ECO 3901
INDUSTRIAL ORGANIZATION II

University of Toronto. Department of Economics. Winter 2022

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Office: Dept. of Econ. Room 309   Course website: https://q.utoronto.ca/courses/250956

Lectures
- Thursdays, 3:00pm to 5:00pm
- Online Lectures (Weeks 1 to 3): Zoom: https://utoronto.zoom.us/j/2070849555 (Passw: 223209)
- In Person Lectures (Weeks 4 to 13): O.I.S.E. -- 252 Bloor Street West. Room OI8214

Office Hours
- Tuesdays, 3:00pm to 5:00pm
- Online: Zoom: https://utoronto.zoom.us/j/2070849555 (Passw: 223209)
- In Person: Department of Economics, Room 309

A. COURSE DESCRIPTION

This course deals with Empirical Industrial Organization. It covers topics related to **econometric models and empirical applications** of competition in industries. We study empirically the determinants of firms' behaviour and market outcomes in the context of problems of market entry/exit, investment, innovation, product design, networks, matching, and natural resources. The course focuses on research papers using **empirical dynamic games** to investigate firms' strategies and competition, and how firms' information and beliefs play a fundamental role in competition and on market outcomes and welfare. The course emphasizes the importance of combining data, economic models, and appropriate identification strategies and econometric techniques to answer empirical questions in economics.

B. MEETINGS

- We have a 2-hours **lecture** every Thursday from 3pm to 5pm.
    - Online Lectures (Weeks 1 to 3): Zoom: https://utoronto.zoom.us/j/2070849555 (Passw: 223209)
    - In Person Lectures (Weeks 4 to 13): O.I.S.E. -- 252 Bloor Street West. Room OI8214

- Office Hours: Tuesdays 3pm to 5pm.
    - Online: Zoom: https://utoronto.zoom.us/j/2070849555 (Passw: 223209)
    - In Person: Department of Economics, Room 309

- We will have class on **Thursday, February 24th**, during Reading Week.

C. EVALUATION

Your final grade will be based on the following requirements.

- **Problem set (50%)**. I will distribute the problem set online on **Tuesday, February 22nd**. Your completed problem set is **due on Thursday, March 17th.**

- **Final exam (50%)**. The final exam is a "Take Home Exam". I will distribute the final exam on the last day of class on **Thursday, April 7th**. Your completed exam is **due on Tuesday, April 12th.**

D. GENERAL REFERENCES

The following are general references which are useful for all the topics covered in this course.

- Aguirregabiria, V. (2019): "Empirical Industrial Organization: Models, Methods and Applications," Chapters 6 to 9.
- Aguirregabiria, V., A. Collard-Wexler, and S. Ryan (2021): "Dynamic Games in Empirical Industrial Organization," *Handbook of Industrial Organization*, Volume 4, Chapter 4, pp. 225-343.
- Aguirregabiria, V., and A. Nevo (2013): "Recent developments in empirical IO: Dynamic demand and dynamic games," *Advances in Economics and Econometrics*, 3, 53–122.
- Berry, S., and G. Compiani (2021): "Empirical Models of Industry Dynamics with Endogenous Market Structure," *Annual Review of Economics*, 13, 309–334.

E. OUTLINE AND REFERENCES

Topic 1: <u>Dynamic games of oligopoly competition: Models and Solution methods</u>

<u>Main references</u>
- Aguirregabiria, V., and P. Mira (2007): "Sequential estimation of dynamic discrete games," *Econometrica*, 75, 1-53.
- Ericson, R. and A. Pakes (1995): "Markov-Perfect Industry Dynamics: A Framework for Empirical Work," *Review of Economic Studies,* 62, 53-82.
- Pakes, A. and P. McGuire (1994): "Computing Markov Perfect Nash Equilibrium: Numerical Implications of a Dynamic Differentiated Product Model," *RAND Journal of Economics*, 25, 555-589.

<u>Additional references</u>
- Doraszelski, U., and K. Judd (2012): "Avoiding the curse of dimensionality in dynamic stochastic games," *Quantitative Economics*, 3 (1): 53–93.
- Doraszelski, U., and M. Satterthwaite (2010): "Computable Markov-Perfect Industry Dynamics," *The RAND Journal of Economics*, 41 (2): 215–243.
- Fershtman, C., & Pakes, A. (2012): "Dynamic games with asymmetric information: A framework for empirical work," *Quarterly Journal of Economics*, 127, 1611-1661.
- Weintraub, G., L. Benkard, and B. Van Roy (2008): "Markov perfect industry dynamics with many firms," *Econometrica*, 76 (6): 1375–1411.

