I have two ongoing research topics: public school teachers' retirement decisions and the correlations among people's health, occupational choices and labor income. In contrast to reduced form regression models, both my research use structural models that depict economic agents who are maximizing their utilities during their lifetime. I focus on the structural models since structural models are useful for predicting the effect of policy reforms. Lifecycle decisions such as labor supply and retirements have been analyzed by many authors (Stock and Wise (1990), Grossman (1972), Cole et al. (2002), etc.). I use structural models on two problems; both involve large panel data sets.

In my primary line of research, the estimated Stock-Wise model is shown to be a powerful tool to model how observable variables such as age, experience, salary, and pension rules influence the retirement decisions. Two contributions were made to improve the out-of-sample fit: 1) restrict the preference error term in the model to fit the sample selection bias in the observed sample; 2) model the changing of pension rules and teachers expectations to fit the observations from different years. Based on the fairly well out-of-sample predictions, we showed that teachers would retire later if there were no or fewer promotions in the pension benefits. Also, the short term and long term effects of potential retention policies were evaluated.

There are several points for further development of the primary research:

- In the previous papers, the parameters used in the Stock-Wise model are borrowed from Ni and Podgursky (2016). We can re-estimate the parameters with the time varying pension rules and with the sample selection problem fixed. Some advance estimation method can be applied to improve the efficiency of the estimation process.

- The previous papers assumed teachers have the same expectations regarding to the future pension rules. Next, we can allow different teachers to have different expectations over the future pension rules and estimate the percentage of teachers who can forecast the future rules.

- For a given potential bonus based retention policy, the short-term and long-term effects can be evaluated. A more general approach needs to be developed to compare all potential bonus-based retention policies and find the optimal.

- We can estimate the effects of changing from Defined Benefit (DB) pension plans to Defined Contribution (DC) pension plans.

- The time varying framework can be used to analyze the pension policies in other states.

In the second research, a life cycle model is used to analyze the causal relationship among health, occupation, and income data from Panel Study of Income Dynamics (PSID). Many channels connect these variables. It is easy to imagine that a healthier person is more productive, but a person with financial means can also afford more investment in their health. The estimates of the relative

importance of these channels based on regression analysis lead to conflicting conclusions. My innovation is to use a large panel data set and structural models to identify causality. Based on the good fit of the model, I conducted several simulation-based counter-factual experiments and concluded that people's education level mainly decides the occupations. 'Manual' occupations lead to higher health deterioration rate than 'non-manual' occupations; while 'non-manual' occupations generate higher labor income than 'manual' occupations. Health affects the labor supplied and labor income, but the effect size varies by occupation.

Also, there are some immediate research points can be done continuing the second paper.

- The method of Simulated Moment (MSM) can be used to estimate some of the parameters in the life-cycle model with the observed data from PISD.

- Savings can be introduced into the model for allowing people smooth consumptions over different periods.

- Medical expenditures should be introduced for improving health status endogenously.

- The health insurance market can be introduced to model and analyze the policies regulating the medical insurance market, such as the Affordable Care Act or other alternatives.

These two applications revealed that structural models could be successfully used in analyzing potential policies and exploring the causal effects. The structural methodology and the estimation technologies are not limited to these two applications. They can be used in other topics, such as job searching, competition between firms, and international trade.

Abstracts of Recent Working Papers

How Do Changing Pension Rules Affect Retirement Behaviour? A Study of Missouri Teachers (Job Market Paper)

From 1995 to 2002 Missouri's teacher pension rules changed frequently. The effects of these rule changes on retirements can usefully be examined in a structural model. I use an option value model to fit a panel data set of Missouri teachers retirements in the presence of these pension enhancements. An important feature of the Missouri experience (and common in other states) was that (1) there were consecutive pension rule enhancements, and (2) the sample of remaining teachers in each year is endogenous to the recent history of pension enhancements. Failure to take into account this endogeneity leads to over-predicting retirement. I developed two methods to correct this sample censoring bias, which greatly improve the model's fit to the Missouri data. Based on the good fit, I use the model to simulate the effects of pension rule changes. I find the pension enhancements in the late 1990's failed to retain experienced teachers, but led to earlier retirements. Simulations also show both higher contribution rates and higher replacement rates

encourage early retirements.

Pensions and Late Career Teacher Retention (under review)

with *Dongwoo Kim, Cory Koedel, Shawn Ni, Michael Podgursky*

A vast research literature is devoted to analyzing causes of and potential remedies for early-career teacher attrition. However, much less attention has been paid to late-career attrition among experienced teachers, which is driven primarily by retirement plan incentives. Although there is some variation across states, it is generally the case that late-career teachers retire at much younger ages than their professional counterparts. Moreover, given the well-documented returns to teaching experience, late-career exits are on average more costly to students in K-12 schools than early-career exits. This study uses structural estimates from a dynamic retirement model to simulate the effect of targeted retention bonuses for senior teachers rated as effective or teaching in high-need fields. While the cost per incremental year of instruction is expensive in the short run, it declines over time. Moreover, because labor supply decisions are forward-looking, a temporary bonus has much smaller effects than a permanent one. These findings highlight the value of stability in policies aimed at extending teachers careers. Overall our results suggest that carefully-targeted retention bonuses can be useful tool in raising the quality of the teaching workforce and closing achievement gaps.

On Policies for Late-Career Teacher Retention (work in progress)
with *Shawn Ni, Michael Podgursky*
Pension rules push experienced teachers in K-12 schools to retire earlier than other professionals. The early exits of late-career exits are costly on student learning and on school finance. This study evaluates policies that remedy the push effect on effective teachers in an option-value model, in which the parameters are policy invariant. We first show that the parameters have good out-of-sample fit under different pension rules, in different states and years. Then we use the model to simulate the effects of several policies for retaining late-career teachers. We find that converting the current defined benefit (DB) to defined contribution (DC) effectively retains teachers; and that under the DB rules well designed retention bonuses can also be quite effective. We choose retention bonuses under the DB rules by solving a problem of optimal policy design.

Dynamics of Occupations, Health, and Earnings (work in progress)
I use a life-cycle model to explore the dynamic relationships among occupations, health, and earnings observed from Panel Study of Income Dynamics (PSID) data. The simulations from the calibrated model fit the data well. Several simulation-based counter-factual experiments show that the occupations are mainly decided by education. 'Manual' occupations lead to faster health deterioration and lower income than 'non-manual' occupations. Conditioning on occupation, health affects the labor supplied and labor income.