# Research Statement

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My general research field is public economics. I study the effect of public policies on the incentives of individuals and firms, and their impact on aggregate efficiency and equity. My core research interests in this field can be grouped into two topical areas: Economics of education and human capital formation; and antitrust and regulatory economics, with applications to the energy sector.

My research in antitrust and regulatory economics is partly motivated by my work experience as an economic consultant. Between 2006 and 2010, I interrupted my first tenure-track appointment at the University of Alabama for personal reasons and took an industry job in Washington, D.C. This detour out of academia has inspired several research ideas motivated by "real world" problems. It also led me to apply industrial organization tools widely used in antitrust and regulation to issues in the education sector, which is my other research area.

In terms of methodology, most of my research is applied theoretic work. However, empirical methods are also used in a few projects. In the sections below, I will describe my contributions, as well as ongoing projects, in my research areas.

## 1. The Economics of Education and Human Capital Formation

My work in the economics of education focuses on a number of aspects related to both the education process and the education sector, including individuals' decisions (the demand side) and schools' choices (the supply side).

Focusing on the hierarchical structure of the education process, My paper **"The Allocation of Public Funds in a Hierarchical Educational System"** (Su 2004) studies the effect of allocating a fixed amount of public budget between basic and higher education. In this hierarchical system, a student's human capital output from basic education becomes an input into higher education. I show that for Pareto efficiency, there is a lower bound on funding basic education. On the other hand, whether there is a corresponding lower bound on funding higher education depends on the development stage of the economy. While allocation policies favoring basic education lead to the usual redistribution from the top to the bottom, policies favoring higher education can result in a reverse redistribution from the bottom to the top. Through inter-generational

links, short-run allocation policies may have long-run effects. A simple rule-of-thumb for long-term development is to focus on basic education for a sufficiently long duration, such that a less developed economy can avoid the under-development trap and income polarization.

Interestingly, the policy implications delivered by this paper appear contrary to the actual policies pursued by many less developed economies. To understand why this is the case, I examine the heterogeneous policy preferences across individuals in the paper **"Endogenous Determination of Public Budget Allocation across Education Stages"** (Su 2006). I show that in less developed economies, high income individuals prefer policies that give them exclusive participation in higher education. If these individuals hold a disproportionate share of political influence, they will allocate a large share of the public budget to higher education, at the expense of basic education. In contrast, in developed economies, even high income individuals prefer a more balanced allocation policy, which leads to expanded participation of middle class individuals in higher education. The model prediction is broadly consistent with both cross-country policy differences and the historical evidence.

Asymmetric information can play an important role in both the education process and the resulting labor market outcomes. Together with Tilman Klumpp, I examine the signal extraction and inference problem faced by both individuals and employers. In the paper **"Second-Order Statistical Discrimination"** (Klumpp and Su 2013a), we extend the standard model of self-fulfilling statistical discrimination from the first moment to the second moment of the human capital distribution. In particular, we show that the expectation that the human capital distribution of female workers exhibits a smaller variation than that of male workers can be self-fulfilling. The expectation of a thin right tail in the female human capital distribution makes employers less likely to hire female workers in high-end jobs (a "glass ceiling" effect), which in turn discourages high-ability females to invest in their human capital compared to high-ability males. At the same time, the expectation of a thick middle section makes employers more likely to hire female workers in middle-level jobs, which encourages low-ability females to invest in their human capital compared to low-ability males. Putting both observations together, the human capital distribution of female workers will in fact exhibit less variation *ex post* than that of male workers, despite the fact that the innate ability distribution may have been *ex ante* identical for both groups.

A related paper **"A Theory of Perceived Discrimination"** (Klumpp and Su 2013b) examines the question of how individuals can maintain persistently different perceptions of whether or not discrimination exists in the labor market, despite observing the same labor market equilibrium outcomes. We use the term "perception" to denote a player's belief about a parameter of the economic environment, which may not be directly observable but can be confirmed or challenged when confronted with the equilibrium outcomes. More specifically, suppose that individuals belong to two identifiable groups (e.g., black and white, or male and female) and compete for a fixed pool of prizes (e.g., job offers or college admissions) by investing effort to

accumulate human capital. We say that discrimination exists if a lower share of prizes is reserved for one group than for the other. If individuals of one group believe that they have been allocated a lower share of the prizes than the other group, they will be discouraged from investing in their human capital, which leads to a lower share of them actually winning the prizes. In other words, their perceptions are not contradicted by the actual outcome even if no such group quota actually exists. In this case, two different environments, with and without discrimination, can lead to the same equilibrium outcome. If this is the case, individuals may "agree to disagree" about whether discrimination exists, because their different perceptions are equally consistent with the observed data.

