WILL PEICHUN WANG
https://bepp.wharton.upenn.edu/profile/21809/
peiw@wharton.upenn.edu
(267) 909-0988

WHARTON SCHOOL, UNIVERSITY OF PENNSYLVANIA

Placement Director: Professor Fernando Ferreira	fferreir@wharton.upenn.edu	(215) 898-7181
Graduate Student Coordinator: Ms. Diana Broach	dhs@wharton.upenn.edu	(215) 898-7761

Office Address
Business Economics and Public Policy Department
3620 Locust Walk
3000 Steinberg Hall-Dietrich Hall
Philadelphia, PA 19104

Home Address
3411 Chestnut Street
Apt 510
Philadelphia, PA 19104
(267) 909-0988

Undergraduate Studies:

BS, Economics (with High Distinction) and Mathematics, Duke University, 2012
Magna Cum Laude

Graduate Studies:

Ph. D. in Applied Economics, The Wharton School, University of Pennsylvania, 2012 to present
Thesis Title: "Essays in Industrial Organization and Applied Microeconomics"
Expected Completion Date: May 2017

Thesis Committee and References:

Professor Ulrich Doraszelski (Co-Chair)
The Wharton School, University of Pennsylvania
1405 Steinberg Hall-Dietrich Hall
3620 Locust Walk, Philadelphia PA 19104
doraszelski@wharton.upenn.edu
(215) 898-7148

Professor Katja Seim (Co-Chair)
The Wharton School, University of Pennsylvania
1457 Steinberg Hall-Dietrich Hall
3620 Locust Walk, Philadelphia PA 19104
kseim@wharton.upenn.edu
(215) 898-8213

Professor Michael Sinkinson
The Wharton School, University of Pennsylvania
1453 Steinberg Hall-Dietrich Hall
3620 Locust Walk, Philadelphia PA 19104
msink@wharton.upenn.edu
(215) 898-0926

Professor Kent Smetters (Teaching)
The Wharton School, University of Pennsylvania
1358 Steinberg Hall-Dietrich Hall
3620 Locust Walk, Philadelphia PA 19104
smetters@wharton.upenn.edu
(215) 898-9811

Research and Teaching Fields:

Primary fields: Industrial Organization, Applied Microeconomics

Secondary fields: Quantitative Marketing, Competitive Strategy, Chinese Economy

Teaching Experience:

Summer 2016 Managerial Economics (EMBA), *T.A.* for Professor Kent Smetters

Summer 2015	Managerial Economics (EMBA), *T.A.* for Professor Kent Smetters
Fall 2014	Managerial Economics (MBA), *T.A.* for Professor Michael Sinkinson
Spring 2012	Financial Markets and Investments (UG), *T.A.* for Professor Jia Li
Fall 2011	Scientific Computing (G), *T.A.* for Professor Mauro Maggioni
Spring 2011	Partial Differential Equations (UG), *T.A.* for Professor J. Thomas Beale
Fall 2009 - Fall 2011	Single Variable Calculus (UG), *Lab Instructor*
Spring 2010	Multivariable Calculus (UG), *Tutor*

Research Experience and Other Employment:

2014 - present	*Fellow*, Leonard Davis Institute of Health Economics
2015 - 2016	*Research Assistant* to Professor Ann Harrison
2013 - 2015	*Research Assistant* to Professor Ulrich Doraszelski
2011 - 2012	*Research Assistant* to Professors Andrew Sweeting and James W. Roberts
2011 - 2012	*Research Assistant* to Professor Marjorie B. McElroy
2010	*Intern*, China Development Bank

Research Papers:

"Innovation Is the New Competition: Product Portfolio Choices with Product Life Cycles"
(Job Market Paper)

"Ownership Concentration and Strategic Supply Reduction,"
with Ulrich Doraszelski, Katja Seim, and Michael Sinkinson (Wharton, UPenn)

"Do Concealed Gun Permits Deter Crime? New Results from a Dynamic Model,"
with Marjorie B. McElroy (Duke)

Research in Progress:

"Can a Tiger Change Its Stripes? Reform of Chinese State-Owned Enterprises,"
with Ann Harrison, Marshall Meyer, Linda Zhao and Minyuan Zhao (Wharton, UPenn)

"A Typology of R&D Processes Based on Market Excludability and Information Appropriability,"
with Andy Wu (Harvard Business School) and Xingtan Zhang (Wharton, UPenn)

"Hospital Differentiation and Network Exclusivity"

Honors, Scholarships, and Fellowships:

2013, 2014, 2015, 2016	Mack Institute for Innovation Management Research Grant
2015	Penn Center for the Study of Contemporary China Research Grant
2015	Wharton Doctoral Travel Grant
2013, 2014	Penn GAPSA Research Travel Grant
2013	Amy Morse Prize
2013	Population Association of America Poster Session Winner
2010 - 2012	Wharton Doctoral Fellowship, Best Thesis in Economics, Harold G. Lundberg Scholarship (2), Faculty Scholar Award Nominee, Allen Starling Johnson, Jr. RA Award, Student Marshal, Davies Fellowship, Order of Omega, Phi Beta Kappa (junior year), Sargent H. Wellman

Scholarship, PRUV Fellowship, Online Discourse Project Fellowship

Conference and Seminar Presentations:

2016	SEA Meetings (scheduled), MIDAs Workshop, Wharton BEPP Seminar, Wharton AEW, PWCC Workshop on Chinese Firm-Level Data, Wharton IO Workshop
2015	London Business School TADC, CES North America Conference, Wharton IO Workshop, Wharton BEPP Seminar
2014	SEA Meetings, Wharton BEPP Seminar (2)
2013	PAA Meetings
2010 - 2012	ACC Meeting of the Minds Conference, Online Civic Discourse Conference, Regional Mathematics and Statistics Conference, PRUV Mathematics Talks

Workshops:

2015	Price Theory Summer Camp (Becker Friedman Institute, Chicago)
2014	CIBER International Business Strategy Workshop (Fuqua, Duke)
2014	Zurich Institute on Computational Economics (University of Zurich)

Institutional Services:

Summer 2015	*Mentor* for Lynn Hua, Summer Undergraduate Minority Research (SUMR) program, Leonard Davis Institute of Health Economics
2013 - 2015	*Board Member*, Penn International Student Advisory Board
2012 - 2013	*Graduate Representative*, Committee on Academic and Related Affairs of the Penn University Council
2012 - 2013	*Graduate Mentor*, Penn Mentoring Program
2010 - 2012	*Co-President*, Delta Sigma Pi Business Fraternity
2009 - 2012	*Social Chair*, Chi Psi Fraternity

Miscellaneous:

Personal Information:	Citizenship: China. DOB: February 21, 1990.
Languages:	English (fluent), Mandarin Chinese (native).
Interests:	Basketball, Golf, Reading, Running.

Research Abstracts:

"Innovation Is the New Competition: Product Portfolio Choices with Product Life Cycles"
(Job Market Paper)

Abstract: The so-called product life cycle, or time path of sales of many high-tech products is bell-shaped. I study the effect of competition on firms' product portfolio choices and product entry and exit decisions in the context of the Chinese smartphone market. I first show that product life cycles endogenously arise in markets with rapid technological innovations, are heterogeneous across products, and are affected by the level of market competition. I then develop a structural model of equilibrium product portfolio choices using product life cycles as an empirically tractable way to capture firms' dynamic incentives in product introductions. I estimate smartphone demand and manufacturers' variable, maintenance, and sunk introduction costs on a detailed monthly market-level dataset of

Chinese smartphones over 2009-2014. Decomposition of handset manufacturers' incentives to introduce new products after a large-scale pro-competitive policy in 2012 shows that the increased competition reduces the average product's short-run profitability by 5% but its lifetime profits by 41% by shortening its product life cycle.

Link: https://sites.google.com/site/willpeichunwang/JMP.pdf

"Ownership Concentration and Strategic Supply Reduction"
with Ulrich Doraszelski, Katja Seim, and Michael Sinkinson (Wharton, UPenn)

Abstract: We explore ownership concentration as a means to seek rents in the context of the U.S. government's planned acquisition of broadcast TV licenses in the ongoing incentive auction. We document the significant purchases of licenses by private equity firms in the run-up to this auction and perform a prospective analysis of the effect of firms controlling multiple licenses on the outcome of the auction. Our results show that multi-license holders are able to earn large rents from a supply reduction strategy where they strategically withhold some of their licenses from the auction to drive up the closing price for the remaining licenses they own. Relative to the case where each license is bid into the auction independently, total spectrum acquisition costs increase by 22%, although the increases are concentrated in a small set of markets. Strategic behavior by multi-license holders reduces economic efficiency as the set of licenses surrendered into the auction is not the socially optimal set. A case study illustrates the mechanism in a specific local media market. We propose a partial remedy that mitigates the effect of ownership concentration and reduces the distortion in payouts to broadcast TV license holders by up to 80%. We further show that the impact of lower participation of license holders could greatly increase the base level of payouts and exacerbate strategic effects.

Link: http://assets.wharton.upenn.edu/~msink/supplyreduction.pdf

"Do Concealed Gun Permits Deter Crime? New Results from a Dynamic Model"
with Marjorie B. McElroy (Duke)

Abstract: Setting off an ongoing controversy, Lott and Mustard (1997) famously contended that so-called shall-issue laws (SILs) deterred violent crime. In this controversy the weapon of choice has been the differences-in-differences (DD) estimator applied to state and county panel data spanning various intervals of time. By treating violent crime as a career choice, this paper brings to bear a more general method, a cohort panel data model (CPDM) that incorporates the fundamental dynamic insights regarding entering and exiting a career. Our model distinguishes among three key parameters that jointly determine the effect of SILs on violent crime, (i) a direct effect on entry decisions, (ii) a surprise effect on exit decisions by individuals who entered criminal careers prior to the passage of SILs, and (iii) a selection effect on exit decisions by those who entered in the presence of SILs. We find significant and time-invariant results that reject the deterrence hypothesis as well as the DD model specification. Our results suggest that passages of SILs contribute to about one third of total violent crimes in 2011, particularly through higher turnovers of violent criminals.