Topic 2: <u>Identification of structural dynamic games</u>

<u>Main references</u>
- Aguirregabiria, V., and P. Mira (2019): "Identification of games of incomplete information with multiple equilibria and unobserved heterogeneity," *Quantitative Economics*, 10(4), 1659-1701.
- Bajari, P., H. Hong, J. Krainer and D. Nekipelov (2007): "Estimating Static Models of Strategic Interactions," *Journal of Business & Economic Statistics*, 28(4), 469-482.

<u>Additional references</u>
- Aguirregabiria, V., and J. Suzuki (2014): "Identification and counterfactuals in dynamic models of market entry and exit," *Quantitative Marketing and Economics*, 12 (3): 267–304.
- Abbring, Jaap, and Øystein Daljord (2020): "Identifying the discount factor in dynamic discrete choice models," *Quantitative Economics*, 11 (2): 471–501.
- An, Y., Y. Hu, and R. Xiao (2021): "Dynamic decisions under subjective expectations: A structural analysis," *Journal of Econometrics*, 222 (1): 645–675.
- Buchholz, N., M. Shum, and H. Xu (2021): "Semiparametric estimation of dynamic discrete choice models," *Journal of Econometrics*, 223 (2): 312–327.
- Hu, Y., and M. Shum (2012): "Nonparametric identification of dynamic models with unobserved state variables," *Journal of Econometrics*, 171 (1), 32–44.
- Komarova, T., F. Sanches, D. Silva, and S. Srisuma (2018): "Joint analysis of the discount factor and payoff parameters in dynamic discrete choice models," *Quantitative Economics*, 9 (3), 1153–1194.

Topic 3: <u>Structural estimation dynamic games</u>

<u>Main references</u>
- Aguirregabiria, V., and P. Mira (2007): "Sequential estimation of dynamic discrete games," *Econometrica*, 75, 1-53.
- Arcidiacono, P., and R. Miller (2011): "Conditional choice probability estimation of dynamic discrete choice models with unobserved heterogeneity," *Econometrica*, 79(6), 1823-1867.
- Bajari, P., L. Benkard and J. Levin (2007): "Estimating dynamic models of imperfect competition," *Econometrica*, 75, 1331-1370.
- Hotz, J., and R. Miller (1993): "Conditional choice probabilities and the estimation of dynamic models," *The Review of Economic Studies*, 60 (3), 497–529.
- Rust, J. (1994): "Structural estimation of Markov decision processes," *Handbook of Econometrics*, Volume 4, 3081–3143.

<u>Additional references</u>
- Aguirregabiria, Victor, and Mathieu Marcoux (2021): "Imposing equilibrium restrictions in the estimation of dynamic discrete games," *Quantitative Economics*, 12(4), 1223-1271.
- Aguirregabiria, V., and A. Magesan (2013): "Euler equations for the estimation of dynamic discrete choice structural models," In Structural Econometric Models (Advances in Econometrics), 31, 3–44.
- Arcidiacono, P., P. Bayer, J. Blevins, and P. Ellickson (2016): "Estimation of dynamic discrete choice models in continuous time with an application to retail competition," *The Review of Economic Studies*, 83 (3): 889–931.
- Arcidiacono, P., and P. Ellickson (2011): "Practical methods for estimation of dynamic discrete choice models," *Annual Review of Economics*, 3 (1): 363–394.

- Berry, S., and G. Compiani (2020): "An instrumental variable approach to dynamic models. Technical report. National Bureau of Economic Research.
- Hotz, J., R. Miller, S. Sanders, and J. Smith (1994): "A simulation estimator for dynamic models of discrete choice," *The Review of Economic Studies*, 61 (2), 265–289.
- Kasahara, H., and K. Shimotsu (2012): "Sequential estimation of structural models with a fixed point constraint," *Econometrica*, 80 (5), 2303–2319.
- Pesendorfer, M., and P. Schmidt-Dengler (2008): "Asymptotic least squares estimators for dynamic games," *The Review of Economic Studies*, 75 (3): 901–928.
- Rust, J. (1987): "Optimal replacement of GMC bus engines: An empirical model of Harold Zurcher," *Econometrica*, 999–1033.

Topic 4: <u>**Market entry and exit**</u>

<u>Main references</u>
- Dunne, T., S. Klimek, M. Roberts, and D. Xu (2013): "Entry, exit, and the determinants of market structure," *The RAND Journal of Economics*, 4 (3): 462–487.
- Igami, M., and N. Yang (2016): "Unobserved heterogeneity in dynamic games: Cannibalization and preemptive entry of hamburger chains in Canada," *Quantitative Economics*, 7 (2), 483–521.

