

BRANDON JOEL TAN

Email:

btan@g.harvard.edu

btan1@worldbank.org

Phone: +1 (609) 933-2285

Website: <https://scholar.harvard.edu/brandonjoeltan>

Office Address:

Littauer Center G27
1805 Cambridge Street
Cambridge, MA 02138

EDUCATION

- 2018 – present Ph.D. in Economics, Harvard University
- *Advisors: Pol Antras, Edward Glaeser, Nathaniel Hendren, Gabriel Kreindler, Michael Kremer, Marc Melitz*
- 2018 – 2020 M.A. in Economics, Harvard University
- 2015 – 2018 B.A. in Economics, Summa cum Laude, Princeton University
- *Certificates/Minors in Applied Math, Statistics & Machine Learning*
- *Halbert White '72 Prize in Economics (top student in the economics department)*
- *Graduated advanced standing in 3 years*

PROFESSIONAL EXPERIENCE

- 2021 Dissertation Fellow, *Federal Reserve Board*
- 2017 – 2020 Consultant, *World Bank Group*
- 2020 – 2021 Consultant, *UNU-WIDER: United Nations*
- 2019 – 2020 Researcher, *International Growth Center – Rwanda*
- 2019 – 2020 Research Consultant, *MFN Partners (Hedge Fund)*
- 2020 Summer FIP, *International Monetary Fund*
- 2019 Economics Consultant, *Monetary Authority of Singapore*
- 2018 – 2019 Quantitative Strategy Team (GovTech), *Prime Minister's Office (Singapore)*
- 2018 Summer Business Analyst, *New York Office, McKinsey & Company*
- 2017 – 2018 Consultant, *Chief Economist Office, International Finance Corporation*
- 2015 International Fellow, *Hope International (Microfinance NGO)*
- 2013 – 2014 Lieutenant, *MTO 1st Commando Battalion, Singapore Armed Forces*
- 2012, 2014 – 2015 Intern, *Ministry of Trade and Industry (Singapore)*

AFFILIATIONS

- 2020 – current Principal Investigator, *Accelerating Health Technologies with Incentive Design*
- 2020 – current Affiliate, *Development Innovation Lab, University of Chicago*
- 2020 – current Affiliate, *Institute for Quantitative Social Science*
- 2019 – current Affiliate, *Opportunity Insights, Harvard University*
- 2019 – current Affiliate, *Development Data Lab*
- 2019 Visiting Researcher, *IDinsight (India)*
- 2019 Visiting Economist, *Centre for Policy Research*
- 2016 – 2018 Associate, *Julis-Rabinowitz Center for Public Policy and Finance*

TEACHING

- API 109-110: Advanced Microeconomic Analysis, Harvard Kennedy School (Masters of Public Administration). *Teaching Fellow.*
- Econ 1010B: Intermediate Macroeconomics, Harvard University (Undergraduate). *Teaching Fellow.*

NON-PROFIT ENGAGEMENT

- 2020 – current *Harvard University Philanthropy Advisory Fellowship*
- 2019 – current Consultant, *Hope International (Microfinance NGO)*
- 2020 Collaborator, *Initiative: Eau (Clean Water NGO)*

2016 – 2017 Consultant, *Adelante (Microfinance NGO)*
2015 – 2017 Project Manager, *Princeton Business Volunteers*

PROFESSIONAL ACTIVITIES

Referee, *Quarterly Journal of Economics*
Referee, *Journal of Development Economics*
Referee, *Education Finance and Policy*

SEMINARS AND CONFERENCES

European Meeting of the Urban Economics Association (2021), AEA/ASSA Annual Meeting (2021), International Monetary Fund (2020), NBER Summer Institute (2020; Development Economics), Pacific Conference for Development Economics (2020), Health and Pandemics Econ Working Group (2020), University of Chicago (2020, 2021), North East Universities Development Consortium Conference (2019), IDInsight (2019), Centre for Policy Research (2019), Centre de Sciences Humaines (2019), Cities & Development Workshop (2019), Harvard University (2018, 2019, 2020, 2021), Princeton University (2018)