Link: https://sites.google.com/site/willpeichunwang/CPDM.pdf

"Can a Tiger Change Its Stripes? Reform of Chinese State-Owned Enterprises"
with Ann Harrison, Marshall W. Meyer, Linda Zhao and Minyuan Zhao (Wharton, UPenn)

Abstract: The majority of state-owned enterprises (SOEs) in China were privatized through ownership reforms over the last two decades. Using a comprehensive dataset of all medium and large enterprises in China between 1998 and 2013, we show that privatized SOEs appear to be unchanged from their state-owned counterparts: compared to private firms that were never state-owned, privatized SOEs are favored

by industrial policies such as low interest loans and government subsidies. These differences are more salient with the Chinese government's trillion-dollar stimulus package introduced after the 2008 global financial crisis. Moreover, both SOEs and privatized SOEs significantly under-perform in profitability compared to private firms, suggesting a misallocation of resources. In this paper, we trace out state control, rather than direct ownership, through firms' ultimate ownership structures to explain the observed policy favoritism and explore its welfare implications.

"A Typology of R&D Processes Based on Market Excludability and Information Appropriability"
with Andy Wu (Harvard Business School) and Xingtan Zhang (Wharton, UPenn)

Abstract: We study the effect of product market competition and inter-competitor information spillovers on firms' innovation efforts. We propose a typology of R&D processes in different industries ranging from films to high-tech based on the excludability of the product market and the appropriability of competitors' information. We then develop a demonstrative model with two firms each engaging in a risky R&D project with correlated but unknown success probabilities. Firms learn about the nature of their projects through both their own research outcomes over time as well as their competitor's; if successful, their products will compete in the market. We characterize two symmetric equilibria in this game: an impatient and a patient equilibrium. The patient equilibrium demonstrates the importance of learning complementarity in R&D processes. We show that while intense product market competition reduces firms' innovation incentives, information spillovers mitigate this negative effect under moderate competition but exacerbate the negative effect under monopoly conditions (e.g. when the first-to-market invention is perfectly appropriated with monopoly status).

"Hospital Differentiation and Network Exclusivity"

Abstract: Hospitals in the US differ significantly in their quality. These differences are also increasing over time due to hospitals quality competition. This paper develops a model of network formation where contracts between hospitals and insurers are determined by Nash bargaining. Model simulations show that hospital differentiation leads to more exclusive networks, high insurance premiums and low enrollment rates, although the magnitudes depend on the relative quality and cost of the hospitals as well as the degree of insurer differentiation. Unlike previous studies of insurer-provider networks, this paper also shows that the ability to renegotiate contracts in the model strengthens the exclusivity of networks. I estimate hospital and insurance demand and insurer-hospital contracting decisions on Massachusetts' State Inpatient Database over 2002-2011. Structural estimates suggest that the exclusive networks observed in the data can be partially attributed to hospital quality differentiation. Further descriptive evidence from New Hampshire's commercial claims data over 2005-2014 also lends support.

Research Statement

Will Peichun Wang
The Wharton School of the University of Pennsylvania
Email: peiw@wharton.upenn.edu
Website: https://bepp.wharton.upenn.edu/profile/21809/

In my research, I use methods in Industrial Organization and Applied Microeconomics to study the organization and regulation of markets, with a focus on technological innovation and the Chinese economy. In particular, I study how different economic settings (broadly defined "markets") give rise to agents' strategic and forward-looking incentives and in turn, how policies should be designed to promote efficiency in these markets. My research aims to combine economic theory with increasingly detailed datasets to both extend empirical methodologies to incorporate agents' more nuanced behaviors as well as carefully examine the specific institutions of the markets for high-stake policy considerations. This statement first explains my research agenda by describing my three working papers (as parts of my dissertation). I then give an overview of my three ongoing projects and conclude with the broader connections of my work to other business research fields and to current policy discussions.

Product portfolio choice is among the most important decisions firms make to thrive in competitive markets today. This is particularly true for high-tech industries where new technologies quickly become available and existing products become obsolete. Moreover, given the fast changing environment in these markets, firms necessarily need to be forward-looking in anticipating the sales performance of their new products in the face of competing products and new technologies.

Firms' product portfolio choices also have important policy implications. In high-tech industries, developing economies typically face market dominance from foreign technology imports. To promote market competition, many developing countries have opted for industrial policies to subsidize domestic firm entry, often at high costs. The high stakes (often spending billions of dollars) of these policies call for careful examinations for whether they are justified by their welfare benefits in promoting competition.

Economists generally believe that higher firm entry brings in more product variety, constrains incumbent firms' market power in setting prices, and thus increases total welfare. However, as established by the recent Industrial Organization literature, firms' endogenous product portfolio choices also counteract the effect of competition. Increased competition also depresses incumbent firms' immediate product profitability and thus their new product introductions. Firms' future outlooks of their products' profitability also play an important role. However, given the large size of product portfolios typical in high-tech markets, fully dynamic models become computationally infeasible.

My job market paper **"Innovation Is the New Competition: Product Portfolio Choices with Product Life Cycles" (working paper, 2016),** studies the effects of competition on firms' product portfolio choices in the context of the Chinese smartphone market. I use the marketing concept of the product life cycle as a heuristic approximation to model forward-looking firms' product portfolio choices. I first show that the time paths of sales of many products, called the product life cycle, are endogenously bell-shaped in high-tech markets, heterogeneous across products, and affected by the level of market competition. I then develop a structural model of the smartphone manufacturers' product portfolio choices and estimate it using a detailed monthly market-level dataset of Chinese smartphones over 2009-2014. In 2012, aimed at promoting competition, the Chinese government implemented a large-scale pro-competitive policy that induced a large inflow of fringe firms. My main findings are: first, the increased competition reduces an average product's immediate profitability, but also its lifetime profitability to a much larger extent through shortening its product life cycle; second, the policy might not have been as successful as it looked in promoting competition – major incumbent firms would have been able to self-regulate through much higher product introductions in the absence of the fringe competition. Product life cycles generated by technological innovations play an important role in this self-regulation: not accounting for firms' future outlooks would largely overstate the welfare benefits of this policy.

