

The Political Economy of Early and College Education - Can Voting Bend the Great Gatsby Curve?

By CHRISTOPHER RAUH*

High inequality goes hand in hand with low intergenerational earnings mobility across countries. In an overlapping generations model, calibrated to the US, education policies are endogenized via probabilistic voting. Exploiting cross-country variations in the bias in voter turnout towards the educated, I replicate the negative relation between inequality and public education expenditure and account for nearly one-quarter of the differences in inequality and mobility. For the US, I find that compulsory voting could foster mobility, whereas inequality is hardly affected. Differences across countries in tertiary education characteristics, in particular the college premium, account for 65% of the differences in inequality.

JEL: E24, H52, I23, I24, J62

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I. Introduction

The positive slope of the “Great Gatsby Curve” in Figure 1 indicates that a higher level of inequality is positively associated with a greater transmission of economic status across time.¹ Even if inequality can be justified as an outcome of differential efforts,

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¹The fitted line and the correlation coefficient are computed excluding the outliers Chile and Switzerland. The name was coined by Alan Krueger and is adopted from the novel “The Great Gatsby”, in which the author F. Scott Fitzgerald challenges the “American Dream” by telling the story of Jay Gatsby, who rises to the high society via shady deals.

this strong positive relationship raises the question of whether inequality also negatively affects equality of opportunity.² Recent increases in income inequality across OECD countries highlight the importance of understanding the underlying causal mechanisms of the relationship between inequality and mobility. Why is a country such as the US, which is characterized by an unequal distribution of earnings, at the same time amongst the most rigid societies in the developed world? What causes these unequal outcomes and how are they transmitted to future generations?

In this paper, I investigate two potential channels for cross-country differences in in-

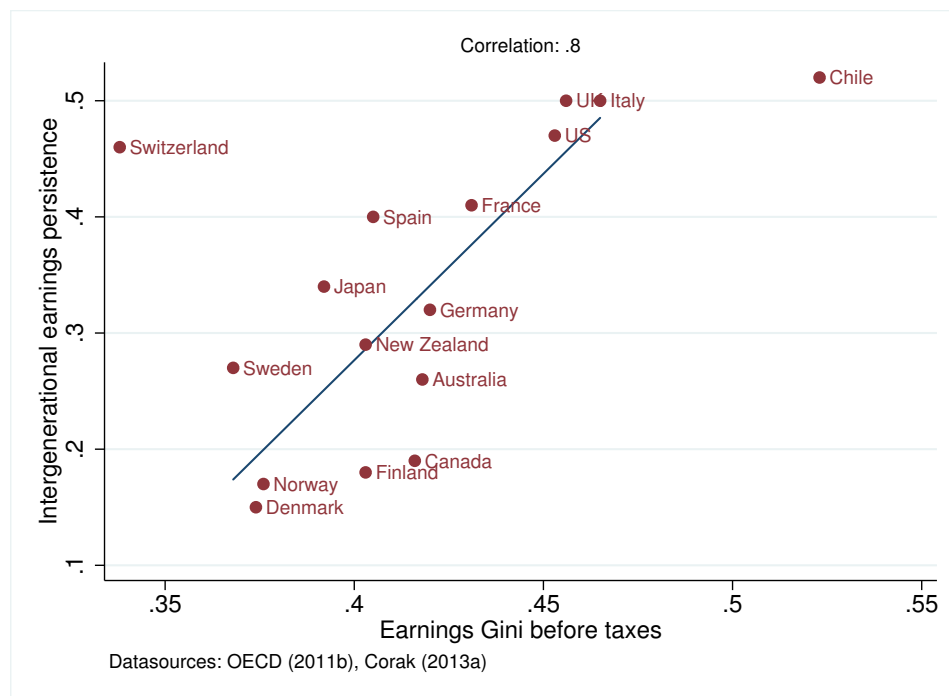


FIGURE 1. GINI BEFORE TAXES VERSUS INTERGENERATIONAL EARNINGS PERSISTENCE

²Few empirical papers have investigated the relationship between inter- and intragenerational inequality. Cooper (1998) finds that in poor neighborhoods redistributive expenditures on human capital have a significant effect in reducing the persistence of economic status across generations, thereby hinting towards a causal relationship. Andrews and Leigh (2009) similarly find that sons that grew up in more unequal states during the 1970s experienced less social mobility by the late 1990s. Aaronson and Mazumder (2008) present how the “snapshot” and the “moving-picture” measure of inequality move parallel between 1940 and 2000 in the US. Duncan, Kalil and Ziol-Guest (2013), controlling for family structure and characteristics, find that between two-thirds and three-quarters of the increase in schooling gaps between low and high income children of cohorts born in the 50’s and 80’s in the US can be accounted for by increases in income inequality. In contrast, Bloome (2013) finds little evidence for an effect of inequality during childhood on intergenerational mobility across US states.

equality and intergenerational mobility consistent with the data patterns. First, a political explanation in terms of a bias in voter turnout. Second, a technological explanation in terms of the college premium.³ A model is specified, which allows for the quantification of the contribution of these two channels to cross-country differences in inequality and mobility.

Education is a strong determinant of earnings and its public provision can be of redistributive nature. Recent increases in inequality have been driven by increases in the top end of the earnings distribution. According to traditional voting models, the provision of public education, in particular non-tertiary education, would be expected to increase when inequality rises through rising top income shares. However, the share of GDP dedicated to non-tertiary as well as tertiary public education is negatively associated with inequality across countries as can be seen in Figure 2. This could occur if the rich prefer private education and public policies are biased in their favor. Indeed private education expenditures are found to be positively associated with inequality across countries. Under the assumption that the rich prefer private education, this could be driven by a bias in voter turnout, as exhibited for a small sample of countries in Figure 3. The share of GDP dedicated to public education is negatively related to the relative turnout of college graduates compared to those with no college education.

Tertiary education characteristics in terms of the college premium, tuition, and completion and enrollment rates vary across countries. In particular, the college premium is highly correlated with inequality and intergenerational earnings persistence as captured by the intergenerational earnings elasticity (IGE).⁴ High returns to education create an incentive to invest in your child, while richer parents have more funds available to invest than the less well off. Therefore, assuming credit market imperfections, high returns to education can drive a wedge between the education that poor and rich children receive. An increase in the college premium raises the returns to investment directly at

³The college premium has mainly been linked to technological developments. See references in Section I.A in the Online Appendix.

⁴Intergenerational earnings persistence is measured by regressing the log of son's earnings on the log of father's earnings to quantify earnings elasticities across generations. This captures the percentage change in a son's adult earning that is associated with a one percentage point increase above the mean in paternal earnings.

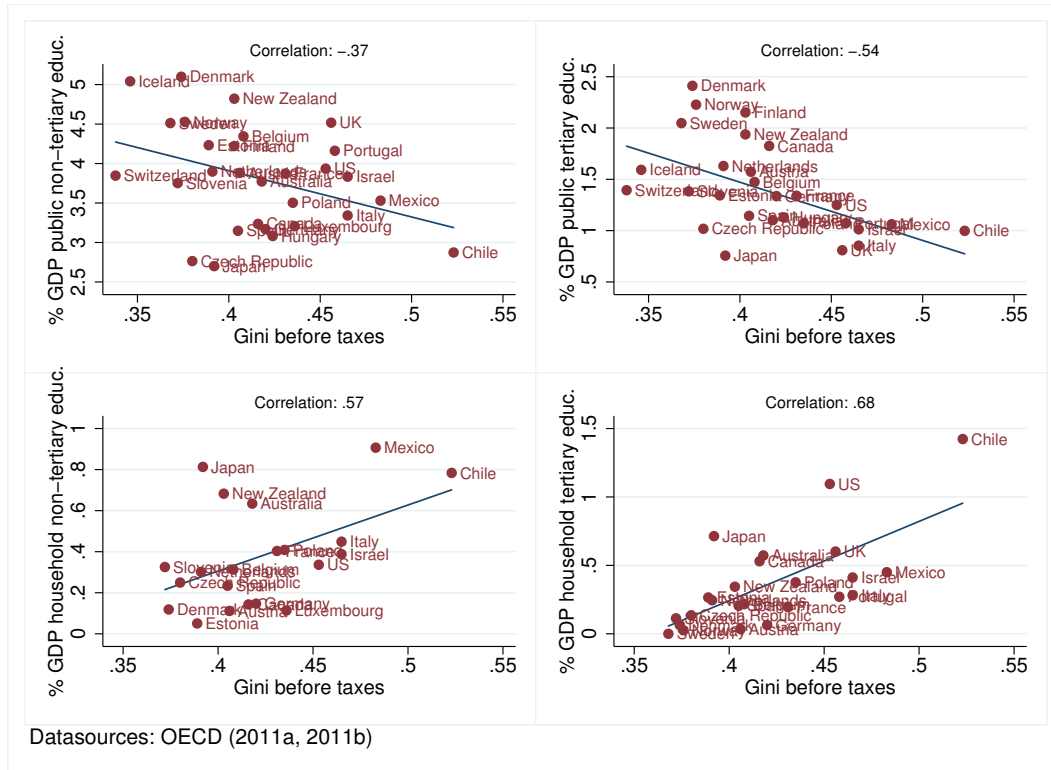


FIGURE 2. GINI BEFORE TAXES VERSUS PUBLIC (TOP) AND HOUSEHOLD (BOTTOM) EXPENDITURE (% OF GDP) DEDICATED TO NON-TERTIARY (LEFT) AND TERTIARY (RIGHT) EDUCATION.

the college level, and assuming dynamic complementarities between early and college education also raises returns to investment in early education.⁵ As can be seen in Figure 4, the college premium, here defined as the relative earnings of college graduates compared to upper secondary education of the population aged 25-64 (OECD 2013b), is positively associated with the Gini as well as with the IGE. In the top panels of Figure 3 in the Online Appendix, one can see the high correlation between the Gini coefficient of

⁵I use the expression “non-tertiary” or “early” to summarize primary and secondary education. Given the evidence of the early formation of cognitive and non-cognitive skills (e.g., Cunha et al. 2006), the consideration of pre-primary education is surely an important factor in the examined dynamics and outcomes from which I abstract. Peer and neighborhood effects, as well as health, are other channels worth mentioning, through which parental income could affect learning aptitude of children, but are not included in the model. Also parental connections could contribute to the intergenerational linkage of earnings. Corak and Piraino (2011) find that about 40% of young Canadian men have worked for an employer that employed their father at some point in time, while 6-9% have the same employer in adulthood. The percentage increases with paternal earnings.

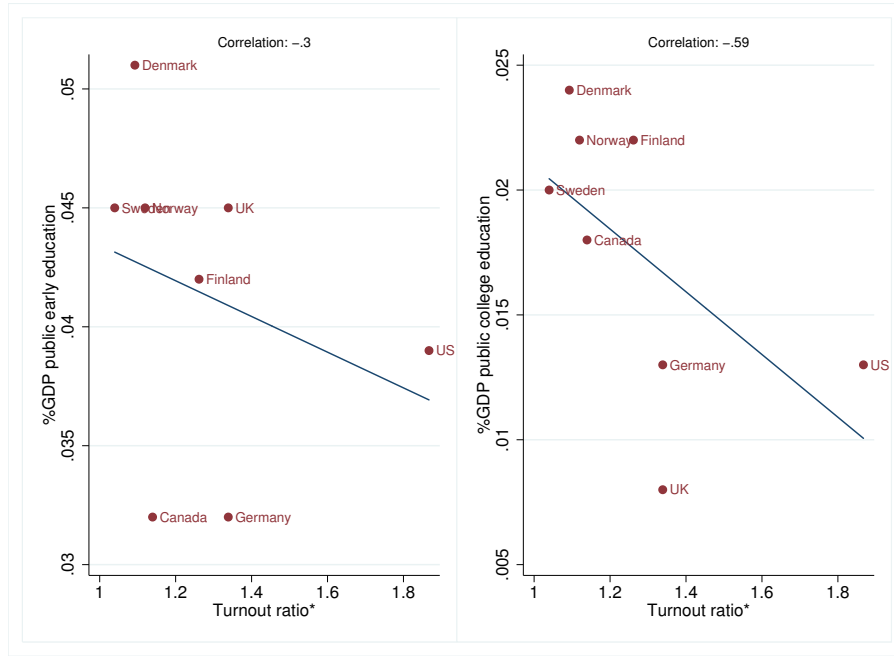


FIGURE 3. TURNOUT RATIO OF COLLEGE GRADUATES TO THOSE THAT DID NOT ATTEND COLLEGE AGED 18-65 VERSUS PUBLIC EXPENDITURES ON EARLY (LEFT) AND COLLEGE (RIGHT) EDUCATION

earnings before taxes, and the share of total education expenditures on non-tertiary and tertiary education financed privately by households. As exhibited in the bottom panels, the shares of total education expenditures financed privately by households are highly positively correlated with the intergenerational transmission of earnings.

