Health Policies and Intergenerational Mobility

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Abstract.— Each year the U.S. government spends about 2% of its GDP on Medicaid, its main means-tested health insurance program. In June 2013, over 28 million children were enrolled in Medicaid. What are the implications of such a large-scale policy intervention for intergenerational mobility and inequality? While the role of education and education policies received a lot of attention in the literature on intergenerational mobility, almost nothing is known on how medical policies affect intergenerational mobility and inequality. This is rather surprising, since health, like education, is highly persistent across generations and health of children have an important impact on how they perform in school. In this paper, I develop and estimate a human-capital based overlapping generations model of household decisions that take into account multidimensionality and dynamic nature of human capital investments. I distinguish two forms of human capital: health capital and human capital, and model explicitly government policies in education and health. The counterfactual simulations show that health policies is an important determinant of intergenerational mobility of income across generations for agents of the bottom of income distribution and there are important interactions between health and education policies.

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1. Introduction

Parental characteristics, such as education, earnings, income, and health are strongly correlated with the same outcomes for children. Estimates of intergenerational elasticity of income, a common measure of intergenerational mobility, varies around 0.4-0.6 for the US – Solon (2002), Solon (2004), Zimmerman (1992), and Mazumder (2005).[1] These estimates imply that if a parent is 10% richer than the average person in the economy, his son is likely to be 4-6% richer as well.[2] Intergenerational elasticity of life span of parents and children in the US is 0.28, and it is higher for father-son (0.356) and mother-daughter (0.32) pairs – Parman (2012). Furthermore, intergenerational mobility is closely related with inequality in a society. In societies with higher income inequality social mobility is lower, especially at the tails of the income distribution. This relation is called "Great Gatsby Curve", see Corak (2013), and it makes the "lottery" in which family a child is born in even more important – Chetty, Hendren, Kline and Saez (2014).

Recent literature shows that initial (pre-labor market conditions) are very important in determining later labor market outcomes of children. For example, Keane and Wolpin (1997) find that unobserved heterogeneity at age 16, explains about 90% of variation in lifetime utility. Huggett, Ventura and Yaron (2011) find that differences in initial conditions (human capital and wealth) at age 23 are more important than shocks received over the working lifetime for the variation in lifetime earnings, lifetime wealth, and lifetime utility. The key question is of course what determines initial conditions of children.

First, genes, or as it is labeled in the literature, nature matters: parents with better health/ability are more likely to give birth to more healthy/able children. Second, nurture, the environment in which children grow, plays an important role. Family background, such as education, parental abilities, health, and earnings determines the environment in which a child is growing up. If parents are educated, healthy and rich, the child most probably will also be educated, healthy and rich. But what if parents are poor, not educated or not healthy? Their children are disadvantaged comparing to the children of healthy, educated and rich parents. The government policies then can play a role and try to equalize opportunities for all children, independently of their family background. Providing access to

[1] Corak (2013) and Guner (2015) review the recent literature on intergenerational mobility.

[2] Intergenerational income elasticity is calculated by regressing the log earnings of sons on log earnings of fathers, controlling for ages of both. However, there are other ways of estimating degree of intergenerational mobility. For example, Chetty et al. (2014) use correlation of parent's and child's income percentile ranks or calculate transition probability of moving from the bottom quintile to the upper one, while Güell, Mora and Telmer (2015) and Clark (2014) use joint distribution of surnames and economic outcomes to study intergenerational mobility.

education and to health facilities, government may counteract the role of parental earnings and disadvantaged environment at home.

Education is known to be an excellent social lift (Restuccia and Urrutia (2004), Caucutt and Lochner (2012), Lee and Seshadri (2014)). On the other hand, we know almost nothing about how medical policies affect intergenerational mobility and inequality. To the best of my knowledge there are only few empirical papers devoted to this question. Mayer and Lopoo (2008) analyze association of total government spending and intergenerational mobility, using variation in the amount of government spending in different US states. They find that higher government spending reduce the importance of parental income for the economic success of children. Furthermore, Aizer (2014) analyzes empirically the relation between intergenerational mobility and different welfare policies, such as foster care, family planning, income transfer programs, residential mobility interventions, educational interventions and public health. Among all welfare policies she considers, increases in spending on health are most strongly associated with reductions in the importance of family background and declines in inequality in the production of child human capital (measured as PISA test scores among 15 year-olds). Case, Lubotsky and Paxton (2002) study health-income gradient, i.e. that children born to low-income parents tend to be in worse health status than children born to high-income parents. They find that neither health at birth, nor access to health insurance affects estimates of health-income gradient, and conclude that health affects intergenerational mobility through other channels, such as parental investments into health. Finally, O'Brien and Robertson (2015), study how Medicaid expansion of 1980s and 1990s affected intergenerational mobility using geographical variation in policy changes and find a positive, but not very large, effect of Medicaid on mobility. They find that increasing the proportion of women aged 15-44 eligible for Medicaid is associated with reduction in rank correlation of incomes of parents and children. They also find that children born to low-income parents after Medicaid expansions are more likely to move upwards. Brown, Kowalski and Lurie (2015) also show that Medicaid expansion affected child's income significantly positively, however they were not studying implications of this for intergenerational mobility. Cohodes, Kleiner, Lovenheim and Grossman (2014) explore the same Medicaid expansion of 1980s and 1990s and find that it had a substantial positive effect on child's schooling outcomes. Hence, while there is some evidence that suggests that health is important for intergenerational mobility, there has not been any attempts to understand the mechanisms through which health and health policies affect intergenerational mobility.

Meanwhile the U.S. government spends significant amount of resources on needs-based medical policies. In June 2013, over 28 million children were enrolled in Medicaid and another 5.7 million were enrolled in State Child Health Insurance

Program (SCHIP).[3] Yet, according to 2012 National Health Interview Survey[4], 36% of families with children in the United States experienced financial burden of medical care, such as problem paying medical bills in the past 12 months, having currently medical bills that they are unable to pay, having currently medical bills that are being paid over time. Poorer families are more likely to experience burden of medical care than the richer ones. In particular, families with income between 139% and 250% of Federal Poverty line (FPL) are affected the most, and this is exactly the group that is not always covered by Medicaid and SCHIP. On the other hand, government policies can also crowd out family investments (Cutler and Gruber 1996). How do then parents allocate their limited recourses between medical expenses and expenditures on other forms of human capital, such as education? Is poor health of children a barrier for upward mobility? How do a large-scale policy intervention, like Medicaid, affect intergenerational mobility and inequality? How do policies on health and education interact? These are the questions I try to answer in this paper.

I develop a human-capital based overlapping generations model of household decisions that take into account multidimensionality and dynamic nature of human capital investments. Following Grossman (1972), I model health as a human capital and hence distinguish two forms of human capital: health capital and human capital (ability). I assume that human capital eventually determines person's productivity while health capital determines physical capacity of acquiring and enjoying productivity. I follow Cunha, Heckman and Schennach (2010) and allow for dynamic complementarity and self-productivity of human capital.[5] These two factors produce a multiplier effect since one type of human capital enhances production of the other type of human capital.

Parents decide on consumption and investments into human and health capital of their children. These investment decisions, together with intrinsic health and ability that is correlated across generations, determine future health and productivity of children when they become adults. Health and human capital of adults define their physical ability to work and labor market productivity. I model explicitly governmental policies in education and health. Government provides educational spending on primary and secondary education, as well as income-based subsidies for college education. Furthermore, it provides income-based medical policy that closely mimics Medicaid in the U.S.

In the paper I replicate important data moments for the US and then I perform

[3]Source: http://kff.org/health-reform/issue-brief/childrens-health-coverage-medicaid-chip-and-the-aca/

[4]Source: http://www.cdc.gov/nchs/data/databriefs/db142.htm

[5]Self-productivity means that human capital produced at one stage make further human capital production more efficient. Dynamic complementarity means that levels of human capital investments at different ages are synergistic and fortify each other.

several counterfactual experiments with medical policies. Results show that Medicaid as well as both education policies (early and late) affects intergenerational mobility in the US. There are important interactions between health and education policies. Changes in both policies have a larger effect than each one in isolation. Especially this interaction effect is important for children of the lowest income quintile. When Medicaid is eliminated, parents face a trade-off between spending their resources on education versus on health of their children. When both college subsidies and Medicaid are eliminated, this trade-off becomes much more significant, especially for poorer households. As a result, we observe that poor households do not invest into early education at all (and also they don't go to college in absense of college subsidies), while richer households substitute health investments (and as a result lower health level) by higher educational spending (and as a result higher ability).

The remainder of the paper is organized as follows: in section 2 I provide a short literature review, section 3 is devoted to the model description, section 4 presents model estimation strategy and benchmark model, in section 5 on can find results for the counterfactual experiments, section 6 concludes.

2. Related Literature

This paper is naturally related to the large literature on intergenerational mobility and inequality. This literature dates back to Becker and Tomes (1979, 1986) and Loury (1981), who explore implications for intergenerational mobility of credit constraints and ability persistence over generations. Following their seminal contributions, a large body of literature is devoted to understand sources of intergenerational mobility and inequality as well as how different public policies affect them.

First, it is well known that inequality and social mobility are negatively correlated (Corak, 2013). However, policies that mitigate inequality do not necessarily work well to increase intergenerational mobility (Becker, Kominers, Murphy and Spenkuch, 2015).

Second, recent literature shows that parental investments into human capital (education) is a very important channel for intergenerational correlation of incomes. Becker et al. (2015) in their theory of intergenerational mobility find that even in a world of perfect capital markets with no differences in ability rich parents tend to invest more into their children's human capital than poor parents and as a result in the top of distribution earnings persistence is stronger than in the middle. There is a very large literature that shows that early childhood investments are very important in determining human capital of a child when he becomes adult

(Cunha and Heckman, 2007; Cunha, Heckman and Schennach, 2010; Heckman, Yi and Zhang, 2013). Family environment along with family in vestments play a crucial role in this process (Carneiro and Heckman, 2003; Cunha, Heckman, Lochner and Masterov, 2006). Lefgren, Lindquist and Sims (2012) examine two transmission channels for intergenerational persistence of income: causal effect of parental income and causal effect of parental human capital. They find that both channels are active, around 37% is due to the causal impact of father's financial resources, the remainder is due to the transmission of father's human capital. Restuccia and Urrutia (2004) build an overlapping generations model with early and late investment in human capital. Their simulations show that around half of intergenerational correlation in earnings is attributed to parental investments into education (particularly, early education). Building a similar model, Caucutt and Lochner (2012) suggest that financial constraints might prevent parents from effective investments into their children. And as a result differences in initial conditions by the age of 20-25 explain up to 60% of variation in lifetime earnings, according to Huggett et al. (2011).

Third, government can intervene and affect both, intergenerational mobility and inequality. Lee and Seshadri (2014) also build an overlapping generations model with early and late investment in children human capital. They also allow on-the-job human capital investments for adults. They find that education subsidies and progressive taxation can significantly reduce the persistence in economic status across generations. However, it should be kept in mind that government investments can crowd out family investments, that's why it is important to keep in mind family responses to changes in government policies (Cutler and Gruber, 1996).

Finally, institutional differences matter. Herrington (2015) compares the US and Norway in mobility and inequality and finds that tax system and public education spendings are responsible for about one-third of difference in inequality and 14% difference in intergenerational earning persistence between Norway and the US. Mayer and Lopoo (2008) assess the relationship between government spending and intergenerational economic mobility using PSID data and find greater intergenerational mobility in high-spending states compared to low-spending states. They also find that the difference in mobility between advantaged and disadvantaged children is smaller in high-spending states and that expenditures aimed at low-income populations increase the future income of low-income children but not high-income children. Rauh (2015) looks at importance of political economy for distributional effects in education and it's implications for inequality and social mobility and finds that voter turnover can explain around one-fourth of cross-country differences in inequality and mobility.