In my other working paper **"Ownership Concentration and Strategic Supply Reduction" (working paper, 2016, joint with Ulrich Doraszelski, Katja Seim and Michael Sinkinson),** we show how firms' strategic behaviors can have large policy implications in a different market setting also with billions of dollars at stake. In particular, we explore ownership concentration as a means to seek rents in the context of the U.S. government's planned acquisition of broadcast TV licenses in the ongoing incentive auction. Our results show that multi-license holders are able to earn large rents from a supply reduction strategy where they strategically withhold some of their licenses from the auction to drive up the closing price for the remaining licenses they own. Strategic behavior by multi-license holders not only increases the government's total spectrum acquisition costs, but also reduces economic efficiency as the set of licenses surrendered into the auction is not the socially optimal set. Finally, we propose a partial remedy that mitigates the effect of ownership concentration and reduces the distortion in payouts to broadcast TV license holders.

While my first two papers address firms' forward-looking and strategic behaviors, my third working paper, **"Do Concealed Gun Permits Deter Crime? New Results from a Dynamic Model" (working paper, 2016, joint with Marjorie B. McElroy),** shows that individuals' forward-looking behaviors also have important policy implications that are beyond economic efficiency measures. In particular, we study the effects of the liberalization of concealed carry laws (so-called shall-issue laws, or SILs) in the U.S. on individuals' choices of violent criminal careers. We propose a new method, a cohort panel data model (CPDM) that incorporates the dynamic insights regarding entering and exiting a career, and identify three key effects: (i) a direct effect on entry decisions, (ii) a surprise effect on exit decisions by individuals who entered criminal

careers prior to the passage of SILs, and (iii) a selection effect on exit decisions by those who entered in the presence of SILs. Unlike the standard differences-in-differences (DD) model that has produced opposite results using different lengths of samples in this literature, the CPDM estimates are significant and time-invariant, rejecting both the deterrence hypothesis of SILs as well as the model restrictions that reduce our model to the standard DD model.

In all three projects, I find that accounting for economic agents' more nuanced strategic and dynamic incentives have strong implications for policies regulating a wide range of markets. In my ongoing work, I continue to explore how agents' incentives are shaped by the specific market structures and institutions and the resulting policy implications, with a focus on technological innovation and the Chinese economy.

In one ongoing project **"Can a Tiger Change Its Stripes? Reform of Chinese State-Owned Enterprises" (work in progress, joint with Ann Harrison, Marshall Meyer, Linda Zhao and Minyuan Zhao),** we study the efficacy of the decade-long state-ownership reform in China. We use a comprehensive dataset of all medium and large enterprises in China between 1998 and 2013 to show that privatized state-owned enterprises (SOEs) remain unchanged from their still state-owned counterparts despite last two decades' ownership reforms in China. We find that, compared to private firms that were never state-owned, privatized SOEs are favored by industrial policies such as low interest loans and government subsidies, while still largely underperforming in profitability, suggesting a misallocation of resources by the government. These differences are particularly salient with the Chinese government's trillion-dollar stimulus package introduced after the 2008 global financial crisis. Unlike previous studies, we trace out state control, rather than direct ownership, through firms' ultimate ownership structures to explain the observed policy favoritism and explore its welfare implication.

My other line of research focuses on technological innovation and how it is determined given the way markets are organized and regulated. In another ongoing project **"A Typology of R&D Processes Based on Market Excludability and Information Appropriability" (work in progress, joint with Andy Wu and Xingtan Zhang),** we propose a new typology of R&D processes across industries based on how firms learn from each other in their innovation efforts and how their innovation results are protected by intellectual property rights in product market competition. We show that, with a demonstrative model, while intense product market competition reduces firms' innovation incentives, information spillovers among competitors mitigate this negative effect under moderate competition but exacerbates the negative effect under perfect intellectual property protection. This paper highlights the importance of understanding different market structures when implementing policies aimed at incentivizing innovation efforts across industries.

The unique structure of the U.S. health care market also gives rise to many distinguishable features of the market as well as specific policy considerations. In particular, in my project **"Hospital Differentiation and Network Exclusivity" (work in progress),** I study the effect of

hospital quality differentiation on the exclusivity of the insurer-provider networks in the local health care market. While quality investments are generally optimal, the rise of star hospitals might also lead to more exclusive downstream networks and soften insurer competition, which raise insurance premiums and lower insurance enrollment rates. This result can be shown with simulations of a Nash bargaining model of network formation, and is strengthened by allowing for contract renegotiation in the model. Structural estimates and descriptive evidence also lend support, using ten years of data from both Massachusetts and New Hampshire.