The quantitative model adopts a structure resembling that of Restuccia and Urrutia (2004). Parents invest in early private education of their offspring, which is a substitute to public education, in order to enhance the imperfectly inherited ability. Subsequently, the household decides whether or not to send their child to college, where the more able one is, the less likely one is to drop out. In each period, households vote on two separate proportional tax rates. Thus, early public education and the college subsidy, which is decreasing in parental earnings, are determined endogenously. The model is characterized by the dynamic complementarity between early and late investment (e.g., Cunha et al. 2006, Cunha and Heckman 2008, Caucutt and Lochner 2012), while incorporating the

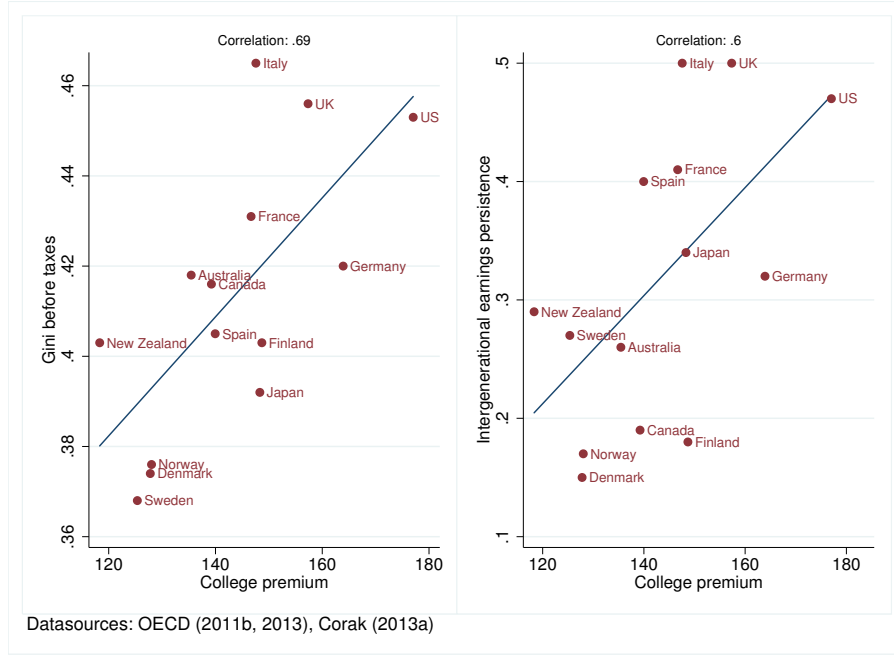


FIGURE 4. COLLEGE PREMIUM VERSUS GINI (LEFT) AND INTERGENERATIONAL EARNINGS PERSISTENCE (RIGHT)

discrete nature of the college investment as in Galor and Zeira (1993).

In the model economy, public education expenditures are endogenous and households vote via probabilistic voting. When households vote, they vote in their own interest for their children concerning their preferred level of public expenditures, yet without altruistic preferences for society as a whole.⁶ Probabilistic voting allows me to exploit the skewness of voter turnout by age and level of education across countries to explain variations in education expenditures and the effects on inequality and mobility. When modelling the political economy, De la Croix and Doepke (2009) emphasize the importance of the responsiveness of politicians to low-income families in the determination of education funding. The voting channel embedded in my model provides a rational,

⁶Surveys indicate that preferences for more public education are not only negatively related to income, but are increasing in the level of education (Busemeyer 2012, Horn 2012). This occurs in my model as well, however the causality is not driven by the education of an individual. Education serves as a proxy for ability, which is positively correlated with the ability of a child. Now since returns to education are assumed to be increasing in ability, holding earnings fixed, a more educated individual on average has a greater demand for public education. Busemeyer (2012) also finds that those still enjoying the benefits of education, as well as people with children, are more likely to support public education.

namely political participation, as in why we might observe differences in the responsiveness across countries. The weights of individuals in the voting process are assigned according to voter turnout by age group and level of education using the voting supplement of the Current Population Survey (CPS) of 2006 for the US, and the European Social Survey 2010 (ESS) and the Canadian Election Study of 2008 for the experiments. I find that observed patterns of public and private education expenditures, inequality, and intergenerational mobility can be reconciled by voter turnout. On average, 23% of differences in intergenerational mobility and 21% of differences in the Gini index compared to the US can be explained by voter turnout. As a robustness check, I repeat the analysis while weighting voters by the fraction of party members per age group and education level. The data is obtained from the World Values Survey 1981-2007 (WVS) and the results exhibit similar patterns. This indicates that the political participation of a society, whether through voting or through party membership, shapes public policy, and thereby influences inequality and intergenerational mobility.

Given that the patterns of voter turnout perform well at explaining cross-country differences, two possible voting policies in the US are considered. First, I enforce compulsory voting. Chong and Olivera (2008) provide empirical evidence that this has an equalizing effect on the income distribution across countries, while Fowler (2013) shows that the introduction of compulsory voting in Australia increased public pension expenditures. Second, I allow parents to vote for their children. I find that the IGE is reduced by 10% under compulsory voting, whereas the extension of electoral franchise to children as of birth by letting their parents vote for them nearly halves earnings persistence. However, the equalizing effect of these policies on pre-tax earnings is comparably low.

The college premium seems to be the most important factor explaining differences in inequality. If dynamic complementarities exist between early and college education, parents have greater incentives to invest in their children's early education when the college premium is higher. Indeed, Ramey and Ramey (2010) find that parental investment in young children has increased with the college premium in the US. Given that parents earn less when they are young and they cannot borrow against the future of their

children, large incentives for private investment combined with imperfect credit markets increase the gap between the education received by rich and poor children at the early stage, and consequently at the college level as well. In a counterfactual exercise, I exogenously adapt the college premium to resemble other countries and control for differences in tuition costs as well as enrollment and completion probabilities finding that this can explain 65% in inequality and 21% in IGE across countries. When combining the tertiary education and voter turnout channel, I find that the model can explain 71% and 29% of the gaps, and 32% and 26% of the variance in IGE and inequality, respectively.

The paper can be summarized in terms of the three principle findings. First, the skewness of voter turnout in terms of age and education can account for a considerable part of the gaps in the IGE across countries. Second, the characteristics of tertiary education in terms of the college premium, tuition costs, and completion probability, can explain a large share of differences to the US in inequality and to a lesser extent intergenerational mobility. Third, policies of compulsory voting or extending the electoral franchise to children as of birth could foster intergenerational mobility in the US.

The remainder of the paper is organized as follows: The related literature is summarized in Section II. The model is explained in Section III with the equilibrium definition following in Section IV. The parameterization is described in Section V, followed by the benchmark results and policy experiments for the US presented in Section VI. In Section VII, experiments shed light on differences between the US benchmark economy and other OECD countries. The robustness of these results is analyzed in Section VIII. Finally, Section IX concludes and outlines questions for future research.

II. Literature review

Becker and Tomes (1979, 1986) and Loury (1981) pioneered the microfoundation of the three fundamental institutions in the determination of a child's future: the family, the labor market, and the state. Their approach is extended and formalized by Solon (2004). Galor and Zeira (1993) present on the macroeconomic level how credit market imperfections and indivisibilities in human capital investments can transmit distributions of

wealth. Glomm and Ravikumar (1992), Durlauf (1996), Bénabou (1996), and Fernandez and Rogerson (1998) demonstrate how locally provided public education affects growth, intergenerational income transmission, and inequality when households are sorted geographically by income. Abstracting from different stages of education and heterogeneous innate ability among individuals, Fernandez and Rogerson (1995) show that richer individuals can be those capturing higher education subsidies, thereby making the transmission of unequal distributions more likely.

The paper is most related to Restuccia and Urrutia (2004), Abbott and Gallipoli (2014), Herrington (2014), and Holter (2014), who use dynastic overlapping generations models to quantitatively study intergenerational mobility. Assuming exogenous taxation and education policies, Restuccia and Urrutia (2004) find that in order to reduce intergenerational persistence an increase in early education expenditures would be more efficient than increasing college subsidies. Abbott and Gallipoli (2014) explain cross-country differences in intergenerational mobility through differences in skill complementarity. Herrington (2014) accounts for a share of the gap in inequality and intergenerational persistence between Norway and the US through variations in the distribution of public spending and revenue sources. Holter (2014) exploits cross-country differences in the progressivity of income taxation to explain part of the gap in intergenerational mobility between the US and Denmark. However, in his partial equilibrium setting, as well as in Restuccia and Urrutia (2004) and Herrington (2014), the shape and level of the taxation function, as in most macroeconomic models, are taken to be exogenously given. This inevitably leads to the question of the political economy of policies. In my model, education expenditures at the different stages of human capital formation are endogenous. Ichino, Karabarbounis and Moretti (2011) use a microeconomic approach to the political economy of the underlying structure of intergenerational income mobility considering a single stage of education. Chetty et al. (2014) corroborate the importance of the effect of tax expenditures on mobility. Using administrative tax records, they find that schools with higher expenditures per student have higher rates of upward mobility and that tax policies remain correlated with mobility even after controlling for a range of factors.

III. The model

The overlapping generations model resembles the one presented by Restuccia and Urrutia (2004). A household exists for two periods and is composed of either a young parent and a young child, or an old parent and an old child, which I will refer to as young and old households, respectively. In a subsequent period, old parents die, whereas the old children become young parents and form households of their own. Consequently, everybody lives for four periods, but only makes decisions during the last two periods of the lifecycle. Population growth is zero and all parents have the same number of children.⁷ Parents take education decisions for their children. Households are heterogenous in their levels of innate ability of the offspring and human capital of the parents. Lifetime utility is derived from consumption as a young household c_y , consumption as an old household c_o , and altruism for the level of human capital of their child h_c . The assumption that parents derive utility from ensuring that their children are equipped with an adequate level of human capital is common in the literature (Glomm and Ravikumar 1992, Galor and Zeira 1993, Benabou 2000). The utility function for consumption $u(c)$ is increasing and concave, while altruistic utility gained from human capital of the child $v(h_c)$ is nondecreasing. Labor is provided inelastically, where human capital is remunerated by competitive firms at a wage rate w .

A. Ability and human capital

Innate ability is assumed to be correlated with parental innate ability. Innate ability is not altered over the lifecycle and can be interpreted as the genetic component. Acquired ability $\hat{a}$ is a function of innate ability and public and private education investments when young, which later affect the probability of college completion and wages. When a child is old, acquired ability $\hat{a}$ transforms into human capital h_c . After becoming a parent, human capital evolves exogenously, while capturing the lifecycle earnings profile. When

⁷While De la Croix and Doepke (2004) demonstrate theoretically how differential fertility rates might play a considerable role in the distribution of human capital investments and preferences for public education among families, Björklund et al. (2004) find no differences in intergenerational mobility by family size in Norwegian data.

becoming a young parent, human capital experiences a shock and converts to h_y , whereas for the old parent human capital is denoted by h_o .

Innate ability a , when passed from one generation to the next, follows a first-order discrete Markov process with mean normalized to one, and transition matrix Ψ , while restricting the vector of states for a and the elements in the transition matrix such that the process is a discrete approximation of a continuous AR(1) process as in

$$(1) \quad \ln(a') = \rho \ln(a) + \varepsilon \text{ where } \varepsilon \sim N(0, \sigma_a^2).$$

Innate ability a is transformed into acquired ability $\hat{a}$ via public education g and private early education e according to the function $f(a, e, g)$ when the offspring is young. The function $f(a, e, g)$ is assumed to be positive, strictly increasing, and concave in all its arguments. Public and private education are treated as perfect substitutes. Following the literature on early skill formation, acquired ability $\hat{a}$ is increasing in innate ability a . Also the return to investment in education is increasing in innate ability, such that $\frac{\partial^2 f}{\partial a \partial e} > 0$, as skill has been found to beget skill (Cunha et al. 2006, Cunha and Heckman 2008). The functional form in the spirit of Ben-Porath (1967) is assumed to be given by

$$(2) \quad \hat{a} = f(a, e, g) = \chi a^{1-\gamma} (g + e)^\gamma.$$

The curvature of f changes with parameter γ , which is also responsible for the relative importance of innate ability versus investment. Parameter χ is the efficiency parameter regulating the level effect of human capital creation.