All of the papers mentioned above as well as others in the literature abstract from health, and human capital is simply modeled as a function of parental and public investment on education. The only exception is Heckman et al. (2013) who also consider health as one of the dimensions of human capital. They show that early health shocks negatively affect all dimensions of child human capital: health, education, socioemotional skills and this effect is very important for policy implications.

On the other hand, the literature on health comes to a conclusion that health is very important in determining later life outcomes. Currie and Gruber (1996a,b) study the effects of the Medicaid expansion to pregnant women and low-income children and find big positive effect for children's health and negative effect for child mortality. Prados (2013) quantifies the health-income feedback and states that it accounts for 17% of earnings inequality. In seminal Grossman (1972)'s paper the notion of health capital is introduced and health is modeled as a result of investments into health and it's depreciation over time. This gave rise to macroeconomic models that incorporate health risks in a life-cycle framework. Attanasio, Kitao and Violante (2010), for example, study tax implications due to projected rise in medical spending financed through Medicare – governmentally provided partial insurance against negative health shocks for older people. Palumbo (1999) and De Nardi, French and Jones (2010) study saving decisions of the elderly and the role of medical shocks in savings behaviour, Jung and Tran (2014) study medical expenditure behavior over the life cycle, separating pure age effects and cohort effects. Ozkan (2014) studies differences in the lifetime profile of health care usage between low- and high-income groups and finds that policies encouraging the use of health care (especially preventive) by the poor early in life have significant welfare gains, even when fully accounting for the increase in taxes required to pay for them. Kopecky and Koreshkova (2014) evaluate joint effect of social security and Medicaid on labor supply, savings, economic inequality and welfare due to idiosyncratic risks in labor earnings, health expenses and survival. Brown et al. (2015) study long-term impact of expansion of Medicaid and State Children's Health Insurance Program that occurred in 1980's and 1990's and find that the government will recoup 56 percent of spending on childhood Medicaid by the time these children reach 60. However, papers on health and health policies typically ignore human capital dimension.

The current paper builds a bridge between literature on health and health policies on the one hand and human capital and human capital policies literature on the other and provides a more structural model to look at the relationship of health and health policies, their interaction with educational policies and intergenerational mobility.

3. The Model

Consider the following overlapping generations model. Time is discrete and the horizon is infinite. Each household consists of one child and parents. Parents can be single mothers or married couples (who act as a single decision making unit). Marital status of parents is denoted by $\theta = 0$ (single) and $\theta = 1$ (married). Each model period corresponds to 7 years. Each person lives for 8 periods: 3 as a child (0-7, 8-14, 15-21), denoted by j, 5 as adult (22-28, 29-35, 36-42, 43-49, 50-57), denoted by t.

Fertility is exogenous; when a person becomes an adult, after 3 periods of childhood, she can have no child or one child that is born in the 1st (22-28), 2nd (29-35) or 3rd (36-42) period of the adulthood. The childbearing status is denoted by $b = 0$ (childless), $b = 1$ (early childbearers), $b = 2$ (middle-age childbearers), and $b = 3$ (late childbearers).

Besides marital status and fertility, households differ by human capital of parents and children. I allow for multidimensionality of human capital. Each child has bidimensional human capital: health capital (h) and other types of human capital (a). The latter includes cognitive and socioemotional skills. Similarly, each parent has her health capital (H) and human capital A (whenever possible I use capital letters to indicate parental variables). Human capital determines earnings potential of an adult, while health determines how much labor he can supply.

If a family does not have children, it just consumes everything. If there is a child, households make two sets of decisions. First, they decide whether or not to buy medical insurance for their children. Then, they decide how much to spend on his education and health. There is also a government in the economy that provides health insurance for poor households. The government also gives education subsidies. While the education subsidies are universal for early education, they are income based for late (college) education.

Children are born with innate health (a^*) and innate ability (h^*), which are correlated across generations. Innate ability, together with investment by parents, government policies and luck, transforms into future ability of a child and eventually determines his productivity as an adult. Similarly, innate health, together with health spending by parents, government policies and luck, transforms into future health of a child and eventually into his health status as an adult.

Parents make decisions to maximize their lifetime utility and are altruistic, i.e. they care about their offspring's utility when they become adults. Thus, they care about leaving their children with high levels of health and human capital. I abstract from assets and physical capital in the model. There is no aggregate uncertainty as well.

3.1. Health, Ability and Human Capital

Human capital is bidimentional, it consists of health capital and human capital. I use the term human capital and ability interchangeably. Ability determines an adult agent's earnings potential. Health capital, on the other hand, determines the quantity of labor supplied by an adult individual on the labor market. For children, current ability and health are inputs for the production of future ability. After three periods with their parents, children become adults and their human capital and health capital determines their ability (productivity) and health as adults.

A central feature of the model is health and human capital production. Following Cunha, Heckman and Schennach (2010) I allow for dynamic complementarity and self-productivity of human capital. Children start their life with innate health h^* and innate ability, a^*, randomly drawn and correlated with their parent's innate health and ability. Let $\Gamma_{a^*|A^*}$ and $\Gamma_{h^*|H^*}$ represent the Markov processes for innate ability and health, where A^* and H^* are innate ability and health of parents.

Given $h_1 = h^*$, during the childhood, next period's health depends on previous period's health, medical spending by parents, denoted by m, and a health shock, denoted by υ. In particular, I assume that health status takes two values, good or bad, and the probability that next period health is equal to h_k, $k \in \{good, bad\}$, is given by the following logit relation

$$Pr(h' = h_k|h, m) = \Lambda(\alpha_0^h + \alpha_1^h h + \alpha_2^h m + \alpha_3^h h \cdot m), \tag{1}$$

where Λ is the logistic function. It is assumed that υ is independent and identically distributed with zero mean and variance σ_υ^2. I allow these production functions be different in the early childhood (period 1 and 2) and late childhood (period 3).

After 3 periods of childhood, children become adults and health in the first period of adulthood is given by

$$Pr(H_1 = H_k|h, m) = \Lambda(\alpha_{30}^h + \alpha_{31}^h h + \alpha_{32}^h m + \alpha_{33}^h h \cdot m). \tag{2}$$

Once H_1 is determined, future health as an adult is given by an exogenous process $Q_{H'|H}$, which captures life-cycle health transitions. Adult's health determines the number of hours an adult can work, denoted by $T_t(H)$. It is assumed that the effect of health on hours work depends on the age of the parent.

Every period parents and government invest into child's ability. These investments, together with the current health and ability, determines next period's ability. The process is, however, not deterministic and each period there is a shock for ability accumulation, denoted by ε. It is independent and identically distributed with zero mean and variance σ_ε^2.

In the 1st and 2nd periods, government provides each household with g units of resources to invest on their children. Given g, parents can complement them with private educational spending, denoted by $e \geq g$. Ability production function in the 1st and 2nd childhood periods take as inputs previous ability and health, amount of parental spending into education, as well as the random shock, ε_j. As health, human capital also can take two values, low and high, and the probability that next period's ability is equal to a_k, $k \in \{high, low\}$ is given by a logit function:

$$Pr(a' = a_k|a, h, e, A) = \Lambda(\alpha_0^a + \alpha_1^a a + \alpha_2^a h + \alpha_3^a e + \alpha_4^a \cdot a \cdot e + \alpha_5^a \cdot h \cdot a + \alpha_6^a A + \alpha_7^a A \cdot e) \quad (3)$$

In the 3rd period of childhood, parents make a decision whether or not to send their child into college. The college tuition is denoted by E. Depending on their income, parents qualify for subsidies to cover this tuition. If they don't send their children to college, children participate in the labor market during the last period of their childhood. Children then supply $t_3(h_3)$ hours in the market and contribute to household income.

After three periods of childhood, accumulated ability, health, along with decision on college education, determines the productivity of the child as an adult, A_1. The process is also subject to a shock ε_3, normally distributed with zero mean and variance σ_{inc}^2, which captures the fact that within a cohort, earnings vary and more than one-third of the variance is attributable to post-education factors (Huggett et al., 2011). A_1 is determined in the following way. First, for each child the following value Π is calculated:

$$\Pi = \alpha_{30}^a + \alpha_{31}^a a + \alpha_{32}^a h + \alpha_{33}^a col + \alpha_{34}^a \cdot a \cdot h + \alpha_{35}^a \cdot h \cdot col + \alpha_{36}^a \cdot a \cdot col + \varepsilon_3. \quad (4)$$

Then four threshold income levels x_1, x_2, x_3, and x_4 are selected such that about 20% of children are in the first, second, third, fourth and fifth quintiles of a normal distribution with zero mean and variance σ_{inc}^2, and each child is placed into the corresponding income quintile as an adult.

Starting from the first adult period, ability, A_1, is characterized by the productivity quintile of an adult and is subject to an exogenous stochastic process, $Q_{A'|A}^\theta$ that captures life-cycle behavior of productivity and is specific to the marital status θ.

3.2. Government

Government taxes income at a proportional tax τ and spends tax revenue on education and health. Governmental budget is balanced:

$$\tau Y = G + F + S,$$

where Y is the total income in the economy, G is the total spending on primary and secondary education, F is the total spending on college subsidies, and S is the total spending on Medicaid/SCHIP.

Education Policy In the US, primary and secondary education is obligatory and is guaranteed for all children of the age 5 to 18.[6] While young (2 to 5 years old) children can attend pre-kindergarten, these classroom based preschool program are run by private organizations and parents need to pay or them. There are, however, several government-funded programs (such as Head Start) that target mostly disadvantaged children.

In the paper I assume that governmental educational spending for children in periods 1 (0-7) and 2 (8-15) are equally distributed among all children and parents can supplement governmental spending. At this stage I ignore any other programs, such as Head Start.

While they are in college, children can receive governmental federal grants for their studies. In the model government also provides income-based college subsidies. Functional form of the college subsidy is chosen to be rather general. For a household with income level $T_t(H)A$, it is given by

$$\kappa(T_t(H)A) = \max\{0, E - \kappa(AT_t(H))^{\phi}\},$$

where E is tuition cost, κ is the slope of the subsidy function and ϕ is a curvature parameter.

Medical Policy In the U.S., the government subsidizes children's health investments through Medicaid and State Children's Health Insurance Program (SCHIP) programs. Medicaid is a means-tested, needs-based social welfare and social protection program. Eligibility is categorical; some of these categories include low-income children below a certain age, pregnant women, parents of Medicaid-eligible children who meet certain income requirements, and low-income adults and seniors. A child may be eligible for Medicaid regardless of the eligibility status of his parents. In the 1997-2011 period all children from birth to age 5 with family incomes up to 133% of the Federal Poverty Line (FPL), that is about $24,644 for a family of three in 2011, were eligible for Medicaid coverage. For children of age

[6] Depending on the state with permission of parents child can drop out before he turns 18

6-18 the threshold was a little lower - 100% of FPL ($18,530 for family of 3 in 2011).[7]

SCHIP was designed to cover uninsured children in families with incomes that are modest but too high to qualify for Medicaid. States are given flexibility in designing their CHIP eligibility requirements and policies within broad federal guidelines. In general, in all states children from birth through age 19 who live in families with incomes above the Medicaid thresholds and up to around 241% of FPL on average are eligible for SCHIP (North Dakota currently has the lowest level at 160% of FPL. New York currently has the highest level at 400% of the FPL.)