<u>Additional references</u>
- Bresnahan, T., and P. Reiss (1994): "Measuring the importance of sunk costs," *Annales D'Économie et de Statistique*, 31, 183–217.

Topic 5: <u>**Dynamic spatial competition in retail markets**</u>

<u>Main references</u>
- Ellickson, P., S. Houghton, and C. Timmins (2013): "Estimating network economies in retail chains: a revealed preference approach," *RAND Journal of Economics*, 44(2), 169-193.
- Holmes, T. (2011): "The Diffusion of Wal-Mart and Economies of Density," *Econometrica*, 79(1), 253-302.
- Seim, K. (2006): "An Empirical Model of Firm Entry with Endogenous Product-Type Choices," RAND Journal of Economics 37(3).

<u>Additional references</u>
- Aguirregabiria, V. and J. Suzuki (2016): "Empirical Models of Market Entry and Spatial Competition in Retail Industries," in *Handbook on the Economics of Retail and Distribution*.
- Arcidiacono, P., P. Bayer, J. Blevins, and P. Ellickson (2016): "Estimation of dynamic discrete choice models in continuous time with an application to retail competition," *The Review of Economic Studies*, *83*(3), 889-931.

Topic 6: <u>**Uncertainty and firms' investment decisions**</u>

<u>Main references</u>
- Collard-Wexler, A. (2013): "Demand fluctuations in the ready-mix concrete industry," *Econometrica*, 81(3), 1003-1037.
- Kalouptsidi, M. (2014): "Time to build and fluctuations in bulk shipping," *American Economic Review*, *104*(2), 564-608.

Additional references
- Kellogg, R. (2014): "The effect of uncertainty on investment: Evidence from Texas oil drilling," *American Economic Review*, *104*(6), 1698-1734.

Topic 7: <u>Dynamic games of innovation</u>

Main references
- Goettler, R. and B. Gordon (2011): "Does AMD spur Intel to innovate more?" *Journal of Political Economy*, 119(6), 1141-1200.
- Igami, M. (2017): "Estimating the Innovator's Dilemma: Structural Analysis of Creative Destruction in the Hard Disk Drive Industry," *Journal of Political Economy*, 125(3), 798-847

Additional references
- Hashmi, A., and J. Van Biesebroeck (2016): "The relationship between market structure and innovation in industry equilibrium: a case study of the global automobile industry," *The Review of Economics and Statistics*, 98 (1), 192–208.

Topic 8: <u>Dynamic price competition</u>

Main references
- Kano, K. (2013): "Menu costs and dynamic duopoly." *International Journal of Industrial Organization*, 31 (1), 102–118.
- Mysliwski, M., F. Sanches, D. Silva, and S. Srisuma (2020): "The Welfare Effects of Promotional Fees," Technical report. CeMMAP Working Paper, CWP35/20.
- Sweeting, A., J. Roberts, and C. Gedge (2020): "A model of dynamic limit pricing with an application to the airline industry," *Journal of Political Economy*, 128 (3), 1148–1193.

Additional references
- Aguirregabiria, Victor (1999): "The dynamics of markups and inventories in retailing firms," *The Review of Economic Studies*, 66 (2): 275–308.
- Gertner, R. (1985): "Dynamic duopoly with price inertia." PhD Thesis, MIT.
- Slade, M. (1998): "Optimal pricing with costly adjustment: evidence from retail grocery prices," *The Review of Economic Studies*, 65 (1), 87–107.
- Sweeting, A, X. Tao, and X. Yao (2021): "Dynamic Oligopoly Pricing with Asymmetric Information: Implications for Horizontal Mergers," manuscript. University of Maryland.

Topic 9: <u>Airline networks</u>

Main references
- Aguirregabiria, V., and C-Y. Ho (2012): "A dynamic oligopoly game of the US airline industry: Estimation and policy experiments," *Journal of Econometrics*, 168(1), 156-173.
- Benkard, C., A. Bodoh-Creed, and J. Lazarev (2019): "Simulating the dynamic effects of horizontal mergers: US airlines," *Manuscript, Yale University*.

Additional references
- Chen, Y. (2021): "Network Structure and Efficiency Gains from Mergers: Evidence from U.S. Freight Railroads," manuscript. University of Toronto.
- Yuan, Z. (2018): "Network Competition in the Airline Industry: A Framework for Empirical Policy Analysis," manuscript. University of Toronto.