Everybody enjoys public education, while choosing the level of private education to supplement it. This sort of structure is not limited to the growing number of charter schools. Investments in early private education can be imagined as anything from piano lessons to out of school tutoring. Data for the US reveals that the gap in “enrichment expenditures” between poor and rich parents has become greater over time (Duncan and Murnane 2011, Kornrich and Furstenberg 2013). Also, in the US a large share of

non-tertiary education is financed locally through property taxes or other local sources. Households are assumed to be able to choose the level of investment by moving into a neighborhood which provides the preferred level of investment and is priced accordingly due to housing prices differentials (Epple and Romano 1996, Fernandez and Rogerson 1997). Hoxby (1998) and Herrington (2014) show a positive relation between per-pupil spending and income.

When the child is old, the household decides on whether or not to send their offspring to college $s \in \{0, 1\}$. Not attending college implies the offspring works for the entire period, whereas going to college implies spending share $\underline{n}$ of the period in college in case of dropping out, and share $\bar{n}$ in case of completion, while working the rest of the period. The earnings of the offspring are shared with the parents at the household level. If the child goes to college, college is completed with probability $\pi(\hat{a})$, consequently dropping out with probability $(1 - \pi(\hat{a}))$. The probability π of completing college is increasing in acquired ability (Light and Strayer 2000, Chatterjee and Ionescu 2010) and is assumed to take the functional form

$$(3) \quad \pi(\hat{a}) = \min\{1, \psi_0(1 + \hat{a})^{\psi_1}\},$$

where $\psi_0 > 0$ and $\psi_1 > 0$. The parameter ψ_0 is responsible for the level effect of acquired ability on the probability of college completion, while the convexity of the function is increasing in ψ_1 . College education comes at a tuition cost T per period. The government subsidizes a share decreasing in parental earnings. The share q of tuition cost T covered by the government is linearly decreasing in parental earnings and is given by

$$(4) \quad q(h_o) = \max\{0, 1 - \kappa w h_o\}.$$

The share covered by the college subsidy is bound from below by 0, such that no household has to pay an additional fee, and from above by 1, assuring that no household receives a subsidy beyond compensation of the actual cost of attending college.

If the offspring completes college, its acquired ability is multiplied by $\bar{\theta}$, while if it drops out only by $\underline{\theta}$ (where $\bar{\theta} > \underline{\theta}$). Therefore, acquired ability is mapped into human capital of the old child h_c by

$$(5) \quad h_c = \begin{cases} \hat{a} & \text{if does not attend college} \\ \bar{\theta}\hat{a} & \text{if completes college} \\ \underline{\theta}\hat{a} & \text{if drops out of college,} \end{cases}$$

where the college completion probability is given by (3). This functional form satisfies the dynamic complementarity between early and late investments in human capital discussed by Cunha et al. (2006) and Cunha and Heckman (2008).⁸

In the transition from old offspring to young parents two things occur. Firstly, individuals can experience a shock ζ_y , commonly referred to as market luck. The shock accounts for the fact that earnings dispersion within a cohort increases over the lifecycle (Huggett, Ventura and Yaron 2006) and for the finding by Huggett, Ventura and Yaron (2011) that only 61% of the variance in lifetime earnings can be attributed to pre-working conditions. The shock is multiplicative and takes either value $\zeta_y \in \{-\zeta, 0, \zeta\}$ with equal probability 1/3. This shock creates no aggregate uncertainty and is permanent. Secondly, their human capital increases exogenously by the lifecycle component $\eta_0 > 1$, such that

$$(6) \quad h_y = \eta_0(1 + \zeta_y)h_c.$$

Young parents are equipped with human capital h_y and choose how much to invest in private early education e . Old parents have human capital h_o , which is given by $h_o =$

⁸Despite recent discussions about the importance of the increased uptake of student loans (Belley, Frenette and Lochner 2011, Lochner and Monge-Naranjo 2012, Abbott et al. 2013), I do not allow households to borrow and abstract from physical capital accumulation. According to a Sallie Mae-Ipsos Report in 2013 student loans pay for only 18% of costs of college attendants. Also, the fact that one model period spans several years allows for the interpretation of borrowing within a given period.

$$\eta_1 h_y,$$

$$(7) \quad h_o = \eta_1 h_y,$$

where $\eta_1 > 1$ represents the increase in the earnings profile through experience later in the lifecycle. Earnings are determined by human capital and the competitive wage w , the rate of return to human capital in the market.

B. Households

Households take tax rates for financing of early (τ_p) and college (τ_q) education, as well as public expenditures on early education (g) and the college education subsidy (q) in t and $t + 1$ as given when maximizing lifetime utility, discounted by $\beta < 1$. The utility of consumption is derived with constant relative risk aversion as in $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$, while the utility derived from leaving the child with human capital h_c is $v(h_c) = \phi h_c^\xi$, where $\phi > 0$ and $\xi > 0$.

The state variables of the old household are $(h_o, \hat{a})$. Let λ be equal to one if a child completes college and zero in case of dropping out. Given wage rate w , the problem of the old parent household can be written as

$$(8) \quad V_o(h_o, \hat{a}) = \max_{s \in \{0,1\}} \{V_o^{s0}(h_o, \hat{a}), E_\lambda[V_o^{s1}(h_o, \hat{a}, \lambda)]\},$$

where $V_o^{s0}(h_o, \hat{a})$ is the value function of not sending the child to college, and $V_o^{s1}(h_o, \hat{a}, \lambda)$ is the value of sending the child to college, which depends on the college completion probability given by (3). The value of not sending a child to college is given by

$$(9) \quad \begin{aligned} V_o^{s0}(h_o, \hat{a}) &= \max_{c_o \geq 0} \left\{ \frac{c_o^{1-\sigma}}{1-\sigma} + \phi h_c^\xi \right\} \\ &\text{subject to} \\ c_o &= (1 - \tau_p - \tau_q)(wh_o + wh_c), \quad h_c = \hat{a}. \end{aligned}$$

The expected value of sending a child to college conditional on completion λ is given by

$$\begin{aligned}
 E_\lambda V_o^{s1}(h_o, \hat{a}, \lambda) &= \pi(\hat{a})V_o^{s1}(h_o, \hat{a}, 1) + (1 - \pi(\hat{a}))V_o^{s1}(h_o, \hat{a}, 0), \\
 &\text{where} \\
 V_o^{s1}(h_o, \hat{a}, \lambda) &= \max_{c_o \geq 0} \left\{ \frac{c_o^{1-\sigma}}{1-\sigma} + \phi h_c^\xi \right\} \\
 (10) \quad &\text{subject to} \\
 c_o + (1 - q(h_o))(\lambda \bar{n} + (1 - \lambda) \underline{n})T &= (1 - \tau_p - \tau_q)(wh_o + \\
 &+ (1 - (\lambda \bar{n} + (1 - \lambda) \underline{n}))wh_c) \\
 h_c &= (\lambda \bar{\theta} + (1 - \lambda) \underline{\theta})\hat{a},
 \end{aligned}$$

where the probability $\pi(\hat{a})$ of completing college is given by (3) and the college subsidy $q(h_o)$ by (4). Let b be the level of education obtained by a parent. This can either be high school, college dropout, or college graduate. Let the distribution of old parent households be summarized by $\mu(x_o)$, where $x_o = (h_o, \hat{a}, a, b)$, and let $s(x_o)$ and $c_o(x_o)$ be the solution to (8), and therefore the policy functions of the college decision and consumption of the old household, respectively.

The state variables of the young household are (h_y, a) . The problem of the young household is given by

$$\begin{aligned}
 V_y(h_y, a) &= \max_{e, c_y \geq 0} \left\{ \frac{c_y^{1-\sigma}}{1-\sigma} + \beta V_o(h'_o, \hat{a}') \right\} \\
 &\text{subject to} \\
 (11) \quad c_y + e &= (1 - \tau_p - \tau_q)wh_y, \\
 \hat{a}' &= \chi a^{1-\gamma}(g + e)^\gamma, \\
 h'_o &= \eta_1 h_y.
 \end{aligned}$$

Let $x_y = (h_y, a, b)$ and let $c_y(x_y)$ be the policy functions of consumption associated with the young, and $e(x_y)$ the policy function determining early private education. The distribution of young parent households is described by $\mu_y(x_y)$. The total mass of households is assumed to be constant and of mass unity each, young parents and old parents house-

holds. Therefore, the total mass of individuals is four (since each household contains one parent and one child).

C. Government

The government levies two proportional tax rates, while running a balanced budget for early and late education separately. First, tax τ_p which is used to finance public early education g . Second, tax τ_q which covers part of tuition cost T for those going to college. Therefore, government expenditures g on early education are given by

$$(12) \quad g = \tau_p Y.$$

The college subsidy depends not only on tax τ_q and total production in the economy, but also on the composition of college students. More specifically, it depends on how many students attend college, how long they attend, and what the earnings of their parents are. The government budget for tertiary education can be summarized by

$$(13) \quad T \int s(x_o) q(h_o) n(\hat{a}) d\mu_o(x_o) = \tau_q Y,$$

where $q(h_o)$ is given by (4), $n(\hat{a}) = \pi(\hat{a})\bar{n} + (1 - \pi(\hat{a}))\underline{n}$ is the time spent in college, and $\pi(\hat{a})$ is given by (3).

An increase in tax rate τ_q , ceteris paribus, leads to a reduction in κ , which for a household sending its offspring to college increases subsidy rate q , given their earnings are not too high and satisfy $wh_o < \frac{1}{\kappa}$.

D. Political economy

The two proportional tax rates are determined jointly through probabilistic voting, which allows for a weighted average of preferences across households instead of only

relying on the median voter.⁹ Due to the two-dimensional problem preferences are unlikely to be single-peaked, not allowing for the identification of the median voter.

In probabilistic voting, parties commit to policies before elections take place. The policy platform is chosen by opportunistic candidates, which only care about being elected. It is assumed that parties differ along an ideological dimension observable to the voter. Candidates know the ideological preference distribution of the voters, wherefore chosen policies are directed towards those voters that are less driven by the ideological component. Candidates have an average popularity common to all voters, which is a random variable and could be subject to a shock, such as a scandal the day before elections take place. Since the policy platform is chosen when the outcome is uncertain, parties maximize the expected share of votes, and thereby the probability of winning the election. There exists a unique political equilibrium in which both parties propose the same policy by maximizing a weighted social welfare function, where weights are determined by how responsive voters are to policies, which might vary due to the ideological component (see Lindbeck and Weibull 1987, Persson and Tabellini 2002). I use voter turnout by age and level of education as weights in the voting process, as candidates might be best of catering to the segment of population actually voting.

The decision of the young parent household does not only depend on tax rates in t , but also on tax rates in $t + 1$ (denoted by a prime), which will be decided upon in the following period. Therefore, the current policy choices (τ_p, τ_q) depend on anticipated future policy choices (τ'_p, τ'_q) for two reasons. Firstly, given returns to wages, the tax rates will determine disposable income. Secondly, τ'_q will determine q' , which for parents wanting to send their children to college could be of importance. Current policy choices and the current distributions of households are mapped via G into the distributions of households in the subsequent period, such that

$$(14) \quad (\mu'_y(x'_y), \mu'_o(x'_o)) = G(\tau_p, \tau_q, \mu_y(x_y), \mu_o(x_o)).$$

⁹Voters only decide on proportional tax rates, not on the actual shape of the tax function. Herrington (2014) and Holter (2014) find that the progressivity of the tax schedule plays an important role. Additionally, Herrington finds that public expenditures on early education are not always uniformly distributed across households as in my model, which could be an outcome of the political economy, as well. Due to computational complexity I abstract from these characteristics.

It is assumed that when voting on the preferred policy in t , they take the anticipated value of $t + 1$ to be the same as in t and ignore the impact their choice will have on the future policy choice. Since agents are atomistic this is a plausible assumption as they do not influence the outcome by themselves. In the steady state equilibrium agents will have rational expectations. Agents correctly take into account how current policy choices affect aggregate decisions and, hence, consider how g and the function $q(h_o)$ react.