The Affordable Care Act (ACA, known also as ObamaCare) was enacted in March 2010 and took effect in January 2014. It increases the level of eligibility for Medicaid for children of 6-18 years old from 100% of FPL to 133% of FPL (effectively to 138% of FPL due to a special deduction to income of 5% while determining Medicaid eligibility). It expands affordable Medicaid coverage for millions of low-income people that were not eligible for Medicaid before. Adults of the age 19-65 with the income lower than 133% of FPL (which is effectively 138%) now have a chance to get Medicaid in states that expanded Medicaid coverage according to ACA. However, there are some issues with implementation of Obamacare on the state level. States might reject implementation of Medicaid expansion. Now there are 29 states that expand Medicaid and 22 states that do not expand Medicaid. If a person lives in a state that does not expand Medicaid coverage, she still might be able to receive Medicaid if her income is less than 100% of FPL. For the purposes of this paper I will consider that all adults of the age 19-21 are not different from children of age 6-18 in terms of Medicaid eligibility and have the same 100% FPL eligibility threshold.

Health Insurance in the Model Economy I model governmental policy with respect to health in a general way, but try to capture the main features of the current policy in the U.S. If parents have low income, their children are eligible for Medicaid/SCHIP. However, there are some short-cuts I have to make in my model. Actual Medicaid/SCHIP policies have higher threshold to be eligible for Medicaid (133% of FPL) for children between ages 0 to 5 than children of age 6-18 (100% of FPL); and children after age 18 are not eligible. In my model childhood periods are 0-7, 8-14 and 15-21. I assume that health policy does not change within model periods, i.e. those who were eligible until age 5 are still eligible until age 7. And those who were eligible until age 18 are eligible until age 21.[8]

Parents decide on buying private insurance for their child and on the amount of

[7] Source: http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Financing-and-Reimbursement/Downloads/Pov-Level-2011.pdf

[8] I abstract from eligibility of teenagers and young adults that got pregnant to Medicaid.

medical spending, taking into account insurance functions. Insurance mechanism is similar to Ozkan (2014). If parents buy private insurance for their child, they pay a tax-deductible insurance premium p_{ins}. Insurance premium is the same for all children of each cohort but might be different for different cohorts. I model insurance premium to be tax deductible as around 85% of private insurances are provided through employers.

If parental income in period j is lower than the threshold $\overline{I_j}$, the child is eligible for Medicaid and SCHIP and parent does not have to pay an insurance premium.[9] I will model insurance functions for private insurance (PRV) and Medicaid/SCHIP (MCD) in the same way. Both of them have a deductible $\eta^{MCD/PRV}$, up to which parents do not receive the reimbursement from insurance company/government, and for each dollar above the threshold $\eta^{MCD/PRV}$, they receive a fraction $\mu^{MCD/PRV}$ as a copayment-rate. Hence, the amount they receive from the government as a subsidy for spending m is given by

$$\chi_j^{MCD/PRV}(m) = \begin{cases} 0 \text{ if } m \leq \eta_j^{MCD/PRV} \\ \mu^{MCD/PRV}(m - \eta_j^{MCD/PRV}) \text{ if } m > \eta_j^{MCD/PRV} \end{cases}.$$

Eligibility for Medicaid/SCHIP indicator is given by

$$\mathcal{I}_j^{MCD}(AT_t(H)) = \begin{cases} 0 \text{ if } AT_t(H) > \overline{I_j} \\ 1 \text{ if } AT_t(H) \leq \overline{I_j}. \end{cases},$$

where $\overline{I_j}$ corresponds to eligibility threshold set up by the Medicaid and SCHIP (which depends on the age of children), A is the productivity of a parent, and $T_t(H)$ is hours devoted by a parent of age t to the labor market (hence $AT_t(H)$ is their total income).

3.3. Household Problem

Households maximize their lifetime utility. The discount factor is $\beta < 1$. The per-period utility from consumption is assumed to take the following functional form

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}.$$

[9]In the data, being eligible for Medicaid and SCHIP does not mean that people enroll into it. Indeed, 8 million children remain uninsured, including 5 million who are eligible for Medicaid and SCHIP but not enrolled (Medicaid website). In paper I will abstract from this fact and assume that if child is Medicaid eligible, he is enrolled into the program, except for the case when parents purchased a private insurance for him.

I start by describing the problem of parents who are childless, either because $b = 0$ (i.e. they never had children) or because their children already left the house or are not yet born.

Childless Parents
State space of the household without children is given by $\mathbf{x} = \{A, H, \theta, b\}$, where A is the current productivity, H is the health status, θ is marital status, and b is parental child-bearing status of parents. If a parent does not have any child at home, then she only consumes. Her value function is given by

$$V_{t,0}(\mathbf{x}) = \max \{u(c) + \beta E_{A',H'} V_{t+1,j}(\mathbf{x}')\},$$

subject to

$$c = (1 - \tau)T_t(H)A,$$

and

$$j = \begin{cases} 0, \; b = 0, \text{ or } b = 1 \text{ and } t > 3, \text{ or } b = 2 \text{ and } t > 4, \\ 1, \text{ otherwise} \end{cases},$$

where τ is the tax rate, $T_t(H)$ is the time that parents devote to labor market as a function of their health. Hence, after-tax income of the household is given by $(1 - \tau)T_t(H)A$, and absent any savings they consume their income in the current period. Note that the value functions of parents are indexed both by their age, t, and the age of their children, j. For a childless parent $j = 0$.

Next period, the household will have the same values of θ and b, but will have new draws for A and H, hence $\mathbf{x}' = \{A', H', \theta, b\}$. A household with no children today can still be without any child next period, if $b = 0$ or the children have already left the house. The household can also have a 1-year old child next period, if, for example, $t = 1$ and $b = 2$, i.e. the parents are one-year old and have their children in the second period. The last constraint summarizes how the number of children evolves for the households.

Parents with Children
Consider now the problem of parents with children. We will first start with the problem of a parent whose child is 3 years old and will become adult next period. We assume that each period parents with children decide whether to buy health insurance for the next period, except when their children is just born, i.e. $j = 1$, in which case they have to decide whether to buy health insurance for the current as well as the next (second period). As a result, a parent with a 3-year-old child arrives to the current period with heath insurance decision already made last period when the child was two years old. This decision was made before parents observe their own as well as their children heath and ability outcomes for the next period As a result, health insurance decision for the third period is not made conditional on

children's current health. Given this insurance decision from last period, a parent with a 3-years old child decides how much to spend on his child's health. The parent also decides whether to send her child to college, given government college subsidy program. The problem for a parent with a 2-years-old child is quite similar. Given the insurance decision from last period, parents decide how much to spend on health and education of their children, given available government policies. When a parent has a 1-years old child, then he decides whether to buy health insurance for the current period, again before observing his child's current health and ability as well as makes a plan whether to buy insurance for the next period after first period health and ability are realized.

Third Period of Childhood ($j = 3$) Given an insurance decision from the last period, in the third period of the childhood parents take decisions on college education, medical spending, and consumption. The parent is altruistic and she cares about the expected utility of her adult child. As a result, parents are motivated to leave their children with highest possible productivity and health.

State space of a parent with a child in the third period of childhood in the beginning of a period is given by $\mathbf{x} = \{a^*, h^*, \theta, b, a, h, A, H\}$, where a^* and h^* are children's innate ability and health, a and h are child's current ability and health, and A and H are parents' current ability and health.

Given their insurance status (insured, i, or uninsured, u), parents' decision whether to send their children to college is given by the following value function

$$V^i_{t,3}(\mathbf{x}) = \max\{V^{c,i}_{t,3}(\mathbf{x}), V^{nc,i}_{t,3}(\mathbf{x})\},$$

and

$$V^u_{t,3}(\mathbf{x}) = \max\{V^{c,u}_{t,3}(\mathbf{x}), V^{nc,u}_{t,3}(\mathbf{x})\},$$

where superscript c corresponds to sending to college, and nc to not sending to college.

The value associated to each of these outcomes reflects optimal decisions by the parents. The value of sending the child to college and purchasing health insurance, for example, is given by

$$V^{c,i}_{t,3}(\mathbf{x}) = \max_{c,m} \left\{ u(c) + \beta E V_{t+1,0}(\mathbf{x}') + \psi E \hat{V}_{1,j}(\mathbf{x}'_{child,j}) \right\},$$

where $E\hat{V}_{1,j}$ is the expected value of the child when he becomes adult and child's state space when she becomes adult, $\mathbf{x}'_{child,j}$, is defined as her initial productivity level, which is the function $f(a_3, h_3, college, \upsilon_3)$, her initial health that is the function $g(h_3, m_3, \varepsilon_3)$, his marital and child-bearing shock, ψ is the degree of altruism of a parent, to which extent he enjoys utility of his child.

The budget constraint associated to this problem is given by:

$$c = (1-\tau)[T_t(H)A) - p_{ins}] - m + \chi^{PRV}(m) - (1-\kappa(T_t(H)A))E, \qquad (5)$$

and

$$\kappa(T_t(H)A) = \max\{0, E - \kappa(AT_t(H))^{\phi}\},$$

where where c is consumption, τ is the tax rate, $T_t(H)$ is a function of health that determines parental labor supply, A is parent's productivity, p_{ins} is private insurance premium, m is medical spending, $\chi^{PRV}(m)$ is private insurance reimbursement of medical spending made by parents, E is the tuition fee for college, $\kappa(T_t(H)A)$ is governmental subsidy for college. Hence, the parent has $(1-\tau)[T_t(H)A - p_{ins}] + \chi^{PRV}(m)$ as her income after paying tax deductible insurance premium and receiving reimbursements from the private insurance company. She spends m on health care of her child and $(1-\kappa(T_t(H)A))E$ on college.

In the same spirit, the value function associated to not sending the child to college and not purchasing private insurance is given by

$$V^{nc,u}_{t,3}(\mathbf{x}) = \max_{c,m} \left\{ u(c) + \beta E V_{t+1,0}(\mathbf{x}') + \psi E \hat{V}_{1,j}(\mathbf{x}_{child,j}) \right\},$$

subject to:

$$c = (1-\tau)[T_t(H)A + t_3(h)a] - m + \chi^{MCD}(m)\mathcal{I}^{MCD}_3(T_t(H)A), \qquad (6)$$

where $t_3(h)a$ is child's hours supplied to the labor market (child works if he does not attend college) and $\chi^{MCD}(m)\mathcal{I}^{MCD}_3(T_t(H)A)$ is reimbursement of medical spending by Medicaid in case child is Medicaid-eligible, i.e. if $\mathcal{I}^{MCD}_3(T_t(H)A) = 1$.

Second Period of Childhood ($j = 2$) As in the third period of childhood, parents arrive to the second period of childhood with an insurance decision from the last period. Then they decide on medical and educational spending and consumption as well as whether to buy insurance for the next period. State space of a parent with a child in the second period of childhood in the beginning of a period is given by $\mathbf{x} = \{a, h, a^*, h^*, A, H, \theta, b\}$. Then, the value function for an insured child is given by

$$V^i_{t,2}(\mathbf{x}) = \max_{c,e,m} \{u(c) + \beta \max\{E_{A',H',a',h'} V^i_{t+1,3}(\mathbf{x}'), E_{A',H',a',h'} V^u_{t+1,3}(\mathbf{x}')\}\},$$

subject to

$$c = (1-\tau)[AT_t(H) - p_{ins}] - m + \chi^{PRV}(m) - e,$$

$$a' = f(a, h, e, \upsilon),\ \text{and}\ e \geq g$$

$$h' = g(h, m, \varepsilon)$$

and

$$Q^t_{H'|H},\ \text{and}\quad Q^t_{A'|A}.$$

where e is parental educational spending, g is governmental spending on secondary education, $Q^t_{H'|H}$ and $Q^t_{A'|A}$ are exogenous stochastic process that captures parental health and productivity life-cycle profiles. The terms $E_{A',H',a',h'}V^i_{t+1,3}(\mathbf{x}')$ and $E_{A',H',a',h'}V^u_{t+1,3}(\mathbf{x}')$ represent the expected value of being insured or uninsured in the third period of childhood, respectively.