My research belongs to the fields of Industrial Organization and Applied Microeconomics. In particular, I focus on how to efficiently organize and regulate markets, with a focus on technological innovation and the Chinese economy. My research contributes to these two literatures by extending empirical work to incorporate economic agents' strategic (e.g. strategic supply reduction in multi-unit auctions and bilateral contracting in networks) and forward-looking behaviors (e.g. high-tech firms' product portfolio choice, individuals' career choice and dynamic R&D competition) based on specific market settings. To further understand the organization of markets in China, I also start to explore how firms are internally organized and affected by the Chinese political economy.

My research agenda is also connected with other business research fields such as Quantitative Marketing and Competitive Strategy. Many of the firms' strategic and forward-looking incentives I study naturally map into how firms should optimally position themselves in the competitive landscape and leverage marketing tools to promote their competitive advantage. For example, my job market paper explains the formation of the product life cycle in high-tech markets, which sheds light on how firms should account for the variation in their products' future sales during product development.

Finally, policy issues and their welfare implications are at the core of my research agenda. My research examines specific market settings and institutions and make suggestions for several high-stake policies. My research is thus broadly applicable to: industrial policies promoting competition in high-tech markets, designs of governments' large-scale procurement auctions, policies that affect individuals' "career" choices (broadly defined, including crimes, marriages, etc.), state ownership reform, intellectual property rights regulation and health policies on encouraging provider quality improvement.

Business Economics and Public Policy
The Wharton School
University of Pennsylvania
1452 Steinberg Hall-Dietrich Hall
3620 Locust Walk
Philadelphia, PA 19104
215.898.7148 phone
215.898.7635 fax
doraszelski@wharton.upenn.edu
bepp.wharton.upenn.edu
Ulrich Doraszelski, Ph.D.
Joseph J. Aresty Professor
Professor of Business Economics and Public Policy

Wharton
University of Pennsylvania

November 10, 2016

Letter of Recommendation for Will Peichun Wang

Dear Colleague,

It is a pleasure to recommend Will Peichun Wang to you. Will is a good student and will be an asset to all but the best economics departments, business schools, government agencies, and consulting firms. His primary fields are industrial organization and applied micro. Being an alumnus of Ken Judd's Zürich Institute for Computational Economics, he is also well-trained in numerical methods.

Will first came to my attention at the end of his first year in our Ph.D. program when I graded his micro prelim, which was a cut above everybody else's. My former colleague J.F. Houde was similarly impressed by his metrics prelim. I have since then gotten to know Will first as a student in my Ph.D. course on numerical methods, then as a research assistant, and finally as a co-author. I currently co-chair his dissertation committee.

Will's job market paper studies product portfolio decisions in the Chinese smartphone market. In this industry, technology evolves rapidly and the typical firm offers many products. Moreover, the sales of a smartphone over time follow a hump-shaped pattern that is known as a product life cycle. Will's overarching question is how changes in the intensity of competition change the product life cycle and how these changes feed back into product portfolio decisions. This question is particularly pertinent since the Chinese government in 2012 spent considerable resources on fostering entry of small domestic firms into the smartphone industry.

Will begins by showing that the product life cycle arises naturally in technologically progressive industries and varies systematically with the quality of the product and the intensity of competition. He then exploits this insight to get a handle on product portfolio decisions. In particular, if the sales of a product follow a pattern that is predictable at the time the product is introduced, then a firm's decision to introduce the product is essentially static.

Will builds a model in which firms first decide to introduce new products or discontinue existing products. Then, given their product portfolios, firms compete in prices. He estimates a random-coefficients demand model and marginal cost from the assumed optimality of prices using sales and price data at the province-month level. He further gets bounds on the cost of maintaining an existing product from the observed discontinuation decisions and bounds on the cost of introducing a new product from the observed introduction decisions. Crucially, these latter decisions depend on the beliefs the firm has about the future sales of the product. Appealing to the product life cycle, Will models these beliefs as a function of the quality of the product and the intensity of competition. He invokes a rational expectations assumption and uses variation in the intensity of competition across provinces to estimate these beliefs. While there are obvious issues with measuring the intensity of competition, Will's idea of using the product life cycle as a heuristic to reduce a dynamic decision to a static one appears to be in line with industry practice. It is also very hard to see how one can make progress without simplifying the problem in some way given the large product portfolios typical for the smartphone industry.

Using his estimates, Will revisits the Chinese government's effort to foster entry of small domestic firms. His counterfactual shuts down new entry. Will's first result decomposes a firm's incentive to introduce a new product in a static and a dynamic part. He finds that the increased competition from new entry reduced the immediate profit of a new product by 5% but its lifetime profit by 41% through shortening the product life cycle. His second result is that the overall impact of the government's policy on products and prices was small. Absent the policy, the incumbent firms would have introduced many more products and only charged modestly higher prices. As a consequence, the welfare gain from the policy was small as well.

While many of the building blocks of Will's job market paper are familiar from the industrial organization literature, parts of the estimation are technically and computationally demanding. The paper is all the more impressive given that it took Will some time to cut through the richness of the data and settle on a topic. The paper thus literally came together over the past few months.

Will also has several other working papers as well as numerous research projects in progress. Below I describe his joint paper with Marjorie McElroy on concealed gun permits that got started when Will was an undergraduate at Duke. I leave it to my colleague Mike Sinkinson to talk about our paper on the FCC incentive auction (also joint

with Katja Seim), but would like to emphasize that Will is a full-fledged co-author on the paper. While he started out as our research assistant, Katja, Mike, and I soon decided that his contributions merit making him a co-author.