FELLOWSHIPS, HONORS AND AWARDS

2020 Fellowship, *Lab for Economic Applications and Policy*
2020 Research Award, *Institute for Quantitative Social Science*
2019, 2020 Grant, *Weiss Fund for Research in Development Economics*
2019, 2020 Research Grant, *Foundations of Human Behavior Initiative*
2019 Graduate Student Award, *Mind Brain Behavior Interfaculty Initiative*
2019 Economics Department Research Award, *Harvard University*
2018 Halbert White '72 Prize in Economics (Ranked 1st in Dept.), *Princeton University*
2018 Phi Beta Kappa, *Princeton University*
2018 Presidential Fellow, *Massachusetts Institute of Technology* (awarded)
2018 1st Place, *Philadelphia Regional Federal Reserve Challenge*
2017 Shapiro Prize for Academic Excellence, *Princeton University*
2016 Mary George Freshman Research Conference, *Princeton University*
2014 Division Commander Coin, *Singapore Armed Forces*
2012 Public Service Commission Scholarship, *Singapore Civil Service* (awarded)

RESEARCH

Urban Transit Infrastructure and Inequality: The Role of Access to Non-Tradable Goods and Services. Presented at NBER Summer Institute: *Urban Economics and European Meeting of the Urban Economics Association.*

With 68% of the world population projected to live in urban areas by 2050, mass transit networks are expanding faster than ever before. But how are the economic gains from such expansions being shared between low- and high-income workers? Existing research focuses on the role of commuting to work, however much of urban travel is related to the consumption of non-tradable goods and services (retail, F&B, personal services etc.). Since low-income workers are overwhelmingly employed in these non-tradable sectors, changes in consumption travel patterns in response to a transit expansion leads to a spatial re-organization of low-income jobs in the city which has important implications for inequality. This paper develops an urban spatial model with heterogeneous worker groups and incorporating travel to consume non-tradable goods and services. We estimate our model using detailed farecard and administrative data from Singapore to quantify the impact of the Downtown Line (DTL). We find large welfare gains for high-income workers, but near zero gains for low-income workers. All workers benefit from improved access to consumption opportunities, but low-income non-tradable sector jobs move to less attractive workplaces. Abstracting away from consumption travel results in a five-fold underestimation of the inequality effects and failure to capture the spatial re-organization of low-income jobs in the city.

Within Firm Supply Chains: Evidence from India (with Shresth Garg). *Revise and Resubmit. Journal of International Economics.*

Vertical integration is central to understanding patterns of economic activity, but there has been limited empirical work measuring the extent to which firms own and utilize direct upstream and downstream production links for sourcing physical inputs. We use administrative data from Karnataka, India on the movement of goods, both within and outside the firm, and find that 13% of input value can be sourced from vertically integrated upstream establishments. Of this potential 13%, somewhere between 30 - 40% of trade actually materializes. This suggests that the supply of physical goods along the production chain is an important rationale for vertical integration. Notably, within the set of vertically integrated firms, firms which source at least one product from within account for over three-quarters of economic activity. We look at factors associated with the decision to source a given product from within, and find that firm size, distance to outside and within firm suppliers, frequency of input requirement, product relationship specificity, volume, R&D requirements and competition both upstream and downstream are important factors. Finally, we look at factors associated with the ownership of a vertically integrated establishment and find that firm size, product specificity, R&D requirements and competition matter.

Grades as Noisy Signals. *Revise and Resubmit. Journal of Labor Economics.*

Letter grades are noisy and coarse measures of academic achievement. However, these grades serve as important signals to both employers and to the student on his or her ability. I study the consequences of these noisy measures using administrative data from the National University of Singapore which records both the letter grades as well as the precise marks (0-100) received for each course that a given student takes. I exploit a regression discontinuity design -- specifically, close to the letter grade cutoffs, individuals with very similar achievement will receive different letter grades. I find that receiving a better grade for students on the margin results in 45 dollars greater monthly earnings post-graduation. Looking at each letter grade cut off, I find that the effect is largest at the A- cutoff, followed by the A and B+ cutoffs. There is a null effect for elective courses, which indicates that only signals for major-relevant courses are important. The effect is driven by courses taken in years 1 and 2 (years 3 and 4 are graduation years), and the effects are significantly larger for men than women. There are two possible mechanisms: 1) Employers use grades as a signal of ability and as a result pay similar students different salaries based on this coarse measure. 2) Students interpret better or worse grades as a signal of their own ability which effects their future behavior and outcomes. Testing the second mechanism, I find that receiving a worse grade for students on the margin results in only slightly lower grades in future semesters, but these students take significantly "easier courses". This indicates that students under invest in human capital accumulation as a result of receiving a noisy negative signal of ability.