The welfare function W is composed of the weighted (remaining) lifetime utility of the young and old households and is maximized over the set of tax rates S . Assigning ω_y as the weight of the young and ω_o as the weight of the old household in the voting process, which depend on the level of education b , the problem is

$$(15) \quad Z(\mu_y(x_y), \mu_o(x_o)) = \arg \max_{\tau_p, \tau_q \in S} W$$

$$(16) \quad W = \int \omega_y(b) V_y(x_y) d\mu_y(x_y) + \int \omega_o(b) V_o(x_o) d\mu_o(x_o).$$

where $S = \{(\tau_p, \tau_q) \in [0, 1]^2 | 0 \leq \tau_p + \tau_q \leq 1\}$. Since W is strictly concave in $\tau = (\tau_p, \tau_q) \in S$, the solution is unique.

IV. Equilibrium

Let total consumption of young and old parent households be $C_y = \int c_y(x_y) d\mu_y(x_y)$ and $C_o = \int c_o(x_o) d\mu_o(x_o)$.

DEFINITION 1: *Given prices, policies, and tax rates, V_y solves the functional equations and the requisite budget constraints in (11), while V_o solves (8) satisfying (9) and (10), with $c_y(x_y)$, $c_o(x_o)$, $s(x_o)$, and $e(x_y)$ as associated policy functions.*

1) *Goods market clearing:*

$$(17) \quad Y = H = C_y + C_o + E + F + g$$

$$(18) \quad E = \int e(x_y) d\mu_y(x_y)$$

$$(19) \quad F = T \int s(x_o)(\pi(\hat{a})\bar{n} + (1 - \pi(\hat{a}))\underline{n}) d\mu_o(x_o)$$

2) *Labor market clearing:*

$$(20) \quad H = \int h_y d\mu_y(x_y) + \int h_o d\mu_o(x_o) + \int ((1 - s(x_o)) + s(x_o)(\pi(\hat{a})(1 - \bar{n})\bar{\theta} + (1 - \pi(\hat{a}))(1 - \underline{n})\underline{\theta})\hat{a} d\mu_o(x_o)$$

3) *The government balances budgets (12) and (13), which determine g and q .*

4) *The laws of motion Φ mapping from state $x_y = (h_y, a, b)$ of the young to state $x'_o = (h'_o, \hat{a}', a', b')$ of the old in the following period, such that $\mu'_o(x'_o) = \Phi(\mu_y(x_y))$, are given by (2) and (7). The laws of motion Ω mapping from state $x_o = (h_o, \hat{a}, a, b)$ of the old to state $x'_y = (h'_y, a')$ of the young in the following period, $\mu'_y(x'_y) = \Omega(\mu_o(x_o))$, are given by (1), (5), and (6).*

5) *The tax rates (τ_p, τ_q) to finance public education expenditures on early education g and the individual college subsidy q , respectively, are given by (15).*

A stationary equilibrium is a competitive equilibrium in which policy functions, as well as subsidies and tax rates, are constant. It is a fixed point in the mapping (14), such that the expected tax rates $\tilde{\tau}_p$ and $\tilde{\tau}_q$ are equal to the solution for τ_p and τ_q , respectively, which are the solution to (15). Also the distributions $\mu_y(x_y) = \mu'_y(x'_y)$ and $\mu_o(x_o) = \mu'_o(x'_o)$ are stationary, hence the distributions can be summarized by $\mu(x)$.

V. Model parameterization

In order to analyze the US economy and conduct cross-country experiments the model is calibrated to the US benchmark economy by matching facts on inequality, mobility,

and public and private education expenditures. The model is governed by 21 parameters summarized in Table 2. Eight parameters are chosen from a priori information or are standard in the literature, while the remaining are determined in the calibration by minimizing the squared distance between model output and 13 data moments.

A. *Independently chosen parameters*

One period in the model is equivalent to 16 years. The discount rate is standard at 0.96 per year, which results in β being set to 0.52. I choose a standard value in the consumption literature of 1.5 for the intertemporal preference parameter σ . College completion requires four years of attendance, which given a period length of 16 years translates into $\bar{n} = 0.25$. Supported by evidence of Stinebrickner and Stinebrickner (2007) dropping out occurs after two years of college attendance ($\underline{n} = 0.125$). The increases in earnings through the lifecycle are determined by the earnings ratio of working males in the given age groups. For η_0 , I take the ratio between those aged 33 and 48 to those between 22 and 32. For η_1 , I take the ratio of males aged between 49 and 64 to those between 33 and 48. Using the IPUMS data of 2011, the increases of earnings over the lifecycle are determined to be $\eta_0 = 1.8$ and $\eta_1 = 1.1$.

VOTING. — Participation in the elections of the president and of congress is highly correlated with the level of education in the US. Since it is more likely for the higher educated to vote, politicians might be better off catering to their interests. In frameworks based on the median voter theorem, this has been incorporated in models by Benabou (2000) and Ichino, Karabarbounis and Moretti (2011) to account for the fact that the decisive voter might not actually be the median voter. Recent research points out the effects of skewed voter turnout and a bias in responsiveness towards policy preferences of the affluent (e.g., Gilens 2012, Schlozman and Brady 2012, Bonica et al. 2013). Additionally, the older an individual, the more likely he/she is to cast his/her vote. To account for these potential biases, I use the 2006 voting supplement of the CPS to compute the share of eligible individuals by education and age group that casted their vote in the 2006 election

of congress. The patterns of voter turnout by age and education are fairly constant across the three elections of congress and the three presidential elections of the years available in the CPS data (1996-2006), as can be seen in Table 7 in the Appendix. The political science literature has established a cross-country relationship between inequality and voter turnout (e.g., Lijphart 1997), but to my knowledge there is no empirical evidence of this relationship holding or being causal within a country. Given that in addition no theoretical model has been able to explain patterns of voter turnout consistently, participation is considered as exogenous.¹⁰

The voting weight for the old parent household ω_o is composed of the sum of the weight assigned to the parents as well as to the offspring. This accounts for the fact that they are on the verge of completing the age of eligibility to vote at the beginning of the period. Since the old offspring has not taken all educational decisions yet, individuals in this age group are only weighted by their age-specific weight, while disregarding education to have an exogenous voting weight. Otherwise, tax rates could alter decisions, and thereby the voting weights of the old offspring. The weights assigned to each age and education level are displayed in Table 1.

Voting preferences are determined at the household level because all decisions in the

TABLE 1—VOTING WEIGHTS

Age	High school or less	Some college	College
18 - 32	.27	.27	.27
33 - 48	.32	.48	.64
49 - 64	.47	.63	.77

Datasource: CPS November voting supplement 2006.

model are determined at the household level. Also, Niemi and Jennings (1991) find that parents play a major role in determining the initial political direction in the early adulthood of their offspring.

¹⁰For more on this discussion see Section VII.A.

B. Calibrated parameters

EDUCATION COSTS AND EXPENDITURES. — In 2009 the share of GDP dedicated to public early education was 3.9% (OECD 2011), which is targeted by γ , the productivity parameter of early education investment. The parameter determining the curvature of the altruism function, ξ , is anchored by the share of household wages parents spend on early private education, estimated to be a total of 2,198 US\$ per child in 2007 according to Kornrich and Furstenberg (2013).¹¹ Using the IPUMS data for 2007, I calculate the average household earnings per child, where no parent is older than 48 and at least one parent is older than 32, and determine it to be 41,068 US\$. Therefore, I estimate that an average parent spends 5.4% of his earnings on private early education of a child.

In 2010-2011 average costs of one year of undergraduate full-time studies at a 4-year institution are 22,092 US\$ according to the U.S. National Center for Education Statistics (NCES).¹² Given a GDP per capita of 49,800 US\$ in 2011, on average, the costs of one year of college rack up to 44% of GDP per capita, which I target via the tuition cost T . The total expenditures of households on tertiary education sum up to 1.1% of total GDP according to the OECD (2011a), which is targeted by the altruism parameter ϕ , the importance parents attach to the human capital outcome of their children. The share of students receiving federal grants is retrieved from the 2011 Digest of Education Statistics.¹³ Of all full-time undergraduate students 64% received financial aid through grants in 2007-2008, which pins down κ , the parameter determining the slope of the college subsidy with respect to parental earnings.

EDUCATION DECISIONS AND OUTCOMES. — In 2009, amongst those completing high school, 71% enrolled into college according to the National Science Foundation, while the high school completion rate is estimated to be 88% (Heckman and LaFontaine 2010).¹⁴

¹¹Their analysis includes expenditures on education, child care, and other miscellaneous goods and services, such as games and instruments, for children.

¹²For more information see the website <http://nces.ed.gov/fastfacts/display.asp?id=76>.

¹³See http://nces.ed.gov/programs/digest/d11/tables/dt11_353.asp.

¹⁴See <http://www.nsf.gov/statistics/seind12/c1/c1s4.htm>.

TABLE 2—BENCHMARK MODEL PARAMETERS

	Independently chosen			
Description	Parameter	Value	Reference	
Coefficient of relative risk aversion	σ	1.5	Standard	
Discount factor	β	0.96	Standard	
Time for college completion	$\bar{n}$	4 years	Standard	
Time for college dropout	$\underline{n}$	2 years	Stinebrickner and Stinebrickner 2007	
Lifecycle wage premium	η_0	1.8	IPUMS 2011	
Lifecycle wage premium	η_1	1.1	IPUMS 2011	
Voting weights of young HH	ω_y	See Table 1 CPS voting supplement 2006		
Voting weights of old HH	ω_o	See Table 1 CPS voting supplement 2006		
	Calibrated			
Description	Parameter	Value	Target	Data
Elasticity wrt early education	γ	0.34	Public early education/GDP	0.039
Tuition cost per period	T	0.44	Annual tuition costs/GDP per cap.	0.44
Slope college subsidy wrt earnings	κ	0.46	Share college students with grant	0.64
“Warm glow”	ϕ	1.375	Private college expenditure/GDP	0.011
Curvature of “warm glow”	ξ	0.78	Private early educe./Mean earnings	0.054
College completion wrt ability	ψ_0	0.29	Fraction attending college	0.62
College completion wrt ability	ψ_1	1.02	College completion rate	0.58
College completion premium	$\bar{\theta}$	1.31	Average college premium	2.53
College dropout premium	$\underline{\theta}$	0.87	Average dropout premium	1.32
Persistence ability transmission	ρ	0.25	Intergenerational earnings persist.	0.40
Level effect of HC prod. func.	χ	1.075	Gini before tax	0.39
STD of noise in ability trans.	σ_a	0.50	Variance of log hourly wages	0.47
Magnitude of market luck shock	ζ	0.375	Share earnings variance post-educ.	0.39

This results in 62% enrolling into college and 38% of non-college workers, which I approach through ψ_0 , a parameter of the probability of college completion. The other parameter of the college completion function, ψ_1 , is pinned down by the fraction of individuals completing college, 58% of first-time, full-time students who enrolled at a 4-year institution in fall 2004 according to the NCES.¹⁵ I use the IPUMS data of the year 2011 to calculate the college completion as well as the dropout premium. The ratio of the average earnings of men aged 33 to 48 with at least four years of college to those with no college education is 2.53, while the ratio of those with less than four years of college to those with no college education is 1.32. These are targeted in the model by the college completion and dropout premium $\bar{\theta}$ and $\underline{\theta}$, respectively.

¹⁵See <http://nces.ed.gov/fastfacts/display.asp?id=40>.

EARNINGS. — The empirical estimation of the IGE was pioneered by Solon (1992) and Zimmerman (1992) finding a persistence of 0.4 in the US.¹⁶ This coefficient is targeted by the parameter for the intergenerational transmission of innate ability ρ , the coefficient of the autoregressive process. The variance of the random shock in the transmission of innate ability σ_a is linked to the variance of log hourly wages of males. In the US in 2005, the variance of log hourly wages of males was 0.47 (Heathcote, Perri and Violante 2010). The Gini coefficient of hourly male wages in the US, my measure for earnings inequality, is 0.39 in 2005 (Heathcote, Perri and Violante 2010) and is targeted by χ , which is the parameter in charge of the level effect of human capital creation at the early stage.¹⁷ The relevant moment for the post-education earnings shock ζ is the share of the variance in earnings of 0.39 which is not explained by initial conditions, such as education, when entering employment (Huggett, Ventura and Yaron 2011).