The value function for an uninsured child is given by

$$V^u_{t,2}(\mathbf{x}) = E\max_{c,e,m}\left\{u(c) + \beta\max\{E_{A',H',a',h'}V^i_{t+1,3}(\mathbf{x}'), E_{A',H',a',h'}V^u_{t+1,3}(\mathbf{x}')\}\right\},$$

subject to

$$c = (1-\tau)[AT_t(H)] - m + \chi^{MCD}(m)\mathcal{I}^{MCD}_2(AT_t(H)) - e,$$

$$a' = f(a, h, e, \upsilon), \text{and}\ e \geq g,$$

$$h' = g(h, m, \varepsilon),$$

and

$$Q^t_{H'|H},\ \text{and}\ \ Q^t_{A'|A}.$$

where $\mathcal{I}^{MCD}_2(AT_t(H))$ is the indicator function for Medicaid eligibility in the period 2.

First Period of Childhood $(j = 1)$ Parents with a one-year-old child decide first whether to buy insurance for the current period. Then they decide how much to spend on education and health of their children as well as whether to buy insurance for the next period. At the start of the period, parents' state space is given by $\widetilde{\mathbf{x}} = \{\theta, b, A, H, A^*, H^*\}$. Hence they do not know yet a or h, and decide whether to buy insurance for the current period. Then a and h are realized and, given their health insurance decisions they decide on e, m and purchasing or not an insurance for the second period. The state space of the parent after the realization of a and h is denote by $\mathbf{x} = \{\theta, b, A, H, h, a\}$. Hence the health insurance decision of parents at the start of the period is characterized by the following value function

$$V_{t,1}(\widetilde{\mathbf{x}}) = \max\{E_{h,a}V^i_{t,1}((\mathbf{x}), E_{h,a}V^u_{t,1}(\mathbf{x})\},$$

where the expectations on a and h are conditional on A^* and H^* (recall that $a = a^*$ and $h = h^*$ in the first period of childhood and the innate health and ability are correlated across generations). Once h and a are realized the problem of parent with a one-year-old child looks very similar to the problem of parents with a two-years-old child. For parents with health insurance, it is given by

$$V^i_{t,1}(\mathbf{x}) = \max_{c,e,m} \left\{ u(c) + \beta \max\{E_{A',H',a',h'} V^i_{t+1,2}(\mathbf{x}'), E_{A',H',a',h'} V^u_{t+1,2}(\mathbf{x}')\} \right\},$$

subject to

$$c = (1-\tau)[AT_t(H) - p_{ins}] - m + \chi^{PRV}(m) - e,$$

$$a' = f(a, h, e, g, \upsilon), \text{ and } e \geq g$$

$$h' = g(h, m, \varepsilon),$$

and

$$Q^t_{H'|H}, \text{ and } \quad Q^t_{A'|A}.$$

For parents without health insurance, the problem reads as

$$V^u_{t,1}(\mathbf{x}) = E\max_{c,e,m} \left\{ u(c) + \beta \max\{E_{A',H',a',h'} V^i_{t+1,2}(\mathbf{x}'), E_{A',H',a',h'} V^u_{t+1,2}(\mathbf{x}')\} \right\},$$

subject to

$$c = (1-\tau)[AT_t(H)] - m + \chi^{MCD}(m)\mathcal{I}^{MCD}_2(AT_t(H)) - e,$$

$$a' = f(a, h, e, g, \upsilon), \text{and } e \geq g,$$

$$h' = g(h, m, \varepsilon),$$

and

$$Q^t_{H'|H}, \text{and } \quad Q^t_{A'|A}.$$

4. Estimation

To estimate the model I adopt a two-step procedure similar to the one used by Gourinchas and Parker (2002), De Nardi, French and Jones (2010), and Coşar, Guner and Tybout (2016). In the first step I select all parameters that could be assigned without simulating the model (either directly from the data or from previous literature). Most importantly, characteristics of public and private insurance schemes, and life cycle health profiles of adults are set in the first step. In the second step, I estimate the rest of the parameters with method of simulated moments, taking the first-step estimates as given. In this section I describe first step estimates, then I turn to the second step estimation.

4.1. First-step estimation

Few parameters can be determined based on available estimates in the literature or can be calculated directly from aggregate statistics.

Discount factor, β. I choose discount factor to be the standard value, 0.96 per year, from the literature.

Coefficient of relative risk-aversion, σ. Coefficient of relative risk-aversion is taken from De Nardi et al. (2010) and is equal to 3.

Government spending for education, g. According to Digest of Education Statistics, total expenditures per pupil in public elementary and secondary schools in 2010-2011 is $12,908.[10]

Variance of health shocks, σ_v, and variance of ability shocks in the first and second periods, σ_ε. As production functions are logits, variances are normalized to $\pi^2/3$.

Several other parameters are estimated directly using micro data.

Data

I use two datasets: Medical Expenditure Panel Survey (MEPS) for the period 1996-2009 to analyze insurance policies and medical spendings and Panel Study of Income Dynamics main survey (PSID, for years 1948-2011) and Child Development Supplement of PSID (CDS-PSID, for years 1997-2011) for the rest of the purposes.

Main source of the data is PSID and CDS-PSID. PSID is a yearly survey (biannual after year 1997) of a nationally representative sample of households in 1968. I am using main study of PSID for information on labor market outcomes, such as hours worked and income, marital status histories from Marital History Supplement, child-bearing information from Child and Adoption History Supplement. Although the Main Study contains information on all members of household, it is limited for the non-head and non-wife members.

CDS-PSID is a research component of PSID that gathers detailed information of children residing in main PSID households. The sample of CDS-PSID are children and their parents in PSID households of the age 0-12 in the year 1997. These

[10]Source: http://nces.ed.gov/programs/digest/d13/tables/dt13_236.55.asp. Variable Expenditure per pupil in average daily attendance

families were recontacted and followed-up in 2002 and 2007. CDS-PSID gathered very extensive information on family demographic and economic data about the CDS target child's family as well as health, well-being, cognition, relationships, and early human capital formation. Moreover, children from CDS were followed in a substudy "CDS Youth's Transition into Adulthood" (TA) that was first conducted in 2005 and biannually since then. The TA was initiated to bridge a gap between CDS sample after they turn out 18 but before they form their own family and become head or wife of the household. The rich data structure of PSID, CDS-PSID, and TA allows for intergenerational links over generations of family members, that is the crucial for the purposes of this paper.

Second source of the data is MEPS - a survey of a representative sample of individuals and households of all ages. It provides information about usage and cost of health care. It's a rotating panel survey, each household is interviewed 5 times over a two-year period. I use information on insurance usage and sources of medical expenditure (out-of-pocket, private insurance company, Medicaid) from this survey. PSID contain data on insurance, but it is more limited. The model design allows to combine different sources of the data, that's why I use MEPS data as a more reliable source. The reliability of MEPS comes from the fact that data on medical expenses and insurance is gathered twice: from the household and confirmed by the medical providers.

I describe now how different variables for the analysis are created (all monetary values are expressed in 2005 dollars):

Parental Health, H. Constructed from the self-rated health variable in PSID for mothers. Mothers rate their health as "excellent", "very good", "good", "fair" or "poor". As model period corresponds to 7 years, I take an average of health over all available observations available during a 7-year period in the data. I create a health dummy where 1 (good health) corresponds to the first three grades, and 0 (bad health) to the other two.

I calculate Markov transition matrix for health evolution of parents, $Q^t_{H'|H}$, explicitly from the data. It's an exogenous stochastic process that depends on age of a parent. Numbers are presented in the Table 1. In general, good health status is very persistent. Bad health status is less persistent, however it becomes more persistent with age.

Table 1: Parental life cycle health profile.

From/To	Bad	Good
22-28 to 29-35		
Bad	0.506	0.494
Good	0.053	0.947
29-35 to 36-42		
Bad	0.595	0.405
Good	0.084	0.916
36-42 to 43-49		
Bad	0.711	0.289
Good	0.098	0.902
43-49 to 50-57		
Bad	0.749	0.251
Good	0.135	0.865

NOTE: Transitions are calculated from PSID 1968-2011.

Hours Worked, $T_t(H)$, $t_3(h_3)$. From PSID, I obtain values of total yearly hours worked by mothers and their spouses and total yearly hours worked by mothers in case of a two-parent and one-parent household, respectively. I average total hours worked over all observations corresponding to a 7-year model period for each level of health, that is also averaged for each of the model periods. Thus, there are two levels of working hours, for good and for bad health, for each model period. The same way I calculate hours worked for children who don't attend to college in their 3rd period of childhood, using PSID Transition to Adulthood. See Table 2 and Table 3 for numbers. People in good health on average have about 16% more of time available for work.

Parental Productivity, A. This variable corresponds to productivity quintiles, calculated from the PSID data. Productivity levels are calculated as follows. First, I divide total taxable income of the household (mother and her spouse if two-parent household, mother's income if one-parent household) by total household hours worked. Then I assign to each household its potential yearly income as the product of hourly productivity times $100 \cdot 52$ (I assume people have 100 available hours per week). The result of the calculations is split into quintiles, thus there are 5 levels of productivity for parents in each age group. Productivity profiles are different by marital status, θ. I present them in Table 4 for married parents and in Table 5 for single parents. Productivity of people from the last

Table 2: Parental hours conditional on health.

Age/Health	Bad	Good
22-28	0.42	0.54
29-35	0.47	0.58
36-42	0.50	0.59
43-49	0.50	0.60
50-57	0.46	0.57

NOTE: Numbers are calculated from PSID 1968-2011.

Table 3: Children's hours conditional on health in period 3 if no college.

Age/Health	Bad	Good
15-21	0.18	0.24

NOTE: Numbers are calculated from CDS PSID 2005-2011.

quintile is 5 to 12 times higher than the one of the people in the 1st quintile, increasing over age.

Table 4: Productivity life-cycle. Married

Average productivity	Q1	Q2	Q3	Q4	Q5
Age 22-28 (t=1)	40.12	73.02	95.16	120.77	187.49
Age 29-35 (t=2)	38.16	74.87	103.97	135.65	223.96
Age 36-42 (t=3)	36.06	79.38	111.62	153.35	262.76
Age 43-49 (t=4)	33.35	75.56	113.68	156.75	307.26
Age 50-57 (t=5)	26.38	69.60	109.87	161.59	339.79

NOTE: Average productivity is calculated for each income quintile from PSID 1968-2011.

I calculate Markov transition matrix for income quintile of parents, $Q^{\theta,t}_{A'|A}$, explicitly from the data. It's an exogenous stochastic process that depends on age and marital status of a parent. The processes are presented in Table 6 for married parents and in Table 7 for single. Productivity is persistent over time, becoming more persistent with age for higher productivity quintiles, especially for single parents.

Table 5: Productivity life-cycle. Singles

Average productivity	Q1	Q2	Q3	Q4	Q5
Age 22-28 (t=1)	10.27	34.35	53.27	75.98	130.92
Age 29-35 (t=2)	11.20	41.63	70.05	108.96	215.50
Age 36-42 (t=3)	11.80	42.07	71.57	115.65	254.21
Age 43-49 (t=4)	9.59	38.50	65.54	109.64	273.61
Age 50-57 (t=5)	3.38	28.55	54.49	89.92	241.86

NOTE: Average productivity is calculated for each income quintile from PSID 1968-2011.