Government Intervention and Bank Market Power: Lessons from the Global Financial Crisis for the COVID-19 Crisis (with Deniz Igan, Maria Soledad Martinez Peria, Nicola Pierri, and Andrea F. Presbitero). *IMF Working Paper. Revise and Resubmit. Journal of Banking and Finance.*

The COVID-19 pandemic could result in large government interventions in the banking industry. To shed light on the possible consequences on market power, we rely on the experience of the global financial crisis and exploit granular data on government interventions in more than 800 banks across 27 countries between 2007 and 2017. For identification, we use a multivariate matching method. We find that intervened banks experience a significant decline in market power with respect to matched non-intervened banks. This effect is more pronounced for larger and longer interventions and is driven by a rise in costs—mostly because of higher loan impairment charges—which is not followed by a similar increase in prices.

Accelerating Broad Availability of a COVID-19 Vaccine (with Ahuja et al.). 2021. *American Economic Review: Papers and Proceedings.*

Vaccinating the world's population quickly in a pandemic has enormous health and economic benefits. We analyze the problem faced by governments in determining the scale and structure of procurement for vaccines. We analyze alternative approaches to procurement, arguing that buyers should directly fund manufacturing capacity and shoulder most of the risk of failure, while maintaining some direct incentives for speed. We analyzed the optimal portfolio of vaccine investments for countries with different characteristics as well as the implications for international cooperation. Our analysis, considered in light of the experience of 2020, suggests lessons for future pandemics.

Market Design to Accelerate COVID-19 Vaccine Availability (with Athey et al.). 2021. *Science.*

We analyze the economic case for accelerating the arrival and distribution of COVID-19 vaccines. With health and economic losses projected in the trillions, we estimate that the capacity put in place for approved vaccines has a global value in the thousands of dollars per annual course, orders of magnitude higher than prices in reported deals. Even though available capacity is substantial and capacity expansion takes time, a strong case can still be made for further expansion. Political constraints on prices create a gap between firms' and society's incentives for speed and scale. We suggest policies to bridge that gap including contracting on capacity rather than doses, fully utilizing capacity even for lower-efficacy vaccines, and designing a vaccine exchange mechanism to ensure that doses are efficiently reallocated between countries.

The Effectiveness of Classroom Incentives: Experimental Evidence from Kenya (with Ronak Jain).
Presented at American Economic Association Meetings 2021.

Many students in developing countries still lag behind their grade in learning. Improving human capital among the poor in the developing world is key to lifting this population out of poverty. Individual-level financial incentives to students for a range of outcomes such as reading books, getting better test scores, or grades have shown to yield little to no effects on student achievement at the mean (Angrist and Lavy 2009, Fryer 2011). We conduct a randomized control trial across 225 schools across Kenya with over 30,000 pupils in our study sample to study the effectiveness of group-level non-monetary incentives in Kenya for entire classes of students both in addition to and in place of individual level incentives in order to see whether student effort and positive peer interactions can be better incentivized. We find that group-level incentives raise test scores by over 0.1 standard deviations, while individual level incentives are ineffective.

Residential Segregation in Urban India (with Sam Asher and Paul Novosad). *Presented at NBER Summer Institute 2020, Pacific Conference for Development Economics 2020, North East Universities Development Consortium 2019.*

Using new administrative data from 3000 cities and over 100,000 urban neighborhoods, we study residential segregation in urban India. We focus on two historically marginalized groups: Scheduled Castes and Scheduled Tribes (SC/STs) and Muslims. On average, both groups are concentrated in poorer cities, but Muslims much more so. Cities with more Muslims are characterized by worse access to schools, doctors and public hospitals, while cities with more SC/STs have better access. Within cities, lower consumption and access to public goods characterize both SC/ST and Muslim neighborhoods. The distribution of segregation in India is similar to that in U.S. cities. Cities segregated along religious lines are also segregated along caste lines. Cities with fewer minorities are more segregated, the opposite pattern of the United States. Caste segregation is associated with worse economic outcomes for both SC/STs and non-SC/STs, but the latter to a lesser extent. SC/STs have worse access to public goods in more segregated cities. Younger cities are less segregated than older cities by caste but not religion, suggesting that caste is becoming less salient in cities.

