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**FONDO NACIONAL DE DESARROLLO CIENTIFICO Y TECNOLOGICO (FONDECYT)**

Moneda 1375, Santiago de Chile - casilla 297-V, Santiago 21

Teléfono: 2435 4350 FAX 2365 4435

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INFORME FINAL  
PROYECTO FONDECYT INICIACION  

OBJETIVOS  
Cumplimiento de los Objetivos planteados en la etapa final, o pendientes de cumplir. Recuerde que en esta sección debe referirse a objetivos desarrollados, NO listar actividades desarrolladas.

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<td>1</td>
<td>To address endogeneity in spatial choice models, putting particular attention in the problems of: 1) the change of scale that occurs in corrected models; 2) exploiting the link between latent-variables and methods to correct for endogeneity; and 3) assessing the weakness and the exogeneity of the instruments.</td>
<td>PARCIAL</td>
<td>Addressed: 1) change of scale and forecasting that while correcting for endogeneity; 2) exploitation of the link between latent-variables 3) detection of weak instruments in Logit models. Future research: 3) development of test for the exogeneity of instruments in Logit models.</td>
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<td>2</td>
<td>To address estimation and forecasting while sampling of alternatives in MEV and Logit Mixture models.</td>
<td>TOTAL</td>
<td>Up to the second year, methods to address sampling of alternatives in MEV and Logit Mixture models were fully developed. Both are reported in two published papers. Results were also obtained for the RRM models, not originally considered in the project. Results for this third case were submitted to a journal. In the third year, an extension for RRM models was added and published.</td>
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<td>3</td>
<td>Address other estimation and specification issues that arise in discrete choice modeling and need to be differentiated from the problems of endogeneity and sampling of alternatives. This may include, but is not limited to a) numerical methods to estimate Logit Mixture models; b) Microeconomic specification of choice models; c) Measuring the complexity in activity scheduling;etc.</td>
<td>PARCIAL</td>
<td>This goal was added to the original version of the project. Regarding the problem of estimation of Logit Mixture models, two aspects were addressed with the collaboration with Professor Elisabetha Cherchi. The first the assessment of impact of the curse of dimensionality and the second I related with the estimation of such model with panel data, with different methods: MSL, EM and HH. Advances were also attained regarding the measurement of the complexity of the activity schedule. The measure proposed is a combination of number of activities and their exclusivity. The results are reported in a conference paper. Other advances have been made regarding the micro-economic specification of discrete choice models. The result is related with the argumentation of a novel hypothesis for finding different values of time between modes.</td>
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Otro(s) aspecto(s) que Ud. considere importante(s) en la evaluación del cumplimiento de objetivos planteados en la propuesta original o en las modificaciones autorizadas por los Consejos.

Goal 1 was not fully addressed, but 1 ISI publication and three conference papers were already produced as a result on the work on it.
Goal 2 was fully achieved and 3 ISI publications resulted from it. The third publication corresponds to an extension that was unexpected when the project was formulated.
Goal 3 was added to the project in the second year. It was partially achieved but 2 ISI and two conference papers were already produced as the result of the work developed on this research line.
RESULTS OBTAINED:
For each specific goal, describe or summarize the results obtained. Relate each one to work already published and/or manuscripts submitted. In the Annex section include additional information deemed pertinent and relevant to the evaluation process.
The maximum length for this section is 5 pages. (Arial or Verdana, font size 10).

**Goal I)** "To address endogeneity in spatial choice models, putting particular attention in the problems of: 1) the change of scale that occurs in corrected models; 2) exploiting the link between latent-variables and methods to correct for endogeneity; and 3) assessing the weakness and the exogeneity of the instruments."

Four results were achieved. The first result is related to the problem of the change of scale that arises in the correction of endogeneity. This is summarized by the following paper: Guevara, C.A. and Benn-Akiva M. "Change of Scale and Forecasting with the Control-Function Method in Logit Models" Transportation Science, Vol. 46, No. 3, August 2012, pp. 425–437

In this paper, we first depict the determinants of the change of scale that occurs when correcting for endogeneity in Logit models with the control-function method, by adapting an existing result for omitted orthogonal attributes in logit models. Then, we study the problem of forecasting under these circumstances. We show that a procedure proposed in previous literature may lead to significant biases, and we suggest novel alternatives to be used with synthetic populations. We use Monte Carlo experimentation and real data on residential location choice to illustrate these results. The paper finishes by summarizing the findings of this investigation and suggesting future lines of research in this area.