Marital, θ, and child-bearing, b, shocks. Marital and child-bearing shocks are calculated from Children and Adoption History Supplement of PSID. A person is considered married if she spends more than half of her adult life (ages 20-60) as married, non-married otherwise. In the model parents can have a child at the 1st, 2nd or 3rd period of adulthood (that correspond to 22-28, 29-35, 36-42 age periods). Using the same Supplement, I calculate the probability of first child born at a particular age frame conditional on giving birth to at least one child. In Table 8 I present these statistics. Around 65% of parents are married most of the time and with 85% probability they have at least one child. While single parents have a child with only 42% probability. The first child is most often born when his parents are 22-28 years old, twice less frequent when they are 29-35 age old and only around 3% when parents are 36-42 old.

Table 8: Marital and child-bear shocks

Married				Non-married			
0.647				0.353			
No child	22-28	29-35	36-42	No child	22-28	29-35	36-42
0.153	0.581	0.235	0.031	0.577	0.276	0.111	0.036

NOTE: Numbers are calculated from Children and Adoption Supplement of PSID 1968-2011.

Child's health, h. In the first two periods of child's life this variable correspond to a health of a child reported by a primary care giver (usually mother) in CDS PSID. "Excellent" and "very good" health corresponds to good health, "good", "fair" or "poor" corresponds to bad health. As you might have noticed,

Table 6: Parental life cycle ability profile. Married

From/To	Q1	Q2	Q3	Q4	Q5
22-28 to 29-35					
Q1	0.613	0.227	0.101	0.036	0.024
Q2	0.216	0.418	0.199	0.125	0.041
Q3	0.124	0.187	0.389	0.216	0.084
Q4	0.052	0.134	0.306	0.314	0.193
Q5	0.014	0.043	0.086	0.233	0.623
29-35 to 36-42					
Q1	0.689	0.227	0.046	0.031	0.007
Q2	0.231	0.399	0.270	0.074	0.026
Q3	0.095	0.277	0.336	0.238	0.053
Q4	0.023	0.113	0.207	0.446	0.211
Q5	0.023	0.037	0.080	0.182	0.678
36-42 to 43-49					
Q1	0.658	0.249	0.077	0.016	0.001
Q2	0.215	0.422	0.239	0.104	0.019
Q3	0.090	0.184	0.423	0.262	0.040
Q4	0.033	0.079	0.164	0.474	0.249
Q5	0.011	0.010	0.067	0.181	0.732
43-49 to 50-57					
Q1	0.667	0.244	0.062	0.027	0.000
Q2	0.156	0.494	0.257	0.061	0.032
Q3	0.105	0.154	0.413	0.255	0.073
Q4	0.015	0.082	0.160	0.511	0.232
Q5	0.008	0.015	0.067	0.159	0.751

NOTE: Transitions are calculated from PSID 1968-2011.

this division is a bit different from that of adult, this happens due to the fact that most of children in the data have rather good health and very few children have "fair" or "poor" health. For the third childhood period health is taken from TA data, where children report their health themselves.

Child's Ability, a. Children of the age 3-17 were administered subtests of Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R)[11], in particular

[11]User Guide on ability measurements is available from https://psidonline.isr.umich.

Table 7: Parental life cycle ability profile. Singles

From/To	Q1	Q2	Q3	Q4	Q5
22-28 to 29-35					
Q1	0.635	0.223	0.060	0.066	0.016
Q2	0.158	0.383	0.283	0.127	0.049
Q3	0.072	0.170	0.299	0.298	0.161
Q4	0.015	0.079	0.193	0.382	0.332
Q5	0.003	0.033	0.086	0.243	0.635
29-35 to 36-42					
Q1	0.694	0.212	0.073	0.011	0.010
Q2	0.126	0.468	0.263	0.100	0.044
Q3	0.074	0.108	0.359	0.290	0.169
Q4	0.031	0.062	0.135	0.543	0.229
Q5	0.008	0.015	0.042	0.167	0.769
36-42 to 43-49					
Q1	0.639	0.289	0.053	0.019	0.000
Q2	0.165	0.401	0.328	0.095	0.012
Q3	0.035	0.175	0.398	0.341	0.050
Q4	0.029	0.048	0.116	0.474	0.333
Q5	0.010	0.008	0.024	0.131	0.826
43-49 to 50-57					
Q1	0.641	0.282	0.048	0.018	0.011
Q2	0.135	0.347	0.414	0.104	0.001
Q3	0.066	0.173	0.379	0.362	0.021
Q4	0.026	0.050	0.074	0.393	0.457
Q5	0.000	0.019	0.036	0.093	0.852

NOTE: Transitions are calculated from PSID 1968-2011.

Letter-Word identification test (that assesses symbolic learning and reading skills), Passage Comprehension (assesses reading comprehension and vocabulary, and ability to use these two skills together in a sentence completion task) and the Applied Problems test (assesses knowledge of mathematical operations and ability to per-

edu/Publications/Papers/tsp/2014-02_Achievement.pdf. This test battery is widely used in child development literature, less in economic literature, for example, see Creel and Farell (2015), Araujo, Carneiro, Cruz-Aguayo and Schady (2014) form computations)[12]. Children of age 3-5 were administered only the Letter-Word Identification and Applied problems subtests, while from age 6 all 3 subtests were performed. That's why I use first two subtests to identify ability in the 1st model period and all 3 subtests in the 2nd and 3rd model periods. CDS-PSID along with raw scores provides age-standardized standard score and percentile scores and W score, that allows to analyze gains in achievement over time. I am using the standard scores (mean 100, standard deviation 15 for each age group), that facilitates comparisons of children of different age. If multiple test scores are available, I use the average of them. Then for each model period I perform a factor analysis of subtests scores. Ability distributions for each age group are presented on the Figure 1. The resulting variable is split into 2 levels: less than median (that corresponds to low ability) and more than median (that corresponds to high ability). Thus, ability of a child is a binary variable: low or high.

Children productivity profiles, a_3. Children productivity profiles for those in $j = 3$ who do not attend college (and, consecutively, work) are calculated in the same way as for parents, using PSID TA data. As seen from the Table 9, productivity of the high ability children is 2.5 times higher than that of the low ability children.

Table 9: Children's productivity in period 3 if no college.

Age/Ability	Low	High
15-21	0.67	0.58

NOTE: Numbers are calculated from CDS PSID 2005-2011.

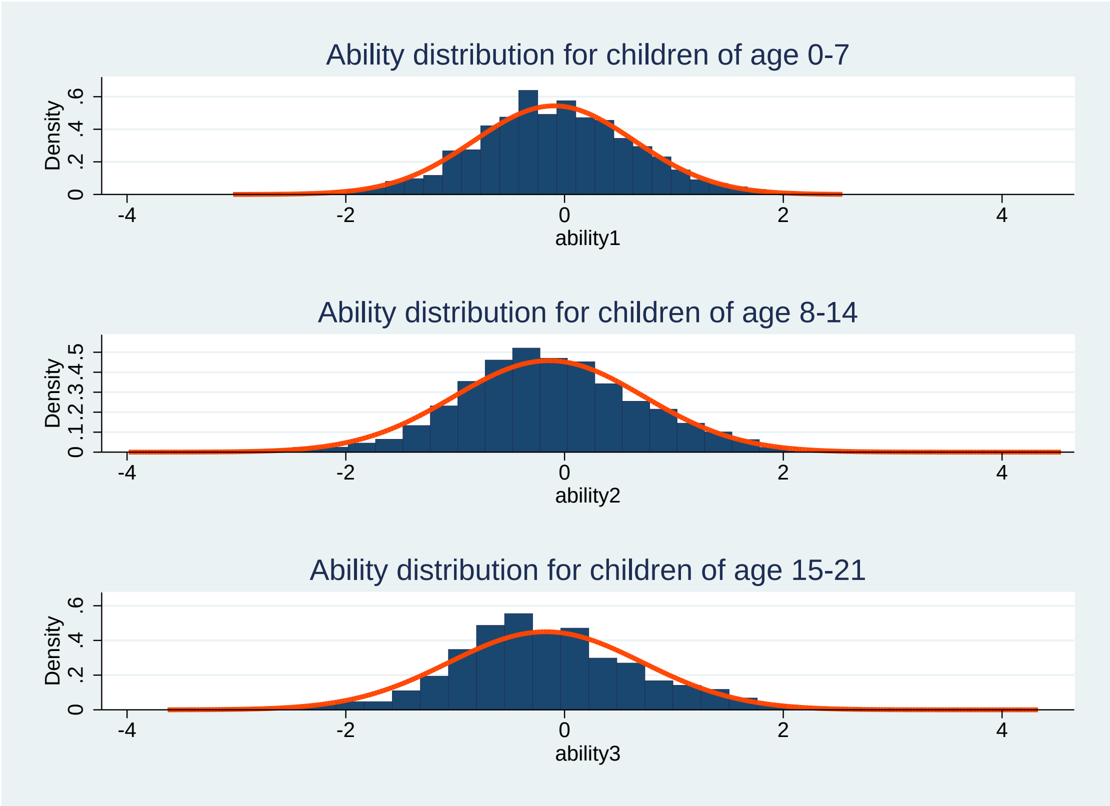
Insurance schemes. As explained in the section 3.2, the insurance schemes are described as:

$$\chi_j^{MCD/PRV}(m) = \begin{cases} 0 \text{ if } m \leq \eta_j^{MCD/PRV} \\ \mu^{MCD/PRV}(m - \eta_j^{MCD/PRV}) \text{ if } m > \eta_j^{MCD/PRV} \end{cases},$$

where $\eta^{MCD/PRV}$ is the deductible, up to which parents do not receive the reimbursement from insurance company/government, and for each dollar above the threshold $\eta^{MCD/PRV}$, they receive a fraction $\mu^{MCD/PRV}$ as a co-payment rate. I use MEPS to estimate these functions for each model period. MEPS provides information on total medical spendings, insurance coverage and sources of payment,

[12] In the CDS-I (1997) Calculations subtest was performed and combined with Applied Problems subtest Broad Math Score was calculated. I don't use Calculations subtest in defining ability as I prefer ability to be defined in a similar manner in all periods.

Figure 1: Ability distribution for different age groups



NOTE: Ability distribution comes from the measure of ability that is constructed in the paper. To construct this measure, subtests of Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R) were used, in particular, standardized measures of Letter-Word identification, Passage Comprehension and the Applied Problems test. For each model period a factor analysis was performed and the first factor is taken as the resulting ability measure.

e.g. private insurance firm or Medicaid. To estimate this function for private insurance I pick a sample of children with private insurance coverage during the entire year and estimate deductible (as an average out-of-pocket expenditure of households with no other expenditures) and co-payment rate from the MEPS data (similar to Ozkan (2014)). For Medicaid it's difficult to estimate parameters due to a large number of people with zero out-of-pocket expenditure, especially for the low-income parents. Thus I assume zero deductible and estimate co-payment rate from the data. As we observe in Table 10, the co-payment rate slightly decreases with the age of the child.

Table 10: Estimates for insurance function

Parameter	Period 1	Period 2	Period 3
η^{MCD}	0.000	0.000	0.000
μ^{MCD}	0.930	0.916	0.897
η^{PRV}	0.044	0.106	0.088
μ^{PRV}	0.818	0.795	0.767

NOTE: Coefficients are calculated from MEPS 1996-2009.