Water Quality and Child Survival: A Meta-Analysis (with Michael Kremer, Stephen Luby, and Ricardo Maertens). *Presented at Virtual Advances with Field Experiments (VAFE) seminar series and BREAD Conference. Submitted.*

Although diarrheal-disease remains a major cause of child mortality in the developing world, water treatment is not included on lists of approved child survival interventions for funding by international agencies. Randomized controlled trials (RCTs) on water treatment are typically powered only to detect effects on intermediate outcomes, such as caregiver-reported diarrhea, since prohibitively large sample sizes would be needed to assess impacts on mortality. First, we find that individual studies with published mortality outcomes suggest much larger reductions in child mortality than predicted by a "simple linear model" based on the multiplication of the estimated diarrheal death rate times the percentage reduction in diarrhea associated with water treatment. Concerned about publication bias, we systematically identify all studies on water interventions to collect data on mortality outcomes (even when not reported in the original manuscript). We conduct a meta-analysis of the effect of interventions to improve water quality on all-cause child mortality with thirteen studies. We find that interventions to improve water quality reduce all-cause child mortality risk by 32% (random-effects RR 0.760: CI 95% 0.596, 0.925; Peto OR 0.740: CI 95% 0.611, 0.896; Bayes OR 0.680; CI 95% 0.468, 0.906). The result is robust to eliminating any one of the thirteen studies from the analysis, and restricting to studies that either pre-specify mortality as an outcome or do not present any estimates on the impact on mortality in the original publication. We also do not find evidence of publication bias. This reduction is ten times larger than the effect predicted by a "simple linear model". The estimated cost per DALY averted from point-of-collection water chlorination in Western Kenya is USD 90 which is 5 percent the cost threshold that the WHO uses to determine whether interventions are highly cost-effective. Our results suggest that meta-analyses may be useful ways of assessing impacts which are difficult to pick up in individual studies because they are rare outcomes.

The Minimum Wage and Firm Networks: Evidence from South Africa. *United Nations WIDER Working Paper.*

There is a large literature on the minimum wage focused on directly exposed firms and geographies. This paper provides new evidence that the minimum wage has significant spillover effects on firms exposed to the minimum wage indirectly via firm supply chains. Using administrative firm-level data from South Africa, I study the impact of the 50% agricultural minimum wage hike in 2013 on the outcomes of firms upstream and downstream from the agriculture sector with an event study design. The minimum wage increased labor costs and revenue (prices) in the agriculture sector, with insignificant disemployment effects. I find that industries with greater upstream exposure to the agriculture sector experienced greater decreases in assets, sales and employment for its medium to large firms following the minimum wage increase, driven by the exit of unprofitable firms. I find that industries with greater downstream exposure to the agriculture sector experienced greater decreases in sales, employment and profits for its small firms, and null effects on exit. These results suggest that the minimum wage has negative second order effects through firm supply

chain networks which must be considered by policymakers. In future work, I will develop a structural model capturing these network dynamics and spillover effects.

Could Vaccine Dose Stretching Reduce COVID-19 Deaths? (with Ahuja et al.). *NBER Entrepreneurship Innovation Policy and the Economy*.

We argue that alternative COVID-19 vaccine dosing regimens could potentially dramatically accelerate global COVID-19 vaccination and reduce mortality, and that the costs of testing these regimens are dwarfed by their potential benefits. We first use the high correlation between neutralizing antibody response and efficacy against disease (Khoury et. al. 2021) to show that half or even quarter doses of some vaccines generate immune responses associated with high vaccine efficacy. We then use an SEIR model to estimate that under these efficacy levels, doubling or quadrupling the rate of vaccination by using fractional doses would dramatically reduce infections and mortality. Since the correlation between immune response and efficacy may not be fully predictive of efficacy with fractional doses, we then use the SEIR model to show that fractional dosing would substantially reduce infections and mortality over a wide range of plausible efficacy levels. Further immunogenicity studies for a range of vaccine and dose combinations could deliver outcomes in weeks and could be conducted with a few hundred healthy volunteers. National regulatory authorities could also decide to test efficacy of fractional dosing in the context of vaccination campaigns based on existing immune response data, as some did for delayed second doses. If efficacy turned out to be high, the approach could be implemented broadly, while if it turned out to be low, downside risk could be limited by administering full doses to those who had received fractional doses. The SEIR model also suggests that delaying second vaccine doses will likely have substantial mortality benefits for multiple, but not all, vaccine-variant combinations, underscoring the importance of ongoing surveillance. Finally, we find that for countries choosing between approved but lower efficacy vaccines available immediately and waiting for mRNA vaccines, using immediately available vaccines typically reduces mortality.