In his joint paper with Marjorie McElroy, Will revisits a central question in the economics of crime, namely whether concealed gun permits decrease or increase violent crime. The long literature on this question typically relies on a difference-in-difference approach that compares states or counties before and after the passage of shall-issue laws with changes in violent crime over time in other states or counties. The findings of this literature range from a negative effect of concealed guns on crime over an insignificant effect to a positive effect.

Will makes the important conceptual point that the difference-in-difference estimate conflates different effects because violent crime is an occupation that people decide to enter and to exit. Concealed gun permits can thus have different effects on three subpopulations: first, an effect on those who decide between violent crime as an occupation and other alternatives; second, an effect on those who have already chosen violent crime as an occupation when the shall-issue law passes; and, third, a selection effect on those who opt for violent crime in spite of concealed gun permits. As more time elapses since the passage of the shall-issue law, the relative size of these subpopulations changes, which may help explain the diverging findings in the literature. Heterogeneity in people's aptitudes for violent crime also plays a central role; in particular, the selection effect may be positive if fewer but more "hardcore" people opt for violent crime.

The paper goes on to develop and estimate a cohort panel data model that nests the difference-in-difference model and allows disentangling the three different effects. A statistical test rejects the difference-in-difference model. Importantly, the cohort panel data model uses similar state or county panel data sets as the existing literature and combines them with novel proxies for the relevant subpopulations of violent criminals. The results suggest that shall-issue laws in addition to increasing overall violent crime also increase turnover—both exit and entry—of violent criminals. This increases the number of people with criminal records but also shortens their violent crime careers. A counterfactual simulation further suggests that the combined effects are large in that eliminating shall-issue laws would reduce violent crime by a third.

I like the paper as it nicely illustrates how thinking about the underlying economics can help interpret more reduced-form estimates. The empirical analysis is carefully executed and the proxies for the different subpopulations seem very reasonable and perhaps the best one can do given the available data. While some more polishing is needed, in my view the paper is ultimately publishable in a good field journal.

In sum, Will is a technically skilled researcher in industrial organization and applied micro. He is very hard working and able to pull things together in a surprisingly short

time. Having been an undergraduate at Duke, his English is excellent. He is a clear presenter and answers questions well. On top of this, Will has a pleasant and optimistic personality and will make for a great colleague. I therefore strongly recommend him to you.

If I can be of any additional assistance, please do not hesitate to contact me by phone at (215) 898-7148 or by email at doraszelski@wharton.upenn.edu.

Sincerely,

Ulrich Doraszelski

Business Economics and Public Policy Department

The Wharton School
University of Pennsylvania

1458 Steinberg Hall-Dietrich Hall
3620 Locust Walk
Philadelphia, PA 19104.6372
215.898.8213 phone
215.898.7635 fax
kseim@wharton.upenn.edu

Katja Seim
Associate Professor of Business Economics and Public Policy

October 16, 2016

Letter of Recommendation for Peichun (Will) Wang

Dear Faculty Search Committee:

I am delighted to provide this reference on behalf of **Will Wang.** Will's research interests and background lie in empirical industrial organization. I have known him since he first began his graduate studies in the Applied Economics program at Wharton and now serve as his co-adviser. I have continuously been impressed by his ability to identify unique data sets to address interesting research questions and his tenacity in answering them. In short, I recommend him highly.

Will's job market paper studies, from a welfare point of view, how a significant decrease in concentration, induced by a pro-competitive industrial policy, affects the number of products and composition of product portfolios in the context of the Chinese smart phone market. The setting shares with other high-tech markets that firms offer multiple products spanning a wide range of the quality spectrum.

The role of market structure in the size and make-up of product portfolios is theoretically ambiguous: higher concentration allows multi-product firms to better internalize the business stealing effects of similar products, by culling closely competing products. Higher concentration also weakens price competition, however, raising margins and incentivizing firms to offer more products or introduce them earlier.

These static tradeoffs are well understood theoretically and assessed in a small empirical literature on endogenous product choice, including Fan (2013), Eizenberg (2014), Nosko (2014), and Berry, Eizenberg and Waldfogel (2016). For example, a recent working paper by Fan and Yang (2016) on product proliferation in the US smart phone market finds that a hypothetical merger between Samsung and LG would lead to a reduced number and variety of products, further reinforcing the negative consumer welfare effects due to increased post-merger prices.

Dynamic considerations serve, in principal, to reinforce the static incentives. Consider the product culling effect that the prior empirical evidence suggests to dominate: by eliminating closely substitutable products in its portfolio, the firm recovers not only per-period fixed costs, but also any sunk cost associated with introducing the product for the first time, at the expense of a limited decline in the firm's overall revenue across its portfolio. Such dynamic effects in firms' equilibrium product choices have been ignored in the literature to date, however, due to the large number of possible product configurations that figure into solving a fully-

specified dynamic game of equilibrium product portfolio choices in most empirical settings. In Will's context, for example, consumers choose among 200+ products and the average manufacturer offers 15 handsets in any given month and market.