4.2. Second-step estimation

After the first step of estimations I am left with 39 parameters to be determined. Let's denote the vector of parameters Ω. It contains 3 parameters for educational subsidy function $\{\kappa, \phi, E\}$, 4 parameters for insurance function $\{\overline{I}_1, \overline{I}_2, \overline{I}_3, p_{ins}\}$, 2 parameters on the main diagonal for intergenerational transmission of ability in the matrix $\Gamma_{a^*|A^*}$ and 2 parameters on the main diagonal for intergenerational transmission of health in the matrix $\Gamma_{h^*|H^*}$. Then, parameters for production functions: 8 parameters for health production function $\{\alpha^h_0, \alpha^h_1, \alpha^h_2\, \alpha^h_3\}$ and $\{\alpha^h_{30}, \alpha^h_{31}, \alpha^h_{32}, \alpha^h_{33}\}$, 7 parameters for ability production function in the first and second periods of childhood (α^a_0, α^a_1, α^a_2, α^a_3, α^a_4, α^a_5, α^a_6, α^a_7) and 10 parameters for ability production function in the third period of childhood $\{\alpha^a_{30}$, α^a_{31}, α^a_{32}, α^a_{33}, α^a_{34}, α^a_{35},α^a_{36},x_1, x_2, x_3, x_4, $\sigma_{inc}\}$. The last parameter is ψ, which characterizes the degree of parental altruism towards their children.

I use a total of 46 moments in the estimation. If the source of the data moments is not mentioned, it means they are calculated from PSID and/or CDS-PSID.

1. (2 moments) Intergenerational mobility variables. First, intergenerational elasticity of income. Calculated as γ_1 in the following regression:

$$logY_{ch} = \gamma_0 + \gamma_1 logY_p,$$

   where Y_{ch} and Y_p are lifetime incomes of a child and parent, respectively. The target number is 0.4 (Solon, 2002; Mazumder, 2005). Second, probability of child moving from the bottom parental productivity quintile to the upper one. In the US this number corresponds to 9% (Chetty et al., 2014).

2. (2 moments) Correlations of child's and parent's health. As parental innate health is unobservable, I look at the correlations of parental health in the period when child is born with child's initial health. $Pr(h = good|H =$

$bad) = 0.782$, $Pr(h = good|H = good) = 0.912$. This persistence difference is rather big, as at birth 86% of children are healthy.

3. (5 moments) Correlations of child's ability with parental productivity quintile in the period the child is born. The same way we don't observe innate parental health, we don't observe innate parental ability. For this reason we use correlations of initial ability of a child and parental productivity measure (productivity quintile) in the period the child is born. $Pr(a = high|Q_A = 1, 2, 3, 4, 5) = 0.368, 0.543, 0.618, 0.677, 0.737$.

4. (3 moments) Share of children in good health in each childhood period (86,86,81%).

5. (6 moments) Unconditional transition probabilities between health states (good/bad) over different periods.$Pr(h_2 = good|h_1 = bad/good) = 0.645/0.893$, $Pr(h_3 = good|h_2 = bad/good) = 0.653/0.836$, $Pr(H_1 = good|h_3 = bad/good) = 0.503/0.796$. We observe that health is persistent over periods, and in the earlier periods bad state is less persistent as in the last period.

6. (5 moments) Share of healthy people in the beginning of the adulthood, by income quintile (86.4, 93.9, 94.9, 96.7, 97.8%).

7. (8 moments) Expected probabilities of transition between ability levels (high/ low) conditional on previous ability, health and parental investments into education: $Pr(a' = high|a = high/low, h = good/bad, e = e_1/e_2)$ where as a measure of parental educational investments (e) in the data I use HOME score.[13] HOME score lower than the median HOME score is denoted e_1, e_2 corresponds to the HOME score that is higher than the median. These moments are very important to identify the parameters of the ability production function. I present these moments in the Table 11. One can notice that given the level of educational spending and the health level, high ability results in higher probability transiting to higher ability next period than low ability. Second important take-off from this table is having good health provides higher probability of transition to high ability for the given level of current ability. Finally, higher educational spending guarantee higher transition probabilities to high ability level.

8. (5 moments) The share of college educated people at the age 25-29, by productivity (wage) quintiles (18,27,34.9,42,65%).

[13] HOME is used by different authors as a measure of parental investments into education. See, for example, Cunha et al. (2010)

Table 11: Ability transitions conditional on health and educational spending

Low Educational Spending				
	Bad Health		Good Health	
Ability	Low	High	Low	High
Low	0.924	0.076	0.793	0.207
High	0.385	0.615	0.314	0.686
High Educational Spending				
Low	0.782	0.218	0.671	0.329
High	0.364	0.636	0.204	0.796

NOTE: Transition probabilities are calculated from CDS-PSID 1997-2011.

9. (3 moments) Total share of college educated people in the economy (44%). Share of college students with federal grants (64%). Average amount of grant per student who received any Title IV aid from the government. In 2010-2011 is 9.630 thousand US$. In 2005 price and per 1 year in a 7-year model period is $4.777.[14].

10. (3 moments) The fraction of children on Medicaid in each childhood period (30.4, 23.7, 15.6%).

11. (4 moments) In each income quintile there should be 20% of people.

The Estimator

Method of simulated moments picks the parameter vector Ω to minimize a weighted sum of square deviations between data moments $\widehat{\pi}$ and their model-based counterpart $\pi(\Omega)$. The estimator then is given by:

$$\widehat{\Omega} = argmin(\widehat{\pi} - \pi(\Omega))'\widehat{W}(\widehat{\pi} - \pi(\Omega)),$$

where $\widehat{W}$ is some positive semi-definite matrix. $\widehat{W}$ represents a weight of each moment relative to all moments, and for any $\widehat{W}$ the estimator $\widehat{\Omega}$ is consistent. Let's assume the same level of importance of each group of moments and give the same weight for each group (that are described above), within each group the weight is distributed equally to all moments.

[14]Source:https://nces.ed.gov/programs/digest/d13/tables/dt13_331.30.asp

All parameters are identified jointly using all data moments and it is difficult to associate individual parameters of Ω to particular moments from $\widehat{\pi}$. Some of the moments, however, play crucial role in identification of particular parameters. For example, threshold levels for Medicaid eligibility $\{\overline{I}_1, \overline{I}_2, \overline{I}_3\}$ have a direct effect on amount of children receiving Medicaid while price of private insurance, p_{ins}, helps with identifying a share of children with private insurance.

Educational parameters $\{\kappa, \phi, E\}$ that enter governmental college subsidy function are mostly connected to such moments as shares of college educated people (total and by productivity quintiles) as well as a share of students with federal grant and an average college subsidy. These parameters determine how many children receive college subsidy and how important is parental income in receiving college subsidy, or, in other words, who exactly gets a college subsidy. The same moments together with intergenerational income elasticity and probability of upward mobility for the lowest income quintile children affect estimates of ability production function in childhood period 3 (α^a_{30}, α^a_{31}, α^a_{32}, α^a_{33}, α^a_{34}, α^a_{35},α^a_{36} σ_{inc}), which determines the initial productivity quintile for children who become adults. Parameters for income thresholds (x_1, x_2, x_3, x_4) just help to mechanically allocate a proper number of individuals to each of the productivity quintiles.

Unconditional transition probabilities for health, shares of healthy children in each life period together with insurance moments help to identify parameters for health production function in periods 1 and 2 $\{\alpha^h_0, \alpha^h_1, \alpha^h_2, \alpha^h_3\}$ and in period 3 $\{\alpha^h_{30}, \alpha^h_{31}, \alpha^h_{32}, \alpha^h_{33}\}$. These parameters should be estimated within the model because their estimation from the data leads to an econometric bias due to unobservability of the health shocks. In particular parameter α^h_2 that is related to medical spendings will have a negative sign if we run a logit in the data. We would interpret this as medical spendings are bad for health, however, in reality people who receive stronger health shocks spend more on medicine to compensate for the shocks. Not accounting for this bias will underestimate the role of medical expenditure in health investment. Moreover, I don't make a direct mapping between medical expenses in the data and medical expenses in the model. In the data only expenses for curative medicine could be observed. However in the model health is a form of capital, that also allows investments into it. Thus it's better to think of curative and preventive spending together while talking about medical spending in the model.

Conditional transition probabilities for health and ability will discipline ability production function in the first two periods of childhood, (α^a_0, α^a_1, α^a_2, α^a_3, α^a_4, α^a_5,α^a_7). These parameters determine relative roles of health, ability and parental and governmental investments for human capital production. It is important that health and ability moments are taken together as health enters ability production function as an input and so, production of health and human capital are very intertwined.

Estimates In the Table 14 I present parameter estimates of Ω.[15] According to the U.S. National Center for Education Statistics (NCES) in 2010-2011 average costs of one year of undergraduate full-time studies at a 4-year institution was 23,118 US$. This would imply $23,118(4/7) = 13,210$ US$ per year during a 7-year model period. The estimate of E implied by the model is $24,500 which is larger. However the cost of college is not only tuition, but also materials, living arrangements etc., which according to College Board[16] is around $13,203 per year. Taking this cost into account college spending is around $20,500 per year in a 7-year period model, that is close to $24,500 estimate we get in the model.

Insurance thresholds for 3 periods of childhood are estimated as $25,000, $42,000 and $121,000, respectively. In the data for a family of three income thresholds are between $29,648 and $74,120 (depending on the state) with an average of $44,657, which is also reasonably close to my estimate from the data for the first two periods. Third period threshold estimate is higher than the 1st and 2nd period thresholds. According to a recent report of Kaiser foundation employee's contribution to the average annual premiums for employer-sponsored health insurance is $4,823, which is also close to the model's estimate of insurance premium $p_{ins} = \$4,000$.[17]

To interpret the estimates of the production functions I calculate marginal effects for an average person. In the Table 12 I present results for the health production function. In the first and second periods of childhood average medical spending are $5,490, in the third period somewhat higher – $9,220. In the first line of the Table 12 I present the baseline probabilities of transiting to a good level of health conditional on the current level of health. The baseline probability of transition to the good health conditional on currently being in the bad health is 66.8% in the 1st and in the 2nd periods and 35.4% in the 3rd period, while conditional on the good health is much higher: 88.9% and 87.6% correspondingly. What is the effect of an additional $1,000 of medical spending? The results are presented in the line 2 of Table 12. For the children in bad health the baseline probability of transitioning to good health increases by 2.2% (1-2 periods) and 2.5% (3rd period), for children in good health the marginal effect of additional spending is much lower: 0.4% and 0.8%. Baseline gap in probabilities of transiting to the good health between healthy and non-healthy children is 22.1% (1-2 periods) and 52.2% (3rd period). Additional $1,000 of medical spending decreases this gap by 8% (1-2 periods) and 3% (3rd period). This result suggests that for an average family investments into health are relatively more beneficial for children in bad

[15] Standard errors are under calculations.

[16] Source: http://trends.collegeboard.org/sites/default/files/College_Pricing_2011.pdf

[17] Source: http://files.kff.org/attachment/ehbs-2014-abstract-summary-of-findings

health.

Table 12: Health production function. Baseline probabilities and marginal effects

	Periods 1,2 $\overline{m}$ =5.49			Period 3 $\overline{m}$ =9.22		
	$h_j = bad$	$h_j = good$	Δh	$h_j = bad$	$h_j = good$	Δh
Baseline probability ($Pr(h_{j+1} = good \vert h_j)$)	0.668	0.889	**0.221**	0.354	0.876	**0.522**
Marginal effect of \$1,000 medical spending ($\overline{m} + \$1,000$)	0.0221	0.00387	**0.2028**	0.0252	0.00799	**0.505**

NOTE: Baseline probabilities and marginal effects are calculated from the estimates of the health production function for the average level of medical spendings in the model.