Can Drinking Water Treatment Reduce Child Mortality?: Evidence from Kenya (with Johannes Haushofer, Michael Kremer, and Ricardo Maertens). *Draft available upon request*.

Diarrheal-disease remains a major cause of child mortality in the developing world (World Health Organization 2017a). This study examines the impact of a water treatment technology designed using behavioral insights on child mortality. Combining free, convenient, salient, and public access through point-of-collection chlorine dispenser systems has been shown to be highly effective in raising take-up of water treatment (Kremer et. al 2011). Existing evidence suggests that water chlorination can significantly reduce caregiver reported diarrhea among children under 5 (Clasen et al. 2015). However, there remain questions of scalability and sustained effects on objective outcomes of interest such as mortality. Evidence Action operates 18,253 chlorine dispensers serving 2 million people across Kenya, adhering to random variation in provision induced by the Kenya WASH Benefits study in the counties of Kakamega and Bungoma (Null et al. 2018). We use supplementary survey data recently collected from the study areas by Haushofer et al. (2018) to examine mortality effects over a 4-year period. 4 years after the installation of point-of-collection dispenser systems, we find that the community-wide provision of dilute chlorine solution reduced all-cause under-5 mortality by 1.41 pp and all-cause under-2 mortality by 1.36 pp relative to control, corresponding to decreases of 63% and 67%, respectively. These estimates are considerably larger than expected based on a meta-analysis on the impact of water treatment on child survival (Kremer et. al 2020), suggesting that dispenser systems may be particularly effective. Additionally, we find that point-of-collection chlorine dispenser systems are highly cost-effective to operate at scale, with an estimated cost per DALY averted of USD 63 -- 3.5 percent the cost threshold suggested by the World Health Organization.

Returns to University Courses. *Preliminary Draft*.

Education is one of the most important determinants of wages at the individual level. However, there is much debate about the mechanisms by which education leads to higher wages. In this paper, I study the returns to taking particular courses and developing specific human capital at the university level. National University of Singapore (NUS) provides a unique setting in which students bid to take courses each semester. I exploit a regression discontinuity design (RDD) to quantify the impact of taking specific courses. Specifically, close to the thresholds that determine a winning bid, individuals with very similar bids may be enrolled or turned away from taking the course. I find that learning a second language increases monthly gross income by about 300 USD. Taking statistics elective courses increases monthly gross income by about 650 USD. I also find evidence for positive income returns to Computer Science related electives, and Finance. I don't find significant returns for elective courses offered by general science or humanities departments. In future work, I will look at occupational choice outcomes, and am planning to implement an RCT where we nudge a treatment group of students to take particular STEM courses via an information intervention.

Do Cities Increase Productivity but Reduce Opportunity? (with Edward Glaeser). *In Progress*.

A long literature now documents that cities appear to enhance productivity for firms and wages for employees, but the Chetty et al. (2018) economic opportunity data suggests that children who grew up in cities have worse adult outcomes. Poorer children earn less as adults if they grow up (1) in denser metropolitan areas, (2) in denser tracts within metropolitan areas, (3) closer to the city center and (4) just inside, as opposed to just outside, a central city school district. We evaluate five explanations for these facts: (1) cities

increase the variance of children's outcomes which makes mobility appear lower because of the Chetty et al. (2018) linear extrapolation procedure, (2) urban parents have less human capital for any given income, which again makes mobility appear lower, (3) cities lower mobility by abetting segregation by income and class, (4) cities enable activities for teenagers and parents, like crime, that distract from human capital accumulation, and (5) cities have environmental hazards, like lead, that reduce adult outcomes. We conclude that cross-metropolitan area facts about density are fragile and may be illusory, but that the within-metropolitan areas facts are robust. For African-Americans, segregation and crime can explain much of the urban opportunity deficit, but there are fewer convincing explanations for lower white mobility. The physical environment itself remains a plausible cause of lower economic mobility in cities, as in Sampson et al. (2019).