TABLE 3—CALIBRATION OF THE US ECONOMY

Target	Data	Model
Public early education exp./GDP	.039	.044
Annual tuition costs/GDP per capita	.44	.42
Share of college students with grants	.64	.57
Private college expenditure/GDP	.011	.010
Private early education exp./Mean earnings	.054	.061
Fraction attending college	.62	.62
College completion rate	.58	.59
Average college premium	2.53	2.91
Average dropout premium	1.32	1.61
Intergenerational earnings elasticity	.40	.39
Gini before tax	.39	.38
Variance log wages	.47	.44
Share of earnings variance post-schooling	.39	.34

¹⁶Concerning other estimates of intergenerational mobility see Solon (1999), Blanden, Gregg and MacMillan (2007) for the UK, Björklund and Jäntti (1997) for a comparison of the US and Sweden, and Solon (2002) or Corak (2013) for a survey of cross-country estimates. Black and Devereux (2011) provide an excellent overview of recent findings.

¹⁷The focus is on the pre-tax and pre-transfer Gini of wages as I am trying to capture inequalities coming about through education and human capital accumulation and their respective returns in the market.

VI. Benchmark economy

The model performs well at replicating the fraction of individuals going to college, the dropout rate, the share tuition costs of one year of college relative to GDP per capita, and the share of GDP households dedicate to tertiary education, as can be seen in Table 3. The average college and dropout premium are overestimated, whereas the share of college students receiving federal grants and the IGE are slightly underestimated. While the correlation in innate ability ρ is 0.25, the intergenerational elasticity in earnings is 0.39. A large part of intergenerational mobility arises due to the underlying structure of the model.¹⁸

In the benchmark, public early education investment accounts for 4.4% of GDP, which is slightly higher than the 3.9% in the data. This can be attributed to the high elasticity of returns to early education expenditures ($\mu = 0.34$). The elasticity of returns to education expenditures has been estimated to be lower, taking values around 0.2 (e.g. Card and Krueger 1992, 1996). However, these estimates might be underestimating the returns, as they exclude private investments (remember in the model investments are $e + g$), and therefore neglect substitution effects. The short time horizon can also be an issue as increasing a teacher's salary might increase motivation marginally, but in the long-run this could also improve the talent pool of teachers.

The model estimates that 57% of the students receive grants, whereas in the data 64% of full-time undergraduates do so. Even though not targeted by the calibration, I find that those receiving grants on average can cover 36% of tuition, which is fairly close to the 32% (7,100 US\$) in the data of the NCES.¹⁹ In the model, public expenditures account for 21% of total tertiary education expenditures, which is far from the 41% in the data. This discrepancy originates in the assumption that colleges do not require input in the model, implemented due to the emphasis on financial aid given tuition costs. Since colleges in the model do not require inputs to produce, their productivity is not dependent

¹⁸The finding that the correlation of the permanent component of wages of brothers is higher than for their physical attributes such as height and weight (Mazumder 2008), which are arguably transmitted more directly via genes, casts doubts on accepting "nature" as the sole explanation of intergenerational persistence in earnings.

¹⁹According to a Sallie Mae-Ipsos Report in 2013 grants and scholarships pay for 30% of costs of college attendants.

on funding. According to the OECD (2012), public expenditures on tertiary education account for 1.3% of GDP in the US, while 18.5% of these funds are spent on scholarships and grants. Hence, the US invests 0.24% of GDP in grants and scholarships, which is close to the 0.25% endogenously arising through probabilistic voting.

The college premium parameter $\bar{\theta}$ is 1.31, but since it is multiplied with acquired ability the actual average college premium is 2.91, 15% higher than what we observe in the data. The college dropout parameter $\underline{\theta}$ is 0.87. The fact that the dropout premium is smaller than unity can be interpreted as dropping out being a negative signal in the labor market and/or the time spent in college without graduating is lost in terms of learning on the job, leading to a relatively lower work experience, which is penalized in the labor market.

Parents highly value the human capital accumulation of their offspring with $\phi = 1.375$, a value close to the 1.37 determined by Blankenau and Youderian (2012). Keane and Wolpin (2001), Johnson (2013), and Lochner and Monge-Naranjo (2012) point out the high parental valuation of children's education given that the young would not attend college without attendance-contingent transfers by their parents even if credits were abundant.

The model does not only perform well at replicating targeted moments, but also comes close to a range of other moments related to inequality and intergenerational mobility. The ratio of mean to median earnings is 1.29 compared to 1.34 in the data using only employed males between 18 and 64 of the IPUMS 2011. For male earnings in 2005, Heathcote, Perri and Violante (2010) determine the P50/P10 percentile ratio to be 2.31 and the P90/P50 percentile ratio to be 2.33, close to 2.54 and 2.23, respectively, in the benchmark economy. Jäntti et al. (2006) estimate the mobility trace index at 0.86 in the US, which signifies marginally less mobility than the mobility trace index of 0.89 in the benchmark economy.²⁰

Additionally, I compare a 3x3 matrix of intergenerational transition probabilities be-

²⁰The trace index is calculated using a 5x5 matrix P of transition probabilities for sons to move to a given earnings quintile conditioned on the earnings quintile of their father. Given the matrix the index is calculated as: $M_T = \frac{5 - \text{tr}(P)}{5 - 1}$ where tr is the trace of the matrix P . The index is bound below by zero and is increasing in mobility.

TABLE 4—EARNINGS TRANSITION MATRIX

Father/Son	Data			Model		
	Bottom	Middle	Top	Bottom	Middle	Top
Bottom tercile	.48	.34	.19	.47	.36	.18
Middle tercile	.30	.37	.34	.38	.37	.29
Top tercile	.21	.29	.50	.15	.31	.54

Note: The left panel is calculated using permanent earnings of fathers and sons of the PSID between 2000-2008.

tween earnings terciles of the model to those I obtain using fathers and sons of the PSID between 2000 and 2008. Correcting for lifecycle effects by taking the residuals of a regression controlling for age and age square and year fixed effects, and then averaging observations over various years, I find, as displayed in Table 4, that persistence is especially high at the bottom and the top, where about half of all sons end up in the same earnings tercile as their father. Comparing the data to the transition matrix obtained for the benchmark case, one can see that the model replicates intergenerational dynamics accurately. For sons of the middle tercile, the model overestimates downward mobility, which is due to the punishing effect of dropping out of college. In Figure 5, the correlation between parental earnings and college attendance and completion becomes apparent. The model accurately replicates the pattern of college attendance conditioned on the parental earnings quintile determined by Bailey and Dynarski (2011) using the National Longitudinal Survey of Youth (NLSY).²¹

In order to determine the share of individuals that are credit constrained in their college decision, I use the methodology of Carneiro and Heckman (2002).²² Comparing individuals by acquired ability, the model exhibits a large share of 23.2% of credit constrained individuals, compared to only 5.2% identified by Carneiro and Heckman (2002) using a sample of white males of the 1979 cohort of the NLSY. Belley, Frenette and

²¹In the data, more children of the bottom quartile drop out of college, which could be linked to two causes. First, despite the finding of Stinebrickner and Stinebrickner (2007) that dropout is usually explained by ability as embedded in the model, financial constraints tightening during college attendance might force some students to drop out. Second, in the model abilities and completion probabilities are perfectly known, whereas in reality some students might realize that they are not prepared for college once they are actually attending college.

²²They define as credit constrained the sum of the gaps between the percentage of the highest income quartile enrolled for each ability tercile and the percentage enrolled in the remaining income quartiles of the given ability tercile.

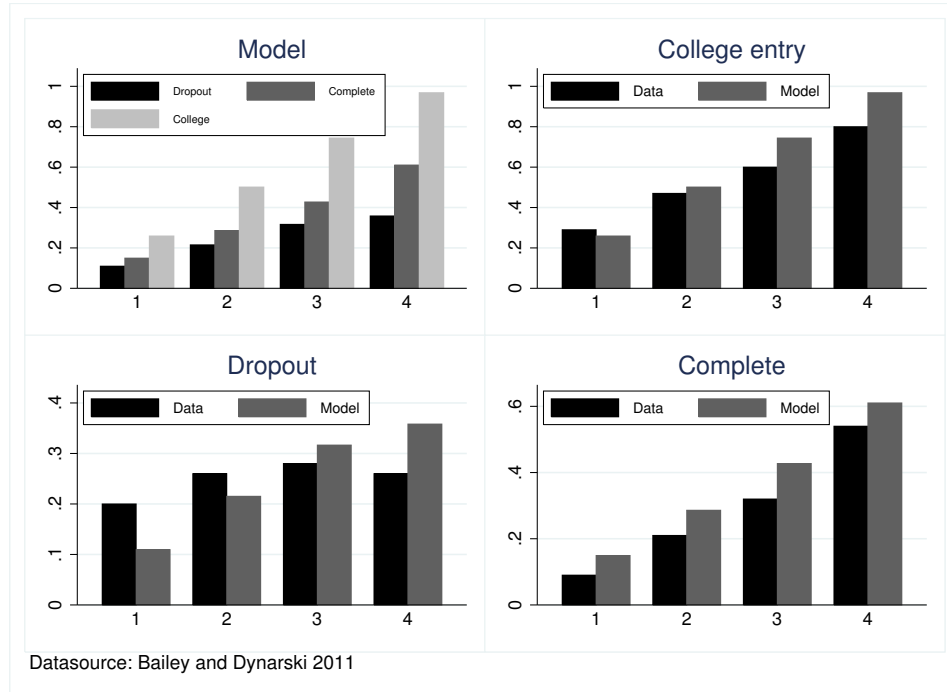


FIGURE 5. DATA VS MODEL OF COLLEGE ATTENDANCE AND COMPLETION RATES (Y-AXIS) BY PARENTAL EARNINGS QUARTILE (X-AXIS)

Lochner (2011), using the NLSY97, find that family income has become a much more important component of the college enrollment decision in the recent past. Given that tuition costs have more than doubled in real terms since the 80's, this is not a surprising development. Recent estimates using the same approach have increased to 16.6% (Bohacek and Kapicka 2012), 24% (Winter 2014), and an upper bound of half of all children (Brown, Scholz and Seshadri 2012).²³ In the benchmark economy the same exercise in terms of innate ability instead of acquired ability, reveals that 27.5% of individuals are credit constrained in their college decision when one does not condition on early investments.

²³The share of potentially credit constrained children estimated by Brown, Scholz and Seshadri (2012) is so high due to the assumption that not all parents are willing to contribute the expected amount according to the expected family contribution schedule, which is used as a guide for the calculation of individual financial aid.

A. *Voting experiments in the US*

Voter turnout in the US is lower and more skewed towards the educated than in most OECD countries. Therefore, one possible policy to counter this would be compulsory voting, as already exists in a number of countries (e.g., Argentina, Australia, Brazil, Peru). I simulate the policy experiment by imposing mandatory voting for all. If everybody were to cast their vote, public education funding of early education would increase from 4.4% to 5.2% of GDP and financial aid expenditures on college would augment from 0.25% to 0.28% of GDP, providing financial aid to 59% of the college students, who would account for 66% of the population. As a consequence the Gini reduces marginally to 0.37, whereas earnings persistence drops to 0.36.²⁴

Another policy, which recently has received attention in the public debate, is the extension of electoral franchise to children as of birth.²⁵ The practical implementation discussed would include parents voting for their children. I simulate this by doubling the benchmark voting weight of young parent households.²⁶ As a result inequality reduces to a Gini of 0.36, whereas intergenerational mobility surges due to the increases in public early education expenditures, thus reducing earnings persistence to 0.21.

One concern is that electoral outcomes are not characterized by “one person = one vote” but by “one dollar = one vote” (Karabarounis 2011, Gilens and Page 2014). Considering the importance of campaign contributions, the US could be particularly vulnerable to this unequal treatment lacking the spirit of democracy. I simulate this voting mechanism by weighting households by their earnings. Now that rich households have a disproportionate say in the elections, I find that the IGE increases to 0.46, whereas pretax inequality is not affected. The scenario of inequality potentially disrupting the political

²⁴This is not to claim that these changes would be immediate, as surely politicians would take time to identify preferences of the electorate, which would take several elections. Also, I am assuming the implementation to be costless, thereby ignoring monitoring costs.

²⁵The extension of franchise to children is commonly referred to as “Demeny voting”, named after Paul Demeny, the author of a paper suggesting half a vote for children to counter low fertility (Demeny 1986). See, for example, http://www.nytimes.com/2013/03/08/world/americas/08iht-letter08.html?_r=1& or <http://mileskorak.com/2013/06/02/should-children-be-given-the-vote-watch-this-tedx-talk/> for recent discussions.