The second result is related to the study of the impact and the detection of weak instruments in Logit models. This result is reported in the following paper: Navarro and Guevara (2013) "Detección De Instrumentos Débiles Al Corregir Endogeneidad En Modelos Logit Binario" submitted to the XVI Chilean Conference in Transportation. An improved version of this article will soon be submitted to an ISI journal.

In this paper we use Monte Carlo simulations to study the detection of weak instruments in binary Logit models, and to analyze their impact in practice. We conclude that, like in linear models, the use weak instruments precludes the correction of endogeneity in this context, and that weakness could be detected contrasting an F-test with critical values that are very similar to those that have been suggested for linear models.

The third result is related to the study of alternative methods to obtain exogenous and strong instruments in practice. This result is reported in the paper Guevara and Polanco (2014) "Correcting For Endogeneity Without Instruments In Discrete Choice Models: The Multiple Indicator Solution" presented at Panamerican Conference in Transportation.

The Control Function (CF) method is the current standard for addressing endogeneity in discrete choice models. However, the CF requires instrumental variables, which may be difficult to obtain. In turn, the Multiple Indicator Solution (MIS) method does not require instruments, but it has only been described so far for linear models. In this article we show that MIS can be extended to discrete choice modeling under mild assumptions. We also use Monte Carlo experiments to illustrate the efficacy and efficiency of MIS and CF. Results suggest that MIS seems to be more robust to mild violations of modeling assumptions.

The Forth result is related to the exploitation of the link between different methods to address endogeneity in discrete choice models. This result is reported in the paper Guevara, Antolin and Bierlaire (2014) "A correction for endogeneity in choice models with psychological construct" presented at hEART 2014, 3rd Symposium of the European Association for Research in Transportation developed in Leeds Uk.

This research aims at integrating two methods mitigating parameter biases resulting from the omission of unobserved factors of decisions in discrete choice models. The first method is to estimate an integrated choice and latent variable model (Walker and Benn-Akiva, 2002, Walker, 2001), where a latent factor captures an unobserved qualitative
attribute (e.g. the comfort of a transport mode). Omitting this attribute can lead to a wrong estimate of the parameters relative to economic factors (e.g. the travel time), and consequently to biased willingness to pay indicators. The second method uses the multiple indicator solution (MIS) to introduce a factor of correction in the choice model, in order to obtain unbiased estimates of the economic factors (Guevara and Polanco, 2014).

Goal II “To address estimation and forecasting while sampling of alternatives in MEV and Logit Mixture models”

Three results have been achieved. The first result is related to the problem of sampling of alternatives in MEV models and is summarized in the following paper: Guevara C.A. and M. Ben-Akiva "Sampling of Alternatives in Multivariate Extreme Value (MEV) Models” Transportation Research B 48, 31-52.

In this article we propose a methodology to achieve consistency, asymptotic normality and efficiency, while sampling alternatives in Multivariate Extreme Value (MEV) models, extending a previous result for Logit. We illustrate the methodology and study the finite sample properties of the estimators using Monte Carlo experimentation and real data on residential location choice from Lisbon, Portugal. Experiments show that the proposed methodology is practical, that it outperforms the uncorrected model, and that it yields acceptable results, even for relatively small samples of alternatives. The paper finishes with a synthesis and an analysis of the impact, limitations and potential extensions of this research.

The second result achieved is related to the problem of sampling of alternatives in Logit Mixture models and is summarized in the following paper: Guevara C.A. and M. Ben-Akiva "Sampling of Alternatives in Multivariate Extreme Value (MEV) Models” In press in Transportation Research B.

In this article, we propose a method to obtain consistent, asymptotically normal and relatively efficient estimators for Logit Mixture models while sampling alternatives. Our method is an extension of previous results for Logit and MEV models. We show that the practical application of the proposed method for Logit Mixture can result in a Naïve approach, in which the kernel is replaced by the usual sampling correction for Logit. We give theoretical support for previous applications of the Naïve approach, showing not only that it yields consistent estimators, but also providing its asymptotic distribution for proper hypothesis testing. We illustrate the proposed method using Monte Carlo experimentation and real data. Results provide further evidence that the Naïve approach is suitable and practical. The article concludes by summarizing the findings of this research, assessing their potential impact, and suggesting extensions of the research in this area.