My current research projects use tools from the theory of industrial organization to examine the strategic interactions among education providers. In the paper **"College Expansion and Curriculum Choice"** (Kaganovich and Su 2015a), Michael Kaganovich and I analyze the impact of college enrollment expansion on student academic achievements and labor market outcomes. We model a college's choice of its curriculum as picking an education production technology out of a menu of horizontally differentiated technologies. We assume that higher-ability (lower-ability) students prefer a more (less) demanding curriculum. Thus, when public policies promote "access" to college education, less selective public colleges adopt a less demanding curriculum in order to accommodate the influx of less able students, which benefits low-ability college students at the expense of those of medium ability. At the same time, it reduces the competitive pressure faced by elite colleges, as less selective colleges become a less appealing alternative for medium ability students. Elite colleges therefore adopt a more demanding curriculum to better serve their most able students, again at the expense of medium ability students. The model prediction is broadly consistent with the observed U-shaped earnings growth profile among college-educated workers in the U.S.

In a related paper **"Returns of Academic Standards and the Selectivity of Colleges"** (Kaganovich and Su 2015b), we examine the relationship between a rising college premium and the diverging selectivity trends of American colleges. We argue that the human capital output from college education is a non-linear function of the difference between a student's pre-college preparation and the curricular standard chosen by the student's college. Thus, colleges affect the distribution of outcomes in the student population by choosing curricular standards in accordance with their objectives, with more selective colleges placing relatively more weight on the quality of its student body (the aggregate human capital) and less selective colleges placing relatively more weight on the quantity of its student body (the number of enrollments). We show that, as a result of the competition among colleges, a rise in the college premium will cause less selective colleges to lower their academic standards, while the effect on more selective colleges is the opposite.

## 2. Antitrust and Regulatory Economics

During my work as an economic consultant, I encountered practical questions concerning the regulation and restructuring of natural monopolies arising in vertically integrated industries. In these industries, incumbents that own essential upstream facilities can extend their market power to potentially competitive downstream markets. One particular example is the electricity industry, where incumbent utilities own essential transmission networks, while electricity generation can be potentially competitive. A shift in the regulatory paradigm during the 1990s prompted policy makers, in the U.S. and elsewhere, to move away from traditional cost-of-service regulation of the vertically integrated firm, to access-based regulation of the upstream monopoly while opening the downstream market to competition. Open-access regulation forces incumbents to lease their essential facilities to competitors at regulated rates, leaving downstream prices to be determined through market competition.

It is generally believed that open-access regulation improves static (allocative) efficiency due to increased downstream competition. However, one may be concerned that forcing firms to share facilities with competitors may discourage them from investing in these facilities, thus diminishing the dynamic efficiency of the market. In a series of papers, Tilman Klumpp and I examine the validity of this concern. In the paper **"Open Access and Dynamic Efficiency"** (Klumpp and Su 2010), we examine theoretically whether open-access regulation, such as that arising from the 1992 U.S. Energy Policy Act, weakens an incumbent's investment incentive. We explicitly model the regulation principles that access tariff should be fair, reasonable, and non-discriminatory, by imposing the following conditions: the incumbent must charge the same access rate to itself and all other competitors, it must earn a zero economic profit from its operation of the natural monopoly facility, and the cost recovery from each downstream firm (including itself) is proportional to the downstream firm's market share. We show that, under certain assumptions on costs and demand, the incumbent chooses an investment level higher than that under monopoly, and the investment increases in the intensity of downstream competition. Our result stands in contrast to the conventional notion that dynamic efficiency must be sacrificed for gains in static efficiency when open-access regulation is implemented.