In the Table 13 I present baseline transition probabilities for ability levels and marginal effect of an additional \$1,000 spending into education. Similar to Table 12, in th first line the baseline probabilities are reported for a child that gets an average amount of parental educational spending (\$4,120) and grows up in a family with an average labor productivity (\$109,000, which results in around \$50,000 as an average household income that is very close to an estimate of the median US household income, \$49,445 in 2010). In the first line I report the baseline probabilities of transiting into the high ability level conditional on current health and ability levels. Two important observations could be made. First, conditional on the level of health (bad/good), probability of having high ability next period is higher for those whose current ability is high: 20.2% versus 8.36% for bad health and 65.5% versus 20.3% for good health. Second, health contributes to the baseline probabilities. For the same level of ability, health produces almost three-fold difference in probability of having high ability next period. An additional parental investment of \$1,000 increases the baseline probabilities of transiting to the high ability next period. Both, current level of ability and current level of health are important. For the same level of health, high level of current ability means higher probability of having higher ability next period (35% versus 1.73% for bad health and 29.8% versus 4.14% for good health). The same level of ability for different level of health also reacts differently. Good health results in higher transition probability than bad health for the same level of ability. From this table we can make a conclusion, that health is an important determinant in ability production, and investing in education is just not enough to insure high productivity of children. One remark should be made here: ability production function is estimated for a binary ability variable, and the ability distribution is normal in shape (see Figure 1). The robustness analysis should be made with respect to ability thresholds.

Table 13: Ability production function. Baseline probabilities and marginal effects

$\overline{e} = 4.12$, $\overline{A} = 109$	Health=bad			Health=Good		
	$a_i = low$	$a_i = high$	Δa	$a_i = low$	$a_i = high$	Δa
Baseline probability ($Pr(a_{j+1} = high \mid a_j = a_i, h)$)	0.0836	0.392	**0.308**	0.203	0.655	**0.452**
Marginal effect of $1,000 educational spending ($\overline{e} + \$1,000, \overline{A}$)	0.0173	0.15	**0.4411**	0.0414	0.298	**0.7086**

NOTE: Baseline probabilities and marginal effects are calculated from the estimates of the ability production function for the average level of educational spendings and the average level of parental income in the model.

Model Fit Table 15 presents all the elements of $\widehat{\pi}$ and correspondent values of $\pi(\Omega)$. As could be seen from the table, model provides a reasonably good fit. As I have more moments than parameters, it is not possible to match exactly all the moments at the same time. Overall the model gives pretty good match. Intergenerational income elasticity is slightly underestimated, however probability of upward mobility is captured pretty well. Gini coefficient is well reproduced; it was not, however, targeted. Model captures very well the fraction of children from different age groups who receive Medicaid. Unconditional health transition probabilities are also very much in line with the data, although the fraction of individuals in good health is increasing in income in the data, the model does not produce this trend well enough. The model overpredicts the share of college graduates in economy, however the average level college subsidies and the fraction of students with college subsidies are lower than in the data. Model replicates well the number of college educated individuals in lower income quintiles, but overestimates their numbers at the top quintile. Conditional transition probabilities for ability during the childhood are slightly overestimated, however the monotonicity in these moments is captured very well. Model matches both the health and ability intergenerational correlations quite well. It underpredicts, however, probability of having good health if child's parent is in good health at the time of child's birth and probability of having high ability at birth conditional on income quintile of parents. Generally, there is a big trade-off between matching well intergenerational correlations and conditional and unconditional transitions for ability and health. The better is the match of intergenerational persistence in health and ability, the worse is the match of the transitions. In my opinion transitions moments are more important to match as they provide better information on the role of current levels of health and ability versus investments into education and medicine.

Table 14: Estimated Parameters

Parameter	Notation	Estimate
Income tax rate	τ	0.12412
Altruism parameter	ψ	0.29
Slope college subsidy wrt earnings	κ	0.5
Curvature parameter in subsidy funtions	ϕ	1.2
Tutition cost (in $1000)	E	24.5
Earnings threshold for eligibility for medical subsidy (in $1000)	I_1, I_2, I_3	25, 42, 121
Insurance premium (in $1000)	p_{ins}	4
	Intergenerational correlations	
Markov transition matrix for innate ability	Γ_a	[0.624 0.376; 0.3431 0.6569]
Markov transition matrix for innate health	Γ_h	[0.5975 0.4025; 0.3301 0.6699]
	Health production function	
Coefficients for health production function in $j = 1, 2$	α_0^h, α_1^h, α_2^h, α_3^h	0.49061, 1.5365, 0.1488, 0.3
Coefficients for health production function in $j = 3$	α_{30}^h, α_{31}^h, α_{32}^h, α_{33}^h	-1.6061, 1.535, 0.1088, 0.1
	Ability production function	
Coefficients for ability production function in $j = 1, 2$	α_0^a, α_1^a, α_2^a, α_3^a, α_4^a, α_5^a, α_6^a, α_7^a	-5.556, 0.559, 0.7015, 0.08, 0.0075, 0.03, 0, 0
Coefficients for ability production function in $j = 3$	α_{30}^a, α_{31}^a, α_{32}^a, α_{33}^a, α_{34}^a, α_{35}^a,α_{36}^a	1.7319, 3, 0, 0.5, 0.51, 0.19, 2.1
Thresholds for productivity quintiles and variance	x_1, x_2, x_3, x_4, σ_{inc}	2.5075, 3.5075, 4.5063, 5.5875, 0.9094

Table 15: Model Fit

Moment	Data	Model
Intergenerational income elasticity	0.4	0.273
Probability of Moving from Q1 to Q5	0.09	0.105
Probability of Moving from Q5 to Q5	0.32	0.279
Gini coefficient	0.4	0.424
Children with public insurance, j=1	0.304	0.358
Children with public insurance, j=2	0.237	0.245
Children with public insurance, j=3	0.156	0.132
$Pr(h = bad \mid H == bad)$	0.218	0.439
$Pr(h = good \mid H == good)$	0.912	0.547
$Pr(h_2 = good \mid h_1 = bad)$	0.645	0.708
$Pr(h_2 = good \mid h_1 = good)$	0.893	0.858
$Pr(h_3 = good \mid h_2 = bad)$	0.653	0.673
$Pr(h_3 = good \mid h_2 = good)$	0.836	0.974
$Pr(H_1 = good \mid h_3 = bad)$	0.503	0.76
$Pr(H_1 = good \mid h_3 = good)$	0.796	0.819
% of people in good health in Q1	0.864	0.789
% of people in good health in Q2	0.939	0.882
% of people in good health in Q3	0.949	0.666
% of people in good health in Q4	0.967	1
% of people in good health in Q5	0.978	0.771
% of children in good health	0.847	0.765
Share of students with federal grant	0.64	0.322
Share of college graduates	0.44	0.638
Average college subsidy	4.777	3.84
% of college educated people in Q1	0.18	0.26
% of college educated people in Q2	0.27	0.165
% of college educated people in Q3	0.349	0.819
% of college educated people in Q4	0.42	0.953
% of college educated people in Q5	0.65	0.956
$Pr(a = high \mid Q_A = 1)$	0.368	0.512
$Pr(a = high \mid Q_A = 2)$	0.543	0.522
$Pr(a = high \mid Q_A = 3)$	0.618	0.529
$Pr(a = high \mid Q_A = 4)$	0.677	0.529
$Pr(a = high \mid Q_A = 5)$	0.737	0.529
$Pr(a_t + 1 = high \mid a_t = low, h_t = bad, e = 1)$	0.076	0.206
$Pr(a_t + 1 = high \mid a_t = low, h_t = good, e = 1)$	0.207	0.344
$Pr(a_t + 1 = high \mid a_t = high, h_t = bad, e = 1)$	0.615	0.334
$Pr(a_t + 1 = high \mid a_t = high, h_t = good, e = 1)$	0.686	0.502
$Pr(a_t + 1 = high \mid a_t = low, h_t = bad, e = 2)$	0.218	0.314
$Pr(a_t + 1 = high \mid a_t = low, h_t = good, e = 2)$	0.329	0.48
$Pr(a_t + 1 = high \mid a_t = high, h_t = bad, e = 2)$	0.636	0.482
$Pr(a_t + 1 = high \mid a_t = high, h_t = good, e = 2)$	0.796	0.653

4.3. Role Of Health

In the model health affects labor income in two ways. The direct effect comes through the determination of physical capacity to work, $T_t(H)$. The indirect effects comes from the accumulated effect of health in human capital accumulation process, that eventually affects productivity level.

In order to understand the importance of these two channels, I shut them one at a time and simulate the model economy while keeping all other parameters at their benchmark values. First, I disregard health differences in supplied working hours. I set the same working hours for healthy and not healthy individuals, i.e. $T_t(H) = T_t$ where T_t is the working hours for entire population of age t (I set them equal to working hours of healthy people). Second, in the human capital production functions I set health-related coefficients equal to zero, i.e. I set α_2^a, α_5^a, α_{32}^a, α_{34}^a, and α_{35}^a equal to zero.

The results of these experiments are presented in Table 16. In the first column the benchmark model results are presented, second column contains the results of the first simulation. If there are no health differences in hours supplied for the labor market, intergenerational income elasticity would increase just slightly, from 0.273 to 0.281, however as health is not as important for labor supply as in the benchmark, the probability of moving upwards would increase by 10%, from 10.6% to 11.7%. If independently of health everyone can work the same hours, relative income levels of those in poor health would increase (and low income people tend to have worse health), and on average they would invest slightly more into education of their children. As a result their children will have higher productivity and higher income. In turn, college will become not as important as in the benchmark, because the only way college affects later life outcomes is through higher initial productivity level.

The indirect effect of health is more important. If health is not important for human capital accumulation (now it is important for labor supply only), average medical expenses decrease. As a result, the average health deteriorates. Now ability becomes the most important determinant of the human capital production. For richer individuals, however, who possess higher ability, investments into education are more efficient than for poor less able individuals, thus the gap in ability between poor and rich increases, which results in higher intergenerational income elasticity (increases from 27.3% to 37.3%, by 36%), lower upward mobility (decreases from 10.5% to 8.73%, by 17%) and higher inequality.

Table 16: Role of Health

Moment	Baseline	No Direct Effect $T_t(H) = T_t$	No Indirect Effect $\alpha_2^a, \alpha_5^a, \alpha_{32}^a, \alpha_{34}^a, \alpha_{35}^a = 0$
Intergenerational Elasticity and Inequality			
Intergenerational lifetime income elasticity	0.273	0.281	0.373
Probability of Moving from Q1 to Q5	0.105	0.117	0.0873
Probability of Moving from Q5 to Q5	0.279	0.265	0.269
Gini coefficient	0.424	0.394	0.433
Children in good health	0.776	0.706	0.742
Share of College Graduates	0.615	0.459	0.676
Medical Expenses			
Average Medical Expenditure	8.042	2.6	4.85
Educational Spendings			
Private Educational Expenditure	0.40	4.73	7.5
Tax rate	0.124	0.1087	0.12

5. Counterfactual Policy Experiments

In this section I present results of the main counterfactual experiments. These experiments highlight the effect of health and governmental health policies on intergenerational mobility. First, I eliminate all government spending on early education keeping the rest of the policies as they are. Second, in the same way I eliminate governmental subsidies for college education. Third, I shut down Medicaid policy keeping educational policies functional. As a result, poor households are left with the option of private insurance and since not all of them can afford it some households will choose to be uninsured. Finally, I eliminate different combinations of these three programs to understand the interaction effect: Medicaid together with early education, Medicaid with late education, and all three policies together.

Table 17 shows the results when we shut down education policies. There is a big effect of early educational policy on intergenerational income elasticity (IIE): eliminating early childhood policies increases IIE by about 10%, from 0.273 in the benchmark model to 0.3 (column 2 of Table 17). Probability of reaching top income quintile by children of parents from the lowest income quintile decreases from 10.5% to 9.73%, by about 7.5%. On the other hand, for children of rich parents probability of staying in the top quintile slightly increases. Without any government subsidy for primary and secondary education, i.e. when $g = 0$, parents subsitute spending on health for spending on education. As a result, due to lower medical spending average health of children in the first and second periods (correspond to early education periods) slightly decreases and share of college graduates also slightly declines. When the college subsidies are eliminated, the share of college educated children decreases from 61.5% to 55%, and the probability of upward mobility for lower income quintile decreases (from 10.5% to 9.73%), however, probability of staying in the top income quintile increases for the reachest from 27.9% to 29.9%. Income elasticity increases by 5.5%.