Topic 10: <u>Mergers and dynamics</u>

<u>Main references</u>
- Benkard, C., A. Bodoh-Creed, and J. Lazarev (2019): "Simulating the dynamic effects of horizontal mergers: US airlines," manuscript, Yale University.
- Jeziorski, P. (2014): "Estimation of cost efficiencies from mergers: Application to US radio," *The RAND Journal of Economics*, *45*(4), 816-846.
- Igami, M., and K. Uetake (2020): "Mergers, innovation, and entry-exit dynamics: consolidation of the hard disk drive industry, 1996-2016," *The Review of Economic Studies*, 87 (6).

<u>Additional references</u>
- Collard-Wexler, A. (2014): "Mergers and sunk costs: An application to the ready-mix concrete industry," *American Economic Journal: Microeconomics* 6 (4): 407–47.
- Gowrisankaran, G. (1999): "A dynamic model of endogenous horizontal mergers," *The RAND Journal of Economics*, 30 (1), 56–83.

Topic 11: <u>Dynamic matching</u>

<u>Main references</u>
- Brancaccio, G., M. Kalouptsidi, and T. Papageorgiou (2020): "Geography, search frictions and endogenous trade costs," *Econometrica*, *88*(2), 657-691.
- Frechette, G., A. Lizzeri, and T. Salz (2019): "Frictions in a competitive, regulated market: Evidence from taxis," *American Economic Review*, 109 (8), 2954–2992.

<u>Additional references</u>
- Buchholz, N. (2018): "Spatial equilibrium, search frictions and dynamic efficiency in the taxi industry." Manuscript. Princeton University.

Topic 12: <u>Dynamic games with firms' non-equilibrium beliefs and learning</u>

<u>Main references</u>
- Aguirregabiria, V., & Magesan, A. (2020): "Identification and estimation of dynamic games when players' beliefs are not in equilibrium," *The Review of Economic Studies* 87 (2): 582–625.

- Ellison, S., C. Snyder, and H. Zhang (2018): "Costs of managerial attention and activity as a source of sticky prices: Structural estimates from an online market," Technical report. National Bureau of Economic Research.
- Jeon, Jihye (2020): "Learning and investment under demand uncertainty in container shipping," *The RAND Journal of Economics*, Forthcoming.

<u>Additional references</u>
- Aguirregabiria, V. (2020): "Identification of Firms' Beliefs in Structural Models of Competition," manuscript.
- Doraszelski, U., Lewis, G., & Pakes, A. (2018): "Just starting out: Learning and equilibrium in a new market," *American Economic Review*, 108, 565-615.
- Hortacsu, A., Luco, F., Puller, S. & Zhu, D. (2019): "Does strategic ability affect efficiency? Evidence from electricity markets," *American Economic Review*, 109(12), 4302-42.

Topic 13: <u>Dynamic games of natural resources extraction</u>

<u>Main references</u>

- Huang, L., and M. Smith (2014): "The dynamic efficiency costs of common-pool resource exploitation," *American Economic Review*, 104 (12), 4071–4103.

<u>Additional references</u>
- Aguirregabiria, V., and A. Luengo (2016): "A Microeconometric Dynamic Structural Model of Copper Mining Decisions," manuscript. University of Toronto.

F. CLASS SCHEDULE

<u>WEEK- DATE</u>	<u>TOPIC</u>
Week 1: Jan. 13	Topic 1: Dynamic games of oligopoly competition: Models and Solution methods
Week 2: Jan. 20	Topic 2: Identification of structural dynamic games
Week 3: Jan. 27	Topic 3: Structural estimation dynamic games
Week 4: Feb. 3	Topic 4: Market entry and exit
Week 5: Feb. 10	Topic 5: Dynamic spatial competition in retail markets
Week 6: Feb. 17	Topic 6: Uncertainty and firms' investment decisions
Week 7: Feb. 24	Topic 7: Dynamic games of innovation / **Tue Feb 22nd: Problem set is handed-out**
Week 8: Mar. 3	Topic 8: Dynamic price competition
Week 9: Mar. 10	Topic 9: Airline networks
Week 10: Mar. 17	Topic 10: Mergers and dynamics / **Thursday, March 17th, Problem set is due**
Week 11: Mar. 24	Topic 11: Dynamic matching
Week 12: Mar. 31	Topic 12: Dynamic games with firms' non-equilibrium beliefs and learning
Week 13: Apr. 7	Topic 13: Dynamic games of natural resources extraction **Final Exam is handed out on Thu, April 7th**
	Your completed exam is **due on Tuesday, April 12th**