The key innovation in Will's paper lies in proposing an empirically tractable way of approximating the stream of future profits. He assumes heuristically that managers have rational expectations over the future sales of a product, the "product life cycle," at the time when they make the product introduction decision, but do not solve the full dynamic product introduction game given the intractable evolution of quality frontiers and product portfolios. This allows him to use a product's life cycle as realized in the data after a product's introduction as a proxy for the firm's expected continuation value, to aid in separate sunk product introduction costs from the per-period fixed product offering costs. He also shows that the resulting proxy correlates well with observable product and market characteristics at the time of the product's introduction, allowing for predictions of continuation values in counterfactuals.

Will's empirical model consists of two stages: firms first choose their product portfolios in a complete information entry game based on static profit and approximated continuation value of their product choices. Will models the entry and exit decisions of non-flagship cell phones only, so that the quality frontier represented by the flagship product evolves exogenously. Given their product choices, firms then compete in Bertrand Nash prices in a second stage. He closes the model with a standard static discrete choice model of demand, which combined with data on monthly units sold and prices from the initial introduction through exit from the market of the major manufacturers' full set of smartphone offerings in each of China's 31 provinces, allows him to estimate consumer smartphone preferences and firms' cost structures over time.

The second-stage estimation results match key data patterns: across products, the product life cycle of sales exhibits a bell shape. Will's model generates such patterns through estimated declining marginal costs that drop, akin to Moore's law, more quickly for newly introduced products than older vintages. Increases in the quality frontier gradually erode such competitive advantages of new products, resulting in a long tail of sales.

In estimating first-stage fixed and sunk costs, Will recognizes that static variable profit at the time of exit is indicative of fixed product offering costs: the last-period variable profit must exceed the fixed cost for a firm to have chosen to offer the product, leading to a bounds estimator for the fixed offering costs. With estimates of preferences and marginal and fixed costs in hand, Will then predicts a product's continuation value, which feeds into a further bounds estimator to identify the sunk product entry costs.

Will uses his estimates to assess the effect of a large scale industrial policy initiated by the Chinese government in 2012 that led to significant entry by domestic fringe firms. He assesses the policy's effect by predicting portfolio choices, prices, and demand in the but-for world where the fringe firm entry did not occur, resulting in increased concentration in the market. His current results suggest that among static incentives, less intense price competition would have generated on net additional product introductions. Importantly, he finds the dynamic reinforcement effect to be significant, with product introductions increasing by an additional 30% due to higher product life cycles in the absence of fringe competition.

As the above illustrates, Will's modeling and estimation approach is complex and has many moving parts. He also was – possibly excessively – careful in choosing which aspect of the setting to focus on. As a result, his estimation has only come together over the past few months, and his estimates are still preliminary and I expect them and the results of the counterfactual to change in future iterations. That said, I believe that his assessment of the contribution of dynamic considerations will make a significant contribution to the still nascent product choice literature.

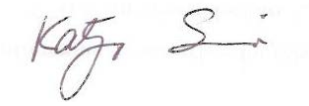
Let me briefly mention Will's joint work with Uli Doraszelski, Mike Sinkinson, and myself. In "Ownership Concentration and Strategic Supply Reduction," we explore the role of ownership concentration among

broadcast spectrum license holders in affecting the U.S. government's ongoing effort at repurposing spectrum from TV broadcasters to wireless service in a two-stage "incentive" auction. Due to the limited number of licenses outstanding, the exercise of market power by holders of multiple licenses is of significant concern; our results suggest that multi-license holders are able to earn large rents from a supply reduction strategy where they withhold some of their licenses from the auction to drive up the closing price for the remaining licenses they own. I leave it to my colleague Mike Sinkinson to describe the project in detail. Here, I want to stress that Will has been a driving force behind the project, completing a significant amount of the data analysis independently and taking the initiative to develop innovative solutions to the scale and complexity of the auction simulations we wanted to consider. He deserves full credit for the work at hand.

As his portfolio demonstrates, Will has been able to develop excellent command of a wide range of empirical techniques. He is thoughtful and has a wide range of knowledge of and insight into questions on innovation and beyond. An advantage to having chosen Wharton for his PhD studies has been his ability to gain significant experience in the classroom, including as a teaching assistant in our regular and executive MBA programs. I understand from my colleague Kent Smetters that Will was critical in helping the students absorb the material, and this background has prepared him well to teach across a range of programs including professional schools. He will make an excellent colleague. In summary, I would encourage any but the best economics departments and professional schools to consider him seriously.

If I can be of further assistance, please do not hesitate to contact me under (650)996-8177 or by email at kseim@wharton.upenn.edu.

Sincerely,



Katja Seim
Associate Professor of Business Economics and Public Policy

Business Economics and Public Policy
The Wharton School, University of Pennsylvania
1453 Steinberg Hall-Dietrich Hall
3620 Locust Walk, Philadelphia, PA 19104
215.898.0926 phone
215.898.7635 fax
msink@wharton.upenn.edu

Michael Sinkinson, PhD
Assistant Professor

November 8th, 2016

Dear Colleague,

It is my pleasure to write a strong recommendation in support of Peichun (Will) Wang. I have known Will for the past four and a half years, as a research assistant, teaching assistant, and co-author. His primary fields are empirical industrial organization and applied microeconomics. I enthusiastically recommend Will to all but the best economics departments, as well as the best business schools, policy schools, government agencies, think tanks, and consulting firms.

