people between the ages of 2 and 17. The questionnaire collected information in three units of analysis: the household and its members, people aged 18 years and over (randomly chosen) and people between 2 to 17 years (also randomly selected in households with people in this age group).

To predict the job opportunities for people with disabilities in Chile, a multinomial logistic regression model was fitted to the responses and was used to predict the probabilities of the different possible outcomes [44]. Multinomial logistic regression was used to predict categorical variables or the probability of category membership on a dependent variable based on multiple independent variables [45]. As in binary logistic regression, multinomial logistic regression uses maximum likelihood estimation to evaluate the probability of categorical membership. Hence, this type of model allowed us to characterize the probability of a respondent's decision for a particular multinomial discrete choice, conditional on the values of the explanatory variables [46]. The distribution functions that characterize explanatory variables are often nonlinear. Thus, once the multinomial regression model

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is created, the parameters are used to make predictions about the probability of an event occurring compared with the reference category.

In this particular case, we wanted to know how changes affected the abovementioned independent variables on the probabilities of the variable (infrastructure choice) in Equation (1) expressed as:

$$P(Y = j/X_1, X_2, \dots, X_k) = P(Y = j/K); j = 0, 1, \dots, J$$
 (1)

In the multinomial case, response probabilities were represented in Equations (2) and (3) as:

$$P(Y = j/X) = \frac{\exp(X\beta_j)}{1 + \sum_{h=1}^{J} \exp(X\beta_h)} = p_j(X, \beta); j = 1, \dots, J$$
 (2)

$$P(Y = 0/X) = \frac{1}{1 + \sum_{h=1}^{J} \exp(X\beta_h)} = p_0(X, \beta)$$
 (3)

We used maximum likelihood to estimate multinomial logit models in which the logarithm of the likelihood function that usually provides consistent and asymptotically normal estimators is expressed by Equation (4) as

$$l(\beta) = \sum_{i=1}^{n} \sum_{j=0}^{J} 1[Y_i = j] \log[p_j(X_i, \beta)]$$
 (4)

3. Results

3.1. Descriptive Analysis

The number of corresponding observations in the sample for the descriptive analysis is 1566. All of the observations surveyed belong to an adult population (legal age) with a cutoff of 30 years, with a disability situation according to the degree in the adult population, contemplated in 3 levels: without disability, mild to moderate disability, and severe disability ("Degree of Disability Situation" variable). Income is analyzed, considering the variables with an autonomous income ("Autonomous income" variable) understood as the income received in the home as a result of productive factors, and calculated on the value of the Chilean minimum income in 2015. Other income variables described are the retirement or old-age pensions or others ("Retirement and pensions" variable), monthly state subsidies ("Monthly subsidies" variable) and annual state subsidies ("Annual state subsidies" variable), in addition to the money contributed by people outside the household ("Money contributed by people outside the home" variable). There were two categorical variables that do not appear in Tables 1 and 2. Both tables only shows continuous variables. These variables are: "Marital status" and "Reason for not attending studies". As will be seen later in the methodology, these variables were recoded, and incorporated as dummy variables to enter the estimation of the multinomial regression model. For the marital status variable, the majority were single people (49.62%) there was one (28.57%) married person, and to a lesser extent there were people who lived with their partner (11.29%). Regarding "Reason for not attending studies", the most common reason was people who were either working (46.97%) or had already finished their studies (19.41%) and to a lesser extent due to "Pregnancy, maternity or paternity".

Most of the people were single (49.6%), and the main reason why they stop studying was because of a job search ("Reason for not attending studies" variable).

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Table 1. Descriptive Statistics ($n = 1566$)	Table 1.	Descriptive	Statistics ((n = 1566)
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Variable	Mean	P50	Std. Dev.	Min	Max
Age	25.13538	26	3.45776	18	30
Autonomous income	263,242.9	225,000	321,588.6	0	3,500,000
Retirement and pensions	752.212	0	8685.625	0	200,000
Monthly subsidies	13,009.27	0	33,088.59	0	390,000
Annual state subsidies	2325.518	0	4490.683	0	40,000
Money contributed by people outside the home	8100.032	0	34,014.36	0	600,000
Degree of Disability Situation	0.0951469	0	0.3436537	0	2
Last approved course	3.863985	4	1.555785	1	8

Table 2. Summary of people with disabilities in Chile.

Variable	Range	N	Marginal Percentag
11	Yes	379	76.9%
Have you ever worked?	No	114	23.1%
	No Disability	443	89.9%
Degree of Disability Situation	Mild to Moderate Disability	34	6.9%
	Severe Disability	16	3.2%
	Married	67	13.6%
Modulation	Cohabitant or partner	133	27.0%
Marital status	Separate	3	0.6%
	Single	290	58.8%
	Help at home or household chores	61	12.4%
	Pregnancy, maternity, or paternity	95	19.3%
	You have a disability	12	2.4%
	Disease that disables it	13	2.6%
	Family problems	379 76.9% 114 23.1% 443 89.9% 34 6.9% 16 3.2% 67 13.6% 133 27.0% 3 0.6% 290 58.8% 61 12.4% 95 19.3% 12 2.4% 13 2.6% 5 1.0% 19 3.9% 83 16.8%	1.0%
	Not interested		3.9%
Main reason why you are not	Finished studying	83	16.8%
currently studying	At this age it is not useful to study, or the person	1	0.20/
	does not know the way to complete studies	1	0.2%
	Economic difficulty	55	11.2%
	Work or look for work	79	16.0%
	Performance issues	6	1.2%
	Another reason. Specify:	31	6.3%
	No data	33	6.7%
	1	40	8.1%
	2	379 76.9% 114 23.1% 443 89.9% 34 6.9% 16 3.2% 67 13.6% 133 27.0% 3 0.6% 290 58.8% 61 12.4% 95 19.3% 12 2.4% 13 2.6% 5 1.0% 19 3.9% 83 16.8% 1 0.2% 55 11.2% 79 16.0% 6 1.2% 31 6.3% 33 6.7% 40 8.1% 70 14.2% 56 11.4% 248 50.3% 22 4.5% 14 2.8% 8 1.6% 35 7.1%	14.2%
	3	56	11.4%
Last approved source	4	248	50.3%
Last approved course	5	22	4.5%
	6	14	2.8%
	7	8	1.6%
	8	35	7.1%
	Valid	493	100.0%