The third result achieved is related to the problem of sampling of alternatives in Random Regret Minimization Models, and is summarized in the following paper: Guevara C.A., Chorus, C. and M. Ben-Akiva “Sampling of Alternatives in RRM Models”, accepted in Transportation Science.

In this article, we propose a methodology to achieve consistency, asymptotic normality and efficiency, while sampling alternatives in Random Regret Minimization models. Our method is an extension of previous results for Logit and MEV models. We illustrate the methodology using Monte Carlo experimentation.

Goal III “Address other estimation and specification issues that arise in discrete choice modeling and need to be differentiated from the problems of endogeneity and sampling of alternatives. This may include, but is not limited to a) numerical methods to estimate Logit Mixture models; b) Microeconomic specification of choice models; c) Measuring the complexity in activity scheduling; d) Random housing bidding models, and e) Choice behavior under large choice sets and/or complex contexts, such as residential location, route choice in public transportation and dynamic models of the land market.”
Four results were achieved. The first result is related to the problem of estimation of Logit Mixture models with many coefficients. This results is summarized in the paper "A Monte Carlo experiment to analyse the curse of dimensionality in estimating random coefficients models with a full variance-covariance matrix", Transportation Research Part B: Methodological Volume 46, Issue 2, February 2012, Pages 321–332

When the dimension of the vector of estimated parameters increases, simulation based methods become impractical, because the number of draws required for estimation grows exponentially with the number of parameters. The curse of dimensionality in simulation methods corresponds to the lack of empirical identification when the number of parameters increases. We investigate this problem in the case of the random coefficients Logit model. We compare the traditional Maximum Simulated Likelihood (MSL) method with two alternative estimation methods: the Expectation–Maximization (EM) and the Laplace Approximation (HH) methods that do not require simulation. We use Monte Carlo experimentation to investigate systematically the performance of the methods under different circumstances, including different numbers of variables, sample sizes and structures of the variance–covariance matrix. Results show that indeed MSL suffers from lack of empirical identification as the dimensionality grows while EM deals much better with this estimation problem. On the other hand, the HH method, although not being simulation-based, showed poor performance with large dimensions, principally because of the necessity of inverting large matrices. The results also show that when MSL is empirically identified this method seems superior to EM and HH in terms of ability to recover the true parameters and estimation time.

The second result is also related to the problem of estimation of Logit Mixture models with panel data. This result is summarized in the paper Cherchi and Guevara (2012) "Maximum Simulated Likelihood and Expectation-Maximization Methods to Estimate Random Coefficients Logit with Panel Data", Transportation Research Record: Journal of the Transportation Research Board, 2302, 65–73.

In this paper, the traditional maximum simulated likelihood (MSL) method is compared with the alternative expectation-maximization (EM) method, which does not require simulation. Previous literature had shown that for cross-sectional data, MSL outperforms the EM method in the ability to recover the true parameters and estimation time and that EM has more difficulty in recovering the true scale of the coefficients. In this paper, the analysis is extended from cross-sectional data to the less volatile case of panel data to explore the effect on the relative performance of the methods with several realizations of the random coefficients. In a series of Monte Carlo experiments, evidence suggested four main conclusions: (a) efficiency increased when the true variance–covariance matrix became diagonal, (b) EM was more robust to the curse of dimensionality in regard to efficiency and estimation time, (c) EM did not recover the true scale with cross-sectional or with panel data, and (d) EM systematically attained more efficient estimators than the MSL method. The results imply that if the purpose of the estimation is only to determine the ratios of the model parameters (e.g., the value of time), the EM method should be preferred. For all other cases, MSL should be used.

The third result is related to the problem of developing a measure of the complexity of the activity schedules. This result is summarized in the paper Cadena, Guevara and Cartes (2013)”Medidas de Complejidad de la Agenda de Actividades” submitted to the XVI Chilean Conference in Transportation. An improved version of this article will soon be submitted to an ISI journal.