²⁶This is debatable given that increased voting weight raises incentives to vote, which thereby could feedback into turnout of young parent households as well. Given that voter turnout is not modelled in the framework, I refrain from speculating about the magnitude of the possible increase in turnout among young parents.

process is one of the perpetuating threats emphasized (e.g., Stiglitz 2012).

VII. Cross-country differences

As visible in the “Great Gatsby Curve”, inequality and intergenerational mobility are negatively associated across countries. In order to identify potential drivers of this relationship, I conduct experiments exploiting cross-country differences in voter turnout and tertiary education characteristics jointly as well as in isolation.

A. Voter turnout

Voter turnout shows strong variations across age groups and levels of education across countries. I am agnostic here on whether this is due to culture or political institutions.²⁷ I use this variation to adjust voting weights in the probabilistic voting process and explain differences in individual earnings inequality and the IGE. The voter turnout by age group and education is determined using the ESS 2010 for European countries and the Canadian Election Study 2010 for Canada, as displayed in the Appendix in Table 10, and assign these weights to the respective age groups and education levels in the probabilistic voting mechanism of the benchmark model.

Voter turnout alone on average explains 21% of the difference in the Gini and 23% of the difference in the IGE to the US. The results are summarized in Table 5 and in Figures 6, 7 and 8, in the Appendix. The model performs well at replicating data moments of the Gini, the IGE, and public expenditures on non-tertiary and tertiary education in a range of OECD countries.

In the UK, the Gini of individual earnings is 0.383 (OECD 2013a), while the IGE is estimated to be 0.31 (Jäntti et al. 2006). Voter turnout is increasing in age and education

²⁷There is strand of literature attempting to explain cross-country differences in voter turnout and specifically low turnout in the US (e.g., Wolfinger and Rosenstone 1980, Powell Jr 1986, Jackman 1987, Blais 2000, Perea 2002). General explanations for cross-country differences range from legal differences, such as compulsory voting or voting facilitation through postal or advanced voting, organizational factors and electoral systems, such as number of parties, party-group alignment, and proportional representation, and population size. Specifically concerning the US there seems to be consensus that the complexity of registration is one reason for the low turnout. Blais (2000) summarizes that there is a lack of solid explanations and there are few robust findings, which explain cross-country differences, with compulsory voting being an exception. So even if the reader is unhappy accepting the notion of exogeneity of voter turnout, maybe he/she can accept the exogeneity of the before mentioned costs and institutions driving differential turnout patterns.

in the UK. However, the bias is relatively lower than in the US. The simulation reveals an earnings persistence of 0.35 accounting for 40% of the gap.²⁸ The Gini only drops to 0.37, but this accounts for 66% of the difference in inequality between the UK and the US. Canada has a Gini of 0.37 (OECD 2013a) and a relatively low earnings persistence of 0.21 (Corak 2013). Voter turnout patterns are capable of explaining 19% of the difference in earnings persistence to the US and 23% of the difference in earnings inequality.

Sweden is characterized by a low earnings persistence of 0.27 (Corak 2013) and a pre-tax Gini of individual earnings of 0.32 (Domeij and Floden 2010). Swedes of all age groups are similarly likely to vote, and voter turnout is not biased towards the highly educated as in the US. The resulting higher levels of chosen public education funding reduce the IGE by 10% to 0.35 and the Gini to 0.37. Thereby, the voter turnout can explain 28% and 7% of the gaps between Sweden and the US in earnings persistence and inequality, respectively. These improvements in inter- and intragenerational equity are accompanied by a 4% increase in aggregate consumption. In Sweden, inequality increased over the 90's, however to a lesser extent than in the US. Similarly, intergenerational mobility remains high despite increases in earnings inequality. The model indicates that the political economy, and more specifically voter participation, might be why the increase in the skill premium in the 90's might have had a less harsh effect on inequality and mobility in Sweden than in the US.

Denmark is amongst the most equal countries and has the lowest IGE of the OECD. The Gini of individual pre-tax earnings is estimated to be 0.294 (OECD 2013a), while the IGE is 0.15 (Corak 2013). In Denmark, voter turnout is relatively high across all age groups and levels of education, resulting in a Gini of 0.37 and an IGE of 0.35, accounting for 6% and 19% of the gaps, respectively. Norway has a similarly low level of earnings persistence of 0.17 (Corak 2013) and a Gini of 0.35 (OECD 2013a). In Norway, voter turnout explains 10% of the difference in inequality and 13% of the difference in earnings persistence. Finland matches the pattern of the other Scandinavian countries with

²⁸The share of a gap between a data moment in the US d_{US} and another country $d_{country}$ explained by moments m_j produced by the model, is calculated using the following definition: $\frac{(m_{US}-m_{country})}{(d_{US}-d_{country})}$.

a pre-tax earnings Gini of 0.31 (OECD 2013a) and an IGE of 0.18 (Corak 2013). For the case of Finland, voter turnout patterns can account for 3% and 12% of the respective gaps.

In Germany, the pre-tax earnings Gini is estimated to be 0.37 (Fuchs-Schündeln, Krueger and Sommer 2010) and the IGE is 0.32 (Corak 2013).²⁹ Both values are in the middle of the distribution of OECD countries. Voting participation in Germany is biased towards the older and more educated, but not to such an extreme extent as in the US. As expected the publicly chosen education expenditures as well as the Gini and the IGE are in the middle range, closing 29% and 33% of the gaps, respectively.

TABLE 5—COUNTERFACTUALS (VOTER TURNOUT)

Country	Intergenerational elasticity			Gini		
	Data	Model	$\Delta_{explained}$	Data	Model	$\Delta_{explained}$
US	.40	.385		.39	.375	
Sweden	.27	.348	.28	.32	.370	.07
UK	.31	.350	.40	.383	.371	.66
Canada	.21	.349	.19	.37	.371	.23
Denmark	.15	.34	.18	.294	.369	.06
Norway	.17	.355	.13	.35	.371	.10
Finland	.18	.358	.12	.313	.373	.03
Germany	.32	.358	.33	.37	.369	.29

Note: The share of a gap between a data moment in the US d_{US} and another country $d_{country}$ explained by moments m_j produced by the model, is calculated using the following definition: $\Delta = \frac{(m_{US} - m_{country})}{(d_{US} - d_{country})}$.

B. Tertiary education and voter turnout

Countries are characterized by varying types of tertiary education. Roughly labeling the countries included in the analysis into the categories defined by Ansell (2010), the Scandinavian countries and Canada could be considered as mass public, the US and the UK as partially private, and neither as an elite tertiary education system.³⁰ Using data from the OECD (2012, 2013), I calculate the college premium and tuition costs relative to the US, which are displayed in Table 8 in the Appendix, and assign them

²⁹In Germany tuition costs vary strongly by state, which is why Germany is excluded from the simulation with tertiary education characteristics.

³⁰Elite tertiary education system are more prevalent in low and middle income countries with high inequality, such as Chile, Brazil, or Mexico.

as exogenous factors in the model. Then I calibrate the model while targeting dropout rates of each country via ψ_0 , a parameter of the college completion probability function, and enrollment via the dropout premium θ . Expenditures on early education and, for those countries with non-zero tuition costs, financial aid are determined endogenously via probabilistic voting given country-specific voter turnout, which is in Table 10 of the Appendix and discussed in further detail in section VII.A.³¹ On average, I find that differences in tertiary education and voter turnout combined can explain 71% of the differences in inequality compared to the US and 29% of the gaps in the IGE. Regressing model moments on data moments, I find that 32% and 26% of the variance in IGE and inequality, respectively, are explained.³² The results are summarized in Table 6 and Figure 6. The high correlations of 0.67 and 0.83 between data and model moments in terms of the Gini and the IGE, respectively, are illustrated in Figure 4 in the Online Appendix.

In the UK, the college premium is relatively high and about three-quarters of the US college premium, whereas average tuition costs are nearly half as cheap. While 29% of the gap in the IGE is explained, the small gap in inequality is fully accounted for. Canada's average tuition costs for tertiary education are about 40% of those of the US (Belley, Frenette and Lochner 2011), while the college premium is about half as high as in the US (OECD 2013*b*). Also, the dropout rates are substantially lower at around 30% (Finnie and Qiu 2008). The model estimates the Gini to be 0.35, which is even lower than it actually is in Canada, thereby covering the entire gap. Earnings persistence drops to 0.34 explaining 24% of the difference.

In all Scandinavian countries tuition is free and, except for Finland, the college premium is about one-third of the US. In Sweden, I find that differences in the characteristics of tertiary education and voter turnout explain 38% of the difference in earnings persistence, which drops to 0.34, and 62% of the gap in the Gini, which reduces to 0.33. In Denmark, tertiary education combined with the patterns of voter turnout accounts for

³¹Since financial aid in the model is a tuition discount, there is no point in voting on financing of college education when tuition costs are zero.

³²The variance explained is computed excluding the US, as the model is trained to replicate the US. Including the US, these number increase to 73% and 45%, respectively.

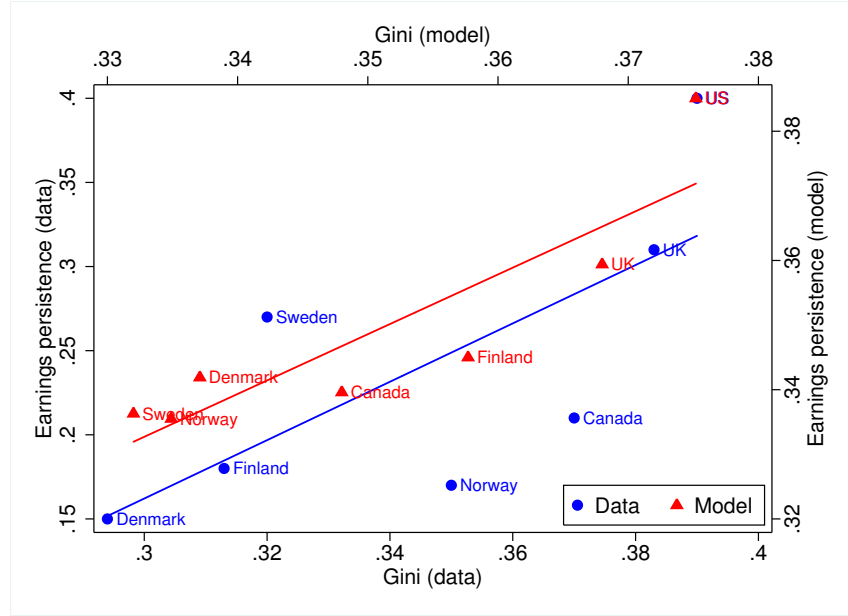


FIGURE 6. COMPARING MODEL MOMENTS WITH COUNTRY-SPECIFIC TERTIARY EDUCATION AND VOTER TURNOUT BY AGE AND EDUCATION (BLUE) AND DATA MOMENTS (RED) OF THE GINI VERSUS INTERGENERATIONAL EARNINGS PERSISTENCE.

17% of the difference in earnings persistence and 40% of the gap in the Gini between Denmark and the US. Both, Gini and earnings persistence, diminish to 0.34 in the simulation. In Norway, 22% of the gap in earnings persistence and the entire difference in earnings inequality are explained by the simulation. In Finland, the college premium is nearly two-thirds of the US, and hence the model closes only 23% and 18% of the gaps in inequality and earnings persistence, respectively.