3.2. Multinomial Logistic Regression

To respond to the research objective, a multinomial logistic regression model was fitted to know the job opportunities for people with disabilities in Chile. Table 1 summarizes the cases related to the people with disabilities in Chile. A linear model was first run on the responses as a function of the predictors to ensure that there were no problems with multicollinearity; only predictors with variance inflation factors (VIF) <2 were included in these models (4).

Regarding the fitted model information, the chi-squared ratio test had a value of 103.754 (p = 0.000), indicating a good model fit. Acceptable values were also obtained for

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the pseudo R-squared (Cox and Snell: 0.789, Nagelkerke: 0.854). Table 3 shows that the power of our logistic multinomial model was suitable because it correctly classified 92.3% of the known observations and can be expected to project future estimates. Table 4 shows the likelihood ratio tests for the effects of the model and the partials whose low p-values show the high significance of the variables in the model. The cut value used for value optimal for classification in this research was 80%.

Table 3. Power of classification of job opportunities for people with disabilities in Chile model
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01 1		Predicted			
Observed	Without Disability	Mild to Moderate Disability	Severe Disability	Percent Correct	
Without disability	1430	0	4	99.7%	
Mild to Moderate Disability	96	1	2	1%	
Severe disability	18	0	7	28%	
Overall Percentage	99.1%	0.1%	0.8%	92.3%	

Table 4. Multinomial logistic regression of job opportunities for people with disabilities in Chile.

E664	Model Fitting Criteria	Likelihood Ratio Tests			
Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.	
Intercept	420,078	0.000	0		
Age	433,173	13.095	1	0.000	
Autonomous income	427,138	7.060	1	0.008	
Retirement and pensions	423,700	3.622	1	0.057	
Monthly subsidies	424,608	4.530	1	0.033	
Annual state subsidies	420,503	0.425	1	0.514	
Money contributed by people outside the home	421,498	1.420	1	0.233	
Marital status	423,938	3.860	3	0.277	
Reason for not attending studies	453,640	33,562	12	0.001	
Last approved course	443,248	23,170	7	0.002	

From what is observed in Table 4, there are different variables that affect job opportunities for people with disabilities in Chile; represented in the dependent variable labeled as "Have you ever worked?".

Within the world literature [5–7] focused on people with disabilities in Chile [47], labor inclusion in disability is described as the degree of disability of a person affects ("Degree of Disability Situation" variable) at the time of having an opportunity of work and to be able to exercise that opportunity. In the estimation of this model "Degree of Disability Situation" was the dependent variable against the reference category.

Some variables that are framed within the labor economy such as whether the person with a disability has an autonomous income ("Autonomous income" variable) or either have state-issued income due to a disability pension or a degree of disability disabling from work ("Retirement and pensions" variable) which would affect the material need of having to resort to a job.

Monthly subsidies also show an incidence in the probability of finding a job. The difference in the odd ratio between the monthly subsidies and the annual subsidies can be explained by the difference in the granting characteristic for each of them. The annual subsidies are usually economic allocations made over the long-term to the person, whereas the monthly subsidies can be temporary or part of a limited in time government program (e.g., subject to government budget restrictions).

Within the model presented, the independent variable of age ("Age" variable) affects the probabilities of having a job. Such a result was widely disseminated in the world literature on the labor market and disability [48–50] and also in previous research studies in Chile [51].

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The proposed model confirms how the educational variables in Chile [6,47] influence job opportunity, not only according to the educational level reached (last approved course variable) but also as the continuation of studies (reason for not attending studies variable) would have statistically affect significantly in the proposed model. This finding coincides with econometric studies carried out in other countries [43,52].

4. Discussion and Conclusions

The incorporation of people with disabilities into the labor market is a particularly pressing task in emerging economies such as Latin America.

The case of Chile is not an exception within the continent. Legal efforts have been made (e.g., National Law 21015) to regulate their incorporation and a census survey was carried out regarding disability and its socioeconomic status.

Despite these efforts, a greater presence of workers with disabilities in the labor market is required and also it is needed more applied research regarding the causes that generate this form of social exclusion. Through this research, the national disability survey sought to investigate the causes of this social marginalization from the labor market. Such findings may be of importance to people with disabilities, to legislators, to companies that promote labor inclusion, and to disability researchers.

Within the present study it was possible to determine how certain variables affect employability of people with disabilities. Although some other variables have an inci-dence within the regression generated, the educational variable is striking. It is estab-lished within the results, that effectively for adults who have some degree of disability, the increase in their employment opportunity is related to their educational level.

Therefore, along with public policies in Chile, such as quota regulations for organizations, Law No. 21.015 on Labor Inclusion, which states that "Public bodies and companies with 100 or more workers must hire at least 1% of people with disabilities", it is necessary to reinforce education for people with disabilities, in addition to making improvements in terms of desertion or low preparation of the physical spaces of these institutions that can affect equality before the development of the educational level of people with disabilities.

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