Households with different income might be affected differently by the same policy. In Table 18 I present households decisions, health and educational outcomes for by income level. All households decrease their spending in health, as a result, health deteriorates for children of all income quintiles, however the effect is stronger for lower income households. Educational spending in response to shutting down educational programs, on the contrary, increase, but only for reach households. Poor households just give up on educational investments while top income quintile completely substitutes governmental educational spending with the private one. However, total spending on ability decrease even for the upper quintile. In absense of college subsidies not a lot happens with medical investment for the lower quintiles (and as a result, with their health), while higher quintiles reduce medical expenses (in order to pay for college). So, lower quintiles (1st, 2nd and 3rd) receive less college education while upper quintiles maintain the level of college attainment, by slight sacrifice in their health.

Table 17: Counterfactual Experiments: Early and Late Education

Moment	Baseline	No Early Education	No College Subsidies
Intergenerational lifetime income elasticity	0.273	0.3	0.288
Probability of Moving from Q1 to Q5	0.105	0.098	0.0973
Probability of Moving from Q5 to Q5	0.279	0.273	0.299
Gini coefficient	0.424	0.425	0.432
Children in good health	0.776	0.75	0.769
Share of College Graduates	0.615	0.604	0.55
Insurance			
Children with Public Insurance	0.245	0.118	0.257
Children with Private Insurance	0.379	0.426	0.408
Children with No Insurance	0.376	0.456	0.335
Medical Expenses			
Average Medical Expenditure	8.042	7.4	8.0
Average Medical Expenditure (Private Insurance)	10.6	10.6	11.5
Average Medical Expenditure (Public Insurance)	5.61	6.74	5.04
Average Medical Expenditure (No Insurance)	2.4	1.61	2.2
Educational Spendings			
Private Educational Expenditure	0.408	2.8	1.6
Tax rate	0.124	0.0263	0.124

Table 18: Counterfactual Experiments: Early and Late Education Policies, by Parental Income Quintile

Moment	Baseline	No Early Education	No College Subsidies
College Education by Parental Income Quintile			
Q1	0.0119	0.0116	0
Q2	0.299	0.25	0.166
Q3	0.782	0.774	0.633
Q4	0.98	0.982	0.96
Q5	1	1	1
Children in Good Health by Parental Income Quintile			
Q1	0.725	0.695	0.72
Q2	0.713	0.697	0.712
Q3	0.761	0.741	0.77
Q4	0.809	0.774	0.78
Q5	0.868	0.857	0.857
Effective Average Medical Expenses by Parental Quintile			
Q1	4.67	4.03	4.66
Q2	5.59	4.66	6.22
Q3	6.26	5.31	7.83
Q4	7.49	6.71	5.95
Q5	16.2	16.5	15.4
Average Medical Out-of-Pocket Expenses			
Q1	2.77	2.65	2.76
Q2	2.69	2.75	3.03
Q3	3.4	3.91	3.57
Q4	6.52	5.26	5.21
Q5	10.9	10.4	10.2
Average Educational Spending by Parental Quintile			
Q1	0	0	0
Q2	0	0	0
Q3	0	0	0
Q4	0	2.89	1.21
Q5	1.99	12.89	6.82

In the Table 19 the results of experiments with Medicaid are presented. Eliminating Medicaid decreases income mobility by 5%. This number is pretty high if we take into account that only about 1/3 of the entire population receives Medicaid while early educational spendings by government is received by the entire population and around 1/3 of population receive college subsidies. Probability of reaching the top income quintile decreases for the bottom income quintile. Average health decreases as a result of a decrease in medical spending. An interesting result is that average investments into education increase. In Table 20 we see, however, that health deteriorates more for lower income quintile and efficient medical spending for them decrease, even though out-of-pocket expenses increase to compensate for the lost medical insurance. Poor people loose more health than rich people. On top of that there is a separation in educational decisions of households. Rich people slightly decrease their medical spending in order to increase educational spending. They compensate a slight decrease in health towards an increase in ability, to ensure a better production process for their children as they know that there is no Medicaid in economy and consecutively, if their children are not rich enough they will not have access to medical insurance.

Table 19: Counterfactual experiments: Medicaid

Moment	Baseline	No Medicaid
Intergenerational lifetime income elasticity	0.273	0.287
Probability of Moving from Q1 to Q5	0.105	0.1
Probability of Moving from Q5 to Q5	0.279	0.28
Gini coefficient	0.424	0.425
Children in good health	0.776	0.758
Share of College Graduates	0.615	0.604
Insurance		
Children with Public Insurance	0.245	0
Children with Private Insurance	0.379	0.431
Children with No Insurance	0.376	0.569
Medical Expenses		
Average Medical Expenditure	8.042	7.118
Average Medical Expenditure (Private Insurance)	10.6	11.1
Average Medical Expenditure (Public Insurance)	5.61	NaN
Average Medical Expenditure (No Insurance)	2.4	1.41
Educational Spendings		
Private Educational Expenditure	0.40	1.5
Tax rate	0.124	0.101

Table 20: Counterfactual experiments: Medicaid, by Parental Income Quintile

Moment	Baseline	No Medicaid
College Education by Parental Income Quintile		
Q1	0.0119	0.0121
Q2	0.299	0.278
Q3	0.782	0.768
Q4	0.98	0.961
Q5	1	1
Children in Good Health by Parental Income Quintile		
Q1	0.725	0.679
Q2	0.713	0.701
Q3	0.761	0.752
Q4	0.809	0.8
Q5	0.868	0.858
Average Medical Expenses by Parental Quintile		
Q1	4.67	3.39
Q2	5.59	4.79
Q3	6.26	4.94
Q4	7.49	6.77
Q5	16.2	15.7
Average Medical OOP Expenses		
Q1	2.77	2.94
Q2	2.69	2.97
Q3	3.4	3.77
Q4	6.52	5.86
Q5	10.9	10.6
Average Educational Spending by Parental Quintile		
Q1	0	0
Q2	0	0
Q3	0	0
Q4	0	0.487
Q5	1.99	6.82

In Tables 21 and 22 I explore the case in which no policies are present in economy, to understand what is the joint effect of policies. First, as a result of having no policies in the economy, parents try to maintain the level of out-of-pocket expenses on health, however their efficient spending decrease, in relative terms decreases more for children of the lowest income quintile. As a result, health deteriorates, and it deteriorates more for the lower income children. Second, as in the case of shutting down the Medicaid only, there is a separation in educational policies. Lower income quintiles pay nothing, while upper income quintiles invest 4 times more than in the benchmark (however the efficient spending decrease as there is no government policy). As a result of lower early education investments and stronger budget constraint less people receive college education. Gini coefficient of inequality increases from 42.2% to 43.5%, intergenerational elasticity of income increases from 0.273 to 0.318 (by 16.5%). In short, absense of two policies together (euducational and medical) produces an interactive effect on households. Health deteriorates more in absense of 2 policies than in absense of MEdicaid only. Investments in education decrease more in absense of 2 policies than in absense of early educational policy only. College attainment in absense of two policies decreases more than in absence of college subsidies only. Due to complementarities in health and ability absense we can observe cross-effects of policies on different types of human capital.

Table 21: Counterfactual experiments: joint effect of educational and health policies

Moment	Baseline	No policies
Intergenerational lifetime income elasticity	0.273	0.318
Probability of Moving from Q1 to Q5	0.105	0.0906
Probability of Moving from Q5 to Q5	0.279	0.298
Gini coefficient	0.424	0.435
Children in good health	0.776	0.749
Share of College Graduates	0.615	0.542
Insurance		
Children with Public Insurance	0.245	0
Children with Private Insurance	0.379	0.439
Children with No Insurance	0.376	0.561
Medical Expenses		
Average Medical Expenditure	8.042	6.88
Average Medical Expenditure (Private Insurance)	10.6	10.9
Average Medical Expenditure (Public Insurance)	5.61	NaN
Average Medical Expenditure (No Insurance)	2.4	1.28
Educational Spendings		
Private Educational Expenditure	0.408	0.972
Tax rate	0.124	0

Table 22: Counterfactual Experiments: Joint Effect of Educational and Health Policies, by Parental Income Quintile

Moment	Baseline	No Policies
College Education by Parental Income Quintile		
Q1	0.0119	0
Q2	0.299	0.134
Q3	0.782	0.605
Q4	0.98	0.98
Q5	1	0.991
Children in Good Health by Parental Income Quintile		
Q1	0.725	0.674
Q2	0.713	0.691
Q3	0.761	0.749
Q4	0.809	0.779
Q5	0.868	0.854
Average Medical Expenses by Parental Quintile		
Q1	4.67	2.6
Q2	5.59	4.58
Q3	6.26	6.66
Q4	7.49	5.39
Q5	16.2	15.2
Average Medical OOP Expenses		
Q1	2.77	2.69
Q2	2.69	2.88
Q3	3.4	3.98
Q4	6.52	4.99
Q5	10.9	10.4
Average Educational Spending by Parental Quintile		
Q1	0	0
Q2	0	0
Q3	0	0
Q4	0	0
Q5	1.99	4.86

5.1. Future directions

Main experiments with shutting down educational and medical policies show that all policies are important for intergenerational mobility. If the role of educational policies was analyzed in previous literature, this paper's contriution is analysis of childhood medical policies. Another contribution of the paper is finding an interaction effect of health and educational policies.

There are several more things that I plan to do in this paper. First, I need to perform robustness checks, including robustness checks for definitions of health and ability. Second, estimation procedure is still running, I believe, the model fit will be improved and standard errors will be calculated. Finally, I plan on performing several more experiments to understand the nature of the relation of health policies with intergenerational mobility and the role of health in human capital accumulation process. First, I am planning to experiment with different insurance schemes. I can analyze potential effects of changes in Affordable Care Health Act that were enacted in 2014 (my model is estimated for the year 2012), universal insurance coverage for all children, introduction of income-dependent insurance subsidies instead of a means-tested program, as well as substituting public insurance policy with conditional cash transfers. Second, I am planning to think about potential cost-neutral policy change, in which a limited budget could be reallocated between existing policies to imporve children's outcomes.

The model possesses high degree of heterogeneity that also can be studied. For example, I can analyze whether time of fertility or marital composition of the society is contributing to intergenerational mobility, and whether policies should take these degrees of heterogeneity into account while being designed.

6. Conclusions

In the U.S. government spends significant amount of resources on needs-based medical policies. In June 2013, over 28 million children were enrolled in Medicaid and another 5.7 million were enrolled in State Child Health Insurance Program (SCHIP). We know very little, however, how medical policies affect intergenerational mobility. This paper tries to fill this gap in the literature.

In this paper, I develop and estimate a human-capital based overlapping generations model of household decisions that take into account multidimensionality and dynamic nature of human capital investments. I distinguish two forms of human capital: health capital and human capital, and model explicitly government policies in education and health.

Results show that Medicaid and education policies affect intergenerational mobility in the US. The important effect of health policy comes through interaction of health policy with educational policies. Changes in all policies together have a larger effect than of each policy in isolation. Especially this interaction effect is important for children of the lower income quintile. In general absence of any policy leads to deterioration of outcomes (health, college attainment) for poor households due to the stronger trade-off between investments into health and education, comparing to richer people, who have higher margin to adjust. As a result we observe separation in household educational decisions by the level of income.

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