C. Tertiary education

In order to isolate the importance of tertiary education I simulate the economy with the voting weights of the US, but the country-specific characteristics of tertiary education. The results are summarized in Table 6 and Figure 9 in the Online Appendix. For all countries the Gini is lower than when only using country-specific voter turnout, and therefore the gap in earnings inequality is closed to a larger extent. On average, 65% of

TABLE 6—COUNTERFACTUALS (TERTIARY EDUCATION AND VOTER TURNOUT)

Country	Intergenerational elasticity					Gini				
	Data	Ter.&Vote	$\Delta_{ter.\&vote}$	Tertiary	$\Delta_{ter.}$	Data	Ter.&Vote	$\Delta_{ter.\&vote}$	Tertiary	$\Delta_{ter.}$
US	.40	.385		.385		.39	.375		.375	
Sweden	.27	.336	.38	.329	.43	.32	.332	.62	.33	.65
UK	.31	.359	.29	.369	.18	.383	.368	1.03	.370	.71
Canada	.21	.340	.24	.340	.24	.37	.348	1.36	.348	1.36
Denmark	.15	.342	.17	.347	.15	.294	.337	.40	.339	.38
Norway	.17	.336	.22	.350	.15	.35	.335	1.01	.334	.94
Finland	.18	.358	.18	.362	.11	.313	.345	.23	.360	.20

Note: The column “Ter.&Vote” refers to results where country-specific voter turnout and tertiary education characteristics are varied, whereas the column “Tertiary” refers to results where only country-specific characteristics in tertiary education are varied. The share of a gap between a data moment in the US d_{US} and another country $d_{country}$ explained by moments m_j produced by the model, is calculated using the following definition: $\Delta = \frac{(m_{US} - m_{country})}{(d_{US} - d_{country})}$. $\Delta_{ter.\&vote}$ and $\Delta_{ter.}$ refer to the share of the difference explained by voting as well as tertiary education, and tertiary education, respectively.

the differences in the Gini and 21% of the differences in intergenerational mobility are accounted for by characteristics of tertiary education. Concerning the IGE, varying levels of education expenditures at the two education stages caused by differences in voter turnout seem to be of a greater importance than the characteristics of tertiary education in some cases. In Canada, Norway, and Sweden, tertiary education contributes more to the lower intergenerational elasticity than voter turnout, whereas in Denmark, Finland, and the UK, the opposite is the case. In Denmark, Norway, and Sweden, where access to college is free and the premium is relatively low, the model exhibits the lowest levels of earnings inequality, as is the case in the data.

VIII. Robustness check using party membership

The educated are more likely to participate in a range of political activities such as signing petitions, attending meetings, writing to congress, or contributing to campaigns (Schlozman and Brady 2012). As a robustness check to the voter turnout experiment, I instead use variations in party membership. Party members spread political propaganda, mobilize voters, and form and shape agendas (Huckfeldt and Sprague 1992, Green and Gerber 2008). Ichino, Karabarbounis and Moretti (2011) find that across countries intergenerational mobility is positively associated with party membership of the poor relative to the rich. I use the first, third, and fifth wave of the World Values Survey to determine

the membership rate (active as well as inactive) by age group and level of education to assign these shares as weights, as displayed in Table 10 in the Appendix, in the probabilistic voting process. Including all countries, on average weighting voters by party membership propensity explains 3% of the difference to the Gini and 14% of the difference to intergenerational earnings persistence of the US. However, if we exclude the UK these shares increase to 12% and 22%, respectively. The results are summarized in Table 9 in the Appendix and in Figures 10, 11, and 12 in the Online Appendix.

In the US, the share of individuals that are active or inactive members of a political party is highest among the countries examined. However, once again participation is biased towards the older and more educated. This causes the IGE to increase slightly compared to the benchmark model due to public early education decreasing to 4.1% of GDP, which is even closer to the 3.9% in the data. The share of subsidies to college education remain unchanged, while earnings inequality experiences a benign increase. The results for other OECD countries exhibit very similar patterns to the results obtained when weighting voters by turnout.

IX. Conclusions

I calibrate a model characterized by dynamic complementarity between early and college education to the US economy. Households vote on tax rates dedicated to the funding of each education level. The model performs well at replicating the US economy across several dimensions including inequality, intergenerational mobility, the share of GDP dedicated to early education, and financial aid to college students. In addition, the model matches details not targeted, such as the intergenerational earnings transition matrix and college attendance by earnings quartile. In the benchmark economy almost one in four individuals is financially constrained in the college decision and mobility is found to be low at the top and the bottom of the earnings distribution.

The negative relation between inequality and intergenerational mobility observed in the data is replicated by the model when simulating with country-specific characteristics of tertiary education. I find that differences in tertiary education can account for

65% of the gaps in earnings inequality and 21% of the gaps in intergenerational earnings persistence between the US and Canada, Denmark, Finland, Norway, Sweden, and the UK. When controlling for country-specific voter turnout by age and level of education in the probabilistic voting process, the negative association between inequality and public expenditures on education observed in cross-country data is reconciled. Political participation in form of voter turnout explains nearly one-quarter of the differences in inequality and intergenerational earnings persistence. As a robustness check, I assign voting weights according to party membership by age and education obtaining similar results.

Concerning voting policies in the US, I find that compulsory voting would reduce earnings persistence by one-tenth, whereas extending electorate franchise to children as of birth and letting their parents vote for them would nearly halve the share of earnings transmitted across generations. However, the effects of these policies on inequality are found to be comparably weak.

The model neglects pre-primary education and abstracts from savings and borrowing decisions, which play a role in college financing, thereby providing fruitful areas for future research.

REFERENCES

- Aaronson, Daniel, and Bhashkar Mazumder.** 2008. "Intergenerational economic mobility in the United States, 1940 to 2000." *Journal of Human Resources*, 43(1): 139–172.
- Abbott, Brant, and Giovanni Gallipoli.** 2014. "Skill Complementarity and the Geography of Intergenerational Mobility." Working Paper.
- Abbott, Brant, Giovanni Gallipoli, Costas Meghir, and Giovanni L Violante.** 2013. "Education policy and intergenerational transfers in equilibrium." National Bureau of Economic Research.

- Andrews, Dan, and Andrew Leigh.** 2009. "More inequality, less social mobility." *Applied Economics Letters*, 16(15): 1489–1492.
- Ansell, Ben W.** 2010. *From the ballot to the blackboard: The redistributive political economy of education*. Cambridge University Press.
- Bailey, Martha J, and Susan M Dynarski.** 2011. "Gains and gaps: Changing inequality in US college entry and completion." National Bureau of Economic Research.
- Becker, Gary S, and Nigel Tomes.** 1979. "An equilibrium theory of the distribution of income and intergenerational mobility." *Journal of Political Economy*, 1153–1189.
- Becker, Gary S, and Nigel Tomes.** 1986. "Human capital and the rise and fall of families." *Journal of Labor Economics*, 4(1).
- Belley, Philippe, Marc Frenette, and Lance Lochner.** 2011. "Post-secondary attendance by parental income in the US and Canada: What role for financial aid policy?" National Bureau of Economic Research.
- Bénabou, Roland.** 1996. "Heterogeneity, Stratification, and Growth: Macroeconomic Implications of Community Structure and School Finance." *American Economic Review*, 584–609.
- Benabou, Roland.** 2000. "Unequal societies: Income distribution and the social contract." *American Economic Review*, 96–129.
- Ben-Porath, Yoram.** 1967. "The production of human capital and the life cycle of earnings." *Journal of Political Economy*, 352–365.
- Björklund, Anders, and Markus Jäntti.** 1997. "Intergenerational income mobility in Sweden compared to the United States." *American Economic Review*, 1009–1018.
- Björklund, Anders, Tor Eriksson, Markus Jäntti, Oddbjörn Rauum, and Eva Österbacka.** 2004. "Family Structure and labour market success: the influence of

siblings and birth order on the earnings of young adults in Norway, Finland and Sweden.” In *Generational Income Mobility in North America and Europe*. , ed. Miles Corak, Chapter 9, 207–225. Cambridge University Press.

Black, Sandra E, and Paul J Devereux. 2011. “Recent developments in intergenerational mobility.” In *Handbook of Labor Economics*. Vol. 4, , ed. David Card and Orley Ashenfelter, 1487–1541. Elsevier.

Blais, André. 2000. *To vote or not to vote?: The merits and limits of rational choice theory*. University of Pittsburgh Pre.

Blanden, Jo, Paul Gregg, and Lindsey MacMillan. 2007. “Accounting for Intergenerational Income Persistence: Noncognitive Skills, Ability and Education.” *Economic Journal*, 117(519): 43–60.

Blankenau, William, and Xiaoyan Youderian. 2012. “Early childhood education expenditures and the intergenerational persistence of income.” Working Paper.

Bloome, Deirdre. 2013. “Income Inequality and Intergenerational Income Mobility in the United States.” Working Paper.

Bohacek, R, and M Kapicka. 2012. “A quantitative analysis of educational reforms in a dynastic framework.” *Manuscript, University of California Santa Barbara*.

Bonica, Adam, Nolan McCarty, Keith T Poole, and Howard Rosenthal. 2013. “Why Hasn’t Democracy Slowed Rising Inequality?” *Journal of Economic Perspectives*, 27(3): 103–123.

Brown, Meta, John Karl Scholz, and Ananth Seshadri. 2012. “A new test of borrowing constraints for education.” *Review of Economic Studies*, 79(2): 511–538.

Busemeyer, Marius R. 2012. “Inequality and the political economy of education: An analysis of individual preferences in OECD countries.” *Journal of European Social Policy*, 22(3): 219–240.

- Card, David, and Alan B Krueger.** 1992. "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States." *Journal of Political Economy*, 100(1): 1–40.
- Card, David, and Alan B Krueger.** 1996. "School Resources and Student Outcomes: An Overview of the Literature and New Evidence from North and South Carolina." *Journal of Economic Perspectives*, 10(4): 31–50.
- Carneiro, Pedro, and James J Heckman.** 2002. "The Evidence on Credit Constraints in Post-Secondary Schooling." *Economic Journal*, 112(482): 705–734.
- Caucutt, Elizabeth M, and Lance Lochner.** 2012. "Early and late human capital investments, borrowing constraints, and the family." National Bureau of Economic Research.
- Chatterjee, Satyajit, and Felicia Ionescu.** 2010. "Insuring student loans against the risk of college failure." Federal Reserve Bank of Philadelphia.
- Chetty, Raj, Nathaniel Hendren, Patrick Kline, and Emmanuel Saez.** 2014. "Where is the land of opportunity? The geography of intergenerational mobility in the united states." National Bureau of Economic Research.
- Chong, Alberto, and Mauricio Olivera.** 2008. "Does compulsory voting help equalize incomes?" *Economics & Politics*, 20(3): 391–415.
- Cooper, Suzanne J.** 1998. "Redistribution and the persistence of income inequality." Research Programs, John F. Kennedy School of Government, Harvard University.
- Corak, Miles.** 2013. "Inequality from Generation to Generation: The Inequality from Generation to Generation: The United States in Comparison." , ed. R. Rycroft, Chapter The Economics of Inequality, Poverty, and Discrimination in the 21st Century. ABCCLIO.
- Corak, Miles, and Patrizio Piraino.** 2011. "The intergenerational transmission of employers." *Journal of Labor Economics*, 29(1): 37–68.

- Cunha, Flavio, and James J Heckman.** 2008. "Formulating, identifying and estimating the technology of cognitive and noncognitive skill formation." *Journal of Human Resources*, 43(4): 738–782.
- Cunha, Flavio, James J Heckman, Lance Lochner, and Dimitriy V Masterov.** 2006. "Interpreting the evidence on life cycle skill formation." *Handbook of the Economics of Education*, 1: 697–812.
- De la Croix, David, and Matthias Doepke.** 2004. "Public versus private education when differential fertility matters." *Journal of Development Economics*, 73(2): 607–629.
- De la Croix, David, and Matthias Doepke.** 2009. "To segregate or to integrate: education politics and democracy." *Review of Economic Studies*, 76(2): 597–628.
- Demeny, Paul.** 1986. "Pronatalist policies in low-fertility countries: Patterns, performance, and prospects." *Population and Development Review*, 335–358.
- Domeij, David, and Martin Floden.** 2010. "Inequality trends in Sweden 1978–2004." *Review of Economic Dynamics*, 13(1): 179–208.
- Duncan, Greg J, and Richard J Murnane.** 2011. *Whither opportunity?: Rising inequality, schools, and children's life chances*. Russell Sage Foundation.
- Duncan, Greg J, Ariel Kalil, and Kathleen M Ziol-Guest.** 2013. "Increasing Inequality in Parent Incomes and Children's Completed Schooling: Correlation or Causation?" Working paper.
- Durlauf, Steven N.** 1996. "A theory of persistent income inequality." *Journal of Economic Growth*, 1(1): 75–93.
- Epple, Dennis, and Richard E Romano.** 1996. "Ends against the middle: Determining public service provision when there are private alternatives." *Journal of Public Economics*, 62(3): 297–325.
- Fernandez, Raquel, and Richard Rogerson.** 1995. "On the political economy of education subsidies." *Review of Economic Studies*, 62(2): 249–262.