An Economic View of Corporate Social Impact (with Hunt Allcott and Giovanni Montanari). Presented at NBER Summer Institute: Corporate Finance.

There is growing interest in measuring firms' social impact in addition to their profits. We lay out an economically grounded definition of corporate social impact and quantify the impact of firms in four familiar industries: autos, airlines, consumer packaged goods, and oil. We conceptualize corporate social impact as the change in social welfare caused by a firm's exit in short-run equilibrium, accounting for consumer surplus, worker surplus, profits, competitors' profits, and externalities, and applying higher welfare weights to lower-income people. We estimate the contribution of each major firm to social surplus using transparent and sometimes novel strategies to identify consumer demand. In our framework, social impact is highly correlated with firm size, firms that sell undifferentiated products have less social impact because consumers can easily substitute, and some firms that sell harmful goods are penalized only slightly because the data show that consumers easily substitute to competitors. This methodology provides a proof of concept for measuring corporate social impact in consistent dollar units using a theoretically grounded welfarist framework.

Drinking Water Chlorination and Child Survival in Rural Kenya (with Michael Kremer, Ricardo Maertens, Amy Pickering and Julie Powers). Data Collection in Progress.

We examine the effect of community-wide provision of chlorine solution on child survival in rural Kenya, where a long-term village-wide chlorination randomized evaluation was implemented. The WASH Benefits Kenya trial was a randomized controlled trial of water treatment, sanitation, handwashing, and nutrition interventions in western Kenya. In communities that were randomized to water treatment, chlorine solution dispensers were installed and refilled as needed. After the WASH Benefits Kenya trial ended, the NGO Evidence Action continued to refill most of the dispensers in the treatment villages. We will estimate the intent-to-treat effect of the community-wide provision of chlorine solution on child survival by 1) comparing post-intervention mortality rates between water treatment and control areas; and 2) comparing changes in mortality rates (before and after the intervention) across treatment and control areas (a difference-in-difference analysis). In addition, for the subsample of children who were enrolled in the original WASH Benefits Kenya study, we will examine effects on motor development, emergent language and literacy, emergent math/numeracy, and socio-emotional development.

Economic Fitness and Freedom: How Equity Markets Reflect the Realization of Economic Growth Potential (with Ted Chu and Marshall Stocker). International Journal of Finance and Economics. 2020.

The relative complexity of a country's economy explains relative per capita wealth. Measures of complexity have also been used to improve the estimation accuracy of gross domestic product (GDP) growth forecasts. Why complexity matters is settled in the theory of gains from trade. Not settled are the determinants of complexity and how complexity can be unleashed to facilitate economic growth. We explore how economic institutions, as measured by an index of economic freedom, and economic complexity interact and impact a country's equity market return. We find complex economies where realized per capita GDP is lower than comparably complex economies experience an acceleration in GDP growth when economic freedom is increased. Simultaneous to the gains in economic institutions and complexity, equity markets outperform, suggesting the wealth of a nation rests on the institutions that facilitate complexity.

SELECT POLICY WORK

A Global Deal for our Pandemic Age (with G20; listed under individuals consulted). 2021. Report of the G20 High Level Independent Panel.

Purchasing COVID-19 Vaccines at Risk: Costs and Benefits for Latin America and the Caribbean (with Accelerating Health Technologies). 2020. Inter-American Development Bank Technical Note.

NON-PROFESSIONAL

2019 – present Vice-President, *Harvard GSAS Christian Fellowship*
2018 – present Drummer, *Hilltop Church*

2015 – 2018 Drummer, *Princeton University Rock Ensemble*
2015 – 2018 Worship Team Leader, *Princeton Faith and Action*
2014 Footballer, *SAFSA Football Club*
2010 Actor, *Disney Channel*
2009 – 2015 Drummer, *Covenant Evangelical Free Church*