In this article we propose a measure for the complexity of agenda of activities, based in the number and the exclusivity of the activities performed. The application of this measure to Santiago de Chile’s 2001 mobility survey, suggests that the agenda of activities of private-modes’ users is more complex than the agenda of public-transport’s users, even after controlling by income, gender household composition and driving license. This result provides preliminary support for a novel hypothesis that might explain between mode differences in the value of time.
The fourth result is related with the microeconomic specification of choice models. This result is summarized in the paper Guevara (2013) “Microeconomic Explanations For Between-Modes Differences” this article was presented at the World Conference in Transportation Research and submitted to Transportation Transportation Research A.

The subjective valuation of travel time savings (SVTTS) obtained from mode choice models is sometimes found to be larger conditional on the choice of car than conditional on the choice of public transportation. This seems contradictory from a classical microeconomic perspective since public transportation is often less comfortable, less accessible and less reliable than car and, therefore, the same individual should be willing to pay relatively more, and not less, for saving a marginal unit of travel time in public transportation. This article describes two plausible novel micro-economic explanations for this seemingly contradictory empirical finding of larger value of time, conditional on the choice of car than on the choice of public transportation, for the same individual. The first explanation follows from noting that the marginal consumption of goods when travelling by car is usually larger than when travelling by public transportation. This effect can be explicitly accounted for with the inclusion of technical constraints relating goods consumption and time assignment in the microeconomic framework of the SVTTS. The second explanation follows from noting that the activity pattern needs not to be the same conditional on the choice of each mode. Since the car is faster and more flexible, a schedule constructed conditional on the choice of car may allow for more complex activity patterns, justifying larger values of time as a resource than conditional on the choice of public transportation. Empirical evidence for this second hypothesis is given using real data on activity patterns complexity from the city of Santiago de Chile. The article finishes summarizing the contributions of this research and proposing lines for further investigation.
OTHER ACHIEVEMENTS OF THE PROJECT:
- Research visit(s) to other institution(s).
- Outreach activities related to the project’s main topic.
- Any other contribution, not addressed elsewhere, that you consider important.

The maximum length for this section is 1 page. (Arial or Verdana, font size 10).

Visit the Intelligent Transportation Systems Lab of the Massachusetts Institute of Technology, Cambridge, MA

I visited MIT’s ITS Lab to work with collaborator Moshe Ben-Akiva on April 2014. We discussed various topics regarding the papers on sampling on alternatives we were working on, particularly the one applied to RRM models. I was re-nominated as a Research affiliate of the ITS Lab of MIT.

Outreach to Society Activity at Universidad de los Andes, December 2013

I developed an outreach to society activity at Universidad de los Andes on December 2013, together with other researchers of the university. I presented there the main results of the project. In this activity we invited professor Ben-Akiva from MIT, but using other funds. Details of the activity can be found following this link http://www.uandes.cl/noticias/primer-seminario-get-uandes-presenta-proyectos-y-desafios-del-transporte-para-2025.html

Visit to the Choice Modeling Centre of the Institute for Transport Studies of the University of Leeds

I visited the lab of Professor Stephane Hess at the University of Leeds, before the hEART conference. I gave a talk to the professors and PhD students of their transportation program and worked with Professor Hess regarding possible future collaborations. I was nominated one of the 12 external affiliated of the Choice Modelling Centre.
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<td>Navarro, P.; Guevara, C.A.</td>
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Título (Idioma original) : Sampling Of Alternatives In Random Regret Minimization Models
Nombre del Congreso : VIII Triennial Symposium on Transportation Analysis
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Título (Idioma original) : CORRECTING FOR ENDOGENEITY WITHOUT INSTRUMENTS IN DISCRETE
CHOICE MODELS: THE MULTIPLE INDICATOR SOLUTION
Nombre del Congreso : XVIII CONGRESO PANAMERICANO DE INGENIERÍA DEL TRÁNSITO,
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Autor (a)(es/as) : Guevara, C. A. Glerum. A and Bierlaire, M.
Título (Idioma original) : A correction for endogeneity in choice models with psychological constructs
**Nombre del Congreso :** 3rd Symposium of the European Association for Research in Transportation  
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**Nombre y Apellidos del(de la) Tutor(a) :** C. Angelo Guevara Cue  
**Título Grado :** Pregrado  
**Institución :** Universidad de los Andes  
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Nombre y Apellidos del(de la) Tutor(a) : Cristian Angelo Guevara
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