- Fernandez, Raquel, and Richard Rogerson.** 1997. "Keeping people out: income distribution, zoning, and the quality of public education." *International Economic Review*, 23–42.
- Fernandez, Raquel, and Richard Rogerson.** 1998. "Public education and income distribution: A dynamic quantitative evaluation of education-finance reform." *American Economic Review*, 813–833.
- Finnie, Ross, and Theresa Qiu.** 2008. "The patterns of persistence in post-secondary education in Canada: evidence from the YITS-B dataset." Canadian Education Project.
- Fowler, Anthony.** 2013. "Electoral and policy consequences of voter turnout: Evidence from compulsory voting in australia." *Quarterly Journal of Political Science*, 8(2): 159–82.
- Fuchs-Schündeln, Nicola, Dirk Krueger, and Mathias Sommer.** 2010. "Inequality trends for Germany in the last two decades: A tale of two countries." *Review of Economic Dynamics*, 13(1): 103–132.
- Galor, Oded, and Joseph Zeira.** 1993. "Income distribution and macroeconomics." *Review of Economic Studies*, 60(1): 35–52.
- Gilens, Martin.** 2012. *Affluence and influence: Economic inequality and political power in America*. Princeton University Press.
- Gilens, Martin, and Benjamin I Page.** 2014. "Testing theories of American politics: Elites, interest groups, and average citizens." *Perspectives on Politics*.
- Glomm, Gerhard, and Balasubrahmanian Ravikumar.** 1992. "Public versus private investment in human capital: endogenous growth and income inequality." *Journal of Political Economy*, 818–834.
- Green, Donald P, and Alan S Gerber.** 2008. *Get out the vote: How to increase voter turnout*. Brookings Institution Press.

- Heathcote, Jonathan, Fabrizio Perri, and Giovanni L Violante.** 2010. "Unequal we stand: An empirical analysis of economic inequality in the United States, 1967–2006." *Review of Economic Dynamics*, 13(1): 15–51.
- Heckman, James J, and Paul A LaFontaine.** 2010. "The American high school graduation rate: Trends and levels." *Review of Economics and Statistics*, 92(2): 244–262.
- Herrington, Christopher.** 2014. "Public Education Financing, Earnings Inequality, and Intergenerational Mobility." Working Paper.
- Holter, Hans.** 2014. "Accounting for Cross-Country Differences in Intergenerational Earnings Persistence: The Impact of Taxation and Public Education Expenditure." *Quantitative Economics*, forthcoming.
- Horn, Daniel.** 2012. "Educational Selectivity and Preferences about Education Spending." Working Paper.
- Hoxby, Caroline M.** 1998. "How much does school spending depend on family income? The historical origins of the current school finance dilemma." *American Economic Review*, 309–314.
- Huckfeldt, Robert, and John Sprague.** 1992. "Political Parties and Electoral Mobilization: Political Structure, Social Structure, and the Party Canvass." *American Political Science Review*, 86(01): 70–86.
- Huggett, Mark, Gustavo Ventura, and Amir Yaron.** 2006. "Human capital and earnings distribution dynamics." *Journal of Monetary Economics*, 53(2): 265–290.
- Huggett, Mark, Gustavo Ventura, and Amir Yaron.** 2011. "Sources of Lifetime Inequality." *American Economic Review*, 101(7): 2923–2954.
- Ichino, Andrea, Loukas Karabarbounis, and Enrico Moretti.** 2011. "The political economy of intergenerational income mobility." *Economic Inquiry*, 49(1): 47–69.
- Jackman, Robert W.** 1987. "Political institutions and voter turnout in the industrial democracies." *American Political Science Review*, 405–423.

- Jäntti, Markus, Bernt Bratsberg, Knut Røed, Oddbjørn Raaum, Robin Naylor, Eva Österbacka, Anders Björklund, and Tor Eriksson.** 2006. "American Exceptionalism in a New Light: A Comparison of Intergenerational Earnings Mobility in the Nordic Countries, the United Kingdom and the United States." Working Paper.
- Johnson, Matthew T.** 2013. "Borrowing constraints, college enrollment, and delayed entry." *Journal of Labor Economics*, 31(4): 669–725.
- Karabarbounis, Loukas.** 2011. "One Dollar, One Vote." *Economic Journal*, 121(553): 621–651.
- Keane, Michael P, and Kenneth I Wolpin.** 2001. "The effect of parental transfers and borrowing constraints on educational attainment." *International Economic Review*, 1051–1103.
- Kornrich, Sabino, and Frank Furstenberg.** 2013. "Investing in Children: Changes in Parental Spending on Children, 1972–2007." *Demography*, 50(1): 1–23.
- Light, Audrey, and Wayne Strayer.** 2000. "Determinants of college completion: School quality or student ability?" *Journal of Human Resources*, 299–332.
- Lijphart, Arend.** 1997. "Unequal participation: democracy's unresolved dilemma." *American Political Science Review*, 1–14.
- Lindbeck, Assar, and Jörgen W Weibull.** 1987. "Balanced-budget redistribution as the outcome of political competition." *Public choice*, 52(3): 273–297.
- Lochner, Lance, and Alexander Monge-Naranjo.** 2012. "Credit Constraints in Education." *Annual Review of Economics*, 4(1): 225–256.
- Loury, Glenn C.** 1981. "Intergenerational transfers and the distribution of earnings." *Econometrica*, 843–867.
- Niemi, Richard G, and M Kent Jennings.** 1991. "Issues and inheritance in the formation of party identification." *American Journal of Political Science*, 970–988.

- OECD.** 2011. "Education at a Glance."
- OECD.** 2012. "Education at a Glance."
- OECD.** 2013a. "Divided We stand: Why Inequality Keeps Rising."
- OECD.** 2013b. "Education at a Glance."
- Perea, Eva Anduiza.** 2002. "Individual characteristics, institutional incentives and electoral abstention in Western Europe." *European Journal of Political Research*, 41(5): 643–673.
- Persson, Torsten, and Guido Enrico Tabellini.** 2002. *Political economics: explaining economic policy*. MIT press.
- Powell Jr, G Bingham.** 1986. "American voter turnout in comparative perspective." *American Political Science Review*, 17–43.
- Ramey, Garey, and Valerie A Ramey.** 2010. "The Rug Rat Race." *Brookings Papers on Economic Activity*, 2010(1): 129–176.
- Restuccia, Diego, and Carlos Urrutia.** 2004. "Intergenerational persistence of earnings: The role of early and college education." *American Economic Review*, 1354–1378.
- Schlozman, Kay Lehman, and Henry E Brady.** 2012. *The unheavenly chorus: Unequal political voice and the broken promise of American democracy*. Princeton University Press.
- Solon, Gary.** 1992. "Intergenerational income mobility in the United States." *American Economic Review*, 393–408.
- Solon, Gary.** 1999. "Intergenerational mobility in the labor market." *Handbook of Labor Economics*, 3: 1761–1800.
- Solon, Gary.** 2002. "Cross-country differences in intergenerational earnings mobility." *Journal of Economic Perspectives*, 16(3): 59–66.

- Solon, Gary.** 2004. "A model of intergenerational mobility variation over time and place." *Generational income mobility in North America and Europe*, 38–47.
- Stiglitz, Joseph.** 2012. *The price of inequality*. Penguin UK.
- Stinebrickner, Todd R, and Ralph Stinebrickner.** 2007. "The effect of credit constraints on the college drop-out decision a direct approach using a new panel study." National Bureau of Economic Research.
- Winter, Christoph.** 2014. "Accounting for the Changing Role of Family Income in Determining College Entry." *Scandinavian Journal of Economics*, 116(4): 909–963.
- Wolfinger, Raymond, and Steven Rosenstone.** 1980. "Who votes?" Yale University Press.
- Zimmerman, David J.** 1992. "Regression toward mediocrity in economic stature." *American Economic Review*, 409–429.

X. Appendix

A. Tables and figures

TABLE 7—VOTING PATTERNS US 1996-2006

Age	Congress			President		
	High school	Some college	College	High school	Some college	College
1998				1996		
18-32	.16	.28	.41	.28	.47	.66
33-48	.32	.49	.63	.45	.65	.79
48-64	.47	.66	.73	.59	.76	.86
2002				2000		
18-32	.15	.26	.44	.29	.47	.67
33-48	.33	.50	.64	.47	.65	.79
48-64	.46	.61	.76	.58	.75	.84
2006				2004		
18-32	.17	.29	.46	.35	.58	.72
33-48	.32	.48	.64	.50	.69	.82
48-64	.47	.63	.77	.60	.78	.85

Note: Datasource: CPS November voting supplement 1996-2006.

TABLE 8—TERTIARY EDUCATION CHARACTERISTICS

Country	Exogenous		Calibrated					
	Premium $\bar{\theta}$	Tuition T	Enrollment			Completion		
			Data	Model	$\bar{\theta}$	Data	Model	ψ_0
US	1.31	.44	.62	.62	.87	.58	.59	.29
Sweden	1.10	0	.76	.74	1.03	.49	.49	.26
UK	1.23	.25	.62	.62	.78	.81	.81	.40
Canada	1.16	.26	.60	.62	.95	.70	.70	.35
Denmark	1.11	0	.65	.66	.98	.82	.82	.44
Norway	1.11	0	.76	.74	1.01	.63	.64	.34
Finland	1.20	0	.68	.66	.88	.72	.72	.36

Note: Datasources: College premium OECD 2013 Table A6.1, Tuition OECD 2012 Table B5.1 (for Canada: Belley, Frenette and Lochner 2011), Enrollment OECD 2012 Table C3.3, Completion rates OECD 2011a Table A4.1. (For Canada: Finnie and Qiu 2008).

Note: The relative college premium $c\bar{p}_j$ of country j is calculated by comparing the college premium cp_j to cp_{US} in the following manner: $c\bar{p}_j = \frac{cp_j - 1}{cp_{US} - 1}$. Then $\bar{\theta}_j = 1 + c\bar{p}_j(\bar{\theta}_{US} - 1)$.

TABLE 9—COUNTERFACTUALS (PARTY MEMBERSHIP)

Country	Intergenerational elasticity			Gini		
	Data	Model	$\Delta_{explained}$	Data	Model	$\Delta_{explained}$
US	.40	.393		.39	.378	
Sweden	.27	.349	.34	.32	.370	.10
UK	.31	.408	-.16	.383	.379	-.31
Canada	.21	.373	.11	.37	.375	.14
Norway	.17	.369	.11	.35	.374	.09
Germany	.32	.370	.30	.37	.374	.17

Note: The share of a gap between a data moment in the US d_{US} and another country $d_{country}$ explained by moments m_j produced by the model, is calculated using the following definition: $\Delta_{explained} = \frac{(m_{US} - m_{country})}{(d_{US} - d_{country})}$.

TABLE 10—VOTING WEIGHTS BASED ON VOTER TURNOUT AND PARTY MEMBERSHIP

		Voter turnout			Party membership		
Age*		High school	Some college	College	High school	Some college	College
US	18 - 32	.27	.27	.27	.38	.38	.38
	33 - 48	.32	.48	.64	.30	.48	.61
	48 - 64	.47	.63	.77	.44	.58	.75
Sweden	18 - 32	.89	.89	.89	.07	.07	.07
	33 - 48	.93	.91	.94	.11	.13	.11
	49 - 64	.95	.99	.97	.17	.13	.16
UK	18 - 32	.51	.51	.51	.09	.09	.09
	33 - 48	.65	.65	.81	.08	.15	.10
	49 - 64	.77	.83	.87	.13	.16	.28
Canada	18 - 32	.78	.78	.78	.14	.14	.14
	33 - 48	.80	.95	.90	.10	.25	.19
	49 - 64	.88	.94	.96	.15	.19	.30
Denmark	18 - 32	.81	.81	.81			
	33 - 48	.89	.90	.94			
	49 - 64	.93	.99	.95			
Norway	18 - 32	.78	.78	.78	.08	.08	.08
	33 - 48	.85	.91	.90	.14	.20	.12
	49 - 64	.86	.92	.93	.22	.28	.26
Finland	18 - 32	.69	.69	.69			
	33 - 48	.66	.76	.88			
	49 - 64	.75	.90	.92			
Germany	18 - 32	.73	.73	.73	.04	.04	.04
	33 - 48	.68	.83	.92	.06	.04	.10
	49 - 64	.78	.87	.93	.07	.05	.15

Note: *Age at time of elections

Datasource: CPS November voting supplement 2006, European Social Survey 2010, World Values Survey 1981-2007, Canadian Election Study 2010. Missing values are left blank.