In a follow-up paper, **"Strategic Investments under Open Access: Theory and Evidence"** (Klumpp and Su, forthcoming), we generalize this framework and test our model predictions empirically. We show that investment incentives can be decomposed into a non-strategic component and a strategic one. Under mild assumptions on demand, the non-strategic incentive implies a larger investment in a more competitive market, while the strategic incentive may strengthen or weaken the non-strategic incentive, depending on the competitive advantage of the incumbent relative to its downstream competitors. The assumptions made in Klumpp and Su (2010) guarantee that the strategic incentive never overwhelms the non-strategic incentive. Under more general conditions, however, the opposite may be possible. We estimate the presence and direction of

strategic investment incentives using a panel dataset of vertically integrated electric utilities that are subject to open-access regulation. We find evidence that investments in transmission facilities are indeed made strategically. Ceteris paribus, incumbent utilities are less likely to invest, and investment levels are lower, when competitors represent a larger share of the downstream wholesale market.

I have also examined the policy impact of restructuring the electricity retail market in the U.S. The focus of this work is on the implications of restructuring on allocative efficiency. Compared to traditional cost-of-service regulation, retail competition—facilitated by open access to the electricity distribution network—may lead to lower costs but higher markup rates, so that the net policy effect on retail prices is ambiguous. In the paper **"Have Customers Benefited from Electricity Retail Competition?"** (Su 2015a), I use a difference-in-difference approach to estimate the policy impact on average retail prices for U.S. states that restructured their electricity retail markets. The results suggest that in restructured states only residential customers have benefited from significantly lower prices, but not commercial or industrial customers. Furthermore, this benefit is transitory and disappears in the long run. Thus, the overall evidence seems to suggest that retail competition fails to yield significant improvement in allocative efficiency.

In the area of antitrust economics, a current project of mine uses a concept similar to the "rational perceptions equilibrium" developed in Klumpp and Su (2013b) to examine the different perceptions of litigants in monopolization cases. In the paper **"Two Tales of Monopolization"** (Eckert, Klumpp and Su 2015), we model the impact of monopolization as a sales quantity cap imposed by one firm (firm 1) on another (firm 2). We show that competition with or without monopolization may lead to the same asymmetric equilibrium outcome. When firm 2 believes that it is quantity constrained, its incentive to invest in either product design or cost-reducing production processes is weakened, which makes firm 2 less competitive than firm 1. Firm 2 will then attribute its low realized market share to monopolization by firm 1. At the same time, firm 1 may believe the opposite and attribute its large realized market share to coordination on an asymmetric equilibrium in which firm 1 happened to make a larger investment that resulted in a competitive advantage. Neither firm's perception of the nature of competition is challenged by the observed data. Furthermore, it is difficult for outside observers, such as antitrust authorities or courts, to distinguish one scenario from the other. Our results thus highlight the tension between committing type I errors (false positives) and type II errors (false negatives) in antitrust practice.

Lastly, I have also worked on some projects where the intended audience consists of policy makers, regulators, and industry practitioners. In the article **"Design of an Economically Efficient Feed-In Tariff Structure for Renewable Energy Development"** (Lesser and Su 2008), Jonathan Lesser and I propose a two-part feed-in tariff to meet the renewable policy goals of regulators. The two-part tariff consists of an auction-based capacity payment and a market-based energy payment. It balances considerations for both dynamic efficiency and static efficiency,

where the capacity payment subsidizes investments in renewable resources capacities, and the energy payment introduces competition in the generation of renewable energies. In the article **"Evaluating Environmental Concerns in Oil Pipeline Projects: The Pricing of Externalities"** (Su 2015b), I survey the literature on the hedonic pricing model and discuss how it can be applied to evaluate environmental externalities associated with oil pipeline projects. I argue that there are important differences between intrinsic externalities arising from the construction and operation of a pipeline itself, and externalities arising from either upstream extraction or downstream refining and consumption of the crude oil. As a result, when proposed pipeline projects face regulatory delays, efficiency implications depend on whether the delays are caused by considerations of externalities that are associated with the pipeline itself, or externalities in upstream and downstream markets connected by the pipeline.

## 3. Other Research

While not directly related to my core research areas, I have also worked on the economics of networks. In the article **"National Terrorists and Optimal Network Structure"** (Enders and Su 2007), Walter Enders and I examine how different counterterrorism policies affect the optimal network structure adopted by terrorist organizations. We model the trade-off between security and intra-group communication faced by terrorist groups, assuming that a more densely connected network is less secure but more efficient for communication. We predict that terrorist groups reduce their network density in response to counterterrorism activities directed at group communications, thus moving away from logistically complicated attacks to simpler and less coordinated ones.

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