In Will's job market paper, he tackles the problem of endogenous product portfolios, specifically modeling the effects of competition and product characteristics on product life cycles. He estimates the model on a large dataset of sales, prices, and characteristics of smartphones in the Chinese smartphone market that spans five years. He finds that taking product life cycles into account is crucial for policy analysis, as product introductions respond endogenously to a pro-competitive policy that he studies. My colleagues will expand further on that paper.

I would like to focus my letter on a different paper, "Ownership Concentration and Strategic Supply Reduction", which is joint with myself, Ulrich Doraszelski and Katja Seim. This project began in early 2013 with Will as our RA on the project. Over the course of the project, it became unanimously apparent to the three of us that he should be made a co-author.

The paper examines the mechanism underlying the FCC's so-called "incentive auction", which combines a reverse auction that acquires broadcast spectrum from thousands of currently-licensed television stations with a forward auction that sells bands of nationwide spectrum to wireless carriers to be used for mobile broadband. One key aspect of the mechanism is the "repacking process" that stands between the reverse and forward auctions. Currently-licensed television stations are located all across the UHF spectrum (roughly 222 MHz in total), while wireless carriers are only interested in a contiguous band of spectrum. So, the FCC hopes to use the reverse auction to identify the low-cost set of licenses it must acquire to create a contiguous nationwide band for a given clearing target (e.g. 126 MHz of spectrum), if it can "move" ("repack") stations that continue to broadcast into the lower part of the UHF spectrum. This process is exceedingly complicated given interference patterns among stations that create

millions of constraints on which stations cannot be located on the same (or often even adjacent) channels.

The incentive auction was announced in 2010. Shortly afterwards, a number of firms began to acquire additional television licenses, specifically in anticipation of the incentive auction. This behavior is what inspired this project: we wanted to understand the impact of multi-license ownership on the reverse auction process. This auction concerns the re-allocation of billions of dollars of assets, and the mechanism is likely to be used again in the future, either in this country or overseas, and so understanding the extent to which it may be vulnerable to multi-license ownership is an important empirical question. We show in the paper that multi-license owners may find it attractive to withdraw licenses from the auction to raise closing prices for other licenses they own. (We note that the auction's designers were aware of the potential of this issue; we view our paper as empirically addressing the issue).

In the paper, we begin by estimating valuations for all auction-eligible UHF licenses. We must do this ex-ante, in contrast to much of the auction literature that uses ex-post bids to infer valuations, for several reasons. First, no data will be released until two years after the completion of the auction. Second, any such data will not be informative for licenses that are withdrawn (as they may have been withdrawn strategically, or may simply have had high valuations). Third, the mechanism itself implies that valuations for licenses that are surrendered in the auction are censored, and so no actual bids from these licenses are observed. This part of the project involved a large data-gathering effort, where Will was instrumental (he was our Research Assistant at this point). He identified data sources, negotiated data licenses, and did an excellent job converting non-traditional data sources into datasets we could use. We used observable license characteristics and anonymized accounting statements to model station cash flows directly as a function of (observed) advertising revenues and license characteristics. In addition, we use a database of transactions to determine distributions of valuations for all licenses.

We then explicitly simulate the auction, taking into account the NP-Complete repacking process for licenses by using the FCC's own repacking software, as well as the uncertainty in our valuation estimates by integrating over simulated draws of license valuations. Our simulations assume full information and full participation, which effectively turns the auction into a normal form game. Our first simulations assume all stations are bid independently (i.e. ignoring multi-license ownership). We then compare that to all possible equilibria under strategic bidding, where multi-license owners are able to withdraw any subset of their licenses in a market. The difference is large: the average equilibrium payout increases on the order of 20%. We further show that this is likely a low-end estimate: reduced participation by licensees further increases payouts, as do bidding strategies that span multiple markets. The paper contains some policy recommendations intended to both increase participation and decrease the potential for strategic bidding.

Will's contribution to the paper is large. While he began as the Research Assistant, he grew into the role of Co-Author. His technical skills are strong: his ability to execute complex empirical work has been clearly established both in this project and in his job market paper. Will is the kind of researcher that develops a real mastery over a setting, the data, and the model. He can answer any question about the paper at the drop of a hat. Working with him has been very rewarding and I am confident that the joint paper would not nearly be as strong without his many contributions.

Besides this project, he has additional research projects in progress with faculty at Duke (Margie McElroy), as well as other faculty at Penn (Ann Harrison and others), and graduate students. All of the above point to a productive research career with a diverse set of co-authors.

Finally, he has proven to be adept at teaching. Being a Teaching Assistant at Wharton in the MBA program is about as challenging an assignment for a graduate student as can be imagined. Will did very well, which was no surprise to me. He was very well-organized while also being hard-working and committed to doing a high-quality job. I was very happy to have him as my TA.

To summarize, Will is a talented researcher in the fields of empirical industrial organization and applied microeconomics. He is a great colleague, as evidenced by the number of faculty that are eager to co-author with him. He is hard-working, technically adept, a great communicator, and a great presenter. I expect him to have a long and productive career as a scholar, and recommend him strongly to you.

Please don't hesitate to contact me at msink@wharton.upenn.edu or (215)898-0926 if I can answer any questions about the above.

Sincerely,



Michael Sinkinson
Assistant Professor, Business Economics and Public Policy
The Wharton School, University of Pennsylvania